Abstract: Science and Engineering Fair of Houston

3236

Automated Plant Watering Using Weather Data

Category:

Embedded Systems

Aarav Joshi

Clear Creek ISD /Clear Lake High School

My project involves the development of an automatic plant-watering system that decides on irrigation amounts based on current weather from an environmental sensor input. For people living in cities like Houston, with frequently changing weather conditions, knowing how to water their plants correctly, especially for plants whose required moisture is quite exacting, like St. Augustine grass, is difficult. This can result in over- or underwatering issues, which may bring on fungus due to overwatering or wilting from lack of water. The objective of this project is to create a system that automatically determines and delivers the correct amount of water by analyzing humidity and weather type each day. This system was tested over seven trials of varying humidity levels and weather. The results of these tests were that the system usually acted very accurately: six of seven tests came within 200 mL of the amount of water that should have been dispensed, with a mean error of approximately 86 mL. One major deviation of 845.8 mL was due to the incorrect identification of the weather by the sensor. Removing this outlier, the system is very reliable. With further refinements in the weather detection and incorporation of temperature, this technology could go a long way in optimizing home irrigation and avoiding both over-watering and under-watering.

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Abstract: Science and Engineering Fair of Houston

3237

VisionLink: Embedded Eyewear for Blink-Based Emergency Communication

Aviral Panda

Conroe ISD /AST: Academy of Science and Technology

Category:

Embedded Systems

Wearable assistive technology has the potential to improve personal safety by enabling hands-free communication during emergencies. This project explores the novel concept of using intentional eye blinking as a method for sending emergency signals. While previous research has shown that eye blinks can be used to monitor fatigue and drowsiness, few systems have investigated deliberate blink patterns as a communication mechanism in a cost effective way. This project addresses that gap by developing a proof-of-concept prototype of smart glasses capable of detecting intentional blink sequences.The system uses infrared eye blink sensors mounted on a glasses frame and a Raspberry Pi Zero 2W to process real time blink data. The glasses continuously monitor for a predefined emergency pattern of five blinks within three seconds. When the pattern is detected, an onboard LED provides visual feedback to confirm signal recognition. Testing was conducted under different user activity conditions, including reading, walking, and running, to evaluate whether intentional signals could be detected during everyday movement. Data collected from multiple trials showed that the system was able to identify intentional blink patterns with an average accuracy of approximately 60%, demonstrating the feasibility of the concept. Although the prototype is not optimized for large scale use, it successfully validates the core idea of blink-based emergency signaling. This proof-of-concept highlights the potential for future development of discreet, hands free safety systems embedded in everyday wearable devices.

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Abstract: Science and Engineering Fair of Houston

3238

Adurnio Smart Irrigation System

Titilayo Ogunjimi

Harmony Public Schools - North District/Harmony School of Advancement

Category:

Embedded Systems

A Smart Irrigation System brings together engineering, programming, and environmental awareness to solve a real‑world problem in a practical and innovative way. By combining Arduino technology with cybersecurity and networking concepts, the project becomes both a technical build and a multimedia learning experience. This introduction sets the stage for understanding how the system works and how the design process helps develop new technical and creative skills.

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Abstract: Science and Engineering Fair of Houston

3239

Category:

Embedded Systems

A Minimally Invasive System For Detecting Heart Disease: A Novel Approach On Combatting The Greatest Killer In The World.

