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Analysis of an Advanced, Automated and Secured Home System for the People with Disabilities- Special Reference to the Deaf People

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Abstract: *This paper presents the implementation of an advanced home automation and security system designed for people with disabilities, with a particular focus on those who have hearing problem. The system is designed to improve accessibility and provide advanced security features through the use of modern microcontroller and machine learning technologies. Many modern sensors were utilized to detect changes in the environment- including fire, temperature, motion, and sound sensors. The machine learning algorithm was trained to analyze the sensor data and provide advanced security features, such as facial recognition, to enhance safety. The system was also equipped with a notification system that alerts individuals of any emergency situations even if they are not in the same room. The system was made user-friendly and customizable, allowing individuals to control their home environment according to their specific needs and preferences. The machine learning algorithm was effective in analyzing sensor data and providing advanced security features, such as facial recognition to enhance safety. By providing an accessible and reliable home automation and security system, individuals can have greater independence and autonomy in their daily lives.*

Keywords: ***Home system, Security, Disabilities, Machine Learning, Arduino, Deaf.***

1. Introduction

The world is evolving at a rapid pace with technology advancing faster than ever before. Home automation systems have become increasingly popular in recent years, offering convenience, comfort, and security to homeowners. The development of these systems has been driven by the need for greater energy efficiency and security, as well as the desire for greater control and ease of use. One particular group of people that stands to benefit greatly from home automation systems are those with disabilities, especially the deaf. Home automation systems offer several benefits for the Deaf, including improved safety and security, increased independence and autonomy, and greater accessibility. For the Deaf, who may not be able to hear alarms or other warning signals, home automation systems can be programmed to alert them through visual or tactile signals, such as flashing lights or vibrations. This can help them to quickly respond to emergencies, such as a fire or break-in. With home automation systems, the Deaf can control various aspects of their homes, such as lighting, temperature, and security, with ease. This can help them to feel more in control of their environment and reduce their reliance on others.

Home automation systems also offer greater accessibility for the Deaf. For example, the app includes a messaging feature that allows the Deaf to communicate with their family or caregivers through text messages. The app also includes a voice recognition feature that can be used to control the various devices and sensors in the home.

The system has been tested in a residential home with a Deaf resident and has been shown to be effective in improving safety, security and accessibility for the Deaf. The system was able to detect potential hazards and emergencies and alert the Deaf resident through visual and tactile signals, allowing them to quickly respond to the situation.

Fig 1: Advanced Home Automation and Security System for the deaf People.

2. State of Home Assistant for Deaf People in Bangladesh

There is limited research on the implementation of home automation and security systems for the Deaf in Bangladesh. However, given the high prevalence of disabilities in Bangladesh, particularly among the Deaf, there is a growing need for accessible and effective home automation and security systems in the country. According to a 2013 survey by the Bangladesh Bureau of Statistics, approximately 7.5% of the population has a disability, with hearing disabilities being one of the most common types of disabilities (Bangladesh Bureau of Statistics, 2013). However, the Deaf in Bangladesh face significant barriers in accessing essential services and resources, including education, healthcare, and employment. In recent years, there have been some efforts to develop accessible technology for people with disabilities in Bangladesh. For example, the Bangladesh Association for the Deaf and Dumb (BADD) has developed a mobile app called "ShabdaNagari" that translates spoken words into sign language (The Daily Star, 2020). The app aims to improve communication between hearing individuals and the Deaf in Bangladesh. However, there is significant need for accessible home automation and security systems for the Deaf in Bangladesh for their greater independence, autonomy, and accessibility while also enhancing their safety and security. As technology continues to advance, there is a growing opportunity to develop accessible and effective home automation and security systems for the Deaf in Bangladesh and around the world.

3. Literature review

The implementation of an advanced home automation and security system for people with disabilities, particularly those who are deaf, is a promising development in the field of smart homes. This section presents a review of existing literature related to home automation and security systems for individuals with disabilities. In a study by Majeed R et.al [1]a smart home automation system was developed for elderly and disabled people. The system utilized various sensors and wireless communication technologies to provide enhanced control over the home environment. The system was found to be effective in enhancing the quality of life of the elderly and disabled individuals, as it provided greater independence and autonomy in their daily lives. Maswadi K et al.[2] conducted a systematic review of literature related to accessibility in smart homes. The authors found that the majority of smart home solutions do not consider the needs of individuals with disabilities. However, the study identified a few solutions that incorporate accessibility features, such as voice control and remote monitoring. The authors emphasized the need for more accessible and customizable smart home solutions for individuals with disabilities[3].

An insightful and informative research[4] article that explores the potential of home automation to improve the quality of life for visually impaired individuals. The article is well-researched and provides valuable insights into the specific needs and challenges faced by visually impaired individuals in a home automation setting. The authors provide a thorough review of existing literature on the topic and present the results of their own survey of visually impaired individuals to identify their specific needs and preferences for home automation. The authors also address potential barriers to the adoption of home automation by visually impaired individuals, such as cost and lack of technical expertise, and provide strategies for overcoming these barriers. Priyanka D. Hatwar et.al. present innovative research[5] article that explores the potential of using gesture recognition technology to control home automation systems. The authors provide a detailed explanation of how the gesture recognition system works and how it can be integrated with a home automation system. They also provide a description of the hardware and software components required for the system. The article presents the results of an experiment in which the authors tested the effectiveness of the gesture recognition system in controlling a home automation system. The results show that the system is effective in controlling home appliances and devices using hand gestures. A low-cost smart home automation via Microsoft speech recognition is developed by M.R. Kamarudin et.al, which a viable and convenient option for those who are interested in home automation but do not want to invest in expensive systems.[6] This technology offers an easy-to-use and hands-free way to control various devices in the home, such as lights, thermostats, and appliances, using voice commands. A study by Ali Hussain et al. developed a smart home system based on neural networks that could automatically adjust the lighting and temperature in a room based on the user's preferences. The system was tested with a group of individuals with mobility impairments, and the results showed that the system significantly improved their quality of life and increased their independence. In recent years, there has been a growing interest in the development of voice-controlled home automation systems. One area of research is the use of Zigbee-based networks, which allow for wireless communication between various devices in the home.

