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Report on

IoT-based Smart Shoe

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Introduction/background

(with specific reference to the project, work done earlier, etc) - about 20 lines

Wearable devices are gaining popularity in the health sector for their convenience and portability. These devices, embedded into clothing or accessories, monitor physical activity, nutrition, health records, and sleep habits. A new proposal suggests creating a shoe-shaped wearable device specifically tailored for elderly people, children, and those with disabilities. Data collected from these devices can be shared with other compatible devices, leveraging the Internet of Things (IoT). IoT integrates various technologies like real-time analytics, cloud computing, machine learning, and sensors. It enables remote monitoring and control of systems, benefiting applications such as military operations, forests, and irrigation systems

Through the gathering of data from various existing technologies that data can then be shared between other compatible devices. Incorporating the Internet of Things into operations is becoming increasingly popular. This technology has diverse functions, including remote applications for military purposes, forests and irrigation systems which require minimal human interaction. The combination of IoT, machine learning, and mobile applications enhances services by utilising information collected from sensors and actuators connected to the Internet. This proposed system overcomes the limitations of existing models and provides advanced functionalities.

Objectives

1. Detecting and Identifying Obstacles, Objects, Road Signs, and Captions Scenes And Conveying Information to the user.
2. Distance Measurement and alert using Ultrasonic Sensors.
3. Emergency Message through GSM Module
4. Timely Alerts for the User and Guardian
5. Sound System for Alerting the User

The smart shoe framework incorporates various technologies, such as computer vision, ultrasonic sensors, GSM modules, and audio systems, to enhance safety and provide crucial information to the user by detecting and identifying obstacles, objects, road signs, and captions scenes, relaying distance measurements, enabling emergency communication, and generating timely alerts, the smart shoe aims to create a safer and more informed user experience.

Methodology

The system's hardware architecture consists of three main units: the sensing and navigation unit, the edge computing unit, and the mobile unit.

All sensors are connected to the edge computing unit where the computation is performed.

The sensing unit consists of a set of sensors, cameras, a GPS module, Ultrasonic sensors, push buttons, and an output sound alarm. The GPS device is used to track the location of the user. It is interfaced with the edge computing device via one of the USB ports of the edge computing device. The trigger and echo pins of the Ultrasonic sensors are interfaced with the GPIO pins of the edge computing device.

