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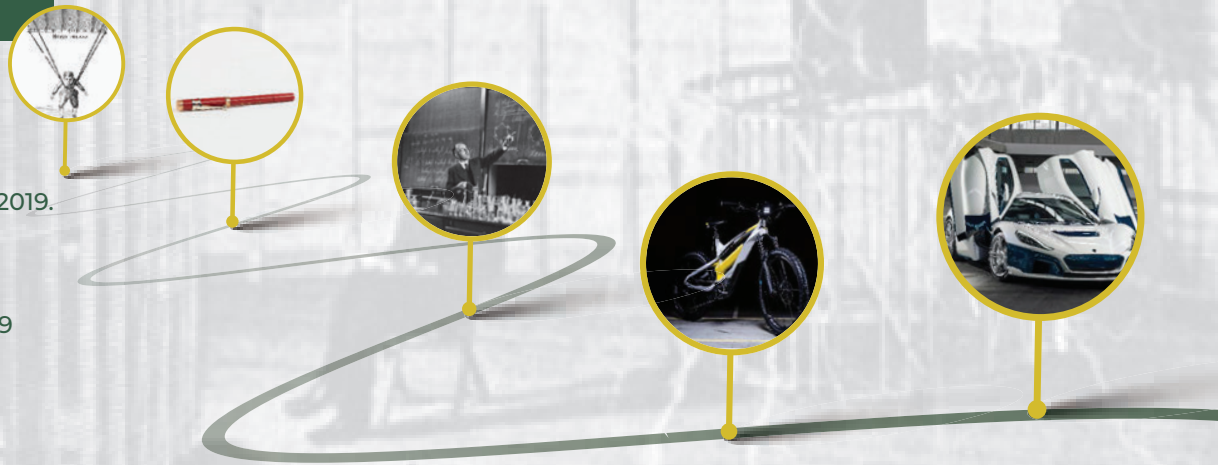
vizionari koji su oblikovali Europu

CROATIAN INNOVATIONS -
visionaries that shaped Europe



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Hrvatske inovacije - vizionari koji su oblikovali Europu

Sadržaj

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Marin Getaldić

(latinizirano Marinus Ghetaldus), hrvatski matematičar i fizičar (Dubrovnik, 1568. - Dubrovnik, 7. ili 8. IV. 1626.). Godine 1588. primljen je za člana Velikoga vijeća (jedna od glavnih institucija Dubrovačke Republike), a zatim se bavio različitim poslovima u službi Republike. Putovanja koja je zbog tih poslova poduzimao ujedno je koristio kako bi se školovao, produbljivao spoznaje iz područja fizike i matematike, provodio znanstvena istraživanja te prijateljevao s istaknutim znanstvenicima svoga doba. Godine 1595. otišao je u London, a 1597. u Antwerpen, gdje je ostao do 1599. Ondje je učio matematiku kod Michela Coigneta i dobio prve poticaje za znanstveni rad. Nakon toga putovao je u Francusku i upoznao Françoisa Viètea, te više puta u Italiju gdje je upoznao Galilea Galileija, njemačkog matematičara i astronoma Christophorusa Claviusa i austrijskog astronoma Christopha Grienbergera, s kojima se poslije dopisivao. Godine 1603. vratio se u Dubrovnik.

Parabolično zrcalo

Parabolično zrcalo u žarištu okuplja svjetlosni snop usporedan s njegovom osi. Pojavu snažne svjetlosti i razvijanje visokih temperatura u žarištu takvog zrcala poznavali su još stari Grci, a u novije se doba taj princip rabi pri izradbi refraktorskih teleskopa te kod sunčanih kolektora za zagrijavanje vode u kućanstvima i za proizvodnju električne energije u posebnim postrojenjima.

Teorijskim osnovama i primjeni paraboličnih zrcala, a time i današnjoj upotrebi obnovljivih izvora energije, pridonio je Dubrovčanin Marin Getaldić. Getaldić se 1601. – 1603. bavio eksperimentalnim radom u području optike, posebice konstrukcijom paraboličnih zrcala i pokusima s njima. Pritom je izradio i vrlo veliko parabolično zrcalo, promjera 66 cm, uz pomoć kojega se moglo rastaliti ne samo olovo nego i srebro, čak i čelik. Nakon Getaldićeve smrti njegov je brat Jakov to zrcalo darovao kardinalu Francescu Barberiniju u Rimu.

Ono se danas nalazi u Nacionalnome pomorskom muzeju (National Maritime Museum) u Greenwichu. Getaldićevi dubrovački optički pokusi bili su poznati i u inozemstvu, pa ih je tako Marin Mersenne ponavljao u Francuskoj. U vezi s konstrukcijama paraboličnoga zrcala Getaldić je napisao raspravu Nekoliko napomena o paraboli (Nonnullae propositiones de parabola), objavljenu 1603. u Rimu. U njoj ističe kako su se parabolična zrcala do tada izrađivala samo na osnovi parabole dobivene od uspravnoga pravokutnog stošca, oko čega se i sam trudio, pa mu je to i uspjelo još 1602. Međutim, pokazao je da se takva zrcala mogu dobiti i s pomoću presjeka oštrokutnoga, tupokutnoga i kosoga stošca, što je i predmet njegove rasprave te njegova glavna inovacija.

Getaldić se bavio i praktičnom primjenom matematike u rješavanju različitih problema. Getaldićevo djelo znatno je utjecalo na razvoj primjene algebre na geometriju prije otkrića analitičke geometrije Renéa Descartesa.

PARABOLIČNO ZRCALO

1602

Faust Vrančić

(Verantius, Veranzio, Verancsics; Faustus, Fausto), leksikograf, izumitelj, filozof, diplomat i svećenik (Šibenik, 1. I. 1551. – Venecija, 20. I. 1617.). U Padovi je studirao filozofiju i pravo (1568. - 1572.) te pokazao veliko zanimanje za matematiku i fiziku. Bio je član Hrvatske bratovštine sv. Jeronima u Rimu (1575.), upravitelj biskupskih dobara u Veszprému u Ugarskoj (1579.), namjesnik kralja Rudolfa II. Habsburgovca (1581.). Zaredio se 1600., a 1605. stupio je u Kongregaciju sv. Pavla u Rimu. Među ostalim, autor je *Rječnika pet najodličnijih europskih jezika, latinskoga, talijanskoga, njemačkoga, dalmatinskoga i ugarskoga* (*Dictionarium quinque nobilissimarum Europae linguarum, Latinae, Italicae, Germanicae, Dalmaticae et Ungaricae*, 1595.), prvoga samostalno tiskanoga rječnika hrvatskoga jezika i prvoga većega mađarskoga rječnika, te poznatog djela iz područja tehnike *Novi strojevi Fausta Vrančića Šibenčanina* (*Machinae novae Fausti Verantii Siceni*, 1615.), u kojem vizionarski donosi tehnička unaprjeđenja, izume i zamisli iz mnogih područja ljudske djelatnosti.

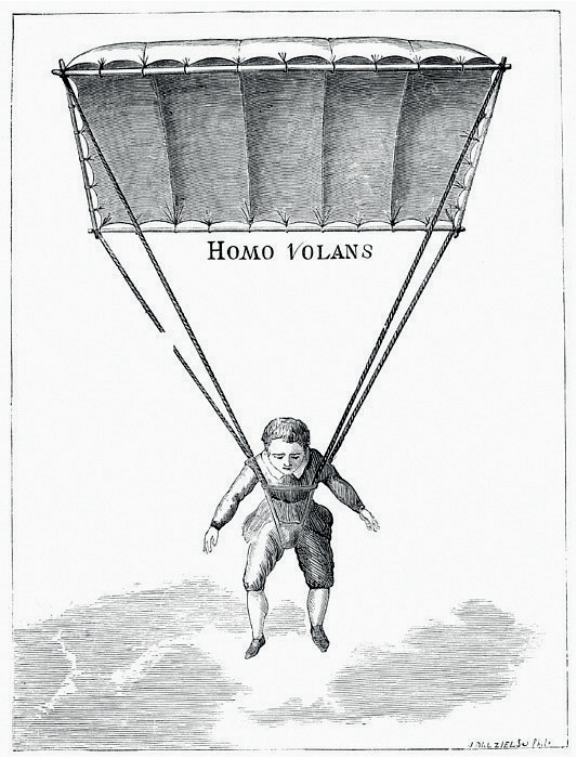
Padobran

Padobran, kupolasta naprava od svile ili umjetnih materijala služi za usporavanje kretanja nekog objekta kroz atmosferu. Jedna od prvih zamisli o upotrebi padobrana veže se uz renesansnog mislioca i izumitelja, Šibenčanina Fausta Vrančića.

Vrančić je padobran opisao u knjizi *Novi strojevi Fausta Vrančića Šibenčanina* (*Machinae novae Fausti Verantii Siceni*) 1615. u Veneciji, na talijanskom, latinskom, španjolskom, francuskom i njemačkom jeziku. U toj se knjizi posvetio konstrukcijama strojeva, tehničkim i arhitektonskim problemima. Djelo sadržava 49 velikih bakroreza s prikazima 56 različitih konstrukcija, među kojima je i padobran, odnosno padobranac kojeg je nazvao Leteći čovjek (Homo volans). Na tom je bakrorezu Vrančić razradio princip djelovanja četverokutnoga padobrana s drvenim okvirom, oko dva stoljeća prije otkrića teorije strujanja zraka i zakona hidraulike.

Vrančić prvi prikazuje sve osnovne dijelove suvremenog padobrana, poput oblika kupole, nosećih konopaca i sustava veza. Posebno je razrađen odnos ploštine padobrana i težine čovjeka te se smatra pretečom suvremenih padobrana, usprkos ranijim grubim opisima te naprave. Iako se spekulacije da je Vrančić i osobno isprobao padobran čine malo vjerojatnima, nedavni pokusi s replikom njegove konstrukcije dokazali su njezinu upotrebljivost.

Unatoč malomu broju tada znanih fizikalnih načela, i drugi Vrančićevi pregledni i precizni crteži izrađeni u perspektivi prikazuju uglavnom eksperimentalno utemeljena, izvediva izvorna tehnička rješenja ili preinake tuđih izuma, namijenjena ponajviše poboljšanju kvalitete svakidašnjega života te boljoj upotrebi pogonske energije vode i vjetra.



PADOBRAN

1602

1615

Ferdinand Kovačević,

hrvatski stručnjak za električnu telegrafiju (Smiljan, 25. IV. 1838. - Zagreb, 27. V. 1913.). Do 1858. školovao se u Gospiću, a 1859. završio je Vojnu akademiju u Bečkom Novom Mjestu. Kao topnički časnik služio je do 1866. (otpusnicu iz vojske dobio je 1872.). Iste godine dodijeljen je Telegrafskoj upravi u Josefovu (danas dio Jaroměřa) u Češkoj, 1869. Telegrafskomu inspektoratu za Hrvatsku i Slavoniju i 1870. novoosnovanoj Direkciji telegrafa za Hrvatsku i Slavoniju u Zagrebu, u kojoj je tajnik od 1872. Umirovljen je 1887. Izumitelj je niza poboljšanja električnoga telegrafa, objavio je niz članaka u stručnim časopisima u Pragu, Beču, Bernu i Berlinu, tri knjige na njemačkome te prvu stručnu knjigu iz područja elektrotehnike na hrvatskome jeziku (1892.).

Dupleksna i kvadrupleksna telegrafija

Dupleksna i kvadrupleksna telegrafija istodobno je slanje dvaju ili četiriju brzojava jednim vodičem, koju je 1876. patentirao u Beču hrvatski stručnjak za električnu telegrafiju Ferdinand Kovačević.

Od kraja 1860-ih u Hrvatskoj se posvetio proučavanju i razradbi teorijske i praktične tematike tada još nove telegrafske tehnike. Rezultate je publicirao u časopisima *Journal télégraphique* (Bern, 1878.), *Revue télégraphique* (Bern, 1878.), *Technische Blätter* (Prag, 1878.), *Zeitschrift für Elektrotechnik* (Beč, 1888. -1889.) i *Elektrotechnische Zeitschrift* (Berlin, 1889.).

U Beču i Budimpešti registrirao je 1876. patent kojim je izumio Diferencijalnu metodu s trajnom strujom za istodobno odašiljanje po jednoj žici dviju brzojavka jednakoga ili protivnoga smjera, kao i četiri brzojavke, dvije po dvije u suprotnim smjerovima. Njegovim je izumom znatno (četiri puta) povećana iskoristivost telegrafskih vodova, odnosno ondje gdje su do tada bila potrebna četiri voda, postao je dovoljan samo jedan.

Osim toga, Kovačević je poboljšao telegrafski aparat Morseova sustava, koji je 1872. uveden u upotrebu u cijeloj Austro-Ugarskoj. Njegove knjige, članci i izumi prinos su razvoju telegrafije u svijetu, a u Hrvatskoj njegov je rad pionirskoga značenja. Bio je član Elektrotehničkoga društva u Beču od 1886.

DUPLEKSNA I KVADRUPLEKSNA TELEGRAFIJA

1602

1615

1876

Autorska prava:
Wikipedia commons, Shutterstock

Nikola Tesla,

izumitelj (Smiljan, 10. VII. 1856. - New York, 7. I. 1943.). Rođen u Lici, gimnaziju je pohađao u Gospiću i Rakovcu kraj Karlovca, gdje je maturirao. Na Visoku tehničku školu u Grazu upisao se 1875. Početkom 1880. otišao je u Prag želeći nastaviti studij, ali nema podatka da je završio studij na kojem od sveučilišta. Godine 1881. radio je u Središnjem telegrafskom uredu u Budimpešti, a potom u Telefonskoj centrali. U jesen 1882. zaposlio se u Edisonovoj telefonskoj podružnici u Parizu, a 1884. prelazi u središnjicu te tvrtke u SAD-u. Godine 1885. osnovao je u New Yorku tvrtku Tesla Electric Light and Manufacturing Company, a 1887. tvrtku Tesla Electric Company, s laboratorijem u kojem je radio na svojim izumima. Stotine izuma prijavio je u 112 patenata u SAD-u, a mnogi od njih ostali su samo zabilježeni u njegovim dnevnicima ili stručnim časopisima. Dobio je mnoga priznanja i počasne doktorate. Nobelovu nagradu odbio je jer ju nije htio podijeliti s Edisonom. Po njemu se nazivaju Tesline visokofrekvencijske struje, Teslin transformator i elektroterapijski postupak teslinizacija. Najveće je priznanje dobio 1960., kada je za jedinicu magnetske indukcije prihvaćen naziv tesla.

Sustav višefaznih izmjeničnih struja, sustav za proizvodnju, prijenos i iskorištavanje višefaznih izmjeničnih struja

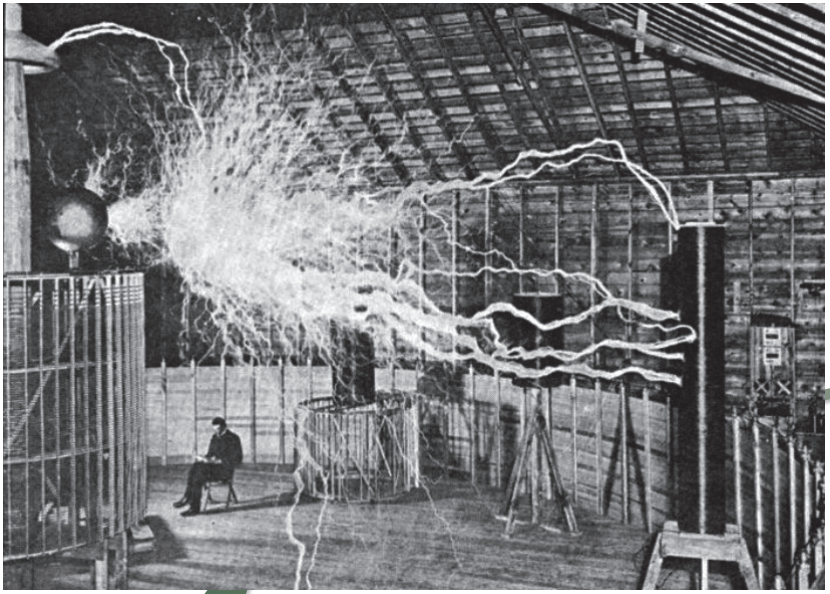
Obuhvaćao je generator dvofazne izmjenične struje te motor s dvama parovima zavojnica napajanih takvom strujom, čime se stvara okretno magnetsko polje koje uzrokuje vrtnju.

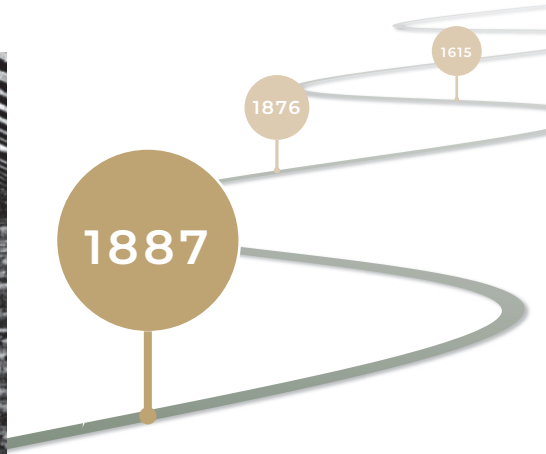
Na ideju o takvom sustavu Tesla je došao za boravka u Budimpešti 1881. U nastojanju da ga realizira otišao je 1884. u SAD i zaposlio se kod Thomasa Alve Edisona, ali njegove ideje nisu naišle na razumijevanje. Od 1887. u vlastitom laboratoriju Tesla radi na praktičnoj primjeni svojih zamisli, pa je u jesen iste godine prijavio prve patente.

Sustav je predložen za elektranu na slapovima Niagare. Elektrana je bila dovršena 1896., a strujom je opskrbljivala oko 40 km udaljen grad Buffalo, čime su dokazane sve prednosti izmjenične struje pred istosmjernom. Uređaji sustava višefaznih izmjeničnih struja jednostavni su po konstrukciji, a time i jeftiniji za proizvodnju i održavanje od onih za istosmjernu struju, pa se za nekoliko godina Teslin sustav počeo rabiti u cijelome svijetu.

Tesla se, kao pravi genij, zanimao za različita područja elektrotehnike i tehnike općenito, te je gotovo sve čega se primio pretvorio u korisne izume kojima je zadužio čovječanstvo. Osim sustavima izmjenične struje bavio se visokofrekvencijskim strujama i njihovim primjenama za rasvjetu te bežični prijenos signala i energije. Za zamišljeni svjetski sustav radiokomunikacija počeo je 1901. graditi veliku radijsku postaju na Long Islandu u New Yorku, visoku 57 m, kojom je želio bežično odašiljati signale i električnu energiju, svima dostupnu i bez naplate, ali je gradnja 1905. bila obustavljena.

SUSTAV VIŠEFAZNIH IZMJENIČNIH STRUJA, SUSTAV ZA PROIZVODNJU, PRIJENOS I ISKORIŠTAVANJE VIŠEFAZNIH IZMJENIČNIH STRUJA





Josip Belušić

(Bellussich, Giuseppe) fizičar i matematičar (Županići kraj Labina, 12. III. 1847. - Trst, 8. I. 1905.). Školovao se u Pazinu i Kopru, studirao je u Beču, a 1875. zaposlio se kao profesor fizike i matematike u učiteljskoj školi u Kopru. Održavao je nastavu na njemačkom, talijanskom i hrvatskom jeziku. Bio je direktor Pomorske škole u Castelnuovu (Italija) te primio titulu docenta te škole. Potkraj 1880-ih radio je na svom izumu velocimetra, koji je i patentirao. Nažalost, Josipu Belušiću gubi se svaki trag nakon 1900. te nije moguće utvrditi njegovu daljnju sudbinu. Pretpostavlja se da je zbog siromaštva prodao prava na patent.

Velocimetar

Velocimetar je električni uređaj za bilježenje brzine putničkih vozila, trajanja vožnje i stajanja vozila, broja prevezenih osoba te vremena ulaska i silaska putnika, koji je konstruirao i službeno predstavio 1887. hrvatski izumitelj Josip Belušić.

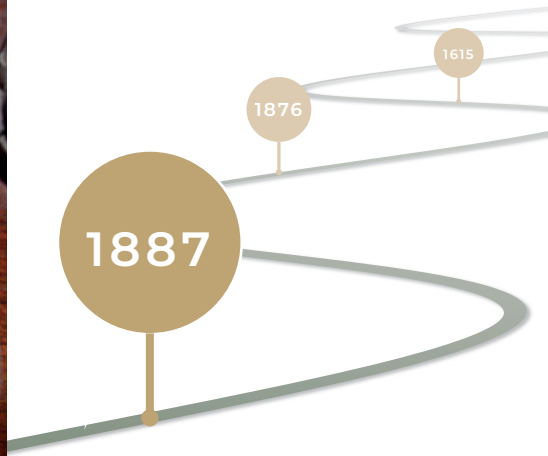
Predviđajući da će se uređaj proširiti svijetom i promijeniti cestovni promet, tršćanski list *Naša sloga* 1889. prvi je donio informacije o novom izumu koji je autor pod nazivom uređaj za nadzor vozila u najmu (*controlare automatico per vettura da nolo*) zaštitio pri nadležnim tijelima Austro-Ugarske Monarhije u Beču.

Prvi pokus velocimetra Josipa Belušića izveden je kočijom na relaciji Trst - Sveti Bartol - Trst, bilježeći sve radnje koje su učinjene. Uz parametre vožnje i putnika, posebno je važna bila mogućnost bilježenja ulaska i izlaska za čak 50 putnika, što ga je činilo pogodnim za omnibuse, koji su kao preteče današnjih tramvaja i autobusa tada služili kao sredstva javnoga prijevoza u gradovima.

Velocimetar je na Svjetskoj izložbi u Parizu 1889. proglašen najboljim u konkurenciji više od 120 uređaja. Nakon natječaja i pokusa 1890. službeno je prihvaćen te je iduće godine prvih sto takvih uređaja bilo ugrađeno u kočije koje su prometovale Parizom, tada po mnogočemu vodećom svjetskom metropolom.

Francuska akademija izumitelja Belušića pohvalila je i nagradila diplomom i zlatnom medaljom, ujedno ga proglasivši i počasnim članom. Uređaj je ujedno bio i tahograf i taksimetar, preteča mjernih nadzornih uređaja koji se danas rabe u kamionima, autobusima i taksijima, bez kojih bi daljnji razvoj cestovnoga prometa u svijetu bio nezamisliv.

VELOCIMETAR



Ivan Vučetić

(Vucetic, Vucetich; Juan), kriminalist, izumitelj daktiloskopije (Hvar, 20. VII. 1858. - Dolores, Argentina, 25. I. 1925.). Osnovnu školu završio je u Hvaru. Nakon odsluženja četverogodišnjega vojnoga roka u Puli 1884. emigrirao je u Argentinu. Godine 1888. zaposlio se u Središnjem uredu policije u La Plati i već 1889. postao voditelj statističkog odjela. Uočavajući nedostatke radova prijašnjih istraživača, 1891. organizirao je i patentirao vlastitu, u svjetskim razmjerima pionirsku metodu klasifikacije otisaka prstiju - daktiloskopiju. Autor je više knjiga, od kojih su važnije *Usporedna daktiloskopija* (*Dactiloscopia comparada*, 1904.) i *Razvoj daktiloskopije* (*Evolución de la Dactiloscopia*, 1905.).

Daktiloskopija, sustav identifikacije osoba prema otiscima prstiju

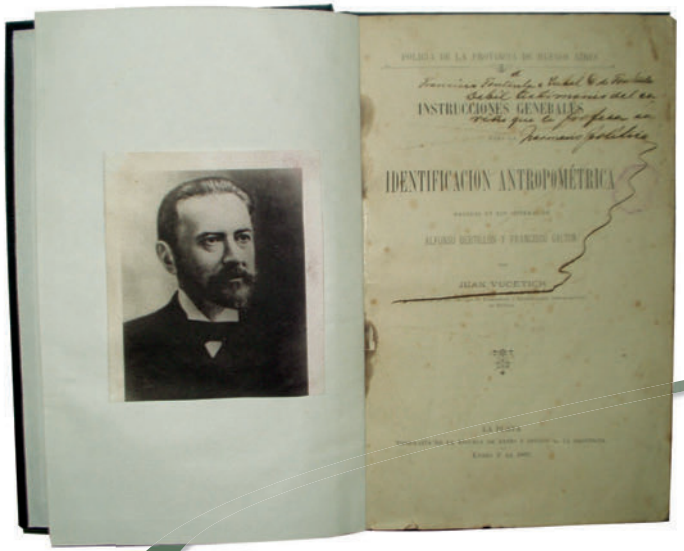
Daktiloskopija je sustav identifikacije osoba prema otiscima prstiju, koji je kao osnivač Službe za identifikaciju u La Plati osmislio i službeno uveo u Argentini 1902. Ivan Vučetić. Osnovnu školu završio je u Hvaru. Nakon odsluženja četverogodišnjega vojnoga roka u Puli 1884. emigrirao je u Argentinu.

U Argentini je 1891. pokrenuo mjesečnik Boletín mensual de la estadística, posvećen praćenju stope kriminaliteta, te mu je bilo povjereno da na temelju antropometrije Alphonsea Bertillona (1853. - 1914.) i zamisli F. Galtona o dokaznoj vrijednosti otisaka prstiju ustroji službu identifikacije osoba. Ubrzo je uveo vlastiti, u svjetskim razmjerima pionirski sustav uzimanja, razvrstavanja i prepoznavanja papilarnih linija svih deset prstiju s pripadnim uređajima, odnosno omogućio sigurno utvrđivanje identiteta pojedine osobe. Za razliku od tadašnjih, ponajprije teorijskih radova, Ivan Vučetić 1891. prvi je proveo razvrstavanje otisaka lijeve i desne ruke po grupama i dao im klasifikacijske oznake.

Njegova daktiloskopska formula jedinstvenoga sustava identifikacije bila je u obliku razlomka, pri čemu se koristio kombinacijom od osam znakova (po četiri broja i slova). Kombiniranjem znakova može se dobiti 1 048 576 osnovnih formula. Na primjenjivomu sustavu klasifikacije otisaka papilarnih linija stvorio je temelje nove znanosti, prvotno nazvanu ikonofalangometrija, koju je prema sugestiji argentinskog znanstvenika Francisca Latzine (1843. - 1922.) poslije nazvao daktiloskopijom.

Vučetićev deseteroprsti sustav službeno je uveden u Argentini 1902., a potom i u drugim zemljama (Austro-Ugarska 1902., Njemačka 1903., Engleska 1904., Rusija 1907., Francuska 1914. itd.), te je i danas prevladavajući sustav identifikacije osoba u svijetu.

DAKTILOSKOPIJA, SUSTAV IDENTIFIKACIJE OSOBA PREMA OTISCIMA PRSTIJU



1876

1892

1897

David Schwarz

(Keszthely, Mađarska, 7. XII. 1850. – Beč, 13. I. 1897.). U rodnome je gradu završio osnovnu školu, a u Hrvatsku se doselio početkom 1860-ih, gdje se u Županji izučio za trgovca. Od kraja 1870-ih živio je u Osijeku, a u drugoj polovici 1880-ih s obitelji se nastanio u Zagrebu. Bavio se trgovinom drvenom građom te je kraj Našica podignuo pilanu. U strojarstvu je bio samouk, no čitajući tehničku literaturu tijekom duljega bolovanja dobio je ideju o zračnome brodu. Napustio je trgovanje i do kraja se života u potpunosti posvetio razvoju svoje ideje. Kad je 1889. na Svjetskoj izložbi u Parizu predstavljen aluminij, uočio je njegovu primjenjivost u zrakoplovnoj tehnici te pošao upoznati tehnologiju proizvodnje u pogonima C. Berga u Lüdenscheidu i Evekingu. Zbog prerane smrti nije doživio prvi uspješan javni let letjelice koju je konstruirao, ali mu kao idejnomu tvorcu i voditelju izradbe prve upravljive aerostatičke letjelice krute konstrukcije nedvojbeno pripada istaknuto mjesto u povijesti razvoja zrakoplovne tehnike.

