Smart Gaurd

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***Abstract*— Individuals with mental disabilities face challenges in basic tasks and are vulnerable to exploitation, emphasizing the need for personal assistants and protective measures. The heightened risk of assault and human trafficking highlights the urgent requirement for personalized protection. Dependent on trusted companions, individuals with mental disabilities require personalized assistance for integration into society. Efforts to enhance their participation involve support services like personal assistants and protective measures. Our exploration of AI and embedded systems led to the development of the Security Guardian System. SGS, equipped with modules such as Arduino, GSM, GPS, HBS, face recognition, and Speech-to-Text converter, efficiently detects threats and aids individuals in distress.**

Keywords-SGS, Arduino, GSM, GPS, HBS, face-recognition, speech-to-text

I. INTRODUCTION

In today's world there has been a gradual increase in several birth of mentally retarded children due to lack of nutrition, lack of rest to the woman during her pregnancy, food, unusual hormone variations, and others. It is necessary to protect and safeguard these kinds of people who are very innocent to understand the things happening in society. Mental retardation is the developmental disability seen in children where the child's brain will not be developed or matured according to their age. Though there is an increase in their physical age, their mental age will be still unchanged and their thoughts will be the same. There are mentally challenged children who are poor in studies, who fight with everyone if they feel irritated, there will be fewer patients, and they will not be able to control their emotions.

The personal assistant and bodyguard make extensive use of sensors and actuators. Various kinds of sensors are used to check the condition of the mentally challenged person and several actuators are required to actuate according to the sensor signals. It is required to have a microcontroller for the working or proper functioning of these sensors and actuators together when required.

II. OBJECTIVES

- Nowadays it is a bit difficult for a mentally challenged girl to save herself from men as we can see several rape cases of these girls. Also, it will be an easy task for the human trafficking of these people. So it is necessary to have a personal assistant or a bodyguard for mentally challenged children. These mentally challenged people will listen to only those whom they love a lot and whom they admire the most.
- It is very difficult for a mentally challenged person to buy some goods from the market as they might not know the calculation of money or the vendors may misuse their innocence and may ask for more money from them. Sometimes they may forget the way home. So, a personal assistant has to assist and safeguard them.
- Today there has been a considerable increase in the birth rate of these kinds of children and it is a necessary thing to facilitate them to lead the normal life as others. Hence these personal assistants and bodyguards will help them to lead normal lives in this society.
- From this system whenever a person is under threat or has any kind of problem system has to sense the situation like the attacker's words or actions will be sent to his helpers through any kind of signals like calls or messages.

III. SOFTWARE REQUIREMENTS

A. Proteus Software

Cadence Tool: A collection of synthesis, place-and-route, and physical design tools for electronic design automation (EDA) of ASICs. The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Lab Center Electronics Ltd and is available in English, French, Spanish, and Chinese languages. The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape-based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high-speed design was added in 2017. [1] Feature-led product releases are typically biannual, while maintenance-based service packs are released as it is required.

