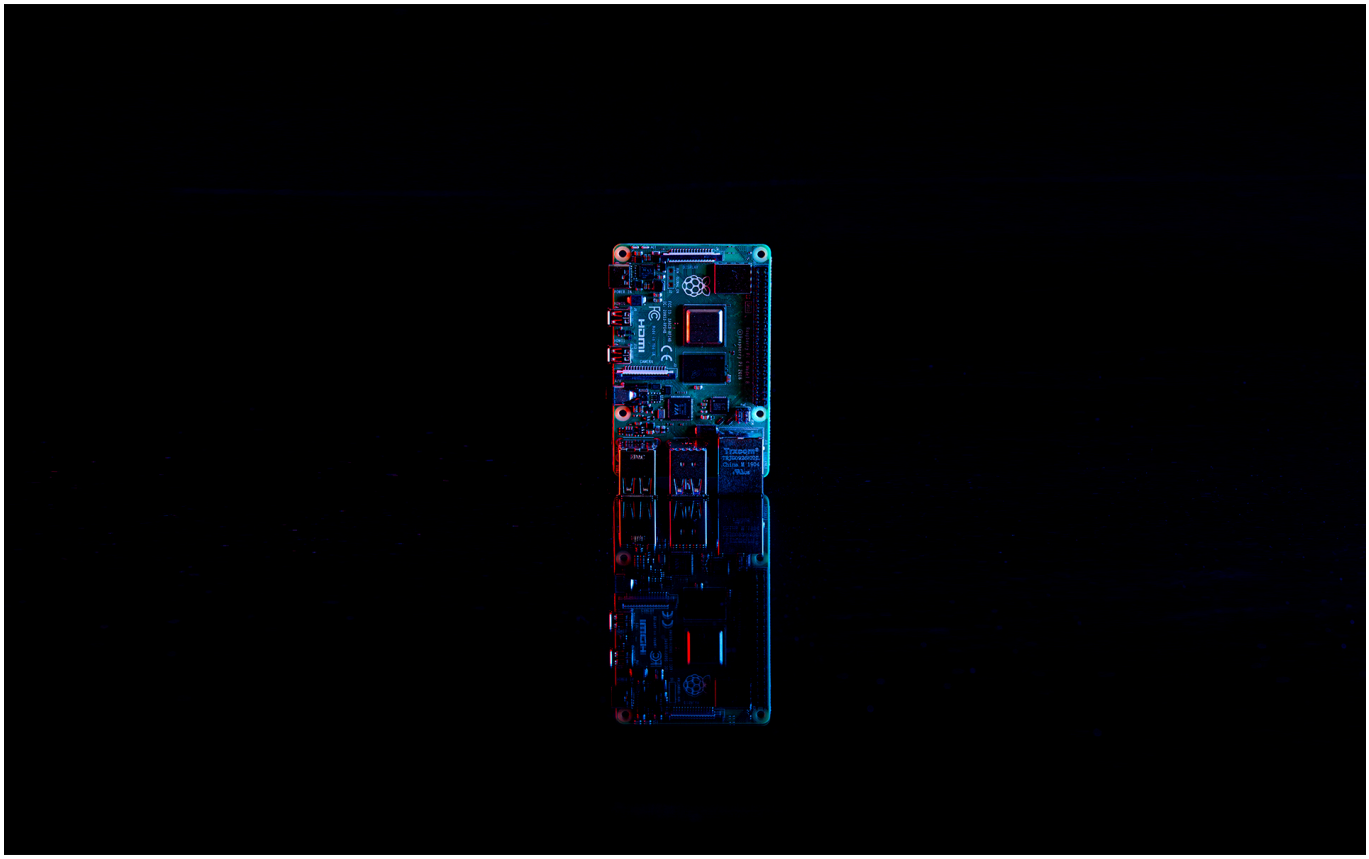
Web Scraping science papers from site: PubMed on the topic - "Raspberry Pi".



Individualized tracking of self-directed motor learning in group-housed mice performing a skilled lever positioning task in the home cage.

https://www.ncbi.nlm.nih.gov/pubmed/29070625

Skilled forelimb function in mice is traditionally studied through behavioral paradigms that require extensive training by investigators and are limited by the number of trials individual animals are able to perform within a supervised session. We developed a skilled lever positioning task that mice can perform within their home cage. The task requires mice to use their forelimb to precisely hold a lever mounted on a rotary encoder within a rewarded position to dispense a water reward. A Raspberry Pi microcomputer is used to record lever position during trials and to control task parameters, thus making this low-footprint apparatus ideal for use within animal housing facilities. Custom Python software automatically increments task difficulty by requiring a longer hold duration, or a more accurate hold position, to dispense a reward. The performance of individual animals within group-housed mice is tracked through radio-frequency identification implants, and data stored on the microcomputer may be accessed remotely through an active internet connection. Mice continuously engage in the task for over 2.5 mo and perform ~500 trials/24 h. Mice required ~15,000 trials to learn to hold the lever within a 10Â° range for 1.5 s and were able to further refine movement accuracy by limiting their error to a 5Â° range within each trial. These results demonstrate the feasibility of autonomously training group-housed mice on a forelimb motor task. This paradigm may be used in the future to assess functional recovery after injury or cortical reorganization induced by self-directed motor learning. NEW & NOTEWORTHY We developed a low-cost system for fully autonomous training of group-housed mice on a forelimb motor task. We demonstrate the feasibility of tracking both end-point, as well as kinematic performance of individual mice, with each performing thousands of trials over 2.5 mo. The task is run and controlled by a Raspberry Pi microcomputer, which allows for cages to be monitored remotely through an active internet connection.

Design of a cathodoluminescence image generator using a Raspberry Pi coupled to a scanning electron microscope.

https://www.ncbi.nlm.nih.gov/pubmed/29390658

In this work, an innovative cathodoluminescence (CL) system is coupled to a scanning electron microscope and synchronized with a Raspberry Pi computer integrated with an innovative

processing signal. The post-processing signal is based on a Python algorithm that correlates the CL and secondary electron (SE) images with a precise dwell time correction. For CL imaging, the emission signal is collected through an optical fiber and transduced to an electrical signal via a photomultiplier tube (PMT). CL Images are registered in a panchromatic mode and can be filtered using a monochromator connected between the optical fiber and the PMT to produce monochromatic CL images. The designed system has been employed to study ZnO samples prepared by electrical arc discharge and microwave methods. CL images are compared with SE images and chemical elemental mapping images to correlate the emission regions of the sample.

Assessment of feasibility of running RSNA's MIRC on a Raspberry Pi: a cost-effective solution for teaching files in radiology.

https://www.ncbi.nlm.nih.gov/pubmed/25547256

The value of a teaching case repository in radiology training programs is immense. The allocation of resources for putting one together is a complex issue, given the factors that have to be coordinated: hardware, software, infrastructure, administration, and ethics. Costs may be significant and cost-effective solutions are desirable.

A low-cost video-oculography system for vestibular function testing.

https://www.ncbi.nlm.nih.gov/pubmed/29060793

In order to remain in focus during head movements, vestibular-ocular reflex causes eyes to move in the opposite direction to head movement. Disorders of vestibular system decrease vision, causing abnormal nystagmus and dizziness. To diagnose abnormal nystagmus, various studies have been reported including the use of rotating chair tests and videonystagmography. However, these tests are unsuitable for home use due to their high costs. Thus, a low-cost video-oculography system is necessary to obtain clinical features at home. In this paper, we present a low-cost video-oculography system using an infrared camera and Raspberry Pi board for tracking the pupils and evaluating a vestibular system. Horizontal eye movement is derived from video data obtained from an infrared camera and infrared light-emitting diodes, and the velocity of head rotation is obtained from a gyroscope sensor. Each pupil was extracted using a morphology operation and a contour detection method. Rotatory chair tests were conducted with our developed device. To evaluate our system, gain, asymmetry, and phase were measured and compared with System 2000. The average IQR errors of gain, phase and asymmetry were 0.81, 2.74 and 17.35, respectively. We

showed that our system is able to measure clinical features.

Ethoscopes: An open platform for high-throughput ethomics.

https://www.ncbi.nlm.nih.gov/pubmed/29049280

Here, we present the use of ethoscopes, which are machines for high-throughput analysis of behavior in Drosophila and other animals. Ethoscopes provide a software and hardware solution that is reproducible and easily scalable. They perform, in real-time, tracking and profiling of behavior by using a supervised machine learning algorithm, are able to deliver behaviorally triggered stimuli to flies in a feedback-loop mode, and are highly customizable and open source. Ethoscopes can be built easily by using 3D printing technology and rely on Raspberry Pi microcomputers and Arduino boards to provide affordable and flexible hardware. All software and construction specifications are available at http://lab.gilest.ro/ethoscope.

Ursane-type nortriterpenes with a five-membered A-ring from Rubus innominatus.

https://www.ncbi.nlm.nih.gov/pubmed/25944373

Two nortriterpenes (rubuminatus A and B), which contain a distinctive contracted a five-membered A-ring ursane-type skeleton, and six triterpenes along with 17 known triterpenes were isolated from the roots of Rubus innominatus S. Moore. These structures were determined to be 19Î±-hydroxy-2-oxo-nor- A(3)-urs-12-en-28-oic acid, 1Î²,19Î±-dihydroxy-2-oxo-nor-A(3)-urs-12-en-28-oic acid, 1Î²,2Î±,3Î±,19Î±-tetrahy droxyurs-12-en-23-formyl-28-oic acid, 1Î²,2Î±,3Î±,19Î±,23- pentahydroxyurs-11-en-28-oic acid, 1-oxo-siaresinolic acid, 2Î±,3Î±-dihydroxyolean-11,13(18)-dien-19Î²,28-olide, 1Î²,2Î±,3Î±-trihydroxy-19-oxo- 18,19-seco-urs-11,13(18)-dien-28-oic acid, and 2-O-benzoyl alphitolic acid based on extensive spectroscopic analyses. In vitro anti-inflammatory abilities to modulate the production of TNF-Î±, IL-1Î², and IL-6 in LPS-induced RAW 264.7 macrophages of the compounds were determined. Rubuminatus A and B, as well as 1-oxo-siaresinolic acid and 2Î±,3Î±-dihydroxyolean-11,13(18)-dien-19Î²,28-olide, exhibited significant inhibitory effects on these cytokines.

First Report of Raspberry bushy dwarf virus in Rubus multibracteatus from China.

https://www.ncbi.nlm.nih.gov/pubmed/30812980

Raspberry bushy dwarf virus (RBDV), genus Idaeovirus, has been reported in commercial Rubus spp. from North and South America, Europe, Australia, New Zealand, and South Africa. Infection can cause reduced vigor and drupelet abortion leading to crumbly fruit and reduced yields (3,4). In recent years, Rubus germplasm in the form of seed, was obtained on several collection trips to The People's Republic of China to increase the diversity of Rubus spp. in the USDA-ARS National Clonal Germplasm Repository, (Corvallis, OR). Before planting in the field, seedlings were tested for the presence of RBDV, Tomato ringspot virus, and Tobacco streak virus using triple-antibody sandwich enzyme-linked immunosorbent assay (TAS-ELISA) (antiserum produced by R. R. Martin). One symptomless plant of R. multibracteatus H. Lev. & Vaniot (PI 618457 in USDA-ARS GRIN database), from Guizhou province in China, tested positive for RBDV (RBDV-China). After mechanical transmission on Chenopodium quinoa Willd., this isolate produced typical symptoms of RBDV (3). To determine if RBDV-China was a contaminant during the handling of the plants, or if the source was a seedborne virus, the coat protein gene was sequenced and compared to published sequences of RBDV. RNA was extracted from leaves of R. multibracteatus and subjected to reverse transcription-polymerase chain reaction (RT-PCR) using primers that flank the coat protein gene. Products from four separate PCR reactions were sequenced directly or were cloned into the plasmid vector pCR 2.1 (Invitrogen, Carlsbad, CA) and then sequenced. The coding sequence of the coat protein gene of RBDV-China was 87.5% (722/825) identical to that isolated from black raspberry (Genbank Accession No. s55890). The predicted amino acid sequences were 91.6% (251/274) identical. Previously, a maximum of five amino acid differences had been observed in the coat proteins of different RBDV strains (1). The 23 differences observed between RBDV-China and the isolate from black raspberry (s55890) confirm that the RBDV in R. multibracteatus is not a greenhouse contaminant but is indeed a unique strain of RBDV. In addition, monoclonal antibodies (MAbs) to RBDV (2) were tested against RBDV-China. In these tests, MAb D1 did not detect RBDV-China, whereas MAb R2 and R5 were able to detect the strain. This is the first strain of RBDV that has been clearly differentiated by MAbs using standard TAS-ELISA tests. Although RBDV is common in commercial Rubus spp. worldwide, to our knowledge, this is the first report of RBDV in R. multibracteatus, and the first report of RBDV from China. The effects of this new strain of RBDV could be more or less severe, or have a different host range than previously studied strains. It is more divergent from the type isolate than any other strain that has been studied to date. Phylogenetic analysis of coat protein genes of RBDV may be useful in understanding the evolution and spread of this virus. References: (1) A. T. Jones et al. Eur. J. Plant Pathol. 106:623, 2000. (2) R. R. Martin. Can. J. Plant. Pathol. 6:264, 1984. (3) A. F. Murant. Raspberry Bushy Dwarf.

Page 229 in: Virus Diseases of Small Fruits. R. H. Converse, ed. U.S. Dep. Agric. Agric. Handb. 631, 1987. (4) B. Strik and R. R. Martin. Plant Dis. 87:294, 2003.

A "Do-It-Yourself" phenotyping system: measuring growth and morphology throughout the diel cycle in rosette shaped plants.

https://www.ncbi.nlm.nih.gov/pubmed/29151842

Improvements in high-throughput phenotyping technologies are rapidly expanding the scope and capacity of plant biology studies to measure growth traits. Nevertheless, the costs of commercial phenotyping equipment and infrastructure remain prohibitively expensive for wide-scale uptake, while academic solutions can require significant local expertise. Here we present a low-cost methodology for plant biologists to build their own phenotyping system for quantifying growth rates and phenotypic characteristics of Arabidopsis thaliana rosettes throughout the diel cycle.

Comparison of the protein-coding genomes of three deep-sea, sulfur-oxidising bacteria: "Candidatus Ruthia magnifica", "Candidatus Vesicomyosocius okutanii" and Thiomicrospira crunogena.

https://www.ncbi.nlm.nih.gov/pubmed/28728564

" Candidatus Ruthia magnifica", "Candidatus Vesicomyosocius okutanii" and Thiomicrospira crunogena are all sulfur-oxidising bacteria found in deep-sea vent environments. Recent research suggests that the two symbiotic organisms, "Candidatus R. magnifica" and "Candidatus V. okutanii", may share common ancestry with the autonomously living species T. crunogena. We used comparative genomics to examine the genome-wide protein-coding content of all three species to explore their similarities. In particular, we used the OrthoMCL algorithm to sort proteins into groups of putative orthologs on the basis of sequence similarity.

An open source device for operant licking in rats.

https://www.ncbi.nlm.nih.gov/pubmed/28229020

We created an easy-to-use device for operant licking experiments and another device that records environmental variables. Both devices use the Raspberry Pi computer to obtain data from multiple input devices (e.g., radio frequency identification tag readers, touch and motion sensors, environmental sensors) and activate output devices (e.g., LED lights, syringe pumps) as needed.

Data gathered from these devices are stored locally on the computer but can be automatically transferred to a remote server via a wireless network. We tested the operant device by training rats to obtain either sucrose or water under the control of a fixed ratio, a variable ratio, or a progressive ratio reinforcement schedule. The lick data demonstrated that the device has sufficient precision and time resolution to record the fast licking behavior of rats. Data from the environment monitoring device also showed reliable measurements. By providing the source code and 3D design under an open source license, we believe these examples will stimulate innovation in behavioral studies. The source code can be found at http://github.com/chen42/openbehavior.

Taking off the training wheels: Measuring auditory P3 during outdoor cycling using an active wet EEG system.

https://www.ncbi.nlm.nih.gov/pubmed/29248602

Mobile EEG allows the investigation of brain activity in increasingly complex environments. In this study, EEG equipment was adapted for use and transportation in a backpack while cycling. Participants performed an auditory oddball task while cycling outside and sitting in an isolated chamber inside the lab. Cycling increased EEG noise and marginally diminished alpha amplitude. However, this increased noise did not influence the ability to measure reliable event related potentials (ERP). The P3 was similar in topography, and morphology when outside on the bike, with a lower amplitude in the outside cycling condition. There was only a minor decrease in the statistical power to measure reliable ERP effects. Unexpectedly, when biking outside significantly decreased P2 and increased N1 amplitude were observed when evoked by both standards and targets compared with sitting in the lab. This may be due to attentional processes filtering the overlapping sounds between the tones used and similar environmental frequencies. This study established methods for mobile recording of ERP signals. Future directions include investigating auditory P2 filtering inside the laboratory.

Benchtop and animal validation of a portable fluorescence microscopic imaging system for potential use in cholecystectomy.

https://www.ncbi.nlm.nih.gov/pubmed/29473349

We propose a portable fluorescence microscopic imaging system (PFMS) for intraoperative display of biliary structure and prevention of iatrogenic injuries during cholecystectomy. The system consists of a light source module, a camera module, and a Raspberry Pi computer with an LCD. Indocyanine

green (ICG) is used as a fluorescent contrast agent for experimental validation of the system. Fluorescence intensities of the ICG aqueous solution at different concentration levels are acquired by our PFMS and compared with those of a commercial Xenogen IVIS system. We study the fluorescence detection depth by superposing different thicknesses of chicken breast on an ICG-loaded agar phantom. We verify the technical feasibility for identifying potential iatrogenic injury in cholecystectomy using a rat model in vivo. The proposed PFMS system is portable, inexpensive, and suitable for deployment in resource-limited settings.

Automated touch sensing in the mouse tapered beam test using Raspberry Pi.

https://www.ncbi.nlm.nih.gov/pubmed/28860079

Rodent models of neurological disease such as stroke are often characterized by motor deficits. One of the tests that are used to assess these motor deficits is the tapered beam test, which provides a sensitive measure of bilateral motor function based on foot faults (slips) made by a rodent traversing a gradually narrowing beam. However, manual frame-by-frame scoring of video recordings is necessary to obtain test results, which is time-consuming and prone to human rater bias.

PYM: a new, affordable, image-based method using a Raspberry Pi to phenotype plant leaf area in a wide diversity of environments.

https://www.ncbi.nlm.nih.gov/pubmed/29151844

Plant science uses increasing amounts of phenotypic data to unravel the complex interactions between biological systems and their variable environments. Originally, phenotyping approaches were limited by manual, often destructive operations, causing large errors. Plant imaging emerged as a viable alternative allowing non-invasive and automated data acquisition. Several procedures based on image analysis were developed to monitor leaf growth as a major phenotyping target. However, in most proposals, a time-consuming parameterization of the analysis pipeline is required to handle variable conditions between images, particularly in the field due to unstable light and interferences with soil surface or weeds. To cope with these difficulties, we developed a low-cost, 2D imaging method, hereafter called PYM. The method is based on plant leaf ability to absorb blue light while reflecting infrared wavelengths. PYM consists of a Raspberry Pi computer equipped with an infrared camera and a blue filter and is associated with scripts that compute projected leaf area. This new method was tested on diverse species placed in contrasting conditions. Application to field

conditions was evaluated on lettuces grown under photovoltaic panels. The objective was to look for possible acclimation of leaf expansion under photovoltaic panels to optimise the use of solar radiation per unit soil area.

Polypeptide synthesis induced in Nicotiana clevelandii protoplasts by infection with raspberry ringspot nepovirus.

https://www.ncbi.nlm.nih.gov/pubmed/8470949

Infection of Nicotiana clevelandii protoplasts by raspberry ringspot nepovirus resulted in the accumulation of about 24 polypeptides that differed in M(r) and pI from polypeptides accumulating in mock-inoculated protoplasts. Similar polypeptides accumulated in protoplasts infected with the S and E strains of RRV but different infection-specific polypeptides were detected in protoplasts infected with tobacco ringspot nepovirus. The M(r) of RRV-specific polypeptides ranged from 210,000 to 18,000 and most are presumed to be derived from others by proteolytic cleavage. No evidence was found for marked changes in polypeptide abundance with time after inoculation or for any virus-specific polypeptide becoming disproportionately abundant in the medium during culture.

A Fully Automated High-Throughput Zebrafish Behavioral Ototoxicity Assay.

https://www.ncbi.nlm.nih.gov/pubmed/28520533

Zebrafish animal models lend themselves to behavioral assays that can facilitate rapid screening of ototoxic, otoprotective, and otoregenerative drugs. Structurally similar to human inner ear hair cells, the mechanosensory hair cells on their lateral line allow the zebrafish to sense water flow and orient head-to-current in a behavior called rheotaxis. This rheotaxis behavior deteriorates in a dose-dependent manner with increased exposure to the ototoxin cisplatin, thereby establishing itself as an excellent biomarker for anatomic damage to lateral line hair cells. Building on work by our group and others, we have built a new, fully automated high-throughput behavioral assay system that uses automated image analysis techniques to quantify rheotaxis behavior. This novel system consists of a custom-designed swimming apparatus and imaging system consisting of network-controlled Raspberry Pi microcomputers capturing infrared video. Automated analysis techniques detect individual zebrafish, compute their orientation, and quantify the rheotaxis behavior of a zebrafish test population, producing a powerful, high-throughput behavioral assay. Using our fully automated biological assay to test a standardized ototoxic dose of cisplatin against varying doses of compounds that protect or regenerate hair cells may facilitate rapid translation of candidate

drugs into preclinical mammalian models of hearing loss.

An affordable cuff-less blood pressure estimation solution.

https://www.ncbi.nlm.nih.gov/pubmed/28325023

This paper presents a cuff-less hypertension pre-screening device that non-invasively monitors the Blood Pressure (BP) and Heart Rate (HR) continuously. The proposed device simultaneously records two clinically significant and highly correlated biomedical signals, viz., Electrocardiogram (ECG) and Photoplethysmogram (PPG). The device provides a common data acquisition platform that can interface with PC/laptop, Smart phone/tablet and Raspberry-pi etc. The hardware stores and processes the recorded ECG and PPG in order to extract the real-time BP and HR using kernel regression approach. The BP and HR estimation error is measured in terms of normalized mean square error, Error Standard Deviation (ESD) and Mean Absolute Error (MAE), with respect to a clinically proven digital BP monitor (OMRON HBP1300). The computed error falls under the maximum standard allowable error mentioned by Association for the Advancement of Medical Instrumentation; MAE <; 5 mmHg and ESD <; 8mmHg. The results are validated using two-tailed dependent sample t-test also. The proposed device is a portable low-cost home and clinic bases solution for continuous health monitoring.

Black raspberry extracts inhibit benzo(a)pyrene diol-epoxide-induced activator protein 1 activation and VEGF transcription by targeting the phosphotidylinositol 3-kinase/Akt pathway.

https://www.ncbi.nlm.nih.gov/pubmed/16397275

Previous studies have shown that freeze-dried black raspberry extract fractions inhibit benzo(a)pyrene [B(a)P]-induced transformation of Syrian hamster embryo cells and benzo(a)pyrene diol-epoxide [B(a)PDE]-induced activator protein-1 (AP-1) activity in mouse epidermal Cl 41 cells. The phosphotidylinositol 3-kinase (PI-3K)/Akt pathway is critical for B(a)PDE-induced AP-1 activation in mouse epidermal Cl 41 cells. In the present study, we determined the potential involvement of PI-3K and its downstream kinases on the inhibition of AP-1 activation by black raspberry fractions, RO-FOO3, RO-FOO4, RO-ME, and RO-DM. In addition, we investigated the effects of these fractions on the expression of the AP-1 target genes, vascular endothelial growth factor (VEGF) and inducible nitric oxide synthase (iNOS). Pretreatment of Cl 41 cells with fractions RO-F003 and RO-ME reduced activation of AP-1 and the expression of VEGF, but not iNOS. In

contrast, fractions RO-F004 and RO-DM had no effect on AP-1 activation or the expression of either VEGF or iNOS. Consistent with inhibition of AP-1 activation, the RO-ME fraction markedly inhibited activation of PI-3K, Akt, and p70 S6 kinase (p70(S6k)). In addition, overexpression of the dominant negative PI-3K mutant delta p85 reduced the induction of VEGF by B(a)PDE. It is likely that the inhibitory effects of fractions RO-FOO3 and RO-ME on B(a)PDE-induced AP-1 activation and VEGF expression are mediated by inhibition of the PI-3K/Akt pathway. In view of the important roles of AP-1 and VEGF in tumor development, one mechanism for the chemopreventive activity of black raspberries may be inhibition of the PI-3K/Akt/AP-1/VEGF pathway.

Euro Banknote Recognition System for Blind People.

https://www.ncbi.nlm.nih.gov/pubmed/28117703

This paper presents the development of a portable system with the aim of allowing blind people to detect and recognize Euro banknotes. The developed device is based on a Raspberry Pi electronic instrument and a Raspberry Pi camera, Pi NoIR (No Infrared filter) dotted with additional infrared light, which is embedded into a pair of sunglasses that permit blind and visually impaired people to independently handle Euro banknotes, especially when receiving their cash back when shopping. The banknote detection is based on the modified Viola and Jones algorithms, while the banknote value recognition relies on the Speed Up Robust Features (SURF) technique. The accuracies of banknote detection and banknote value recognition are 84% and 97.5%, respectively.

Anticancer effects elicited by combination of Rubus extract with phthalocyanine photosensitiser on MCF-7 human breast cancer cells.

https://www.ncbi.nlm.nih.gov/pubmed/28662924

Photodynamic therapy (PDT) is a novel approach for the treatment of cancer and other related diseases. Breast cancer remains the most common cause of cancer-related death in women. This study was carried out to investigate the photosensitizing capacity of Rubus fairholmianus root acetone extract (RFRA) in vitro.

A combination of Raspberry Pi and SoftEther VPN for controlling research devices via the Internet.

https://www.ncbi.nlm.nih.gov/pubmed/29090743

Remote control over devices for experiments may increase the efficiency of operant research and expand the area where behavior can be studied. This article introduces a combination of Raspberry PiÂ® (Pi) and SoftEther VPNÂ® that allows for such remote control via the Internet. The Pi is a small Linux computer with a great degree of flexibility for customization. Test results indicate that a Pi-based interface meets the requirement for conducting operant research. SoftEther VPNÂ® allows for establishing an extensive private network on the Internet using a single private Wi-Fi router. Step-by-step instructions are provided in the present article for setting up the Pi along with SoftEther VPNÂ® . Their potential for improving the way of conducting research is discussed.

Phenolics from Rubus fairholmianus induces cytotoxicity and apoptosis in human breast adenocarcinoma cells.

https://www.ncbi.nlm.nih.gov/pubmed/28803117

Herbal medicine is an important part of health care system in most of the countries. Rubus fairholmianus is an unexplored berry in folkloric medicine. In this study, we aimed to understand the importance of R.Â fairholmianus in pharmaceutical industry for the development of cost-effective cancer therapeutic drugs using inÂ vivo and inÂ vitro analysis. Chemical characterization, antioxidant, antiproliferative and apoptosis inducing properties of R.Â fairholmianus root methanolic column subfraction (RFM) were investigated. The RFM displayed the presence of alpha-tocopherol, flavonol glycoside and apigenin in the chemical characterization. DPPH (2, 2-diphenyl-1-picrylhydrazyl) and ABTS (2, 2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid)) radical scavenging assays exhibited an activity of 7.56Â Î¼g/mL (IC50) and 20514.7Â Î¼M trolox equivalents/g respectively. The solid and ascites tumors in mice were reduced significantly upon 100Â mg/kg RFM treatment by reducing the tumor volume (1.86Â cm3), tumor weight (69%) and increasing life span (31.74 days). The morphological features of RFM treated MCF-7Â cells showed the cell damage and decreased cell numbers. The viability of treated cells decreased with 67.73% at 20Â Î¼g/mL against 96.50% in untreated cells. The treated cells (20Â Î¼g/mL) resulted in a substantial decrease (pÂ <Â 0.001) in cellular ATP proliferation, increased the LDH cytotoxicity, increased apoptotic cells population (33.92%) and reduced the population of viable cells (Annexin V-/PI-) (45.56%). Increased caspase 3/7 activity and cytochrome c release were also observed in treated cells. This is the first evidence about inÂ vitro and inÂ vivo anticancer activity of R.Â fairholmianus phenolics. The major phenolics such as alpha-tocopherol, flavonol glycoside, and apigenin might be the reason behind the caspase-mediated apoptosis. Further work is warranted to

study the individual effects of these bioactive compounds in the induction of cell death. Due to the apoptosis inducing properties, it can be considered as an effective adjuvant therapeutic agent in clinical trials.