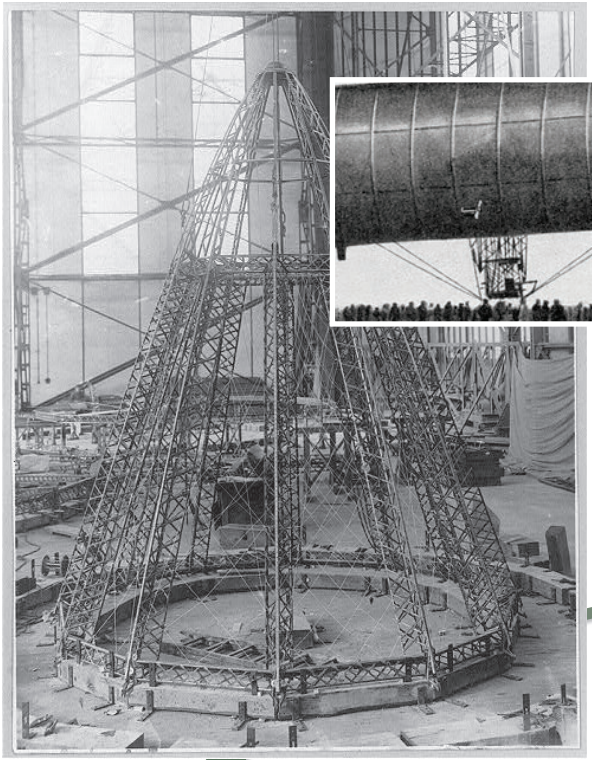
Zračni brod (cepelin)

Zračni brod je brod krute konstrukcije, upravljiva letjelica lakša od zraka (aerostat) s vlastitim pogonom i krutom potkonstrukcijom koja mu daje stalan oblik, kakvu je prvi konstruirao David Schwarz. Na zamisao o zračnome brodu Schwarz je došao kasnih 1880-ih čitajući tehničku literaturu. Zrakom su u to doba letjeli tek leteći baloni bez mogućnosti upravljanja.

U izradbi prvih nacrta pomagao mu je šumarski inženjer Josip Pfister. Prvotni planovi vjerojatno su predviđali drveni kostur, no uočivši primjenjivost aluminija u zrakoplovnoj tehnici, u izum je uključio još jednu inovaciju - metalno tijelo letjelice. Zaposlio se kod tvorničara Carla Berga u Njemačkoj i posvetio istraživanju mogućnosti povećanja čvrstoće aluminijskih slitina te spajanja dijelova zakivanjem i lemljenjem. Razvio je posebnu slitinu aluminija, preteču duraluminija.

Schwarzov novi zračni brod sastavljen je 1896. kraj Berlina. Bio je aerodinamična cilindrična oblika sa stožastim prednjim dijelom, aluminijske rešetkaste konstrukcije s limenom oplatom, duljine 38,32 m i promjera 12 m, a uz donji dio trupa bila je pričvršćena gondola. Nosivost broda bila je 240 kg (jedna osoba i 130 kg balasta). Zbog vodika nedovoljne čistoće pokusno polijetanje 1896. nije uspjelo.

Schwarz je iznenada preminuo početkom 1897. Njegov udio u poslovnome pothvatu preuzela je njegova udovica Melanija. Preuzevši Melanijin udio, Berg je 1898. s Ferdinandom von Zeppelinom i njegovim Društvom za promicanje zrakoplovstva ugovorio daljnju proizvodnju brodova. Zeppelin je 1900. prema Schwarzovu projektu izradio vlastiti zračni brod i nezasluženo stekao slavu tvorca prvoga zračnoga broda, dok je Schwarz pao u zaborav.



ZRAČNI BROD (CEPELIN)

1876

1887

1897

Franjo Hanaman,

hrvatski kemičar i metalurg (Drenovci kraj Županje, 30. VI. 1878. - Zagreb, 23. I. 1941.). Diplomirao je 1899. u Beču, gdje je 1903. - 1912. s Aleksandrom Justom razradio postupak proizvodnje volframove žarne niti i njezine primjene u električnoj žarulji. Hanaman je 1911. - 1915. vodio Institut za ispitivanje materijala u Beču, a doktorirao je 1913. u Berlinu. U Zagrebu je 1919. - 1922. bio generalni direktor Jugoslavenske industrije motora. Na Tehničkoj visokoj školi u Zagrebu izabran je za privatnoga docenta 1920., a za redovitoga profesora anorganske kemijske tehnologije 1922., kada je osnovao prvi inženjerski zavod, Zavod za anorgansku kemijsku tehnologiju i metalurgiju. Obnašao je dužnost dekana Kemičko-inženjerskog odjela (1922. - 1924.), izabran je za rektora Tehničke visoke škole (1924.). U razdoblju od 1934. do 1939. bio je glavni urednik časopisa *Arhiva za hemiju i farmaciju* (danas *Croatica Chemica Acta*).

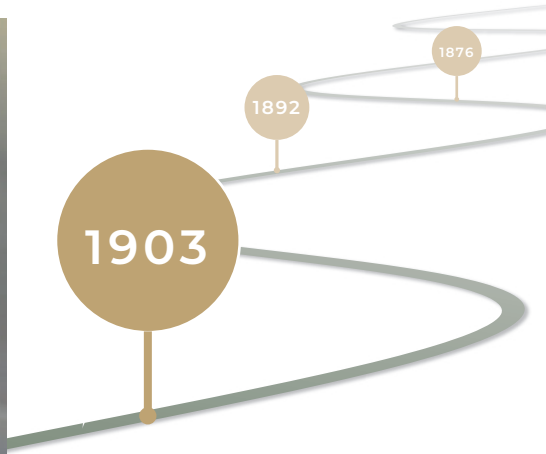
Žarulja s volframovom niti

Žarulja s volframovom niti električna je žarulja za koju su postupak proizvodnje volframove žarne niti i njezine primjene razvili Franjo Hanaman i Aleksandar Just 1903. Zahvaljujući visokom talištu volframova se nit, za razliku od dotadašnjih niti za žarulje, mogla zagrijati na višu temperaturu i tako postići veću svjetlosnu učinkovitost. Taj je izum bio iznimno važan jer je uz njegovu pomoć konačno utemeljena ekonomična rasvjeta s pomoću električne energije, koja se tek odnedavna zamjenjuje štedljivijim vrstama svjetiljki.

Hanaman je još od 1900. kao asistent na katedri analitičke kemije Tehničke visoke škole u Beču (*Technische Hochschule*), zajedno s mađarskim kemičarem njemačkoga podrijetla A. Justom, radio na usavršavanju električne žarulje s metalnom žarnom niti. Svojim prvim patentom DRP 154262 iz 1903., pod imenom *Postupak proizvodnje žarnih tijela od volframa ili molibdena za električne žarulje* (*Verfahren zur Herstellung von Glühkörpern aus Wolfram oder Molybdän für elektrische Glühlampen*), razradili su tehnologiju dobivanja volframovih niti postupkom supstitucije.

Postupak su poslije dodatno usavršili, pa je njihova žarulja u usporedbi s Edisonovom žaruljom s ugljenom niti trošila trećinu električne energije i trajala dulje. Hanaman i Just ostali su u povijesti zabilježeni kao tvorci moderne rasvjete, a njihova briga za energetsku učinkovitost danas je posebno aktualna.

ŽARULJA S VOLFRAMOVOM NITI



Slavoljub Eduard Penkala,

hrvatski izumitelj (Liptovský Mikuláš, Slovačka, 20. IV. 1871. - Zagreb, 5. II. 1922.). Osnovnu školu završio je u rodnome gradu u tadašnjoj Ugarskoj, srednju u Bielsko-Biali u Poljskoj, a u Dresdenu je 1898. na Visokoj tehničkoj školi diplomirao kemiju, te poslije i doktorirao. Neko je vrijeme radio u tvornici kemijskih proizvoda u Košicama, a potom se 1900. preselio u Zagreb, gdje je dobio posao nadzornika mjera za istočno područje Austro-Ugarske Monarhije. Počeo se baviti tehnikom te je do kraja života, u početku u svojem domu i priručnoj radionici u središtu Zagreba, ostvario osamdesetak izuma. Tijekom vremena razvio se i u uspješna poduzetnika te je svoje izume proizvodio u svojim radionicama i tvornicama koje su zapošljavale stotine radnika, a prodavao ih je diljem svijeta.

Automatska mehanička olovka

Automatska mehanička olovka je olovka koju je izumio i 1906. patentirao Slavoljub Penkala. Do Penkalina izuma, grafitne olovke bile su ili drvene ili mehaničke s vrlo složenim načinom mijenjanja i namještanja grafitnog uloška.

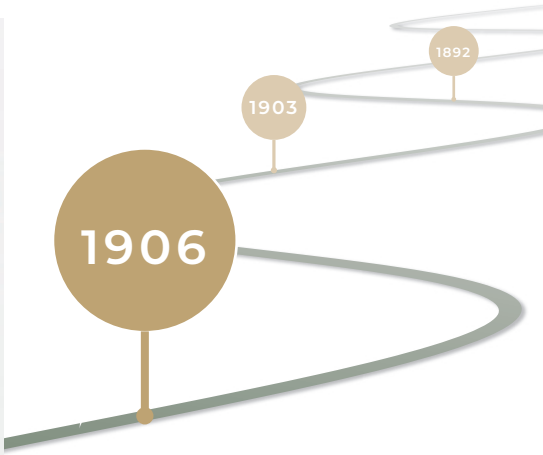
Penkalinu automatsku olovku nije trebalo šiljiti, a njezin bi tanki grafitni uložak, kako se trošio pisanjem, izlazio iz tijela olovke pritiskom na papir. Olovka je doživjela još nekoliko poboljšanja i inačica, poput promjena u mehanizmu izlaska mine, dodatka tzv. knipse za kvačenje o džep (što je danas dio gotovo svake mehaničke i kemijske olovke), modela dvostrane penkale s crvenom i plavom minom na krajevima, inačica u različitim bojama za slikare, stiliziranih modela i sl.

Tijelo penkale izrađivalo se od ebonita, čvrste polimerne mase koju je dodatno usavršio te poslije rabio za gramofonske ploče, zbog čega su bile manje lomljive. Olovka je ubrzo postala hit na svjetskome tržištu. Tijekom vremena u Hrvatskoj se naziv penkala uvriježio za različita pisala, a napose za kemijske olovke s gustom tintom i kuglicom na vrhu.

Prvi Penkalini patenti bili su inačica termos-boce 1903. te rotirajuća četkica za zube 1904. Radio je na poboljšanju kvalitete zvuka u snimanju i reprodukciji te je uoči I. svjetskoga rata pridonio usavršavanju austrougarskih vojnih prislušnih radiostanica nazvanih Penkala. U suradnji s bratom Rudolfom osmislio je automatske kočnice za brdske željeznice. U svom je laboratoriju Elevator od 1907. razvijao i proizvodio različite kemijske preparate.

Penkala je prvi u Hrvatskoj konstruirao vlastiti zrakoplov 1910., tek nekoliko godina nakon prvoga leta zrakoplova braće Wright. Osim toga, prijavio je 1908. i 1909. dva patenta za uređaj čijim se principom danas koriste helikopteri i zračne lebdjelice, konstruirane tek pedesetak godina kasnije.

AUTOMATSKA MEHANIČKA OLOVKA



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Lavoslav (Leopold) Ružička,

organski kemičar (Vukovar, 13. IX. 1887. - Mammern na Bodenskom jezeru, 26. IX. 1976.). Završio je klasičnu gimnaziju u Osijeku (1906.), diplomirao kemiju na Tehničkoj visokoj školi u Karlsruheu u Njemačkoj (1908.), gdje je pod voditeljstvom H. Staudingera, budućega dobitnika Nobelove nagrade za kemiju, doktorirao (1910.). Godine 1912. Staudinger je postao profesor visoke tehničke škole (Eidgenössische Technische Hochschule, ETH) u Zürichu, a s njim je u Zürich došao i Ružička, koji je 1917. dobio švicarsko državljanstvo, 1918. postao privatni docent, a 1923. naslovni profesor. Već kao Staudingerov suradnik otkrio je strukturu piretrina, insekticida dobivenog iz dalmatinskoga buhača. Godine 1925. - 1926. radio je u Ženevi, a 1926. - 1929. bio je profesor organske kemije na Sveučilištu u Utrechtu u Nizozemskoj, da bi 1929. postao profesor i predstojnik Laboratorija za organsku kemiju na ETH-u. Ružička je objavio 582 rada, a za svoja otkrića u području sintetske organske kemije primio je osam počasnih doktorata, sedam nagrada i medalja, uključujući i Nobelovu nagradu za kemiju (1939.), te 24 počasna članstva u različitim znanstvenim društvima. Tijekom radnog vijeka održavao je tijesne veze sa znanstvenicima iz matične domovine, mnoge od njih pozivao je na specijalizaciju u svoj laboratorij, a među njima bio je i Vladimir Prelog, također dobitnik Nobelove nagrade za kemiju 1975.

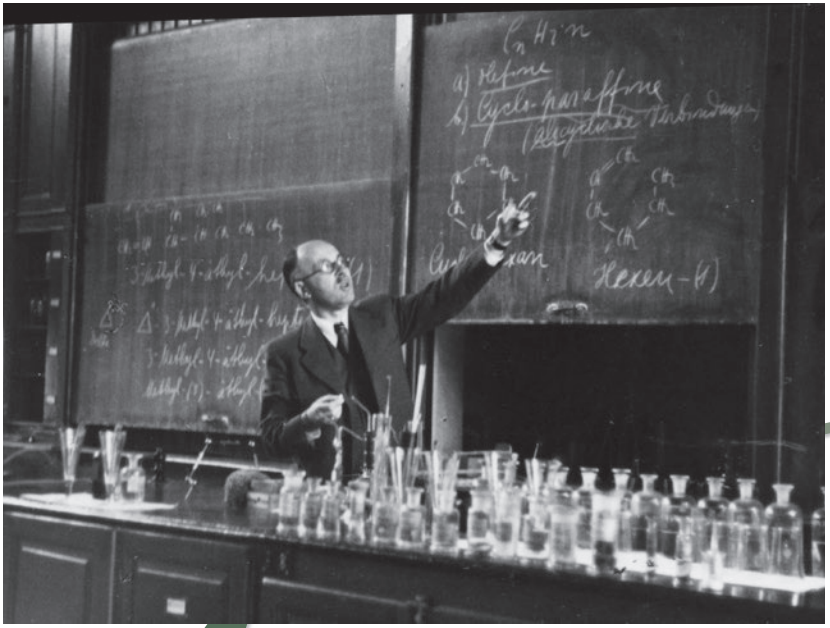
Sinteza spolnih organa

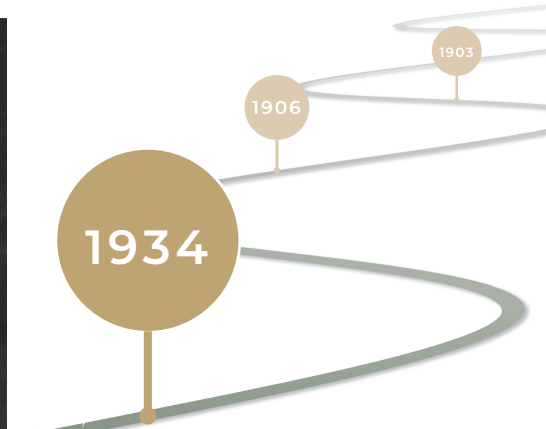
Važan doprinos istraživanju i sintezi spolnih hormona dao je Lavoslav Ružička, švicarsko-hrvatski kemičar i prvi znanstvenik hrvatskog podrijetla koji je dobio Nobelovu nagradu. Ružička je prvi umjetno djelomično sintetizirao spolni hormon androsteron i testosteron, razjasnio njihove strukture metodama dehidrogenacije i odredio njihove konfiguracije.

Otkriće djelovanja testosterona počelo je još 1920-ih godina, kada su američki znanstvenici izolirali tvar iz goveđih testisa i tim ekstraktom remaskulinizirali kastrirane štakore, svinje i pijetlove. Kasnije se utvrdilo da se radi o testosteronu. Koju godinu poslije njemački kemičar Adolph Butenandt izolirao je androsteron iz ljudskog urina (1931.) i naznačio početak jedne sasvim nove ere u kemiji - kemije steroida. U 1930-ima došlo je do velikog međunarodnog zanimanja za steroidne spojeve, ali metode izolacije iz prirodnih izvora zahtijevale su prilično veliku količinu polaznog biološkog materijala.

Nakon 1935. uslijedio je ubrzani razvoj i sinteza mnogih strukturnih analoga testosterona. U tim sintezama sudjelovao je i jedan švicarski kemijski koncern, s kojim je od 1930. surađivao Lavoslav Ružička i njegov laboratorij na tehničkoj visokoj školi (ETH) u Zürichu. Kroz nekoliko sljedećih godina suradnja je dovela do značajnih znanstvenih i komercijalnih uspjeha u istraživanju muških spolnih hormona.

SINTEZA SPOLNIH ORGANA





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Mario Puratić (Puretić),

izumitelj, preporoditelj svjetskoga ribarstva (Sumartin, Brač, 26. VI. 1904. – Santa Barbara, SAD, 6. I. 1993.). Iselio se u SAD 1929. te radio u čeličanama i u luci Brooklynu u New Yorku. Nakon II. svjetskoga rata preselio se u San Pedro, staru komišku ribarsku koloniju, te se zaposlio kao ribar. Tijekom rada na tunolovcima susretao se s tadašnjim mukotrpnim ljudskim radom koji je pratio ribare. Kreativna duha, želeći ribarima olakšati rad, izumio je mehanički koloturnik za brzo i lako izvlačenje mreže iz mora nazvan Power Block, koji je patentirao 1954. Zbog zasluga u ribarstvu proglašen je 1975. izumiteljem godine u SAD-u, počasnim građaninom Islanda, a od 1972. na kanadskoj novčanici od pet dolara nalazi se slika ribarskoga broda s njegovim koloturnikom. Nastavio je svoj rad na izumima te je od 1954. Patentnom uredu SAD-a prijavio više od 20 pronalazaka.

Mehanički koloturnik

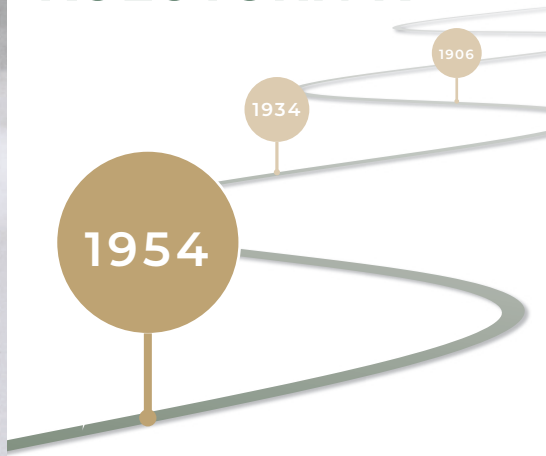
Puratićev mehanički koloturnik namijenjen je učinkovitom izvlačenju ribarskih mreža plivarica i potegača, koji je izumio i pod nazivom Power Block patentirao 1954.

Sastojao se od posebno prilagođenoga kolotura sa žlijebom obloženim gumom, zavješenoga na brodsku dizalicu. Prvi koloturnici bili su pogonjeni brodskim vitlom i užetom, dok se danas rabe hidraulični sustavi koji omogućuju daljinsko upravljanje, tj. promjenu smjera i broja okretaja koloturnika. Prevlačenjem jednoga kraja mreže plivarice preko koloturnika, te njegovim okretanjem, mreža se izvlači na palubu uz minimalan ljudski rad.

Nakon višegodišnjega rada i usavršavanja Puratić je 1970. američkom Patentnom uredu dostavio unaprijeđenu verziju izuma. Godine 1958. tvrtka iz Seattlea, u kojoj je Puratić radio kao savjetnik, uključila se u proizvodnju i usavršavanje koloturnika te danas proizvodi četiri modela, ovisno o veličini broda, mreže, područja ribarenja te načinu pogona hidrauličnoga sustava.

Danas i mnoge druge tvrtke proizvode žljebaste Puratićeve koloturnike raznih veličina, snaga i tipova. Svojim izumom Puratić je pokrenuo pravu revoluciju u svjetskome ribarstvu. Primjena koloturnika za manje se od desetljeća proširila sa sjevernoga Pacifika i američke zapadne obale po cijelom svijetu te je uvedena u sve svjetske ribarske flote.

MEHANIČKI KOLOTURNIK



Leo Sternbach (Henryk),

kemičar (Opatija, 7. V. 1908. – Chapell Hill, 28. IX. 2005.). Rođen je u poljskoj židovskoj obitelji u Opatiji, gdje je polazio osnovnu školu i pomagao ocu, uspješnom ljekarniku i autoru više patenata, u obiteljskoj ljekarni. S trinaest godina odselio se u Villach, Graz, potom u Krakov, gdje je diplomirao kemiju (1929.) i doktorirao organsku kemiju (1931.) na krakovskom sveučilištu. Za njegovu karijeru bio je presudan susret s hrvatskim kemičarem i nobelovcem Lavoslavom Ružičkom, koji ga je 1937. pozvao kao suradnika na visoku tehničku školu (ETH) u Zürichu. Od 1940. radio je u jednoj farmaceutskoj tvrtki, najprije u Baselu u Švicarskoj, a od 1941. u SAD-u gdje je ostao do umirovljenja 1973., a do 2005. bio je konzultant te tvrtke. Suautor je 122 znanstvena rada i više od 240 patentnih prijava, od kojih je vrlo značajna sinteza biotina (vitamina B) koja je u upotebi i danas. Do 1990. četvrtina prihoda tvrtke ostvarena je na temelju Sternbachovih izuma. Zbog doprinosa farmaceutskoj industriji primljen je u američku Nacionalnu izumiteljsku dvoranu slavnih (2005.). Američka novinarska kuća U.S. News & World Report ubraja ga među 25 najutjecajnijih ljudi XX. stoljeća.

Diazepam

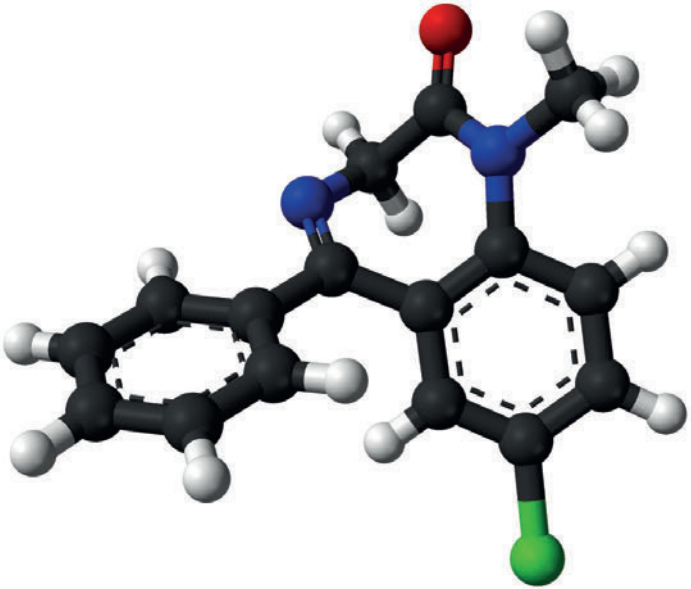
Diazepam je sredstvo iz skupine benzodiazepina koje služi za umanjenje tjeskobe, ublažavanje grčeva, otklanjanje nesanice i dr. Izumitelj diazepama je Leo (Henryk) Sternbach, znanstvenik rođen u Opatiji, koji je radio u Švicarskoj, a zatim u SAD-u.

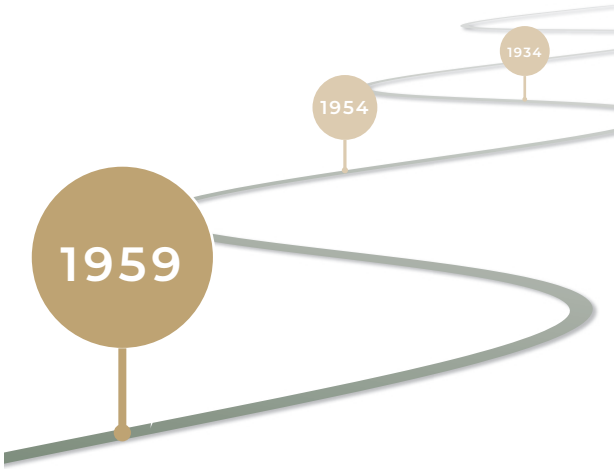
Diazepam je pozitivni alosterički modulator receptora GABAA te pojačava učinak prirodnog neurotrasmitera gama-aminomaslačne kiseline (GABA) te stoga djeluje kao depresor središnjega živčanog sustava. Patentiran je 1959., a 1963. odobren je za upotrebu kao lijek. U razdoblju od 1969. do 1982. bio je jedan od najčešće propisivanih lijekova u Americi.

Danas se diazepam prodaje u više od 500 generičkih oblika lijekova. Znatan doprinos istraživanju i razvoju benzodiazepinske skupine lijekova dala je i druga skupina hrvatskih znanstvenika i stručnih suradnika okupljenih oko Franje Kajfeža, autora pojednostavnjenoga postupka sinteze diazepama.

Zbog doprinosa farmaceutskoj industriji primljen je u američku Nacionalnu izumiteljsku dvoranu slavnih (2005.). Američka novinarska kuća U.S. News & World Report ubraja ga među 25 najutjecajnijih ljudi XX. stoljeća.

DIAZEPAM





Istraživački tim

koji je razvio antibiotik azitromicin činili su Slobodan Đokić (Danilovgrad, Crna Gora, 30. XI. 1926. – Zagreb, 6. X. 1994.), Gabrijela Kobrehel (Obedišće kraj Novoselca, 1. III. 1941.), Gorjana Lazarevski (Omiš, 13. I. 1946.) i Zrinka Tamburašev (Sisak, 22. IX. 1921. – Zagreb, 24. IV. 2003.). Školovani na Sveučilištu u Zagrebu, radni vijek proveli su u zagrebačkom farmaceutskom poduzeću u kojem su za svoja otkrića primili mnoge domaće i inozemne nagrade. Pod vodstvom S. Đokića, direktora istraživačkog instituta 1971. – 1990., tim je radio na kemijskim transformacijama makrolidnih antibiotika te su 1967. – 1978. ostvarili priznanje više patenata, među kojima je najistaknutiji patent za pripravu azitromicina i njegovih derivata iz 1981.

Azitromicin

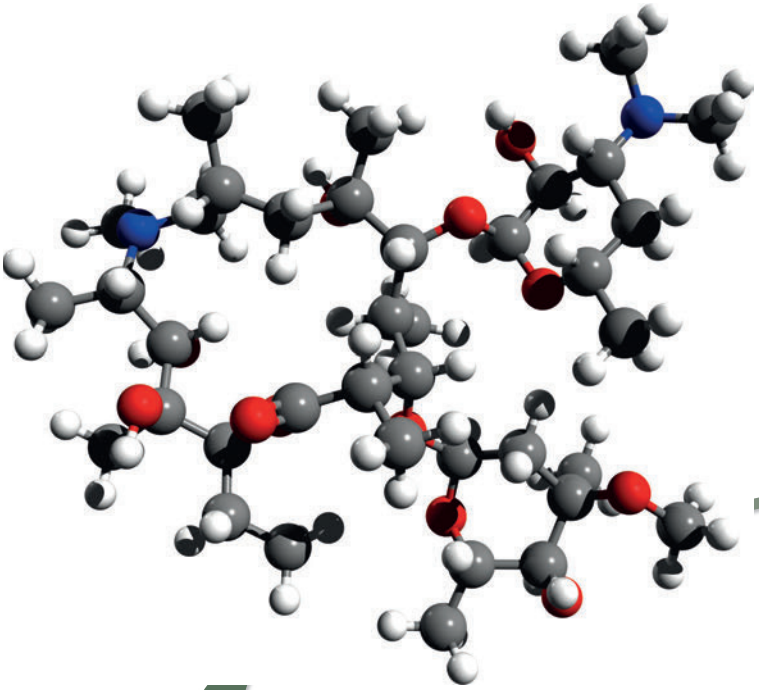
Azitromicin je polusintetički makrolidni antibiotik, prvi predstavnik nove vrste antibiotika nazvane azalidi, koji je pokazanim dugogodišnjim uspjehom ujedno postao zlatni standard za tu vrstu antibiotika. Azitromicin su u razdoblju od 1979. do 1981. sintetizirali i patentirali suradnici istraživačkog instituta jednog zagrebačkog farmaceutskog poduzeća

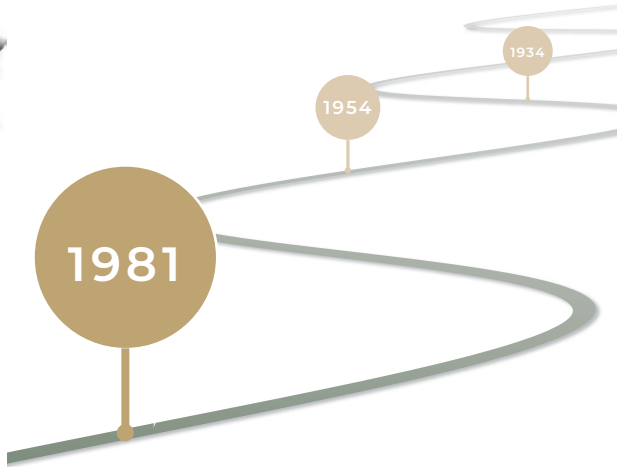
Njihov je uspjeh u stvaranju te djelatne tvari omogućio proizvodnju antibiotika povećanoga spektra antibakterijskoga djelovanja u odnosu na njegove prethodnike, izvrsnih farmakokinetičkih svojstava s dugim vremenom poluživota lijeka u odnosu na već postojeće antibiotike. Izum azitromicina među najvećim je dostignućima znanosti i njezine komercijalizacije u Hrvatskoj.

