Solemate: Electronic Shoe to Assist Visually Challenged

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Abstract— The Keen Shoes for the Outwardly Disabled venture presents a comprehensive arrangement to upgrade the security and independence of people with visual impedances. In expansion to the ESP-CAM and YOLO-powered protest discovery framework, the venture coordinating an ultrasonic sensor to identify sudden deterrents within the user's way. This extra layer of location guarantees a more strong security instrument, as the ultrasonic sensor instantly recognizes and communicates the nearness of unexpected deterrents to the client by means of the sound criticism framework.

The ESP-CAM captures real-time pictures, and the YOLO calculation forms these pictures for productive protest acknowledgment, cautioning the client to potential risks. At the same time, the ultrasonic sensor improves the system's responsiveness by identifying objects in near nearness, contributing to a more comprehensive and versatile security net. The Arduino Nano coordinates the consistent collaboration between these components, giving a cohesive and coordinates involvement for the client.

The consideration of an ultrasonic sensor adjusts with the project's commitment to making a proactive and flexible arrangement for the outwardly impeded. By combining cutting-edge advances, counting ESP-CAM, YOLO, and ultrasonic detecting, the Savvy Shoes for the Outwardly Impeded extend points to rethink portability for people with visual disabilities, advancing a more secure and more autonomous way of life. This extend not as it were addresses prompt security concerns but moreover opens roads for assist headways in assistive innovation for the outwardly disabled community.

Keywords— Smart shoe, Adruino, Yolo, terrain detection, ESPcam .

I. INTRODUCTION

Vision is one of the most important senses of as most of the information humans gets from the environment is via sight. WHO reported that in august 2014, about 285 million people suffer from lack of vision .It is estimated worldwide: 39 millionaire blind and 246 million have less vision. Around 90% of the visually impaired live in low income conditions. 82% of people living with blindness are around 50 and above. Globally, uncorrected refractive errors are the main cause of moderate and severe visual impairment; cataract is the leading cause of blindness in middle- and low-income countries. The number of people visually impaired from infectious diseases has reduced in the last 20 years according to global estimates work. 80% of the visual impairments can be prevented or cured. The basic problem which every blind person faces is with regard to commutation and navigation in daily life. The most basic tools for them are walking cane and guide dogs and also on kindness of fellow commuters. The most commonly used tool is still the blind stick. It suffers from drawbacks like lots of practice, range of motion, less reliability in terms of dynamic hurdles and also range detection. We will try to modify this cane with electronic components and sensors. The ever growing technology and with recent developments can help in artificial and accurate navigation. Our model uses GPS technology along with Bluetooth module which then will initiate an android application which will connect to Google maps for navigation. In addition we have used ultrasonic which help in obstacle detection and on hurdle recognition will ring the speaker for different durations to indicate different distances. We wish at presenting an inexpensive and light weight and accurate model which helps in effortless navigation for the blind. Distress mechanism will send locations of longitude and latitude to preregistered mobile numbers in situations of panic.

II. OBJECTIVE

- Create a dependable and productive protest location framework utilizing ESP-CAM and YOLO to recognize impediments and potential risks within the user's way.
- Coordinated an ultrasonic sensor to upgrade the system's responsiveness, recognizing sudden

impediments in near nearness and giving quick criticism.
- Actualize GPS following through the SIM808 module to empower real-time area observing and help for caregivers or adored ones.
- Utilize an Arduino Nano as the central handling unit to guarantee consistent communication and coordination among the different equipment components.
- Give sound criticism through earphones to transfer imperative data to the client, counting identified objects, course, and GPS area upgrades.

III. METHODOLOGY AND ARCHITECTURE

1.Requirements Analysis:
a.Define the specific requirements for YOLO-based object detection, ESP32 for image capture, and GSM-based GPS tracking.
b.Identify parameters such as detection accuracy, image capture frequency, GPS update intervals, and user preferences.

2.Hardware Integration:
a.Integrate the ESP32 for image capture, implementing the necessary interfaces for communication with the YOLO algorithm.
b.Integrate the SIM808 GSM module and configure it for GPS tracking.
c.Establish connections with the Arduino Nano to orchestrate communication between components.

3.YOLO Object Detection:
a.Implement the YOLO algorithm for real-time object detection using images captured by the ESP32.
b.Fine-tune YOLO parameters to optimize detection accuracy and efficiency.