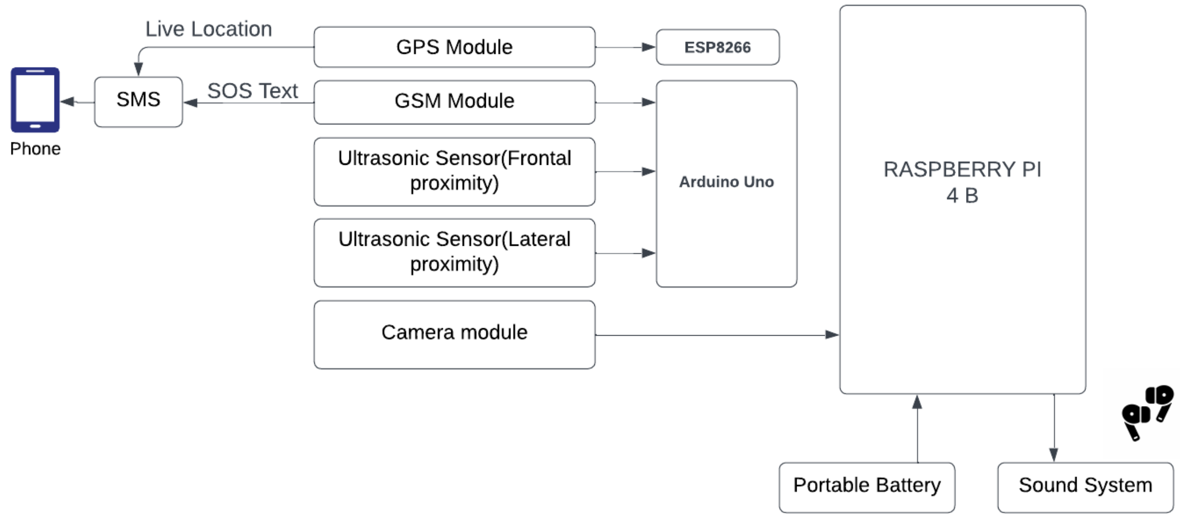

Fig. 1 Block diagram of IoT-based smart shoes

The flowchart describes the functionality of an IoT-based smart shoe that is equipped with several sensors and devices. The shoe uses two ultrasonic sensors - frontal and lateral - to detect obstacles within a range of 2 metres. If an obstacle is detected, the shoe provides a warning signal through buzzers. The shoe also has a GSM module that can send an "I'm fine" message if the user presses the buzzer by mistake. In case of an emergency, the user can press another button to send a distress message(SOS Text) that includes the location detected by the GPS module. All the data collected by the shoe for object detection is transmitted to a Raspberry Pi Model 4, which can also provide output through earphones for the same.

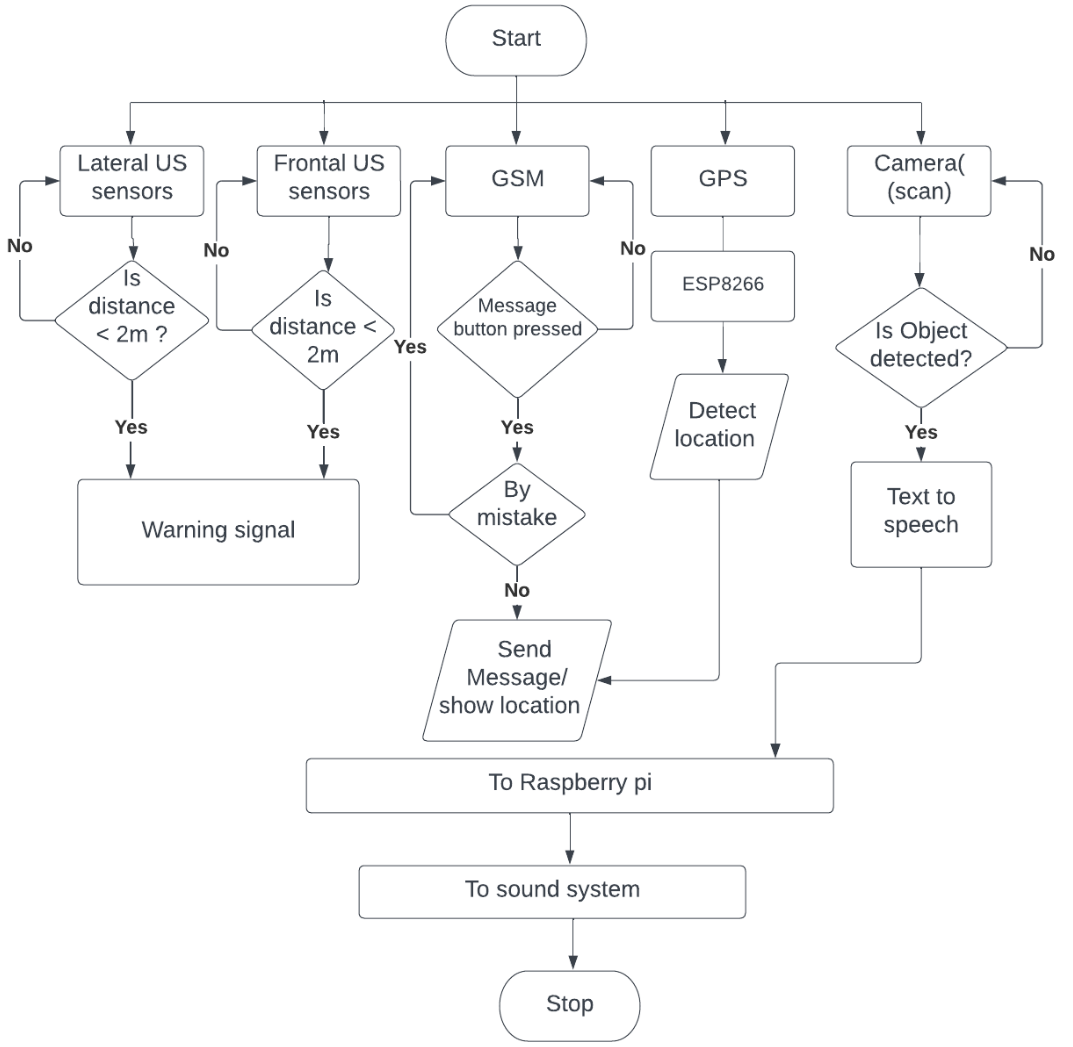

Fig 2: Flow chart of IoT-based smart shoe

Results and Conclusions

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http://maps.google.com/maps?q=13.119897,77.617141
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Fig:GPS location extracted from NMEA codes on serial monitor of Arduino IDE