Ryan Berger

Private/The Emery/Weiner School

Projected to cause 35.6 million deaths by 2050, heart disease has become one of the leading causes of death worldwide. Current diagnostic methods for coronary artery disease (CAD), atherosclerosis, arrhythmia, and overall cardiac health are largely reactive rather than being optimized for early detection. To address this, an inexpensive, minimally invasive, integrated system was designed and built to support early heart disease detection via live sensing, local processing, and integrated machine learning (ML) within a single unified software. The system consists of three main parts. First, an Arduino-based electrocardiogram (EKG) was developed using a custom printed circuit board (PCB) for live signal acquisition and filtering. These signals would later be processed through an ML model for arrhythmia detection with adaptive thresholding, which achieved an accuracy of 99.26% when evaluated on public datasets. Second, Griess reactions were executed on blood simulants with varying nitrite concentrations to model early atherosclerosis-related detection. To support this, a fully custom-built spectrophotometer was engineered to measure absorbance, demonstrating over 90% accuracy when compared to laboratory spectrophotometers. Finally, a logistic regression model was designed to assess future patient risk, performing at an accuracy of 85.8%, while simultaneously generating individualized treatment recommendations. By integrating custom hardware, software, chemical sensing, and machine learning into a single system, this project demonstrates a practical step toward improving early heart disease detection technology. With additional testing and validation, this system could facilitate earlier detection in both clinical and at-home settings.

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Abstract: Science and Engineering Fair of Houston

3240

Adaptive Sensor Fusion for Fault-Tolerant Autonomous Ground Vehicle

Aariz Vastani

Clear Creek ISD /Clear Brook High School

Category:

Embedded Systems

In the real world, we use sensors to help with many things, like diagnostics, position, etc. However, what would happen if a sensor started giving inaccurate data to the machine or just didn't work? Then you would need to have a redundant sensor. So, my research solves this issue on the program side, making the robot follow a specific path using the sensors, and occasionally, I intentionally introduced sensor faults to evaluate system performance. I used a Kalman Filter and Sensor Fusion and PID (mostly) for programming, and built a robot with an IMU, GPS, and Encoders. In the end, the robot did mainly stay on path, but there were times where the robot didn't stay exactly on path, but which happens due to friction, ground level, slipping of wheels, etc.

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Abstract: Science and Engineering Fair of Houston

3241

Category:

Embedded Systems

EcoHawk: YOLOv11 Low-Altitude Drone System for Simultaneous Detection, Geospatial Quantification, and Risk Mapping of Invasive Species with Real-Time Authority Notification

Shriya Venkat

Conroe ISD /AST: Academy of Science and Technology

In this project, the researcher developed the engineering goal of creating a real-time drone system that would fly over an area, state the location of each invasive plant, create a risk assessment map, and alert the authorities in order to reduce the number of areas with a high concentration of invasive plants. Previous studies demonstrate a step toward stronger invasive identification efforts, but all with a lack of accessibility for the average person to control, with the ability to only identify one invasive plant. The experimenter assembled a drone using a soldering iron, 4 motors, a drone frame, and a Pixhawk and trained a machine learning model with 13,000 images to identify 16 invasive plant species. This system was tested on five different public parks and compared to expert derived ground truth data to determine how feasible this solution would be in the real world. From these procedures, the conclusion was developed that the drone would perform well in an actual situation, with the drone only missing 1-2 detections in each location and attaining a top-5 accuracy score of 0.89, which is higher than the average CLS model. In a real world setting, this could be used to reduce the economic burden and health impacts of invasive plant species, allowing for a transition to data driven eradication.

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Abstract: Science and Engineering Fair of Houston

3242

Category:

Embedded Systems

GlucoSight: A Machine Learning-Based Digital Twin Framework on Solar-Powered Raspberry Pi for Data-Driven, Non-Invasive Glycemic Prediction and Intervention in Resource-Constrained Environments