4.GPS Module Integration (SIM808):
a.Integrate the SIM808 module into the hardware setup, configuring it for GSM-based GPS tracking.
b.Establish communication protocols between the Arduino Nano and SIM808 for retrieving and transmitting GPS data.

5.Software Development for YOLO and GPS:
a.Develop firmware for the Arduino Nano to control the ESP32, execute YOLO object detection, and manage GPS tracking through the SIM808.
b.Implement algorithms to process YOLO outputs, identify detected objects, and format GPS coordinates for transmission.

6.User Permissions and Preferences:
a.Implement user-friendly mechanisms for configuring object detection preferences, image capture frequency, and GPS tracking intervals.
b.Ensure clear interfaces for users to customize settings based on their preferences.

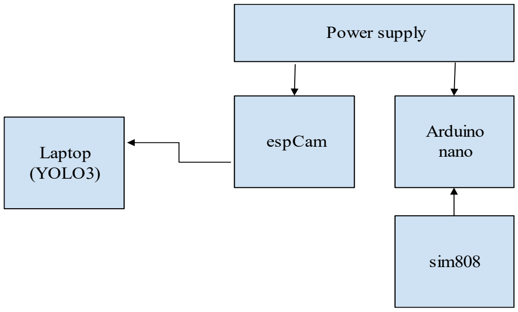
7.SMS-Based GPS Communication:
a.Develop firmware to enable the Arduino Nano to communicate with the SIM808 module for sending SMS messages containing GPS coordinates.
b.Implement secure communication protocols to protect the transmission of location data via SMS.

8.Remote Monitoring System:
a.Develop a remote monitoring system accessible to family members or caregivers.
b.Design interfaces to interpret YOLO-detected objects, GPS coordinates, and system status through a user-friendly platform.

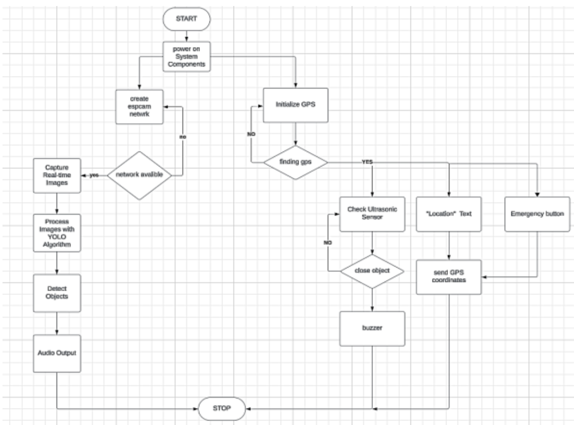
9.Testing and Calibration:
a.Conduct extensive testing to validate the accuracy and reliability of YOLO-based object detection and GSM-based GPS tracking.
b.Calibrate the system to account for variations in image conditions, GPS signal strength, and GSM communication.

10.Documentation:
a.Document the entire integration process, including hardware specifications, software functionalities, and user instructions for YOLO, ESP32, and GSM-based GPS tracking.
b.Provide clear guidelines for users and caregivers on how to interpret and utilize information provided by the system.

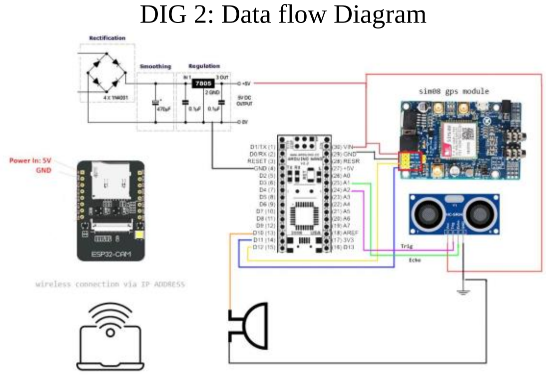
11.Continuous Optimization and Updates:
a.Implement mechanisms for continuous optimization of the entire system, addressing any identified issues or opportunities for improvement.
b.Plan for future updates and enhancements based on user feedback, advancements in technology, and emerging needs in the assistive technology landscape.