Iznimno terapijsko djelovanje učinilo ga je jednim od najuspješnijih antibiotika na svjetskoj razini. Azitromicin se danas rabi kao vrlo učinkovit lijek za liječenje mnogih bakterijskih infekcija gornjih i donjih dišnih puteva, infekcija kože i potkožnog tkiva, spolno prenosivih bolesti, infekcija želuca i dvanaesnika, upale zdjelice te sve više i za prevenciju bakterijskih infekcija u djece i onih sa slabim imunitetom.

Američko kemijsko društvo (American Chemical Society, ACS) 2000. je godine timu autora dodijelilo priznanje za unapređenje globalne dobrobiti čovječanstva u području zdravlja i imenovalo ih „Herojima kemije".

AZITROMICIN





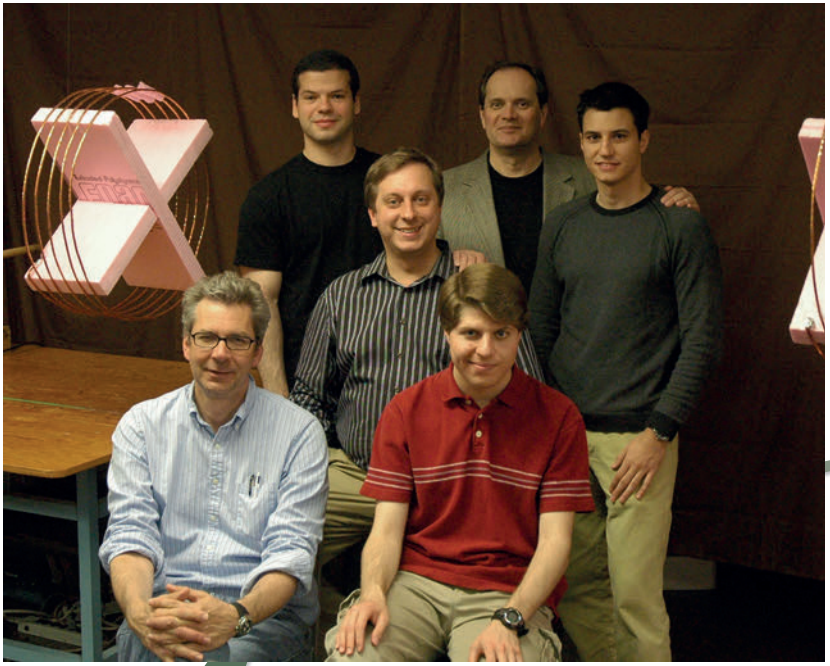
Marin Soljačić,

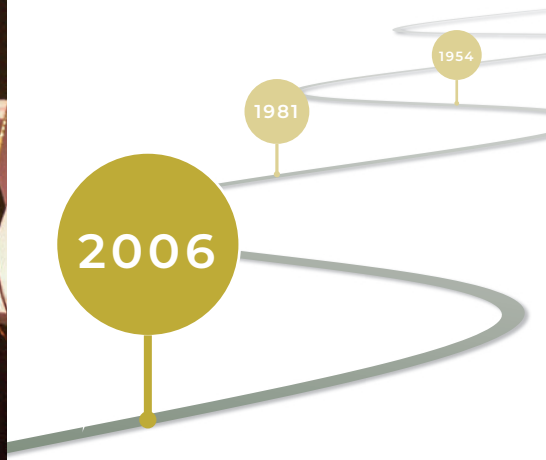
hrvatski inženjer fizike i elektrotehnike (Zagreb, 7. II. 1974.). Maturirao je u Zagrebu, a diplomirao na Massachusetts Institute of Technology (MIT) u Cambridgeu, SAD. Doktorirao je iz područja fizike na Sveučilištu Princeton 2000. Od iste je godine na MIT-ju postdoktorand, od 2003. vodeći istraživač u Laboratoriju za elektroniku, a od 2005. profesor fizike (isprva kao docent, od 2010. izvanredni profesor, a od 2011. redoviti profesor). Jedan je od osnivača i direktor tvrtke koja se bavi praktičnim primjenama bežičnoga nezračećeg prijenosa energije. Znanstveni su mu interesi vezani i uz fizikalne pojave koje prate nove nanostrukturirane materijale, nelinearnu optiku i nanofotoniku. U posljednje se vrijeme bavi istraživanjem fotoničkih kristala u sunčanim ćelijama. Koautor je mnogobrojnih patenata i znanstvenih radova u vodećim znanstvenim časopisima. Dobitnik je više značajnih međunarodnih nagrada i priznanja za inovativna otkrića i mlade znanstvenike.

Bežični nezračeći prijenos energije

Bežični nezračeći prijenos energije jest prijenos električne energije bez upotrebe vodiča, pri čemu se, za razliku od tradicionalnih metoda zasnovanih na elektromagnetskom zračenju, rabe elektromagnetska polja i parovi objekata iste rezonantne frekvencije, pa su rasipanje i gubitak energije te neželjeni utjecaj na druge objekte u okolini minimalni. Inspiriran radovima Nikole Tesle u tom području prije više od 100 godina, princip takvog prijenosa primjenjiv na sobnim udaljenostima otkrio je Marin Soljačić s grupom znanstvenika te ga predstavio radom 2006. godine. Ubrzo je grupa uspjela izvesti eksperiment bežičnoga nezračećeg prijenosa energije u kojem su energijom iz strujne mreže, uz pomoć dviju zavojnica ugođenih na rezonantnu frekvenciju od 10 MHz, uspjeli upaliti žarulju od 60 W, uz učinkovitost prijenosa od 40 %. Otkriće i eksperiment objavljeni su u uglednome znanstvenom časopisu Science 2007. godine, što je potaknulo znatno zanimanje javnosti. Iako je praktična primjena Soljačićeva otkrića još u razvoju, očekuje se da će omogućiti bežično punjenje prijenosnih računala, mobilnih telefona, raznih kućanskih uređaja, ali i tvorničkih robota te napose električnih automobila, što je čini vrlo perspektivnom zelenom tehnologijom.

BEŽIČNI NEZRAČEĆI PRIJENOS ENERGIJE





Autorska prava: Marin Soljačić

Zvonimir Viduka

diplomirao je na Elektrotehničkom fakultetu u Zagrebu, smjer industrijska elektronika. Godine 1994. pokreće tvrtku ALTPRO, koja postaje jedna od vodećih hrvatskih inovativnih tehnoloških tvrtki . Tvrtka u svojem 25-godišnjem radu s preko 1000 proizvoda iz područja elektrotehničkih uređaja za željezničku infrastrukturu i vozila postaje partner željeznicama na svih šest kontinenata. Prema studiji Europske komisije iz 2012. godine tvrtka ALTPRO svrstana je među 22 vodeće tvrtke na svijetu. Za svoje uspješne poduzetničke i inovativne rezultate Viduka je dobio važna društvena i gospodarska priznanja, uključujući preko 70 nagrada za inovativni i inženjerski rad na nacionalnim i međunarodnim sajmovima inovacija. Sudjelovao je u izradi Nacionalne strategije inovacija RH i Industrijske strategije RH 2015. godine, kao i projekta Hrvatske izvozne ofenzive 2006. Potpredsjednik je Klastera za željeznice jugoistočne Europe te Saveza za željeznicu. Predsjednik je gospodarsko-znanstvenog savjeta na Fakultetu prometnih znanosti te gospodarski član Hrvatske akademije tehničkih znanosti.

Sustav osiguranja željezničko - cestovnog prijelaza

Sustav osiguranja željezničko-cestovnog prijelaza RLC23 visoko je tehnološki inovativni proizvod koji je u potpunosti razvijen u Hrvatskoj na temelju ideja Zvonimira Viduke i interesa mnogih svjetskih željeznica. Njegova je uloga automatizirana zaštita željezničko-cestovnih prijelaza (mjesta gdje se sijeku cestovni i željeznički promet), točaka gdje se događa najviše teških nesreća i incidenata.

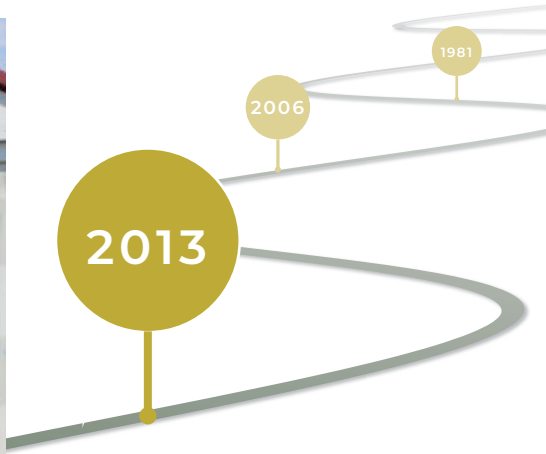
Sastoji se od središnje upravljačke jedinice, senzora za detekciju nadolazećeg vlaka, branika te svjetlosnih signala za upozoravanje sudionika cestovnog i željezničkog prometa. Prve ugradnje RLC23 počele su 2013. te je u šest godina sustav instaliran u 15 zemalja svijeta na tri kontinenta, a interes za njega dosad su pokazale željeznice iz 70 zemalja.

Glavna značajka sustava koja ga izdvaja od konkurencije jest upotreba niza tehnoloških inovacija koje omogućavaju visoku pouzdanost, olakšavaju održavanje, analitiku i povezivanje s drugim sustavima, novim i starim, što je bitno za različite željeznice. Sustav RLC23 certificiran je za najvišu razinu sigurnosti (SIL 4) u neovisnim certifikacijskim ustanovama tipa A kao trenutno jedini proizvod toga tipa na svjetskom tržištu.

Proizvod je u potpunosti prilagođen najnovijim ekološkim standardima s obzirom na to da nema nikakvog utjecaja na okoliš, a u proizvodnji se koriste komponente usklađene s regulativom zaštite okoliša. Za svoj rad koristi električnu energiju iz mreže, no lako se prilagođava i alternativnim izvorima napajanja. Na taj način može biti potpuno energetski neovisan.

Sustav je izlagan na sajmovima inovacija i novih proizvoda širom svijeta te je dobio veliki broj nagrada i priznanja, kao i najviša gospodarska priznanja u Republici Hrvatskoj.

SUSTAV OSIGURANJA ŽELJEZNIČKO-CESTOVNOG PRIJELAZA RLC23



Ante Elez, Stjepan Tvorić, Stjepan Car

Dr. sc. Ante Elez, rođen je 1979. godine, diplomirao je 2003. na Fakultetu elektrotehnike i računarstva u Zagrebu. Nakon diplome zaposlio se u tvrtki KONČAR – Institut za elektrotehniku d.d., gdje je proveo 13 godina baveći se primijenjenim znanstvenim istraživanjem iz područja dijagnostike rotacijskih strojeva i razvoja sustava za monitoring. Od 2014. godine paralelno predaje na Tehničkom veleučilištu u Zagrebu. Krajem 2016. imenovan je za člana Uprave tvrtke KONČAR – Generatori i motori d.d. i zadužen za tehnološki razvoj tvrtke. Objavio je šest znanstvenih članaka i 16 referata u zbornicima istaknutih međunarodnih znanstvenih skupova, kao i šest referata u zbornicima stručnih skupova, te je razvio 11 novih proizvoda.

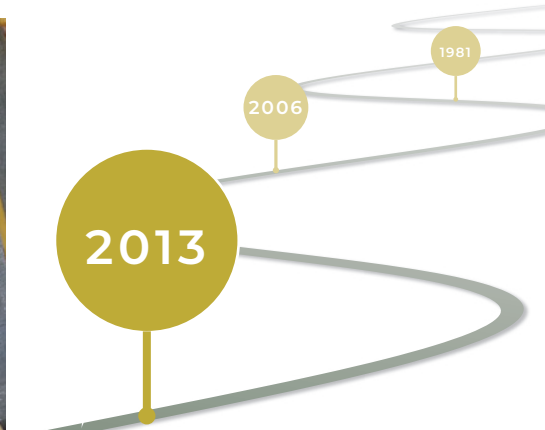
Stjepan Tvorić. rođen je 1985., a diplomirao 2009. godine na Fakultetu elektrotehnike i računarstva u Zagrebu, na temu Modeliranje asinkronog vučnog motora metodom konačnih elemenata. Od 2009. zaposlen je kao razvojni inženjer u tvrtki KONČAR – Institut za elektrotehniku. Polaznik je doktorskog studija na kojem istražuje temu: Otkrivanje kvarova rotora kaveznog asinkronog motora analizom magnetskog polja u zračnom rasporu. Od 2014. godine drži vježbe i predavanja na Tehničkom veleučilištu u Zagrebu. Član je sekcije HRO CIGRE-a i individualni član međunarodne organizacije CIGRE-a.

Izv. prof. dr. sc. Stjepan Car rođen je 1949. godine. Nakon završetka studija zaposlio se u Institutu KONČAR, gdje je 18 godina radio na istraživačkim i razvojnim zadacima iz područja rotacijskih strojeva i elektromotornih pogona. Osam godina bio je član Uprave tvrtke KONČAR – Elektroindustrija d.d. odgovoran za područje korporativnog razvoja, a 15 godina obnašao je dužnost predsjednika Uprave društva KONČAR – Institut za elektrotehniku d.d. Objavio je preko 80 znanstvenih i stručnih članaka i referata, autor je triju patenata i monografije 50 godina primijenjenih znanstvenih istraživanja i razvoja na području elektrotehnike. Dobitnik je godišnje nagrade za 2007. godinu koju mu je dodijelila Hrvatska zajednica tehničke kulture, a 2012. primio je Državnu nagradu tehničke kulture za životno djelo „Faust Vrančić" za trajan doprinos i ukupnu djelatnost u razvoju tehničke kulture. Predsjednik Republike Hrvatske odlikovao ga je Ordenom Danice Hrvatske s likom Nikole Tesle.

Monitoring i dijagnostika izmjeničnih strojeva praćenjem polja u zračnom rasporu

Električni izmjenični strojevi kao pretvarači mehaničke energije u električnu i obratno imaju ogromno gospodarsko značenje, zbog čega trajni nadzor njihova rada i nastajanje različitih kvarnih stanja ima posebnu važnost za siguran i pouzdan rad. Nova teoretski razrađena i mjerenjima potvrđena metoda, koju su autori otkrili 2013. godine, bazira se na praćenju promjena induciranih napona u mjernim svicima, smještenima u zračni raspor na površinu zuba ili otvora utora. Parovi svitaka smještaju se po obodu stroja razmaknutih za polni korak i spajaju tako da izlazni napon bude jednak njihovoj razlici. Bilo koji kvar u namotima stroja ili promjeni geometrije zračnog raspora izazvat će promjene u induciranim naponima. Analizom oblika napona i njegove efektivne vrijednosti moguće je nedvosmisleno utvrditi vrstu i mjesto kvara: puknuće jednog ili više štapova ili kratkospojnog prstena kaveznog namota ili pak ekscentričnost i njenu veličinu. Postavljanjem mjernih svitaka na rotor i bežičnim prijenosom signala pomoću uređaja koji se napaja iz energije viših harmonika magnetskog polja u zračnom rasporu mogu se pratiti nastajanja kvarnih stanja u namotima statora. Novost dijagnostike sastoji se u smještaju mjernih svitaka, njihovu spajanju i obradi induciranih napona u svicima, kao i algoritmu prepoznavanja vrste kvara. Metoda mjerenja i analiza magnetskog polja primjenom informatičko-komunikacijske tehnologije omogućuju trajni uvid u stanje i rad električnog stroja.

MONITORING I DIJAGNOSTIKA IZMJENIČNIH STROJEVA PRAĆENJEM POLJA U ZRAČNOM RASPORU



Autorska prava: Končar

Prof. dr. sc. Stjepan Lakušić

diplomirao je na Građevinskom fakultetu Sveučilišta u Zagrebu 1994. godine. Magistarski rad pod naslovom „Utjecaj netočnosti izradbe konstrukcijskih elemenata na propisanu širinu tramvajskog kolosijeka" obranio je 1998., a doktorsku disertaciju pod naslovom „Dinamički utjecaj vozila na tramvajski kolosijek" 2003. na Građevinskom fakultetu Sveučilišta u Zagrebu. U svojstvu istraživača radio je na znanstvenim projektima iz područja željeznica, buke i vibracija od cestovnog i tračničkog prometa. Sudjelovao je na 76 međunarodnih skupova te 19 domaćih. Objavio je 164 znanstvena rada, urednik je 11 knjiga i deset zbornika radova. Od 2012. glavni je i odgovorni urednik znanstvenog časopisa GRAĐEVINAR. Dobitnik je osam nagrada za inovativna tehnička rješenja na međunarodnim i domaćim izložbama te dvije nagrade za objavljeni znanstveni rad na međunarodnim konferencijama.

Od 2008. godine do danas obnaša dužnost pročelnika Katedre za željeznice, od 2014. do 2018. prodekana za znanost, a od 2019. obnaša dužnost dekana na Građevinskom fakultetu u Zagrebu. Član je više domaćih i inozemnih strukovnih organizacija. Pokrenuo je dva znanstvena i dva stručna skupa. Bio je gostujući nastavnik na građevinskim fakultetima u Rijeci i Skopju.

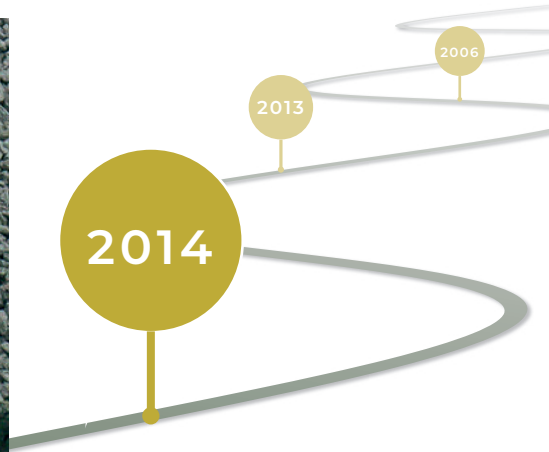
Betonske barijere za zaštitu od buke s recikliranom gumom – Ruconbar

RUCONBAR (RUbberized COncrete Noise BARriers) ekološka je, visoko apsorbirajuća barijera za zaštitu od buke, čiji se apsorbirajući sloj sastoji od reciklirane gume i betona. Projekt je pokrenut na Građevinskom fakultetu Sveučilišta u Zagrebu 2009. godine, gdje je ispitana početna zamisao betonskih mješavina s gumenim granulama. Projekt RUCONBAR u razdoblju od 2011. do 2014. godine sufinancira Europska unija u sklopu inicijative CIP Eko Inovacije Izvršne agencije za konkurentnost i inovacije – EACI.

RUCONBAR je građevinski proizvod od betona sastavljen od apsorbirajućeg i nosivog sloja. Primjenom 40 % gumenih granula dobivenih recikliranjem starih automobilskih guma u apsorbirajućem sloju dobiven je proizvod koji predstavlja inovativno rješenje u području zaštite od buke, jedinstven na tržištu. Inovativnost rješenja proizlazi iz jedinstvenog načina izvedbe apsorbirajućeg sloja barijere. Ugradnjom gumenih granula dobivenih reciklažom otpadnih automobilskih guma i kamene sitneži određenog granulometrijskog sastava u betonsku mješavinu proizvodi se sloj laganog poroznog betona optimalnih svojstava za apsorpciju prometne buke. Osim izuzetno dobrih i konkurentnih svojstava zvučne apsorpcije, barijera RUCONBAR ima poboljšana i ostala značajna svojstva, poput otpornosti na smrzavanje i odmrzavanje i vatrootpornost.

Glavne su ekološke koristi RUCONBARA: smanjenje emisije stakleničkih plinova za 31 % u odnosu na slična rješenja na tržištu; smanjenje iskorištavanja neobnovljivih izvora i zaštita prirodnog krajolika; recikliranje otpadnih automobilskih guma. Za orijentaciju, pri proizvodnji jednog kilometra barijere za zaštitu od buke visine 3 metra (3000 m^2 barijere) moguće je iskoristiti 50 tona gumenih granula dobivenih reciklažom 8000 otpadnih automobilskih guma.

BETONSKE BARIJERE ZA ZAŠTITU OD BUKE S RECIKLIRANOM GUMOM – RUCONBAR



Josipa Majić

osnivačica je i glavna izvršna direktorica u londonskom poduzeću s uredima u Zagrebu i Palo Altu koje analizira biometrijske podatke i razvija afektivne računalne sustave. Nakon studija na Sveučilištu u Zagrebu osnovala je poduzeće u dobi od 22 godine. Prije toga radila je na sustavu za praćenje pacijenata, pomažući djeci i korisnicima diljem svijeta da uče iz biometrijskih uvida.

Josipa je glavna vizionarska snaga koja stoji iza proizvoda poduzeća i cjelokupne strategije, odgovorna za uspješnu globalnu suradnju s klijentima skupine Fortune 100. Časopis TIME priznao ju je kao izumiteljicu 10 najinovativnijih proizvoda godine.

Teddy, pametna igračka

Teddy je prva pametna igračka na tržištu: osobni čuvar opremljen senzorima koji prate vitalno stanje vaših najmlađih. Vrhunska tehnologija smještena u Teddyjevoj šapi omogućila je Teddyju da postane najpristupačniji način za provjeru vitalnog stanja vaših najmlađih.

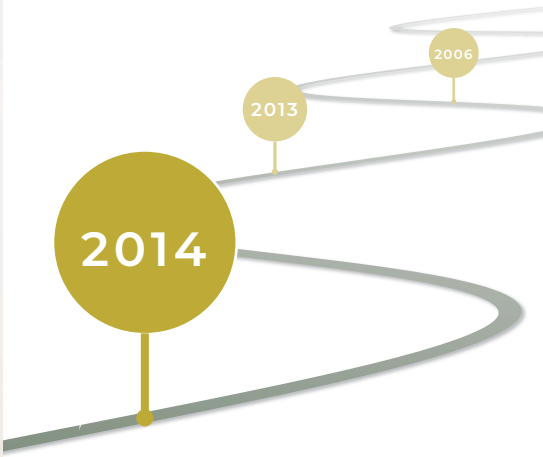
Teddy je pomno kreiran savršeni čuvar vaših najmlađih. Napravljen u Europi, od pažljivo biranih, najfinijih materijala i najboljeg pliša, dolazi u nježnoj kremastoj boji te pruža jedinstveno iskustvo djeci i njihovim roditeljima.

Prava čarolija događa se unutar samog Teddyja. Njegova posebnost krije se u elektroničkom modulu povezanom s mobilnom aplikacijom. Teddyjev senzor, koji mjeri tjelesnu i ambijentalnu temperaturu, kao i svi elektronički dijelovi, sigurno su smješteni unutar plastičnog kućišta koje se nalazi u posebno dizajniranoj Teddyjevoj šapi. Zaštitni mehanizam omogućuje da senzor bude siguran od dodira djece i dostupan samo roditeljima.

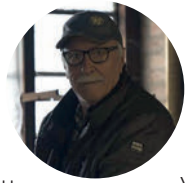
Akcelerometar smješten unutar okruglog kućišta omogućuje Teddyju da se probudi i na najmanji pokret, ali i da bude u stanju mirovanja kada nije u uporabi. Korištenje Teddyja vrlo je jednostavno. Sve što je potrebno učiniti jest prisloniti prst, čelo ili vrat na senzor smješten na njegovoj šapi. Rezultati tjelesne temperature mogu se dobiti samim zagrljajem Teddyja.

Teddy je povezan s mobilnom aplikacijom na koju se šalju prikupljeni podaci i preko koje se mogu vidjeti rezultati mjerenja. Prijateljski osmišljen dizajn omogućuje jednostavno praćenje povećanja ili pada temperature, kreiranje podsjetnika i alarma te lakše praćenje stanja svojih najmilijih.

TEDDY, PAMETNA IGRAČKA



Frano Pokrajčić



rođen je 3. veljače 1951. godine u Tomislavgradu. U Tomislavgradu je završio osmogodišnju školu, a srednju klasičnu franjevačku školu završio je Splitu. Višu tehničku tekstilnu školu – kemijski smjer u Varaždinu završio je kao najbolji student u generaciji i stekao zvanje inženjera. Ima 44 godine radnog staža u proizvodnji na bazi PVC-a i PU-a, a za svoj rad više je puta nagrađivan. Tijekom svoje karijere prošao je sve stupnjeve, od radnika u tvornici, rukovoditelja proizvodnje, direktora, predstavnika kompanije, a na kraju i vlasnika. Svoju kompaniju koja se bavi proizvodnjom širokog asortimana proizvoda osnovao je 1991. godine, a 1993. pokrenuo je proizvodnju plastificiranih tkanina zahvaljujući kojoj je 2004. nastala ideja, a 2014. i patent za inovaciju „Vodom protiv vode".

Vodom protiv vode – obrana od poplave

„Vodom protiv vode – obrana od poplave" ideja je koja je razvijena 2004. godine tijekom promatranja velikih problema i šteta uzrokovanih poplavama.

Ideja je godinama usavršavana, a konačno rješenje patentirano 2014. godine sastoji se od cijevi zatvorenih na krajevima koje se pumpama preko ventila pune i prazne. Zaštitni nasipi „Vodom protiv vode" sastoje se od plastičnih cijevi dugačkih od 10 do 20 metara, koje se pomoću posebnih spojnih elemenata spajaju u jedan nasip potrebne dužine i visine, pune se vodom i postaju brana nadolazećoj vodi.

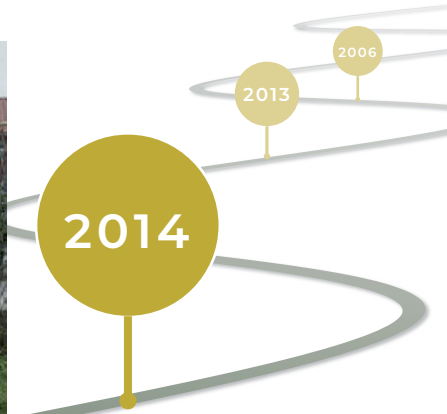
Kod sustava zaštite „Vodom protiv vode" nije potrebna gradnja nasipa s vrećama pijeska, već se vrlo brzo i s manje potrebnih ljudi mogu postaviti nasipi od plastičnih cijevi napunjenih upravo vodom koja prijeti stvaranjem štete. U situacijama u kojima je inače potrebno 500 vojnika za punjenje i postavljanje vreća s pijeskom, pomoću inovacije „Vodom protiv vode" to postavljanje i rastavljanje izvodi se s pet radnika, dvadeset je puta brže od postavljanja klasičnih nasipa od vreća i pruža mogućnost višestrukog brzog odgovora na izvanredne situacije.