Assessing the Influence of Temperature Changes on the Geometric Stability of Smartphone- and Raspberry Pi Cameras.

https://www.ncbi.nlm.nih.gov/pubmed/31979284

Knowledge about the interior and exterior camera orientation parameters is required to establish the relationship between 2D image content and 3D object data. Camera calibration is used to determine the interior orientation parameters, which are valid as long as the camera remains stable. However, information about the temporal stability of low-cost cameras due to the physical impact of temperature changes, such as those in smartphones, is still missing. This study investigates on the one hand the influence of heat dissipating smartphone components at the geometric integrity of implemented cameras and on the other hand the impact of ambient temperature changes at the geometry of uncoupled low-cost cameras considering a Raspberry Pi camera module that is exposed to controlled thermal radiation changes. If these impacts are neglected, transferring image measurements into object space will lead to wrong measurements due to high correlations between temperature and camera's geometric stability. Monte-Carlo simulation is used to simulate temperature-related variations of the interior orientation parameters to assess the extent of potential errors in the 3D data ranging from a few millimetres up to five centimetres on a target in X- and Y-direction. The target is positioned at a distance of 10 m to the camera and the Z-axis is aligned with camera's depth direction.

A New Metre for Cheap, Quick, Reliable and Simple Thermal Transmittance (U-Value) Measurements in Buildings.

https://www.ncbi.nlm.nih.gov/pubmed/28869521

This paper deals with the thermal transmittance measurement focused on buildings and specifically in building energy retrofitting. Today, if many thermal transmittance measurements in a short time are needed, the current devices, based on the measurement of the heat flow through the wall, cannot carry out them, except if a great amount of devices are used at once along with intensive and tedious post-processing and analysis work. In this paper, from well-known physical laws, authors develop a methodology based on three temperatures measurements, which is implemented

by a novel thermal transmittance metre. The paper shows its development step by step. As a result the developed device is modular, scalable, and fully wireless; it is capable of taking as many measurements at once as user needs. The developed system is compared working together on a same test to the currently used one based on heat flow. The results show that the developed metre allows carrying out thermal transmittance measurements in buildings in a cheap, quick, reliable and simple way.

Low Computational-Cost Footprint Deformities Diagnosis Sensor through Angles, Dimensions Analysis and Image Processing Techniques.

https://www.ncbi.nlm.nih.gov/pubmed/29165397

Manual measurements of foot anthropometry can lead to errors since this task involves the experience of the specialist who performs them, resulting in different subjective measures from the same footprint. Moreover, some of the diagnoses that are given to classify a footprint deformity are based on a qualitative interpretation by the physician; there is no quantitative interpretation of the footprint. The importance of providing a correct and accurate diagnosis lies in the need to ensure that an appropriate treatment is provided for the improvement of the patient without risking his or her health. Therefore, this article presents a smart sensor that integrates the capture of the footprint, a low computational-cost analysis of the image and the interpretation of the results through a quantitative evaluation. The smart sensor implemented required the use of a camera (Logitech C920) connected to a Raspberry Pi 3, where a graphical interface was made for the capture and processing of the image, and it was adapted to a podoscope conventionally used by specialists such as orthopedist, physiotherapists and podiatrists. The footprint diagnosis smart sensor (FPDSS) has proven to be robust to different types of deformity, precise, sensitive and correlated in 0.99 with the measurements from the digitalized image of the ink mat.

A Portable, Inexpensive, Nonmydriatic Fundus Camera Based on the Raspberry PiÂ® Computer.

https://www.ncbi.nlm.nih.gov/pubmed/28396802

Purpose. Nonmydriatic fundus cameras allow retinal photography without pharmacologic dilation of the pupil. However, currently available nonmydriatic fundus cameras are bulky, not portable, and expensive. Taking advantage of recent advances in mobile technology, we sought to create a nonmydriatic fundus camera that was affordable and could be carried in a white coat pocket.

Methods. We built a point-and-shoot prototype camera using a Raspberry Pi computer, an infrared-sensitive camera board, a dual infrared and white light light-emitting diode, a battery, a 5-inch touchscreen liquid crystal display, and a disposable 20-diopter condensing lens. Our prototype camera was based on indirect ophthalmoscopy with both infrared and white lights. Results. The prototype camera measured 133mm Ã— 91mm Ã— 45mm and weighed 386 grams. The total cost of the components, including the disposable lens, was $185.20. The camera was able to obtain good-quality fundus images without pharmacologic dilation of the pupils. Conclusion. A fully functional, inexpensive, handheld, nonmydriatic fundus camera can be easily assembled from a relatively small number of components. With modest improvements, such a camera could be useful for a variety of healthcare professionals, particularly those who work in settings where a traditional table-mounted nonmydriatic fundus camera would be inconvenient.

Low-cost 3D printed 1â€‰â€‰nm resolution smartphone sensor-based spectrometer: instrument design and application in ultraviolet spectroscopy.

https://www.ncbi.nlm.nih.gov/pubmed/29088154

We report on the development of a low-cost spectrometer, based on off-the-shelf optical components, a 3D printed housing, and a modified Raspberry Pi camera module. With a bandwidth and spectral resolution of â‰ˆ60â€‰â€‰nm and 1Â nm, respectively, this device was designed for ultraviolet (UV) remote sensing of atmospheric sulphur dioxide (SO2), â‰ˆ310â€‰â€‰nm. To the best of our knowledge, this is the first report of both a UV spectrometer and a nanometer resolution spectrometer based on smartphone sensor technology. The device performance was assessed and validated by measuring column amounts of SO2 within quartz cells with a differential optical absorption spectroscopy processing routine. This system could easily be reconfigured to cover other UV-visible-near-infrared spectral regions, as well as alternate spectral ranges and/or linewidths. Hence, our intention is also to highlight how this framework could be applied to build bespoke, low-cost, spectrometers for a range of scientific applications.

A Real-Time Wireless Sweat Rate Measurement System for Physical Activity Monitoring.

https://www.ncbi.nlm.nih.gov/pubmed/29439398

There has been significant research on the physiology of sweat in the past decade, with one of the main interests being the development of a real-time hydration monitor that utilizes sweat. The contents of sweat have been known for decades; sweat provides significant information on the

physiological condition of the human body. However, it is important to know the sweat rate as well, as sweat rate alters the concentration of the sweat constituents, and ultimately affects the accuracy of hydration detection. Towards this goal, a calorimetric based flow-rate detection system was built and tested to determine sweat rate in real time. The proposed sweat rate monitoring system has been validated through both controlled lab experiments (syringe pump) and human trials. An Internet of Things (IoT) platform was embedded, with the sensor using a Simblee board and Raspberry Pi. The overall prototype is capable of sending sweat rate information in real time to either a smartphone or directly to the cloud. Based on a proven theoretical concept, our overall system implementation features a pioneer device that can truly measure the rate of sweat in real time, which was tested and validated on human subjects. Our realization of the real-time sweat rate watch is capable of detecting sweat rates as low as 0.15 ÂµL/min/cmÂ², with an average error in accuracy of 18% compared to manual sweat rate readings.

Accurate Sample Time Reconstruction of Inertial FIFO Data.

https://www.ncbi.nlm.nih.gov/pubmed/29236032

In the context of modern cyber-physical systems, the accuracy of underlying sensor data plays an increasingly important role in sensor data fusion and feature extraction. The raw events of multiple sensors have to be aligned in time to enable high quality sensor fusion results. However, the growing number of simultaneously connected sensor devices make the energy saving data acquisition and processing more and more difficult. Hence, most of the modern sensors offer a first-in-first-out (FIFO) interface to store multiple data samples and to relax timing constraints, when handling multiple sensor devices. However, using the FIFO interface increases the negative influence of individual clock drifts-introduced by fabrication inaccuracies, temperature changes and wear-out effects-onto the sampling data reconstruction. Furthermore, additional timing offset errors due to communication and software latencies increases with a growing number of sensor devices. In this article, we present an approach for an accurate sample time reconstruction independent of the actual clock drift with the help of an internal sensor timer. Such timers are already available in modern sensors, manufactured in micro-electromechanical systems (MEMS) technology. The presented approach focuses on calculating accurate time stamps using the sensor FIFO interface in a forward-only processing manner as a robust and energy saving solution. The proposed algorithm is able to lower the overall standard deviation of reconstructed sampling periods below 40 Î¼ s, while run-time savings of up to 42% are achieved, compared to single sample acquisition.

Bedside patient data viewer using RFID and e-Ink technology.

https://www.ncbi.nlm.nih.gov/pubmed/24825678

In the daily routine of hospitals, which work with paper based medical records, the staff has to find the appropriate patient file if it needs information about the patient. With the introduction of ELGA the Austrian hospitals have to use specific standards for their clinical documentation. These structured documents can be used to feed an e-Ink reader with information about every patient in a hospital. Combined with RFID and security measures, the clinical staff is supported during the patient file searching process. The developed experimental setup of the Bedside Patient Data Viewer demonstrates a prototype of such a system. An Amazon Kindle Paperwhite is used to display processed data, supplied by a Raspberry Pi with an attached RFID module for identification purposes. Results show that such a system can be implemented, however a lot of organizational and technical issues remain to be solved.

Exploration of assistive technology for uniform laparoscopic surgery.

https://www.ncbi.nlm.nih.gov/pubmed/29457703

Laparoscopic surgery is less invasive than open surgery and is now common in various medical fields. However, laparoscopic surgery is more difficult than open surgery and often requires additional time for the operator to achieve mastery. Therefore, we investigated the use of assistive technology for uniform laparoscopic surgery.

Identification of a Novel Gnao-Mediated Alternate Olfactory Signaling Pathway in Murine OSNs.

https://www.ncbi.nlm.nih.gov/pubmed/27065801

It is generally agreed that in olfactory sensory neurons (OSNs), the binding of odorant molecules to their specific olfactory receptor (OR) triggers a cAMP-dependent signaling cascade, activating cyclic-nucleotide gated (CNG) channels. However, considerable controversy dating back more than 20 years has surrounded the question of whether alternate signaling plays a role in mammalian olfactory transduction. In this study, we demonstrate a specific alternate signaling pathway in Olfr73-expressing OSNs. Methylisoeugenol (MIEG) and at least one other known weak Olfr73 agonist (Raspberry Ketone) trigger a signaling cascade independent from the canonical pathway, leading to the depolarization of the cell. Interestingly, this pathway is mediated by Gnao activation, leading to Cl(-) efflux; however, the activation of adenylyl cyclase III (ACIII), the recruitment of

Ca(2+) from extra-or intracellular stores, and phosphatidylinositol 3-kinase-dependent signaling (PI signaling) are not involved. Furthermore, we demonstrated that our newly identified pathway coexists with the canonical olfactory cAMP pathway in the same OSN and can be triggered by the same OR in a ligand-selective manner. We suggest that this pathway might reflect a mechanism for odor recognition predominantly used in early developmental stages before olfactory cAMP signaling is fully developed. Taken together, our findings support the existence of at least one odor-induced alternate signal transduction pathway in native OSNs mediated by Olfr73 in a ligand-selective manner.

Raspberry Pi: a 35-dollar device for viewing DICOM images.

https://www.ncbi.nlm.nih.gov/pubmed/25741057

Raspberry Pi Ã© um computador de baixo custo criado com propostas educativas. Utiliza o Linux e seus softwares sÃ£o gratuitos, em sua maioria. HÃ¡ softwares para visualizaÃ§Ã£o de imagens no formato DICOM. Com o uso de um monitor externo, a resoluÃ§Ã£o suportada (1920 Ã— 1200 pixels) permite a criaÃ§Ã£o de estaÃ§Ãµes de visualizaÃ§Ã£o simples de exames com custo reduzido.

Cost-effective flow-through nanohole array-based biosensing platform for the label-free detection of uropathogenic E. coli in real time.

https://www.ncbi.nlm.nih.gov/pubmed/29414075

Rapid, inexpensive and sensitive detection of uropathogenic Escherichia coli (UPEC), a common cause of ascending urinary tract infections (UTIs) including cystitis and pyelonephritis, is critical given the increasing number of cases and its recurrence worldwide. In this paper, we present a label-free nanoplasmonic sensing platform, built with off-the-shelf optical and electronic components, which can detect intact UPEC at concentrations lower than the physiological limit for UTI diagnosis, in real time. The sensing platform consists of a red LED light source, lens assembly, CMOS detector, Raspberry Pi interface in conjugation with a metallic flow-through nanohole array-based sensor. Detection is achieved exploiting nanoplasmonic phenomena from the nanohole arrays through surface plasmon resonance imaging (SPRi) technique. The platform has a bulk sensitivity of 212 pixel intensity unit (PIU)/refractive index unit (RIU), and a resolution in the order of 10-6 RIU. We demonstrate capture and detection of UPEC with a detection limit of ~100â€¯CFU/ml - a concentration well below the threshold limit for UTI diagnosis in clinical samples. We also

demonstrate detection of UPEC in spiked human urine samples for two different concentrations of bacteria. This work is particularly relevant for point-of-care applications, especially for regions around the world where accessibility to medical facilities is heavily dependent upon economy, and availability.

Biomimetic synthesis of raspberry-like hybrid polymer-silica core-shell nanoparticles by templating colloidal particles with hairy polyamine shell.

https://www.ncbi.nlm.nih.gov/pubmed/20347275

The nanoparticles composed of polystyrene core and poly[2-(diethylamino)ethyl methacrylate] (PDEA) hairy shell were used as colloidal templates for in situ silica mineralization, allowing the well-controlled synthesis of hybrid silica core-shell nanoparticles with raspberry-like morphology and hollow silica nanoparticles by subsequent calcination. Silica deposition was performed by simply stirring a mixture of the polymeric core-shell particles in isopropanol, tetramethyl orthosilicate (TMOS) and water at 25 degrees C for 2.5h. No experimental evidence was found for nontemplated silica formation, which indicated that silica deposition occurred exclusively in the PDEA shell and formed PDEA-silica hybrid shell. The resulting hybrid silica core-shell particles were characterized by transmission electron microscopy (TEM), thermogravimetry, aqueous electrophoresis, and X-ray photoelectron spectroscopy. TEM studies indicated that the hybrid particles have well-defined core-shell structure with raspberry morphology after silica deposition. We found that the surface nanostructure of hybrid nanoparticles and the composition distribution of PDEA-silica hybrid shell could be well controlled by adjusting the silicification conditions. These new hybrid core-shell nanoparticles and hollow silica nanoparticles would have potential applications for high-performance coatings, encapsulation and delivery of active organic molecules.

Proposal for an Embedded System Architecture Using a GNDVI Algorithm to Support UAV-Based Agrochemical Spraying.

https://www.ncbi.nlm.nih.gov/pubmed/31817832

An important area in precision agriculture is related to the efficient use of chemicals applied onto fields. Efforts have been made to diminish their use, aiming at cost reduction and fewer chemical residues in the final agricultural products. The use of unmanned aerial vehicles (UAVs) presents itself as an attractive and cheap alternative for spraying pesticides and fertilizers compared to conventional mass spraying performed by ordinary manned aircraft. Besides being cheaper than

manned aircraft, small UAVs are capable of performing fine-grained instead of the mass spraying. Observing this improved method, this paper reports the design of an embedded real-time UAV spraying control system supported by onboard image processing. The proposal uses a normalized difference vegetation index (NDVI) algorithm to detect the exact locations in which the chemicals are needed. Using this information, the automated spraying control system performs punctual applications while the UAV navigates over the crops. The system architecture is designed to run on low-cost hardware, which demands an efficient NDVI algorithm. The experiments were conducted using Raspberry Pi 3 as the embedded hardware. First, experiments in a laboratory were conducted in which the algorithm was proved to be correct and efficient. Then, field tests in real conditions were conducted for validation purposes. These validation tests were performed in an agronomic research station with the Raspberry hardware integrated into a UAV flying over a field of crops. The average CPU usage was about 20% while memory consumption was about 70 MB for high definition images, with 4% CPU usage and 20.3 MB RAM being observed for low-resolution images. The average current measured to execute the proposed algorithm was 0.11 A. The obtained results prove that the proposed solution is efficient in terms of processing and energy consumption when used in embedded hardware and provides measurements which are coherent with the commercial GreenSeeker equipment.

Compact and low-cost THz QTDS system.

https://www.ncbi.nlm.nih.gov/pubmed/26368172

We present a terahertz quasi time domain spectroscopy (QTDS) system setup which is improved regarding cost and compactness. The diode laser is mounted directly onto the optical delay line, making the optical setup more compact. The system is operated using a Raspberry Pi and an additional sound card. This combination replaces the desktop/laptop computer, the lock-in-amplifier, the stage controller and the signal generator. We examined not only a commercially available stepper motor driven delay line, but also the repurposed internal mechanics from a DVD drive. We characterize the performance of the new system concept.

GryphSens: A Smartphone-Based Portable Diagnostic Reader for the Rapid Detection of Progesterone in Milk.

https://www.ncbi.nlm.nih.gov/pubmed/28489036

Enzyme-linked immunosorbent assay (ELISA) is a popular assay technique for the detection and

quantification of various biological substances due its high sensitivity and specificity. More often, it requires large and expensive laboratory instruments, which makes it difficult to conduct when the tests must be performed quickly at the point-of-care (POC). To increase portability and ease of use, we propose a portable diagnostic system based on a Raspberry Pi imaging sensor for the rapid detection of progesterone in milk samples. We designed, assembled, and tested a standalone portable diagnostic reader and validated it for progesterone detection against a standard ELISA assay using a commercial plate reader. The portable POC device yielded consistent results, regardless of differences in the cameras and flashlights between various smartphone devices. An Android application was built to provide front-end access to users, control the diagnostic reader, and display and store the progesterone measurement on the smartphone. The diagnostic reader takes images of the samples, reads the pixel values, processes the results, and presents the results on the handheld device. The proposed POC reader can perform to superior levels of performance as a plate reader, while adding the desirable qualities of portability and ease of use.

Differential effects of black raspberry and strawberry extracts on BaPDE-induced activation of transcription factors and their target genes.

https://www.ncbi.nlm.nih.gov/pubmed/18085529

The chemopreventive properties of edible berries have been demonstrated both in vitro and in vivo, however, the specific molecular mechanisms underlying their anti-cancer effects are largely unknown. Our previous studies have shown that a methanol extract fraction of freeze-dried black raspberries inhibits benzoapyrene (BaP)-induced transformation of Syrian hamster embryo cells. This fraction also blocks activation of activator protein-1 (AP-1) and nuclear factor kappaB (NF-kappaB) induced by benzoapyrene diol-epoxide (BaPDE) in mouse epidermal JB6 Cl 41 cells. To determine if different berry types exhibit specific mechanisms for their anti-cancer effects, we compared the effects of extract fractions from both black raspberries and strawberries on BaPDE-induced activation of various signaling pathways in Cl 41 cells. Black raspberry fractions inhibited the activation of AP-1, NF-kappaB, and nuclear factor of activated T cells (NFAT) by BaPDE as well as their upstream PI-3K/Akt-p70(S6K) and mitogen-activated protein kinase pathways. In contrast, strawberry fractions inhibited NFAT activation, but did not inhibit the activation of AP-1, NF-kappaB or the PI-3K/Akt-p70(S6K) and mitogen-activated protein kinase pathways. Consistent with the effects on NFAT activation, tumor necrosis factor-alpha (TNF-alpha) induction by BaPDE was blocked by extract fractions of both black raspberries and strawberries, whereas

vascular endothelial growth factor (VEGF) expression, which depends on AP-1 activation, was suppressed by black raspberry fractions but not strawberry fractions. These results suggest that black raspberry and strawberry components may target different signaling pathways in exerting their anti-carcinogenic effects.

Low cost and open source multi-fluorescence imaging system for teaching and research in biology and bioengineering.

https://www.ncbi.nlm.nih.gov/pubmed/29140977

The advent of easy-to-use open source microcontrollers, off-the-shelf electronics and customizable manufacturing technologies has facilitated the development of inexpensive scientific devices and laboratory equipment. In this study, we describe an imaging system that integrates low-cost and open-source hardware, software and genetic resources. The multi-fluorescence imaging system consists of readily available 470 nm LEDs, a Raspberry Pi camera and a set of filters made with low cost acrylics. This device allows imaging in scales ranging from single colonies to entire plates. We developed a set of genetic components (e.g. promoters, coding sequences, terminators) and vectors following the standard framework of Golden Gate, which allowed the fabrication of genetic constructs in a combinatorial, low cost and robust manner. In order to provide simultaneous imaging of multiple wavelength signals, we screened a series of long stokes shift fluorescent proteins that could be combined with cyan/green fluorescent proteins. We found CyOFP1, mBeRFP and sfGFP to be the most compatible set for 3-channel fluorescent imaging. We developed open source Python code to operate the hardware to run time-lapse experiments with automated control of illumination and camera and a Python module to analyze data and extract meaningful biological information. To demonstrate the potential application of this integral system, we tested its performance on a diverse range of imaging assays often used in disciplines such as microbial ecology, microbiology and synthetic biology. We also assessed its potential use in a high school environment to teach biology, hardware design, optics, and programming. Together, these results demonstrate the successful integration of open source hardware, software, genetic resources and customizable manufacturing to obtain a powerful, low cost and robust system for education, scientific research and bioengineering. All the resources developed here are available under open source licenses.

4273Ï€: bioinformatics education on low cost ARM hardware.

https://www.ncbi.nlm.nih.gov/pubmed/23937194

Teaching bioinformatics at universities is complicated by typical computer classroom settings. As well as running software locally and online, students should gain experience of systems administration. For a future career in biology or bioinformatics, the installation of software is a useful skill. We propose that this may be taught by running the course on GNU/Linux running on inexpensive Raspberry Pi computer hardware, for which students may be granted full administrator access.

A smart city application: a fully controlled street lighting isle based on Raspberry-Pi card, a ZigBee sensor network and WiMAX.

https://www.ncbi.nlm.nih.gov/pubmed/25529206

A smart city application has been realized and tested. It is a fully remote controlled isle of lamp posts based on new technologies. It has been designed and organized in different hierarchical layers, which perform local activities to physically control the lamp posts and transmit information with another for remote control. Locally, each lamp post uses an electronic card for management and a ZigBee tlc network transmits data to a central control unit, which manages the whole isle. The central unit is realized with a Raspberry-Pi control card due to its good computing performance at very low price. Finally, a WiMAX connection was tested and used to remotely control the smart grid, thus overcoming the distance limitations of commercial Wi-Fi networks. The isle has been realized and tested for some months in the field.

A low-cost touchscreen operant chamber using a Raspberry Piâ„¢.

https://www.ncbi.nlm.nih.gov/pubmed/29520633

The development of a touchscreen platform for rodent testing has allowed new methods for cognitive testing that have been back-translated from clinical assessment tools to preclinical animal models. This platform for cognitive assessment in animals is comparable to human neuropsychological tests such as those employed by the Cambridge Neuropsychological Test Automated Battery, and thus has several advantages compared to the standard maze apparatuses typically employed in rodent behavioral testing, such as the Morris water maze. These include improved translation of preclinical models, as well as high throughput and the automation of animal testing. However, these systems are relatively expensive, which can impede progress for researchers with limited resources. Here we describe a low-cost touchscreen operant chamber based on the single-board computer, Raspberry PiTM, which is capable of performing tasks similar

to those supported by current state-of-the-art systems. This system provides an affordable alternative for cognitive testing in a touchscreen operant paradigm for researchers with limited funding.

Use of Low-Cost Acquisition Systems with an Embedded Linux Device for Volcanic Monitoring.

https://www.ncbi.nlm.nih.gov/pubmed/26295394

This paper describes the development of a low-cost multiparameter acquisition system for volcanic monitoring that is applicable to gravimetry and geodesy, as well as to the visual monitoring of volcanic activity. The acquisition system was developed using a System on a Chip (SoC) Broadcom BCM2835 Linux operating system (based on DebianTM) that allows for the construction of a complete monitoring system offering multiple possibilities for storage, data-processing, configuration, and the real-time monitoring of volcanic activity. This multiparametric acquisition system was developed with a software environment, as well as with different hardware modules designed for each parameter to be monitored. The device presented here has been used and validated under different scenarios for monitoring ocean tides, ground deformation, and gravity, as well as for monitoring with images the island of Tenerife and ground deformation on the island of El Hierro.

Smart CEI Moncloa: An IoT-based Platform for People Flow and Environmental Monitoring on a Smart University Campus.

https://www.ncbi.nlm.nih.gov/pubmed/29292790

Internet of Things platforms for Smart Cities are technologically complex and deploying them at large scale involves high costs and risks. Therefore, pilot schemes that allow validating proof of concepts, experimenting with different technologies and services, and fine-tuning them before migrating them to actual scenarios, are especially important in this context. The IoT platform deployed across the engineering schools of the Universidad PolitÃ©cnica de Madrid in the Moncloa Campus of International Excellence represents a good example of a test bench for experimentation with Smart City services. This paper presents the main features of this platform, putting special emphasis on the technological challenges faced and on the solutions adopted, as well as on the functionality, services and potential that the platform offers.

The â‚¬100 lab: A 3D-printable open-source platform for fluorescence microscopy, optogenetics, and accurate temperature control during behaviour of zebrafish, Drosophila, and Caenorhabditis elegans.

https://www.ncbi.nlm.nih.gov/pubmed/28719603

Small, genetically tractable species such as larval zebrafish, Drosophila, or Caenorhabditis elegans have become key model organisms in modern neuroscience. In addition to their low maintenance costs and easy sharing of strains across labs, one key appeal is the possibility to monitor single or groups of animals in a behavioural arena while controlling the activity of select neurons using optogenetic or thermogenetic tools. However, the purchase of a commercial solution for these types of experiments, including an appropriate camera system as well as a controlled behavioural arena, can be costly. Here, we present a low-cost and modular open-source alternative called 'FlyPi'. Our design is based on a 3D-printed mainframe, a Raspberry Pi computer, and high-definition camera system as well as Arduino-based optical and thermal control circuits. Depending on the configuration, FlyPi can be assembled for well under â‚¬100 and features optional modules for light-emitting diode (LED)-based fluorescence microscopy and optogenetic stimulation as well as a Peltier-based temperature stimulator for thermogenetics. The complete version with all modules costs approximately â‚¬200 or substantially less if the user is prepared to 'shop around'. All functions of FlyPi can be controlled through a custom-written graphical user interface. To demonstrate FlyPi's capabilities, we present its use in a series of state-of-the-art neurogenetics experiments. In addition, we demonstrate FlyPi's utility as a medical diagnostic tool as well as a teaching aid at Neurogenetics courses held at several African universities. Taken together, the low cost and modular nature as well as fully open design of FlyPi make it a highly versatile tool in a range of applications, including the classroom, diagnostic centres, and research labs.

A Distributed Wireless Camera System for the Management of Parking Spaces.

https://www.ncbi.nlm.nih.gov/pubmed/29283371

The importance of detection of parking space availability is still growing, particularly in major cities. This paper deals with the design of a distributed wireless camera system for the management of parking spaces, which can determine occupancy of the parking space based on the information from multiple cameras. The proposed system uses small camera modules based on Raspberry Pi Zero and computationally efficient algorithm for the occupancy detection based on the histogram of oriented gradients (HOG) feature descriptor and support vector machine (SVM) classifier. We have

included information about the orientation of the vehicle as a supporting feature, which has enabled us to achieve better accuracy. The described solution can deliver occupancy information at the rate of 10 parking spaces per second with more than 90% accuracy in a wide range of conditions. Reliability of the implemented algorithm is evaluated with three different test sets which altogether contain over 700,000 samples of parking spaces.

A Bioacoustic Record of a Conservancy in the Mount Kenya Ecosystem.

https://www.ncbi.nlm.nih.gov/pubmed/27932917

Environmental degradation is a major threat facing ecosystems around the world. In order to determine ecosystems in need of conservation interventions, we must monitor the biodiversity of these ecosystems effectively. Bioacoustic approaches offer a means to monitor ecosystems of interest in a sustainable manner. In this work we show how a bioacoustic record from the Dedan Kimathi University wildlife conservancy, a conservancy in the Mount Kenya ecosystem, was obtained in a cost effective manner. A subset of the dataset was annotated with the identities of bird species present since they serve as useful indicator species. These data reveal the spatial distribution of species within the conservancy and also point to the effects of major highways on bird populations. This dataset will provide data to train automatic species recognition systems for birds found within the Mount Kenya ecosystem. Such systems are necessary if bioacoustic approaches are to be employed at the large scales necessary to influence wildlife conservation measures.