DIG 1: System Architecture



DIG 2: Data flow Diagram

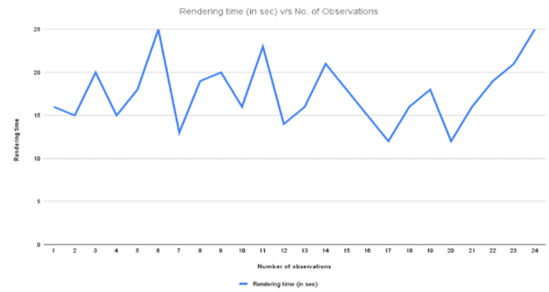


DIG 3: Circuit Diagram

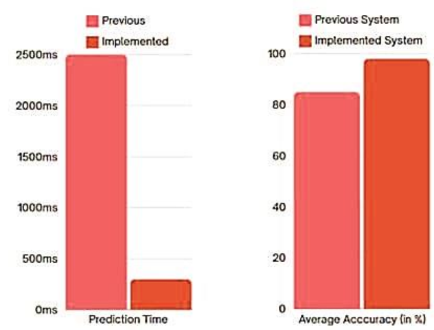
IV. RESULTS

The integration of advanced technologies like computer vision and machine learning has revolutionized the capabilities of wearable devices, particularly smart shoes. These innovative footwear solutions now employ state-of-the-art object detection algorithms such as You Only Look Once (YOLO) to enhance user safety, navigation assistance, and overall functionality. However, to ensure the effectiveness and reliability of these smart shoe systems, a comprehensive performance evaluation is imperative.

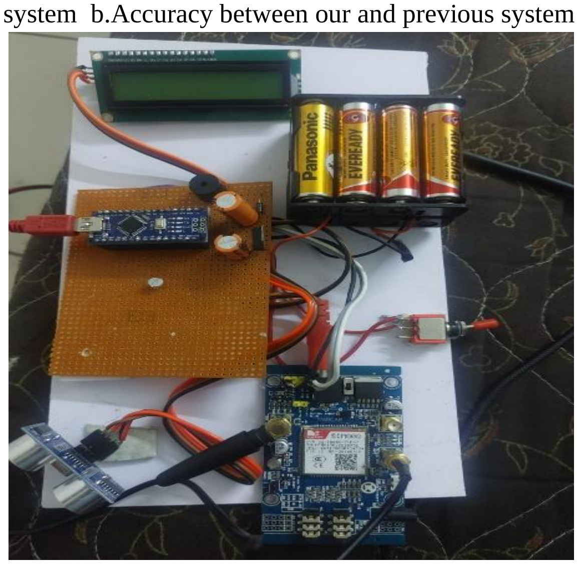
Here are the few observations made by us:-



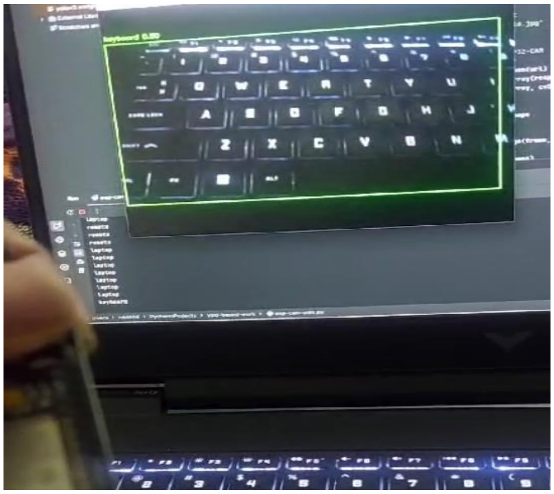
DIG 4: Rendering time vs No of Observation



DIG 5: a. prediction time between our and previous system b.Accuracy between our and previous system



DIG 6 : Circuit assembled



DIG 7 : Esp cam Recognising Remote

V. FUTURE SCOPE

1. Advanced Object Recognition: Future developments could focus on improving the accuracy and range of object recognition. Integration with more advanced computer vision algorithms or machine learning models could enhance the system's ability to identify a broader range of objects and environmental features.
2. AI-based Navigation Assistance: Implementing artificial intelligence (AI) for navigation assistance could enable the system to learn from user interactions and adapt to individual preferences. AI-driven navigation could also provide more context-aware guidance.
3. Integration with Wearable Devices: Integrating the project with other wearable devices, such as smart glasses or haptic feedback devices, could enhance the user experience. Wearables could provide additional sensory feedback and complement the audio-based feedback system.
4. Cloud-Based Services: Leveraging cloud-based services for data storage, processing, and updates could enhance the scalability and efficiency of the system. Cloud integration could also facilitate remote monitoring and management of the Smart Shoes.
5. Enhanced GPS Tracking Features: Future iterations could include features such as geo-fencing and route planning. This would enable users to set boundaries and plan optimized routes, enhancing their ability to navigate specific areas with confidence.
6. Enhanced Camera Technology: Integrating more advanced camera technologies, such as higher resolution sensors, depth-sensing cameras, or infrared cameras, could significantly improve the quality of image capture. This enhancement would contribute to better object recognition, especially in challenging lighting conditions or complex environments.