Nakon upotrebe cijevi se vrlo brzo prazne kroz za to izrađene otvore. Kod skladištenja zauzimaju vrlo malo mjesta jer se slažu u pakete koji se mogu složiti na palete. Sustav se može višekratno upotrebljavati, a uz pravilno korištenje može trajati najmanje 15 godina.

Ovim postupkom omogućene su brojne uštede i inovacije u procesu obrane od poplava.

Materijali od kojih se izrađuju sustavi nisu toksični, nego zdravstveno ispravni.

VODOM PROTIV VODE - OBRANA OD POPLAVE



Bojan Jerbić, Darko Chudy

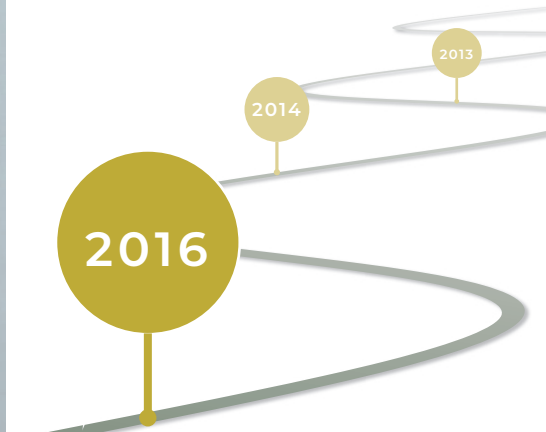
Bojan Jerbić, redoviti je profesor na Fakultetu strojarstva i brodogradnje Sveučilišta u Zagrebu. Na istom je fakultetu diplomirao u području robotike, potom magistrirao, a doktorat je obranio 1993. godine u području umjetne inteligencije. Usavršavao se u SAD-u, a zajedno sa svojim suradnicima održava suradnju s mnogim europskim sveučilištima. Znanstvena istraživanja provodi u području umjetne inteligencije u robotici. Bavi se istraživanjem i razvojem inteligentnih modela upravljanja višeagentskim robotskim sustavima, medicinskom robotikom, interakcijom robota i ljudi i modelima robotske svijesti. Objavio je više od 100 znanstvenih i stručnih radova, tri knjige te je sudjelovao u brojnim istraživačkim i razvojnim projektima. Zahvaljujući istraživačkim projektima i suradnji s gospodarstvom razvio je jedan od najnaprednijih laboratorija za primijenjenu robotiku u Europi.

Darko Chudy rođen je u Zagrebu 8. veljače 1962. godine. Specijalist je neurokirurg i vršilac dužnosti pročelnika Zavoda za neurokirurgiju u Kliničkoj bolnici Dubrava. Godine 2000. na Medicinskom fakultetu Sveučilišta u Zagrebu obranio je disertaciju te stekao akademski stupanj doktora medicinskih znanosti. Voditelj je Odjela za neurokirurgiju u KB-u Dubrava od 2007. godine. U Klinici za neurokirurgiju KBC-a Zagreb započeo je s operacijama iz područja stereotaktičke neurokirurgije, prvi je u Republici Hrvatskoj ponovno uveo funkcijsku stereotaktičku neurokirurgiju i metodu duboke mozgovne stimulacije u bolesnika s poremećajima pokretanja (Mb Parkinson, distonije) i neizlječivim bolnim sindromima. Za vrijeme svog rada u Zavodu za neurokirurgiju KB-a Dubrava uveo je duboku mozgovnu stimulaciju u bolesnika u minimalnom stanju svijesti i vegetativnom stanju.

RONNA - robotska neuronavigacija

RONNA je interdisciplinarni projekt Sveučilišta u Zagrebu, započet 2007. godine. Cilj projekta bilo je smanjivanje opterećenja koje osjetljivi i izazovni neurokirurški postupci predstavljaju za kirurga. Istraživački timovi Fakulteta strojarstva i brodogradnje (FSB), Zagreb (Hrvatska) i Kliničke bolnice Dubrava (KBD), Zagreb (Hrvatska), pod vodstvom prof. dr. sc. Bojana Jerbića i prof. dr. sc. Darka Chudyja, dr. med., počeli su eksperimentirati s mogućnostima primjene robota u minimalno invazivnim neurokirurškim postupcima. Danas je RONNA robotski neuronavigacijski sustav koji se temelji na artikuliranim robotskim rukama te je namijenjen minimalno invazivnim stereotaktičkim postupcima kao što su biopsije, stereoelektroencefalografija (SEEG), operacije za liječenje epilepsije, duboka stimulacija mozga (Deep Brain Stimulation – DBS) i tumorske resekcije. RONNA se može konfigurirati kao sustav s jednom ili dvije ruke. Sustav s jednom rukom namijenjen je stereotaktičkoj neuronavigaciji i služi kao navigacijska pomoć kirurgu. Konfiguracija s dvije ruke samostalnija je, pri čemu druga ruka obavlja invazivne operativne zahvate kao što su bušenje kosti, umetanje sonde ili igle i slično. Postupci lokalizacije u prostoru slike i u fizičkom prostoru potpuno su automatizirani i RONNA osigurava potpuno autonoman postupak registracije pacijenta koji ne zahtijeva dodatno uključivanje medicinskog osoblja. Primjena RONNA-e u stereotaktičkim neurokirurškim postupcima skraćuje vrijeme operacije, manje je invazivna, omogućava brži oporavak pacijenta, a operativni resursi bolnice bolje se iskorištavaju. Od 2016. godine počela su klinička ispitivanja RONNA-e. Četvrta generacija RONNA-e (G4) trenutačno radi svaki tjedan u Kliničkoj bolnici Dubrava u Zagrebu.

RONNA - ROBOTSKA NEURONAVIGACIJA



Inga Kovačić-Sindik

rođena je 1960. godine u Splitu, Hrvatska. Odrasla je i fakultetski školovana u Splitu, a po zanimanju je diplomirana inženjerka kemijske tehnologije. Završila je postdiplomski studij u Zagrebu te preko 50 različitih stručnih tečajeva u području tehnologije obrade i pročišćavanja vode, zraka i zaštite okoliša, a sve u s ciljem pronalaska rješenja za vraćanje prirodnog balansa između čovjeka i prirode. Tijekom svog tridesetogodišnjeg profesionalnog razvoja bavila se radovima na testiranju i ispitivanju mogućnosti korištenja otpadnih materijala iz različitih industrija u svrhu tretmana i obrade vode te razvojem i primjenom prirodnih materijala u svrhu pročišćavanja zraka. Vlasnica je privatne tvrtke i voditeljica odjela za istraživanje i razvoj te vodi deseteročlani stručni tim. Ugradnjom pametne tehnologije i strojnog učenja u prirodne materijale kojima se imitiraju prirodni procesi pročišćavanja zraka nastoji doprinijeti rješavanju globalnog problema onečišćenja zraka stakleničkom plinovima. Kao rezultat njezinog dugogodišnjeg rada nastao je veći broj intelektualnih vlasništva i srodnih prava (patenti, žigovi, autorska prava), a 2018. dobila je nagradu za najbolju inovatoricu Europe.

Pametni ekološki sustav za pročišćavanje i modificiranje zraka

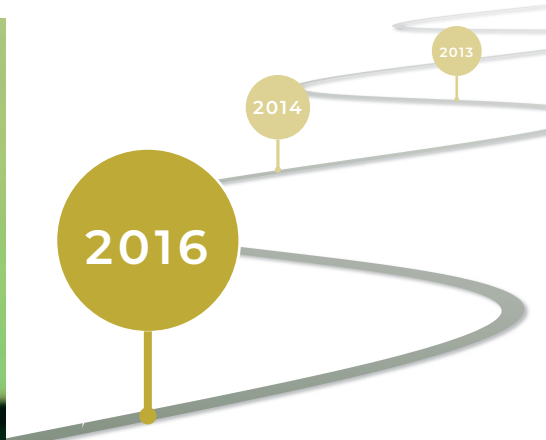
Pametni ekološki sustav za pročišćavanje i modificiranje zraka služi za uklanjanje i redukciju zagađivača unutar zatvorenog prostora. Inovacija je nastala 2016. godine, a njeni tehnički detalji zaštićeni su trima patentima i dvama autorskim pravima.

Ovaj tehnološki napredan sustav u sebi integrira 11 različitih metodologija koje omogućuju pročišćavanje i obradu zraka u zatvorenim prostorima uz automatsko mjerenje, kontrolu, upravljanje, nadzor te programsku regulaciju. Uređaj omogućava proizvodnju optimalnog zraka za svog korisnika. Svojim senzornim elementima sustav automatski detektira i kontrolira najveći broj zagađivača u prostoru, među kojima su za čovjeka posebno opasni alergeni, isparivi plinovi i formaldehidi, radon, virusi i bakterije, nakon čega se putem informacijsko-komunikacijske tehnike uključuje optimalni sustav upravljanja pročišćivanjem i obradom zraka u zatvorenim prostorima. Uređaj posjeduje univerzalni aktivno-pasivni filterski kompozit, koji je također inovacija.

Dio tehničkih elemenata inovacije tehnološkog postupka umjetne proizvodnje mikroklimatskih uvjeta u izoliranoj sobi ili kabini, kojim se mogu proizvesti bilo koje vrste klima, integriran je u ekološki sustav za pročišćavanje i obradu zraka u unutarnjim prostorima, čime je korisnicima sustava omogućeno da budu neprestano izloženi utjecaju jedne od najzdravijih svjetskih klima, a to je mediteranska, dalmatinska klima.

Inovatorica Inga Kovačić Sindik dobila je posebnu povelju za globalni doprinos filterima za pročišćavanje zraka, a u studenom 2018. i glavnu nagradu za najbolju inovatoricu Europe.

PAMETNI EKOLOŠKI SUSTAV ZA PROČIŠĆAVANJE I MODIFICIRANJE ZRAKA



Nenad Grgec, Jasna Gajinov, Filip Grgec, Luka Grgec

Nenad Grgec diplomirao je i magistrirao na Ekonomskom fakultetu u Zagrebu. Obavljao je i niz odgovornih menadžerskih poslova – od direktora marketinga, prodaje i razvoja do predsjednika uprave kompanija. Godine 2008., nakon završenog projekta pod nazivom „Revitalizacija marketinga" za jednu od najvećih kompanija za proizvodnju higijenskih i medicinskih proizvoda u jugoistočnoj Europi i izvođenja slične kompanije iz okvira postojećih tržišnih okruženja i limita na europsko tržište, osniva vlastitu kompaniju s jasnim ciljem i opredjeljenjem: „biti različit, inovativan i determiniram kvalitetom".

Jasna Gajinov diplomirala je na Edukacijsko-rehabilitacijskom fakultetu u Zagrebu. Radi na razvoju i pozicioniranju vlastitih robnih marki u zemlji i inozemstvu, na razvoju vlastite distribucije na domaćim tržištima, kao i na razvoju distribucije u zemlje okruženja za vlastite brendove. Voditeljica je prodaje proizvoda iz produktnog portfelja kompanije i voditeljica projektnih timova u području razvojnih planova te u aktivnostima kompanije na stranim tržištima, kao i na pozicioniranju kompanije na zahtjevnim tržištima, tzv. PL (private label) proizvoda.

Filip Grgec student je Ekonomskog fakulteta Sveučilišta u Zagrebu. U kompaniji je zadužen za koordinaciju aktivnosti proizvodnje – prodaje – nabave te za provođenje različitih procesa koji proizlaze iz zahtjeva ISO 9001, IFS, FSC i PEFC certifikata. Kao voditelj ili član projektnih timova radi na nizu aktivnosti i na razvoju novih proizvoda te modifikaciji – kako novih proizvoda, tako i tehničko-tehnoloških procesa usko povezanih s osnovnom djelatnošću kompanije.

Luka Grgec student je Ekonomskog fakulteta Sveučilišta u Zagrebu. Kao vanjski član projektnog tima za razvoj novih proizvoda svojim mladenačkim pogledom i pristupom daje timu potrebnu širinu razmišljanja kod razvoja novih proizvoda, kao i usmjerenost na kupce mlađe populacije. Poznavanjem novih tehnologija i digitalnog marketinga daje timu neophodnu svježinu ideja i drugačiji pristup poslovnim problemima ili fazama u razvoju samog proizvoda ili proizvodnje.

Štapići za uši

Iz proizvodnog procesa štapića za uši u potpunosti je izbačena plastika te je zamijenjena papirnatom ambalažom. Tako se u proizvodnom procesu umjesto plastičnih štapića upotrebljavaju papirnati, plastična kutijica zamijenjena je papirnatom, a inovacija je papirnati easy open poklopac koji je u potpunosti zamijenio plastični. Godina nastanka inovacije je 2017., a priprema i testiranja trajali su više od godinu dana. Osim inovacije samog proizvoda napravljena je i tehnološka inovacija u samoj proizvodnoj liniji na kojoj su uvedena još dva nova stroja za formiranje kartonskih kutijica, ali i stroj za zatvaranje tih kutijica kartonskim poklopcem. Na taj je način kompletan proizvodni proces automatiziran, povećane su produktivnost i efikasnost, odnosno kapaciteti cijele linije, te je smanjena količina smeća koje nastaje i onečišćenje okoliša plastičnim proizvodima. Proizvod je u potpunosti prilagođen ekološkim standardima, a s obzirom na to da je cijeli od papira i pamuka, potpuno je biorazgradiv. Proizvod je u potpunosti u skladu s direktivom EU-a o smanjenju utjecaja jednokratne plastike, kojom se zabranjuju plastični štapići za uši. Ovim proizvodom otišlo se korak dalje od onoga što propisuje ta direktiva te je tržištu ponuđen potpuno ekološki proizvod bez prisustva plastike.

ŠTAPIĆI ZA UŠI OD PAPIRA S EASY OPEN KARTONSKIM POKLOPCEM I KARTONSKOM KUTIJOM

2014

2016

2017

Dorian Crnoja

rođen je u Osijeku u Hrvatskoj 27. veljače 2000. godine. Već s deset godina se počeo baviti tehnikom. Dolaskom u Zagreb s 13 godina počeo se snažnije zanimati za elektroniku. Zbog svoje ljubavi prema tehnici upisao je Strojarsku tehničku školu Fausta Vrančića, smjer tehničar za mehatroniku. Kroz godine svog odrastanja bavio se umjetnošću, književnošću, građevinom i arhitekturom, no pronašao se u elektrotehnici. Želja mu je oduvijek bila postati izumitelj po uzoru na Nikolu Teslu i fiktivnog lika Marvela Tonyja Starka. Inspiriran njihovim radom odlučio je napraviti ovaj punjač. Za svoj izum osvojio je dva zlata na međunarodnim natjecanjima (juniorsko u Nürnbergu, seniorsko u Seoulu).

DC charger, pametna narukvica

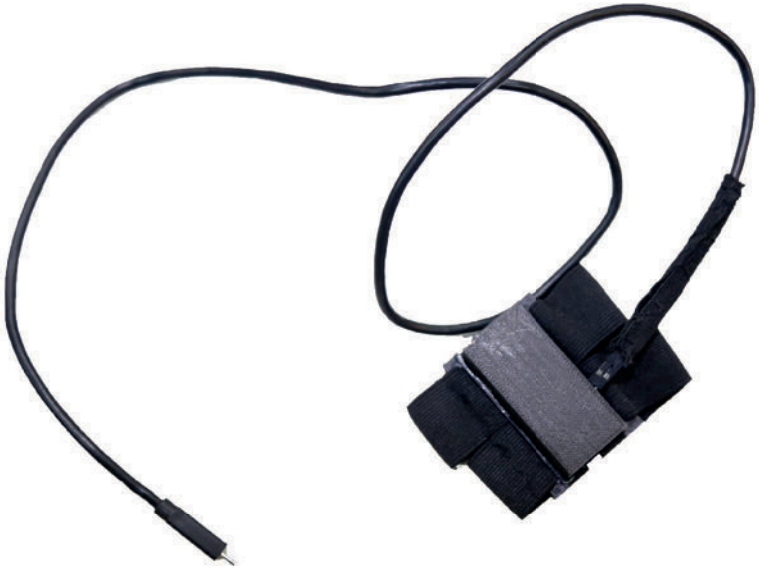
DC *charger* punjač je koji puni mobitel električnom energijom tijela. Ideja je nastala 2017. godine, a realizirana je sredinom 2018. godine. Ideja je nastala tijekom laboratorijskih vježbi u školi, kada se inovatoru ispraznio mobilni uređaj. Pojavila se potreba za izvorom električne energije koja nije ovisna o vremenu i prostoru.

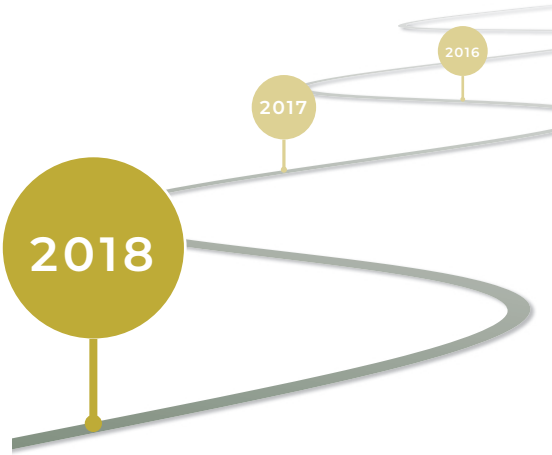
Što znači da niste ograničeni utičnicama, solarnim panelima ili prijenosnima baterijskim punjačima (koje morate prije upotrebe napuniti). Ovaj uređaj omogućava punjenje mobilnog uređaja bez obzira na mjesto na kojem se nalazite. Od realizacije ideje do prvog modela prošlo je tjedan dana. Zamislite da se nalazite u situaciji u kojoj ste na izletu, izgubili ste se, a mobitel vam se prazni. Utičnica vam nije blizu, *powerbank* koji ste ponijeli već se ispraznio, solarni panel vam je bio pretežak da biste ste ga stavili u svoju torbu i zauzimao bi puno mjesta. DC *charger* savršeno je rješenje takvog problema. Mala naprava jednostavna za korištenje promijenit će sve.

DC *charger* u prvotnoj i trenutnoj primjeni služi kao punjač mobitela. Plan je u skorije vrijeme to proširiti na pametne satove, kamperske lampe i *low-voltage* laptope. Ovaj uređaj ekološki je prihvatljiv, nije štetan za okolinu, nema visoko zračenje, ne izaziva nikakve kožne bolesti. Za njegovu izradu koriste se metali koji nisu štetni za čovjeka i koji se mogu reciklirati.

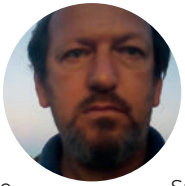
DC *charger* u najboljem slučaju postiže struju do 500 mA i napon do 7 V. Prvi uređaj bio je veličine 100 x 100 mm, a posljednji model 30 x 70 mm.

DC CHARGER, PAMETNA NARUKVICA





Franjo Vragolović



rođen je u Strizivojni, a završio je smjer računarske tehnike na Elektrotehničkom fakultetu Zagreb. Od 1995. godine autor se bavi dizajnom i razvojem proizvoda informacijskih tehnologija i *embedded* sustava. Počeo je s jednim od najzahtjevnijih proizvoda: terensko ručno računalo, a nastavio nizom ne manje zahtjevnih proizvoda, kao npr. ulični parkirni automat i automat za prodaju karata i naplatu.

Tijekom svoje profesionalne karijere autor se bavio projektiranjem informacijskih sustava, organizacijom proizvodnje, montažom i sklapanjem elektroničkih uređaja, produkt-dizajnom, razvojem sistemskog i korisničkog softwarea za mikrokontrolerske sustave i PC računala i grafičkim dizajnom.

Od 1996. godine do danas autor je osvojio niz nagrada i priznanja za inovacije i nove proizvode na izložbama i salonima inovacija.

Samoodrživa dekorativna struktura "SOLARNO ŽIVO DRVO"

Samoodrživa dekorativna struktura „SOLARNO ŽIVO DRVO" složeni je integrirani proizvod izveden u obliku drveta s ugrađenom infrastrukturom kao kod živih organizama: postolje (korijen), konstrukcija (stablo i grane), solarni paneli (listovi), elektronikom za nadzor funkcija strukture (živčani sustav), sustav za navodnjavanje (hranidbeni sustav – krvotok), kao i funkcionalnim elementima namijenjenima modernom urbanom životu: ambijentalna rasvjeta, komunikacija s internetom (WiFi) itd.

Proizvod je dizajniran za urbane i ruralne sredine, za vanjske – otvorene i poluotvorene prostore (parkovi, gradski trgovi, šetališta, terase itd.), a namijenjen je za dekoraciju prostora, rad i odmor. Stvara poseban ugođaj po danu, a naročito u večernjim satima.

„Struktura" se koristi Sunčevom energijom za obavljanje mnogobrojnih funkcija, poput akumulacije solarne – električne energije, napajanja susjednih objekata električnom energijom, ambijentalne rasvjete i rasvjete okolnog prostora, punjenja mobilnih uređaja, WiFi pristupa internetu, poboljšanja kvalitete zraka, proizvodnje kisika i smanjenje emisije CO_2 te kao udobno mjesto za odmor, zabavu i druženje. Ovakva je struktura jedinstven inovativni proizvod i projekt u odnosu na slična rješenja, prije svega zbog posebne osobine „solarno i živo".

Struktura doprinosi poboljšanju kvalitete zraka u urbanim sredinama – proizvodnjom kisika, kao i svaka prava biljka, te smanjenjem emisije štetnih plinova upotrebom Sunčeve energije.

Svim tim osobinama proizvod uvelike doprinosi razvoju svijesti o klimatskim promjenama kod građana te ističe potrebu za upotrebom obnovljivih izvora energije i za kružnom ekonomijom.

SAMOODRŽIVA DEKORATIVNA STRUKTURA ”SOLARNO ŽIVO DRVO”

2016

2017

2018

Autorska prava: Franjo Vragolović

Alen Hrga

bio je izniman student te svoje usavršavanje nastavlja na doktorskom studiju Fakulteta elektrotehnike i računarstva. Jedan je od malobrojnih stručnjaka na području *blockchain* tehnologije, a svoja računarska znanja primjenjuje u području energetike. Tijekom studija sudjelovao je na projektima iz raznih grana računarstva, a danas je i autor akademskih članaka iz toga područja.

Iva Klarić

studentica je na diplomskom studiju Fakulteta elektrotehnike i računarstva. Jedna je od glavnih pokretača inicijative Smart Waste, koja je i dovela do inovacije. Domensko znanje i jedinstven pristup u timu inovatora u vidu stručnosti i preciznosti upravljanja projektom stekla je vođenjem mnogobrojnih radionica tijekom studija i sudjelovanjem na njima.

Matko Zvrak

magistar je inženjer računarstva koji je već tijekom studija bio voditelj mnogobrojnih projekta i inicijativa, ostvario je i međunarodno iskustvo i kontakte tijekom studentske razmjene na AGH-u pri Sveučilištu u Krakovu te tijekom stručnog usavršavanja u NATO-ovu sjedištu u Bruxellesu, a danas je suvlasnik tvrtke koja podupire ovu inovaciju i stoji iza nje.

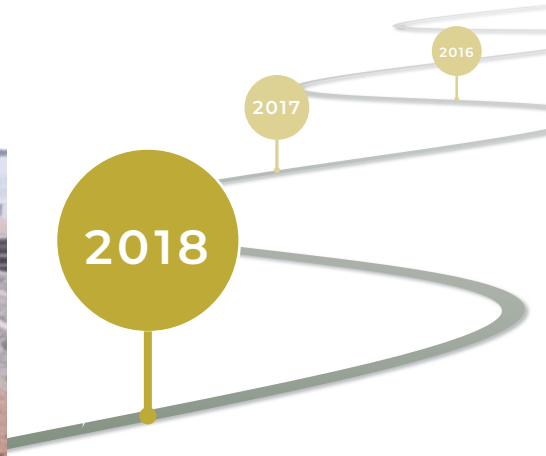
Smart Waste, sveobuhvatni sustav za nadzor gospodarenja otpadom

Smart Waste sveobuhvatni je sustav za nadzor gospodarenja otpadom. Pokriva cijeli proces gospodarenja otpadom, s fokusom na krajnjeg korisnika, tj. građane i komunalna poduzeća pod jedinicama lokalne samouprave. Osim njih, inovacija uključuje i otkupljivače te obrađivače otpada, koji vraćaju resurse u proces izdvajanjem iz sekundarnih sirovina te svi zajedno čine kružno gospodarstvo.

Sustav je ostvaren kao integracija spremnika, senzora, vrećica, QR/bar-kodova, RFID čipova te kompleksnog, modularnog programskog rješenja. Princip sakupljanja otpada od vrata-do-vrata okosnica je rješenja, što je u skladu s regulativama i napucima EU-a. Ovaj inovativni pristup jedinstven je na trenutnom tržištu te nudi svim akterima procesa podršku u obavljanju njihovih aktivnosti, dok zbog svoje modularnosti omogućuje različite modele ulaganja u njega. Na taj se način osigurava da korisnici s različitim potrebama odaberu samo onaj dio rješenja koji im je potreban, svodeći troškove na minimum.

Komunalna poduzeća, lokalne samouprave, otkupljivači i obrađivači otpada te cjelokupno građanstvo jedino zajedničkim naporom mogu postići održivu budućnost, a upravo je Smart Waste platforma koja to omogućuje jer sadrži važne elemente unaprjeđenja sustava u gradovima i općinama. Odvajanjem otpada na kućnom pragu problemu se pristupa na samom izvoru, a edukacija ljudi rezultira dugoročno održivim sustavom. Zajednički interesi komunalnih poduzeća – smanjenje troškova gospodarenja otpadom; građana – manja komunalna naknada te ostalih aktera – konkretni su poticaji zbog kojih vjerujemo da će se sustav koristiti na razini svih lokalnih samouprava u Republici Hrvatskoj.

SMART WASTE, SVEOBUHVATNI SUSTAV ZA NADZOR GOSPODARENJA OTPADOM



Fotografije su ustupili autori

DOROTEA BRAJKOVIĆ rođena je u Zagrebu. Upisuje preddiplomski studij na Agronomskom fakultetu u Zagrebu. Pridružuje se programu „studenti tutori" i počinje sudjelovati na izvannastavnoj aktivnosti unutar koje sudjeluje u projektu „Gradski vrtovi". Osvaja Rektorovu nagradu 2018. godine. Stručnu praksu izvršava na pokušalištu fakulteta i u laboratoriju fakulteta za biljnu bakteriologiju. U laboratoriju više godina sudjeluje u istraživanjima, analizama te u izradi vlastitog završnog i diplomskog rada. Nakon završenog studija upisuje se u Učilište terapijskih vještina Galbanum i stječe zvanje fitoterapeuta. Završava tečaj crtanja i slikanja u Centru za likovni odgoj u Zagrebu i postaje članicom likovne udruge.

MATEO CAHUN rođen je u Zagrebu. Pohađao je prirodoslovno-matematičku gimnaziju u Zagrebu (V. gimnazija), a nakon mature posvećuje se Tehničkom veleučilištu u Zagrebu, gdje studira informatiku. Ove godine planira postati prvostupnikom i nastaviti studij na Fakultetu elektrotehnike i računarstva u Zagrebu. Posebne vještine koje je stekao tijekom srednje škole uključuju sekvencijalno programiranje i elektroničke primjene. Tijekom fakultetskog obrazovanja proširuje znanje i počinje izrađivati mobilne aplikacije, internetske stranice i ostale manje vlastite projekte.

