Home Security for the Visually Disabled

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Abstract— Over the course of the last few decades, security systems have undergone radical overhauls and have transitioned into such sophisticated devices that some even completely shun any form of human interventions. Inspite of its tremendous innovations, however, such setups have not yet made their way into homes and residences, partly owing to the fact that the equipment bear high price tags and lack user friendliness.In today's fast paced world, where everyone is engaged in their work, blind or disabled members of the family are left alone at home. As a consequence, guardians will neither be able to concentrate on their work, nor take care of their loved ones. This paper aims at providing a system concept and prototype model to provide a safety system for the blind and disabled. This system provides measures for overall detection of movement outside the house and alerting the person inside. It also aims at identifying the person at the door based on biometric authentication. This user friendly system is cost effective. It accounts for safety of the person at home and also peace of mind of the guardian.

Index Terms— Bluetooth, camera, database, doorbell, fingerprint.

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1 INTRODUCTION

ACCORDING to estimates by the World Health Organization, about 285 million people suffer from some kind of visual disability, of whom 39 million are blind, resulting in 0.7% of the world population.

Up lately, the need for household security has spiraled up significantly. Combined with the fact that home owners of today lead inherently busy lives, the upsurge of premise burglary over the past years has called for a more up-to-date method of dealing with intruders across homes. Many a times, it happens that the residents of a home leave the main door unlocked while going out or leave their disabled loved ones alone at home, which calls for nothing but trouble.

One method to restrict entry to homes that has been widely adopted over the last few years is access control system. Access control system is the selective restriction of access to a place or other resource by the means of passwords, keycards or biometric verifications. When a credential is presented to a secure reader, the reader attempts to verify the authenticity of the credential information, and passes it to a microcomputer. The control panel relates the credentials to an access control list, allows or denies the presented request, and sends a transaction log to a database. For cases where access is denied in accordance to the access control list, the door remains locked. If

there is a match between the credential and the access control list, the control panel drives a relay that releases a magnetic lock, which in turn unlocks the door. Compared to traditional locking mechanisms, today's access control systems are fairly reliable and have garnered quite a reputation in the security sector. Despite the availability of such sophisticated home entry mechanisms, foolproof residence security is still an unaccomplished chapter today. As mentioned earlier, the occupants of homes tend to leave the entrances open, welcoming intruders or would-be criminals. It is needless to mention that credentials can be passed around, thus sabotaging the access control system. If someone knows someone else's password or steals his or her keycard, that person can gain access without the latter's consent.

To combat this, we have used fingerprint authentication. Our solution approach aims to develop a security solution for homes that would differentiate between genuine visitors and intruders. It also focuses on detection of even the slightest movement outside the door, even before the person approaches the doorbell. In case of genuine visitors, the blind person will be notified that it is safe to open the door and let the person into the house. Whereas in case of intruders the inhabitants as well as the guardians will be alerted. Here, no use of password based authentication proves to be an advantage to the inhabitants, which in turn is a disadvantage for the intruders.

2 LITERATURE REVIEW

Research in the field of household security is not a novel concept. In fact, over the years that have followed up, there has been a growing trend in the exploration of smart systems

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that attempts to spontaneously recognize people and allow access. We have referred few papers and come out with the research work of a few of them.

- In their paper "Intelligent Intrusion Prevention System For Households Based on System-On-Chip Computer"[1], the authors came up with a real-time monitoring system that attempts to detect motion and whenever some movement is sensed, it starts to record the video feed for viewing offline later. The real-time video feed can be accessed from smartphones or computers through web browsers. The system does not provide any automatic access control to open or close the main door. The biggest drawback of the system, however, is that it cannot intelligently detect intruders and just rely on the owner's discretion to decide on that.

- In their paper "Study of Automated Face Recognition System for Office Door Access Control Application" [2] researchers have proposed a surveillance system which records video upon detecting motion, uploads it to the cloud and sends notifications to the household's owners through text messages. This system also cannot spontaneously identify visitors.

- In the next paper "Face Recognition and Spoofing Detection System Adapted To Visually-Impaired People" [3], authors devised a system that would open the door upon recognizing a known face and raise an alarm for unknown faces. The system is very innovative but it skips a pretty big question. What if the unknown person was some genuine guest or a delivery man? It is just not feasible to ring an alarm every time an unknown person comes about.

3 PROPOSED SYSTEM

This project focuses on ensuring safety of blind and physically challenged people inside their houses and making them aware of their surroundings.

This project consists of:
- A device fitted at the door which detects motion of objects outside and alerts the person inside the house with a beep sound.
- A database which consists of a record of finger print id along with the name of the person.
- A finger print scanner at the doorbell, which captures the finger print of the visitor when the bell is rung.
- The finger print captured is compared with those in the database. If a match is found, a speaker present in the house announces the name of the visitor so as to inform the blind/disabled person inside as to who is at the door.

- In case a match is not found, the camera present at the door captures an image of the visitor and sends it to the guardian of the blind/disabled person on his android phone, who then views the image. A call is then connected to the blind/disabled person, who then takes the opinion of the guardian before answering the door.