Oliver Fan

Katy ISD/James E. Taylor - HS

Type-2 diabetes affects 537 million people worldwide, with 80% living in low-income countries where continuous glucose monitors cost $300-400 monthly and remain unaffordable. This project developed an AI system to predict blood glucose and optimize meal timing without requiring CGM devices. The system integrated four components. A CLIP ViT-B/32 vision transformer estimated meal macronutrients from photographs using the Nutrition5k dataset. Two MLP models predicted glucose: a fine-grained model for 30-120 minute predictions and a coarse-grained model for 6-24 hour daily planning, using pharmacokinetic features from the ShanghaiT2DM dataset. A MaskablePPO reinforcement learning agent learned safe meal and insulin modifications through 300,000 simulated timesteps, with action masking to prevent dangerous recommendations. The pipeline was deployed to a Raspberry Pi 5 with solar power for completely off-grid operation. Food recognition achieved R-squared of 0.794 across macronutrients. Fine-grained glucose prediction reached R-squared of 0.922 at 30 minutes and 0.604 at 120 minutes, with 97.5-99.5% clinical safety (Clarke A+B zones). Coarse-grained prediction achieved R-squared of 0.501 at 24 hours with 96.7% safety, enabling day-ahead meal planning. The RL recommender achieved 98.0% Time-in-Range (target: >70%) and 0.67% hypoglycemia (target: <4%). The system runs offline on ~$220 solar-powered hardware with less than one second total inference time. This research demonstrated that AI can provide personalized glucose management across immediate and daily time horizons without expensive continuous monitoring, potentially benefiting 430 million diabetics in developing countries who currently lack access to modern diabetes technology.

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Abstract: Science and Engineering Fair of Houston

3243

Designing and Optimizing a Reliable Li-Fi Optical Communication System

Zaid Asad

Clear Creek ISD /Clear Brook High School

Category:

Embedded Systems

Abstract: The purpose of this project was to develop Li-Fi system with limited hardware that demonstrated reliable communication. Additionally, this system aimed to function under the influence of ambient light and constant LED brightness to avoid flickering. This goal was met with the use of a Raspberry Pi Pico to control the system, a 1 Watt LED to send the signal, and a TEPT4400 phototransistor to receive the signal. On top of this, the system used synchronized timing, a simple checksum error detection algorithm, and pulse width modulation to improve its quality. When the first iteration of the Li-Fi system was tested, it resulted in a large error rate of 0.415 errors per bit, nearly an error every other bit. After synchronizing the data stream, the error rate dropped to 0.004 errors per bit. Then, a checksum algorithm was added to send an extra byte of data at the end of the message to verify if the message was received correctly. This dropped the effective bit error rate to 0. Lastly, the modulation of the data stream was switched from a simple on-off keying system to a pulse-width modulation system. This decreases the amount of flickering of the LED and makes it more resistant to ambient light. The final prototype met all design criteria: reliable data transmission, constant illumination, and operation under ambient light. Future improvements could increase range and data rate with optical lenses, higher-speed hardware, or more advanced modulation techniques.

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Abstract: Science and Engineering Fair of Houston

3244

Category:

Embedded Systems

ParaScreener: A Novel Modular and Expandable Device for Low-Cost Point-Of-Care Self Screening of Hematologic Neglected Tropical Diseases

Yuva Gade, Sahana Gade

Fort Bend ISD /Austin High School

Neglected tropical diseases (NTDs) and other hematological parasitic infections continue to cause preventable illness in underserved regions where diagnostic access is limited, with hundreds of millions of people affected annually. Traditional microscopy screening is time-consuming and depends heavily on trained specialists, resulting in increasing delays and possible human error, proving unrealistic for point of care screening. In the previous year, this project demonstrated a low-cost embedded TinyML system for Chagas disease screening. The goal of this continuation project was to expand the same core idea into a modular, multi-disease point-of-care diagnostic platform. The updated system uses an ESP32-S3 microcontroller running optimized parasite-specific convolutional neural networks (CNNs), paired with an ESP32-CAM for image capture and a ESP32-2432S028R touchscreen. Disease models are stored on a microSD card, allowing multiple diseases to be screened without any hardware changes. To improve reliability in real-world conditions, each test performs 16 total inferences by dividing the microscope image into four overlapping 128 by 128 regions and running each region through the model four times. Majority voting determines the final result, reducing sensitivity to noise, focus variation, and lighting differences. The screen includes visual controls, multilingual support, and disease reference images with symptoms. The platform currently supports Chagas disease, Malaria, Leishmaniasis, Babesiosis, and Microfilariae screening, achieving 96% accuracy average trained models. This work demonstrates that a low-cost device can serve as universal diagnostic framework for NTD screening. Furthermore, for the future because these parasites are detectable at only 300 to 400X magnification, the results support the feasibility of a complete ~$40 diagnostic device integrating fixed optics, integrated AI and software, and a user interface for point-of-care deployment.