Several studies have explored the potential benefits of developing voice control systems for Zigbee-based home automation networks. A study by J. Zhu et al. developed a voice control system for Zigbee-based smart home networks that allowed users to control various devices using natural language commands[7]. The system was tested with a group of users and the results showed that it significantly improved the usability and accessibility of the home environment. IoT-based home automation has gained popularity in recent years due to its potential to enhance the comfort, security, and energy efficiency of homes. Several studies have investigated the design and implementation of IoT-based home automation systems.

A study by Dr. R N Kulkarniet al. proposed an IoT-based home automation system[8] that uses a cloud-based architecture to enable remote monitoring and control of various devices in the home. The results showed that it significantly improved the convenience and efficiency of home management.

Another study by Haris Isyanto et al. proposed a smart home system that uses a combination of IoT devices to provide personalized automation and energy management.[9] The system showed that it can significantly reduce energy consumption and improve the comfort of the home environment. Niaz Mostakim et al. [10] presents an intelligent home system that uses various sensors to collect data about the environment and appliances within the house, and uses this data to automate various tasks such as controlling the temperature, lighting, and security of the home. The authors also describe the communication protocols used to transmit data between different components of the system. The authors then describe the design and implementation of the different subsystems of the intelligent home, including the temperature control system, lighting control system, and security system.

4. Description of the Proposed Method

The implementation of a wireless advanced home automation and security system for the Deaf can significantly improve the safety, security and accessibility of the home environment for individuals with hearing disabilities. While there are significant challenges to implementing such a system in Bangladesh, including limited access to technology and resources, there are also several opportunities to leverage existing technology and expertise to develop effective and accessible home automation and security systems. An ad-hoc network is implemented for deaf people who require special need. ESP8266 and ESP32 microcontrollers with built-in Wi-Fi capabilities can were used to create an ad-hoc network that does not rely on an existing infrastructure. Sensors is installed throughout the home to detect sound, motion, or other events that could indicate a security breach. The sensors are connected to the microcontrollers using various wireless protocols and the microcontrollers were programmed to process the sensor data and send alerts to the user's smartphone or other devices. To ensure that deaf people are alerted to a security breach, a visual alert can be added to the system, such as an LED light that flashes or changes color. The system will consist of a range of smart home devices and technologies, such as motion sensors, cameras, smart locks, and doorbells, which will be integrated into a centralized control hub. The hub will be designed to allow Deaf individuals to remotely monitor and control their home environment using visual and tactile alerts, voice recognition technology, and customizable notifications.

One of the key features of the proposed system is its use of motion sensors and cameras for surveillance and monitoring. These devices will be strategically placed throughout the home to detect potential hazards or emergencies, such as intruders, fires, or rain water. The sensors are linked to the control hub, which will immediately notify the Deaf user via visual alerts in the event of a detected hazard or emergency. Additionally, the system is programmed to automatically alert emergency help services or other designated contacts in case of an emergency. Another important feature of the proposed system is the use of smart locks and doorbells to provide secure entry and exit to the home. These devices will be linked to the control hub and can be remotely controlled by the Deaf user using a mobile application or other web-based interface. The system will also include customizable notifications, allowing the user to receive alerts when the doorbell is rung or when a door is opened or closed. To ensure that the proposed system be user-friendly for Deaf individuals, it is designed with a range of visual and tactile alerts, as well as voice recognition technology. These features will enable the user to effectively interact with and control the system using non-auditory cues. The system will be thoroughly tested and evaluated to ensure that it is effective, accessible, and sustainable over the long-term. Through collaboration and innovation, stakeholders in Bangladesh can work together to develop and implement accessible and effective home automation and security systems for the Deaf, promoting greater independence, autonomy, and safety for individuals with hearing disabilities [11][12]
The system includes a range of devices and technologies[13] [14] such as smart doorbells, vibrating alarm clocks, visual smoke alarms, text message alerts, smart home devices and public transportation alerts. These visual alerts can be customized to meet the specific needs and preferences of each deaf individual. The system ensures that the user can be alerted to important information, such as incoming calls, messages, or emergency situations, through a range of visual cues that are easy to understand and rely on.