- A device fitted on the belt of the blind person so as to alert him before he bumps into objects.

4 HARDWARE REQUIREMENTS

4.1 Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (*shields*) and other circuits. Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. A program for Arduino may be written in any programming language with compilers that produce binary machine code for the target processor. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java.

Fig1. Arduino

4.2 R307 Fingerprint Scanner

In R307 fingerprint scanner, a high powered DSP chip does the image rendering, calculation, feature-finding and searching. This fingerprint scanner uses the Adafruit fingerprint sensor library. We can enroll new fingers directly- up to 162 finger prints can be stored on the onboard FLASH memory. There is a blue LED in the lens that lights up during a photo so you know it is working. There are basically two requirements for using the optical fingerprint sensor. First is you'll need to

enroll fingerprints -that means assigning ID #'s to each print so you can query them later. Once you have enrolled all your prints, you can easily 'search' the sensor, asking it to identify which ID (if any) is currently being photographed.

Fig2. R307 Fingerprint Scanner

This sensor consists of 6 pins. In which, the first wire from the left is the black wire ground, then the two data pins, RX is the white wire, TX is the green wire and then the red power wire. This sensor is not only easy to use, but it also comes with fairly straight-forward Windows software that makes testing the module simple.

The code is uploaded to the Arduino as usual. In case a match for the fingerprint is found, the sensor returns the ID of the fingerprint and a confidence value. The 'confidence' is a score number (from 0 to 255) that indicates how good of a match the print is, higher is better.

4.3 PIR Motion Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. They are low power and low cost, pretty rugged, have a wide lens range, and are easy to interface with.

Most PIR modules have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the final one will be power. Power is usually 3-5VDC input but may be as high as 12V. Sometimes larger modules don't have direct output and instead just operate a relay in which case there is ground, power and the two switch connections.

Fig3. PIR sensor

4.4 HC05 Bluetooth Module

HC-05 module is an easy to use Bluetooth module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc. The HC-05 Bluetooth Module has 6pins. They are as follows: enable, Vcc, Gnd, TXD & RXD, state, button switch.
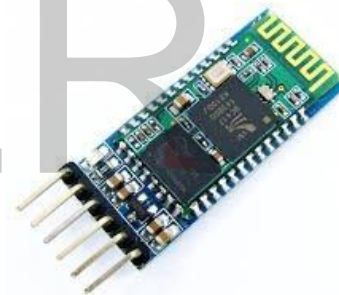

Fig4. Bluetooth Module

4.5 Ultrasonic Sensor HC SR04

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The ultrasonic sensor has four pins. They are VCC, trigger pulse input, echo pulse output and ground.
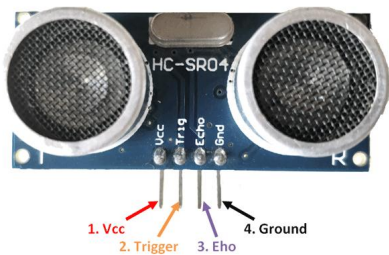
Fig5. Ultrasonic Sensor5

5   SOFTWARE REQUIREMENTS

5.1   Thunkable App Inventor

Thunkable App Inventor makes building Android apps easy for everyone. It is a drag and drop programming tool to let you build any app you can think of. We can use the Thunkable app to help develop your own Android apps. Connect any project you are working on at thunkable.com to your Thunkable app over WiFi, to make your app work. The app mirrors everything you do on thunkable.com, so as you change your app on thunkable.com, it will automatically update on your phone, where you can instantly see the result of your change and interact with it.

5.2   Cloud Stitch

Cloud stitch provides us with spreadsheets using which we can store the fingerprint ids returned by R307 fingerprint scanner and the name of the person. This database is maintained in the cloud and is connected to our app via the URL. Cloud stitch provides us with the ability to utilize the database as and when needed. Also, we can modify the database as per our wish

6   IMPLEMENTATION

This project presents a system concept and prototype model to provide a safety system for the blind/disabled. This system is intended to provide overall measures for detection of movement outside the house and ensuring the safety of the blind/disabled person when alone at home.
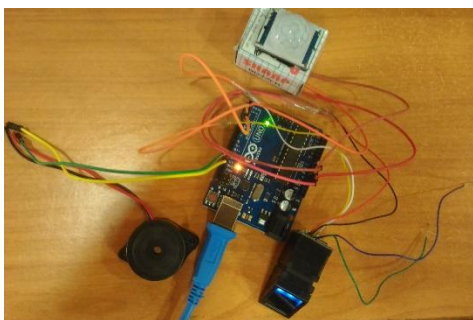

Fig6. System prototype

The system consists of an Arduino, the guardian's and disabled person's android phones, camera, finger print sensor, ultrasonic sensor etc. The finger print scanner scans the finger print of the visitor when he rings the doorbell. R307 fingerprint scanner used here returns the respective fingerprint ids for each stored fingerprint along with a confidence value. In case the fingerprint which is being scanned is not recognized by the fingerprint scanner or if the id is not found in the cloud stitch database, the value 0 is returned.