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Abstract: Science and Engineering Fair of Houston

3245

VirtualEye: A Novel, Innovative, and Cost-Effective Solution for the Visually Impaired Leveraging AI

Shivam Gupta

Friendswood ISD /Friendswood High School

Category:

Embedded Systems

Visual impairment affects at least 2.2 billion people worldwide, significantly limiting independence in daily activities such as reading text, recognizing objects, and navigating unfamiliar environments. This project evaluated VirtualEye, a low-cost wearable assistive system leveraging Artificial Intelligence and Machine Vision to deliver real- time support to visually impaired individuals through its various functionalities. A simulation-based framework was utilized to conduct an evaluation of various performance parameters. Rigorous data analysis was done through automated scripts on datasets and controlled inputs, simulating diverse real-world conditions such as varying lighting conditions and object types. Performance focused on output correctness and run-to-run consistency, with automated scoring against ground-truth labels. Key metrics included accuracy, precision, specificity, and recall, enabling identification of misclassification trends across modules. Results demonstrated strong reliability: accuracy ranged from 91% to 96% across various functional features, while precision hovered around 90%, reflecting a high proportion of true positives and minimal false positives. These consistent outcomes underscored the system's effectiveness for core assistive functions involving accurate recognition and interpretation of visual information in everyday scenarios. VirtualEye holds substantial promise for enhancing independence in education and mobility. By providing access to printed materials, accurate currency verification, and heightened environmental awareness, it empowers users to engage with confidence in academic and community settings. Its integration of multiple accessibility features into a single, lightweight wearable workflow minimizes dependence on external aid, fostering greater autonomy, social inclusion, and better quality of life for individuals with visual impairments thereby aligning with the United Nations Sustainable Development Goals.

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Abstract: Science and Engineering Fair of Houston

3246

Exploring the Usability, Comfort, and Effectiveness of an Affordable Arduino-Based Smart Cane

Daimy Andrade

Conroe ISD /ASHP: Academy for Science and Health Prof

Category:

Embedded Systems

Visual impairment limits independent mobility, and while the traditional white cane remains an assistive tool, it is primarily limited to detecting ground level obstacles. To address gaps in spatial awareness, this study presents the design and evaluation of a low cost Arduino based smart cane that enhances obstacle detection through ultrasonic sensing and feedback. The prototype incorporates three ultrasonic sensors oriented left, center, and right. Directional information is conveyed using distinct auditory frequencies: left obstacles use an A3 tone at 220 Hz, right obstacles use a G4 tone at 392 Hz, and frontal obstacles use higher frequencies, including E5 at 659 Hz for medium proximity and C6 at 1047 Hz for very close hazards. Distance is encoded through alert intensity. Objects beyond 70 cm produce no alerts, distances between 30 and 70 cm generate slow to medium beeping with pulsed vibration, and objects within 30 cm trigger very fast beeping with strong continuous vibration. A sequential mixed methods evaluation was conducted with 13 participants across two development phases. Quantitative results showed high ratings for comfort, confidence, learnability, and obstacle detection, with most responses between 5 and 7 on a seven point scale. Qualitative feedback indicated that negative comments were primarily associated with Phase 1, citing narrow detection angles, false positives, weak vibration strength, and handle ergonomics. Phase 2 feedback was more positive, highlighting improved weight balance, clearer alerts, and increased confidence during navigation. Participants reported greater perceived independence and most indicated they would consider regular use if commercially available.