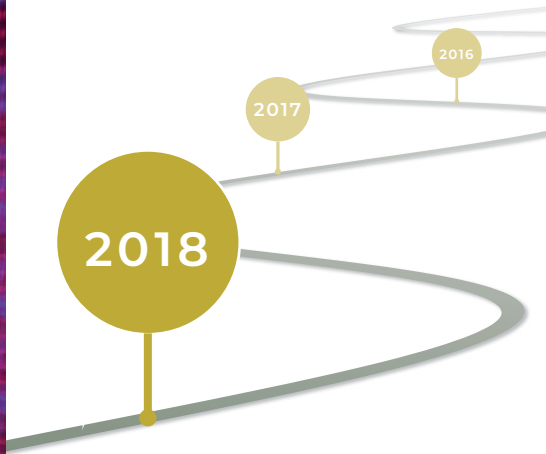
SREĆKO ARANDIA-KREŠIĆ rođen u Metkoviću, bolivijskog je podrijetla. Završava osnovnu školu, a kasnije prirodoslovno-matematičku gimnaziju (V. gimnazija) u Zagrebu. Nakon srednje škole krenuo je na studij mehatronike na Fakultetu strojarstva i brodogradnje u Zagrebu. Ove godine završava preddiplomski studij i stječe titulu prvostupnika inženjera. Područje njegova interesa relativno je veliko, a uključuje: modeliranje u CAD sustavima, grafički dizajn u alatu Blender, rad na neuronskim mrežama, korištenje softverskih alata MATLAB i tensorflow, projektiranje termodinamičkih, pneumatskih i hidrauličnih sustava, simulacije sustava krutih tijela i proračunavanje konstrukcijskih sustava s naglaskom na metodu konačnih elemenata i teoriju elastičnosti.

MARKO RATKOVIĆ rođen u Gospiću, a doselio se u Zagreb gdje je pohađao osnovnu školu. Odlučio je nastaviti svoje obrazovanje u prirodoslovno-matematičkoj gimnaziji u Zagrebu (V. gimnazija). Prvostupničku, univ. bacc. ing. el. tech. inf. diplomu dobiva 2018. godine na Fakultetu elektrotehnike i računarstva u Zagrebu. Trenutno pohađa diplomski studij elektrostrojarstva i automatizacije u istoj ustanovi. Nekoliko je zanimljivih projekata osim „Urbanog vrta" u kojima je sudjelovao, poput instalacije trofaznih sustava u domaćinstva, električarskih poslova u kućanstvima, kalibracije i centriranja kotača i diskova, programiranja automobila igračaka, izrade robota za igru „Četiri u nizu", mehaničkog i električnog dizajniranja te izrade sustava upravljanja u MATLAB-u za obrnuto njihalo.

Urbani vrt

Inovacija mladog interdisciplinarnog istraživačkog tima studenata uz vodstvo mentora dovršena je u prosincu 2018. godine pod originalnim nazivom „Urbani vrt". „Urban Oasis – Inteligentni aeroponski IoT urbani vrt" nalazi se na rubu postignuća područja interneta stvari (IoT), aeroponskog načina uzgoja, naprednih algoritamskih rješenja te strasti za prirodom, hranom i biljem. „Urban Oasis" osobni je vrt, proizvod veličine prosječnog hladnjaka u kućanstvu, koji omogućuje da se biljnim vrstama pomoću tehnologije omogući nekoliko različitih mikroklima te da im se optimizira trajanje rasta, potrošnja vode i energije. Ovaj pristup prikladan je pri istovremenom uzgoju nekoliko potpuno različitih biljnih vrsta na istom mjestu, koje prirodno ne bi mogle rasti u takvim uvjetima, ali ni jedna zajedno s drugom. Sam dizajn predstavlja okruženje pogodno za provođenje većeg broja brzih eksperimenata za identifikaciju aeroponskog uzgoja i razvoja biljnih vrsta u različitim uvjetima, uz višespektralne kamere s visokom rezolucijom, te za analizu, arhiviranje, statističku obradu i konačno modeliranje pomoću neuronskih mreža. Dizajn nudi četiri osnovne uloge: prehrambenu, nutritivnu, terapeutsku i brižnu, koje se prilagođavaju specifičnoj namjeni, ostavljajući dojam potpuno osobno dizajniranog proizvoda.

URBANI VRT



Fotografije su ustupili autori

Siniša Brođanac

Uređaj za detekciju i dojavu pada motocikla i lokacije vozača

do početka Domovinskog rata živio je s obitelji u Vukovaru. Godine 1992. doselio se u Istru, a u Puli je pohađao školu za industrijskog mehaničara (smjer alatničara), tijekom koje se upoznao s raznim materijalima i alatima koji se koriste u brodogradnji. U narednim godinama stekao je iskustvo u raznovrsnim poslovima, istovremeno njegujući strast prema motociklima. Godine 2006. prihvaća ponudu koja uključuje istraživanje i prodaju GPS uređaja za nadzor vozila na području Hrvatske, a zatim osmišljava uređaj kojemu je cilj očuvati živote i sigurnost motociklista, ove visoko rizične skupine vozača u prometu.

Nakon realizacije prototipa 2014. godine Siniša dobiva mnogobrojna domaća i međunarodna priznanja, među kojima valja istaknuti zlatnu medalju u Genevi i specijalno priznanje korejske udruge inovatora *KIPA*, srebrnu medalju u Nürnbergu 2017. godine te, po drugi puta, specijalno priznanje *KIPA*-e.

Uređaj za detekciju i dojavu pada motocikla i lokacije vozača automatski je sustav koji pomoću svog pametnog senzora prepoznaje da je motociklist imao nesreću i upozorava prethodno odabrane kontakte slanjem SMS ili e-mail poruke s koordinatama nesreće. Od trenutka nesreće potrebno je do 30 sekundi do slanja upozorenja o lokaciji unesrećenog, što omogućava interventnom timu da ranije stigne na mjesto nesreće i pomogne unesrećenom u što kraćem roku.

Pametni senzor načinjen je od dva živina prekidača podešena pod određenim kutovima. Senzor detektira gubitak gripa pod kotačima, odnosno prestanak prianjanja guma uz cestu. Senzor je ugrađen u vodootporno kućište, nema električne komponente ni sklopove koji bi proizvodili elektromagnetske ili radiovalove, stoga ne može prouzročiti smetnje ni štetna zračenja u okolišu.

Uređaj je nastao kao odgovor izumitelja Siniše Brođanca na učestale motociklističke nesreće njegovih poznanika i kolega motociklista. Potraga za bliskim prijateljem i motociklistom, koja je trajala puna četiri dana u travnja 2013. godine, bila je pokretač cijele ideje. Prvi prototip nastao je 2014. godine, a zatim je uslijedilo usavršavanje i potraga za potencijalnim investitorima koji bi omogućili serijsku proizvodnju i uvrstili ovaj uređaj u primarnu zaštitnu opremu svakog motociklista na cesti. Godine 2016. predan je zahtjev za patent, a 2019. dobivena je potvrda o patentu.

Uređaj se može koristiti kao alarmni sustav protiv krađe, a dodatnim funkcijama putem aplikacije korisnicima je omogućeno razmjenjivanje korisnih informacija poput stanja prometa, preporučenih odmarališta, smještaja, iskustava i slično.

UREĐAJ ZA DETEKCIJU I DOJAVU PADA MOTOCIKLA I LOKACIJE VOZAČA

2017

2018

2019

Autorska prava: Siniša Brođanac

Greyp Bikes

G6 je lagan kao pero zahvaljujući svojem kompozitnom okviru ojačanom ugljičnim vlaknima T700 i bateriji rađenoj po mjeri koju je osmislio i razvio sam proizvođač. G6 je električni bicikl s pedalama (*pedelec*), što znači da biciklistu kod okretanja pedala pomaže elektromotor. U trenutku kada prestanete okretati pedale, motor prestaje pomagati. Pomoć kod okretanja pedala bit će veća ili manja ovisno o količini sile koja se primjenjuje na pedale, ali G6 i u tom pogledu nudi posebnu mogućnost: možete ručno namjestiti željenu razinu pomoći!

G6 ima središnji inteligentni modul koji je u potpunosti osmislio i razvio sam proizvođač. Zahvaljujući ugrađenom rješenju eSim, G6 je u svakom trenutku povezan s internetom. Zahvaljujući toj povezanosti, G6 nudi mnoštvo uzbudljivih značajki, a vlasnik ima stalan pregled bicikla, čak i na daljinu.

Sklop tipki za upravljanje drugačiji je pristup upravljačkoj palici za bicikl. Za razliku od standardnih varijanti, kod G6 sklop tipki za upravljanje ima čak 12 mogućnosti. Počevši od 12 tipki za navigaciju kroz zaslone aplikacija i jedinstvene značajke, ovaj će bicikl nuditi još više mogućnosti u budućnosti. Prelazite sa značajke na značajku u najbržoj traci.

G6 je opremljen dvjema ugrađenim kamerama: jedna se nalazi na prednjoj strani, a druga na stražnjoj. Prednja kamera ugrađena je u središnji inteligentni modul, dok se stražnja kamera nalazi ispod sjedišta. Te će dvije kamere svakako dobro doći za sve zanimljive i uzbudljive stvari koje se mogu dogoditi dok jurite nizbrdicom ili kad jednostavno putujete kući s posla. Obje kamere imaju širok kut s razlučivosti od 1080p pri 30 slika u sekundi.

G6 ELEKTRIČNI BICIKL

Rimac Automobili

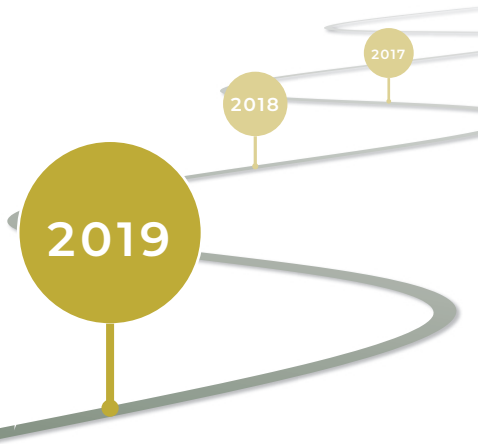
C_Two je potpuno električni GT hiperautomobil, jednako pogodan za pistu kao i za putovanja preko kontinenata. Podesiv, personaliziran i iznimno moćan, C_Two predstavlja ono što je moguće kada je istinskoj inovaciji i strasti dopušten nesmetan razvoj.

Nadovezujući se na znanje prikupljeno iz zapanjujuće snažnog automobila Concept_One, potpuno novi C_Two kombinira najbolje materijale i prilagođenu tehnologiju za izradu nečeg revolucionarnog i izrazito upotrebljivog, s performansama i karakterom koji podiže ovu vrstu automobila na novu razinu. Drugi automobil poput njega jednostavno ne postoji. Njegov proizvođač stoji iza cjelokupnog dizajna, izrade i proizvodnje te je ovaj automobil stvoren od nule, uz potpuno nove, revolucionarne tehnologije – C_Two dolazi sa školjkom u potpunosti izrađenom od ugljičnih vlakana, s krovom od ojačanog ugljika te s ugrađenom baterijom i pogonskim sklopom.

U pogledu tehnologije i rasporeda potpuno inovativna baterija isporučuje 120 kWh energije i 1,4 MW snage uz iznimno upravljanje toplinom. Uz najveću brzinu od 412 km/h (258 mph), postizanje brzine od 0 do 100 km/h (60 mph) u 1,85 sekundi i do 161 km/h (100 mph) u 4,3 sekunde, C_Two na nevjerojatan način iskorištava trenutni moment koji je dostupan samo električnom vozilu i trenje koje omogućuju jedinstvena pogonska osovina i gume rađene po mjeri.

Štoviše, C_Two održava svoje zapanjujuće ubrzanje tijekom cijelog ciklusa s punim gasom, postižući brzinu od 300 km/h (186 mph) od nule u samo 11,8* sekundi. Sljedeća generacija R-AWTV sustava (All-Wheel Torque Vectoring ili vektorski okretni moment na svim kotačima) upravlja četirima elektromotorima, po jednim za svaki kotač te je u stanju (i mora!) proizvesti 1.914 KS (1.408 kW) snage i 2.300 Nm okretnog momenta – dva i pol puta više od suvremenog hiperautomobila.

C_TWO, ELEKTRIČNI GT HIPERAUTOMOBIL



Grad Sveta Nedelja – grad za ugodno življenje i pametno poslovanje

Smješten na zapadnim vratima Zagreba, iznimno povoljnog geoprometnog i geostrateškog položaja, gospodarski i demografski jedan je od najstabilnijih manjih gradova u Hrvatskoj. Visok gospodarski razvoj, poduzetničke zone i prirodne ljepote samo su neke od prepoznatljivosti koje grad Sveta Nedelja čine privlačnim i ugodnim za život i stanovanje.

Grad Sveta Nedelja poznat je po nizu uspješnih tvrtki. Prema podacima iz 2017. godine na području Svete Nedelje uspješno djeluje 795 poduzeća, koja zapošljavaju 8829 osoba (što je gotovo 1000 više nego prethodne godine). Jedan od značajnijih resursa svetonedeljskog gospodarstva četiri su radne zone udaljene svega pola kilometra od autoceste Bregana-Lipovac.

Stopa izgrađenosti u zonama iznosi od 60 do 70 %, a Grad je snažno usmjeren na privlačenje investitora – kako niskim komunalnim doprinosima, tako i prilagodljivošću u razvoju potrebne infrastrukture. Zemljišne knjige grada usklađene su s katastrom, a vrijeme izdavanja građevinskih i lokacijskih dozvola iznosi u prosjeku sedam, a najdulje 14 dana.

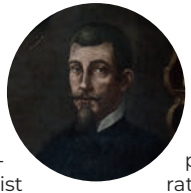
Sveta Nedelja opravdano nosi status Grada za pametno poslovanje i ugodan život, a tome svjedoči i nagrada osvojena u listopadu 2018. godine, kojom je Sveta Nedelja proglašena najboljim gospodarskim gradom u Hrvatskoj u kategoriji srednjih gradova.

U prosincu 2018. godine donesena je Odluka o gradskim porezima, kojom je ukinut prirez u Svetoj Nedelji (sa 6 % na 0 %) i porez na potrošnju.

GRAD SVETA NEDELJA – GRAD ZA UGODNO ŽIVLJENJE I PAMETNO POSLOVANJE

Autorska prava: Grad Sveta Nedelja

Marino Ghetaldi



(Marin Getaldić in Croatian, Marinus Ghetaldus in Latin), Croatian mathematician and physicist (Dubrovnik, 1568 – Dubrovnik, 7 or 8 April 1626). In 1588, he was accepted as a member of the Grand Council (one of the main institutions in the Republic of Ragusa), and from then on, he did different kinds of work in the service of the Republic. He also used the travels he had to undertake for his work as an opportunity to pursue education, deepen his findings in the fields of physics and mathematics, conduct scientific research and affiliate himself with noted scientists of the time. In 1595, he went to London, and later, in 1597 to Antwerp, where he remained until 1599. There he studied mathematics under Michel Coignet and received his first encouragement to pursue scientific work. Afterwards he travelled to France and met François Viète, and visited Italy multiple times where he met Galileo Galilei, German mathematician and astronomer Christopher Clavius and Austrian astronomer Christoph Grienberger, all of whom he later remained in correspondence with. He returned to Dubrovnik in 1603.

Parabolic mirror

The parabolic mirror gathers a beam of light parallel to its axis in its focal point. The appearance of strong light and the development of high temperatures in the focal point of such a mirror was known even by the early Greeks, and in recent times this principle is used for making refracting telescopes and solar collectors for domestic water heating and producing electricity in specialised plants.

The Ragusan Marino Ghetaldi made a contribution to the theoretical foundations and the application of parabolic mirrors, and consequently to the current use of renewable energy sources. From 1601 to 1603, Ghetaldi was involved in experimental work in the field of optics, especially the construction of parabolic mirrors and experiments with them. He also made a very large parabolic mirror, 66 cm in diameter, which could melt not only lead, but also silver, and even steel. After Ghetaldi's death, his brother Jakov gave the mirror to Cardinal Francesco Barberini in Rome.

Today it is kept in the National Maritime Museum in Greenwich. Ghetaldi's optical experiments in Dubrovnik were also known abroad, and were replicated by Marin Mersenne in France. In relation to the construction of parabolic mirrors, Ghetaldi wrote a treatise titled *A Few Notes on the Parabola* (*Nonnullae propositiones de parabola*), published in 1603 in Rome. In it, he points out that until then, parabolic mirrors were only made on the basis of a parabola from a right rectangular cone, something he also tried to do and succeeded in 1602. However, he demonstrated that such mirrors can also be made with the cross-section of an acute-angled, obtuse-angled and oblique cone, which is the subject of his treatise and his main innovation.

Ghetaldi was also working on the practical application of mathematics in solving different problems. Ghetaldi's work had a significant influence on the development of applied algebra in geometry before René Descartes's discovery of analytical geometry.

PARABOLIC MIRROR

1602

Photos courtesy of: Dubrovnik Museums, Božidar Gjukić; National Maritime Museum, Greenwich, London

Fausto Veranzio

(Verantius, Vrančić, Verancsics; Faustus, Faust), lexicographer, inventor, philosopher, diplomat and priest (Šibenik, 1 January 1551 – Venice, 20 January 1617). He studied philosophy and law in Padua (1568–72) and showed great interest in mathematics and physics. He was a member of the Croatian confraternity of St Jerome in Rome (1575), the administrator of the Bishop's estate in Veszprém in Hungary (1579) and the secretary of King Rudolf II of Habsburg (1581). He was ordained in 1600, and in 1605 he entered the Congregation of St Paul in Rome. In addition, he is the author of the *Dictionary of the Five Noblest European Languages, Latin, Italian, German, Dalmatian and Hungarian* (*Dictionarium quinque nobilissimarum Europae linguarum, Latinae, Italicae, Germanicae, Dalmaticae et Ungaricae*, 1595), the first independently printed Croatian dictionary and the first larger dictionary of Hungarian. He also wrote the famous technical work *New Machines by Fausto Veranzio from Šibenik* (*Machinae novae Fausti Verantii Siceni*, 1615), in which he presents visionary technical improvements, inventions and ideas from many areas of human activity.

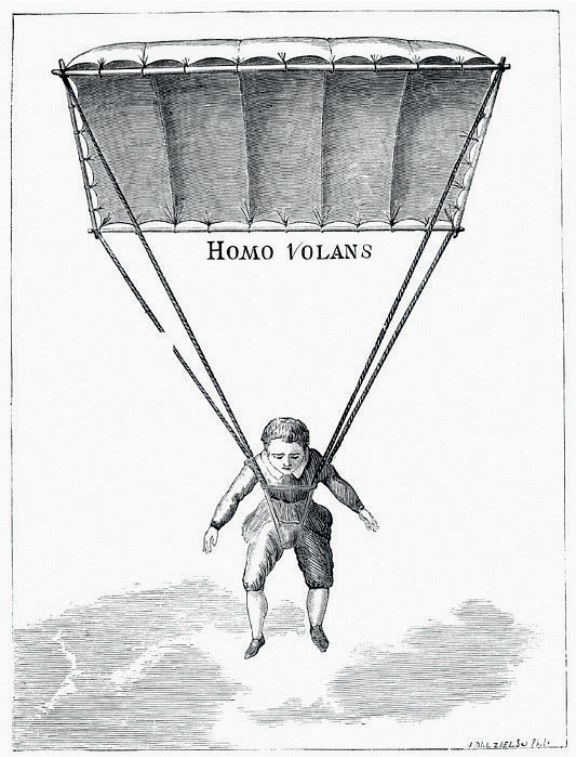
Parachute

The parachute, a dome-shaped device made from silk or artificial materials, used to slow down the movement of an object through the atmosphere. One of the first ideas on the use of a parachute is attributed to the Renaissance thinker and inventor Fausto Veranzio from Šibenik.

Veranzio described the parachute in the book *New Machines by Fausto Veranzio from Šibenik (Machinae novae Fausti Verantii Siceni*) in 1615 in Venice, in Italian, Latin, Spanish, French and German. In the book he deals with the construction of machines as well as technical and architectural problems. The work contains 49 large etchings with images of 56 different designs, among them the parachute and the parachutist he called the Flying Man (*Homo volans*). In that etching, Veranzio exposed the working principle of a rectangular parachute with a wooden frame, some two centuries before the discovery of the theory of air flow and the laws of hydraulics.

Veranzio was the first to present all the parts of the modern parachute, such as the dome shape, supporting ropes and connection system. The relation between the surface of the parachute and the weight of the man is especially well elaborated, which is why it is considered to be the precursor to modern parachutes, despite earlier rough descriptions of the device. Although speculations that Veranzio personally tested his parachute seem unlikely, recent experiments with a replica of his design demonstrated its usability.

Despite the small number of physical principles that were known at the time, Veranzio's other clear and precise drawings in perspective also show the mainly experimentally based, but potentially feasible and original technical solutions or modifications of other people's inventions, whose main purpose was to improve the quality of everyday life and lead to more efficient use of water and wind power.



PARACHUTE

1602

1615

Photos courtesy of:
"Faust Vrančić" Memorial Center, Prvić Luka

Ferdinand Kovačević,

Croatian expert in electrical telegraphy (Smiljan, 25 April 1838 – Zagreb, 27 May 1913). He went to school in Gospić until 1858, and in 1859 he graduated from the Military Academy in Wiener Neustadt. Until 1866, he served as an artillery officer (he received discharge papers from the military in 1872). In that same year, he was assigned to the Telegraph Administration in Josefov (now part of Jaroměř) in the Czech Republic, in 1869 to the Telegraph Inspectorate for Croatia and Slavonia and in 1870 to the newly founded Telegraph Direction for Croatia and Slavonia, where he held the post of secretary from 1872. He invented a number of improvements to the electrical telegraph, published numerous articles in specialised journals in Prague, Vienna, Bern and Berlin, and also wrote three books in German as well as the first book in the field of electrical engineering in Croatian (1892).

Duplex and quadruplex telegraphy

Duplex and quadruplex telegraphy, the simultaneous sending of two or four telegraphs on a single wire, patented in Vienna in 1876 by the Croatian expert in electrical telegraphy, Ferdinand Kovačević.

From the late 1860s in Croatia, he dedicated himself to the research and development of the theoretical and practical aspects of the, then still novel, telegraph technology. He published his results in the *Journal télégraphique* (Bern, 1878), *Revue télégraphique* (Bern, 1878), *Technische Blätter* (Prague, 1878), *Zeitschrift für Elektrotechnik* (Vienna, 1888–89) and *Elektrotechnische Zeitschrift* (Berlin, 1889).

In 1876, in Vienna and Budapest, he registered the patent *Differential method with constant current for the simultaneous transmission of two telegrams on a single wire in the same or opposite direction as well as four telegrams, two by two, in different directions*. His invention significantly increased the efficiency of telegraph lines (by four times). This meant that instead of the four lines necessary until then, one line now became sufficient.

In addition, Kovačević improved the Morse system telegraph, which was introduced in 1872 in all of Austria-Hungary. His books, articles and inventions made a contribution to the global development of telegraphy in, and his work is considered pioneering in Croatia. He was a member of the Electrical Engineering Society in Vienna from 1886.

DUPLEX AND QUADRUPLEX TELEGRAPHY

1602

1615

1876

Photos courtesy of:
Wikimedia commons, Shutterstock

Nikola Tesla,

inventor (Smiljan, 10 July 1856 – New York, 7 January 1943). Born in Lika, he attended grammar school in Gospić and Rakovac near Karlovac, where he graduated. In 1875, he enrolled in the Polytechnic School in Graz. At the beginning of 1880, he went to Prague in the hope of continuing his studies, but it is unknown whether he completed his studies at any of the universities. In 1881, he worked at the Central Telegraph Office in Budapest, and later at the Telephone Exchange. He started working at Edison's telephone branch in Paris in the autumn of 1882, and in 1884 he moved to the company's headquarters in the US. In 1885 in New York, he founded the Tesla Electric Light and Manufacturing Company, and later, in 1887, the Tesla Electric Company, with a laboratory where he worked on his inventions. He filed hundreds of inventions in 112 patents in the US, while many others remained only in his diaries or scientific journals. He received many acknowledgements and honorary doctorates. He refused the Nobel Prize because he did not wish to share it with Edison. Tesla high-frequency currents, the Tesla coil and the electrical therapy procedure called "teslinisation" are named after him. He received his greatest acknowledgement in 1960, when the term "tesla" was accepted as the unit of magnetic induction.

Polyphase AC system

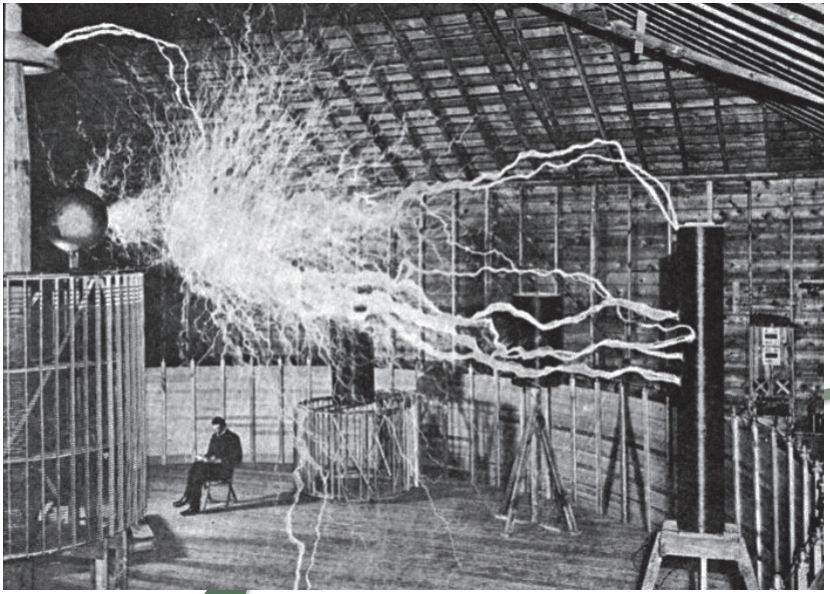
The system included a two-phase alternating current generator and motor with two pairs of coils powered by alternating current, which generates a rotating magnetic field causing rotation.

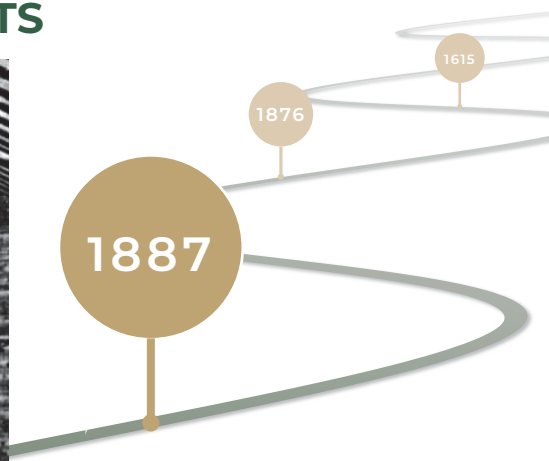
Tesla came to the idea for such a system during his stay in Budapest in 1881. In order to bring it to life, he went to the US in 1884 and started working for Thomas Alva Edison. However, his ideas were not met with understanding. From 1887, Tesla worked on the practical application of his ideas in his private laboratory, filing his first patents in autumn of the same year.

The system was proposed for the power plant on Niagara Falls. The power plant was finished in 1896. It supplied electricity to the city of Buffalo, around 40 kilometres away, which demonstrated all of the advantages of alternating over direct current. Devices using the polyphase AC system have a simple design and are thus cheaper to produce and maintain compared to those made for direct current, which is why in a few years, Tesla's systems started being used all around the world.

As a true genius, Tesla was interested in different fields of electrical engineering and technology in general, and he turned almost anything he tried his hand at into useful inventions which indebted humankind. In addition to the alternating current systems, he also worked with high-frequency currents and their applications for lighting as well as the wireless transmission of signals and energy. In order to realise his global radiocommunications system, in 1901 he began the construction of a large, 57-metre-tall radio station on Long Island in New York, with which he wanted to wirelessly transmit signals and electricity, available to everybody and free of charge. However, construction was suspended in 1905.

POLYPHASE AC SYSTEM, A SYSTEM FOR THE PRODUCTION, TRANSMISSION AND USE OF POLYPHASE ALTERNATING CURRENTS





Photos courtesy of: Wikimedia commons

Josip Belušić

(Bellussich, Giuseppe), physicist and mathematician (Županići near Labin, 12 March 1847 – Trieste, 8 January 1905). He attended school in Pazin and Koper, studied in Vienna, and in 1875 he started working as a physics and mathematics professor in the teacher-training school in Koper. He taught in German, Italian and Croatian. He was the headmaster of the Maritime School in Castelnuovo (Italy) where he received the title of assistant professor. In the late 1880s, he worked on his speedometer invention, which he also patented. Unfortunately, there is no record of Josip Belušić after 1900, and his fate from then on is impossible to establish. It is assumed that he sold the rights to the patent due to poverty.