A versatile and compact surface plasmon resonance spectrometer based on single board computer.

https://www.ncbi.nlm.nih.gov/pubmed/32012556

The widespread diffusion of low-cost but high-performance hardware is enhancing the realization of scientific equipment with features at the research laboratory level. In this paper, we demonstrate hardware implementation of a surface plasmon resonance compact device with high accuracy and measurement times appropriate for many applications. Image acquisition is realized by a Raspberry Pi single board computer with a camera module, and a Python code is used to process data. A flexible optical setup can work in two different configurations, namely, the inspection mode and angle resolved measurement mode. The inspection mode is used to precisely locate the light-emitting diode interrogation beam on the sample, avoiding uneven or faulty regions. The measurement mode allows us to monitor in real time the position of the minimum reflectivity with

subpixel resolution. Performance tests show a resolution in the bulk refractive index of 4.9 Ã— 10-6 refractive index units for 10 s acquisition time.

Design and Construction of an ROV for Underwater Exploration.

https://www.ncbi.nlm.nih.gov/pubmed/31817652

The design of a remotely operated vehicle (ROV) with a size of 18.41 cm Ã— 29.50 cm Ã— 33.50 cm, and a weight of 15.64 kg, is introduced herein. The main goal is to capture underwater video by remote control communication in real time via Ethernet protocol. The ROV moves under the six brushless motors governed through a smart PID controller (Proportional + Integral + Derivative) and by using pulse-wide modulation with short pulses of 1 Î¼s to improve the stability of the position in relation to the translational, ascent or descent, and rotational movements on three axes to capture images of 800 Ã— 640 pixels on a video graphic array standard. The motion control, 3D position, temperature sensing, and video capture are performed at the same time, exploiting the four cores of the Raspberry Pi 3, using the threading library for parallel computing. In such a way, experimental results show that the video capture stage can process up to 42 frames per second on a Raspberry Pi 3. The remote control of the ROV is executed under a graphical user interface developed in Python, which is suitable for different operating systems, such as GNU/Linux, Windows, Android, and OS X. The proposed ROV can reach up to 100 m underwater, thus solving the issue of divers who can only reach 30 m depth. In addition, the proposed ROV can be useful in underwater applications such as surveillance, operations, maintenance, and measurement.

Early detection of E. coli and total coliform using an automated, colorimetric and fluorometric fiber optics-based device.

https://www.ncbi.nlm.nih.gov/pubmed/31372607

Lack of access to clean water is a major global issue that affects millions of people worldwide. Drinking contaminated water can be extremely hazardous, so it is imperative that it is tested sufficiently. One method commonly used to determine the quality of water is testing for both E. coli and total coliform. Here, we present a cost-effective and automated device which can concurrently test drinking water samples for both E. coli and total coliform using an EPA-approved reagent. Equipped with a Raspberry Pi microcontroller and camera, we perform automated periodic measurements of both the absorption and fluorescence of the water under test over 24 hours. In each test, 100 mL of the water sample is split into a custom designed 40-well plate, where the

transmitted blue light and the fluorescent light (under UV excitation) are collected by 520 individual optical fibers. Images of these fiber outputs are then acquired periodically, and digitally processed to determine the presence of the bacteria in each well of the 40-well plate. We demonstrate that this cost-effective device, weighing 1.66 kg, can automatically detect the presence of both E. coli and total coliform in drinking water within âˆ¼16 hours, down to a level of one colony-forming unit (CFU) per 100 mL. Furthermore, due to its automated analysis, this approach is also more sensitive than a manual count performed by an expert, reducing the time needed to determine whether the water under test is safe to drink or not.

Universal electronics for miniature and automated chemical assays.

https://www.ncbi.nlm.nih.gov/pubmed/25535820

This minireview discusses universal electronic modules (generic programmable units) and their use by analytical chemists to construct inexpensive, miniature or automated devices. Recently, open-source platforms have gained considerable popularity among tech-savvy chemists because their implementation often does not require expert knowledge and investment of funds. Thus, chemistry students and researchers can easily start implementing them after a few hours of reading tutorials and trial-and-error. Single-board microcontrollers and micro-computers such as Arduino, Teensy, Raspberry Pi or BeagleBone enable collecting experimental data with high precision as well as efficient control of electric potentials and actuation of mechanical systems. They are readily programmed using high-level languages, such as C, C++, JavaScript or Python. They can also be coupled with mobile consumer electronics, including smartphones as well as teleinformatic networks. More demanding analytical tasks require fast signal processing. Field-programmable gate arrays enable efficient and inexpensive prototyping of high-performance analytical platforms, thus becoming increasingly popular among analytical chemists. This minireview discusses the advantages and drawbacks of universal electronic modules, considering their application in prototyping and manufacture of intelligent analytical instrumentation.

Low cost audiovisual playback and recording triggered by radio frequency identification using Raspberry Pi.

https://www.ncbi.nlm.nih.gov/pubmed/25870771

Playbacks of visual or audio stimuli to wild animals is a widely used experimental tool in behavioral ecology. In many cases, however, playback experiments are constrained by observer limitations

such as the time observers can be present, or the accuracy of observation. These problems are particularly apparent when playbacks are triggered by specific events, such as performing a specific behavior, or are targeted to specific individuals. We developed a low-cost automated playback/recording system, using two field-deployable devices: radio-frequency identification (RFID) readers and Raspberry Pi micro-computers. This system detects a specific passive integrated transponder (PIT) tag attached to an individual, and subsequently plays back the stimuli, or records audio or visual information. To demonstrate the utility of this system and to test one of its possible applications, we tagged female and male tree swallows (Tachycineta bicolor) from two box-nesting populations with PIT tags and carried out playbacks of nestling begging calls every time focal females entered the nestbox over a six-hour period. We show that the RFID-Raspberry Pi system presents a versatile, low-cost, field-deployable system that can be adapted for many audio and visual playback purposes. In addition, the set-up does not require programming knowledge, and it easily customized to many other applications, depending on the research questions. Here, we discuss the possible applications and limitations of the system. The low cost and the small learning curve of the RFID-Raspberry Pi system provides a powerful new tool to field biologists.

A High-Resolution Minimicroscope System for Wireless Real-Time Monitoring.

https://www.ncbi.nlm.nih.gov/pubmed/28880156

Compact, cost-effective, and high-performance microscope that enables the real-time imaging of cells and lab-on-a-chip devices is highly demanded for cell biology and biomedical engineering. This paper aims to present the design and application of an inexpensive wireless minimicroscope with resolution up to 2592 Ã— 1944 pixels and speed up to 90Â f/s.

Cost effective raspberry pi-based radio frequency identification tagging of mice suitable for automated in vivo imaging.

https://www.ncbi.nlm.nih.gov/pubmed/27899319

Automation of animal experimentation improves consistency, reduces potential for error while decreasing animal stress and increasing well-being. Radio frequency identification (RFID) tagging can identify individual mice in group housing environments enabling animal-specific tracking of physiological parameters.

UAV Landing Using Computer Vision Techniques for Human Detection.

https://www.ncbi.nlm.nih.gov/pubmed/31979142

The capability of drones to perform autonomous missions has led retail companies to use them for deliveries, saving time and human resources. In these services, the delivery depends on the Global Positioning System (GPS) to define an approximate landing point. However, the landscape can interfere with the satellite signal (e.g., tall buildings), reducing the accuracy of this approach. Changes in the environment can also invalidate the security of a previously defined landing site (e.g., irregular terrain, swimming pool). Therefore, the main goal of this work is to improve the process of goods delivery using drones, focusing on the detection of the potential receiver. We developed a solution that has been improved along its iterative assessment composed of five test scenarios. The built prototype complements the GPS through Computer Vision (CV) algorithms, based on Convolutional Neural Networks (CNN), running in a Raspberry Pi 3 with a Pi NoIR Camera (i.e., No InfraRed-without infrared filter). The experiments were performed with the models Single Shot Detector (SSD) MobileNet-V2, and SSDLite-MobileNet-V2. The best results were obtained in the afternoon, with the SSDLite architecture, for distances and heights between 2.5-10 m, with recalls from 59%-76%. The results confirm that a low computing power and cost-effective system can perform aerial human detection, estimating the landing position without an additional visual marker.

Comparison of the protein-coding gene content of Chlamydia trachomatis and Protochlamydia amoebophila using a Raspberry Pi computer.

https://www.ncbi.nlm.nih.gov/pubmed/26462790

To demonstrate the bioinformatics capabilities of a low-cost computer, the Raspberry Pi, we present a comparison of the protein-coding gene content of two species in phylum Chlamydiae: Chlamydia trachomatis, a common sexually transmitted infection of humans, and Candidatus Protochlamydia amoebophila, a recently discovered amoebal endosymbiont. Identifying species-specific proteins and differences in protein families could provide insights into the unique phenotypes of the two species.

Total alkaloids of Rubus aleaefolius Poir inhibit hepatocellular carcinoma growth in vivo and in vitro via activation of mitochondrial-dependent apoptosis.

https://www.ncbi.nlm.nih.gov/pubmed/23338043

The aim of this study was to evaluate the therapeutic efficacy of Rubus aleaefolius Poir total

alkaloids (TARAP) against hepatocellular carcinoma growth in vivo and in vitro, and to investigate the possible molecular mechanisms mediating its biological activity. Nude mice were implanted with HepG2 human hepatocellular carcinoma cells and fed with vehicle (physiological saline) or 3 g/kg/d dose of TARAP, 5 days per week, for 21 days. The in vivo efficacy of TARAP against tumor growth was investigated by evaluating its effect on tumor volume and tumor weight in mice with HCC xenografts and its adverse effect was determined by measuring the body weight gain. The in vitro effect of TARAP on the viability of HepG2 cells was determined by MTT assay. HepG2 cell morphology was observed via phase-contrast microscopy. Apoptosis in tumor tissues or in HepG2 cells was analyzed by TUNEL assay or FACS analysis with Annexin V/PI, respectively. The loss of mitochondrial membrane potential in HepG2 cells was determined via JC-1 staining followed by FACS analysis. Activation of caspase-9 and -3 in HepG2 cells was examined by a colorimetric assay. The mRNA and protein expression of Bcl-2 and Bax in tumor tissues were measured by RT-PCR and immunohistochemistry. TARAP reduced tumor volume and tumor weight, but had no effect on the body weight gain in HCC mice. TARAP decreased the viability of HepG2 cells and induced cell morphological changes in vitro in a dose- and time-dependent manner. In addition, TARAP induced apoptosis both in tumor tissues and in HepG2 cells. Moreover, TARAP treatment resulted in the collapse of mitochondrial membrane potential in HepG2 cells, as well as the activation of caspase-9 and -3. Furthermore, administration of TARAP increased the pro-apoptotic Bax/Bcl-2 ratio in HCC mouse tumors, at both transcriptional and translational levels. TARAP inhibits hepatocellular carcinoma growth both in vivo and in vitro probably through the activation of mitochondrial-dependent apoptosis, which may, in part, explain its anticancer activity. These results suggest that total alkaloids in Rubus aleaefolius Poir may be a potential novel therapeutic agent for the treatment of hepatocellular carcinoma and other cancers.

Integration of enabling methods for the automated flow preparation of piperazine-2-carboxamide.

https://www.ncbi.nlm.nih.gov/pubmed/24778715

Here we describe the use of a new open-source software package and a Raspberry Pi(Â®) computer for the simultaneous control of multiple flow chemistry devices and its application to a machine-assisted, multi-step flow preparation of pyrazine-2-carboxamide - a component of Rifater(Â®), used in the treatment of tuberculosis - and its reduced derivative piperazine-2-carboxamide.

Inexpensive telecytology solutions that use the Raspberry Pi and the iPhone.

https://www.ncbi.nlm.nih.gov/pubmed/31051730

There is currently substantial interest in dynamic telecytology-the presentation of microscopic findings by live video feed to a cytopathologist at a remote location. However, the initial costs of a telecytology system can be high. We present several low-cost alternatives along with their performance characteristics.

VEHIOT: Design and Evaluation of an IoT Architecture Based on Low-Cost Devices to Be Embedded in Production Vehicles.

https://www.ncbi.nlm.nih.gov/pubmed/29415507

Nowadays, the current vehicles are incorporating control systems in order to improve their stability and handling. These control systems need to know the vehicle dynamics through the variables (lateral acceleration, roll rate, roll angle, sideslip angle, etc.) that are obtained or estimated from sensors. For this goal, it is necessary to mount on vehicles not only low-cost sensors, but also low-cost embedded systems, which allow acquiring data from sensors and executing the developed algorithms to estimate and to control with novel higher speed computing. All these devices have to be integrated in an adequate architecture with enough performance in terms of accuracy, reliability and processing time. In this article, an architecture to carry out the estimation and control of vehicle dynamics has been developed. This architecture was designed considering the basic principles of IoT and integrates low-cost sensors and embedded hardware for orchestrating the experiments. A comparison of two different low-cost systems in terms of accuracy, acquisition time and reliability has been done. Both devices have been compared with the VBOX device from Racelogic, which has been used as the ground truth. The comparison has been made from tests carried out in a real vehicle. The lateral acceleration and roll rate have been analyzed in order to quantify the error of these devices.

Elemental: An Open-Source Wireless Hardware and Software Platform for Building Energy and Indoor Environmental Monitoring and Control.

https://www.ncbi.nlm.nih.gov/pubmed/31540360

This work demonstrates an open-source hardware and software platform for monitoring the performance of buildings, called Elemental, that is designed to provide data on indoor environmental quality, energy usage, HVAC operation, and other factors to its users. It combines: (i) custom printed

circuit boards (PCBs) with RFM69 frequency shift keying (FSK) radio frequency (RF) transceivers for wireless sensors, control nodes, and USB gateway, (ii) a Raspberry Pi 3B with custom firmware acting as either a centralized or distributed backhaul, and (iii) a custom dockerized application for the backend called Brood that serves as the director software managing message brokering via Message Queuing Telemetry Transport (MQTT) protocol using VerneMQ, database storage using InfluxDB, and data visualization using Grafana. The platform is built around the idea of a private, secure, and open technology for the built environment. Among its many applications, the platform allows occupants to investigate anomalies in energy usage, environmental quality, and thermal performance via a comprehensive dashboard with rich querying capabilities. It also includes multiple frontends to view and analyze building activity data, which can be used directly in building controls or to provide recommendations on how to increase operational efficiency or improve operating conditions. Here, we demonstrate three distinct applications of the Elemental platform, including: (1) deployment in a research lab for long-term data collection and automated analysis, (2) use as a full-home energy and environmental monitoring solution, and (3) fault and anomaly detection and diagnostics of individual building systems at the zone-level. Through these applications we demonstrate that the platform allows easy and virtually unlimited datalogging, monitoring, and analysis of real-time sensor data with low setup costs. Low-power sensor nodes placed in abundance in a building can also provide precise and immediate fault-detection, allowing for tuning equipment for more efficient operation and faster maintenance during the lifetime of the building.

On the Possibility of Predicting Glycaemia 'On the Fly' with Constrained IoT Devices in Type 1 Diabetes Mellitus Patients.

https://www.ncbi.nlm.nih.gov/pubmed/31635378

Type 1 Diabetes Mellitus (DM1) patients are used to checking their blood glucose levels several times per day through finger sticks and, by subjectively handling this information, to try to predict their future glycaemia in order to choose a proper strategy to keep their glucose levels under control, in terms of insulin dosages and other factors. However, recent Internet of Things (IoT) devices and novel biosensors have allowed the continuous collection of the value of the glucose level by means of Continuous Glucose Monitoring (CGM) so that, with the proper Machine Learning (ML) algorithms, glucose evolution can be modeled, thus permitting a forecast of this variable. On the other hand, glycaemia dynamics require that such a model be user-centric and should be recalculated continuously in order to reflect the exact status of the patient, i.e., an 'on-the-fly'

approach. In order to avoid, for example, the risk of being disconnected from the Internet, it would be ideal if this task could be performed locally in constrained devices like smartphones, but this would only be feasible if the execution times were fast enough. Therefore, in order to analyze if such a possibility is viable or not, an extensive, passive, CGM study has been carried out with 25 DM1 patients in order to build a solid dataset. Then, some well-known univariate algorithms have been executed in a desktop computer (as a reference) and two constrained devices: a smartphone and a Raspberry Pi, taking into account only past glycaemia data to forecast glucose levels. The results indicate that it is possible to forecast, in a smartphone, a 15-min horizon with a Root Mean Squared Error (RMSE) of 11.65 mg/dL in just 16.15 s, employing a 10-min sampling of the past 6 h of data and the Random Forest algorithm. With the Raspberry Pi, the computational effort increases to 56.49 s assuming the previously mentioned parameters, but this can be improved to 34.89 s if Support Vector Machines are applied, achieving in this case an RMSE of 19.90 mg/dL. Thus, this paper concludes that local on-the-fly forecasting of glycaemia would be affordable with constrained devices.

A new acquisition and imaging system for environmental measurements: an experience on the Italian cultural heritage.

https://www.ncbi.nlm.nih.gov/pubmed/24859030

A new acquisition system for remote control of wall paintings has been realized and tested in the field. The system measures temperature and atmospheric pressure in an archeological site where a fresco has been put under control. The measuring chain has been designed to be used in unfavorable environments where neither electric power nor telecommunication infrastructures are available. The environmental parameters obtained from the local monitoring are then transferred remotely allowing an easier management by experts in the field of conservation of cultural heritage. The local acquisition system uses an electronic card based on microcontrollers and sends the data to a central unit realized with a Raspberry-Pi. The latter manages a high quality camera to pick up pictures of the fresco. Finally, to realize the remote control at a site not reached by internet signals, a WiMAX connection based on different communication technologies such as WiMAX, Ethernet, GPRS and Satellite, has been set up.

Design and Implementation of Cloud-Centric Configuration Repository for DIY IoT Applications.

https://www.ncbi.nlm.nih.gov/pubmed/29415450

The Do-It-Yourself (DIY) vision for the design of a smart and customizable IoT application demands the involvement of the general public in its development process. The general public lacks the technical knowledge for programming state-of-the-art prototyping and development kits. The latest IoT kits, for example, Raspberry Pi, are revolutionizing the DIY paradigm for IoT, and more than ever, a DIY intuitive programming interface is required to enable the masses to interact with and customize the behavior of remote IoT devices on the Internet. However, in most cases, these DIY toolkits store the resultant configuration data in local storage and, thus, cannot be accessed remotely. This paper presents the novel implementation of such a system, which not only enables the general public to customize the behavior of remote IoT devices through a visual interface, but also makes the configuration available everywhere and anytime by leveraging the power of cloud-based platforms. The interface enables the visualization of the resources exposed by remote embedded resources in the form of graphical virtual objects (VOs). These VOs are used to create the service design through simple operations like drag-and-drop and the setting of properties. The configuration created as a result is maintained as an XML document, which is ingested by the cloud platform, thus making it available to be used anywhere. We use the HTTP approach for the communication between the cloud and IoT toolbox and the cloud and real devices, but for communication between the toolbox and actual resources, CoAP is used. Finally, a smart home case study has been implemented and presented in order to assess the effectiveness of the proposed work.

Predictive Maintenance with Sensor Data Analytics on a Raspberry Pi-Based Experimental Platform.

https://www.ncbi.nlm.nih.gov/pubmed/31505843

Predictive maintenance techniques can determine the conditions of equipment in order to evaluate when maintenance should be performed. Thus, it minimizes the unexpected device downtime, lowers the maintenance costs, extends equipment lifecycle, etc. Therefore, this article developed a predictive maintenance mechanism with the construction of a test platform and data analysis along with machine learning. The information transmission of sensors was based on Raspberry Pi via the TCP/IP (Transmission Control Protocol/Internet Protocol) communication protocol. The sensors used for environmental sensing were implemented on the programmable interface controller and the data were stored in time sequence. A statistical analysis software platform was adopted for data

preprocessing, modelling, and prediction to provide necessary maintenance decision. Using multivariate analysis users can obtain more information about the equipment's status, and the administrator can also determine the operational situation before unexpected device anomalies. The developed modules are decisively helpful in preventing unpredictable losses, thus improving the quality of services.

A multi-sensor RSS spatial sensing-based robust stochastic optimization algorithm for enhanced wireless tethering.

https://www.ncbi.nlm.nih.gov/pubmed/25615734

The reliability of wireless communication in a network of mobile wireless robot nodes depends on the received radio signal strength (RSS). When the robot nodes are deployed in hostile environments with ionizing radiations (such as in some scientific facilities), there is a possibility that some electronic components may fail randomly (due to radiation effects), which causes problems in wireless connectivity. The objective of this paper is to maximize robot mission capabilities by maximizing the wireless network capacity and to reduce the risk of communication failure. Thus, in this paper, we consider a multi-node wireless tethering structure called the "server-relay-client" framework that uses (multiple) relay nodes in between a server and a client node. We propose a robust stochastic optimization (RSO) algorithm using a multi-sensor-based RSS sampling method at the relay nodes to efficiently improve and balance the RSS between the source and client nodes to improve the network capacity and to provide redundant networking abilities. We use pre-processing techniques, such as exponential moving averaging and spatial averaging filters on the RSS data for smoothing. We apply a receiver spatial diversity concept and employ a position controller on the relay node using a stochastic gradient ascent method for self-positioning the relay node to achieve the RSS balancing task. The effectiveness of the proposed solution is validated by extensive simulations and field experiments in CERN facilities. For the field trials, we used a youBot mobile robot platform as the relay node, and two stand-alone Raspberry Pi computers as the client and server nodes. The algorithm has been proven to be robust to noise in the radio signals and to work effectively even under non-line-of-sight conditions.

Automating mouse weighing in group homecages with Raspberry Pi micro-computers.

https://www.ncbi.nlm.nih.gov/pubmed/28476590

Operant training systems make use of water or food restriction and make it necessary to weigh

animals to ensure compliance with experimental endpoints. In other applications periodic weighing is necessary to assess drug side-effects, or as an endpoint in feeding experiments. Periodic weighing while essential can disrupt animal circadian rhythms and social structure.

Chemopreventive activity of ellagitannins and their derivatives from black raspberry seeds on HT-29 colon cancer cells.

https://www.ncbi.nlm.nih.gov/pubmed/25906041

Black raspberry (BRB) seeds are a major waste product after fruit processing. The seeds are abundant in ellagitannins (ET), a class of hydrolysable tannins, which are hydrolyzed to ellagic acid (EA) and further metabolized to urolithin A (UA) and urolithin B (UB), known to be bioavailable in the colon and the prostate. In this study, the anti-cancer activities of these compounds were evaluated on HT-29 colon cancer cells. ET, EA, UA and UB inhibited the proliferation of the cancer cells. EA caused a slight, but significant cell cycle arrest at the G1 phase, and urolithins caused cell cycle arrest at the G2/M phase and upregulated p21 expression. Apoptotic cells were detected by Annexin V-FITC/PI assay when treated with the compounds. Disruption in mitochondrial membrane potential and activation of caspases 8 and 9 suggest that both extrinsic and intrinsic apoptotic pathways may be involved. Activation of caspase 3 and cleavage of PARP further confirmed the induction of the apoptosis. ET, EA, UA and UB showed anti-cancer activity by arresting the cell cycle and inducing apoptosis on HT-29 human colon cancer cells. This study suggests that the BRB seeds could be a potential source of anti-cancer ET.

GLOS: GLOve for Speech Recognition.

https://www.ncbi.nlm.nih.gov/pubmed/31946592

Technological advancements in the field of Biomedical Engineering have allowed impaired individuals to use assistive devices in order to improve their quality of life. In the case of deafblind subjects, who experience both visual and auditory loss, the majority of available assistive devices are invasive (e.g. cochlear implants). Non-invasive technological improvements are extremely limited, in part due to the lack of scientific research interest in dual sensory loss [1]. In this paper we aim to present GLOS, a low-cost and non-invasive device that will allow the deafblind individuals to comprehend speeches in real-time. The proposed wearable device uses off-the-shelf components such as a Raspberry Pi 3 board, a simple microphone, and haptic feedback vibrating disks. The recorded speech from the microphone is processed by the board and encoded into 5 haptic

vibrating modules attached to a glove. Each haptic vibrating module is placed on a different finger of the right hand. The current available non-invasive solutions do not use speech and therefore they do not allow for live communication (e.g. MyVox [2], Sparsha [3] and Mobile Lorm Glove [4]) or require long procedures to convert the messages (e.g. Finger Braille Teaching System [5]). This new biomedical device aims at overcoming these limitations. The authors tested the device in a preliminary testing and it was shown that GLOS has an average accuracy of 91.67% when tested for the recognition of twenty encoded sentences. The authors were deprived of both visual and hearing inputs and were trained for half hour per day for a period of 30 days.

A Distributed Testbed for 5G Scenarios: An Experimental Study.

https://www.ncbi.nlm.nih.gov/pubmed/31861500

This paper demonstrates the use of Universal Software Radio Peripheral (USRP), together with Raspberry Pi3 B+ (RP3) as the brain (or the decision making engine), to develop a distributed wireless network in which nodes can communicate with other nodes independently and make decision autonomously. In other words, each USRP node (i.e., sensor) is embedded with separate processing units (i.e., RP3), which has not been investigated in the literature, so that each node can make independent decisions in a distributed manner. The proposed testbed in this paper is compared with the traditional distributed testbed, which has been widely used in the literature. In the traditional distributed testbed, there is a single processing unit (i.e., a personal computer) that makes decisions in a centralized manner, and each node (i.e., USRP) is connected to the processing unit via a switch. The single processing unit exchanges control messages with nodes via the switch, while the nodes exchange data packets among themselves using a wireless medium in a distributed manner. The main disadvantage of the traditional testbed is that, despite the network being distributed in nature, decisions are made in a centralized manner. Hence, the response delay of the control message exchange is always neglected. The use of such testbed is mainly due to the limited hardware and monetary cost to acquire a separate processing unit for each node. The experiment in our testbed has shown the increase of end-to-end delay and decrease of packet delivery ratio due to software and hardware delays. The observed multihop transmission is performed using device-to-device (D2D) communication, which has been enabled in 5G. Therefore, nodes can either communicate with other nodes via: (a) a direct communication with the base station at the macrocell, which helps to improve network performance; or (b) D2D that improve spectrum efficiency, whereby traffic is offloaded from macrocell to small cells. Our testbed is the first

of its kind in this scale, and it uses RP3 as the distributed decision-making engine incorporated into the USRP/GNU radio platform. This work provides an insight to the development of a 5G network.

High Frequency Sampling of TTL Pulses on a Raspberry Pi for Diffuse Correlation Spectroscopy Applications.

https://www.ncbi.nlm.nih.gov/pubmed/26274961

Diffuse Correlation Spectroscopy (DCS) is a well-established optical technique that has been used for non-invasive measurement of blood flow in tissues. Instrumentation for DCS includes a correlation device that computes the temporal intensity autocorrelation of a coherent laser source after it has undergone diffuse scattering through a turbid medium. Typically, the signal acquisition and its autocorrelation are performed by a correlation board. These boards have dedicated hardware to acquire and compute intensity autocorrelations of rapidly varying input signal and usually are quite expensive. Here we show that a Raspberry Pi minicomputer can acquire and store a rapidly varying time-signal with high fidelity. We show that this signal collected by a Raspberry Pi device can be processed numerically to yield intensity autocorrelations well suited for DCS applications. DCS measurements made using the Raspberry Pi device were compared to those acquired using a commercial hardware autocorrelation board to investigate the stability, performance, and accuracy of the data acquired in controlled experiments. This paper represents a first step toward lowering the instrumentation cost of a DCS system and may offer the potential to make DCS become more widely used in biomedical applications.