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Abstract: Science and Engineering Fair of Houston

3247

GardenerEye: Early detection of Basil Plant stress using Image Analysis and Environmental Sensors

Krishay Kondapalli

Cypress Fairbanks ISD/Bridgeland - HS

Category:

Embedded Systems

Urban and rooftop gardens often struggle to maintain healthy plants due to limited space and changing weather conditions. Identifying nutrient deficiencies early, such as a lack of nitrogen, is important for preventing plant stress. This project aims to build an inexpensive monitoring system using a Raspberry Pi camera and environmental sensors to track the health of basil plants over time. The system works by analyzing leaf images to detect early signs of yellowing in specific areas of the leaves. It also uses sensors to collect data on soil moisture, temperature, humidity, and light levels. The system is expected to detect plant stress earlier than unaided human observation, allowing for quicker intervention. By combining images and sensor data in an easy-to-understand format, this project helps support healthier plants and more efficient urban gardening practices.

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Abstract: Science and Engineering Fair of Houston

3248

Neuroflight: exploring the applications of BCIs for consumer use.

Boone Roeser, Luiz Felipe Costa Coimbra, Carter Lawrence

Private/ST. JOHN'S SCHOOL

Category:

Embedded Systems

In the United States, millions of people experience moderate to severe fine motor limitations in their hands and fingers, which restricts their ability to interact with everyday devices, like TV remotes or phones. To address this issue, the team aims to develop a non-invasive Brain-Computer Interface (BCI) capable of translating electroencephalography (EEG) signals into real-time drone instructions, eliminating the need for physical inputs. The team's solution uses an EEG headset, real-time signal processing with machine learning classification, and a quadrotor drone that takes the converted brain activity's input. EEG signals are captured from brain regions involved in motor imagery, filtering the noisy EEG signals using a real-time preprocessing pipeline, and classified using a deep convolutional neural network (CNN) optimized for speed and accuracy. These classified intentions can then be mapped to drone control inputs. The project was divided into three major systems: software, electronics, and structural design. The software system focuses on EEG preprocessing, artifact removal, and neural network-based motor imagery classification, emphasizing real-time performance. The electronics system focuses on the creation of an EEG and of a drone flight control system built around an STM32-based controller. The structural system focuses on the design and creation of a lightweight yet durable quadrotor capable of housing all electronic components in a stable manner and of a transmitter capable of getting converted signals to the drone. By successfully achieving EEG-based drone control, this team will demonstrate the potential of accessible, non-invasive BCIs as universal input devices, with applications extending beyond drones to many consumer technologies.

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Abstract: Science and Engineering Fair of Houston

3249

Category:

Embedded Systems

Bridging Gesture Input with Communication Accessibility for Deaf/ Nonverbal Individuals: A Probabilistic Markov Chain Framework for Airtyping Word Prediction

Ishan Pendyala, Ethan Praisoody

Friendswood ISD /Friendswood High School

Communication barriers remain a major challenge for deaf and nonverbal individuals. In the United States, approximately 3.6% of the population (~11 million people) experience hearing loss, yet nearly 97% of individuals with hearing disabilities do not use sign language. Even for those who do, communication requires the presence of another person fluent in sign language, limiting spontaneous interaction in public, professional, or emergency settings. As a result, deaf and nonverbal individuals lack fast, natural tools for real-time communication, leading to social anxiety, communication disparities, and safety risks. We present a dual-wrist-mounted "air-typing" device that enables hands-based text input without speech, physical keyboards, or sign-language interpretation. The system detects typing-like finger tap gestures in real time. To resolve ambiguity arising from finger-level input, where multiple letters may correspond to the same finger, we novelly create finger-wise Markov Chain models that jointly capture probabilities of letter-pair transitions and part-of-speech (POS) trigrams. This probabilistic structure enables predictions of intended words from noisy gesture sequences, allowing high-level prediction performance despite significant input uncertainty. Predicted words are verbalized via an audio speaker, enabling natural, real-time communication. The proposed air-typing decoder was evaluated on sentences from the Brown corpus (n=798) and achieves a Top-1 next-word prediction accuracy of 79.2% and a Top-5 accuracy of 98.8%, with a mean reciprocal rank (MRR) of 0.874, indicating that correct predictions are typically ranked first or second. This lightweight and interpretable system improves independence, safety, and quality of life for deaf and nonverbal users, effectively giving them a voice.