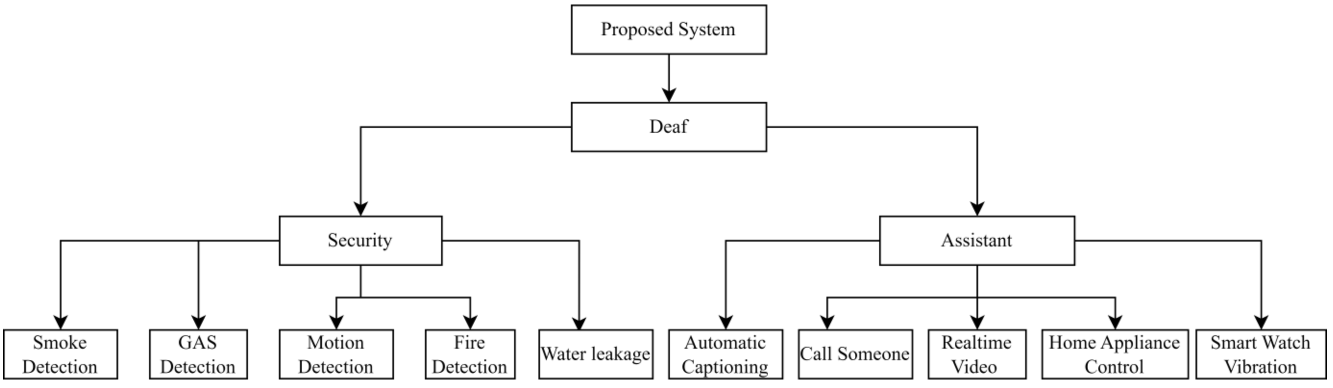

Fig 2: Modules of Proposed System

Smart [15] home devices such as smart smoke detectors, smart water leak detectors and smart CO2 detectors can be configured to send alerts to a designated person or device when an event occur. By using smart home devices with alert capabilities, deaf individuals can have greater peace of mind knowing that they will be alerted to potential dangers or other important events in their home. Vibration notifications are a popular form of sensory feedback that can be used to alert deaf individuals to events or statuses in the home. Smartwatches, bracelets, or other wearable devices can be programmed to vibrate when a certain event occurs, such as a fire alarm, phone call, or visitor at the door. This type of sensory feedback is discreet, yet effective, and can provide deaf individuals with a greater sense of independence and safety. This system can make the deaf people stay connected and informed about important events or statuses in their home. Incorporating automatic captioning technology into the home automation system can be a great way to provide visual feedback for audio-based content such as phone calls, television, or music. This can be especially helpful for the people who may have difficulty understanding audio content. Speech-to-text software can be used to convert audio into text and display it on a screen, providing visual feedback that deaf individuals can easily understand. A deaf individual could use a voice command-based device to turn on the lights or adjust the temperature in their home, without the need for physical controls. The device could also be programmed to provide feedback to the user through visual displays or vibration alerts, to ensure that they are aware of the device's status and any changes made.

5. Implementation Technique Using Microcontroller

Let the disability state/condition be represented by an integer variable C_d.
Let G_s, S_s, M_s, F_s and W_s represent Gas, Smoke, Motion, Fire and Water Leakage sensor readings from the environment respectively. The corresponding Alerts signal actuator are labeled A_g, A_s, A_m,A_f and A_w.The representation of the threshold levels for emergency alert response for each sensor byt_g,t_s, t_m,t_f andt_w respectively.

i. For Gas leakage detection

The Grove - Gas Sensor (MQ2) module is helpful for detecting gas leaks (home and industry). It can detect H2, LPG, CH4, CO, alcohol, cigarette smoke, and propane. As a result of its high sensitivity and quick response time, measurements may be obtained immediately. The sensor's sensitivity can be changed with a potentiometer. The triggered output responses from the microcontroller for gas leakage detection to the deaf people are as expressed:

$$\text{If } A_g > t_g; \quad L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \tag{1}$$

where L_f is flashing light state, 1 for Light on, 0 for otherwise and V_a is vibration alert response, where 1 for response ON and 0 for otherwise. The overall flowchart of the Gas sensor's sensing is shown in figure 3.