The **GPS module** gives live location through satellite signals in the form of NMEA codes. These codes are broken down to get a subset of it which are the latitude and longitude values. The **GSM module** sends a message every time it is triggered with the button. Only message commands are used from the set of AT commands available for GSM functions. With every message, the live location is sent as a google maps link.

Ultrasonic sensors give continuous distance outputs in serial monitor and buzzer buzzes at frontal or lateral 20cm obstacle detection.

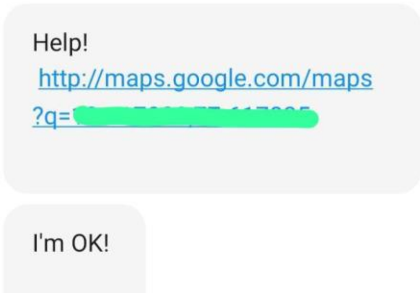
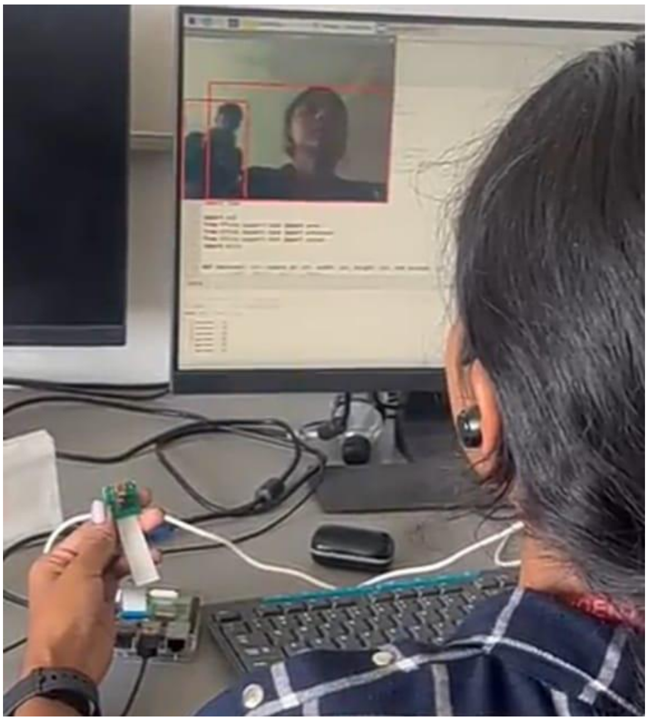


Fig 3: Message received by Guardian

Fig 4: SMS received by guardian

The Thonny IDE in the Raspbian OS legacy has 2 files.

1. Detect.py - Focusses on the model of object detection, it has parsers to run the raspberry as soon as it is powered on. To dump a machine learning model , tflite library is imported and the object detection through pi camera , by computer vision is executed. This gives us a list of objects found , which is converted to dictionaries to specify the number of objects present. This file is executed for the final output.
2. Utils.py - test4.py. All the requirements for detect.py are imported in this file. The gtts module for voice output is coded accordingly to get the output in earphones of the user.



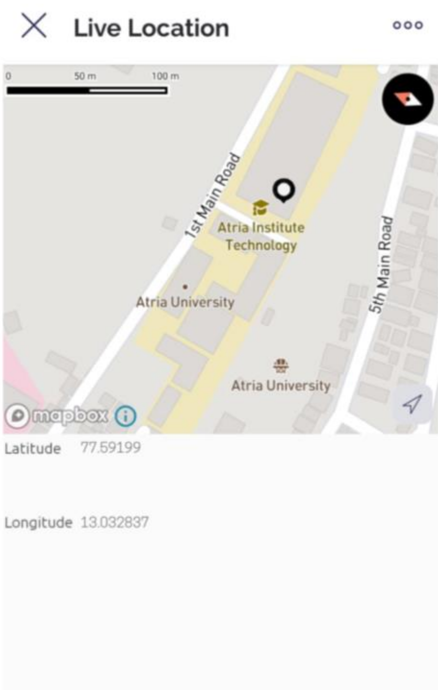


Fig 5: Object detection with sound using Raspberry pi 4

Fig 6: Live Location using Blynk App

GPS module, while connected to ESP8266, provides continuous live location access to the guardian. Blynk provides a mobile app available for iOS and Android devices.It shows the live location of the user.