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Abstract: Science and Engineering Fair of Houston

3250

Category:

Embedded Systems

AeroSense: A Wearable Sleep Apnea Monitoring Device and Adaptive Air-Pillow Intervention System Using Blood Oxygen and Snoring Analysis via LSTM and MLP Models

Felicia Xu

Conroe ISD /AST: Academy of Science and Technology

Obstructive sleep apnea (OSA) is a prevalent chronic sleep disorder affecting an estimated 85.6 million U.S. adults, with approximately 80% remaining undiagnosed. Untreated OSA significantly increases the risk of cardiovascular disease and sudden death, while existing treatments are often expensive, invasive, or associated with poor compliance. This project presents a wearable sleep apnea monitoring and adaptive intervention system that combines real-time physiological sensing with machine-learning–based detection. The system analyzes blood oxygen saturation (SpO_2) and snoring signals to identify apnea events and trigger physical interventions, including inflatable air pillows and vibration, designed to reduce airway obstruction through positional adjustment. After comparing and testing four types of machine learning models and conducting model training, snoring audio and blood oxygen (SpO_2) data were ultimately analyzed using Convolutional Neural Network and Long Short-Term Memory hybrid (CNN–LSTM) models, achieving accuracies of 0.8673 for snoring and 0.898 for SpO_2 detection. Model outputs were combined with an adaptive weighted decision-fusion system to improve robustness. The system was implemented in a compact wearable prototype that went through three iterations, integrating physiological sensing, on-device processing, and adaptive interventions. Controlled, non-human testing demonstrated real-time detection and intervention, with accuracies of 0.78 using SpO_2 only, 0.83 using snoring only, and 0.91 when both data streams were combined. Continuous observation confirmed system stability and responsiveness. The wearable prototype demonstrates the feasibility of a low-cost, non-invasive approach and lays the foundation for accessible sleep apnea monitoring and intervention, with potential to improve sleep quality and reduce associated health risks.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

[ ] Human participants [ ] potentially hazardous biological agents

[ ] Vertebrate animals [ ] microorganisms [ ] rDNA [ ] tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

[X] yes [ ] no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

[ ] yes [X] no

4. This project is a continuation of previous research.

[ ] yes [X] no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

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[X] yes [ ] no

Abstract: Science and Engineering Fair of Houston

3251

LiDAR Assisted Navigation Device (LAND) for Visually Impaired

Carter Collison

Conroe ISD /AST: Academy of Science and Technology

Category:

Embedded Systems

Currently, over 40 million people are blind, yet the best tool to assist them in navigating their environment is the white cane. The cane is limited by its range and field of view, resulting in 52% of people reporting annual head injuries. While canes are decent at preventing major accidents, they are outdated in this new era of technology. The purpose of my project was to develop a headset device that used LiDAR to detect objects and haptic vibrators to provide real-time location- and distance-specific feedback about obstacles. This engineering goal was achieved, and the headset's utility was evaluated with tests intended to be synonymous with real situations that blind people experience. Programming allowed for randomized distribution of objects and simple data collection. Results of the first two tests demonstrate the technical capability of the headset, with 98% accuracy at identifying the location and distance of stationary objects and an 82% accuracy at identifying quickly moving objects which represent environmental dangers and a risk to head injuries. The final, real world simulation demonstrated a 39% faster navigation from one point to another with the headset. Potential improvements to this device include adding different modes to customize the user experience, as is done with hearing aids, or improving feedback precision with piezoelectric actuators for the haptic feedback system. In summary, this inexpensive headset detects stationary and in-motion objects and can improve navigation and ease uncertainty of walking alone, which could improve the quality of life for a blind person.