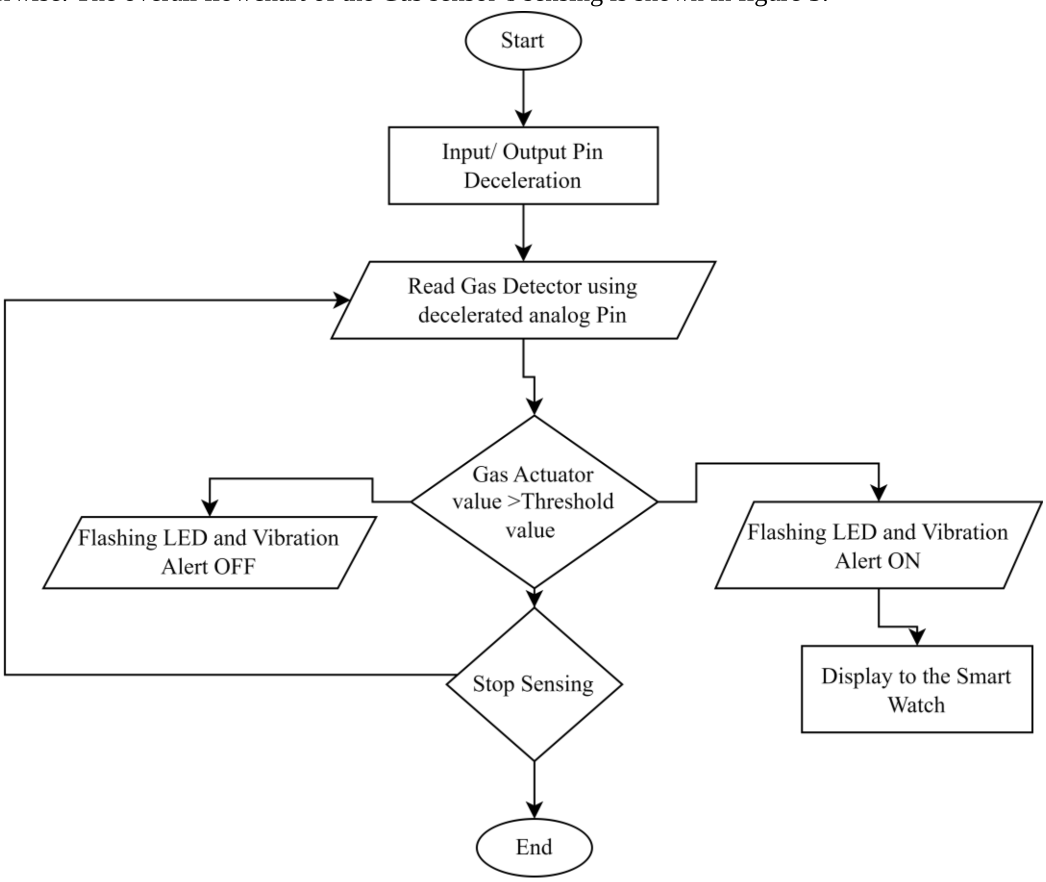

Fig 3: Flowchart of Gas sensing system.

ii. For Smoke leakage detection

The MQ-135 sensor is a gas sensor that can detect the presence of a variety of gases in the air. It is widely used in applications such as air quality monitoring, gas leakage detection, and smoke detection. The sensor contains a sensing element that changes its resistance when it comes into contact with the target gas. The change in resistance is proportional to the concentration of the gas in the air, which allows the sensor to detect and measure the gas concentration. The triggered output responses from the microcontroller for Smoke detection to the deaf people are as expressed:

$$\text{If } A_s > t_s; \quad L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \tag{2}$$

where L_f is flashing light state, 1 for ON, 0 otherwise and V_a is vibration alert response, where 1 for ON and 0 for otherwise. The overall flowchart of the smoke sensor sensing is shown in figure 4.

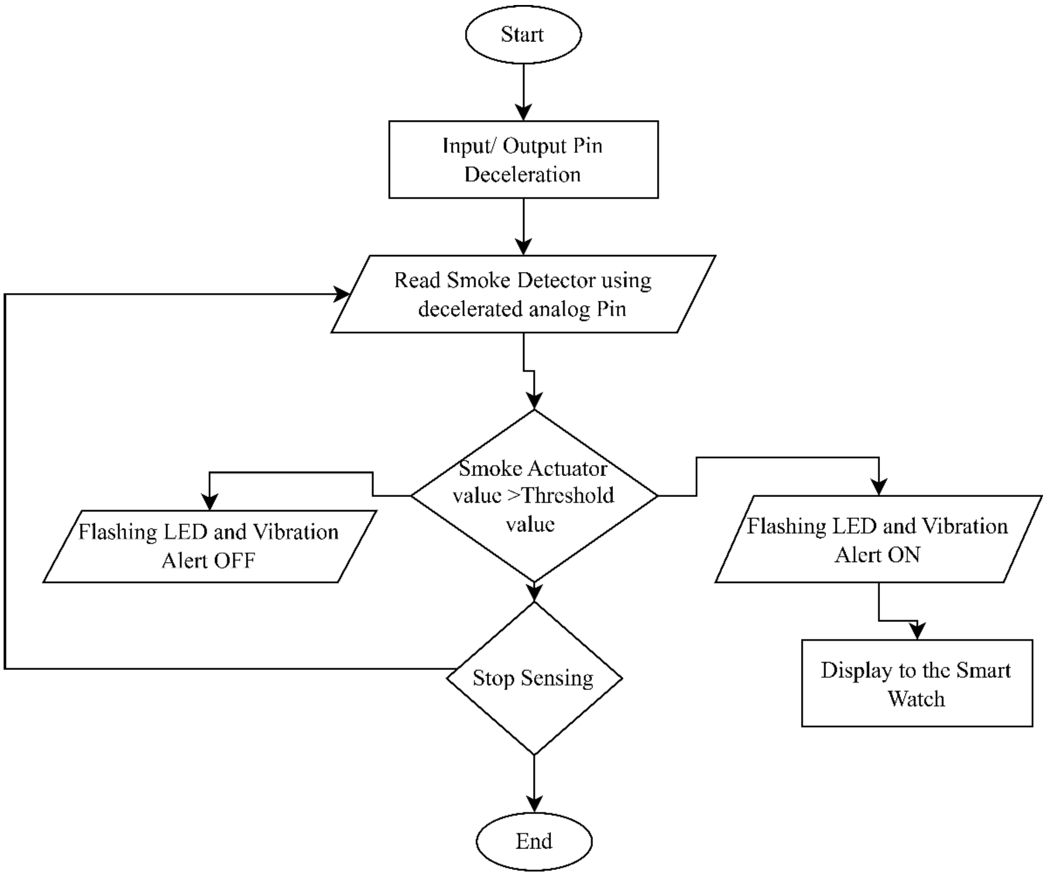

Fig 4: Flowchart of smoke detector system.

iii. For Motion detection

The HC-SR501 PIR Motion Sensor Detector Module is a passive infrared sensor that detects motion. It detects changes in the infrared radiation released by objects in its range of view, such as the body heat of a moving human, by detecting variations in the infrared radiation. The triggered output responses from the microcontroller for Motion detection to the deaf people are as expressed:

$$\text{If } A_m > t_m; \quad L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \tag{3}$$

where L_f is flashing light state, 1 for ON, 0 otherwise and V_a is vibration alert response, where 1 for ON and 0 for otherwise. The overall flowchart of the motion sensor sensing is shown in figure 5.