B. Modules

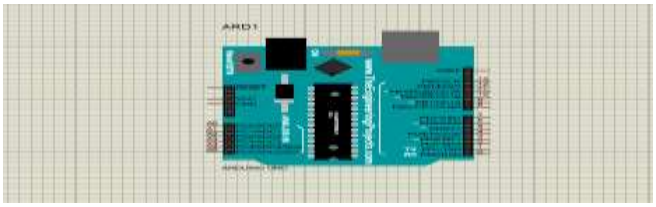


Fig 1: Arduino UNO

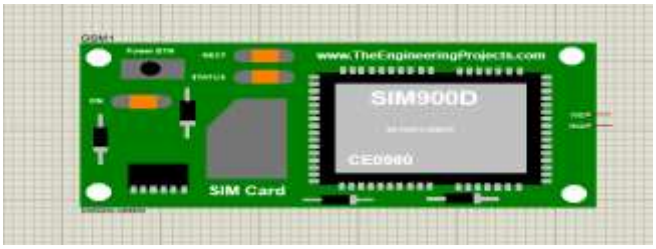


Fig 2: GSM Module

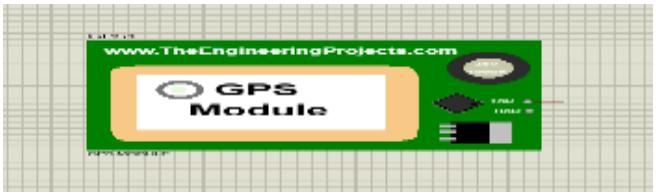


Fig 3: GPS Module

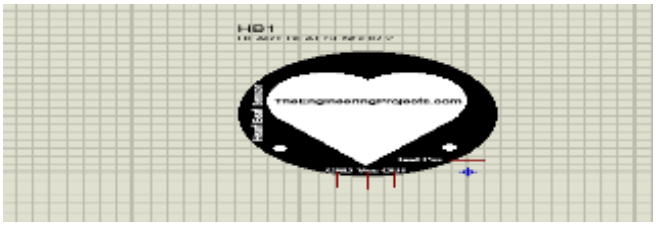
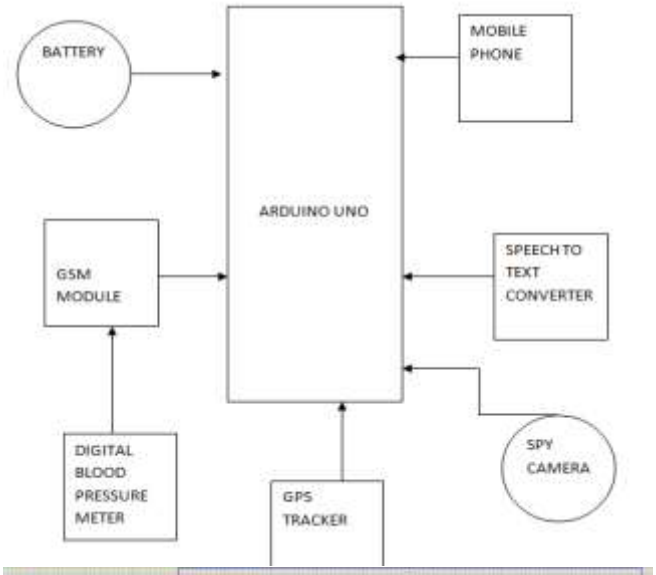


Fig 4: Heartbeat Sensor

IV. Methodology and Implementation

A. *Methodology*



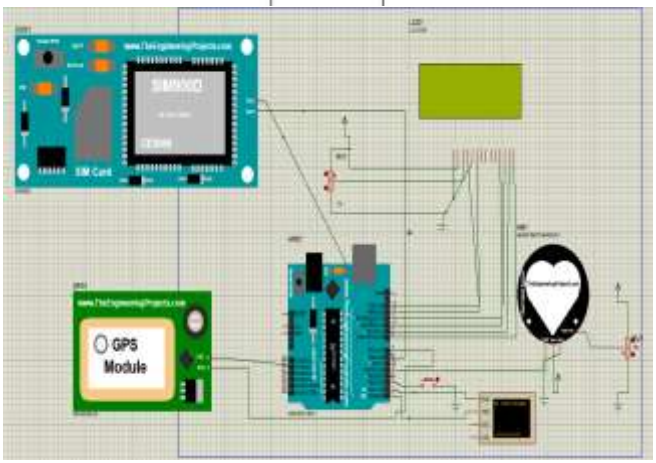


Fig 5: Circuit Diagram

B. *Circuits and Explanation*

1) *Theory of Heartbeat sensing technique :*

To change the default, adjust the template as follows Basically as shown in Fig 3.1, there are two ways to measure the heartbeat. The first way is the manual way while the second way is with the use of a sensor. Here in our project, we implemented the second way, i.e. the technique of measuring heartbeat with the help of a sensor called a heartbeat sensor(HB Sensor). The heartbeat sensor works based on the principle of photoplethysmography. It measures the changes in the volume of blood through any organ of the body due to which there is a change in the light intensity through that organ (avascular region). In the case of applications where the heart pulse rate is to be monitored, the timing of the pulses is the most important parameter to be calculated. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by the blood, the signal pulses are equivalent to the heartbeat pulses.

The heartbeat sensor consists of an LED (light-emitting diode) and a detector, maybe a light-detecting resistor or a photodiode. The heartbeat pulses cause variation in the blood flow to different regions of the body.

When the tissue is illuminated with the light source, that is when the light emitted by the lead, either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and some of it may be transmitted or the reflected light will be received by the light detector. The amount of light absorbed depends on the volume of blood in that tissue. The detector output is in the form of an electrical signal and it will be proportional to the heartbeat rate. Thus, heart rate is calculated corresponding to the amount of light received back.

2) *Theory of GSM technique :*

GSM stands for Global System for Mobile Communication. Nowadays, GSM is used by more than 800 million end users spread across 190 countries which represents around 70 percent of today's digital wireless market. In GSM, the geographical area is divided into hexagonal cells. The sides of the hexagon depend upon the power of the transmitter and the load on the transmitter (number of end users). At the center of the cell, there is a base station that consists of a transceiver (combination of transmitter and receiver) and an antenna.

GSM is a combination of TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access) and Frequency hopping. GSM uses two frequency bands of width 25 MHz that range from 890 to 915 MHz frequency band for up-link and 935 to 960 MHz frequency for down-link purposes. Later on, two 75 MHz bands were also added ranging from 1710 to 1785 MHz for up-link and 1805 to 1880 MHz for down-link. Up-link is nothing but the link from the ground station to a satellite while down-link is the link from a

satellite down to one or more ground stations or receivers. GSM divides the 25 MHz band into 124 channels each having 200 KHz width and the remaining 200 KHz will be left unused as a guard band that avoids interference.