Speedometer

The speedometer, an electrical device for recoding the speed of passenger vehicles, the amount of time the vehicle is in motion or stationary, the number of passengers and the time at which passengers entered and exited, constructed and officially presented in 1887 by Croatian inventor Josip Belušić.

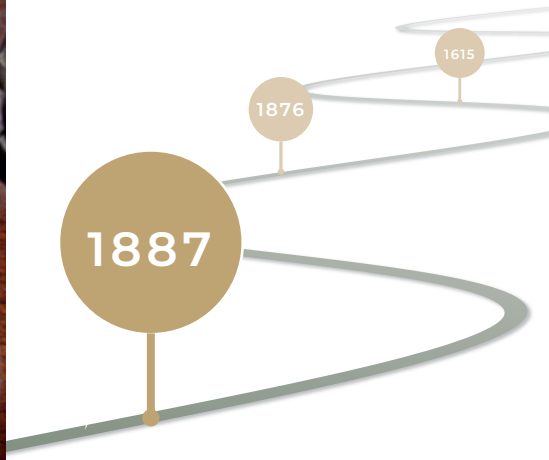
Assuming that the device would spread across the world and change the nature of road transport, in 1889 the Trieste journal *Naša sloga* first presented the new invention, which was protected by its creator with the competent authorities of the Austro-Hungarian Monarchy in Vienna under the term “device for hackney vehicle control” (*controlare automatico per vettura da nolo*).

The first test of Josip Belušić’s speedometer was carried out by carriage on the Trieste – Sveti Bartol – Trieste route, recording all actions. In addition to the parameters related to driving and passengers, the possibility of recording the entering and exiting for as many as 50 passengers was particularly important. This made the speedometer suitable for omnibuses, which were a means of public transportation in towns at the time, as precursors to modern trams and buses.

At the World Exposition of 1889 in Paris, the speedometer was declared the best in competition with more than 120 devices. After tenders and tests in 1890, the device was officially accepted, and the following year the first hundred speedometers were installed in carriages running in Paris, a leading world metropolis in many respects at the time.

The French Academy commended the inventor Belušić and awarded him a diploma and gold medal, as well as naming him an honorary member. The device was at the same time a tachograph and a taximeter, a precursor to the measuring and monitoring devices that are used today in trucks, buses and taxis, without which it would be impossible to imagine the further development of global road transport.

SPEEDOMETER



Photos courtesy of: Končar via Technical Museum Nikola Tesla

Juan Vucetich

(Vucetic, Vucetić; Ivan), criminologist, inventor of dactyloscopy (Hvar, 20 July 1858 – Dolores, Argentina, 25 January 1925). He finished elementary school in Hvar. After completing four years of military service in Pula, he immigrated to Argentina in 1884. In 1888, he started working in the Central Police Office in La Plata, and soon after, in 1889, he became the head of the statistics department. Noticing the shortcomings of previous researchers' works, in 1891 he organised and patented his own, globally pioneering method for fingerprint classification called dactyloscopy. He wrote several books, the more important being *Comparative Dactyloscopy* (*Dactiloscopía comparada*, 1904) and *The Development of Dactyloscopy* (*Evolución de la Dactiloscopia*, 1905).

Dactyloscopy

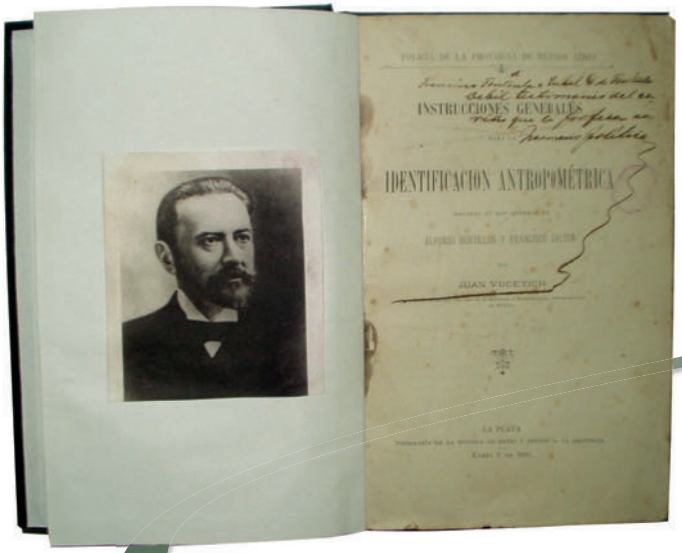
Dactyloscopy, a system for the identification of persons on the basis of fingerprints, created and officially introduced in Argentina in 1902 by Juan Vucetich, the founder of the Identification Service in La Plata. He finished elementary school in Hvar. After completing four years of military service in Pula, he immigrated to Argentina in 1884.

In 1891 in Argentina, he started the monthly journal *Boletín mensual de la estadística*, dedicated to tracking crime rates, and was entrusted with establishing an identification service on the basis of the anthropometry of Alphonse Bertillon (1853–1914) and F. Galton's idea on the value of fingerprints as evidence. He soon introduced his own, globally pioneering system for taking, sorting and recognising the papillary ridges of all ten fingers using accompanying devices and enabling the reliable identification of individual persons. As opposed to the primarily theoretical works of the time, in 1891 Juan Vucetich was the first to sort fingerprints from the left and right hands into groups and give them classification marks.

His dactyloscopy formula with a simple identification system was in the form of a fraction, using an eight-character combination (four numbers and letters). By combining the characters, 1 048 576 basic formulas can be produced. On the basis of this practicable classification system of papillary ridge prints, he laid the foundations for a new science, initially known as iconophalangometry. At the suggestion of Argentinian scientist Francisco Latzina (1843–1922), he later called it dactyloscopy.

Vucetich's ten finger system was officially introduced in Argentina in 1902, and afterwards in other countries (in Austria-Hungary in 1902, Germany in 1903, the United Kingdom in 1904, Russia in 1907, France in 1914 and so on). It is still the most widely used identification system in the world.

DACTYLOSCOPY, A SYSTEM FOR THE IDENTIFICATION OF PERSONS ON THE BASIS OF FINGERPRINTS



1876

1892

1897

Photos courtesy of: Police Museum Zagreb

David Schwarz

(Keszthely, Hungary, 7 December 1850 – Vienna, 13 January 1897). He finished elementary school in his home town and moved to Croatia at the beginning of 1860, where he finished an apprenticeship as a merchant in Županja. From the late 1870s, he lived in Osijek, while in the latter half of the 1880s he moved to Zagreb with his family. He traded in timber and founded a saw mill near Našice. He was self-taught in the field of machinery, and came to the idea of an airship while reading technical literature during a period of prolonged illness. Having left trading, for the remainder of his life, he dedicated himself entirely to the realisation of his idea. When aluminium was presented in 1889 at the World Exhibition in Paris, he noticed its possible application in aircraft technology and went to familiarise himself with its manufacturing technology in C. Berg's plants in Lüdenscheid and Eveking. Due to his premature death, he did not live to see the first successful public flight of the aircraft he designed, but as the originator of the idea for the first steerable aerostatic rigid structure aircraft and the leader behind its construction, he undoubtedly deserves a notable place in the history of aircraft technology development.

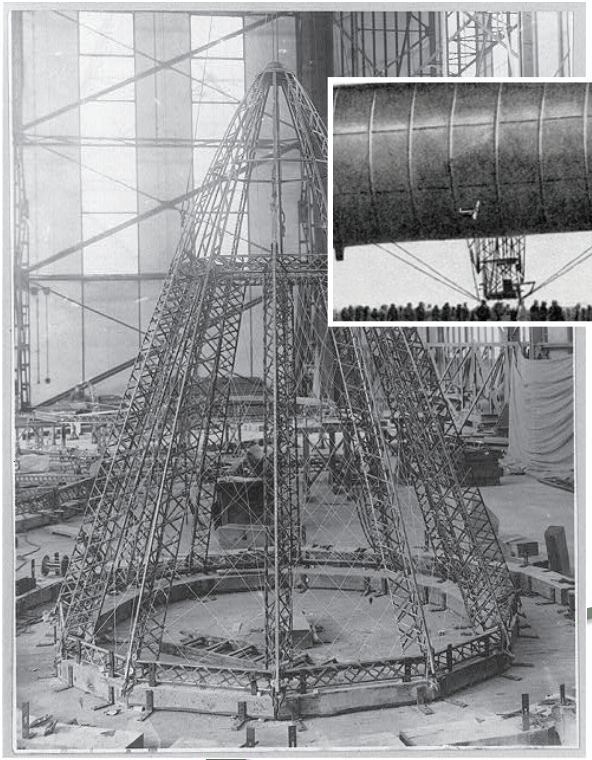
Airship (zeppelin)

The rigid structure airship, a steerable aircraft lighter than air (aerostat) with its own drive and rigid subconstruction that lends it a permanent shape, the type first designed by David Schwarz. Schwarz came to the idea of an airship in the late 1880s while reading technical literature. The only aircraft in the sky at the time were flying balloons with no steering capability.

He made his first drafts with the help of forestry engineer Josip Pfister. His initial plans likely included a wooden frame, but noticing the applicability of aluminium in aircraft technology, he included another innovation in his invention – a metal body for the aircraft. He started working for the industrialist Carl Berg in Germany and dedicated himself to exploring the possibility of the increased rigidity of aluminium alloys and connecting parts by riveting and soldering. He developed a special aluminium alloy, a precursor to duralumin.

Schwarz's new airship was assembled in 1896 near Berlin. It had an aerodynamic cylindrical shape with a conical front end, an aluminium mesh structure and tin plating. It measured 38.32 m in length and 12 m in diameter, with a gondola attached to the lower part of the frame. The airship had a carrying capacity of 240 kg (one person and 130 kg of ballast). However, due to helium of insufficient purity, the test flight in 1896 failed.

Schwarz died suddenly at the beginning of 1897. His share in the business venture was taken over by his widow Melanie. After taking over Melanie's share, in 1898 Berg made an agreement for the further production of airships with Ferdinand von Zeppelin and his Society for the Promotion of Aviation. In 1900, Zeppelin made his own airship following Schwarz's design, claiming undeserved fame as the creator of the first airship and leaving Schwarz forgotten.



AIRSHIP (ZEPPELIN)

1876

1887

1897

Photos courtesy of:
The Miroslav Krleža institute of lexicography; Wikimedia commons

Franjo Hanaman,

Croatian chemist and metallurgist (Drenovci near Županja, 30 June 1878 – Zagreb, 23 January 1941). He graduated in 1899 in Vienna, where together with Alexander Just, he developed the production process for the tungsten filament and its application in the electrical light bulb between 1903 and 1912. From 1911 to 1915, Hanaman served as the head of the Materials Testing Institute in Vienna. He completed his doctoral studies in 1913 in Berlin. Between 1919 and 1922, he was the general director of the Yugoslavian Motor Industry. He was elected as a private assistant professor at the High Technical School in Zagreb in 1920, and afterwards as a full professor of inorganic chemical technology in 1922, when he founded the first engineering department, the Department of Inorganic Chemical Technology and Metallurgy. He served as the dean of the Chemical Engineering Department (1922–24) and was elected rector of the High Technical School (1924). From 1934 to 1939, he was the editor-in-chief of the *Archive of Chemistry and Pharmacology* (now known as *Croatica Chemica Acta*).

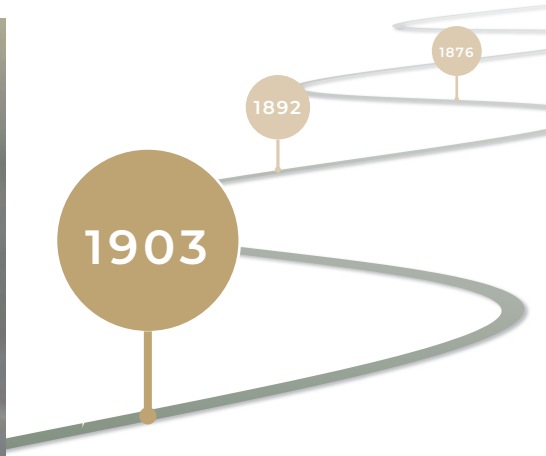
Tungsten filament light bulb

The tungsten filament light bulb, an electrical light bulb whose tungsten filament production process and applications were developed by Franjo Hanaman and Alexander Just in 1903. Owing to its high melting point, the tungsten filament, unlike other light bulb filaments until that time, could be heated to a higher temperature and thus achieve better lighting efficiency. This was an exceptionally important invention which finally enabled economical electrical lighting, which is only recently being replaced by energy-conserving lighting.

From 1900, while working as an assistant at the department of analytical chemistry at the College of Technology in Vienna (*Technische Hochschule*) and together with German-born Hungarian chemist A. Just, Hanaman worked on perfecting the metal filament electrical light bulb. With their first patent DRP 154262 from 1903 under the name *The Process of Producing Tungsten or Molybdenum Incandescent Bodies for Electrical Light Bulbs* (*Verfahren zur Herstellung von Glühkörpern aus Wolfram oder Molybdän für elektrische Glühlampen*), they developed the technology of obtaining tungsten filaments using the substitution process.

They later further refined the process, and in comparison with Edison's carbon filament light bulb, their light bulb consumed a third of the energy and lasted longer. Hanaman and Just made history as the fathers of modern lighting, and their concern for energy efficiency reflects a very current topic.

TUNGSTEN FILAMENT LIGHT BULB



Photos courtesy of: Končar via Technical Museum Nikola Tesla; Wikimedia commons

Slavoljub Eduard Penkala,

Automatic mechanical pencil

Croatian inventor (Liptovský Mikuláš, Slovakia, 20 April 1871 – Zagreb, 5 February 1922). He finished elementary school in his home town in Hungary and attended high school in Bielsko-Biała in Poland. In Dresden, he graduated in chemistry in 1898 at the Higher Technical School, and later also completed his doctoral studies. He worked for some time in a chemical products factory in Košice, and in 1900 he moved to Zagreb, where he was employed as a measurements supervisor for the eastern part of the Austro-Hungarian Monarchy. He started being involved in the field of technology and by the end of his life, at first in his home and ancillary workshop in the centre of Zagreb, he produced some 80 inventions. Over time, he also became a successful entrepreneur. His inventions were made in his workshops and factories, which employed hundreds of workers, and were sold all over the world.

The automatic mechanical pencil, a pencil invented and patented in 1906 by Slavoljub Penkala. Until Penkala's invention, graphite pencils were either mechanical or made from wood, with a very complex method of replacing and adjusting the lead.

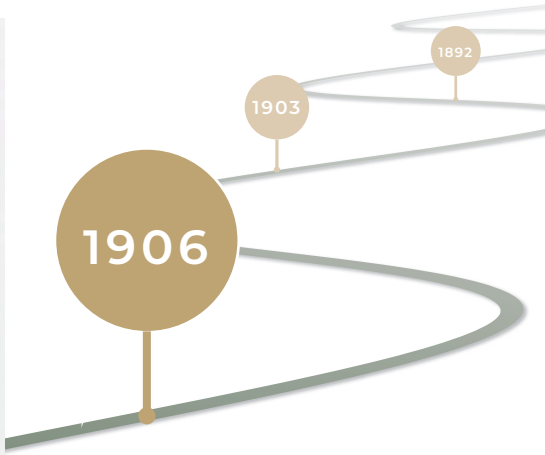
Penkala's automatic pencil did not have to be sharpened, and its thin lead, as it was being worn by writing, would come out of the body of the pencil by being pressed to paper. The pencil saw a few more improvements and versions, such as changes to the mechanism of extending the lead, the addition of a clip for attaching the pen to a pocket, a two-sided ballpoint pen model with red and blue ink cartridges on the ends, variants in different colours for painters, stylised models and so on.

The body of the pen was made from ebonite, a firm polymer mass that Penkala perfected and later used in music records, making them more resistant to breaking. The pencil soon became a hit on the global market. Over time, in Croatian the term "penkala" came to be used for different kinds of writing implements, especially for ballpoint pens with thick ink and a ball in its tip.

Penkala's first patents were a variant of the thermos flask in 1903, and a rotating toothbrush in 1904. He worked on improving the sound quality in recording and playback, and before World War I he contributed to the refinement of Austro-Hungarian military wiretapping radio stations called Penkala. Also, in collaboration with his brother Rudolph, he designed automatic brakes for mountain railways. From 1907, in his Elevator laboratory, he developed and made different chemical products.

In 1910, Penkala was the first in Croatia to construct his own plane, just a few years after the first flight of the Wright brothers' aircraft. In addition, in 1908 and 1909, he registered two patents for a device whose working principle is used today in helicopters and hovercraft, only made some fifty years later.

AUTOMATIC MECHANICAL PENCIL



Photos courtesy of: Technical Musem Nikola Tesla via Novena d.o.o.; Wikimedia commons

Leopold (Lavoslav) Ružička,

organic chemist (Vukovar, 13 September 1887 – Mammern on Lake Constance, 26 September 1976). He finished a classics-programme secondary school in Osijek (1906) and graduated in chemistry from the High Technical School in Karlsruhe in Germany (1908), where he also earned his doctorate (1910) under the guidance of H. Staudinger, a future laureate of the Nobel Prize in Chemistry. When in 1912 Staudinger became a professor at the Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule, ETH) in Zürich, Ružička came with him. There he received Swiss citizenship in 1917, became a private assistant professor in 1918, and an adjunct professor in 1923. Already while working as Staudinger's associate, he discovered the structure of pyrethrin, an insecticide derived from the Dalmatian chrysanthemum. In 1925 and 1926, he worked in Geneva, while from 1926 to 1929, he served as professor of organic chemistry at the University of Utrecht in the Netherlands, after which, in 1929, he became a professor and the head of the Laboratory for Organic Chemistry at the ETH. Ružička published 582 papers, while his discoveries in the field of synthetic organic chemistry earned him eight honorary doctorates, seven awards and medals, including the Nobel Prize in Chemistry (1939) as well as 24 honorary memberships in various scientific associations. Over the course of his career, he maintained close ties with scientists from his home country. He invited many of them to pursue specialisation in his laboratory, among them Vladimir Prelog, also a laureate of the Nobel Prize for Chemistry in 1975.

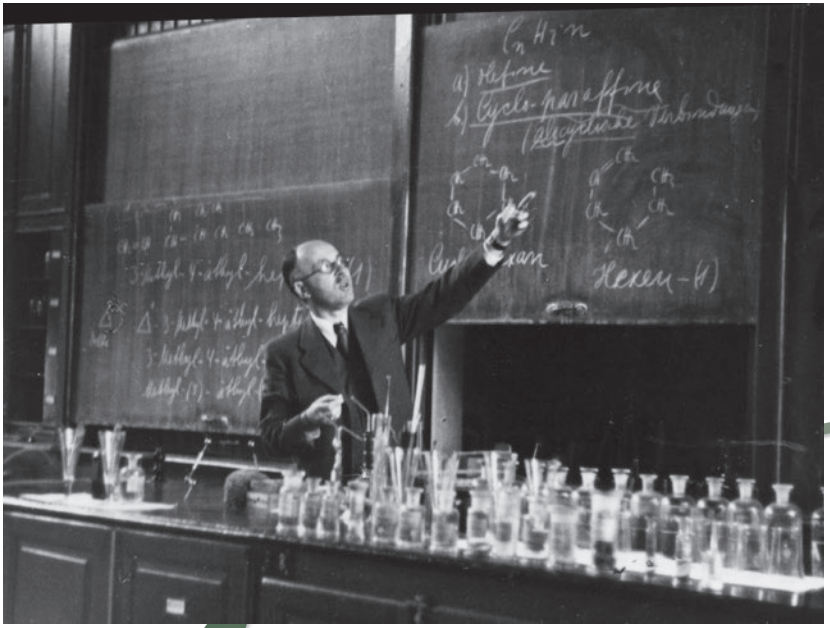
Synthesis of sex hormones

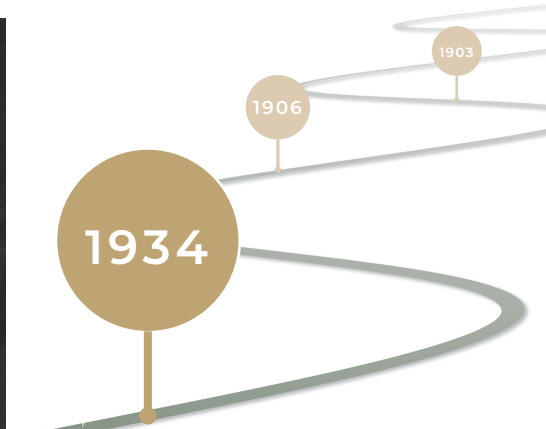
An important contribution to the research and synthesis of sex hormones was made by Leopold Ružička, a Swiss-Croatian chemist and the first scientist of Croatian origin to receive the Nobel Prize. Ružička was the first to partially synthesise the sex hormones androsterone and testosterone by artificial means, shed light on their structures by way of dehydrogenation methods and determined their configurations.

The beginnings of the discovery of the effect of testosterone date back to the 1920s, when American scientists isolated a substance from bovine testicles and used the extract to remaculinise castrated rats, pigs and roosters. Later, it was established that the substance in question was testosterone. A few years later, German chemist Adolf Butenandt isolated androsterone from human urine (1931) and marked the beginning of an entirely new era in chemistry – steroid chemistry. The 1930s saw great interest from the international community in steroid compounds, but the methods of isolation from natural sources required a strikingly high amount of original biological material.

After 1935, rapid development and synthesis of many structural analogues to testosterone ensued. A Swiss chemical concern with which Leopold Ružička collaborated from 1930 and his own laboratory at the Swiss Federal Institute of Technology (ETH) in Zürich also participated in those syntheses. Over the following few years, this collaboration brought about significant scientific and commercial success in male sex hormone research.

SYNTHESIS OF SEX HORMONES





Photos courtesy of: Wikimedia commons

Mario Puratić (Puretić),

inventor, revolutionary in the field of global fishing (Sumartin, Brač, 26 June 1904 – Santa Barbara, USA, 6 January 1993). He immigrated to the USA in 1929 and worked in steel works and the Brooklyn harbour in New York. After World War II, he moved to San Pedro, an old Komiža fishing colony, and found work as a fisherman. While working on tuna seiners, he became familiar with the back-breaking work of the fishermen at the time. As a man of creative spirit and wanting to make the fishermen's work easier, he invented the mechanical block and tackle for quickly and easily pulling out the net from the sea, called the Power Block, which he also patented in 1954. Owing to his contribution to fishery, he was named inventor of the year in the USA in 1975 and an honorary citizen of Iceland. Also, from 1972, the Canadian five-dollar bill bears an image of a fishing boat with his block and tackle. He continued working on inventions, filing more than 20 innovations to the U.S. Patent and Trademark Office from 1954.

Puretic Power Block

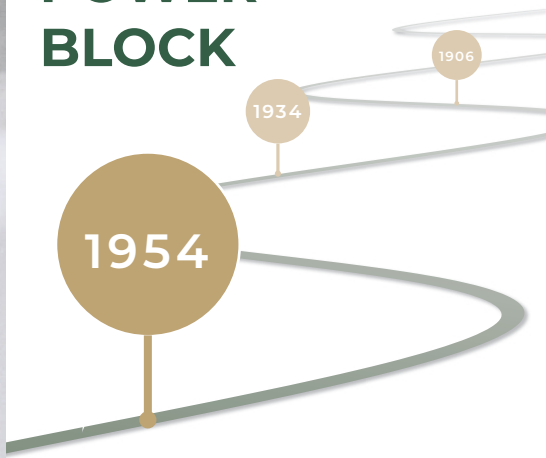
The Puretic Power Block, a mechanical block and tackle for efficiently pulling out purse and boat seine fishing nets, invented and patented under the name Power Block in 1954 by Mario Puratić.

It consisted of a specially adapted pulley with a rubber-coated groove, suspended to a boat derrick. The first block and tackle systems were operated by a boat winch and rope, while nowadays hydraulic systems are used, which enable remote control, i.e. changing the direction and the number of rotations of the block and tackle. By hanging one end of the purse seine over the block and tackle and turning it, the net is pulled to the deck with minimum human effort.

After years of work and perfecting the invention, in 1970 Puratić submitted the improved version to the U.S. Patent and Trademark Office. In 1958, a company from Seattle, in which Puratić worked as a consultant, joined the production and work on refining the block and tackle and now makes four models to suit the different sizes of boat and net, the fishing area and operating method of the hydraulic system.

Today, many other companies also make the grooved Puretic Power Blocks of varying sizes, strengths and types. With his invention, Puratić started a veritable revolution in fishing worldwide. In less than a decade, the use of the block and tackle spread from the north Pacific and the American west coast to the rest of the world and was introduced in all world fishing fleets.

PURETIC POWER BLOCK



Photos courtesy of: National Oceanic and Atmospheric Administration (NOAA), Central Library Historical Fisheries Collection, Department of Commerce and the NOAA Photo Library; Bank of Canada

Leo Sternbach (Henryk), chemist

Leo Sternbach (Opatija, 7 May 1908 – Chapel Hill, 28 September 2005). He was born in a Polish Jewish family in Opatija, where he attended elementary school and helped his father, a successful pharmacist and creator of several patents, in the family pharmacy. At 13 years old, he moved to Villach, Graz, and afterwards to Kraków, where he graduated in chemistry (1929) and earned his doctorate in organic chemistry (1931) at the University in Kraków. A key moment in his career was meeting the Croatian chemist and Nobel Prize laureate Leopold Ružička, who invited him to be an associate at the Swiss Federal Institute of Technology (ETH) in Zürich in 1937. From 1940 he worked at a pharmaceutical company, first in Basel in Switzerland, and from 1941 in the US, where he remained until his retirement in 1973, but nevertheless serving as a consultant for the same company until 2005. He co-authored 122 scientific works and filed for more than 240 patents, among them the very significant synthesis of biotin (vitamin B) that is still in use today. By 1990, a quarter of the company's revenue was earned by Sternbach's inventions. Owing to his contribution to the pharmaceutical industry, he was accepted into the American National Inventors Hall of Fame (2005). The American news agency U.S. News & World Report lists him among the 25 most influential people of the 20th century.

Diazepam

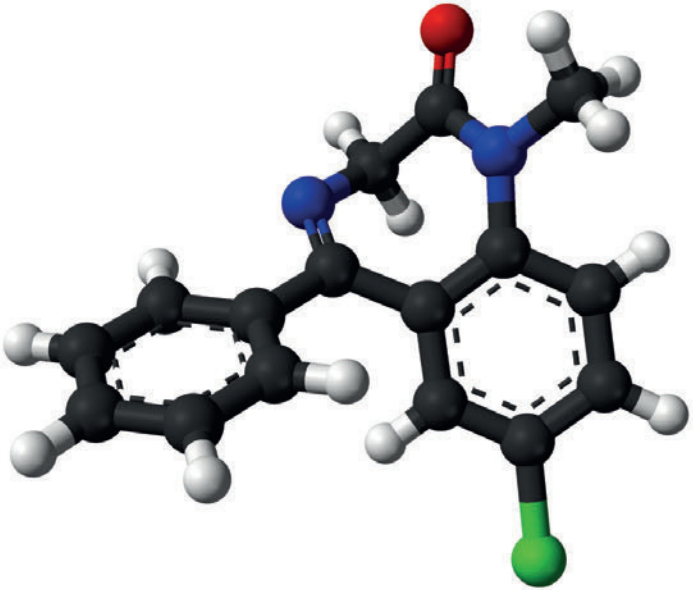
Diazepam, a substance from the benzodiazepine family, used for reducing anxiety, alleviating cramps, treating insomnia and so on. Diazepam was invented by Leo (Henryk) Sternbach, a scientist born in Opatija, who worked in Switzerland and later in the US.