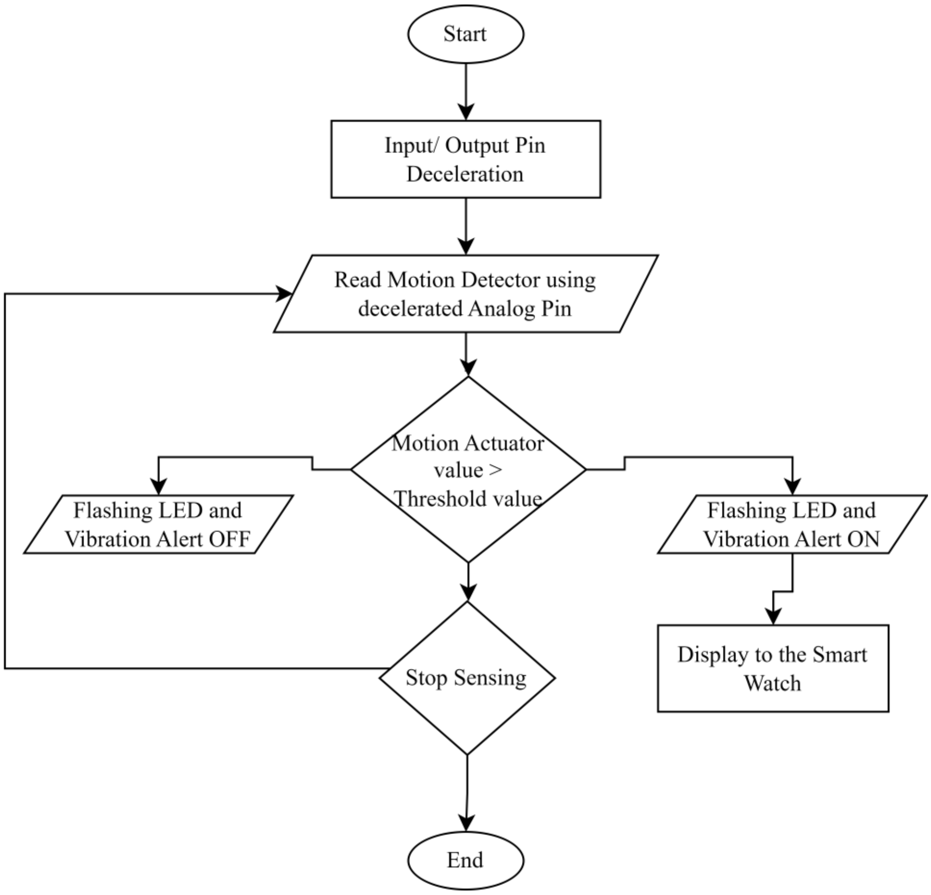

Fig 5: Flowchart of motion sensor system.

iv. For Fire detection

The AB007 Flame Sensor Module is an electronic sensor module that is used to detect the presence of a flame. The module consists of an infrared (IR) receiver and an IR emitting diode that work together to detect the IR radiation emitted by a flame. When the module detects the IR radiation from a flame, it generates an output signal that can be used to trigger other devices, such as alarms, relays, or microcontrollers. The output signal is usually a digital signal that switches from high to low when a flame is detected. The output responses from the microcontroller for Motion detection to the deaf people are as expressed:

$$\text{If } A_f > t_f; \quad L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \tag{4}$$

where L_f is flashing light state, 1 for ON, 0 otherwise and V_a is vibration alert response, where 1 for ON and 0 for otherwise. The overall flowchart of the motion sensor sensing is shown in figure 6.

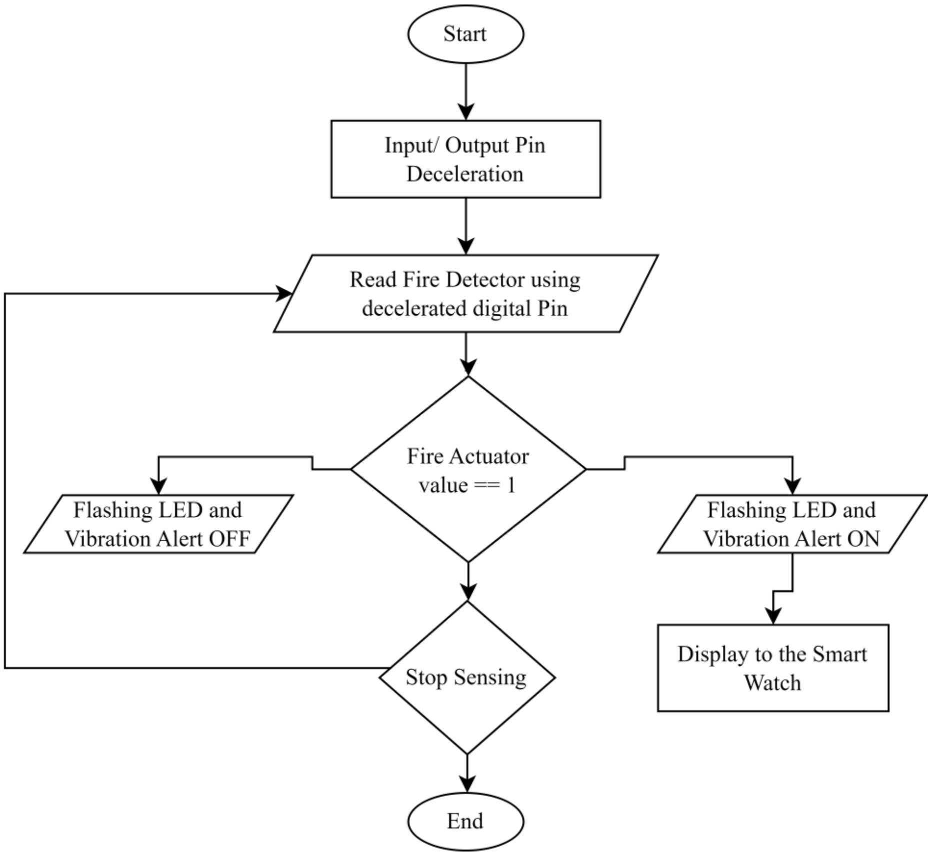

Fig 6: Flowchart of fire sensor sensing system.