A Python-based laboratory course for image and video signal processing on embedded systems.

https://www.ncbi.nlm.nih.gov/pubmed/31667401

The usage of embedded systems is omnipresent in our everyday life, e.g., in smartphones, tablets, or automotive devices. These devices are able to deal with challenging image processing tasks like real-time detection of faces or high dynamic range imaging. However, the size and computational power of an embedded system is a limiting demand. To help students understanding these challenges, a new lab course "Image and Video Signal Processing on Embedded Systems" has been developed and is presented in this paper. The Raspberry Pi 3 Model B and the open source programming language Python have been chosen, because of low hardware cost and free availability of the programming language. In this lab course the students learn handling both hard-

and software, Python as an alternative to MATLAB, the image signal processing path, and how to develop an embedded image processing system, from the idea to implementation and debugging. At the beginning of the lab course an introduction to Python and the Raspberry Pi is given. After that, various experiments like the implementation of a corner detector and creation of a panorama image are prepared in the lab course. Students participating in the lab course develop a profound understanding of embedded image and video processing algorithms which is verified by comparing questionnaires at the beginning and the end of the lab course. Moreover, compared to a peer group attending an accompanying lecture with exercises, students having participated in this lab course outperform their peer group in the exam for the lecture by 0.5 on a five-point scale.

libRoadRunner: a high performance SBML simulation and analysis library.

https://www.ncbi.nlm.nih.gov/pubmed/26085503

This article presents libRoadRunner, an extensible, high-performance, cross-platform, open-source software library for the simulation and analysis of models expressed using Systems Biology Markup Language (SBML). SBML is the most widely used standard for representing dynamic networks, especially biochemical networks. libRoadRunner is fast enough to support large-scale problems such as tissue models, studies that require large numbers of repeated runs and interactive simulations.

An online peak extraction algorithm for ion mobility spectrometry data.

https://www.ncbi.nlm.nih.gov/pubmed/26157473

Ion mobility (IM) spectrometry (IMS), coupled with multi-capillary columns (MCCs), has been gaining importance for biotechnological and medical applications because of its ability to detect and quantify volatile organic compounds (VOC) at low concentrations in the air or in exhaled breath at ambient pressure and temperature. Ongoing miniaturization of spectrometers creates the need for reliable data analysis on-the-fly in small embedded low-power devices. We present the first fully automated online peak extraction method for MCC/IMS measurements consisting of several thousand individual spectra. Each individual spectrum is processed as it arrives, removing the need to store the measurement before starting the analysis, as is currently the state of the art. Thus the analysis device can be an inexpensive low-power system such as the Raspberry Pi. The key idea is to extract one-dimensional peak models (with four parameters) from each spectrum and then merge these into peak chains and finally two-dimensional peak models. We describe the different

algorithmic steps in detail and evaluate the online method against state-of-the-art peak extraction methods.

Thermal Transmission through Existing Building Enclosures: Destructive Monitoring in Intermediate Layers versus Non-Destructive Monitoring with Sensors on Surfaces.

https://www.ncbi.nlm.nih.gov/pubmed/29292781

Opaque enclosures of buildings play an essential role in the level of comfort experienced indoors and annual energy demand. The impact of solar radiation and thermal inertia of the materials that make up the multi-layer enclosures substantially modify thermal transmittance behaviour of the enclosures. This dynamic form of heat transfer, additionally affected by indoor HVAC systems, has a substantial effect on the parameters that define comfort. It also has an impact on energy demand within a daily cycle as well as throughout a one-year use cycle. This study describes the destructive monitoring of an existing block of flats located in Alicante. Once the enclosure was opened, sensors of temperature (PT100), air velocity, and relative humidity were located in the different layers of the enclosure, as well as in the interior and exterior surfaces. A pyranometer was also installed to measure solar radiation levels. A temperature data correction algorithm was drawn up to address irregularities produced in the enclosure. The algorithm was applied using a Raspberry Pi processor in the data collection system. The comparative results of temperature gradients versus non-destructive monitoring systems are presented, providing measures of the transmittance value, surface temperatures and indoor and outdoor air temperatures. This remote sensing system can be used in future studies to quantify and compare the energy savings of different enclosure construction solutions.

A phase I pilot study evaluating the beneficial effects of black raspberries in patients with Barrett's esophagus.

https://www.ncbi.nlm.nih.gov/pubmed/30450163

Black raspberries inhibit a broad range of cancers in preclinical models which has led to clinical evaluations targeting premalignant lesions of the colon, oral cavity and esophagus. A phase I pilot study was conducted in twenty Barrett's esophagus (BE) patients to investigate the effect of lyophilized black raspberries (LBR) on urinary metabolites and markers of lipid peroxidation, DNA damage and tissue markers of cellular proliferation, detoxification, and inflammation. Surveys, biopsies, blood and urine samples were collected before and after 6 months of LBR treatment (32 or

45 g). LBR significantly reduced urinary excretion of 8-epi-prostaglandin F2Î±, a marker of lipid peroxidation linked to oxidative stress and free radical damage. Urinary levels of the ellagitannin metabolites, urolithin A-glucuronide, urolithin A-sulfate and dimethylellagic acid glucuronide were significantly increased following 12 and 26 weeks of LBR consumption and may prove useful as indicators of compliance in future clinical studies. Immunohistochemical staining of BE biopsies following LBR treatment showed significant increases in mean GST-pi levels, with 55.6% of subjects responding favorably. In summary, LBR significantly decreased urinary lipid peroxidation levels and significantly increased GST-pi, a marker of detoxification, in BE epithelium. Still, LBR may need to be formulated differently, administered at higher concentrations or multiple times a day to increase efficacy.

Ultraviolet Imaging with Low Cost Smartphone Sensors: Development and Application of a Raspberry Pi-Based UV Camera.

https://www.ncbi.nlm.nih.gov/pubmed/27782054

Here, we report, for what we believe to be the first time, on the modification of a low cost sensor, designed for the smartphone camera market, to develop an ultraviolet (UV) camera system. This was achieved via adaptation of Raspberry Pi cameras, which are based on back-illuminated complementary metal-oxide semiconductor (CMOS) sensors, and we demonstrated the utility of these devices for applications at wavelengths as low as 310 nm, by remotely sensing power station smokestack emissions in this spectral region. Given the very low cost of these units, â‰ˆ USD 25, they are suitable for widespread proliferation in a variety of UV imaging applications, e.g., in atmospheric science, volcanology, forensics and surface smoothness measurements.

An IoT-Based Ship Berthing Method Using a Set of Ultrasonic Sensors.

https://www.ncbi.nlm.nih.gov/pubmed/31779227

It is indisputable that a great deal of brand new technologies such as the internet of things, (IoT) big data, and cloud computing are conquering every aspect of our life. So, in the branch of marine technology, the mentioned technologies are also being applied to obtain more features and to automate marine-related operations as well as creating novel smart devices. As a result of this, traditional ports and ships are being replaced by smart ports and vessels. To achieve this transition, numerous applications need to be developed to make them smart. The purpose of this paper is to present a dedicated an IoT-based system for automating linkage procedures by searching for

available locations via port-mounted sensors and planned ship notification. In the experimental system, we have used smartphone as an alternative to the client-side vessel of the system and created an Android app called "Smart Ship Berthing" instead of the charging program, for instance, NORIVIS 4, VDASH, ODYSSEY, etc. To test our proposed server-side system, we used Raspberry Pi with a combination of an ultrasonic sensor to detect the ship and modify the empty berth for anchoring. The experimental results show that the set of UR sensors have high accuracy to detect ships at the port for ship berthing and our proposed system is very amenable to implementation in the real marine environment.

AMi: a GUI-based, open-source system for imaging samples in multi-well plates.

https://www.ncbi.nlm.nih.gov/pubmed/31397323

Described here are instructions for building and using an inexpensive automated microscope (AMi) that has been specifically designed for viewing and imaging the contents of multi-well plates. The X, Y, Z translation stage is controlled through dedicated software (AMiGUI) that is being made freely available. Movements are controlled by an Arduino-based board running grbl, and the graphical user interface and image acquisition are controlled via a Raspberry Pi microcomputer running Python. Images can be written to the Raspberry Pi or to a remote disk. Plates with multiple sample wells at each row/column position are supported, and a script file for automated z-stack depth-of-field enhancement is written along with the images. The graphical user interface and real-time imaging also make it easy to manually inspect and capture images of individual samples.

Low-cost web-based Supervisory Control and Data Acquisition system for a microgrid testbed: A case study in design and implementation for academic and research applications.

https://www.ncbi.nlm.nih.gov/pubmed/31687569

This paper presents the design and implementation of a low-cost Supervisory Control and Data Acquisition system based on a Web interface to be applied to a Hybrid Renewable Energy System (HRES) microgrid. This development will provide a reliable and low-cost control and data acquisition systems for the Renewable Energy Laboratory at Universitat PolitÃ¨cnica de ValÃ¨ncia (LabDER-UPV) in Spain, oriented to the research on microgrid stability and energy generation. The developed low-cost SCADA operates on a microgrid that incorporates a photovoltaic array, a wind turbine, a biomass gasification plant and a battery bank as an energy storage system. Sensors and power meters for electrical parameters, such as voltage, current, frequency, power factor, power

generation, and energy consumption, were processed digitally and integrated into Arduino-based devices. A master device on a Raspberry-PI board was set up to send all this information to a local database (DB), and a MySQL Web-DB linked to a Web SCADA interface, programmed in HTML5. The communications protocols include TCP/IP, I2C, SPI, and Serial communication; Arduino-based slave devices communicate with the master Raspberry-PI using NRF24L01 wireless radio frequency transceivers. Finally, a comparison between a standard SCADA against the developed Web-based SCADA system is carried out. The results of the operative tests and the cost comparison of the own-designed developed Web-SCADA system prove its reliability and low-cost, on average an 86% cheaper than a standard brandmark solution, for controlling, monitoring and data logging information, as well as for local and remote operation system when applied to the HRES microgrid testbed.

Robust estimation of simulated urinary volume from camera images under bathroom illumination.

https://www.ncbi.nlm.nih.gov/pubmed/28268361

General uroflowmetry method involves the risk of nosocomial infections or time and effort of the recording. Medical institutions, therefore, need to measure voided volume simply and hygienically. Multiple cylindrical model that can estimate the fluid flow rate from the photographed image using camera has been proposed in an earlier study. This study implemented a flow rate estimation by using a general-purpose camera system (Raspberry Pi Camera Module) and the multiple cylindrical model. However, large amounts of noise in extracting liquid region are generated by the variation of the illumination when performing measurements in the bathroom. So the estimation error gets very large. In other words, the specifications of the previous study's camera setup regarding the shutter type and the frame rate was too strict. In this study, we relax the specifications to achieve a flow rate estimation using a general-purpose camera. In order to determine the appropriate approximate curve, we propose a binarizing method using background subtraction at each scanning row and a curve approximation method using RANSAC. Finally, by evaluating the estimation accuracy of our experiment and by comparing it with the earlier study's results, we show the effectiveness of our proposed method for flow rate estimation.

Toward a low-cost gait analysis system for clinical and free-living assessment.

https://www.ncbi.nlm.nih.gov/pubmed/28268692

Gait is an important clinical assessment tool since changes in gait may reflect changes in general health. Measurement of gait is a complex process which has been restricted to bespoke clinical facilities until recently. The use of inexpensive wearable technologies is an attractive alternative and offers the potential to assess gait in any environment. In this paper we present the development of a low cost analysis gait system built using entirely open source components. The system is used to capture spatio-temporal gait characteristics derived from an existing conceptual model, sensitive to ageing and neurodegenerative pathology (e.g. Parkinson's disease). We demonstrate the system is suitable for use in a clinical unit and will lead to pragmatic use in a free-living (home) environment. The system consists of a wearable (tri-axial accelerometer and gyroscope) with a Raspberry Pi module for data storage and analysis. This forms ongoing work to develop gait as a low cost diagnostic in modern healthcare.

WiseEye: Next Generation Expandable and Programmable Camera Trap Platform for Wildlife Research.

https://www.ncbi.nlm.nih.gov/pubmed/28076444

The widespread availability of relatively cheap, reliable and easy to use digital camera traps has led to their extensive use for wildlife research, monitoring and public outreach. Users of these units are, however, often frustrated by the limited options for controlling camera functions, the generation of large numbers of images, and the lack of flexibility to suit different research environments and questions. We describe the development of a user-customisable open source camera trap platform named 'WiseEye', designed to provide flexible camera trap technology for wildlife researchers. The novel platform is based on a Raspberry Pi single-board computer and compatible peripherals that allow the user to control its functions and performance. We introduce the concept of confirmatory sensing, in which the Passive Infrared triggering is confirmed through other modalities (i.e. radar, pixel change) to reduce the occurrence of false positives images. This concept, together with user-definable metadata, aided identification of spurious images and greatly reduced post-collection processing time. When tested against a commercial camera trap, WiseEye was found to reduce the incidence of false positive images and false negatives across a range of test conditions. WiseEye represents a step-change in camera trap functionality, greatly increasing the value of this technology for wildlife research and conservation management.

Prosomes. Ubiquity and inter-species structural variation.

https://www.ncbi.nlm.nih.gov/pubmed/2423694

The "prosomes", a novel type of ubiquitous ribonucleoprotein particle of extraordinary stability and of defined electron microscopical structure, have been characterized in several cell types and species. Identified as a 19 S sub-component of free mRNA-protein complexes, including globin and other repressed mRNA, in the cytoplasm of duck, mouse and HeLa cells, they were previously found to inhibit protein synthesis in vitro. In all cells studied, electron microscopy shows an identical, seemingly ring-like but rather raspberry-shaped particle of 12 nm diameter, resistant to EDTA and 1% (w/v) Sarkosyl. Two-dimensional electrophoretic analysis of prosomal proteins shows a characteristic pattern in the 19,000 to 35,000 Mr range of pI 4 to 7, with an additional 56,000 Mr component specific to avian species. The prosomes found in globin mRNA-protein complexes contain about 25 protein components, 16 of which have identical molecular weight and pI values in duck and mouse, and which are also found in the prosomes of the heterogeneous free mRNPs of HeLa cells. Seral and monoclonal antibodies raised in mice against the prosomes of duck erythroblasts cross-react with some of the proteins of the mouse and HeLa cell particles. Prosomes isolated from duck and mouse globin mRNP, both contain small cytoplasmic RNAs of 70 to 90 nucleotides, which represent about 15% of the particle mass. The molecular weight and the 3'-terminal oligonucleotide of each one of these small cytoplasmic RNAs are identical in the two animal species; fingerprints of their oligonucleotides generated by RNase T1 show that more than 80% of spots are identical. In contrast, the prosomes of HeLa cells, associated with a large population of repressed mRNA, contain at least 12 small cytoplasmic RNA species. All prosomal RNAs tested so far hybridize to mRNA. The data available indicate that prosomes constitute a novel class of ubiquitous cellular ribonucleoprotein complexes, present in the nucleus and cytoplasm that, in its structural variations shown here, reflects function and species.

Intra-Minute Cloud Passing Forecasting Based on a Low Cost IoT Sensor-A Solution for Smoothing the Output Power of PV Power Plants.

https://www.ncbi.nlm.nih.gov/pubmed/28505078

Clouds moving at a high speed in front of the Sun can cause step changes in the output power of photovoltaic (PV) power plants, which can lead to voltage fluctuations and stability problems in the connected electricity networks. These effects can be reduced effectively by proper short-term cloud passing forecasting and suitable PV power plant output power control. This paper proposes a low-cost Internet of Things (IoT)-based solution for intra-minute cloud passing forecasting. The

hardware consists of a Raspberry PI Model B 3 with a WiFi connection and an OmniVision OV5647 sensor with a mounted wide-angle lens, a circular polarizing (CPL) filter and a natural density (ND) filter. The completely new algorithm for cloud passing forecasting uses the green and blue colors in the photo to determine the position of the Sun, to recognize the clouds, and to predict their movement. The image processing is performed in several stages, considering selectively only a small part of the photo relevant to the movement of the clouds in the vicinity of the Sun in the next minute. The proposed algorithm is compact, fast and suitable for implementation on low cost processors with low computation power. The speed of the cloud parts closest to the Sun is used to predict when the clouds will cover the Sun. WiFi communication is used to transmit this data to the PV power plant control system in order to decrease the output power slowly and smoothly.

Black raspberries in cancer clinical trials: Past, present and future.

https://www.ncbi.nlm.nih.gov/pubmed/27594930

Black raspberries (BRB) inhibit a broad range of cancers in preclinical models, including in vivo models of oral, esophageal, colon, breast and skin cancer. Promising preclinical results have led to clinical evaluations in cancer patients or patients at increased risk for cancer development.

Design of a Solar Tracking System Using the Brightest Region in the Sky Image Sensor.

https://www.ncbi.nlm.nih.gov/pubmed/27898002

Solar energy is certainly an energy source worth exploring and utilizing because of the environmental protection it offers. However, the conversion efficiency of solar energy is still low. If the photovoltaic panel perpendicularly tracks the sun, the solar energy conversion efficiency will be improved. In this article, we propose an innovative method to track the sun using an image sensor. In our method, it is logical to assume the points of the brightest region in the sky image representing the location of the sun. Then, the center of the brightest region is assumed to be the solar-center, and is mathematically calculated using an embedded processor (Raspberry Pi). Finally, the location information on the sun center is sent to the embedded processor to control two servo motors that are capable of moving both horizontally and vertically to track the sun. In comparison with the existing sun tracking methods using image sensors, such as the Hough transform method, our method based on the brightest region in the sky image remains accurate under conditions such as a sunny day and building shelter. The practical sun tracking system using our method was implemented and tested. The results reveal that the system successfully captured the real sun

center in most weather conditions, and the servo motor system was able to direct the photovoltaic panel perpendicularly to the sun center. In addition, our system can be easily and practically integrated, and can operate in real-time.

A Novel Certificateless Signature Scheme for Smart Objects in the Internet-of-Things.

https://www.ncbi.nlm.nih.gov/pubmed/28468313

Rapid advances in wireless communications and pervasive computing technologies have resulted in increasing interest and popularity of Internet-of-Things (IoT) architecture, ubiquitously providing intelligence and convenience to our daily life. In IoT-based network environments, smart objects are embedded everywhere as ubiquitous things connected in a pervasive manner. Ensuring security for interactions between these smart things is significantly more important, and a topic of ongoing interest. In this paper, we present a certificateless signature scheme for smart objects in IoT-based pervasive computing environments. We evaluate the utility of the proposed scheme in IoT-oriented testbeds, i.e., Arduino Uno and Raspberry PI 2. Experiment results present the practicability of the proposed scheme. Moreover, we revisit the scheme of Wang et al. (2015) and revealed that a malicious super type I adversary can easily forge a legitimate signature to cheat any receiver as he/she wishes in the scheme. The superiority of the proposed certificateless signature scheme over relevant studies is demonstrated in terms of the summarized security and performance comparisons.

An Autonomous Underwater Recorder Based on a Single Board Computer.

https://www.ncbi.nlm.nih.gov/pubmed/26076479

As industrial activities continue to grow on the Brazilian coast, underwater sound measurements are becoming of great scientific importance as they are essential to evaluate the impact of these activities on local ecosystems. In this context, the use of commercial underwater recorders is not always the most feasible alternative, due to their high cost and lack of flexibility. Design and construction of more affordable alternatives from scratch can become complex because it requires profound knowledge in areas such as electronics and low-level programming. With the aim of providing a solution; a well succeeded model of a highly flexible, low-cost alternative to commercial recorders was built based on a Raspberry Pi single board computer. A properly working prototype was assembled and it demonstrated adequate performance levels in all tested situations. The prototype was equipped with a power management module which was thoroughly evaluated. It is

estimated that it will allow for great battery savings on long-term scheduled recordings. The underwater recording device was successfully deployed at selected locations along the Brazilian coast, where it adequately recorded animal and manmade acoustic events, among others. Although power consumption may not be as efficient as that of commercial and/or micro-processed solutions, the advantage offered by the proposed device is its high customizability, lower development time and inherently, its cost.

A System for Weeds and Crops Identification-Reaching over 10 FPS on Raspberry Pi with the Usage of MobileNets, DenseNet and Custom Modifications.

https://www.ncbi.nlm.nih.gov/pubmed/31480480

Automated weeding is an important research area in agrorobotics. Weeds can be removed mechanically or with the precise usage of herbicides. Deep Learning techniques achieved state of the art results in many computer vision tasks, however their deployment on low-cost mobile computers is still challenging. The described system contains several novelties, compared both with its previous version and related work. It is a part of a project of the automatic weeding machine, developed by the Warsaw University of Technology and MCMS Warka Ltd. Obtained models reach satisfying accuracy (detecting 47-67% of weed area, misclasifing as weed 0.1-0.9% of crop area) at over 10 FPS on the Raspberry Pi 3B+ computer. It was tested for four different plant species at different growth stadiums and lighting conditions. The system performing semantic segmentation is based on Convolutional Neural Networks. Its custom architecture combines U-Net, MobileNets, DenseNet and ResNet concepts. Amount of needed manual ground truth labels was significantly decreased by the usage of the knowledge distillation process, learning final model which mimics an ensemble of complex models on a large database of unlabeled data. Further decrease of the inference time was obtained by two custom modifications: in the usage of separable convolutions in DenseNet block and in the number of channels in each layer. In the authors' opinion, the described novelties can be easily transferred to other agrorobotics tasks.

Shake-it-off: a simple ultrasonic cryo-EM specimen-preparation device.

https://www.ncbi.nlm.nih.gov/pubmed/31793900

Although microscopes and image-analysis software for electron cryomicroscopy (cryo-EM) have improved dramatically in recent years, specimen-preparation methods have lagged behind. Most strategies still rely on blotting microscope grids with paper to produce a thin film of solution suitable

for vitrification. This approach loses more than 99.9% of the applied sample and requires several seconds, leading to problematic air-water interface interactions for macromolecules in the resulting thin film of solution and complicating time-resolved studies. Recently developed self-wicking EM grids allow the use of small volumes of sample, with nanowires on the grid bars removing excess solution to produce a thin film within tens of milliseconds from sample application to freezing. Here, a simple cryo-EM specimen-preparation device that uses components from an ultrasonic humidifier to transfer protein solution onto a self-wicking EM grid is presented. The device is controlled by a Raspberry Pi single-board computer and all components are either widely available or can be manufactured by online services, allowing the device to be constructed in laboratories that specialize in cryo-EM rather than instrument design. The simple open-source design permits the straightforward customization of the instrument for specialized experiments.

Accelerating Health Data Sharing: A Solution Based on the Internet of Things and Distributed Ledger Technologies.

https://www.ncbi.nlm.nih.gov/pubmed/31172963

Huge amounts of health-related data are generated every moment with the rapid development of Internet of Things (IoT) and wearable technologies. These big health data contain great value and can bring benefit to all stakeholders in the health care ecosystem. Currently, most of these data are siloed and fragmented in different health care systems or public and private databases. It prevents the fulfillment of intelligent health care inspired by these big data. Security and privacy concerns and the lack of ensured authenticity trails of data bring even more obstacles to health data sharing. With a decentralized and consensus-driven nature, distributed ledger technologies (DLTs) provide reliable solutions such as blockchain, Ethereum, and IOTA Tangle to facilitate the health care data sharing.

Phenotiki: an open software and hardware platform for affordable and easy image-based phenotyping of rosette-shaped plants.

https://www.ncbi.nlm.nih.gov/pubmed/28066963

Phenotyping is important to understand plant biology, but current solutions are costly, not versatile or are difficult to deploy. To solve this problem, we present Phenotiki, an affordable system for plant phenotyping that, relying on off-the-shelf parts, provides an easy to install and maintain platform, offering an out-of-box experience for a well-established phenotyping need: imaging rosette-shaped

plants. The accompanying software (with available source code) processes data originating from our device seamlessly and automatically. Our software relies on machine learning to devise robust algorithms, and includes an automated leaf count obtained from 2D images without the need of depth (3D). Our affordable device (~â‚¬200) can be deployed in growth chambers or greenhouse to acquire optical 2D images of approximately up to 60 adult Arabidopsis rosettes concurrently. Data from the device are processed remotely on a workstation or via a cloud application (based on CyVerse). In this paper, we present a proof-of-concept validation experiment on top-view images of 24 Arabidopsis plants in a combination of genotypes that has not been compared previously. Phenotypic analysis with respect to morphology, growth, color and leaf count has not been performed comprehensively before now. We confirm the findings of others on some of the extracted traits, showing that we can phenotype at reduced cost. We also perform extensive validations with external measurements and with higher fidelity equipment, and find no loss in statistical accuracy when we use the affordable setting that we propose. Device set-up instructions and analysis software are publicly available (http://phenotiki.com).

Fatty acid profile of new promising unconventional plant oils for cosmetic use.

https://www.ncbi.nlm.nih.gov/pubmed/26659407

Oils have been used on the cosmetic application since antiquity. With the growing interest in cosmetic formulation of strictly natural origin there has been also an increased interest in the use of alternative oils obtained from nuts, herbs, fruit and vegetable seeds. Due to lack of good scientific reports on the cosmetic plant oils available in Poland, the aim of our research was to characterize fatty acids (FA) profile and oxidative quality of selected unconventional plant oils, which are used as cosmetics or potential cosmetic ingredients.

FingerScanner: Embedding a Fingerprint Scanner in a Raspberry Pi.

https://www.ncbi.nlm.nih.gov/pubmed/26861340

Nowadays, researchers are paying increasing attention to embedding systems. Cost reduction has lead to an increase in the number of platforms supporting the operating system Linux, jointly with the Raspberry Pi motherboard. Thus, embedding devices on Raspberry-Linux systems is a goal in order to make competitive commercial products. This paper presents a low-cost fingerprint recognition system embedded into a Raspberry Pi with Linux.

Biochemical characterization of an organic solvent-tolerant glycosyltransferase from Bacillus licheniformis PI15 with potential application for raspberry ketone glycoside production.

https://www.ncbi.nlm.nih.gov/pubmed/31628682

Raspberry ketone is a primary aroma component of the red raspberry. The glycosylation of this compound is a potential approach used to improve its pharmaceutical properties. In this work, raspberry ketone glycosides are produced in bacteria for the first time. Bacillus licheniformis PI15, an organic solvent-tolerant glycosyltransferase-producing strain, was isolated from chemically polluted soil. The cloning and heterologous expression of a glycosyltransferase, which was designated PI-GT1, in Escherichia coli BL21 resulted in the expression of an active and soluble protein that accounted for 15% of the total cell protein content. Purified PI-GT1 was highly active and stable over a broad pH range (6.0-10.0) and showed excellent pH stability. PI-GT1 maintained almost 60% of its maximal activity after 3Â H of incubation at 20-40Â Â°C and demonstrated optimal activity at 30Â Â°C. Additionally, PI-GT1 displayed high stability and activity in the presence of hydrophilic solvents with log PÂ â‰¤Â -0.2 and retained more than 80% of its activity after 3Â H of treatment. Supplementation with 10% DMSO markedly improved the glycosylation of raspberry ketone, resulting in a value 26 times higher than that in aqueous solution. The organic solvent-tolerant PI-GT1 may have potential uses in industrial chemical and pharmaceutical synthesis applications.

Assembly of a UV-LED induced fluorescence system for rapid determination of amiloride in pharmaceutical tablet and human serum.

https://www.ncbi.nlm.nih.gov/pubmed/31202352

A simple and sensitive fluorescence method has been developed for the determination of amiloride (AMI) in pharmaceutical tablet and human serum with a portable, cost-effective, and easy-to-operate fluorescence system. The fluorescence system was assembled with some optical and electronic devices mainly including a 370â€¯nm light-emitting-diode (LED) as light source, a fiber spectrometer and a Raspberry Pi computer. With the system, AMI produced a strong fluorescence emission at 413â€¯nm, and the emitted intensity can maintain good stability with in a wide pH range from 2 to 8. The proposed method was successfully applied to the determinations of AMI in pharmaceutical tablet and human serum. Their detection limits were 1.67â€¯ngâ€¯mL-1 and 1.43â€¯ngâ€¯mL-1 respectively, and the recovery was in the range of 94.06-114.0%. Those obtained results proved

that the proposed methods combined with the developed fluorescence system could be employed for the routine analysis of amiloride in pharmaceutical tablet and human serum, especially for the fast analysis of them under field conditions.

An Internet of Things (IoT) Application on Volcano Monitoring.

https://www.ncbi.nlm.nih.gov/pubmed/31717744

In the last few years, there has been a huge interest in the Internet of Things (hereinafter IoT) field. Among the large number of IoT technologies, the low-power wide-area network (hereinafter LPWAN) has emerged providing low power, low data-rate communication over long distances, enabling battery-operated devices to operate for long time periods. This paper introduces an application of long-range (hereinafter LoRa) technology, one of the most popular LPWANs, to volcanic surveillance. The first low-power and low-cost wireless network based on LoRa to monitor the soil temperature in thermal anomaly zones in volcanic areas has been developed. A total of eight thermometers (end devices) have been deployed on a Teide volcano in Tenerife (Canary Islands). In addition, a repeater device was developed to extend the network range when the gateway did not have a line of sight connection with the thermometers. Combining LoRa communication capabilities with microchip microcontrollers (end devices and repeater) and a Raspberry Pi board (gateway), three main milestones have been achieved: (i) extreme low-power consumption, (ii) real-time and proper temperature acquisition, and (iii) a reliable network operation. The first results are shown. These results provide enough quality for a proper volcanic surveillance.