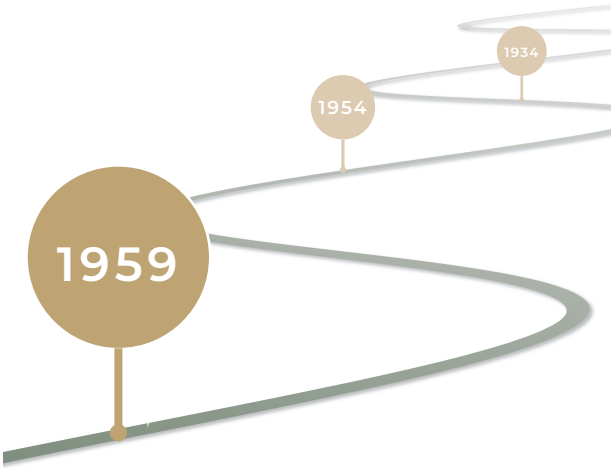
Diazepam is a positive allosteric modulator of the $GABA_A$ receptor, which increases the effect of the natural neurotransmitter gamma-aminobutyric acid (GABA) and thus acts as a depressor of the central nervous system. It was patented in 1959, and in 1963 it was approved for use as a drug. From 1969 to 1982 it was one of the most frequently prescribed drugs in America.

Diazepam is currently sold in the form of more than 500 generic drugs. A significant contribution to the research and development of the benzodiazepine class of drugs was also made by another group of Croatian scientists and expert associates gathered around Franjo Kajfež, the originator of the simplified process of diazepam synthesis.

Owing to his contribution to the pharmaceutical industry, Sternbach was accepted into the American National Inventors Hall of Fame (2005). The American news agency U.S. News & World Report lists him among the 25 most influential people of the 20th century.

DIAZEPAM





Photos courtesy of: Wikimedia commons

Research team

Members of the research team that developed the antibiotic were Slobodan Đokić (Danilovgrad, Montenegro, 30 November 1926 – Zagreb, 6 October 1994), Gabrijela Kobrehel (Obedišće near Novoselec, 1 March 1941), Gorjana Lazarevski (Omiš, 13 January 1946) and Zrinka Tamburašev (Sisak, 22 September 1921 – Zagreb, 24 April 2003). After finishing education at the University of Zagreb, they spent their working lives in a Zagreb pharmaceutical company, where they received numerous domestic and international awards for their discoveries. Under the leadership of S. Đokić, the head of the research institute from 1971 to 1990, the team worked on chemical transformations of macrolide antibiotics. From 1967 to 1978, they had several patents approved, the most remarkable among them being the patent for producing azithromycin and its derivatives in 1981.

Azithromycin

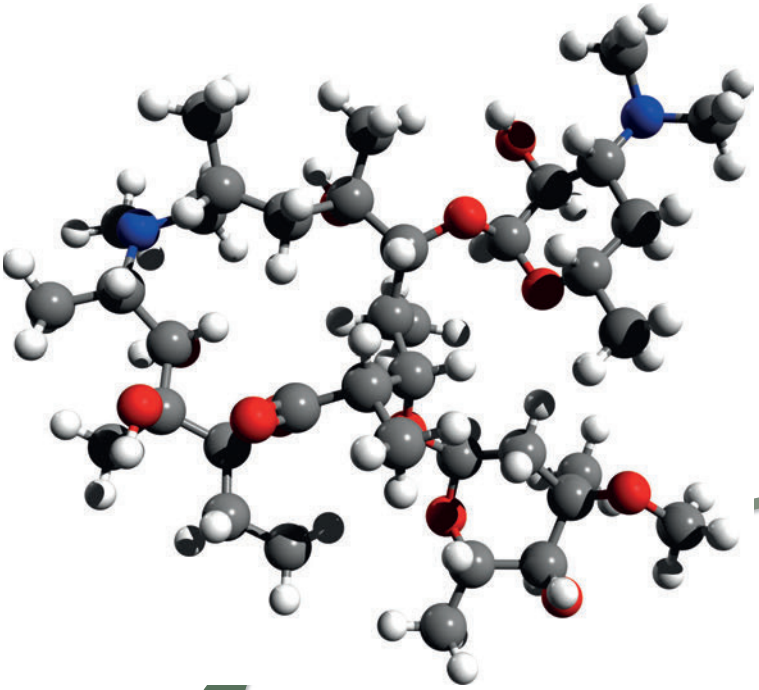
Azithromycin, a semi-synthetic macrolide antibiotic, the first representative of a new type of antibiotics called azalides and also the gold standard for this type of antibiotic thanks to its proven long-lasting success. Between 1979 and 1981, azithromycin was synthesised and patented by the associates of a research institute belonging to a pharmaceutical company in Zagreb.

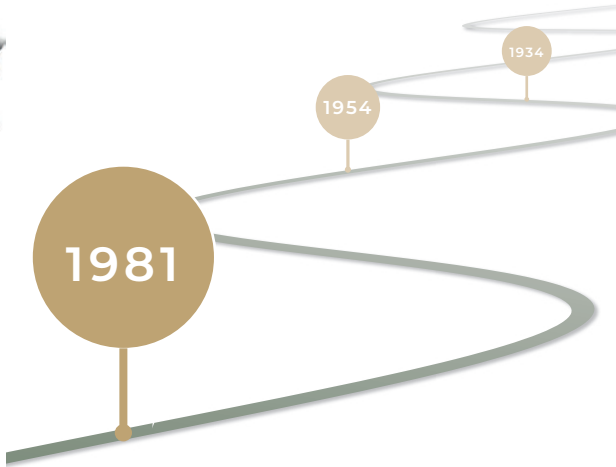
Their success in creating this active substance enabled the production of an antibiotic of increased scope of antibacterial activity compared to its precursors, excellent pharmacokinetic properties with a long drug half-life in comparison with existing antibiotics. The invention of azithromycin is among the greatest achievements of science and its commercialisation in Croatia.

Its exceptional therapeutic effect made it one of the most successful antibiotics worldwide. Today, azithromycin is used as a very effective drug for treating many bacterial infections of the upper and lower respiratory tract, skin and subcutaneous tissue infections, sexually transmitted diseases, stomach and duodenum infections, pelvic inflammations and increasingly for the prevention of bacterial infections in children and persons with a weak immune system.

The American Chemical Society (ACS) granted recognition to the research team for the improvement of humanity's welfare in the area of health and named them "Heroes of Chemistry" in 2000.

AZITHROMYCIN





Photos courtesy of: Wikimedia commons

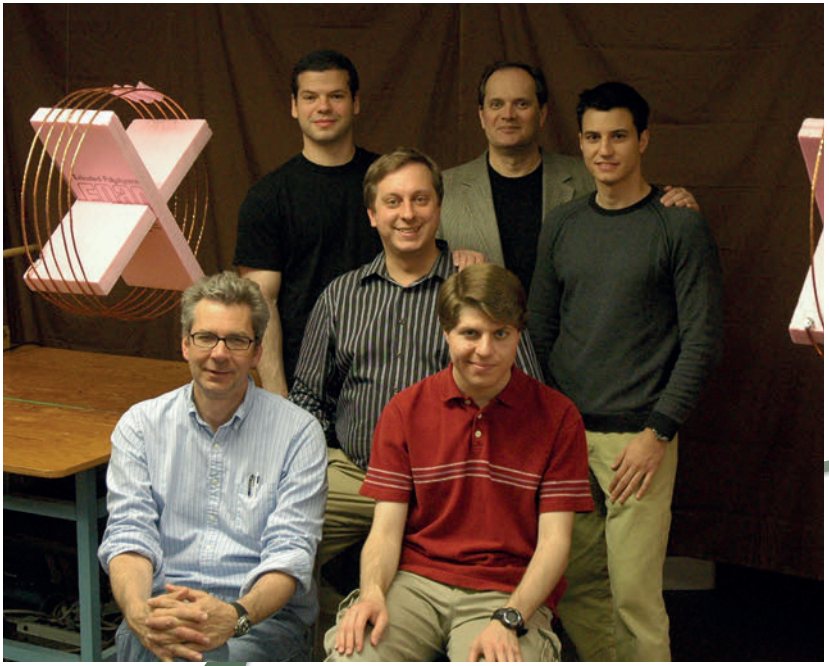
Marin Soljačić,

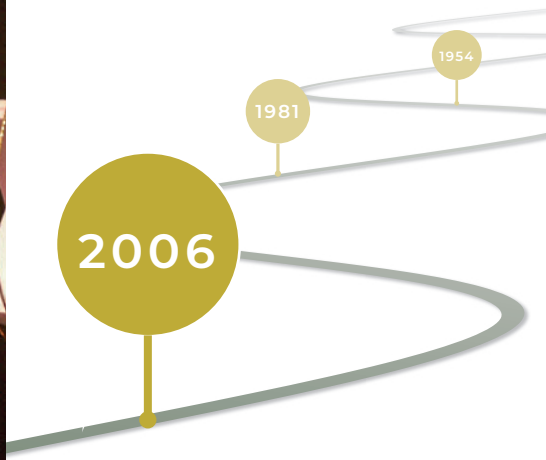
atian physics and electrical engineer (Zagreb, 7 February 1974). He finished high school in Zagreb, and later graduated from the Massachusetts Institute of Technology (MIT) in Cambridge, USA. In 2000 he earned his doctorate in physics from Princeton University. That same year he became a postdoctoral fellow at MIT, and from 2003 he served as a principal research scientist in the Research Lab of Electronics and a physics professor from 2005 (at first as an assistant professor, from 2010 as an associate professor and as a full professor since 2011). He is one of founders and the director of a company working on the practical applications of wireless non-radiative energy transfer. His scientific interests are also related to physical phenomena that occur with nanostructured materials, non-linear optics and nanophotonics. More recently, he has been involved in researching photonic crystals in solar cells. He co-authored numerous patents and scientific papers in leading scientific journals. He has received several important international awards and acknowledgements for innovative discoveries and young scientists.

Wireless non-radiative energy transfer

Wireless non-radiative energy transfer, the transfer of electricity without the use of conductors where, unlike traditional methods based on electromagnetic radiation, electromagnetic fields and pairs of objects of the same resonant frequency are used, reducing the dissipation and loss of energy and unwanted influence on other objects to a minimum. Inspired by the work of Nikola Tesla in that area done more than a hundred years before, the principle of this transfer usable for indoor distances discovered by Marin Soljačić with a team of scientists, and was presented in a 2006 paper. The group soon managed to conduct an experiment of wireless non-radiative energy transfer, in which by way of two coils tuned to a resonant frequency of 10 MHz they managed to use energy from a power network to turn on a 60 W light bulb, with 40% transfer efficiency. This discovery and experiment were published in the respected scientific journal Science in 2007, which aroused great public interest. Even though the practical application of Soljačić's invention is still in development, it is expected that it will enable the wireless charging of laptops, mobile phones, various household appliances as well as factory robots and especially electrical cars, which makes it a rather promising form of green technology.

WIRELESS NON-RADIATIVE ENERGY TRANSFER





Photos courtesy of: Marin Soljačić

Zvonimir Viduka

graduated in Industrial Electronics from the Faculty of Electrical Engineering in Zagreb. In 1994, he started one of the leading innovative tech companies in Croatia. Over the last 25 years, the company has become an important partner to railways from all six continents, with more than a thousand products in the field of electrical engineering for railway infrastructure and rolling stock. A 2012 study by the European Commission placed the company among the top 22 companies in the world based on results. For his success in innovation and entrepreneurship, Mr Viduka has received notable community and business awards, including over 70 awards for innovative and engineering work at both national and international innovation fairs. He took part in the drafting of the National Strategy of Croatian Innovation and the Industrial Development Strategy of the Republic of Croatia 2015, as well as the Croatian Export Offensive Project in 2006.

He is the Vice President of the Rail Cluster for South-East Europe and the Railway Union. He is the President of the Economic-Science Committee at the Faculty of Transport and Traffic Sciences and an economic member of the Croatian Academy of Engineering.

Level Crossing Protection System

The RLC23 Level Crossing Protection System is a high-tech, innovative product, developed in its entirety in Croatia based on ideas by Zvonimir Viduka and the interest of many of the world's railways. The role of the system is the automated protection of level crossings, which is where railway lines and roads meet on the same level, leading to the greatest number of major accidents and incidents.

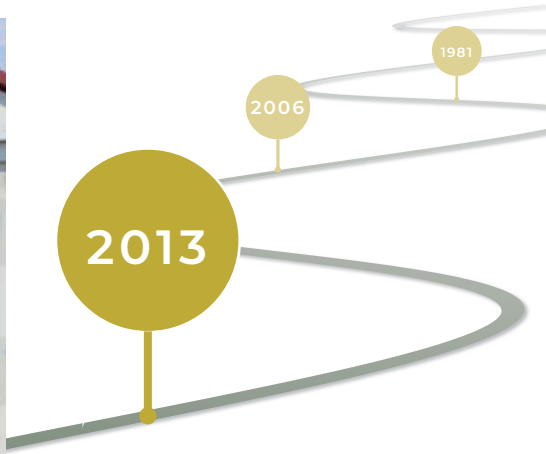
The system consists of a central control unit, an approaching train detection sensor, barriers, and a level crossing signal with flashing lights for warning road vehicles and railway traffic participants. The RLC23 system saw its first application in 2013. During the 6-year period since, the system has been installed in 15 countries across three continents, with railways from more than 70 countries expressing interest in its adoption.

The system's main distinguishing feature is the use of a series of technological innovations which ensure a high level of reliability, in addition to facilitating maintenance, analytics, and interoperability with other systems, both new and old, which is a priority for different railways. The RLC23 system has been certified as type A for the highest safety integrity level (SIL 4) by independent certification bodies, currently the only product with such a high ranking on the worldwide market.

The product is fully adapted to the latest environmental standards since it has no environmental impact, and its components are manufactured in accordance with environmental protection regulations. For its operation, the system uses power from the grid, but it is also easily adapted to alternative power sources. In this way, it can be completely energy-independent.

The system has been exhibited at invention and innovation fairs all over the world, receiving a large number of awards and widespread recognition, as well as the highest business awards of the Republic of Croatia.

LEVEL CROSSING PROTECTION SYSTEM RLC23



Photos courtesy of: Altpro

Ante Elez was born in 1979. He graduated from the University of Zagreb, Faculty of Electrical Engineering and Computing in 2003. After graduating, he found employment at the largest national institute for electrical engineering, where he spent 13 years working on applied scientific research in the field of rotary machine diagnostics and monitoring systems development. Since 2014, he has also been teaching at the Zagreb University of Applied Sciences. Near the end of 2016, he was appointed member of the Management Board of the largest national company dealing with generators and motors, in charge of the company's technological development. He has published 6 scientific articles and 16 papers in journals of prominent international scientific conferences, as well as 6 papers in the proceedings of professional conferences. He has also developed 11 new products.

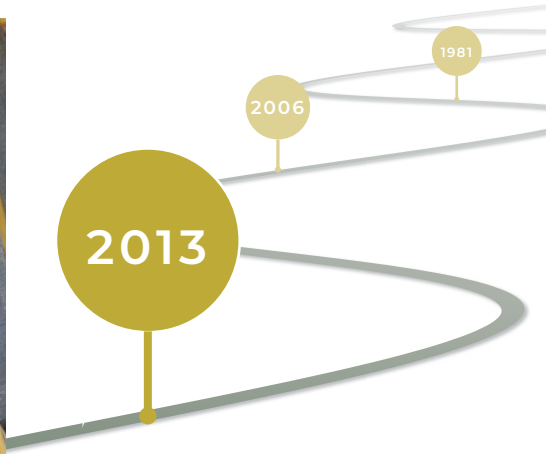
Stjepan Tvorić was born in 1985. He graduated from the University of Zagreb, Faculty of Electrical Engineering and Computing in 2003, on the topic of Modelling of Asynchronous Traction Motors Using the Finite Element Method. Since 2009, he has been working as a development engineer at the largest national institute for electrical engineering. He is currently pursuing a postgraduate doctoral degree, where he is researching: Detecting rotor faults in squirrel-cage asynchronous motors using the method of analysing magnetic fields in the air-gap. Since 2014, he has been teaching at the Zagreb University of Applied Sciences. He is a member of HRO CIGRÉ (the Croatian branch of the International Council on Large Electric Systems) and an individual member of the CIGRÉ global organisation.

Stjepan Car was born in 1949. After graduating, he began working at the national electrical engineering institute, where he worked for 18 years on research and development of rotating machines and electric motor drives. For eight years, he was a member of the management board of the national electro-industrial company, in charge of corporate development, and for 15 years he served as board chairman at the national institute for electrical engineering. He has published more than 80 scientific and technical articles and papers, in addition to authoring three patents and a monograph and dedicating 50 years of his life to applied scientific research and development in the field of electrical engineering. In 2007, he received the annual award from the Croatian Association of Technical Culture, and in 2012, he was awarded the National "Faust Vrančić" Lifetime Achievement Award for Technical Culture for his lasting contribution and overall input in developing technical culture. He was decorated by the President of Croatia with The Order of Danica Hrvatska with the image of Nikola Tesla for innovation.

Monitoring and Diagnostics of AC Machines by Magnetic Field Analysis in the Air-Gap

As converters of mechanical energy to electric energy and vice-versa, AC machines have tremendous economic significance. Continuously monitoring their operation and the emergence of various faulty states is vital for their safe and reliable operation. The method, discovered by the authors in 2013, is based on monitoring the changes in induced voltages in measuring coils embedded in the air-gap on the surface of the stator tooth or the stator slot wedge. Pairs of coils are placed along the machine circumference on the pole pitch, connected in such a way that the output voltage equals their difference. Any faults in the machine's winding or the changes in the air-gap's geometry will result in changes to the induced voltages. By analysing the voltage waveform and its effective value, it is possible to unambiguously determine the type and position of the fault: one or more broken rotor bars or end rings, or, alternatively, eccentricity and its size. By placing measuring coils on the rotor and wirelessly transferring signals by means of a device powered by the higher harmonics of the magnetic field in the air-gap, it is possible to monitor the emergence of stator winding failures.The innovation of the diagnostics consists of the placement of the measuring coils, their coupling and processing of induced voltage in the coils, as well as the algorithm for detecting the type of failure. The method of measurement and the analysis of the magnetic field through the use of information and communications technology (ICT) enable continuous insight into the condition and operation of the electric machine.

MONITORING AND DIAGNOSTICS OF AC MACHINES BY MAGNETIC FIELD ANALYSIS IN THE AIR-GAP



Photos courtesy of: Končar

Prof. Stjepan Lakušić, PhD CE,

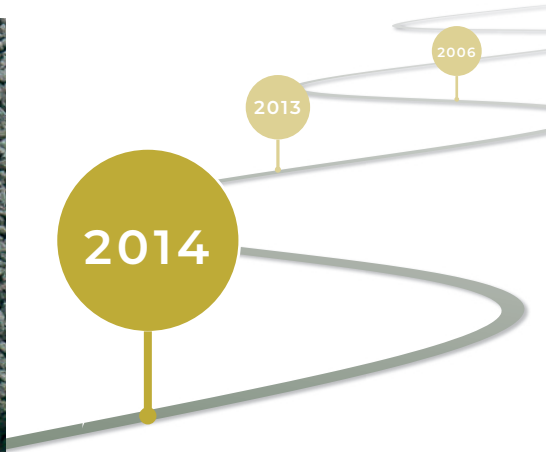
graduated from the Faculty of Civil Engineering, University of Zagreb in 1994. He defended his master's thesis, titled "The Influence of Incorrectly Manufactured Constructive Elements on the Prescribed Gauge of the Tram Track" in 1998. His PhD thesis, with the title "Dynamic Behaviour of the Tram-Track Interaction", was presented at the Faculty of Civil Engineering, University of Zagreb. As a researcher, he has worked on scientific projects in the fields of railways, and noise and vibration from road and rail traffic. He has participated in 76 international and 19 national conferences. He has published 164 scientific papers, edited 11 books and 10 symposia. He has been the editor-in-chief at the scientific journal GRAĐEVINAR since 2012, published by the Croatian Association of Civil Engineers. He has received 8 awards for innovative technical solutions at international and domestic exhibitions and 2 awards for published scientific papers at international conferences.

Since 2008, he has been serving as the Head of the Department of Railways. Between 2014 and 2018, he held the position of Associate Dean of Science, and as of 2019, he has been serving as Dean at the Faculty of Civil Engineering in Zagreb. He is a member of several domestic and foreign trade organisations. He was the initiator behind two scientific and two professional conferences. He was also a visiting teacher at the Faculties of Civil Engineering in Rijeka and Skopje.

Rubberised Concrete Noise Barriers - Ruconbar

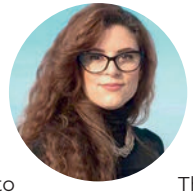
RUCONBAR (RUbberised COncrete Noise BARriers) is an ecological, highly absorbent noise barrier, whose absorbent layer consists of recycled rubber and concrete. The project was launched at the Faculty of Civil Engineering, University of Zagreb in 2009, where the initial idea of concrete mixtures with rubber granules was examined. The RUCONBAR project was co-financed by the European Union in the period from 2011 to 2014, under the CIP Eco-Innovation initiative, by the Executive Agency for Competitiveness and Innovation – EACI. In essence, RUCONBAR is a concrete construction product composed of an absorbent layer and a supporting layer. By using 40% of rubber granules in the absorbent layer obtained by recycling old rubber tyres, a product was developed that represents an innovative solution in the field of noise protection, unique in the market. The solution's innovativeness lies in the unique method of production of the barrier's absorbent layer. By incorporating rubber granules recycled from waste tyres and stone particles of a certain granulometric composition into the concrete mixture, a layer of light porous concrete is produced, exhibiting optimal traffic noise absorption properties. In addition to exceptionally good and competitive sound absorption properties, the RUCONBAR barrier is also superior in terms of other significant properties such as freeze-thaw resistance and fire resistance. RUCONBAR's principal environmental benefits are: reducing greenhouse gas emissions by 31% compared to similar solutions on the market; lowering our dependency on non-renewable energy sources and protecting natural landscapes; recycling waste automotive tyres. As an example, to produce a 1 km-long noise barrier, 3 metres in height (a 3000 m^2 barrier), up to 50 tonnes of rubber granules can be used, sourced from 8000 waste tyres.

RUBBERISED CONCRETE NOISE BARRIERS - RUCONBAR



Photos courtesy of:
Faculty of Civil Engineering,
University of Zagreb

Josipa Majić



is the founder and CEO at a London-based company with offices in Zagreb and Palo Alto that analyses biometric data and creates affective computing systems. After attending the University of Zagreb, she founded the company at the age of 22. Prior to that she worked on a patient monitoring system, helping children and users worldwide to learn from biometric insights.

Josipa is the main visionary behind the company's products and overall strategy, responsible for successful customer relationships with Fortune 100 clients globally. She was acknowledged by TIME Magazine in their list of the top 10 most innovative products of the year.

Teddy Smart Toy Bear

Teddy is the first smart toy of its kind on the market; a personal guardian equipped with sensors that monitor the vital condition of your little ones. The state-of-the-art technology in Teddy's paw has allowed Teddy to become the most accessible way to check your children's vital signs.

Teddy is the perfect guardian, carefully designed for your little ones. Made in Europe from the finest, carefully selected materials and top-quality plush, Teddy is soothingly cream-coloured, providing a unique experience for children and their parents.

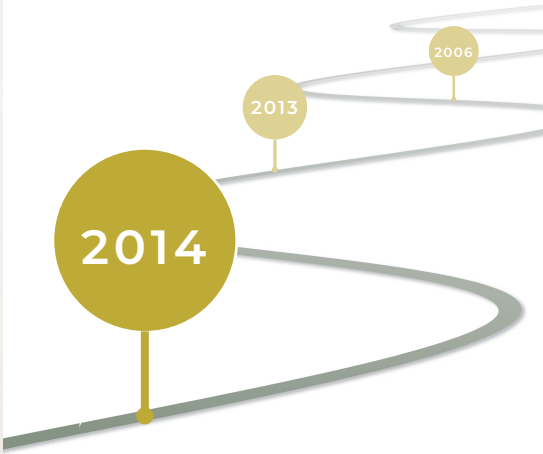
However, it is inside Teddy where the real magic happens. The electronic module linked with a mobile app is what makes him special. Teddy's sensor, monitoring body and ambient temperature, as well as all other electronic parts, are securely housed inside a plastic casing in Teddy's specially-designed paw. The protective mechanism allows the sensor to be safe from child contact and accessible only to parents.

The accelerometer, located inside the round casing, allows Teddy to wake up to the slightest movement, also making sure that he stays idle when not in use. Using Teddy is very simple. All you have to do is press the child's finger, forehead, or neck against the sensor located in the toy bear's paw. It is possible to get a body temperature reading just by hugging Teddy.

Teddy is linked to a mobile app which receives the collected data and displays the values obtained.

The friendly design allows temperature spikes and drops to be easily monitored, in addition to other features, such as creating reminders and alarms, making it easier to track your loved one's condition.

TEDDY THE GUARDIAN



Photos courtesy of: Josipa Majić

Frano Pokrajčić

was born on 3 February 1951 in Tomislavgrad. He attended primary school in Tomislavgrad and graduated from the Franciscan Classical Grammar School in Split. He graduated top of his class from the Higher Textile Technology School in Varaždin with a major in chemistry, earning the title of engineer. He has 44 years of work experience in PVC and PU production and has received multiple awards for his work. During his career, he rose through the ranks, from factory worker, to production manager, director, company representative, and ultimately, the owner. His company, a manufacturer of a wide range of products, was founded in 1991. In 1993, the company started producing laminated fabrics, which ultimately led to his idea in 2004, and the innovative Water against Water patent in 2014.

Water against Water – Flood Defence System

Water against Water – Flood Defence System is an idea which was first developed in 2004 after witnessing the enormous problems and damage caused by flooding.

The idea had been perfected and built upon for years, with the definitive solution finally patented in 2014. The final product consists of large tubes closed at the ends, which can be filled with water and inflated or deflated using water pumps. The Water against Water flood barriers consist of plastic tubes, approximately 10 to 20 meters in length, which can be joined into a single barrier of the required length and height by using special fittings and connecting modular elements. After the barriers are filled with water, they act as a dam against the incoming flood.

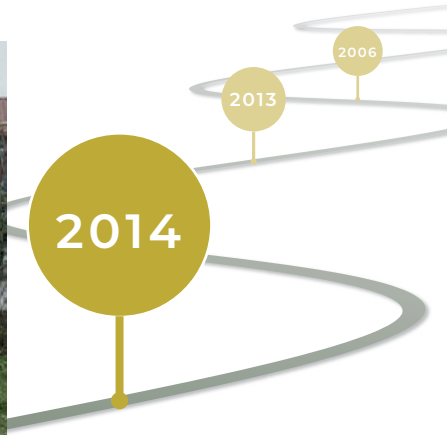
When using the Water against Water – Flood Defence System, traditional sandbagging is no longer necessary since a flood barrier can be erected much faster and with fewer people by relying on plastic tubes filled with the very water which threatens to cause damage. In situations which would normally require 500 service personnel to fill and deploy sandbags, by using the Water against Water – Flood Defence System, the same result can be achieved with only 5 workers, and 20 times faster than sandbagging, which makes it far more flexible and several times more responsive when it comes to reacting to emergency situations.

After they are no longer necessary, the tubes can easily be deflated using special valves. They occupy very little room in storage since they are folded in packages which can be stacked on pallets. The system can be reused multiple times. If handled properly, it can easily last for 15 years or more.

This process has led to considerable savings and innovations in the flood defence process.

The materials used in their production have been declared non-toxic and not hazardous to health.

WATER AGAINST WATER – FLOOD DEFENCE SYSTEM



Photos courtesy of: Franjo Pokrajčić

Bojan Jerbić, Darko Chudy

Bojan Jerbić is a full professor at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb. He graduated from the same faculty in the field of robotics, followed by a Master's Degree. He earned his PhD in the field of artificial intelligence in 1993. He continued his education and training in the United States. Together with his colleagues, he frequently collaborates with many European universities. He conducts scientific research in the field of artificial intelligence in robotics. He is engaged in the research and development of intelligent models of management of multi-agent robotic systems, medical robotics, the interaction of robots and humans, and models of robotic consciousness. He has published more than 100 scientific and professional papers, as well as three books, and has participated in numerous research and development projects. Owing to his research projects and co-operation with the industry, he has developed one of the most advanced laboratories for applied robotics in Europe.