v. For water detection

The Grove - Water Sensor is an electronic sensor module that is used to detect the presence of water or other conductive liquids. The module consists of two probes that are placed in the liquid being monitored. When the probes are immersed in a conductive liquid, a small electrical current flow between them, which is detected by the module. The triggered output responses from the microcontroller for water leakage detection to the deaf people are as expressed:

$$\text{If } A_w > t_w; \quad L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \qquad (5)$$

where L_f is flashing light state, 1 for ON, 0 otherwise and V_a is vibration alert response, where 1 for ON and 0 for otherwise. The overall flowchart of the water leakage sensor sensing is shown in figure 7.

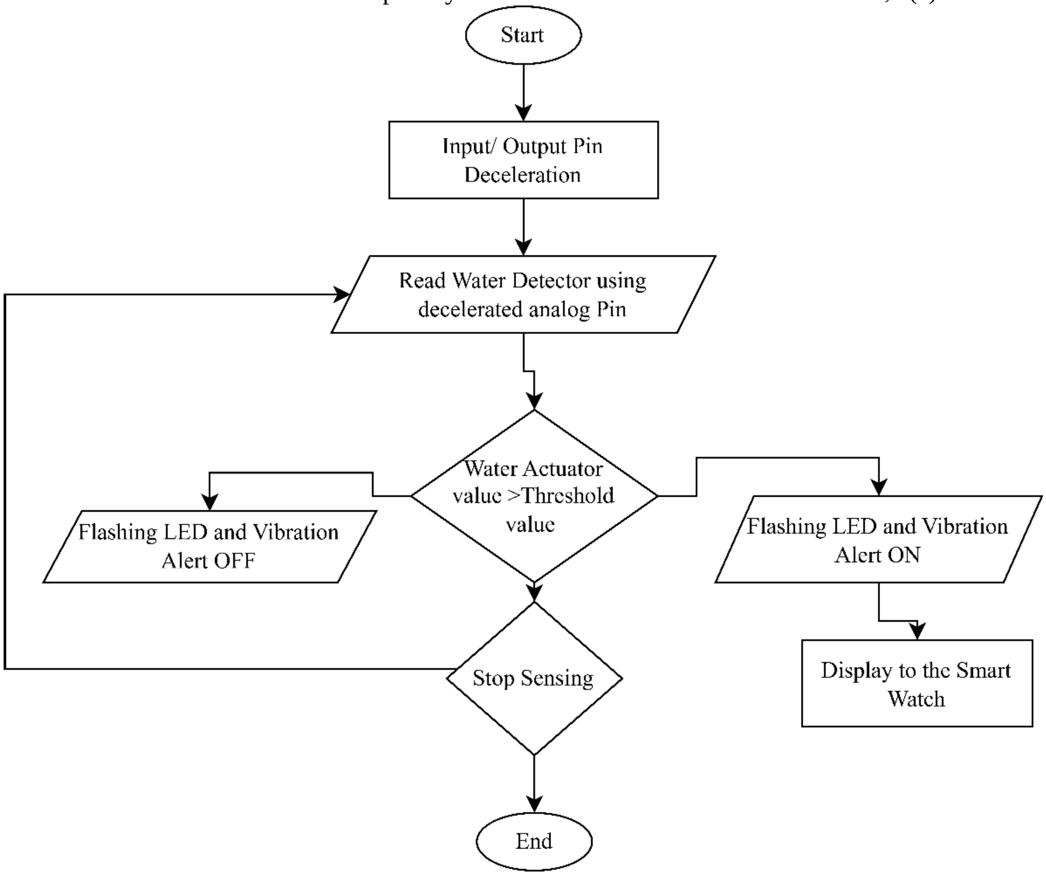

Fig 7: Flowchart of water detection system.

vi. Voice command-based home appliance controlling

Deaf people can control the home appliance i.e., air conditioner, light, washing machine using voice command through Bluetooth controlling. Using the application, the deaf people can control easily and after controlling the flash light or vibration watch will give the acknowledgement as the home appliances are activated or not.

The triggered output responses from the microcontroller for water leakage detection to the deaf people are as expressed:
Let us consider the string array to store the string compared with voice command is C_A and the voice that the disabled people will give to the microcontroller is V_c. The representation of home appliance is H_a. Here d will be 1, 2, 3 for light, Air conditioner and washing machine respectively.

If $C_A == V_c$; $H_d \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases}$

$$V_a \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases} \quad (6)$$

$$L_f \begin{cases} 1 & C_d = 1 \\ 0 & otherwise \end{cases}$$

WhereL_f is flash light state, 1 for ON, 0 otherwise H_d is home appliance state, 1 for ON, 0 otherwise and V_a is vibration alert response, where 1 for ON and 0 for otherwise. The overall flowchart of this action is shown in figure 8.