3) Theory of Face Recognition :

As it is a real-time face recognition in which we access the camera through OpenCV. Many algorithms can be applied for face recognition like Eigenfaces, Local Binary Patterns Histograms (LBPH), Fisherfaces, Scale Invariant Feature Transform, Speed Up Robust Features (SURF), etc.

But LBPH is one of the easiest face recognition algorithms. It can represent local features in the images. It is possible to get great results (mainly in a controlled environment). It is robust against monotonic grayscale transformations. LBPH extracts features from every collected image, unlike other algorithms which consider all the collected image datasets as a whole. In our project, we collected around 100 images for each label in the dataset to train the dataset. We used OpenCV to collect and train the dataset. We use the train.yml file to train the model.
For face detection, we used a Haar cascade classifier to detect the face. Using a Haar-like feature, there is a search for the desired object. Boosting is used to select the most suitable features for the desired object in a given part of the image. By combining all the features, we detect the human face.

For face recognition Divide face images into local regions to extract LBP histograms. The LBP histograms extracted from each sub-region are used for calculation and combined into a single histogram. The nearest-neighbor classifier is used to match the new image with the trained template. From this, we identify the real-time detected image as one of the trained labeled images. The accuracy from this algorithm is stored in a text file and then given to the Arduino directory.

4) Theory of Speech Analysis :

Speech-to-text is the process of recognizing the voice and representing it in a textual manner. For speech recognition, we can use different deep speech algorithms like automatic speech recognition, computer speech recognition, or just speech-to-text. A hidden Markov model (HMM) is a statistical Markov model in which the system being modeled is assumed to be a Markov process with unobserved states.

In our project, we used a speech recognition package that contains many different libraries or classes from which we convert speech to text. Python supports many speech recognition engines and APIs, including Google Speech Engine, Google Cloud Speech API, Microsoft Bing Voice Recognition, and IBM Speech to Text. We used two more packages like pyaudio. The PyAudio library serves as a cross-platform Input-Output module and provides bindings with PortAudio.

Speech recognition APIs work by breaking down the audio of a speech recording into individual sounds, analyzing each sound, using algorithms to find the most probable word fit in that language, and transcribing those sounds into text.

For speech sentiment analysis we used the textblob package which contains all the NLTK APIs required to apply all the NLP tasks. Sentiment analysis is the process of determining the attitude or the emotion of the obtained text, i.e., whether it is positive negative, or neutral. The sentiment function of textblob returns two properties, polarity, and subjectivity. Polarity is a float that lies in the range of [-1,1] where 1 means a positive statement and -1 means a negative statement. Then this float value is stored in a file and given to the Arduino directory.

5) Theory of GPS technique :

Global Positioning System (GPS) is a worldwide radio-navigation system formed from the constellation of 24 satellites and their ground stations. The Global Positioning System is mainly funded and controlled by the U.S. DOD (Department of Defense). The system was initially designed for the operation of the U. S. military services. But now, there are many civil users of GPS across the whole world. At present, civil users are allowed to use the Standard Positioning Service without any kind of charge or restrictions.

As shown in Fig 3.2, Global Positioning System tracking is a method to fetch information about exactly where something is. For example, a GPS tracking system may be placed in a vehicle, on special GPS devices, or on a cell phone. GPS units can either be fixed or portable. GPS works by providing information on the exact location. It can also track the movement of a vehicle or person. So, for example, a GPS tracking system can be used by a contract company to monitor the route and progress of a delivery truck, and by parents to check on the location of their child, or even to monitor high-valued assets in transit.

A GPS tracking system uses the Global Navigation Satellite System (GNSS) network. This network incorporates a range of satellites that use microwave signals that are transmitted to GPS devices to give information on location, time and direction, and vehicle speed. Hence, a GPS tracking system potentially gives real-time and historical navigation data on any kind of journey.

V. RESULTS AND DISCUSSION

A. Results

For face recognition we have used Python as our major programming language and using IDLE interpreter we have developed an LBPH face recognition system with the help of OpenCV. As we have used our laptop camera to recognize the face due to present circumstances, the accuracy level decreased a bit due to a decrease in image quality. Even though we tried to get accuracy i.e., confidence level in this project as much as possible in the range of 65% - & 75%. Therefore, to interface with the Arduino we stored it in a file and given to the Arduino directory.

For speech recognition by accessing the laptop microphone by audio library, the speech made by us is converted using google_speech API, and using textblob NLTK tool the speech sentiment is detected which gives then float value between -1 to 1 in which -1 to 0 is negative speech and 0 to 1 is positive speech. These float values are then given to Arduino by storing it in a file to interface it.