Darko Chudy was born in Zagreb on 8 February 1962. He is a neurosurgery specialist and acting head of the Department of Neurosurgery at Clinical Hospital Dubrava. He defended his doctoral dissertation at the School of Medicine, University of Zagreb in 2000, earning a PhD in Medical Science. He has been the head of the Department of Neurosurgery at Clinical Hospital Dubrava since 2007. At the Neurosurgery Clinic of the University Hospital Centre Zagreb, he started out by performing surgeries in the field of stereotactic neurosurgery. He was the first surgeon in the Republic of Croatia to reintroduce functional stereotactic neurosurgery and the method of deep brain stimulation in patients with neurological movement disorders (Mb Parkinson's, dystonia) and incurable pain syndromes. During his tenure at the Department of Neurosurgery of Clinical Hospital Dubrava, he introduced deep brain stimulation in patients with a minimal state of consciousness and vegetative condition.

RONNA – Robotic neuro-navigation

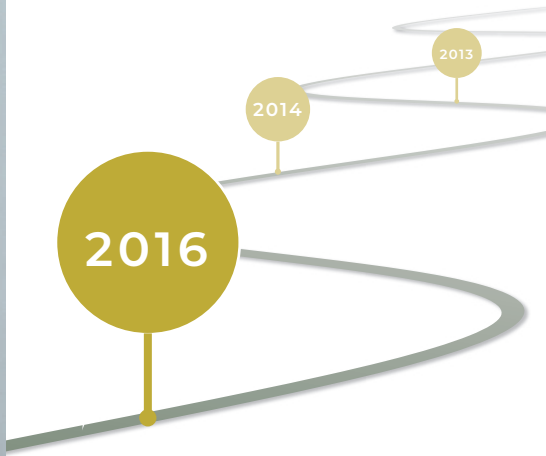
RONNA is an interdisciplinary project of the University of Zagreb which started in 2007. The goal was to reduce the load of sensitive and challenging neurosurgical procedures imposed on the surgeon. The research teams of the Faculty of Mechanical Engineering and Naval Architecture (FSB), Zagreb (Croatia) and University Hospital Dubrava (KBD), Zagreb (Croatia), under the leadership of Prof. Bojan Jerbić, PhD and Prof. Darko Chudy, PhD, began experimenting with the possibilities of robot application in minimally-invasive neurosurgical procedures.

Today, RONNA is a robotic neuronavigation system based on articulated robotic arms and is intended for minimal invasive stereotactic procedures such as biopsies, Stereoelectroencephalography (SEEG), epilepsy surgeries, Deep brain stimulation (DBS) and tumour resections. RONNA can be configured as a single arm or dual arm system. The single arm system is intended for stereotactic neuronavigation and serves as a navigation assistant to the surgeon. The dual arm configuration is more autonomous, whereby the second arm performs the invasive operation tasks such as bone drilling, probe or needle insertion, etc.

The localisation procedures in the image space and in the physical space are fully automated and RONNA provides a fully autonomous patient registration procedure that does not require additional involvement of the medical personnel. The application of RONNA in stereotactic neurosurgical procedures shortens surgery time, is less invasive, the recovery of the patient is faster and operational resources of the hospital are better utilised.

Clinical trials with RONNA have started in 2016. Currently, the RONNA fourth generation (G4) operates on a weekly basis at the University Hospital Dubrava in Zagreb, Croatia.

RONNA - ROBOTIC NEURO-NAVIGATION



Photos courtesy of:
Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

Inga Kovačić-Sindik

was born in 1960 in Split, Croatia. She grew up and received her education in Split – a degree in chemical engineering. She completed her postgraduate studies in Zagreb, in addition to more than 50 different professional courses in the field of water treatment and purification technology, as well as air and environmental technology, all in the function of finding solutions to restore the natural balance between man and nature.

During her thirty-year professional development, she has been involved in researching and testing the use of waste materials from various industries for water treatment and processing, and the development and application of natural materials for air purification.

She is the owner of a private company and the head of Research and Development, leading a team of 10 experts. By incorporating smart technology and machine learning into natural materials that imitate natural air purification processes, she strives to contribute to solving the global challenge of greenhouse gas emissions. A large number of intellectual property and related rights (patents, trademarks, copyrights) are a result of her lifelong dedication. In 2018, she received the award for Best European Innovator.

The eco smart system for air purification and modification

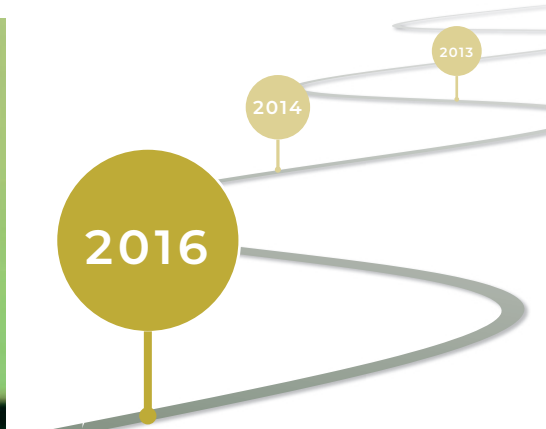
The purpose of the Eco Smart System for Air Purification and Modification is to remove and reduce air-pollutants inside closed spaces. The innovation was created in 2016, and its technical details are protected by three patents and two copyrights.

This technologically advanced system integrates 11 different methodologies that allow for the purification and processing of indoor air with automatic measurement, control, management, monitoring and programme regulation. The device enables the production of optimum air for its user. With its sensory elements, the system automatically detects and controls the largest number of pollutants in the space, among which allergens, vapour gases, formaldehyde, radon, viruses and bacteria pose the greatest danger to people. Via information communication technology, the optimal air purification and treatment system in enclosed spaces is then activated. The device possesses a universal active-passive filter composite, which is another innovative feature.

Integrated into the Eco Smart System for Air Purification and Modification, there are also parts of the technical elements that innovate the technological process of artificial production of micro-climate conditions in isolated rooms or cabins, that can produce any kind of climate. This feature allows users to be continuously exposed to the benefits of the Mediterranean/Dalmatian climate, one of the world's healthiest climates.

As an innovator, Inga Kovačić Sindik has received a special charter for global contribution to air purification filters at these exhibitions, and in 2018, she received the award for Best European Innovator.

THE ECO SMART SYSTEM FOR AIR PURIFICATION AND MODIFICATION



Photos courtesy of: Inga Kovačić Sindik

Nenad Grgec, Jasna Gajinov, Filip Grgec, Luka Grgec

Nenad Grgec graduated and received his Master's Degree from the Faculty of Economics & Business in Zagreb. He has also held a number of managerial positions; including director of marketing, sales and development and chairman of the board at various companies.

In 2008, after completing the "Marketing Revitalisation" project for one of the largest companies for the production of hygienic and medical products in South-East European Union and guiding and introducing a similar company into the EU market from the restrictions of pre-existing market environments, he started his own company with a clear goal and commitment to "be different, innovative, and determined by quality".

Jasna Gajinov graduated from the Faculty of Education and Rehabilitation Sciences of the University of Zagreb. She is actively working on the development and positioning of own brands both domestically and abroad, as well as on developing an own-brand distribution network on domestic markets and in neighbouring countries. She is the project team leader and sales manager for products from the company's product portfolio, in the area of development plans and company activities on foreign markets, as well as positioning the company in demanding markets of so-called PL (private label) products.

Filip Grgec is a student at the Faculty of Economics & Business, University of Zagreb. Within the company, he is responsible for coordinating the activities of manufacturing, sales and procurement, as well as the implementation of various processes arising from ISO 9001, IFS, FSC and PEFC certification. As a leader or member of project teams, he is working on a range of activities, developing new products, and modifying both new products and technical-technological processes closely related to the company's business base.

Luka Grgec is a student at the Faculty of Economics & Business, University of Zagreb. As an external member of the project team for new product development, his youthful perspective and approach gives the team the breadth of insight needed to develop new products. Focusing on younger customers with knowledge of new technologies and digital marketing gives the team the necessary freshness of ideas and a different approach to business problems or development phases in the production process or the product itself.

Cotton buds

Plastic has been completely removed from the cotton bud manufacturing process, replacing it with paper packaging. During the manufacturing process, paper stems are used in place of plastic, the plastic box is replaced by one made of paper, and the innovation lies in the "easy open" paper cover, completely replacing the plastic variety. The innovation was first designed in 2017, with preparation and testing lasting over a year. In addition to the innovation of the product itself, a technological innovation has been made on the production line, where two new machines for cardboard boxes have been introduced, as well as a machine for closing these boxes with a cardboard cover. In this way, the entire production process is automated, increasing productivity as well as efficiency, i.e. full line capacity, reducing the amount of waste generated, as well as the environmental contamination caused by plastic products. The product is fully adapted in line with environmental standards, and since it is made of paper and cotton, it is completely biodegradable. The product is fully in line with the EU directive on the reduction of single-use plastic, which banned plastic cotton buds. This product is a step further from what even the directive itself prescribes, offering the market a completely eco-friendly product without the presence of plastic.

COTTON BUDS WITH PAPER STEMS & AN EASY-OPEN CARDBOARD COVER AND CARDBOARD BOX

2014

2016

2017

Photos courtesy of: Incite code

Dorian Crnoja

was born in Osijek in Croatia on 27 February 2000. He started dabbling in engineering as early as 10 years old. After coming to Zagreb at 13 years of age, he started to be more interested in electronics. His love for engineering led him to enrol in the Faust Vrančić Mechanical Engineering School, studying to become a mechatronics technician. As he was growing up, he showed interest in art, literature, architecture, and construction, but electrical engineering turned out to be his greatest passion. Since as long as he can remember, his greatest dream has been to become an inventor like the great Nikola Tesla and the fictional Marvel hero Tony Stark. Inspired by their work, he decided to try his hand at building this charger. For his invention, he received two gold medals at international exhibitions (a junior exhibition in Nuremberg and a senior exhibition in Seoul).

DC Charger SmartBand

The DC Charger is a charger which can recharge a mobile phone using the body's electric energy. The idea was first created in 2017 and came to life in mid-2018. It came about during lab experiments at school, when the innovator's mobile device battery ran out. There was a need for a source of electricity that was not time- or space-dependent.

The idea is to no longer have to rely on power sockets, solar panels, and portable battery chargers (which you must recharge before use). This device allows you to charge your mobile device regardless of where you are. The idea's implementation took one week, culminating in the development of the first model. Imagine being in a situation where you are on a trip, and you get lost while your mobile phone is running out of battery. There are no power outlets, your portable charger is already empty, the solar panel was too heavy to put it in your bag and it would just take up too much space. The DC Charger is the perfect solution to such a problem. A small, easy-to-use device that will change everything.

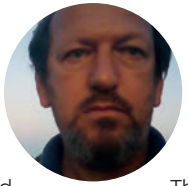
In its original and current use, the DC Charger serves as a mobile phone charger. The plan is to expand the number of possible uses to include smart watches, camping lights, and low-voltage laptops in the near future. The device is eco-friendly, non-hazardous to the environment, it does not emit a high level of radiation, nor does it cause any rashes or skin conditions. Recyclable metals that are not harmful to human health are used in its production.

In ideal circumstances, the DC Charger achieves power of up to 500mA and voltage up to 7V. The first device was 100x100mm, and the latest model 30x70mm.

DC CHARGER SMARTBAND

Photos courtesy of: Dorian Crnoja

Franjo Vragolović



born in Strizivojna and graduated from the Faculty of Electrical Engineering in Zagreb. Since 1995, the author has been involved in the design and development of information technology products and embedded systems. He started with one of the most demanding products, a hand-held field computer, and continued with a range of no less demanding products: street parking ticketing and billing machines, etc.

In the course of his professional career, he worked on designing information systems, organising manufacturing, constructing and assembling electronic devices, designing products, developing system and user software for microcontroller systems and PCs and graphic design.

Since 1996, the author has won a number of awards and recognition for innovations and new products at exhibitions and innovation salons.

Self-sustainable decorative structure "LIVE SOLAR TREE"

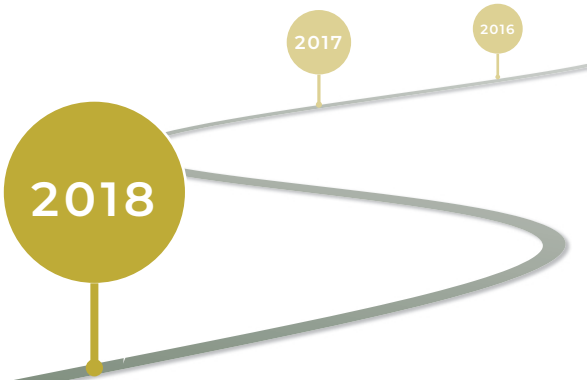
The self-sustainable decorative structure LIVE SOLAR TREE is a complex integrated product shaped like a tree, with built-in infrastructure imitating living organisms: a base (roots), construction (tree trunk and branches), solar panels (leaves), electronic elements for monitoring the structure's functions (nervous system), irrigation system (feeding system – bloodstream), as well as functional elements designed for contemporary urban life; ambient lighting, internet connection (Wi-Fi), etc.

The 'structure' relies on solar power to carry out numerous functions such as accumulating solar-generated electricity, supplying neighbouring elements with electrical power, providing ambient lighting and surrounding lighting, mobile charging, Wi-Fi internet access, improving air quality; oxygen production and reduction of CO_2 emissions, and providing a great place to rest, socialise, and have fun. A structure such as this is a unique innovative project that combines the distinctive features of plant and animal life in a complex technological project unlike any of the similar solutions, in particular due to its special "solar and live" feature.

It is designed for urban and rural environments, to be used outdoors – in open and semi-open spaces (parks, town squares, promenades, terraces, etc.), and its purpose is decorative, as well as to be used for work and relaxation. It creates a special atmosphere during the day, particularly in the evening.

The structure contributes to the improvement of air quality in urban environments; by producing oxygen just like any other plant and reducing the emission of harmful gases by using solar energy. All of these features contribute greatly to the awareness of citizens about climate change, the need for renewable energy sources, and the circular economy.

SELF-SUSTAINABLE DECORATIVE STRUCTURE “LIVE SOLAR TREE”



Photos courtesy of: Franjo Vragolović

Alen Hrga

was an exceptional student, who now continues his education with PhD studies at the Faculty of Electrical Engineering and Computing. As one of the few experts in the field of "blockchain" technology, he has found a way to apply his computer science expertise in the field of energetics. During his studies, he participated in projects from various fields of computer science, and today he is the author of academic articles in the field.

Iva Klarić

is a graduate student at the Faculty of Electrical Engineering and Computing. She is one of the main originators of the Smart Waste initiative which led to the innovation. By participating in and conducting a large number of workshops during the course of her study, she has gained an enviable level of knowledge in her field, as well as a unique approach to the team of innovators in terms of expertise and precision of project management.

Matko Zurak

is a Master of Computer Engineering who has been the head of many projects and initiatives already during the course of his studies. He has also gained international experience and made valuable connections when he participated in the student exchange program at the AGH University of Science and Technology in Kraków. He also completed a professional training program at the NATO headquarters in Brussels, and today, he is the co-owner of the company which stands behind and supports this innovation.

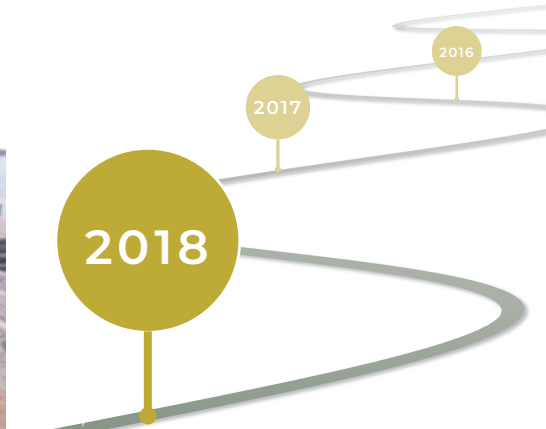
Smart Waste, comprehensive waste management system

Smart Waste is a comprehensive waste management system. It covers the entire process of waste management with the end users in mind, i.e. the residents and the utility companies run by municipalities or other local self-government units. The innovation also incorporates the companies that buy and process waste and complete a circular economy by extracting resources from secondary raw materials and injecting them back into the process.

The system has been implemented through the integration of containers, sensors, bags, QR/Bar codes, RFID chips, and a complex, modular programming solution. The principle of collecting waste door-to-door is the backbone of the solution, in line with EU regulations and guidelines. This innovative approach is unique in the current market. It provides support to all stakeholders in the performance of their activities, while offering a variety of investment models due to its modularity. This enables users with different needs to select only the part of the solution that they themselves need, reducing costs to a minimum.

Utility companies, local self-government units, companies that collect and process waste, as well as the entire citizenry can only reach a viable future through a common effort. With the process of waste sorting at the doorstep, we tackle the problem at its very source, and educating the populace results in a system that is viable in the long-term. Common interests of utility companies (such as reducing waste management costs), citizens (such as lower communal fees), and other stakeholders, are palpable incentives that we believe will ultimately lead to the system being implemented at the level of all local self-government units of the Republic of Croatia.

SMART WASTE, COMPREHENSIVE WASTE MANAGEMENT SYSTEM



Photos courtesy of authors

DOROTEA BRAJKOVIĆ was born in Zagreb. She started her undergraduate study at the Faculty of Agriculture in Zagreb. She joined the 'student tutor' programme where she participated in the "City Gardens" project. She won the Rector's Award in 2018. She underwent practical training at the Faculty's experimental fields and in the Plant Bacteriology Laboratory of the Faculty of Agriculture. In the laboratory, she has been involved in research and analysis while working on her own final and graduate thesis over a period of several years. After finishing her studies, she enrolled at the School of Complementary Therapies Galbanum, gaining the title of phytotherapist. She completed a drawing and painting course at the Centre for Visual Arts in Zagreb, becoming a member of an art association.

MATEO CAHUN was born in Zagreb. He attended the 5th Gymnasium in Zagreb specialising in science and mathematics. After graduating, he enrolled at the Zagreb University of Applied Sciences, studying Computer Science. This year he plans to graduate and continue his studies at the Faculty of Electrical Engineering and Computing in Zagreb. The special skills he has acquired during high school include sequential programming and electronic applications. During his college education, he expanded his knowledge and started making mobile applications, websites, and other smaller projects of his own.

SREĆKO ARANDIA-KREŠIĆ was born in Metković and is of Bolivian ancestry. He finished elementary school and later on, the 5th Gymnasium in Zagreb specialising in science and mathematics. After leaving high school, he went on to study mechatronics at the Faculty of Mechanical Engineering and Naval Architecture in Zagreb- This year he is set to complete his undergraduate studies and acquire the title of Bachelor of Engineering. The field of his interest is relatively broad, including modelling in CAD systems, graphic design in Blender, neural network operation, use of MATLAB and tensorflow software tools, design of thermodynamic, pneumatic and hydraulic systems, rigid bodies system simulation, and calculation of structural systems with an emphasis on finite element methods and elasticity theory.

MARKO RATKOVIĆ, born in Gospić, moved to Zagreb at an early age, where he attended elementary school. He decided to pursue his education at the 5th Gymnasium in Zagreb specialising in science and mathematics. He received his first degree from the Faculty of Electrical Engineering and Computing in Zagreb in 2018, earning the title of Bachelor of Electrical Engineering and Information Technology. He is currently attending a graduate study of electrical engineering and automation at the same institution. He has participated in several exciting projects apart from "Urban Garden", such as: installing three-phase electric power in households, household electrical work, calibrating and centering wheels and discs, programming toy cars, making "Connect 4" robots, and mechanical and electrical design and manufacturing of control systems in MATLAB for the reverse swivel.

Urban garden

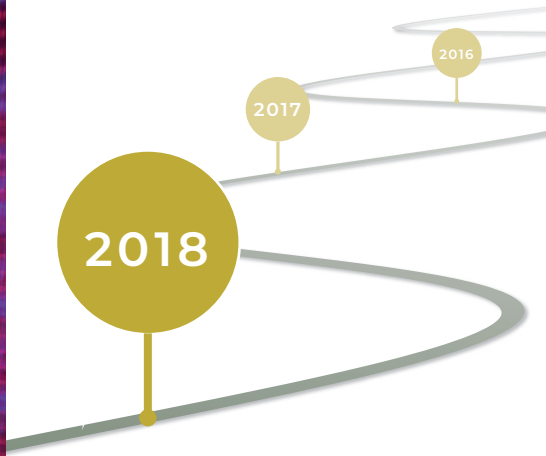
The innovation by the young interdisciplinary research team of students with mentorship was completed in December 2018 under the original name "Urban Garden". The "Urban Oasis – Intelligent Aeroponic IoT Urban Garden" is at the forefront of the achievement of the Internet of Things (IoT), aeroponic growing, advanced algorithmic solutions, and the passion for nature, food and herbs.

"Urban Oasis" is a personal garden, a product the size of an average household refrigerator, which, with the help of technology, allows plant species to thrive in several different microclimates, optimising the duration of growth, water and energy consumption. This approach is suitable for the simultaneous growth of several completely different plant species at the same location, which could not naturally grow in such conditions, especially not together.

Its design is also an environment conducive to carrying out a number of rapid experiments to identify aeroponic growth and plant species development in different conditions, with multi-spectrum high-resolution cameras, analysis, archiving, statistical processing, and final modelling by neural networks.

The design offers four basic roles, nutritional, nutritive, therapeutic, and caring, tailored to its specific purpose, leaving the impression of a fully personalised product.

URBAN GARDEN



Photos courtesy of authors

Siniša Brođanac

(born 13 June 1982 in Vukovar) spent his early years living with his family in the city of Vukovar until the breakout of the Croatian War of Independence. In 1992, he moved to Istria. He attended the industrial school in Pula (to become an industrial mechanic – toolmaker), which is when he learned about different tools and materials used in shipbuilding. In the coming years, he gained experience working in a variety of jobs, while nurturing his passion for motorcycles. In 2006, he accepted an offer which involved researching and selling GPS devices for vehicle surveillance in Croatia, which soon led him to design a device that aims to preserve the lives and safety of motorcyclists, a high-risk group of road users.

After completing the prototype in 2014, Siniša received numerous national and international awards, including the gold medal in Geneva and special recognition by KIPA, the Korean association of innovators, as well as the silver medal in Nuremberg in 2017 and, for the second time, the special recognition by KIPA.

Automatic Crash Detection and Rapid Alert System for Motorcycles

The Automatic Crash Detection and Rapid Alert System for Motorcycles is an automated system which detects motorcycle accidents by using a smart sensor and alerts pre-selected contacts via a text message or an e-mail with the specific crash coordinates. From the moment the accident happens, it takes no more than 30 seconds to alert someone to the location of the injured motorcyclists, allowing the emergency services to arrive on the scene and give assistance as quickly as possible.

The smart sensor is composed of two mercury switches set under specific angles. The sensor detects when the wheels begin to lose grip, i.e., when they no longer have any traction against the road. The sensor is placed inside a waterproof case, and it does not contain any electrical components or circuits that produce electromagnetic or radio waves, so it cannot cause any disturbance or harmful radiation in the environment.

The device was created by the inventor Siniša Brođanac in response to frequent motorcycle accidents of his acquaintances and fellow motorcyclists. The search for a close friend and motorcyclist, which took four full days in April 2013, was the driving force behind the whole idea. The first prototype was completed in 2014, followed by improvements and modifications and the search for potential investors who would enable serial production and add this device to the list of primary protective equipment of every motorcycle on the road. The patent application for the device was submitted in 2016, and the patent certificate was issued in 2019.

The device can also be used as an anti-theft alarm system, and additional features enabled via the app let users exchange useful information, such as traffic conditions, recommended rest areas, accommodation, experiences, and the like.

AUTOMATIC CRASH DETECTION AND RAPID ALERT SYSTEM FOR MOTORCYCLES

2017

2018

2019

Photos courtesy of: Siniša Brođanac

G6 PEDAL ELECTRIC CYCLE

Greyp Bikes

The G6 is as light as a feather thanks, to its T700 carbon fibre reinforced composite frame and a custom battery pack designed and developed in-house. The G6 is a pedelec – pedal electric cycle, meaning the rider's pedalling is assisted by an electric motor. The minute you stop pedalling, the motor stops assisting. The amount of pedal assistance will be higher or lower depending on the amount of force applied to the pedals – but the G6 offers a treat here: you can manually adjust your preferred assistance level!

The G6 has a central intelligence module completely designed and developed in-house. Thanks to the built-in eSim solution, the G6 is connected to the internet at all times. Thanks to this connectedness, the G6 offers a bunch of cool features and the owner has a constant overview of the bicycle, even remotely.

The control button cluster is a different approach to a bicycle joystick. Unlike your regular one, the G6's control button cluster has no less than 12 possibilities. Starting with 12 buttons to navigate through the app screens and unique features, it will only offer more possibilities in the future. Go from feature to feature in the fastest lane.

The G6 is equipped with two built-in cameras: one in the front, and the other in the back. The front camera is integrated in the central intelligence module, while the rear one is beneath the seat post. These two will come in handy for all the cool gnarly stuff you tend to get yourself into during those downhill rides or just your regular commutes. Both cameras are wide angle 1080p@30fps.

G6 PEDAL ELECTRIC CYCLE

Photos courtesy of:
Greyp Bikes

Rimac Automobili

The C_Two is a pure electric GT hypercar as capable on track as it is crossing continents. Configurable, personal and extremely powerful, representing what is possible when true innovation and passion is allowed free rein.

Building on the knowledge gleaned from the brilliantly powerful Concept_One, the all-new C_Two combines the very best materials and bespoke technology to produce something both revolutionary and eminently useable, with performance and character that elevates the genre. There is - quite literally - no other car like it. Designed, engineered and produced in-house it is made entirely from scratch with all-new, groundbreaking technologies - the C_Two features a full carbonfibre monocoque with bonded carbon roof, integrated battery pack and powertrain.

An innovative battery pack in technology and layout delivers 120 kWh energy and 1.4MW of power with exceptional thermal management. With a top speed of 258 mph (412 km/h), a zero to 60mph time of 1.85 seconds and a zero to 100 mph (161 km/h) time of 4.3, the C_Two makes devastating use of the instant-torque available to an electric vehicle and the traction made possible by the unique drivetrain and bespoke tyres.

More than that, the C_Two maintains its eye-widening acceleration throughout a full-throttle cycle, achieving 186 mph (300 km/h) from rest in just 11.8* seconds. Next-generation R-AWTV

(All-Wheel Torque Vectoring) controls four electric motors, one per each wheel and is available (and necessary!) to harness 1,914 hp (1,408 kW) of power and 2,300 Nm of torque - two and a half times the torque output of a contemporary hypercar. The C_Two is limited to 150 units and starts production in 2020.

C_TWO, ELECTRIC GT HYPERCAR

Photos courtesy of: Rimac Automobili

Sveta Nedelja – a town for pleasant living and smart business

Situated on Zagreb's western doorstep, Sveta Nedelja's exceptionally favourable transit and geo-strategic position make it one of the demographically most stable small towns in Croatia. High economic development, entrepreneurial zones, and natural beauty are just some of the distinguishing features that make the town of Sveta Nedelja an attractive and pleasant location for work and living.

The City of Sveta Nedelja is known for a number of successful companies. According to data from 2017, in the area of Sveta Nedelja, there are 795 successful companies, employing 8829 workers (almost 1000 more than in the previous year). One of the most significant economic resources of Sveta Nedelja are its 4 economic development zones, only 500 meters from the Bregana-Lipovac motorway.

The rate of construction in the zones is 60-70%, and the town is strongly geared towards attracting investors – both by offering low public utility rates and by its adaptability in terms of developing the necessary infrastructure.

The land and property registries are all updated in line with the cadastre, and the time for issuing building and location permits is 7 days on average, up to a maximum of 14 days.

Sveta Nedelja justifiably carries the status of the town for smart business and pleasant living, as evidenced by the fact that Sveta Nedelja was declared the best economic town in Croatia in the category of medium-sized cities in 2018.

In December 2018, the Decision on municipal tax annulled the surtax in Sveta Nedelja (from 6% to 0%) and the tax on consumption.

SVETA NEDELJA – A TOWN FOR PLEASANT LIVING AND SMART BUSINESS

Autorska prava: The town of Sveta Nedelja

Croatian innovations - visionaries that shaped Europe


THE GREENS/EFA
in the European Parliament


DAVOR ŠKRLEC
Member of the European Parliament