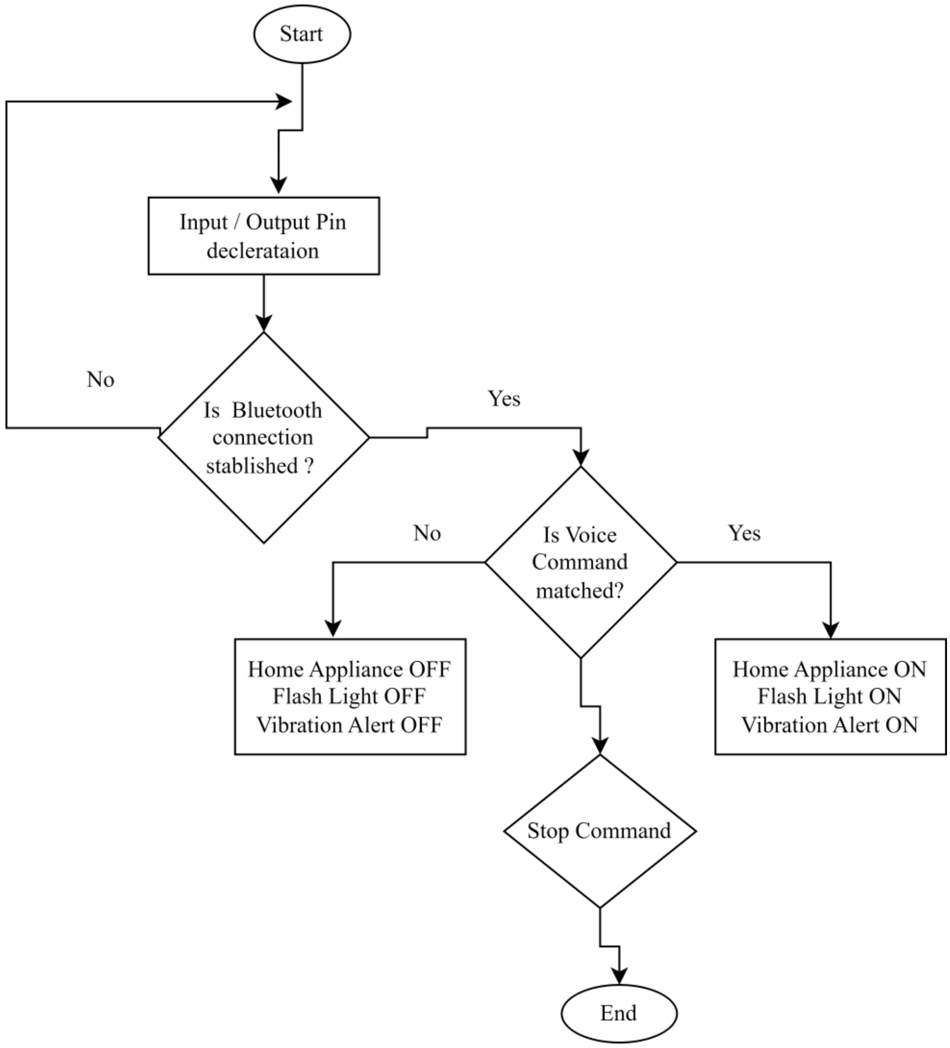

Fig 8: Flowchart of voice command home appliance control system.

5. Implementation Technique Using Machine Learning

i. Automatic Captioning

Implementing automatic captioning using machine learning can be an effective way to improve accessibility for deaf people. The process involves collecting a significant amount of data, including audio and text data. This data is then used to train machine learning models that can transcribe speech to text. The accuracy of the captions can be improved by using more advanced machine learning algorithms, such as deep learning, which can capture the nuances of speech and language better. Once the model has been trained, it can be integrated into various applications and devices, such as video players, live streaming platforms, and mobile devices, to automatically generate captions in real-time. This technology can significantly improve the quality of life for deaf people, allowing them to enjoy a wider range of media and communication without relying on others for translation

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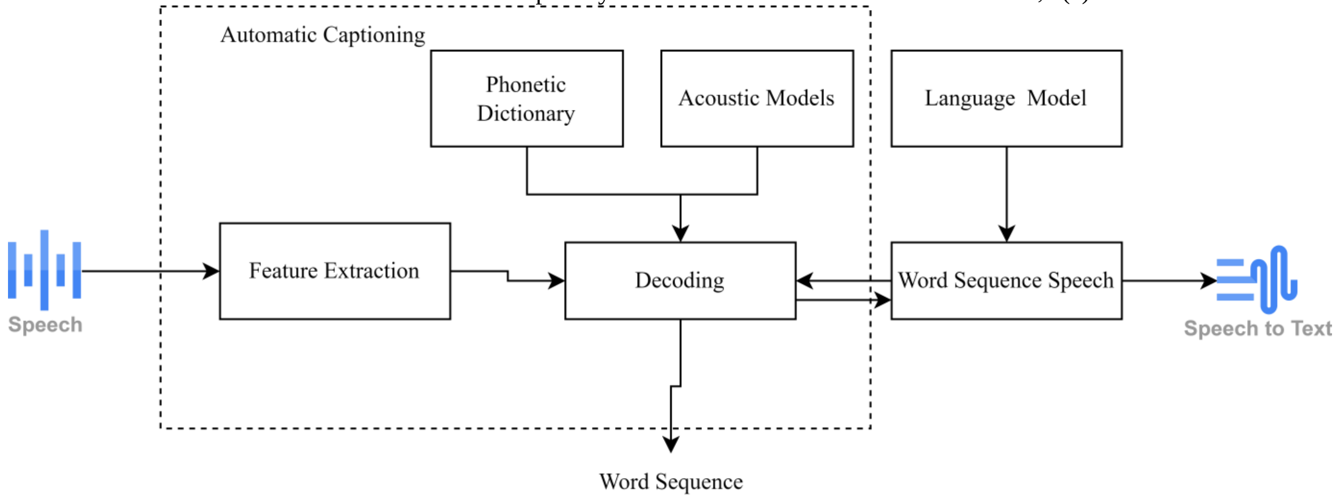