The finger print id is compared with those in the cloud stitch database. The "Keep me safe!" app running on the disabled/blind person's android phone receives the values returned by the fingerprint scanner through Bluetooth using the Bluetooth module. The app then goes on to find the corresponding name stored along with the fingerprint id from the database. Text to speech conversion then takes place and the android phone present with the disabled person then announces the name of the person at the door.

Another app contains the camera feature to click a picture. The phone in which this app runs is placed in a case and placed at the door. In case the fingerprint id returned by R307 does not match with those present in the database (meaning a new visitor has arrived at the house), this particular app clicks a picture of the person at the door and send it to the guardian. The guardian then receives this picture on his phone and is alerted by a notification. He then views the picture and connects a call to the blind/disabled person at home, so as to alert him in case of an unknown visitor or in case otherwise tell him that a known relative is at the door and that it is safe to open the door. Also, in case of an unknown visitor, i.e. in case a match for fingerprint id is not present in the database, the android phone present with the disabled person speaks up asking him to be aware.

A wearable device containing the ultrasonic sensor and a buzzer will be fitted on the belt of the person to alert him before he bumps into objects.

7   KEEP ME SAFE APP

This app contains various features.
Firstly, it receives values returned by the fingerprint scanner via Bluetooth and compares them with the cloud stitch database. In case a match is found, it finds the corresponding name stored along with the id and does a text to speech conversion. In case a match is not found, it gives the person a "be aware" message. This alerts the blind person who is alone

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at home about the identity of the person at the door.

Secondly, Keep me safe! app is present in the android phone which is placed in a case at the door. This app clicks a picture of the person who is at the door in case a match for the fingerprint is not found and sends the image to the guardian who is away from home at the moment.

Next, Keep me safe! app present with the guardian receives images of the person at the door in case of new visitors and alerts the guardian with a notification. The guardian then views the image and a call is connected to the disabled person at home in order to alert him.
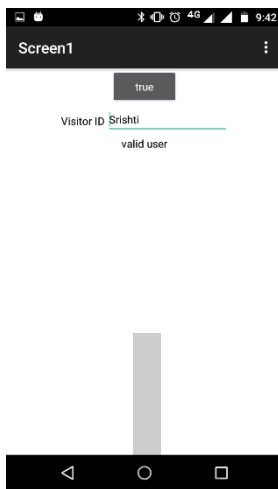

Fig7. App displaying known person

Fig8. App clicks picture in case of unknown visitor

8 RESULT

"Keep me safe!" is focused on ensuring safety of blind/disabled people when alone at home. It helps them know the exact identity of the person at the door before answering the door. It also aims on detecting any movement outside the house and alerting through a beep sound.

Ultimately, it also accounts for the peace of mind of the care takers of the blind/disabled, who may be busy with their schedule

9 CONCLUSION

The recurring concern of sound household security cannot be resolved by a single package. Nevertheless, as opposed to commercially available systems, our solution provides a smarter, more user friendly approach which comes at a lesser cost. The components are readily available at electronics hobbyist shops and do not escalate the total system's cost from any aspect. The main drawback of visually impaired is that they deprive themselves of what they deserve. Home security for visually disabled helps them in making them confident and independent.

In this paper, a detailed explanation about home security for visually disabled has been given. With the introduction of this prototype, the lives of visually impaired will become much easier and independent. It is user friendly, easily adaptable and has multipurpose functionality. Our designed system has shown satisfactory performance in real world tests and as such it assets a practical implementation.

10 FUTURE ENHANCEMENT

We can also use raspberry pi and interface with Arduino to develop the following features which can be more helpful for the visually impaired people:

- People with visual impairment face various problems in their daily life as the modern assistive devices are often not meeting the consumer requirements in term of price and level of assistance. We can develop a new design of assistive smart glasses for visually impaired, which will assist in multiple daily tasks using the advantage of wearable design format. The application, i.e. text recognition technology that can help reading from hardcopy materials. The building cost can be kept low by using single board computer raspberry pi as the heart of processing and the raspberry pi camera for image capturing.

- A low cost outdoor assistive navigation system for blind people can be developed i.e. an off-line navigation device that uses 3-D sounds to provide navigation instructions to the user. The device relays directional information to the user through special Audio Bone

headphones, which use bone conduction technology. Sounds are recorded and can therefore be selected by the blind user. Navigation processing is handled by a Raspberry Pi. We can use a magnetic compass and gyroscope to calculate the direction that the user is facing. Route queries of the destination address are geocoded using the Geo-Coder- US module and passed to the MoNav module to generate a pedestrian route. Additional capabilities of the device include speech recognition and voice prompts for obtaining the user's desired destination address. The user can input the address by speaking into a microphone. The entire system is mounted to a pack that sits on the user's waist. It will be very light and portable and it does not impede any of the user's senses while it is being used.

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