VI. LITRATURE OVERVIEW

1. The study "Smart Shoes for Visually Impaired People Using Sensors and Haptic Feedback" (Pradeepa & Shankar, 2023) presents a solution that uses ultrasonic and proximity sensors combined with customizable haptic feedback for comprehensive obstacle detection and spatial awareness. It integrates with smartphones via Bluetooth for navigation and data analysis. However, this reliance on smartphones increases cost and complexity, and the haptic feedback requires individual adjustments. Continuous sensory data processing also affects battery life.
2. In "Low-Cost Smart Shoe for Visually Impaired" (Ahamed, Abdullah, & Rashid, 2023), the authors utilize an Arduino microcontroller to create an affordable and accessible smart shoe focusing on core functionalities like obstacle detection and voice alerts. This open-source design allows further customization but lacks advanced features like GPS and haptic feedback. Voice alerts might not be suitable in noisy environments or for users with hearing impairments, and the Arduino platform may limit future software updates and feature expansions.
3. "Smart Navigational Shoes for Visually Impaired Person" (Patel & Darji, 2022) integrates GPS for route planning and voice guidance, offering vibration feedback for discreet navigation along with emergency alerts and fall detection for enhanced safety. The reliance on GPS can be affected by signal availability, and the complex navigation functionalities might require user training, also

resulting in increased battery consumption due to continuous location tracking.

4. The study "Smart Shoes for Climbing Stairs by Visually Impaired Individuals" (Iqbal, Khan, & Jeon, 2021) uses inertial measurement units (IMUs) for precise stair detection and step counting, providing real-time audio feedback to guide users. While the system aids in stair climbing, IMU-based detection may need further testing for reliability. The audio feedback might not be effective in noisy environments, and the feature set is limited to stair navigation.
5. "Development of a Navigation System for Visually Impaired People Using Smart Shoes and Mobile Sensing" (Lee, Lee, & Lee, 2019) combines smart shoes with smartphone sensors and cloud-based processing for obstacle detection and route planning. It offers personalized safety zones and virtual pathways, using machine learning to improve accuracy and user experience. However, this system's complexity, heavy reliance on smartphone integration and cloud computing, and the need for initial setup and configuration may pose challenges and raise privacy concerns.

VII. CONCLUSION

The Smart Shoes for the Visually Impaired project represents a significant step forward in leveraging technology to enhance the mobility and independence of individuals with visual impairments. By integrating advanced components such as the ESP32-CAM, Arduino Nano, YOLO algorithm, and pyttsx3, the project addresses the specific challenges faced by visually impaired individuals in navigating their surroundings.

The real-time object detection capability powered by the YOLO algorithm provides immediate feedback about the environment, enabling users to make informed decisions and navigate safely. The integration of pyttsx3 for text-to-speech synthesis enhances accessibility by converting visual information into audible cues, creating a user-friendly interface.

The project's applications span a range of scenarios, including obstacle detection, public transportation assistance, indoor navigation, and emergency response. The versatility of the system contributes to its potential as a comprehensive assistive technology solution.

While the project brings valuable advantages, such as enhanced mobility, adaptability, and real-time information, it is essential to acknowledge its limitations. Factors like object recognition accuracy, environmental constraints, and technological dependencies highlight areas for potential improvement.

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[3] Smart Navigational Shoes for Visually Impaired Person (R.A. Patel & M.B. Darji, 2022)

[4] Smart Shoes for Climbing Stairs by Visually Impaired Individuals (Z. Iqbal, M.A. Khan, & S.W. Jeon, 2021)

[5] Development of a Navigation System for Visually Impaired People Using Smart Shoes and Mobile Sensing (H. Lee, S. Lee, & H. Lee, 2019)