The heartbeat sensor, GSM Module, and GPS Module are interfaced with the Arduino UNO board to get a desirable and

proper link. The software we used for the implementation is the Proteus 8 Professional. First, the Arduino is interfaced with the heartbeat sensor, and a potentiometer of suitable value is selected and connected to the sensor. A button will be connected to the UNO board. The output will be displayed both in LCD and Virtual terminal via GSM Module when the button is pressed with the help of Serial software.h library of Arduino IDE. Similarly, the latitude and longitude values calculated by the GPS Tracker will be interfaced with the GSM Module, and the output is obtained in the Virtual terminal. For interfacing tiny GPS with Arduino, we need to include the TinyGPS.h library in Arduino IDE. Finally, the Speech recognizer and Face recognition outputs are interfaced with Arduino using the concept of exporting the file into Arduino.

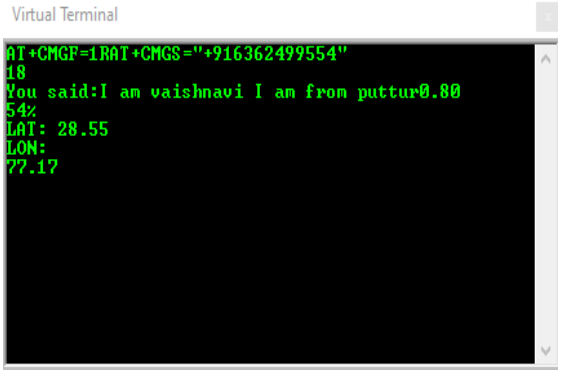


Fig 6: Virtual Terminal Output

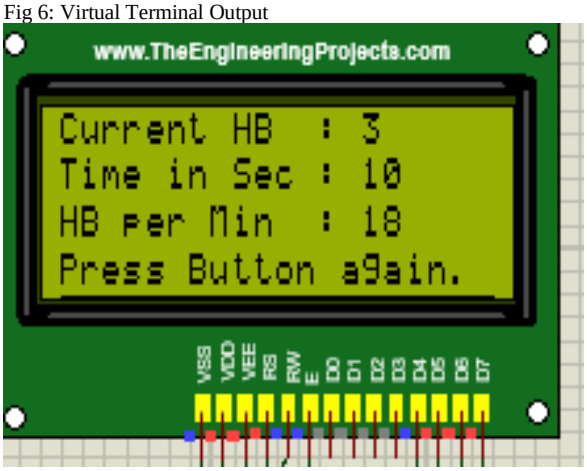


Fig 7: LCD Output

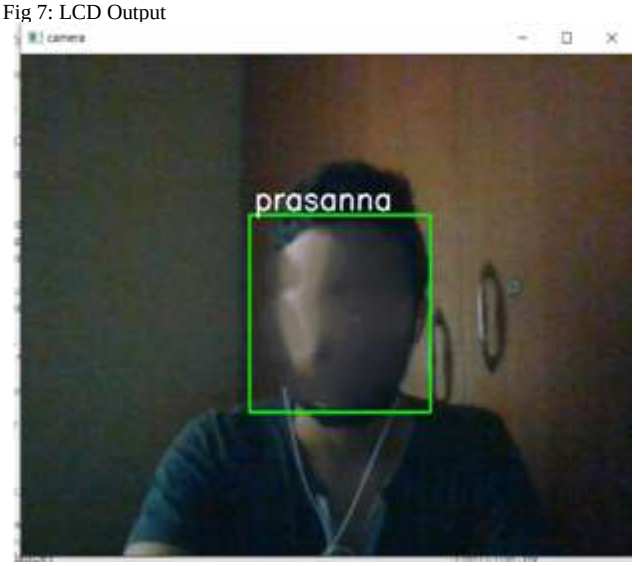


Fig 8: Face Recognition output (Blurred image to hide identity)

B. Discussion

As discussed in the result part, the accuracy level decreases a bit due to the usage of the laptop camera. So, in Arduino, we gave the condition that if the accuracy level is less than 50% then it checks for speech output i.e., if the speech is less or greater than 0. As we are using speech, face, and heartbeat sensing, the dip in the accuracy level of face recognition is compensated by the other 2 parameters.

With the increase in resistance value potentiometer used in the heartbeat sensor, the heart rate per minute decreases. This is because, as blood volume decreases, there will be more reflected light in the HB Sensor leading to an increase in resistance of the photoresistor used in the Sensor. Thus, as the resistance of the potentiometer varies there will be variations in HB rate corresponding to real-time variations.

As we are using the GSM Module in the software, we cannot put the SIM card into the module. So, it cannot send the message to any client but if implemented to hardware it is possible to send the alert message to the client. In Proteus software, we have shown the output by sending the alert message to the virtual terminal.

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