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Abstract: Science and Engineering Fair of Houston

3252

The Problem You Can't Smell!: Atmospheric Methane Detection in Rural Areas IV

Addison Binford

Conroe ISD /ASHP: Academy for Science and Health Prof

Category:

Embedded Systems

Public awareness of climate change has been focused on the effects of CO2 in the atmosphere. However, recent studies have shown methane is also a key contributor to the greenhouse effect. Oil and gas production, septic systems, marshes, and glaciers are just some of the ways methane can be introduced into our atmosphere. We cannot eliminate all possible sources, but it is possible to observe and report when methane concentrations increase in your own area. Companies that make methane detectors have products that are either too expensive, bulky, or are made to detect large amounts of methane and ignore the small concentrations. The goal of this project is to design a methane detector that can be part of a large network of small, inexpensive detectors that are accurate enough to provide useful information. With too few people to check all the sites, it is possible that many methane leaks are missed. The idea here is to help industry by allowing the general public to help out with monitoring and reporting. For this project, I built a small methane detector capable of detecting methane concentrations of less than 1% in air, verified with 2.5% methane calibration gas. Additional experiments show this prototype detector is sensitive enough to detect concentrations below 0.5%. Overall cost to build this design is approximately $75USD. Most of the cost is the electronic components. This projects purpose is to help detect low concentrations of methane and discover the start of methane leaks before they become methane plumes.

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Abstract: Science and Engineering Fair of Houston

3253

IceAlert: Cost-Efficient, Easily-Integratable Black Ice Detection System for Vehicles

Nathalie McDaniel, Jaya Lal, Mira Pemmanda

Private/ST. JOHN'S SCHOOL

Category:

Embedded Systems

Black ice is a transparent, hazardous road condition that is difficult to detect visually and can cause sudden loss of traction, resulting in vehicle crashes. This project develops a real-time black ice detection system that combines low-cost embedded hardware with deep learning-based computer vision to identify ice on road surfaces. A vehicle-mounted near-infrared (NIR) camera connects to a Raspberry Pi which sits in a compact, weather-resistant enclosure designed for installation on a vehicle's front grill, providing a clear forward-facing view of the road while minimizing obstruction. An external LED, placed on the outside of the car in the front windshield, provides immediate visual alerts when black ice is detected. NIR imaging enhances contrast between dry pavement, wet pavement, and ice because these surfaces reflect NIR light differently. Captured images are analyzed with You Only Look Once Version 8 (YOLOv8), a real-time object detection model trained on annotated images collected indoors and outdoors. A data pipeline converts annotations to YOLO format, preserves train/validation/test splits, and applies augmentation (brightness variation, blur, weather simulation) to improve generalization. During operation, the system runs predictions on the live camera feed and assigns low, medium, or high hazard levels based on model confidence and estimated ice coverage, then triggers the LED alert. Additionally, the team is working on incorporating air temperature and humidity sensing to estimate dew point and flag conditions where ice formation is more likely and not possible, helping distinguish black ice from wet pavement that can appear similar in NIR.

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Abstract: Science and Engineering Fair of Houston

3254

Dual Stylo

Connor Brack, Juan Ortega, Jesus Saldana

Fort Bend ISD /Willowridge High School

Category:

Embedded Systems

A translator pen is a device that captures text and translates it into another language of your choice. ESL students often struggle with translating their language to another language, such as English. Roughly 10% of students are proficient in the TELPAS every year. This translator pen will help increase that rate because it is easy to use and very accessible.

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