Method for collecting thermocouple data via secured shell over a wireless local area network in real time.

https://www.ncbi.nlm.nih.gov/pubmed/25832280

This manuscript addresses the design, hardware details, construction, and programming of an apparatus allowing an experimenter to monitor and record high-temperature thermocouple measurements of dynamic systems in real time. The apparatus uses wireless network technology to bridge the gap between a dynamic (moving) sample frame and the static laboratory frame. Our design is a custom solution applied to samples that rotate through large angular displacements where hard-wired and typical slip-ring solutions are not practical because of noise considerations. The apparatus consists of a Raspberry PI mini-Linux computer, an Arduino micro-controller, an Ocean Controls thermocouple multiplexer shield, and k-type thermocouples.

A Simple and Low-Cost Monitoring System to Investigate Environmental Conditions in a Biological Research Laboratory.

https://www.ncbi.nlm.nih.gov/pubmed/26771659

Basic equipment such as incubation and refrigeration systems plays a critical role in nearly all aspects of the traditional biological research laboratory. Their proper functioning is therefore essential to ensure reliable and repeatable experimental results. Despite this fact, in many academic laboratories little attention is paid to validating and monitoring their function, primarily due to the cost and/or technical complexity of available commercial solutions. We have therefore developed a simple and low-cost monitoring system that combines a "Raspberry Pi" single-board computer with USB-connected sensor interfaces to track and log parameters such as temperature and pressure, and send email alert messages as appropriate. The system is controlled by open-source software, and we have also generated scripts to automate software setup so that no background in programming is required to install and use it. We have applied it to investigate the behaviour of our own equipment, and present here the results along with the details of the monitoring system used to obtain them.

Brain tumor segmentation approach based on the extreme learning machine and significantly fast and robust fuzzy C-means clustering algorithms running on Raspberry Pi hardware.

https://www.ncbi.nlm.nih.gov/pubmed/31812927

Automatic decision support systems have gained importance in health sector in recent years. In parallel with recent developments in the fields of artificial intelligence and image processing, embedded systems are also used in decision support systems for tumor diagnosis. Extreme learning machine (ELM), is a recently developed, quick and efficient algorithm which can quickly and flawlessly diagnose tumors using machine learning techniques. Similarly, significantly fast and robust fuzzy C-means clustering algorithm (FRFCM) is a novel and fast algorithm which can display a high performance. In the present study, a brain tumor segmentation approach is proposed based on extreme learning machine and significantly fast and robust fuzzy C-means clustering algorithms (BTS-ELM-FRFCM) running on Raspberry Pi (PRI) hardware. The present study mainly aims to introduce a new segmentation system hardware containing new algorithms and offering a high level of accuracy the health sector. PRI's are useful mobile devices due to their cost-effectiveness and satisfying hardware. 3200 training images were used to train ELM in the present study. 20 pieces of

MRI images were used for testing process. Figure of merid (FOM), Jaccard similarity coefficient (JSC) and Dice indexes were used in order to evaluate the performance of the proposed approach. In addition, the proposed method was compared with brain tumor segmentation based on support vector machine (BTS-SVM), brain tumor segmentation based on fuzzy C-means (BTS-FCM) and brain tumor segmentation based on self-organizing maps and k-means (BTS-SOM). The statistical analysis on FOM, JSC and Dice results obtained using four different approaches indicated that BTS-ELM-FRFCM displayed the highest performance. Thus, it can be concluded that the embedded system designed in the present study can perform brain tumor segmentation with a high accuracy rate.

Infrared enthalpymetric methods: A new, fast and simple alternative for sodium determination in food sauces.

https://www.ncbi.nlm.nih.gov/pubmed/31525594

This work developed a new technique and an application of an existing approach to determine sodium in food sauces, involving enthalpimetric reactions in the infrared. Infrared Thermometric Titration (TT-IR) was utilized, with simple analyzers and low-cost measurement instruments for the acquisition of the surface temperature generated in the sodium precipitation reaction and development of software for the acquisition and processing of data using Raspberry Pi. The sodium was also quantified by Thermal Infrared Enthalpimetry (TIE), a recently developed technique. The rapid and simple quantification of sodium by the TT-IR and TIE showed the possibility of a selective reaction for sodium, using aluminum nitrate, potassium and ammonium fluoride in an acid medium, with reduction of the reagents and without the digestion step in the sample preparation. The results acquired through TT-IR and TIE corroborated the Flame Atomic Emission Spectrometry (FAES) with 96 to 103% and 95 to 102%, respectively.

Bringing computational science to the public.

https://www.ncbi.nlm.nih.gov/pubmed/27006868

The increasing use of computers in science allowsÂ for the scientific analyses of large datasets at an increasing pace. We provided examples and interactive demonstrations at Dundee Science Centre as part of the 2015 Women in Science festival, to present aspects of computational science to the general public. We used low-cost Raspberry Pi computers to provide hands on experience in computer programming and demonstrated the application of computers to biology. Computer games

were used as a means to introduce computers to younger visitors. The success of the event was evaluated by voluntary feedback forms completed by visitors, in conjunction with our own self-evaluation. This work builds on the original work of the 4273Ï€ bioinformatics education program of Barker et al. (2013, BMC Bioinform. 14:243). 4273Ï€ provides open source education materials in bioinformatics. This work looks at the potential to adapt similar materials for public engagement events.

Void sorcerer: an open source, open access framework for mouse uroflowmetry.

https://www.ncbi.nlm.nih.gov/pubmed/31317056

Observational and experimental studies of rodent voiding behaviors have greatly contributed to our understanding of lower urinary tract function including the complex social, environmental, and internal stimuli that affect voiding in health and models of disease. Void spot assays (VSA), cystometry (awake or anesthetized), and uroflowmetry are techniques commonly used in rodent models to assess voiding. Uroflowmetry is non-invasive and can be performed multiple times in the same freely moving animals and can be used to generate synchronized video corresponding to each void to characterize micturition patterns (e.g., droplets versus solid stream). However, approaches to evaluate uroflowmetry in rodent models vary widely across laboratories. Most importantly, an open access software to run these tests is not freely available (although complete systems are commercially available), limiting use of this important assay. We developed the Void Sorcerer, an uroflowmetry system for mice for reliable determination of frequency, voided volume, voiding duration, interval times between micturitions, and flow rate. This report provides a detailed description of how to build this system and includes open access software for developing uroflowmetry capability in their laboratories and improve upon it in a cost-effective manner. Our goals are to improve access, increase reproducibility among laboratories, and facilitate standardizing testing procedures.

A Middleware Solution for Wireless IoT Applications in Sparse Smart Cities.

https://www.ncbi.nlm.nih.gov/pubmed/29099745

The spread of off-the-shelf mobile devices equipped with multiple wireless interfaces together with sophisticated sensors is paving the way to novel wireless Internet of Things (IoT) environments, characterized by multi-hop infrastructure-less wireless networks where devices carried by users act as sensors/actuators as well as network nodes. In particular, the paper presents Real Ad-hoc

Multi-hop Peer-to peer-Wireless IoT Application (RAMP-WIA), a novel solution that facilitates the development, deployment, and management of applications in sparse Smart City environments, characterized by users willing to collaborate by allowing new applications to be deployed on their smartphones to remotely monitor and control fixed/mobile devices. RAMP-WIA allows users to dynamically configure single-hop wireless links, to manage opportunistically multi-hop packet dispatching considering that the network topology (together with the availability of sensors and actuators) may abruptly change, to actuate reliably sensor nodes specifically considering that only part of them could be actually reachable in a timely manner, and to upgrade dynamically the nodes through over-the-air distribution of new software components. The paper also reports the performance of RAMP-WIA on simple but realistic cases of small-scale deployment scenarios with off-the-shelf Android smartphones and Raspberry Pi devices; these results show not only the feasibility and soundness of the proposed approach, but also the efficiency of the middleware implemented when deployed on real testbeds.

Transitioning EEG experiments away from the laboratory using a Raspberry Pi 2.

https://www.ncbi.nlm.nih.gov/pubmed/27894782

Electroencephalography (EEG) experiments are typically performed in controlled laboratory settings to minimise noise and produce reliable measurements. These controlled conditions also reduce the applicability of the obtained results to more varied environments and may limit their relevance to everyday situations.

Facile assembly of an affordable miniature multicolor fluorescence microscope made of 3D-printed parts enables detection of single cells.

https://www.ncbi.nlm.nih.gov/pubmed/31600202

Fluorescence microscopy is one of the workhorses of biomedical research and laboratory diagnosis; however, their cost, size, maintenance, and fragility has prevented their adoption in developing countries or low-resource settings. Although significant advances have decreased their size, cost and accessibility, their designs and assembly remain rather complex. Here, inspired on the simple mechanism from a nut and a bolt, we report the construction of a portable fluorescence microscope that operates in bright-field mode and in three fluorescence channels: UV, green, and red. It is assembled in under 10 min from only six 3D printed parts, basic electronic components, a microcomputer (Raspberry Pi) and a camera, all of which can be readily purchased in most locations

or online for US $122. The microcomputer was programmed in Python language to capture time-lapse images and videos. Resolution and illumination conditions of the microscope were characterized, and its performance was compared with a high-end fluorescence microscope in bright-field and fluorescence mode. We demonstrate that our miniature microscope can resolve and track single cells in both modes. The instructions on how to assemble the microscope are shown in a video, and the software to control it and the design files of the 3D-printed parts are freely available online. Our portable microscope is ideal in applications where space is at a premium, such as lab-on-a-chips or space missions, and can find applications in basic and clinical research, diagnostics, telemedicine and in educational settings.

Handheld projective imaging device for near-infrared fluorescence imaging and intraoperative guidance of sentinel lymph node resection.

https://www.ncbi.nlm.nih.gov/pubmed/31436070

We propose a handheld projective imaging device for orthotopic projection of near-infrared fluorescence images onto target biological tissue at visible wavelengths without any additional visual aid. The device integrates a laser diode light source module, a camera module, a projector, an ultrasonic distance sensor, a Raspberry Pi single-board computer, and a battery module in a rugged handheld unit. It is calibrated at the detected working distance for seamless coregistration between fluorescence emission and projective imaging at the target tissue site. The proposed device is able to achieve a projection resolution higher than 314â€‰â€‰Î¼m and a planar projection bias less than 1 mm at a projection field of view of 58â€‰â€‰Ã—â€‰â€‰108â€‰â€‰mm2 and a working distance of 27 cm. Technical feasibility for projective imaging is verified in an ex vivo model of chicken breast tissue using indocyanine green as a fluorescence agent. Clinical utility for image-guided surgery is demonstrated in a clinical trial where sentinel lymph nodes in breast cancer patients are identified and resected under the guidance of projective imaging. Our ex vivo and in vivo experiments imply the clinical utility of deploying the proposed device for image-guided surgical interventions in resource-limited settings.

Exploiting open source 3D printer architecture for laboratory robotics to automate high-throughput time-lapse imaging for analytical microbiology.

https://www.ncbi.nlm.nih.gov/pubmed/31743346

Growth in open-source hardware designs combined with the low-cost of high performance

optoelectronic and robotics components has supported a resurgence of in-house custom lab equipment development. We describe a low cost (below $700), open-source, fully customizable high-throughput imaging system for analytical microbiology applications. The system comprises a Raspberry Pi camera mounted on an aluminium extrusion frame with 3D-printed joints controlled by an Arduino microcontroller running open-source Repetier Host Firmware. The camera position is controlled by simple G-code scripts supplied from a Raspberry Pi singleboard computer and allow customized time-lapse imaging of microdevices over a large imaging area. Open-source OctoPrint software allows remote access and control. This simple yet effective design allows high-throughput microbiology testing in multiple formats including formats for bacterial motility, colony growth, microtitre plates and microfluidic devices termed 'lab-on-a-comb' to screen the effects of different culture media components and antibiotics on bacterial growth. The open-source robot design allows customization of the size of the imaging area; the current design has an imaging area of ~420 Ã— 300mm, which allows 29 'lab-on-a-comb' devices to be imaged which is equivalent 3480 individual 1Î¼l samples. The system can also be modified for fluorescence detection using LED and emission filters embedded on the PiCam for more sensitive detection of bacterial growth using fluorescent dyes.

Low-cost automatic temperature monitoring system with alerts for laboratory rearing units.

https://www.ncbi.nlm.nih.gov/pubmed/31667111

Monitoring accurately temperature is a key issue in biological studies involving living experimental material. It is especially true for insects which body temperature is mostly controlled by environmental temperature, with profound consequences of a few degrees variation on most physiological processes such as survival, development, fecundity, and mobility. If programmable rearing units can be purchased, it remains important to monitor and store temperature information acquired inside the rearing unit to ensure that observed phenomena are not the result of unintended and not scarily noticeable changes in temperature, and to account for the effect of temperature variation in statistical analysis. As most laboratories involved in insect rearing dispose of a large number of rearing units, the technical solution should meet the monitoring needs while being affordable and adaptable to various experimental designs. For that purpose, we designed a low cost (below 100â,¬) and open source automatic temperature monitoring system for rearing units in laboratory. Key features providing advantage over pre-existing methods include: â€¢Highly configurable temperature monitoring and life-time storage capacityâ€¢Email alerts based on

configurable user-defined thresholdâ€¢Automatic configurable reports in the form of dashboards.

A Real-Time Health 4.0 Framework with Novel Feature Extraction and Classification for Brain-Controlled IoT-Enabled Environments.

https://www.ncbi.nlm.nih.gov/pubmed/31393827

In this letter, we propose two novel methods for four-class motor imagery (MI) classification using electroencephalography (EEG). Also, we developed a real-time health 4.0 (H4.0) architecture for brain-controlled internet of things (IoT) enabled environments (BCE), which uses the classified MI task to assist disabled persons in controlling IoT-enabled environments such as lighting and heating, ventilation, and air-conditioning (HVAC). The first method for classification involves a simple and low-complex classification framework using a combination of regularized Riemannian mean (RRM) and linear SVM. Although this method performs better compared to state-of-the-art techniques, it still suffers from a nonnegligible misclassification rate. Hence, to overcome this, the second method offers a persistent decision engine (PDE) for the MI classification, which improves classification accuracy (CA) significantly. The proposed methods are validated using an in-house recorded four-class MI data set (data set I, collected over 14 subjects), and a four-class MI data set 2a of BCI competition IV (data set II, collected over 9 subjects). The proposed RRM architecture obtained average CAs of 74.30% and 67.60% when validated using datasets I and II, respectively. When analyzed along with the proposed PDE classification framework, an average CA of 92.25% on 12 subjects of data set I and 82.54% on 7 subjects of data set II is obtained. The results show that the PDE algorithm is more reliable for the classification of four-class MI and is also feasible for BCE applications. The proposed low-complex BCE architecture is implemented in real time using Raspberry Pi 3 Model B+ along with the Virgo EEG data acquisition system. The hardware implementation results show that the proposed system architecture is well suited for body-wearable devices in the scenario of Health 4.0. We strongly feel that this study can aid in driving the future scope of BCE research.

Intrinsic Physical Unclonable Function (PUF) Sensors in Commodity Devices.

https://www.ncbi.nlm.nih.gov/pubmed/31141896

The environment-dependent feature of physical unclonable functions (PUFs) is capable of sensing environment changes. This paper presents an analysis and categorization of a variety of PUF sensors. Prior works have demonstrated that PUFs can be used as sensors while providing a

security authentication assurance. However, most of the PUF sensors need a dedicated circuit. It can be difficult to implemented in commercial off-the-shelf devices. This paper focuses on the intrinsic Dynamic Random Access Memory (DRAM) PUF-based sensors, which requires no modifications for hardware. The preliminary experimental results on Raspberry Pi have demonstrated the feasibility of our design. Furthermore, we configured the DRAM PUF-based sensor in a DRAM PUF-based key generation scheme which improves the practicability of the design.

MVO Automation Platform: Addressing Unmet Needs in Clinical Laboratories with Microcontrollers, 3D Printing, and Open-Source Hardware/Software.

https://www.ncbi.nlm.nih.gov/pubmed/29746790

Laboratory automation improves test reproducibility, which is vital to patient care in clinical laboratories. Many small and specialty laboratories are excluded from the benefits of automation due to low sample number, cost, space, and/or lack of automation expertise. The Minimum Viable Option (MVO) automation platform was developed to address these hurdles and fulfill an unmet need. Consumer 3D printing enabled rapid iterative prototyping to allow for a variety of instrumentation and assay setups and procedures. Three MVO versions have been produced. MVOv1.1 successfully performed part of a clinical assay, and results were comparable to those of commercial automation. Raspberry Pi 3 Model B (RPI3) single-board computers with Sense Hardware Attached on Top (HAT) and Raspberry Pi Camera Module V2 hardware were remotely accessed and evaluated for their suitability to qualify the latest MVOv1.2 platform. Sense HAT temperature, barometric pressure, and relative humidity sensors were stable in climate-controlled environments and are useful in identifying appropriate laboratory spaces for automation placement. The RPI3 with camera plus digital dial indicator logged axis travel experiments. RPI3 with camera and Sense HAT as a light source showed promise when used for photometric dispensing tests. Individual well standard curves were necessary for well-to-well light and path length compensations.

Adopted children's co-production and use of 'trove' (a digitally enhanced memory box) to better understand their care histories through precious objects.

https://www.ncbi.nlm.nih.gov/pubmed/29807440

This article presents an innovative project to develop and trial a prototype product called 'trove' to start to address challenges identified regarding current practice of life story work with children who

are looked after and adopted. trove is a digitally enhanced memory box that utilises raspberry pi (a small single board computer) and radio-frequency identification (RFID) technologies to enable children to record their memories and to attach these to their precious objects using an electronic tag: providing a safe 'container' for their mementoes and memories. Located in theories of narrative identity and object attachment and drawing on Brodinsky's concept of communicative openness, we describe the children's engagements in the design and report the results of a small trial of 10 troves with adopted children in England.

Real-Time Retinal Processing for High-Resolution Optogenetic Stimulation Device.

https://www.ncbi.nlm.nih.gov/pubmed/30441690

We present in this paper an image processing technique called Circular Distortion and Motion Compensation (CDMC) that can perform real-time retinal processing with geometric compensation for the ring structure arraignment in the retina for bipolar and ganglion cells. The system was running on an embedded platform of Raspberry Pi 3 and managed to achieve a respectable 12 frames per second on a 640×480 resolution live video capture from a webcam. The system emulates biological processes occurring in the retina such as motion estimation and temporal filtering while compensating for the radial shift of ganglion and bipolar cells in human retina. The proposed algorithm is efficient enough to run on mobile hardware with battery powered device in real-time and it is ideal for high resolution optogenetic stimulation devices that targets the retina.

WiFi-controlled portable atomic force microscope.

https://www.ncbi.nlm.nih.gov/pubmed/31120597

This article proposes to develop a WiFi-controlled portable atomic force microscope (AFM). The AFM consists of a horizontal probe, controlling circuits, digital to analog (D/A) and analog to digital (A/D) interfaces, a microcomputer (Raspberry Pi, RPi), and a laptop. The proposed AFM uses a pocket-size power supply to drive the controlling circuits, the D/A and A/D interfaces, as well as the RPi that constructs network hotspots and generates scanning signals. With special design and integration of the whole system, both of the AFM probe and electronic controlling system are portable. At a distance of 50â€‰m from the proposed AFM, experiments in the constant height mode and the constant force mode are conducted to evaluate its performance. The results show that this WiFi-controlled AFM has a maximum scan range of 3.6â€‰Ã—â€‰3.6 Î¼m2 with nanometer order resolution. Meanwhile, it achieves satisfactory image contrast, stability, and

repeatability. Compared with conventional AFMs, the AFM proposed in this paper no longer relies on commercial AC mains supply or high-voltage DC power supply, and realizes WiFi-controlled AFM scanning and imaging in 50â€‰m or farther without wire or network cable connection to a laptop or a desktop computer. Given credits to these features, WiFi-controlled AFMs are expected to own a wider range of application, especially in isolated environments, outdoor researches, or even fieldwork investigations.

A Self Assistive Device for Deaf & Blind People Using IOT : Kathu-Kann Thaan Thunai Eyanthiram.

https://www.ncbi.nlm.nih.gov/pubmed/30820679

This paper presents Google speech API based aid for deaf and blind people. The live streaming speech on the microphone is sent to Google API server which converts the speech signal into text and displaying onto a LCD screen and amplifies the speech via speaker. The aid will use Request procedure protocol to send the encoded Mp3 audio to Google API server where the speech signal is converted into suitable text and sent back to the Raspberry pi using repeated request protocol. This aid is designed to address issue with mild deafness and blind person. This will enable the deaf and blind persons to work effectively at home, office and any public places with ease. The aid works at low latency at good internet connectivity.

Effect of the PiAstra Benchtop Flash-Heating Pasteurizer on Immune Factors of Donor Human Milk.

https://www.ncbi.nlm.nih.gov/pubmed/29565633

PiAstra is a simulated flash-heat (FH) pasteurization temperature monitoring system designed using Raspberry Pi technology for the pasteurization of human milk. This study analyzed the effect of the PiAstra FH method on human milk immune components (immunoglobulin A [IgA] and lactoferrin activity).

Real-Time Human Physical Activity Recognition with Low Latency Prediction Feedback Using Raw IMU Data.

https://www.ncbi.nlm.nih.gov/pubmed/30440382

In the realm of Human Activity Recognition (HAR), supervised machine learning and deep learning

are commonly used. Their training is done using time and frequency features extracted from raw data (inertial and gyroscopic). Nevertheless, raw data are seldom employed. In this paper, a dataset of able-bodied participants is recorded using 3 custom wireless motion sensors providing embedded IMU and sEMG detection and processing and a base station (a Raspberry Pi 3) running a classification algorithm. A Support Vector Machine with Radius Basis Function Kernel (RBF-SVM) is augmented using Spherical Normalization to achieve a motion classification accuracy of 97.35% between 8 body motions. The proposed classifier allows for real-time prediction callback with low latency output.

Using Deep Learning and Low-Cost RGB and Thermal Cameras to Detect Pedestrians in Aerial Images Captured by Multirotor UAV.

https://www.ncbi.nlm.nih.gov/pubmed/30002290

The use of Unmanned Aerial Vehicles (UAV) has been increasing over the last few years in many sorts of applications due mainly to the decreasing cost of this technology. One can see the use of the UAV in several civilian applications such as surveillance and search and rescue. Automatic detection of pedestrians in aerial images is a challenging task. The computing vision system must deal with many sources of variability in the aerial images captured with the UAV, e.g., low-resolution images of pedestrians, images captured at distinct angles due to the degrees of freedom that a UAV can move, the camera platform possibly experiencing some instability while the UAV flies, among others. In this work, we created and evaluated different implementations of Pattern Recognition Systems (PRS) aiming at the automatic detection of pedestrians in aerial images captured with multirotor UAV. The main goal is to assess the feasibility and suitability of distinct PRS implementations running on top of low-cost computing platforms, e.g., single-board computers such as the Raspberry Pi or regular laptops without a GPU. For that, we used four machine learning techniques in the feature extraction and classification steps, namely Haar cascade, LBP cascade, HOG + SVM and Convolutional Neural Networks (CNN). In order to improve the system performance (especially the processing time) and also to decrease the rate of false alarms, we applied the Saliency Map (SM) and Thermal Image Processing (TIP) within the segmentation and detection steps of the PRS. The classification results show the CNN to be the best technique with 99.7% accuracy, followed by HOG + SVM with 92.3%. In situations of partial occlusion, the CNN showed 71.1% sensitivity, which can be considered a good result in comparison with the current state-of-the-art, since part of the original image data is missing. As demonstrated in the

experiments, by combining TIP with CNN, the PRS can process more than two frames per second (fps), whereas the PRS that combines TIP with HOG + SVM was able to process 100 fps. It is important to mention that our experiments show that a trade-off analysis must be performed during the design of a pedestrian detection PRS. The faster implementations lead to a decrease in the PRS accuracy. For instance, by using HOG + SVM with TIP, the PRS presented the best performance results, but the obtained accuracy was 35 percentage points lower than the CNN. The obtained results indicate that the best detection technique (i.e., the CNN) requires more computational resources to decrease the PRS computation time. Therefore, this work shows and discusses the pros/cons of each technique and trade-off situations, and hence, one can use such an analysis to improve and tailor the design of a PRS to detect pedestrians in aerial images.

Real-time implementation of Kalman filter to improve accuracy in the measurement of time of flight in an ultrasonic pulse-echo setup.

https://www.ncbi.nlm.nih.gov/pubmed/30831700

In this paper, we demonstrate a hardware implementation of Kalman filter to enhance accuracy in the measurements of time-of-flight in an ultrasonic pulse echo technique (operated at 10 MHz). Pulser-receivers and other respective circuit units are designed using off-the-shelf electronic components. The advanced reduced instruction-set computing machine processor based Raspberry Pi single board computer is used to implement the Kalman filter and control various processes. Additionally, a graphical user interface is designed using Qt software, under the Debian open source operating system. The software has capability to measure and display the time-of-flight and ultrasonic propagation velocity in a liquid under test. The designed system with the Kalman filter exhibited an extremely small error of about 0.01% in the time-of-flight measurements compared with other systems. The functionality of the developed approach to measure time of flight and thereby ultrasonic velocity with significant improvement has been discussed in this article. It was experimentally verified that by improving other parameters such as the separation between the transducer and the reflector and cell structure, significant improvement in the accuracy of ultrasonic velocity in the liquid under test is achieved.

Affordable remote monitoring of plant growth in facilities using Raspberry Pi computers.

https://www.ncbi.nlm.nih.gov/pubmed/31467803

Environmentally controlled facilities, such as growth chambers, are essential tools for experimental

research. Automated, low-cost, remote-monitoring hardware can greatly improve both reproducibility and maintenance.

A Robust Decision Support System for Wireless Healthcare Based on Hybrid Prediction Algorithm.

https://www.ncbi.nlm.nih.gov/pubmed/31065862

Analysis of healthcare data becomes a tedious task as large volume of unlabelled information is generated. In this article, an algorithm is proposed to reduce the complexity involved in analysis of healthcare data. The proposed algorithm predicts the health status of elderly from the data collected at health centres by utilizing PCA (principle component analysis) and SVM (support vector machine) algorithms. The performance of proposed algorithm is assessed by comparing it with well-known methods like quadratic Discriminant, linear Discriminant, logistic regression, KNN weighted and SVM medium Gaussian using F-measure. At that point, the pre-prepared information is subjected to the dimensionality decrease process by playing out the Feature Selection errand. So, chosen component analysis are investigated by the proposed work SVM-based enhanced recursive element determination, and its precision is assessed and contrasted with the other customary classifiers, for example, quadratic Discriminant, Linear Discriminant, Logistic Regression, KNN Weighted and SVM Medium Gaussian. Here, we built up a shrewd versatile information module for the remote procurement and transmission of EHR (Electronic Health Record) chronicles, together with an online watcher for showing the EHR datasets on a PC, advanced cell or tablet. So as to characterize the highlights required by clients, we demonstrated the elderly checking system in home and healing facility settings. Utilizing this data, we built up a portable information exchange module in light of a Raspberry Pi.

Design and Implementation of an Integrated IoT Blockchain Platform for Sensing Data Integrity.

https://www.ncbi.nlm.nih.gov/pubmed/31091799

With the rapid development of communication technologies, the Internet of Things (IoT) is getting out of its infancy, into full maturity, and tends to be developed in an explosively rapid way, with more and more data transmitted and processed. As a result, the ability to manage devices deployed worldwide has been given more and advanced requirements in practical application performances. Most existing IoT platforms are highly centralized architectures, which suffer from various technical

limitations, such as a cyber-attack and single point of failure. A new solution direction is essential to enhance data accessing, while regulating it with government mandates in privacy and security. In this paper, we propose an integrated IoT platform using blockchain technology to guarantee sensing data integrity. The aim of this platform is to afford the device owner a practical application that provides a comprehensive, immutable log and allows easy access to their devices deployed in different domains. It also provides characteristics of general IoT systems, allows for real-time monitoring, and control between the end user and device. The business logic of the application is defined by the smart contract, which contains rules and conditions. The proposed approach is backed by a proof of concept implementation in realistic IoT scenarios, utilizing Raspberry Pi devices and a permissioned network called Hyperledger Fabric. Lastly, a benchmark study using various performance metrics is made to highlight the significance of the proposed work. The analysis results indicate that the designed platform is suitable for the resource-constrained IoT architecture and is scalable to be extended in various IoT scenarios.