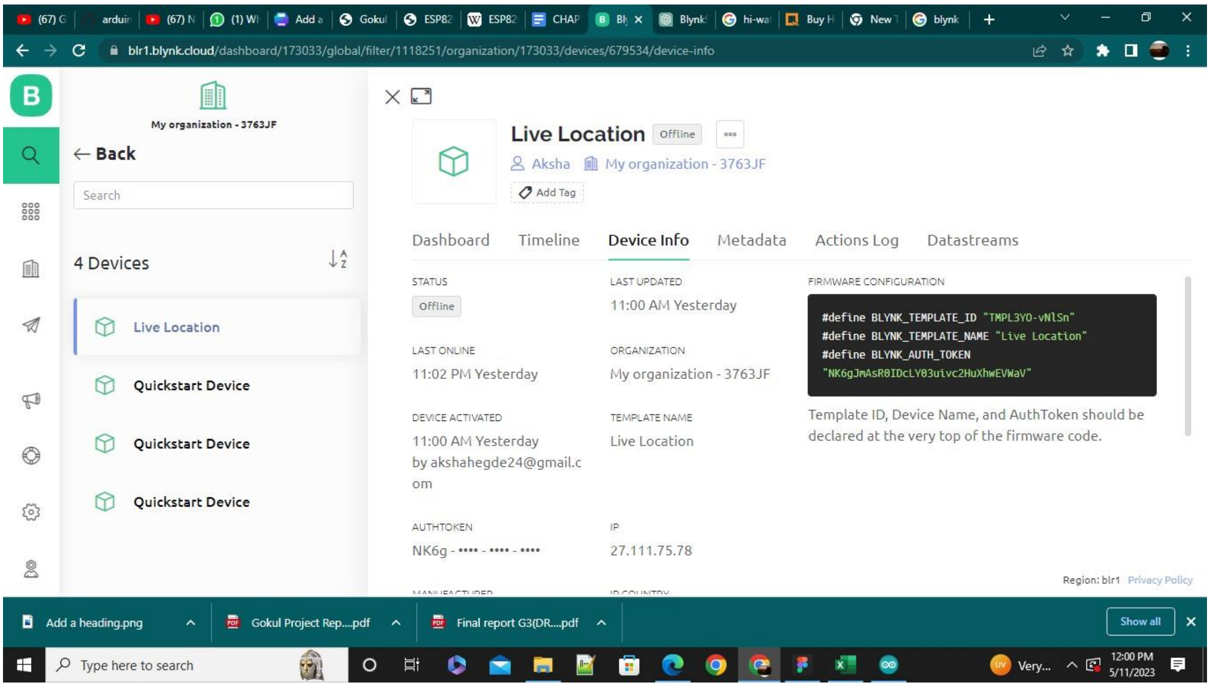


Fig 7: Blynk Web Dashboard

Scope for future work

With the existing technologies combined into a shoe, the model can be a technological blessing for people in need, especially visually impaired people. This shoe can be further modified and put into use in many other fields like-

1. Women Safety: GPS, and GSM feature enabled others disabled
2. Children safety: SOS Alert message to guardians
3. Alzheimer's Patients: Alerting Guardians and nurses
4. Visually Impaired people: All features

Captions can also be provided to the images captured instead of only objects. Below is the model developed which can be implemented in the near future when a tflite file of the same can be created for Raspberry Pi implementation.