City Scale Particulate Matter Monitoring Using LoRaWAN Based Air Quality IoT Devices.

https://www.ncbi.nlm.nih.gov/pubmed/30626131

Air Quality (AQ) is a very topical issue for many cities and has a direct impact on citizen health. The AQ of a large UK city is being investigated using low-cost Particulate Matter (PM) sensors, and the results obtained by these sensors have been compared with government operated AQ stations. In the first pilot deployment, six AQ Internet of Things (IoT) devices have been designed and built, each with four different low-cost PM sensors, and they have been deployed at two locations within the city. These devices are equipped with LoRaWAN wireless network transceivers to test city scale Low-Power Wide Area Network (LPWAN) coverage. The study concludes that (i) the physical device developed can operate at a city scale; (ii) some low-cost PM sensors are viable for monitoring AQ and for detecting PM trends; (iii) LoRaWAN is suitable for city scale sensor coverage where connectivity is an issue. Based on the findings from this first pilot project, a larger LoRaWAN enabled AQ sensor network is being deployed across the city of Southampton in the UK.

Low-energy/pulse response and high-resolution-CMOS camera for spatiotemporal femtosecond laser pulses characterization @ 1.55 Î¼m.

https://www.ncbi.nlm.nih.gov/pubmed/31043009

In this work, we present a commercial CMOS (Complementary Metal Oxide Semiconductor)

Raspberry Pi camera implemented as a Near-Infrared detector for both spatial and temporal characterization of femtosecond pulses delivered from a femtosecond Erbium Doped Fiber laser (fs-EDFL) @ 1.55 Âµm, based on the Two Photon Absorption (TPA) process. The capacity of the device was assessed by measuring the spatial beam profile of the fs-EDFL and comparing the experimental results with the theoretical Fresnel diffraction pattern. We also demonstrate the potential of the CMOS Raspberry Pi camera as a wavefront sensor through its a nonlinear response in a Shack-Hartmann array and for the temporal characterization of the femtosecond pulses delivered from the fs-EDFL through TPA Intensity autocorrelation measurements. The direct pulse detection and measurement, through the nonlinear response with a CMOS, is proposed as a novel and affordable high-resolution and high-sensitivity alternative to costly detectors such as CCDs, wavefront sensors and beam profilers @ 1.55 Âµm. The measured fluence threshold, down to 17.5 ÂµJ/cm2, and pJ/pulse energy response represents the lowest reported values applied as a beam profiler and a TPA Shack-Hartmann wavefront sensor, to our knowledge.

A head mounted device stimulator for optogenetic retinal prosthesis.

https://www.ncbi.nlm.nih.gov/pubmed/30156188

Our main objective is to demonstrate that compact high radiance gallium nitride displays can be used with conventional virtual reality optics to stimulate an optogenetic retina. Hence, we aim to introduce a non-invasive approach to restore vision for people with conditions such as retinitis pigmentosa where there is a remaining viable communication link between the retina and the visual cortex.

Implanted Nanosensors in Marine Organisms for Physiological Biologging: Design, Feasibility, and Species Variability.

https://www.ncbi.nlm.nih.gov/pubmed/30525471

In recent decades, biologists have sought to tag animals with various sensors to study aspects of their behavior otherwise inaccessible from controlled laboratory experiments. Despite this, chemical information, both environmental and physiological, remains challenging to collect despite its tremendous potential to elucidate a wide range of animal behaviors. In this work, we explore the design, feasibility, and data collection constraints of implantable, near-infrared fluorescent nanosensors based on DNA-wrapped single-wall carbon nanotubes (SWNT) embedded within a biocompatible poly(ethylene glycol) diacrylate (PEGDA) hydrogel. These sensors are enabled by

Corona Phase Molecular Recognition (CoPhMoRe) to provide selective chemical detection for marine organism biologging. Riboflavin, a key nutrient in oxidative phosphorylation, is utilized as a model analyte in in vitro and ex vivo tissue measurements. Nine species of bony fish, sharks, eels, and turtles were utilized on site at OceanogrÃ fic in Valencia, Spain to investigate sensor design parameters, including implantation depth, sensor imaging and detection limits, fluence, and stability, as well as acute and long-term biocompatibility. Hydrogels were implanted subcutaneously and imaged using a customized, field-portable Raspberry Pi camera system. Hydrogels could be detected up to depths of 7 mm in the skin and muscle tissue of deceased teleost fish (Sparus aurata and Stenotomus chrysops) and a deceased catshark (Galeus melastomus). The effects of tissue heterogeneity on hydrogel delivery and fluorescence visibility were explored, with darker tissues masking hydrogel fluorescence. Hydrogels were implanted into a living eastern river cooter (Pseudemys concinna), a European eel (Anguilla anguilla), and a second species of catshark (Scyliorhinus stellaris). The animals displayed no observable changes in movement and feeding patterns. Imaging by high-resolution ultrasound indicated no changes in tissue structure in the eel and catshark. In the turtle, some tissue reaction was detected upon dissection and histopathology. Analysis of movement patterns in sarasa comet goldfish (Carassius auratus) indicated that the hydrogel implants did not affect swimming patterns. Taken together, these results indicate that this implantable form factor is a promising technique for biologging using aquatic vertebrates with further development. Future work will tune the sensor detection range to the physiological range of riboflavin, develop strategies to normalize sensor signal to account for the optical heterogeneity of animal tissues, and design a flexible, wearable device incorporating optoelectronic components that will enable sensor measurements in moving animals. This work advances the application of nanosensors to organisms beyond the commonly used rodent and zebrafish models and is an important step toward the physiological biologging of aquatic organisms.

A low-cost, open-source digital stripchart recorder for chromatographic detectors using a Raspberry Pi.

https://www.ncbi.nlm.nih.gov/pubmed/30975526

One of the most critical aspects of chromatographic analysis is effective data acquisition and processing. Typical approaches include software platforms designed for specific instruments or commercial data acquisition hardware boards, both of which require expensive licenses to use and operate. To increase the access and affordability of chromatographic data acquisition, especially for

systems in which software control has become obsolete or must be written in-house, an open-source digital stripchart recorder has been developed. This system is built upon a Raspberry Pi single-board computer and a plug-in printed circuit board with the necessary integrated circuits for data acquisition. Using an open-source software called Processing, a complete user interface to control the system was developed that enables the acquisition, filtering, and processing of chromatographic data. The system performs comparably to more expensive platforms, with calculated values for peak area, retention time, and plate count all within 3% of the values calculated by a widely used commercial chromatography data software package.

Real-Time Vehicle Roll Angle Estimation Based on Neural Networks in IoT Low-Cost Devices.

https://www.ncbi.nlm.nih.gov/pubmed/29986499

The high rate of vehicle-crash victims has a fatal economic and social impact in today’s societies. In particular, road crashes where heavy vehicles are involved cause more severe damage because they are prone to rollover. For this reason, many researches are focused on developing RSC Roll Stability Control (RSC) systems. Concerning the design of RSC systems with an adequate performance, it is mandatory to know the dynamics of the vehicle. The main problem arises from the lack of ability to directly capture several required dynamic vehicle variables, such as roll angle, from low-cost sensors. Previous studies demonstrate that low-cost sensors can provide data in real-time with the required precision and reliability. Even more, other research works indicate that neural networks are efficient mechanisms to estimate roll angle. Nevertheless, it is necessary to assess that the fusion of data coming from low-cost devices and estimations provided by neural networks can fulfill hard real-time processing constraints, achieving high level of accuracy during circulation of a vehicle in real situations. In order to address this issue, this study has two main goals: (1) Design and develop an IoT based architecture, integrating ANN in low cost kits with different hardware architectures in order to estimate under real-time constraints the vehicle roll angle. This architecture is able to work under high dynamic conditions, by following specific best practices and considerations during its design; (2) assess that the IoT architecture deployed in low-cost experimental kits achieve the hard real-time performance constraints estimating the roll angle with the required calculation accuracy. To fulfil these objectives, an experimental environment was set up, composed of a van with two set of low-cost kits, one including a Raspberry Pi 3 Model Band the other having an Intel Edison System on Chip linked to a SparkFun 9 Degrees of Freedom module. This experimental environment be tested in different maneuvers for comparison purposes. Neural

networks embedded in low-cost sensor kits provide roll angle estimations highly approximated to real values. Even more, Intel Edison and Raspberry Pi 3 Model B have enough computing capabilities to successfully run roll angle estimation based on neural networks to determine rollover risk situations, fulfilling real-time operation restrictions stated for this problem.

Full Impedance Cardiography measurement device using Raspberry PI3 and System-on-Chip biomedical Instrumentation Solutions.

https://www.ncbi.nlm.nih.gov/pubmed/29990025

Impedance Cardiography (ICG) is a non-invasive method for monitoring cardiac dynamics using Electrical Bioimpedance (EBI) measurements. Since its appearance more than 40 years ago, ICG has been used for assessing hemodynamic parameters. This paper present a measurement system based on two System on Chip (SoC) solutions and Raspberry PI, implementing both a full 3-lead ECG recorder and an impedance cardiographer, for educational and research development purposes. Raspberry PI is a platform supporting Do-It-Yourself project and education applications across the world. The development is part of Biosignal PI, an open hardware platform focusing in quick prototyping of physiological measurement instrumentation. The SoC used for sensing cardiac biopotential is the ADAS1000, and for the EBI measurement is the AD5933. The recording were wirelessly transmitted through Bluetooth to a PC, where the waveforms were displayed, and hemodynamic parameters such as heart rate, stroke volume, ejection time and cardiac output were extracted from the ICG and ECG recordings. These results show how Raspberry PI can be used for quick prototyping using relatively widely available and affordable components, for supporting developers in research and engineering education. The design and development documents, will be available on www.BiosignalPI.com, for open access under a Non Commercial-Share A like 4.0 International License.

Design, manufacture and deployment of a low-cost area radiation monitoring system using Raspberry Pi computers and open-source software.

https://www.ncbi.nlm.nih.gov/pubmed/30762221

Monitoring of background radiation levels in radiopharmaceutical laboratories is a key tool in minimising dose to workers. Retrofitting area monitoring systems in an existing laboratory can be disruptive and prohibitively expensive. We set out to develop a flexible low-cost area monitoring system utilising the power of inexpensive single board computers and open-source software. A

complete system has been developed which includes local and remote real-time display with local warning, dose rate logging and automated plotting and backup of results from over 20 individual monitors connected via wifi.

A Multimodal Adaptive Wireless Control Interface for People With Upper-Body Disabilities.

https://www.ncbi.nlm.nih.gov/pubmed/29877820

This paper describes a multimodal body-machine interface (BoMI) to help individuals with upper-limb disabilities using advanced assistive technologies, such as robotic arms. The proposed system uses a wearable and wireless body sensor network (WBSN) supporting up to six sensor nodes to measure the natural upper-body gesture of the users and translate it into control commands. Natural gesture of the head and upper-body parts, as well as muscular activity, are measured using inertial measurement units (IMUs) and surface electromyography (sEMG) using custom-designed multimodal wireless sensor nodes. An IMU sensing node is attached to a headset worn by the user. It has a size of 2.9 cm 2.9 cm, a maximum power consumption of 31 mW, and provides angular precision of 1. Multimodal patch sensor nodes, including both IMU and sEMG sensing modalities are placed over the user able-body parts to measure the motion and muscular activity. These nodes have a size of 2.5 cm 4.0 cm and a maximum power consumption of 11 mW. The proposed BoMI runs on a Raspberry Pi. It can adapt to several types of users through different control scenarios using the head and shoulder motion, as well as muscular activity, and provides a power autonomy of up to 24Â h. JACO, a 6-DoF assistive robotic arm, is used as a testbed to evaluate the performance of the proposed BoMI. Ten able-bodied subjects performed ADLs while operating the AT device, using the Test d'Ã‰valuation des Membres SupÃ©rieurs de Personnes Ã‚gÃ©es to evaluate and compare the proposed BoMI with the conventional joystick controller. It is shown that the users can perform all tasks with the proposed BoMI, almost as fast as with the joystick controller, with only 30% time overhead on average, while being potentially more accessible to the upper-body disabled who cannot use the conventional joystick controller. Tests show that control performance with the proposed BoMI improved by up to 17% on average, after three trials.

Marker-Based Multi-Sensor Fusion Indoor Localization System for Micro Air Vehicles.

https://www.ncbi.nlm.nih.gov/pubmed/29799441

A novel multi-sensor fusion indoor localization algorithm based on ArUco marker is designed in this paper. The proposed ArUco mapping algorithm can build and correct the map of markers online with

Grubbs criterion and K-mean clustering, which avoids the map distortion due to lack of correction. Based on the conception of multi-sensor information fusion, the federated Kalman filter is utilized to synthesize the multi-source information from markers, optical flow, ultrasonic and the inertial sensor, which can obtain a continuous localization result and effectively reduce the position drift due to the long-term loss of markers in pure marker localization. The proposed algorithm can be easily implemented in a hardware of one Raspberry Pi Zero and two STM32 micro controllers produced by STMicroelectronics (Geneva, Switzerland). Thus, a small-size and low-cost marker-based localization system is presented. The experimental results show that the speed estimation result of the proposed system is better than Px4flow, and it has the centimeter accuracy of mapping and positioning. The presented system not only gives satisfying localization precision, but also has the potential to expand other sensors (such as visual odometry, ultra wideband (UWB) beacon and lidar) to further improve the localization performance. The proposed system can be reliably employed in Micro Aerial Vehicle (MAV) visual localization and robotics control.

Real-time localization of the parathyroid gland in surgical field using Raspberry Pi during thyroidectomy: a preliminary report.

https://www.ncbi.nlm.nih.gov/pubmed/29984104

We created an auto-para viewer, an autofluorescence imaging device, to localize the parathyroid glands during thyroidectomy using an inexpensive Raspberry Pi. A special emission filter in the auto-para viewer was designed to pass 1/100 of visible light and nearly all infrared light longer than 808 nm. With this emission filter, we simultaneously acquired an autofluorescence image of the parathyroid and a visible light image of the surrounding surgical field. The auto-para viewer displayed four times brighter autofluorescence of the parathyroid glands compared to the background tissues without operating room light. Additionally, it showed two times brighter autofluorescence than the background tissues simultaneously showing the surgical field illuminated by the visible light from the operating room light. The NOIR camera, using the auto-para viewer, could reduce the camera's exposure time so the parathyroid glands to be viewed in real-time, which is expected to prevent unintentional damage to the parathyroid gland during thyroidectomy.

Wearable Sensors Integrated with Internet of Things for Advancing eHealth Care.

https://www.ncbi.nlm.nih.gov/pubmed/29882790

Health and sociological indicators alert that life expectancy is increasing, hence so are the years that

patients have to live with chronic diseases and co-morbidities. With the advancement in ICT, new tools and paradigms are been explored to provide effective and efficient health care. Telemedicine and health sensors stand as indispensable tools for promoting patient engagement, self-management of diseases and assist doctors to remotely follow up patients. In this paper, we evaluate a rapid prototyping solution for information merging based on five health sensors and two low-cost ubiquitous computing components: Arduino and Raspberry Pi. Our study, which is entirely described with the purpose of reproducibility, aimed to evaluate the extent to which portable technologies are capable of integrating wearable sensors by comparing two deployment scenarios: Raspberry Pi 3 and Personal Computer. The integration is implemented using a choreography engine to transmit data from sensors to a display unit using web services and a simple communication protocol with two modes of data retrieval. Performance of the two set-ups is compared by means of the latency in the wearable data transmission and data loss. PC has a delay of 0.051 Â± 0.0035 s (max = 0.2504 s), whereas the Raspberry Pi yields a delay of 0.0175 Â± 0.149 s (max = 0.294 s) for N = 300. Our analysis confirms that portable devices ($p << 0.01$) are suitable to support the transmission and analysis of biometric signals into scalable telemedicine systems.

COSMOS: Collaborative, Seamless and Adaptive Sentinel for the Internet of Things.

https://www.ncbi.nlm.nih.gov/pubmed/30934750

The Internet of Things (IoT) became established during the last decade as an emerging technology with considerable potentialities and applicability. Its paradigm of everything connected together penetrated the real world, with smart devices located in several daily appliances. Such intelligent objects are able to communicate autonomously through already existing network infrastructures, thus generating a more concrete integration between real world and computer-based systems. On the downside, the great benefit carried by the IoT paradigm in our life brings simultaneously severe security issues, since the information exchanged among the objects frequently remains unprotected from malicious attackers. The paper at hand proposes COSMOS (Collaborative, Seamless and Adaptive Sentinel for the Internet of Things), a novel sentinel to protect smart environments from cyber threats. Our sentinel shields the IoT devices using multiple defensive rings, resulting in a more accurate and robust protection. Additionally, we discuss the current deployment of the sentinel on a commodity device (i.e., Raspberry Pi). Exhaustive experiments are conducted on the sentinel, demonstrating that it performs meticulously even in heavily stressing conditions. Each defensive

layer is tested, reaching a remarkable performance, thus proving the applicability of COSMOS in a distributed and dynamic scenario such as IoT. With the aim of easing the enjoyment of the proposed sentinel, we further developed a friendly and ease-to-use COSMOS App, so that end-users can manage sentinel(s) directly using their own devices (e.g., smartphone).

Real-Time Multi-Scale Face Detector on Embedded Devices.

https://www.ncbi.nlm.nih.gov/pubmed/31075955

Face detection is the basic step in video face analysis and has been studied for many years. However, achieving real-time performance on computation-resource-limited embedded devices still remains an open challenge. To address this problem, in this paper we propose a face detector, EagleEye, which shows a good trade-off between high accuracy and fast speed on the popular embedded device with low computation power (e.g., the Raspberry Pi 3b+). The EagleEye is designed to have low floating-point operations per second (FLOPS) as well as enough capacity, and its accuracy is further improved without adding too much FLOPS. Specifically, we design five strategies for building efficient face detectors with a good balance of accuracy and running speed. The first two strategies help to build a detector with low computation complexity and enough capacity. We use convolution factorization to change traditional convolutions into more sparse depth-wise convolutions to save computation costs and we use successive downsampling convolutions at the beginning of the face detection network. The latter three strategies significantly improve the accuracy of the light-weight detector without adding too much computation costs. We design an efficient context module to utilize context information to benefit the face detection. We also adopt information preserving activation function to increase the network capacity. Finally, we use focal loss to further improve the accuracy by handling the class imbalance problem better. Experiments show that the EagleEye outperforms the other face detectors with the same order of computation costs, on both runtime efficiency and accuracy.

Physiological Sensing Now Open to the World: New Resources Are Allowing Us to Learn, Experiment, and Create Imaginative Solutions for Biomedical Applications.

https://www.ncbi.nlm.nih.gov/pubmed/29553933

With the advent of low-cost computing platforms, such as Arduino (http://www.arduino.cc) and Raspberry Pi (http://www.raspberrypi.org), it has become clear that lowering the cost barrier and shortening the learning curve, with the backing of a motivated community, would play a

transformational role in the way people learn, experiment, and create imaginative solutions to outstanding problems that can benefit from embedded systems.

End-to-End Sample Tracking in the Laboratory Using a Custom Internet of Things Device.

https://www.ncbi.nlm.nih.gov/pubmed/30016131

We describe a custom Internet of Things (IoT) device used for tracking barcoded containers end to end in a high-throughput analysis and purification laboratory. Our IoT device fills an important gap that previously prevented us from fully tracking barcoded sample containers through manual steps in a multistep workflow, such as when samples are "parked" for temporary storage, or when using instrumentation not otherwise equipped with barcode scanners, a common occurrence found with specific centrifugal evaporation instruments. The custom device reads container barcodes and sends a small amount of data to our back-end data systems. Once data have been received and processed, users are alerted to any system responses via aural and visual feedback. Components of the IoT system include a low-cost headless IoT computer, a barcode reader, and a multicolor LED strip. We believe that the model for our device will facilitate simple and rapid deployment of IoT to the broader laboratory community. All source code and device configurations will be released into the public domain and made freely available.

Design, implementation, and operation of a rapid, robust named entity recognition web service.

https://www.ncbi.nlm.nih.gov/pubmed/30850898

Most BioCreative tasks to date have focused on assessing the quality of text-mining annotations in terms of precision and recall. Interoperability, speed, and stability are, however, other important factors to consider for practical applications of text mining. For about a decade, we have run named entity recognition (NER) web services, which are designed to be efficient, implemented using a multi-threaded queueing system to robustly handle many simultaneous requests, and hosted at a supercomputer facility. To participate in this new task, we extended the existing NER tagging service with support for the BeCalm API. The tagger suffered no downtime during the challenge and, as in earlier tests, proved to be highly efficient, consistently processing requests of 5000 abstracts in less than half a minute. In fact, the majority of this time was spent not on the NER task but rather on retrieving the document texts from the challenge servers. The latter was found to be the main bottleneck even when hosting a copy of the tagging service on a Raspberry Pi 3, showing that local

document storage or caching would be desirable features to include in future revisions of the API standard.

Lightweight Driver Monitoring System Based on Multi-Task Mobilenets.

https://www.ncbi.nlm.nih.gov/pubmed/31330770

Research on driver status recognition has been actively conducted to reduce fatal crashes caused by the driver's distraction and drowsiness. As in many other research areas, deep-learning-based algorithms are showing excellent performance for driver status recognition. However, despite decades of research in the driver status recognition area, the visual image-based driver monitoring system has not been widely used in the automobile industry. This is because the system requires high-performance processors, as well as has a hierarchical structure in which each procedure is affected by an inaccuracy from the previous procedure. To avoid using a hierarchical structure, we propose a method using Mobilenets without the functions of face detection and tracking and show this method is enabled to recognize facial behaviors that indicate the driver's distraction. However, frames per second processed by Mobilenets with a Raspberry pi, one of the single-board computers, is not enough to recognize the driver status. To alleviate this problem, we propose a lightweight driver monitoring system using a resource sharing device in a vehicle (e.g., a driver's mobile phone). The proposed system is based on Multi-Task Mobilenets (MT-Mobilenets), which consists of the Mobilenets' base and multi-task classifier. The three Softmax regressions of the multi-task classifier help one Mobilenets base recognize facial behaviors related to the driver status, such as distraction, fatigue, and drowsiness. The proposed system based on MT-Mobilenets improved the accuracy of the driver status recognition with Raspberry Pi by using one additional device.

Copigmentation effects of phenolics on color enhancement and stability of blackberry wine residue anthocyanins: Chromaticity, kinetics and structural simulation.

https://www.ncbi.nlm.nih.gov/pubmed/30724200

To expound the copigmentation effects of phenolics on blackberry wine residue anthocyanins (BWRA), the color and stability of BWRA with storage, thermal, light and oxidation treatments were evaluated by chromaticity, kinetics and structural simulation analysis. Results indicated that phenolic acids showed preferable copigmetation on BWRA solutions with the enhanced color, thermostability at 50-70â€¯Â°C and light stability, whereas the degradation was accelerated at 90â€¯Â°C.

Meanwhile, flavonoids promoted the oxidation stability of BWRA. Of all the phenolic acids, ferulic acid presented the best copigmentation effect, and among the flavonoids rutin was the most active. Structural simulation suggested rutin and ferulic acid had the largest volume, potential energy (164.8 and 32.8â€¯kcal/mol), minimized energy (39.2 and 11.3â€¯kal/mol) and van der Waals energy (81.6 and 28.1â€¯kcal/mol), respectively, which were favorable to the stabilization of the flavylium ion. The hydrogen bonding, Ï€-Ï€ stacking and solvent effects were together involved in the copigmentation mechanism.

Thermal Imaging Metrology with a Smartphone Sensor.

https://www.ncbi.nlm.nih.gov/pubmed/29986406

Thermal imaging cameras are expensive, particularly those designed for measuring high temperature objects with low measurement uncertainty. A wide range of research and industrial applications would benefit from lower cost temperature imaging sensors with improved metrology. To address this problem, we present the first ever quantification methodology for the temperature measurement performance of an ultra-low cost thermal imaging system based on a smartphone sensor. The camera was formed from a back illuminated silicon Complementary Metal Oxide Semiconductor (CMOS) sensor, developed for the smartphone camera market. It was packaged for use with a Raspberry Pi computer. We designed and fitted a custom-made triplet lens assembly. The system performance was characterised with a range of state-of-the-art techniques and metrics: establishing a temperature resolution of below 10 °C in the range 600â•»1000 °C. Furthermore, the scene dependent aspects of combined uncertainty were considered. The minimum angular subtense for which an accurate thermal measurement could be made was determined to be 1.35°, which corresponds to a 23 mm bar at a distance of 1 m, or 45:1 field-of-view in radiation thermometer nomenclature.

A Sensor Network Approach for Violence Detection in Smart Cities Using Deep Learning.

https://www.ncbi.nlm.nih.gov/pubmed/30965646

Citizen safety in modern urban environments is an important aspect of life quality. Implementation of a smart city approach to video surveillance depends heavily on the capability of gathering and processing huge amounts of live urban data. Analyzing data from high bandwidth surveillance video streams provided by large size distributed sensor networks is particularly challenging. We propose here an efficient method for automatic violent behavior detection designed for video sensor

networks. Known solutions to real-time violence detection are not suitable for implementation in a resource-constrained environment due to the high processing power requirements. Our algorithm achieves real-time processing on a Raspberry PI-embedded architecture. To ensure separation of temporal and spatial information processing we employ a computationally effective cascaded approach. It consists of a deep neural network followed by a time domain classifier. In contrast with current approaches, the deep neural network input is fed exclusively with motion vector features extracted directly from the MPEG encoded video stream. As proven by results, we achieve state-of-the-art performance, while running on a low computational resources embedded architecture.

On-Board Real-Time Trajectory Planning for Fixed Wing Unmanned Aerial Vehicles in Extreme Environments.

https://www.ncbi.nlm.nih.gov/pubmed/31546639

A team from the University of Bristol have developed a method of operating fixed wing Unmanned Aerial Vehicles (UAVs) at long-range and high-altitude over VolcÃ¡n de Fuego in Guatemala for the purposes of volcanic monitoring and ash-sampling. Conventionally, the mission plans must be carefully designed prior to flight, to cope with altitude gains in excess of 3000 m, reaching 9 km from the ground control station and 4500 m above mean sea level. This means the climb route cannot be modified mid-flight. At these scales, atmospheric conditions change over the course of a flight and so a real-time trajectory planner (RTTP) is desirable, calculating a route on-board the aircraft. This paper presents an RTTP based around a genetic algorithm optimisation running on a Raspberry Pi 3 B+, the first of its kind to be flown on-board a UAV. Four flights are presented, each having calculated a new and valid trajectory on-board, from the ground control station to the summit region of VolcaÅ„ de Fuego. The RTTP flights are shown to have approximately equivalent efficiency characteristics to conventionally planned missions. This technology is promising for the future of long-range UAV operations and further development is likely to see significant energy and efficiency savings.

Wireless Sensor Networks Composed of Standard Microcomputers and Smartphones for Applications in Structural Health Monitoring.

https://www.ncbi.nlm.nih.gov/pubmed/31058871

Wireless sensor networks have attracted great attention for applications in structural health

monitoring due to their ease of use, flexibility of deployment, and cost-effectiveness. This paper presents a software framework for WiFi-based wireless sensor networks composed of low-cost mass market single-board computers. A number of specific system-level software components were developed to enable robust data acquisition, data processing, sensor network communication, and timing with a focus on structural health monitoring (SHM) applications. The framework was validated on Raspberry Pi computers, and its performance was studied in detail. The paper presents several characteristics of the measurement quality such as sampling accuracy and time synchronization and discusses the specific limitations of the system. The implementation includes a complementary smartphone application that is utilized for data acquisition, visualization, and analysis. A prototypical implementation further demonstrates the feasibility of integrating smartphones as data acquisition nodes into the network, utilizing their internal sensors. The measurement system was employed in several monitoring campaigns, three of which are documented in detail. The suitability of the system is evaluated based on comparisons of target quantities with reference measurements. The results indicate that the presented system can robustly achieve a measurement performance commensurate with that required in many typical SHM tasks such as modal identification. As such, it represents a cost-effective alternative to more traditional monitoring solutions.

Design of Low-Cost Vehicle Roll Angle Estimator Based on Kalman Filters and an Iot Architecture.

https://www.ncbi.nlm.nih.gov/pubmed/29865271

In recent years, there have been many advances in vehicle technologies based on the efficient use of real-time data provided by embedded sensors. Some of these technologies can help you avoid or reduce the severity of a crash such as the Roll Stability Control (RSC) systems for commercial vehicles. In RSC, several critical variables to consider such as sideslip or roll angle can only be directly measured using expensive equipment. These kind of devices would increase the price of commercial vehicles. Nevertheless, sideslip or roll angle or values can be estimated using MEMS sensors in combination with data fusion algorithms. The objectives stated for this research work consist of integrating roll angle estimators based on Linear and Unscented Kalman filters to evaluate the precision of the results obtained and determining the fulfillment of the hard real-time processing constraints to embed this kind of estimators in IoT architectures based on low-cost equipment able to be deployed in commercial vehicles. An experimental testbed composed of a van with two sets of low-cost kits was set up, the first one including a Raspberry Pi 3 Model B, and the other having an

Intel Edison System on Chip. This experimental environment was tested under different conditions for comparison. The results obtained from low-cost experimental kits, based on IoT architectures and including estimators based on Kalman filters, provide accurate roll angle estimation. Also, these results show that the processing time to get the data and execute the estimations based on Kalman Filters fulfill hard real time constraints.

Nesting box imager: Contact-free, real-time measurement of activity, surface body temperature, and respiratory rate applied to hibernating mouse models.

https://www.ncbi.nlm.nih.gov/pubmed/31339883

Noncontact methods to measure animal activity and physiology are necessary to monitor undisturbed states such as hibernation. Although some noncontact measurement systems are commercially available, they are often incompatible with realistic habitats, which feature freely moving animals in small, cluttered environments. A growing market of single-board computers, microcontrollers, and inexpensive sensors has made it possible to assemble bespoke integrated sensor systems at significantly lower price points. Herein, we describe a custom-built nesting box imager (NBI) that uses a single-board computer (Raspberry Pi) with a passive infrared (IR) motion sensor, silicon charge-coupled device (CCD), and IR camera CCD to monitor the activity, surface body temperature, and respiratory rate of the meadow jumping mouse during hibernation cycles. The data are logged up to 12 samples per minute and postprocessed using custom Matlab scripts. The entire unit can be built at a price point below US$400, which will be drastically reduced as IR (thermal) arrays are integrated into more consumer electronics and become less expensive.

Low-cost, sub-micron resolution, wide-field computational microscopy using opensource hardware.

https://www.ncbi.nlm.nih.gov/pubmed/31092867

The revolution in low-cost consumer photography and computation provides fertile opportunity for a disruptive reduction in the cost of biomedical imaging. Conventional approaches to low-cost microscopy are fundamentally restricted, however, to modest field of view (FOV) and/or resolution. We report a low-cost microscopy technique, implemented with a Raspberry Pi single-board computer and color camera combined with Fourier ptychography (FP), to computationally construct 25-megapixel images with sub-micron resolution. New image-construction techniques were developed to enable the use of the low-cost Bayer color sensor, to compensate for the highly

aberrated re-used camera lens and to compensate for misalignments associated with the 3D-printed microscope structure. This high ratio of performance to cost is of particular interest to high-throughput microscopy applications, ranging from drug discovery and digital pathology to health screening in low-income countries. 3D models and assembly instructions of our microscope are made available for open source use.

Utilization of Open Source Technology to Create Cost-Effective Microscope Camera Systems for Teaching.

https://www.ncbi.nlm.nih.gov/pubmed/29910968

Open source technologies and mobile innovations have radically changed the way people interact with technology. These innovations and advancements have been used across various disciplines and already have a significant impact. Microscopy, with focus on visually appealing contrasting colors for better appreciation of morphology, forms the core of the disciplines such as Pathology, microbiology, and anatomy. Here, learning happens with the aid of multi-head microscopes and digital camera systems for teaching larger groups and in organizing interactive sessions for students or faculty of other departments.

Microfluidic Point-of-Care Ecarin-Based Clotting and Chromogenic Assays for Monitoring Direct Thrombin Inhibitors.

https://www.ncbi.nlm.nih.gov/pubmed/30936586

Direct thrombin inhibitors (DTIs), such as bivalirudin and dabigatran, have maintained steady inpatient and outpatient use as substitutes for heparin and warfarin, respectively, because of their high bioavailability and relatively safe "on-therapy" range. Current clinical methods lack the capacity to directly quantify plasma DTI concentrations across wide ranges. At present, the gold standard is the ecarin clotting time (ECT), where ecarin maximizes thrombin activity and clotting time is evaluated to assess DTIs' anticoagulation capability. This work focused on the development of a microfluidic paper analytic device (ÂµPAD) that can quantify the extent of anticoagulation as well as DTI concentration within a patient's whole blood sample. Capillary action propels a small blood sample to flow through the nitrocellulose paper channels. Digital images of whole blood migration are then captured by our self-coded Raspberry Pi and/or the Samsung Galaxy S8 smartphone camera. Both the flow length and the blue absorbance from the plasma front on the Î¼PAD were measured, allowing simultaneous, dual assays: ecarin clotting test (ECT) and ecarin chromogenic

assay (ECA). Statistically significant ($p < .05$) changes in flow and absorbance were observed within our translational research study. Currently, there are no quantitative, commercially available point-of-care tests for the ECT and ECA within the United States. Both the ECT and ECA assays could be instrumental to differentiate between supratherapeutic and subtherapeutic incidents during bridging anticoagulant therapy and limit the unwarranted use of reversal agents.

Integrating field-based heat tents and cyber-physical system technology to phenotype high night-time temperature impact on winter wheat.

https://www.ncbi.nlm.nih.gov/pubmed/31044000

Many agronomic traits have been bred into modern wheat varieties, but wheat (Triticum aestivum L.) continues to be vulnerable to heat stress, with high night-time temperature (HNT) stress shown to have large negative impact on yield and quality. Global mean temperature during the day is consistently warming with the minimum night temperature increasing at a much quicker pace. Currently, there is no system or method that allows crop scientists to impose HNT stress at key developmental stages on wheat or crops in general under field conditions, involving diverse genotypes and maintaining a dynamic temperature differential within the tents compared to the outside.

Evaluation of Strategies for the Development of Efficient Code for Raspberry Pi Devices.

https://www.ncbi.nlm.nih.gov/pubmed/30469380

The Internet of Things (IoT) is faced with challenges that require green solutions and energy-efficient paradigms. Architectures (such as ARM) have evolved significantly in recent years, with improvements to processor efficiency, essential for always-on devices, as a focal point. However, as far as software is concerned, few approaches analyse the advantages of writing efficient code when programming IoT devices. Therefore, this proposal aims to improve source code optimization to achieve better execution times. In addition, the importance of various techniques for writing efficient code for Raspberry Pi devices is analysed, with the objective of increasing execution speed. A complete set of tests have been developed exclusively for analysing and measuring the improvements achieved when applying each of these techniques. This will raise awareness of the significant impact the recommended techniques can have.

Smart Cupboard for Assessing Memory in Home Environment.

https://www.ncbi.nlm.nih.gov/pubmed/31167485

Sensor systems for the Internet of Things (IoT) make it possible to continuously monitor people, gathering information without any extra effort from them. Thus, the IoT can be very helpful in the context of early disease detection, which can improve peoples' quality of life by applying the right treatment and measures at an early stage. This paper presents a new use of IoT sensor systems-we present a novel three-door smart cupboard that can measure the memory of a user, aiming at detecting potential memory losses. The smart cupboard has three sensors connected to a Raspberry Pi, whose aim is to detect which doors are opened. Inside of the Raspberry Pi, a Python script detects the openings of the doors, and classifies the events between attempts of finding something without success and the events of actually finding it, in order to measure the user's memory concerning the objects' locations (among the three compartments of the smart cupboard). The smart cupboard was assessed with 23 different users in a controlled environment. This smart cupboard was powered by an external battery. The memory assessments of the smart cupboard were compared with a validated test of memory assessment about face-name associations and a self-reported test about self-perceived memory. We found a significant correlation between the smart cupboard results and both memory measurement methods. Thus, we conclude that the proposed novel smart cupboard successfully measured memory.

Robust IoT-based nursing-care support system with smart bio-objects.

https://www.ncbi.nlm.nih.gov/pubmed/30396339

The significant advancement in the mobile sensing technologies has brought great interests on application development for the Internet-of-Things (IoT). With the advantages of contactlessness data retrieval and efficient data processing of intelligent IoT-based objects, versatile innovative types of on-demand medical relevant services have promptly been developed and deployed. Critical characteristics involved within the data processing and operation must thoroughly be considered. To achieve the efficiency of data retrieval and the robustness of communications among IoT-based objects, sturdy security primitives are required to preserve data confidentiality and entity authentication.

A Vision-Based Counting and Recognition System for Flying Insects in Intelligent Agriculture.

https://www.ncbi.nlm.nih.gov/pubmed/29747429

Rapid and accurate counting and recognition of flying insects are of great importance, especially for pest control. Traditional manual identification and counting of flying insects is labor intensive and inefficient. In this study, a vision-based counting and classification system for flying insects is designed and implemented. The system is constructed as follows: firstly, a yellow sticky trap is installed in the surveillance area to trap flying insects and a camera is set up to collect real-time images. Then the detection and coarse counting method based on You Only Look Once (YOLO) object detection, the classification method and fine counting based on Support Vector Machines (SVM) using global features are designed. Finally, the insect counting and recognition system is implemented on Raspberry PI. Six species of flying insects including bee, fly, mosquito, moth, chafer and fruit fly are selected to assess the effectiveness of the system. Compared with the conventional methods, the test results show promising performance. The average counting accuracy is 92.50% and average classifying accuracy is 90.18% on Raspberry PI. The proposed system is easy-to-use and provides efficient and accurate recognition data, therefore, it can be used for intelligent agriculture applications.

PhyloPi: An affordable, purpose built phylogenetic pipeline for the HIV drug resistance testing facility.

https://www.ncbi.nlm.nih.gov/pubmed/30835760

Phylogenetic analysis plays a crucial role in quality control in the HIV drug resistance testing laboratory. If previous patient sequence data is available sample swaps can be detected and investigated. As Antiretroviral treatment coverage is increasing in many developing countries, so is the need for HIV drug resistance testing. In countries with multiple languages, transcription errors are easily made with patient identifiers. Here a self-contained blastn integrated phylogenetic pipeline can be especially useful. Even though our pipeline can run on any unix based system, a Raspberry Pi 3 is used here as a very affordable and integrated solution.

An Emergency Response System: Construction, Validation, and Experiments for Disaster Management in a Vehicular Environment.

https://www.ncbi.nlm.nih.gov/pubmed/30866451

Natural disasters and catastrophes not only cost the loss of human lives, but adversely affect the progress toward sustainable development of the country. As soon as disaster strikes, the first and foremost challenge for the concerned authorities is to make an expeditious response. Consequently,

they need to be highly-organized, properly-trained, and sufficiently-equipped to effectively respond and limit the destructive effects of a disaster. In such circumstances, communication plays a vital role, whereby the consequences of tasks assigned to the workers for rescue and relief services may be streamlined by relaying necessary information among themselves. Moreover, most of the infrastructure is either severely damaged or completely destroyed in post-disaster scenarios; therefore, a Vehicular Ad Hoc Network (VANET) is used to carry out the rescue operation, as it does not require any pre-existing infrastructure. In this context, the current work proposes and validates an effective way to relay the crucial information through the development of an application and the deployment of an experimental TestBed in a vehicular environment. The TestBed may able to provide a way to design and validate the algorithms. It provides a number of vehicles with onboard units embedded with a credit-card-size microcomputer called Raspberry Pi and a Global Positioning System (GPS) module. Additionally, it dispatches one of the pre-defined codes of emergency messages based on the level of urgency through multiple hops to a central control room. Depending on the message code received from a client, the server takes appropriate action. Furthermore, the solution also provides a graphical interface that is easy to interpret and to understand at the control room to visualize the rescue operation on the fly.

An IoT Solution for Online Monitoring of Anesthetics in Human Serum Based on an Integrated Fluidic Bioelectronic System.

https://www.ncbi.nlm.nih.gov/pubmed/30072339

In this paper, we present the design, the implementation and the validation of a novel Internet of Things (IoT) drug monitoring system for the online continuous and simultaneous detection of two main anesthetics, e.g., propofol and paracetamol, in undiluted human serum. The described full system consists of a custom-built electronic Raspberry Pi (RPi) based Printed Circuit Board (PCB) that drives and reads out the signal from an electrochemical sensing platform integrated into a fluidic system. Thanks to the Polydimethylsiloxane (PDMS) fluidic device, the analyzed sample is automatically fluxed on the sensing site. The IoT network is supported by a Cloud system, which allows the doctor to control and share all the patient's data through a dedicated Android application and a smart watch. The validation closes with the first ever demonstration that our system successfully works for the simultaneous monitoring of propofol and paracetamol in undiluted human serum by measuring the concentration trends of these two drugs in fluxing conditions over time.

From Lab on a Chip to Point of Care Devices: The Role of Open Source Microcontrollers.

https://www.ncbi.nlm.nih.gov/pubmed/30424336

Microcontrollers are programmable, integrated circuit chips. In the last two decades, their applications to industrial instruments, vehicles, and household appliances have reached the extent that microcontrollers are now the number-one selling electronic chip of all kinds. Simultaneously, the field of lab-on-a-chip research and technology has seen major technological leaps towards sample handling, sample preparation, and sensing for use in molecular diagnostic devices. Yet, the transformation from a laboratory based lab-on-a-chip technology to actual point-of-care device products has largely been limited to a fraction of the foreseen potential. We believe that increased knowledge of the vast possibilities that becomes available with open source microcontrollers, especially when embedded in easy-to-use development environments, such as the Arduino or Raspberry Pi, could potentially solve and even bridge the gap between lab-on-a-chip technology and real-life point of care applications. The profuse availability and extraordinary capabilities of microcontrollers, namely within computation, communication, and networking, combined with easy-to-use development environments, as well as a very active and fast moving community of makers, who are eager to share their knowledge, could potentially be the difference between a dreadful "chip-in-a-lab"-situation, and the next successful start-up. Here follows a brief insight into how open source microcontrollers could potentially have a transformative effect on the field of lab-on-a-chip research and technology. Details in some specific areas of application are briefly treated before addressing challenges and future perspectives.

Design and Implementation of a Walking Stick Aid for Visually Challenged People.

https://www.ncbi.nlm.nih.gov/pubmed/30609745

Visually challenged people (VCPs) face many difficulties in their routine life. Usually, in many cases, they need to depend upon others, which makes them unconfident in an unfamiliar environment. Thus, in this paper, we present an aid that helps in detecting obstacles and water puddles in their way. This system comprises a walking stick and Android-based applications (APPs). The walking stick is embedded with Raspberry Pi and programmable interface controller (PIC) as a control kernel, sensors, a global position system (GPS) module, and alert-providing components. Sensors help to detect obstacles, and the VCP is informed through vibrations or a buzzer according to the obstacle detected. The GPS module receives the coordinates of the VCP's location, and the location can be tracked by parents using an APP. Another important APP is used, called an emergency

APP, by which the VCP can communicate with parents or friends immediately by just shaking his/her cell phone or pushing the power button four times in 5 s in panic situations. We used fewer components to make the device simple, lighter, and cozy with very good features. This device will help VCPs to live an independent life up to some extent (with security), which ultimately will increase their confidence level in an unknown environment.

Barrier Access Control Using Sensors Platform and Vehicle License Plate Characters Recognition.

https://www.ncbi.nlm.nih.gov/pubmed/31323933

The paper proposes a sensors platform to control a barrier that is installed for vehicles entrance. This platform is automatized by image-based license plate recognition of the vehicle. However, in situations where standardized license plates are not used, such image-based recognition becomes non-trivial and challenging due to the variations in license plate background, fonts and deformations. The proposed method first detects the approaching vehicle via ultrasonic sensors and, at the same time, captures its image via a camera installed along with the barrier. From this image, the license plate is automatically extracted and further processed to segment the license plate characters. Finally, these characters are recognized with the help of a standard optical character recognition (OCR) pipeline. The evaluation of the proposed system shows an accuracy of 98% for license plates extraction, 96% for character segmentation and 93% for character recognition.

Proposition and Real-Time Implementation of an Energy-Aware Routing Protocol for a Software Defined Wireless Sensor Network.

https://www.ncbi.nlm.nih.gov/pubmed/31216728

A wireless sensor network (WSN) has achieved significant importance in tracking different physical or environmental conditions using wireless sensor nodes. Such types of networks are used in various applications including smart cities, smart building, military target tracking and surveillance, natural disaster relief, and smart homes. However, the limited power capacity of sensor nodes is considered a major issue that hampers the performance of a WSN. A plethora of research has been conducted to reduce the energy consumption of sensor nodes in traditional WSN, however the limited functional capability of such networks is the main constraint in designing sophisticated and dynamic solutions. Given this, software defined networking (SDN) has revolutionized traditional networks by providing a programmable and flexible framework. Therefore, SDN concepts can be

utilized in designing energy-efficient WSN solutions. In this paper, we exploit SDN capabilities to conserve energy consumption in a traditional WSN. To achieve this, an energy-aware multihop routing protocol (named EASDN) is proposed for software defined wireless sensor network (SDWSN). The proposed protocol is evaluated in a real environment. For this purpose, a test bed is developed using Raspberry Pi. The experimental results show that the proposed algorithm exhibits promising results in terms of network lifetime, average energy consumption, the packet delivery ratio, and average delay in comparison to an existing energy efficient routing protocol for SDWSN and a traditional source routing algorithm.

Low-Cost and Data Anonymised City Traffic Flow Data Collection to Support Intelligent Traffic System.

https://www.ncbi.nlm.nih.gov/pubmed/30654549

There are many methods of collecting traffic flow data, especially using smart phone apps. However, few current solutions balance the need for collecting full route data whilst respecting privacy and remaining low-cost. This project looks into the creation of a wireless sensor network (WSN) that can balance these requirements in an attempt to negate some of the concerns that come with this type of technology. Our proposed system only collects location data within a defined city area. This data is collected with a randomized identifier, which limits repeated identification of the source vehicle and its occupants. Data collected is shared between vehicle and roadside base stations when the two are in range. To deal with the fluid nature of this scenario, a purposely designed Media Access Control (MAC) protocol was designed and implemented using the beacon-slotted ALOHA (Advocates of Linux Open-source Hawaii Association) mechanism.

Obstacle detection for lake-deployed autonomous surface vehicles using RGB imagery.

https://www.ncbi.nlm.nih.gov/pubmed/30346984

We describe and test an obstacle-detection system for small, lake-deployed autonomous surface vehicles (ASVs) that relies on a low-cost, consumer-grade camera and runs on a single-board computer. A key feature of lakes that must be accounted for is the frequent presence of the shoreline in images as well as the land-sky boundary. These particularities, along with variable weather conditions, result in a wide range of scene variations, including the possible presence of glint. The implemented algorithm is based on two main steps. First, possible obstacles are detected using an innovative gradient-based image processing algorithm developed especially for a camera

with a low viewing angle to the water (i.e., the situation for a small ASV). Then, true and false positives are differentiated using correlation-based multi-frame analysis. The algorithm was tested extensively on a small ASV deployed in Lake Geneva. Under operational conditions, the algorithm processed 640Ã—480-pixel images from a Raspberry Pi Camera at about 3-4 Hz on a Raspberry Pi 3 Model B computer. The present algorithm demonstrates that single-board computers can be used for effective and low-cost obstacle detection systems for ASVs operating in variable lake conditions.

Technology review: prototyping platforms for monitoring ambient conditions.

https://www.ncbi.nlm.nih.gov/pubmed/29737193

The monitoring of ambient conditions in indoor spaces is very essential owing to the amount of time spent indoors. Specifically, the monitoring of air quality is significant because contaminated air affects the health, comfort and productivity of occupants. This research work presents a technology review of prototyping platforms for monitoring ambient conditions in indoor spaces. It involves the research on sensors (for CO2, air quality and ambient conditions), IoT platforms, and novel and commercial prototyping platforms. The ultimate objective of this review is to enable the easy identification, selection and utilisation of the technologies best suited for monitoring ambient conditions in indoor spaces. Following the review, it is recommended to use metal oxide sensors, optical sensors and electrochemical sensors for IAQ monitoring (including NDIR sensors for CO2 monitoring), Raspberry Pi for data processing, ZigBee and Wi-Fi for data communication, and ThingSpeak IoT platform for data storage, analysis and visualisation.

Development of a Laparoscopic Box Trainer Based on Open Source Hardware and Artificial Intelligence for Objective Assessment of Surgical Psychomotor Skills.

https://www.ncbi.nlm.nih.gov/pubmed/29809097

A trainer for online laparoscopic surgical skills assessment based on the performance of experts and nonexperts is presented. The system uses computer vision, augmented reality, and artificial intelligence algorithms, implemented into a Raspberry Pi board with Python programming language.

IoT in Radiology: Using Raspberry Pi to Automatically Log Telephone Calls in the Reading Room.

https://www.ncbi.nlm.nih.gov/pubmed/29725966

The work environment for medical imaging such as distractions, ergonomics, distance, temperature, humidity, and lighting conditions generates a paucity of data and is difficult to analyze. The emergence of Internet of Things (IoT) with decreasing cost of single-board computers like Raspberry Pi makes creating customized hardware to collect data from the clinical environment within the reach of a clinical imaging informaticist. This article will walk the reader through a series of basic project using a variety sensors and devices in conjunction with a Pi to gather data, culminating in a complex example designed to automatically detect and log telephone calls.

VEO-Engine: Interfacing and Reasoning with an Emotion Ontology for Device Visual Expression.

https://www.ncbi.nlm.nih.gov/pubmed/30701263

In order for machines to understand or express emotion to users, the specific emotions must be formally defined and the software coded to how those emotions are to be expressed. This is particularly important if devices or computer-based tools are utilized in clinical settings, which may be stressful for patients and where emotions can dominate their decision making. We have reported our development and feasibility results of an ontology, Visualized Emotion Ontology (VEO), that links abstract visualizations that express specific emotions. Here, we used VEO with the VEO-Engine, a software API package that interfaces with the VEO. The VEO-Engine was developed in Java using Apache Jena and OWL-API. The software package was tested on a Raspberry Pi machine with a small touchscreen display that linked each visualization to an emotion. The VEO-Engine stores input parameters of emotional situations and valences to reason and interpret users' emotions using the ontology-based reasoner. With this software, devices can interfaced wirelessly, so smart devices with visual displays can interact with the ontology. By means of the VEO-Engine, we show the portability and usability of the VEO in human-computer interaction.

qCon: QoS-Aware Network Resource Management for Fog Computing.

https://www.ncbi.nlm.nih.gov/pubmed/30322161

Fog computing is a new computing paradigm that employs computation and network resources at the edge of a network to build small clouds, which perform as small data centers. In fog computing, lightweight virtualization (e.g., containers) has been widely used to achieve low overhead for performance-limited fog devices such as WiFi access points (APs) and set-top boxes. Unfortunately, containers have a weakness in the control of network bandwidth for outbound traffic, which poses a

challenge to fog computing. Existing solutions for containers fail to achieve desirable network bandwidth control, which causes bandwidth-sensitive applications to suffer unacceptable network performance. In this paper, we propose qCon, which is a QoS-aware network resource management framework for containers to limit the rate of outbound traffic in fog computing. qCon aims to provide both proportional share scheduling and bandwidth shaping to satisfy various performance demands from containers while implementing a lightweight framework. For this purpose, qCon supports the following three scheduling policies that can be applied to containers simultaneously: proportional share scheduling, minimum bandwidth reservation, and maximum bandwidth limitation. For a lightweight implementation, qCon develops its own scheduling framework on the Linux bridge by interposing qCon's scheduling interface on the frame processing function of the bridge. To show qCon's effectiveness in a real fog computing environment, we implement qCon in a Docker container infrastructure on a performance-limited fog device-a Raspberry Pi 3 Model B board.

Apoptotic efficacy of multifaceted biosynthesized silver nanoparticles on human adenocarcinoma cells.

https://www.ncbi.nlm.nih.gov/pubmed/30254325

Metallic nanoparticles (NPs) especially silver (Ag) NPs have shown immense potential in medical applications due to their distinctive physio-chemical and biological properties. This article reports the conjugation of Ag NPs with Rubus fairholmianus extract. The modification of Ag NPs was confirmed using various physico-chemical characterization techniques. The cytotoxic effect of Rubus-conjugated Ag NPs (RAgNPs) was studied by LDH assay and proliferation by ATP assay. The apoptotic inducing ability of the NPs were investigated by Annexin V/PI staining, caspase 3/7 analysis, cytochrome c release, intracellular ROS analysis, Hoechst staining and mitochondrial membrane potential analysis using flow cytometry. The expression of apoptotic proteins caspase 3, Bax and P53 were analyzed using ELISA and caspase 3, Bax using western blotting. Cells treated with 10â€‰Âµg/mL RAgNPs showed an increased number of cell death by microscopic analysis compared to untreated control cells. The RAgNPs induced a statistically significant dose-dependent decrease in proliferation (pâ€‰<â€‰0.001 for 5 and 10â€‰Âµg/mL) and increased cytotoxicity in MCF-7 cells. A 1.83 fold increase in cytotoxicity was observed in cells treated with 10â€‰Âµg/mL (pâ€‰<â€‰0.05) compared to the untreated cells. Nuclear damage and intracellular ROS production were observed upon treatment with all tested concentrations of RAgNPs and the highest concentrations (5 and 10â€‰Âµg/mL) showed significant (pâ€‰<â€‰0.05, pâ€‰<â€‰0.01)

expression of caspase 3, Bax and P53 proteins. The data strongly suggest that RAgNPs induces cell death in MCF-7 cells through the mitochondrial-mediated intrinsic apoptosis pathway. The present investigation supports the potential of RAgNPs in anticancer drug development.

A highly integrated real-time digital PCR device for accurate DNA quantitative analysis.

https://www.ncbi.nlm.nih.gov/pubmed/30660930

Misclassification of positive partitions in microfluidic digital polymerase chain reaction (dPCR) can cause the false positives and false negatives, which significantly alter the resulting estimate of target DNA molecules. To address this issue, establishing real-time fluorescence interrogation of each partition in microfluidic arrays is an effective way in which false positive and false negative partitions can be eliminated. However, currently available devices for real-time fluorescence interrogation are either not competent for microfluidic digital array, or they are bulky, expensive and entail peripheral equipment due to low integration. Therefore, in this study, a Raspberry Pi based, low-cost and highly integrated device is presented to achieve real-time fluorescence detection for microfluidic digital array, termed real-time dPCR device. In the device, uniform thermocycler, streamlined real-time fluorescence imaging setup, and compact data processing system are all integrated to undergo on-chip dPCR amplification, real-time fluorescence detection, and data analysis. Using this real-time dPCR device, the accuracy of DNA absolute quantification by dPCR is improved, since the misclassification of positive partitions is efficiently reduced based on the characteristic real-time fluorescence curves of positive partitions in a self-priming microfluidic chip. Compared with end-point dPCR on our device and commercialized QuantStudioâ„¢ 3D dPCR system, the real-time dPCR on our device exhibits a higher accuracy for DNA quantification. In addition, this real-time dPCR device is much smaller and cheaper than the commercialized Digital PCR system, but not sacrificing the capability of error correction for absolute quantitation analysis. Conclusively, this highly integrated real-time dPCR device is very beneficial for DNA quantitative analysis where the determination accuracy is pivotal.

Detection of Volatile Compounds Emitted by Bacteria in Wounds Using Gas Sensors.

https://www.ncbi.nlm.nih.gov/pubmed/30925832

In this paper we analyze an experiment for the use of low-cost gas sensors intended to detect bacteria in wounds using a non-intrusive technique. Seven different genera/species of microbes tend to be present in most wound infections. Detection of these bacteria usually requires sample

and laboratory testing which is costly, inconvenient and time-consuming. The validation processes for these sensors with nineteen types of microbes (1 Candida, 2 Enterococcus, 6 Staphylococcus, 1 Aeromonas, 1 Micrococcus, 2 E. coli and 6 Pseudomonas) are presented here, in which four sensors were evaluated: TGS-826 used for ammonia and amines, MQ-3 used for alcohol detection, MQ-135 for COâ‚‚ and MQ-138 for acetone detection. Validation was undertaken by studying the behavior of the sensors at different distances and gas concentrations. Preliminary results with liquid cultures of 10â•¸ CFU/mL and solid cultures of 10â•¸ CFU/cm2 of the 6 Pseudomonas aeruginosa strains revealed that the four gas sensors showed a response at a height of 5 mm. The ammonia detection response of the TGS-826 to Pseudomonas showed the highest responses for the experimental samples over the background signals, with a difference between the values â€‹â€‹of up to 60 units in the solid samples and the most consistent and constant values. This could suggest that this sensor is a good detector of Pseudomonas aeruginosa, and the recording made of its values â€‹â€‹could be indicative of the detection of this species. All the species revealed similar COâ‚‚ emission and a high response rate with acetone for Micrococcus, Aeromonas and Staphylococcus.