Fig 8: Image input for image captioning model

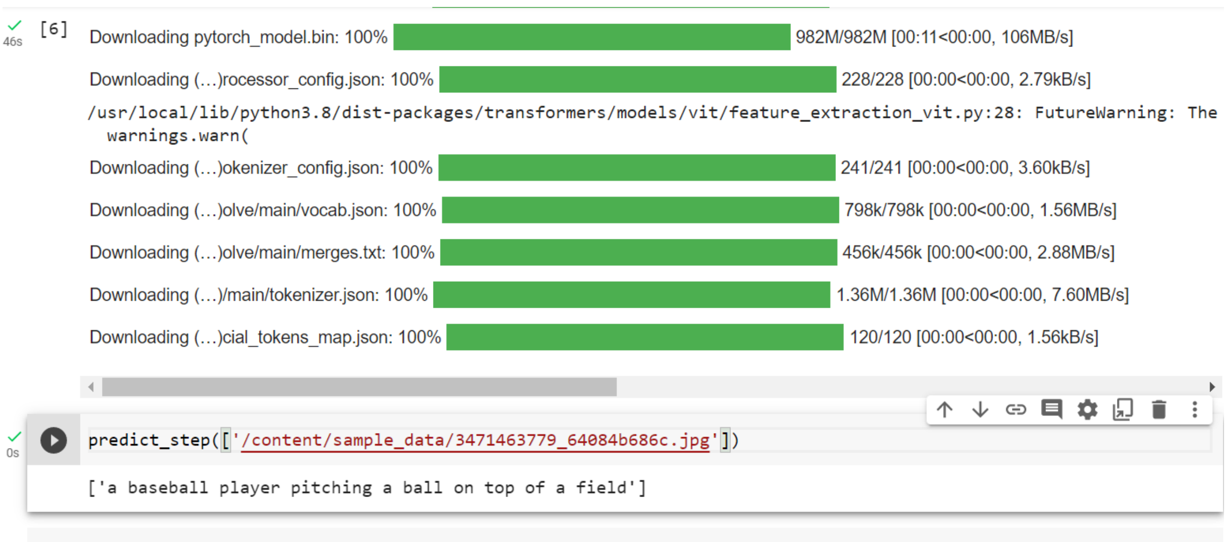


Fig 9. Image Caption Generation using Transformer

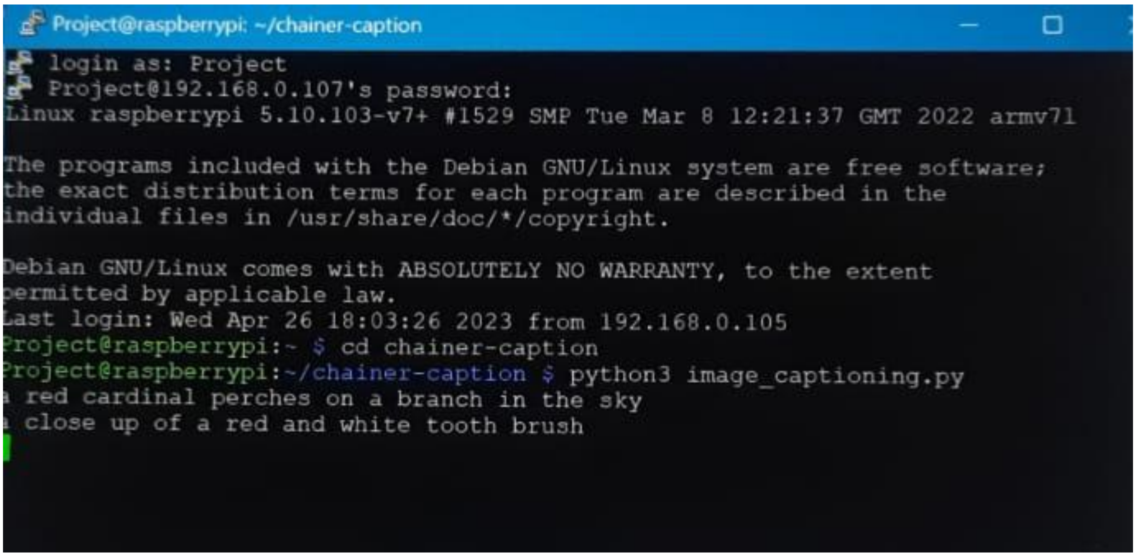


Fig 10 : Image captioning model implementation on Raspberry Pi 3 model through putty