Spatio-Temporal Optimization of Perishable Goods' Shelf Life by a Pro-Active WSN-Based Architecture.

https://www.ncbi.nlm.nih.gov/pubmed/30004468

The waste in the perishable goods supply-chain has prompted many global organizations (e.g., FAO and WHO), to develop the Hazard Analysis and Critical Control Points (HACCP) protocol that ensures a high degree of food quality, minimizing the losses in all the stages of the farm-to-fork chain. It has been proven that good warehouse management practices improve the average life of perishable goods. The advances in wireless sensors network (WSN) technology offers the possibility of a "smart" storage organization. In this paper, a low cost reprogrammable WSN-based architecture for functional warehouse management is proposed. The management is based on the continuous monitoring of environmental parameters (i.e., temperature, light exposure and relative humidity), and on their combination to extract a spatial real-time prediction of the product shelf life. For each product, the quality decay is computed by using a 1st order kinetic Arrhenius model to the whole storage site area. It strives to identify, in a way compatible with the other products' shelf lives, the position within the warehouse that maximizes the food expiration date. The shelf life computing and the "first-expired first-out" logistic problem are entrusted to a Raspberry Pi-based central unit, which

manages a set of automated pallet transporters for the displacement of products, according to the computed shelf lives. The management unit supports several commercial light/temperature/humidity sensor solutions, implementing ZigBee, Bluetooth and HTTP-request interfaces. A proof of concept of the presented pro-active WSN-based architecture is also shown. Comparing the proposed monitoring system for the storage of e.g., agricultural products, with a typical one, the experimental results show an improvement of the expected expiration date of about 1.2 Â± 0.5 days, for each pallet, when placed in a non-refrigerated environment. In order to stress the versatility of the WSN solution, a section is dedicated to the implemented system user interfaces that highlight detecting critical situations and allow timely automatic or human interventions, minimizing the latter.

A facial expression controlled wheelchair for people with disabilities.

https://www.ncbi.nlm.nih.gov/pubmed/30337084

In order to improve assistive technologies for people with reduced mobility, this paper develops a new intelligent real-time emotion detection system to control equipment, such as electric wheelchairs (EWC) or robotic assistance vehicles. Every year, degenerative diseases and traumas prohibit thousands of people to easily control the joystick of their wheelchairs with their hands. Most current technologies are considered invasive and uncomfortable such as those requiring the user to wear some body sensor to control the wheelchair.

Standoff Optical Glucose Sensing in Photosynthetic Organisms by a Quantum Dot Fluorescent Probe.

https://www.ncbi.nlm.nih.gov/pubmed/30058800

Glucose is a major product of photosynthesis and a key energy source for cellular respiration in organisms. Herein, we enable in vivo optical glucose sensing in wild-type plants using a quantum dot (QD) ratiometric approach. The optical probe is formed by a pair of QDs: thioglycolic acid-capped QDs which remain invariable to glucose (acting as an internal fluorescent reference control) and boronic acid (BA)-conjugated QDs (BA-QD) that quench their fluorescence in response to glucose. The fluorescence response of the QD probe is within the visible light window where photosynthetic tissues have a relatively low background. It is highly selective against other common sugars found in plants and can be used to quantify glucose levels above 500 Î¼M in planta within the physiological range. We demonstrate that the QD fluorescent probe reports glucose from single chloroplast to algae cells (Chara zeylanica) and plant leaf tissues (Arabidopsis thaliana) in vivo via

confocal microscopy and to a standoff Raspberry Pi camera setup. QD-based probes exhibit bright fluorescence, no photobleaching, tunable emission peak, and a size under plant cell wall porosity offering great potential for selective in vivo monitoring of glucose in photosynthetic organisms in situ.

Development of a Smart Mobile Data Module for Fetal Monitoring in E-Healthcare.

https://www.ncbi.nlm.nih.gov/pubmed/29572752

The fetal heart rate (FHR) is a marker of fetal well-being in utero (when monitoring maternal and/or fetal pathologies) and during labor. Here, we developed a smart mobile data module for the remote acquisition and transmission (via a Wi-Fi or 4G connection) of FHR recordings, together with a web-based viewer for displaying the FHR datasets on a computer, smartphone or tablet. In order to define the features required by users, we modelled the fetal monitoring procedure (in home and hospital settings) via semi-structured interviews with midwives and obstetricians. Using this information, we developed a mobile data transfer module based on a Raspberry Pi. When connected to a standalone fetal monitor, the module acquires the FHR signal and sends it (via a Wi-Fi or a 3G/4G mobile internet connection) to a secure server within our hospital information system. The archived, digitized signal data are linked to the patient's electronic medical records. An HTML5/JavaScript web viewer converts the digitized FHR data into easily readable and interpretable graphs for viewing on a computer (running Windows, Linux or MacOS) or a mobile device (running Android, iOS or Windows Phone OS). The data can be viewed in real time or offline. The application includes tools required for correct interpretation of the data (signal loss calculation, scale adjustment, and precise measurements of the signal's characteristics). We performed a proof-of-concept case study of the transmission, reception and visualization of FHR data for a pregnant woman at 30Â weeks of amenorrhea. She was hospitalized in the pregnancy assessment unit and FHR data were acquired three times a day with a Philips AvalonÂ® FM30 fetal monitor. The prototype (Raspberry Pi) was connected to the fetal monitor's RS232 port. The emission and reception of prerecorded signals were tested and the web server correctly received the signals, and the FHR recording was visualized in real time on a computer, a tablet and smartphones (running Android and iOS) via the web viewer. This process did not perturb the hospital's computer network. There was no data delay or loss during a 60-min test. The web viewer was tested successfully in the various usage situations. The system was as user-friendly as expected, and enabled rapid, secure archiving. We have developed a system for the acquisition, transmission, recording and visualization of RCF data. Healthcare professionals can view the FHR data remotely on their computer, tablet or

smartphone. Integration of FHR data into a hospital information system enables optimal, secure, long-term data archiving.

Resource Optimization Techniques and Security Levels for Wireless Sensor Networks Based on the ARSy Framework.

https://www.ncbi.nlm.nih.gov/pubmed/29772773

Wireless Sensor Networks (WSNs) with limited battery, central processing units (CPUs), and memory resources are a widely implemented technology for early warning detection systems. The main advantage of WSNs is their ability to be deployed in areas that are difficult to access by humans. In such areas, regular maintenance may be impossible; therefore, WSN devices must utilize their limited resources to operate for as long as possible, but longer operations require maintenance. One method of maintenance is to apply a resource adaptation policy when a system reaches a critical threshold. This study discusses the application of a security level adaptation model, such as an ARSy Framework, for using resources more efficiently. A single node comprising a Raspberry Pi 3 Model B and a DS18B20 temperature sensor were tested in a laboratory under normal and stressful conditions. The result shows that under normal conditions, the system operates approximately three times longer than under stressful conditions. Maintaining the stability of the resources also enables the security level of a network's data output to stay at a high or medium level.

Raspberry Pi-powered imaging for plant phenotyping.

https://www.ncbi.nlm.nih.gov/pubmed/29732261

Image-based phenomics is a powerful approach to capture and quantify plant diversity. However, commercial platforms that make consistent image acquisition easy are often cost-prohibitive. To make high-throughput phenotyping methods more accessible, low-cost microcomputers and cameras can be used to acquire plant image data.

Automated translating beam profiler for in situ laser beam spot-size and focal position measurements.

https://www.ncbi.nlm.nih.gov/pubmed/29604797

We present a simple and convenient, high-resolution solution for automated laser-beam profiling

with axial translation. The device is based on a Raspberry Pi computer, Pi Noir CMOS camera, stepper motor, and commercial translation stage. We also provide software to run the device. The CMOS sensor is sensitive over a large wavelength range between 300 and 1100 nm and can be translated over 25 mm along the beam axis. The sensor head can be reversed without changing its axial position, allowing for a quantitative estimate of beam overlap with counter-propagating laser beams. Although not limited to this application, the intended use for this device is the automated measurement of the focal position and spot-size of a Gaussian laser beam. We present example data of one such measurement to illustrate device performance.

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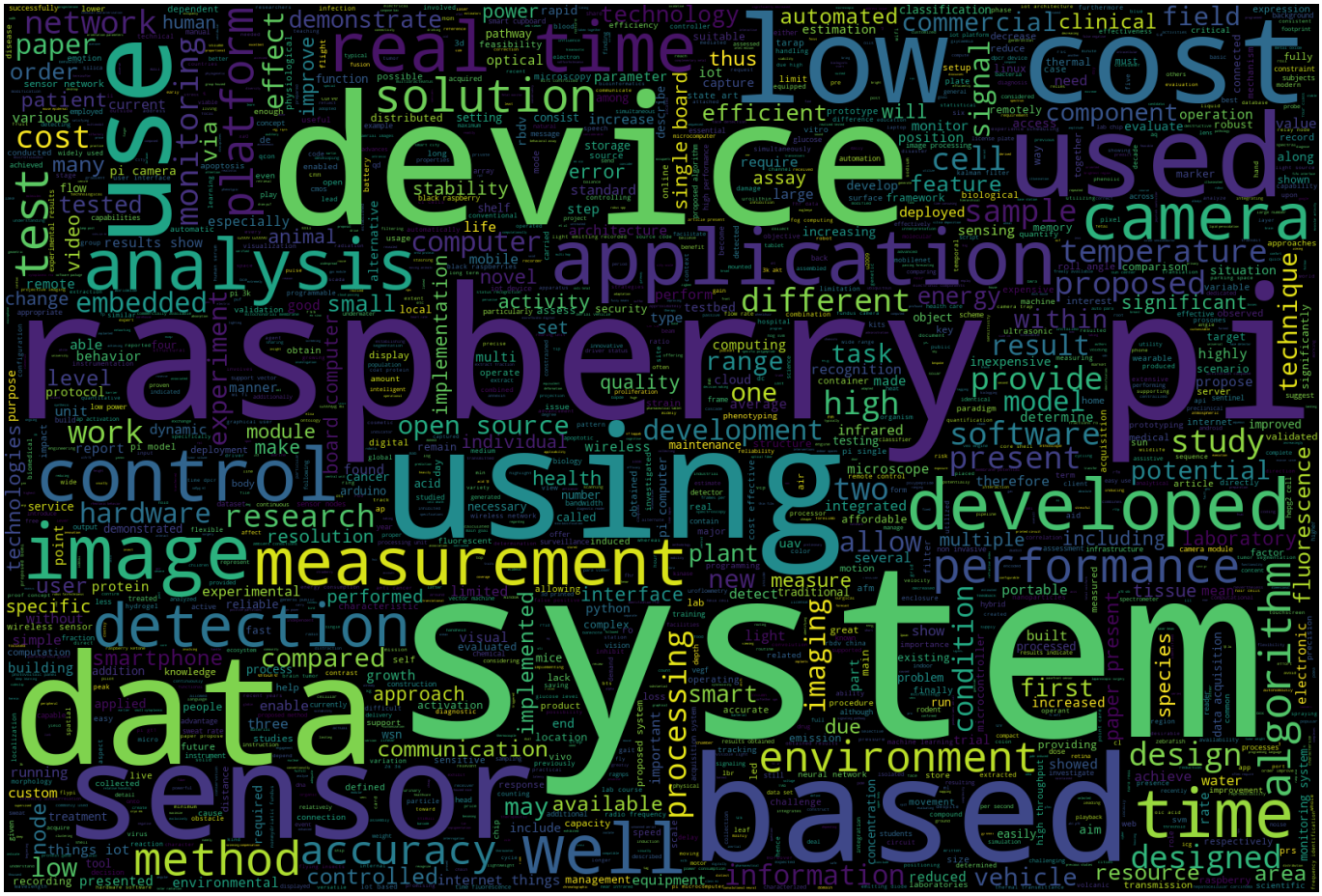

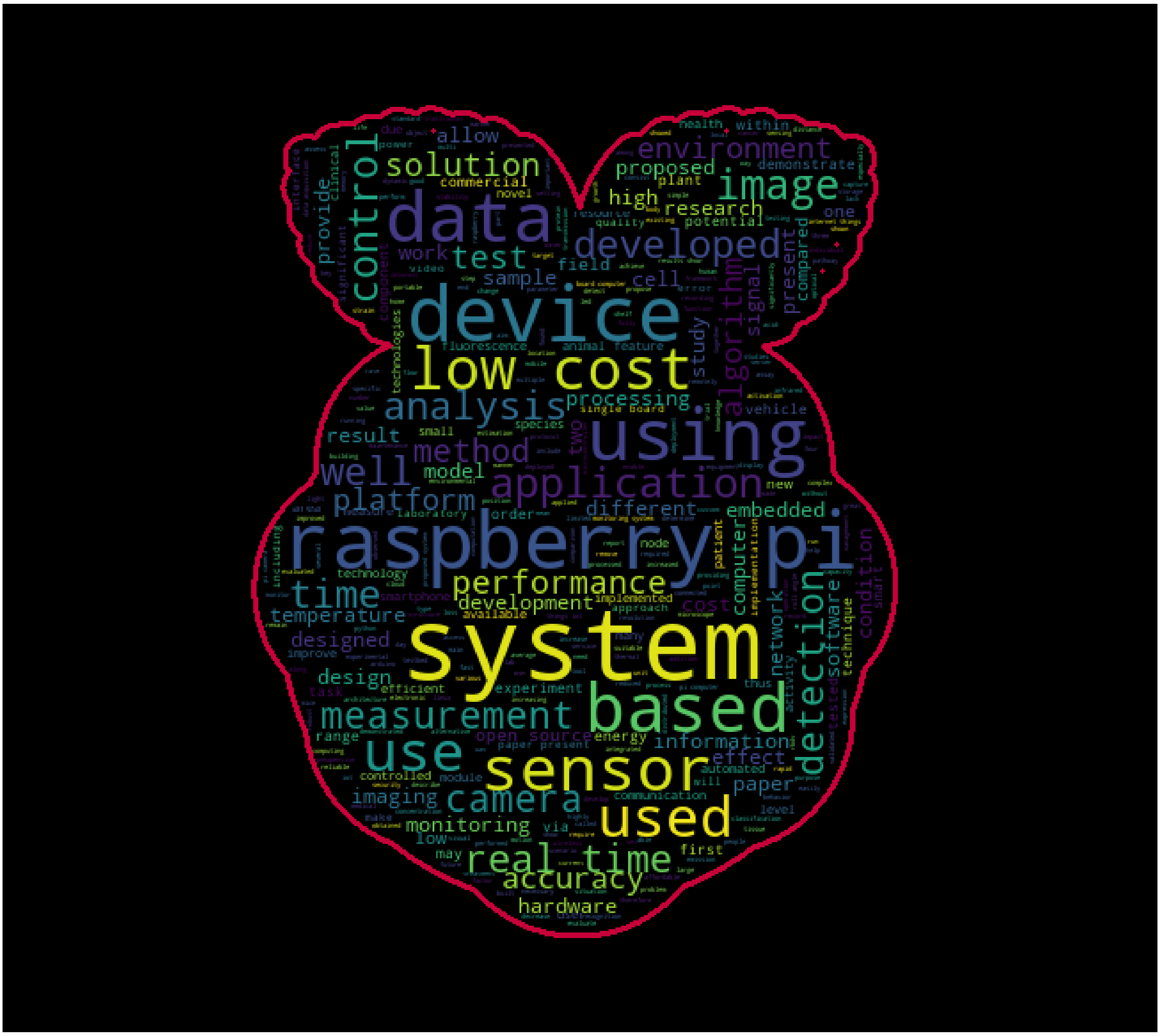

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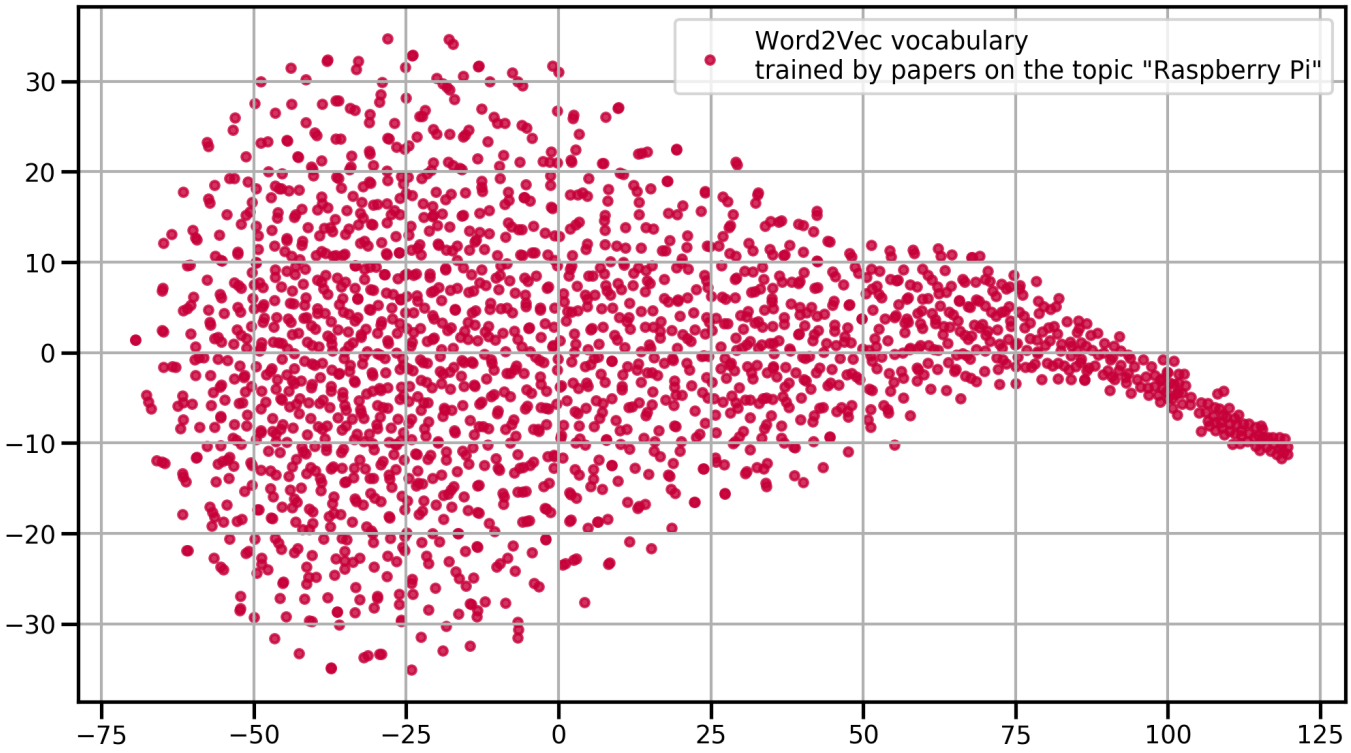
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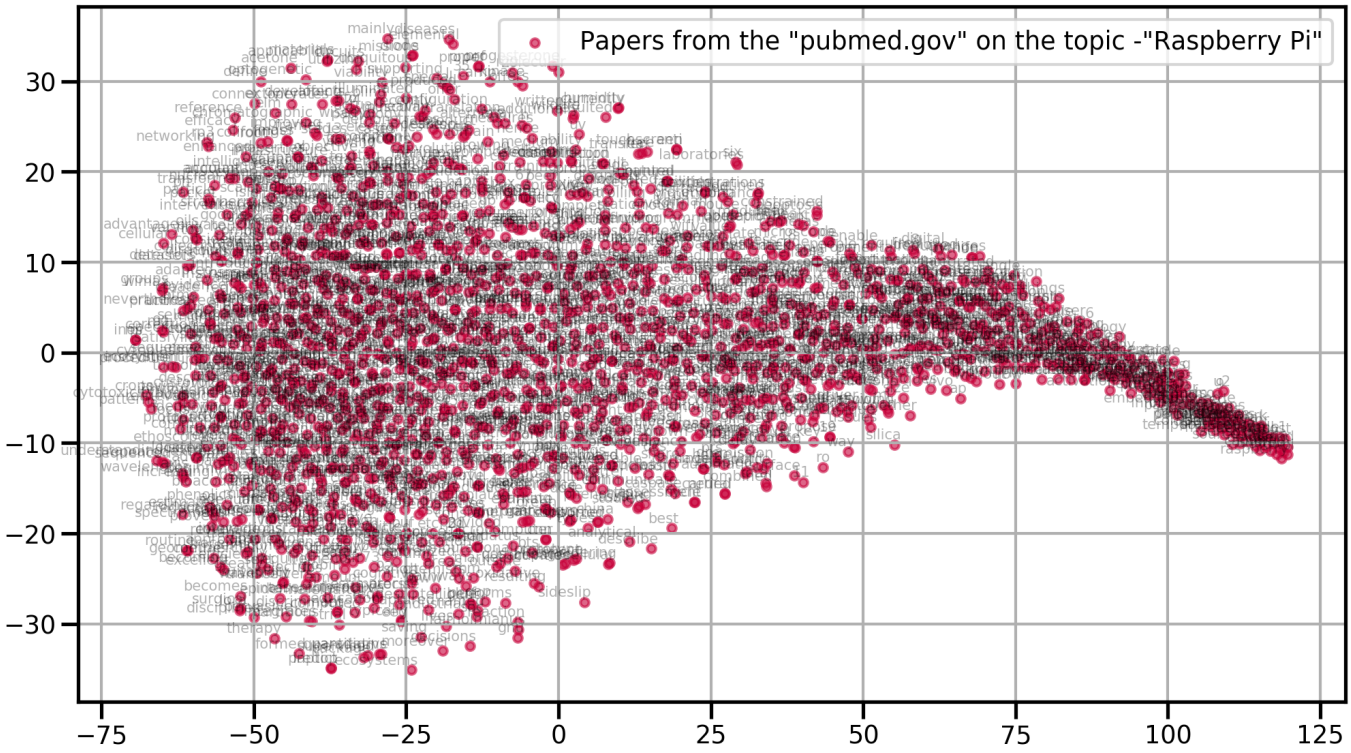
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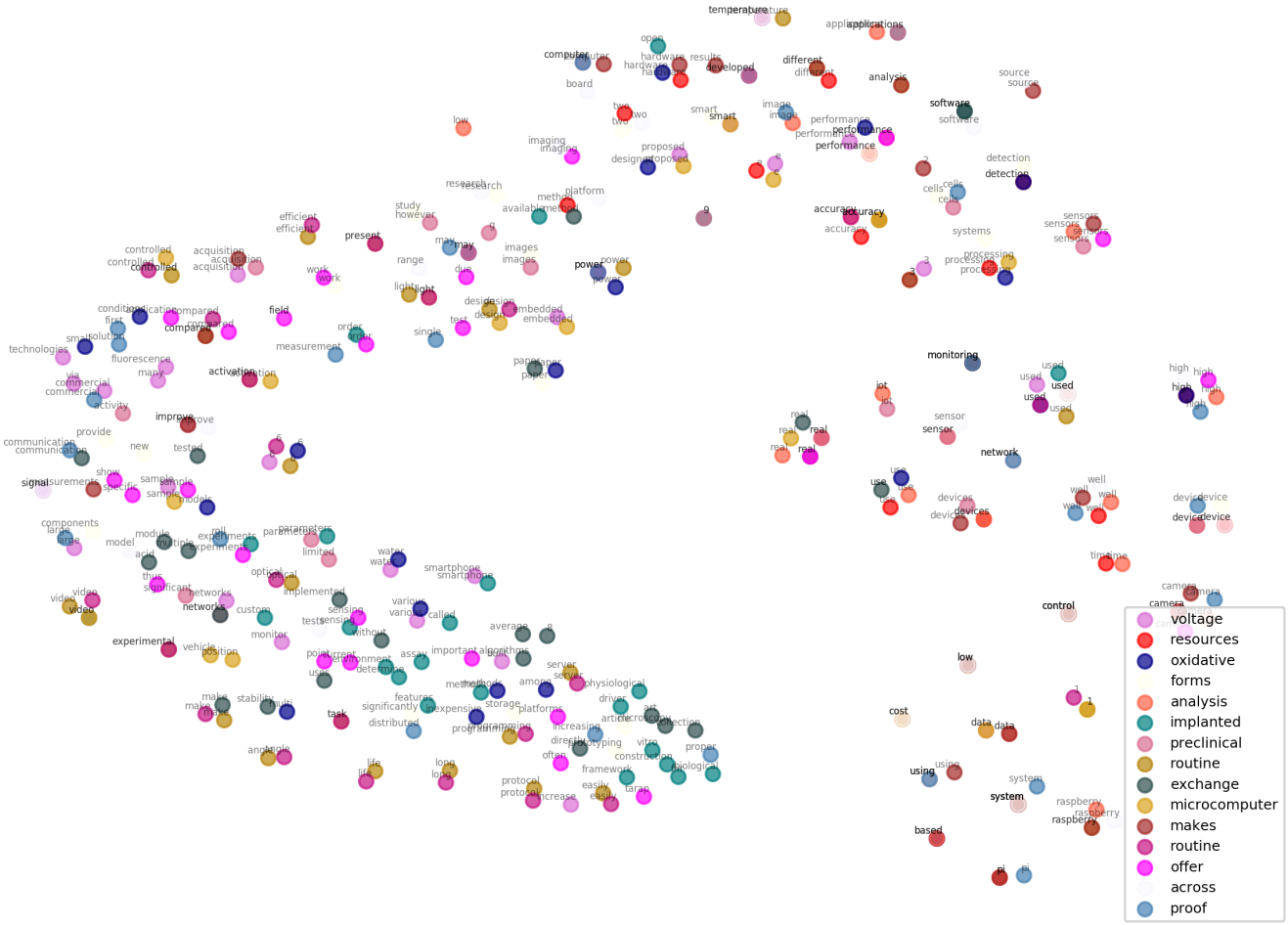

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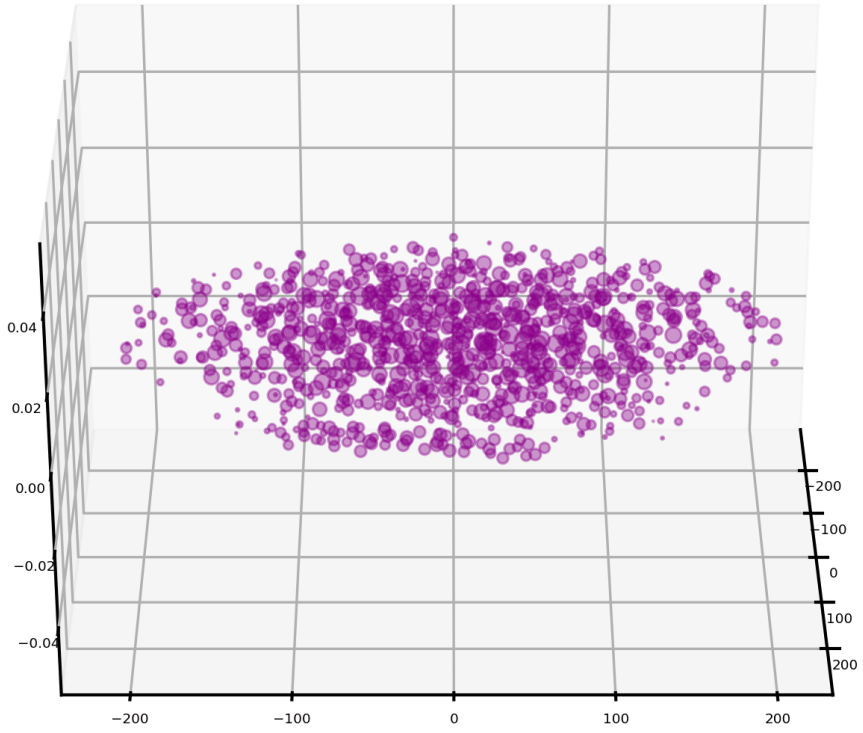

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