Fig 9: Process Diagram of Automatic Captioning.

ii. Real time Video Monitoring

Implementing a machine learning based system to detect abnormalities in real-time video can be a useful tool for deaf people. The process involves training a machine learning model on a large dataset of normal and abnormal video footage to identify patterns and anomalies. The model can be fine-tuned to detect specific types of abnormalities, such as motion, color changes, or object movements. Once the model has been trained, it can be integrated into various devices, such as security cameras or mobile devices, to monitor real-time video feeds and provide alerts when an abnormality is detected. This technology can help deaf people feel more secure and safe by alerting them to potential danger or unusual events that they might not have noticed otherwise. The use of machine learning can also improve the accuracy and efficiency of abnormality detection, reducing false positives and minimizing the risk of missing important events.

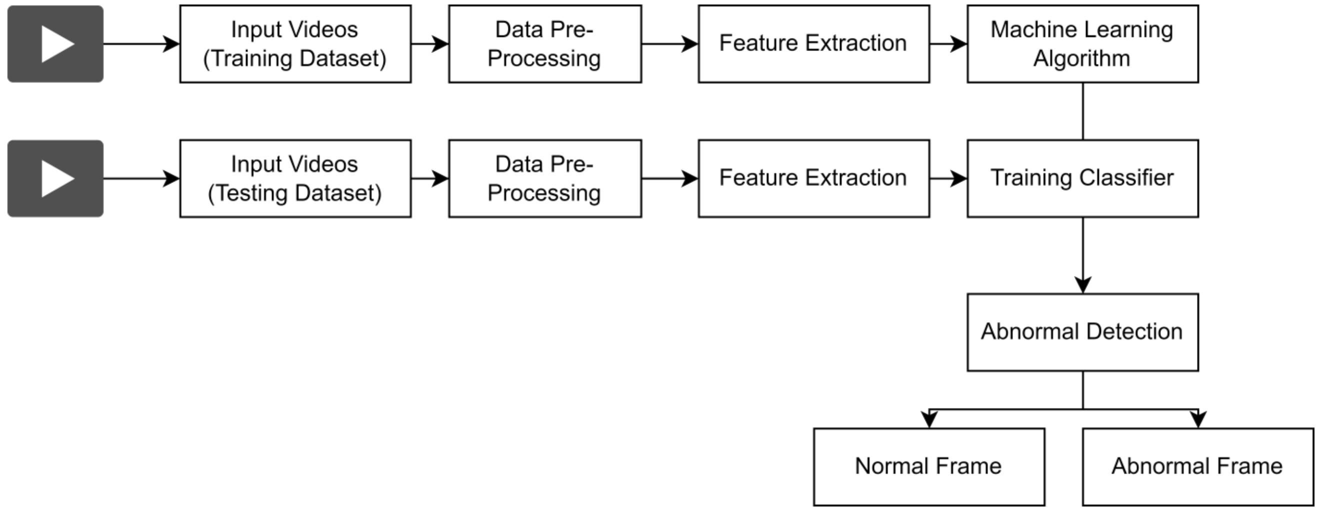

Fig 10: Process diagram of detecting abnormal in the real time video.

6. Results and Discussions

In this study a range of security detection systems like gas detection, fire detection, smoke detection, water detection and motion detection systems were designed and implemented. Flow diagram for each system and its mathematical based were given. All the systems were tested in real life situation and it was seen that the systems function well. For page limit, in this paper, implementation circuits and diagrams were not included with this text.

Implementing a wireless advanced home automation and security system for people with disabilities, especially deaf people, can have several positive results. The system can provide an increased level of independence for deaf people, allowing them to control various devices and appliances in their home without the need for physical interaction. The use of wireless technology can also provide greater flexibility in terms of device placement and ease of installation. The security features of the system can also help deaf people feel more secure and safe in their homes. The system is configured to send alerts and notifications to the user's mobile device, providing real-time updates on any unusual events or potential security breaches. Overall, the implementation of such a system can greatly improve the quality of life for deaf people, providing them with greater independence, flexibility and security in their homes.

Table 1*: Testing result of automatic captioning for deaf people using vosk-model-small-en-us-0.15*

Voice of Sentence	Number of speeches to give correct sentence in noise free environment	Number of speeches to give correct sentence in noisy environment	Number of speeches to give correct sentence in low noise environment
Do you hear me	1	3	2
What are you doing	1	3	3
Your phone is ringing	1	4	3

Data Table 1 shows the result of automatic captioning. For a complete sentence the number of given input and the converting accurate text generation in the noise free, noisy and low noise environment are given in the above table. The accuracy of generating automatic caption depends of the environment. If the environment is noise free the accuracy will be high and if the environment is noisy then the accuracy will be low. The accuracy of automatic captioning using machine learning can vary depending on the specific algorithm and the quality and quantity of training data used to develop the algorithm. However, many modern automatic captioning systems can achieve high accuracy rates, particularly for certain types of content.

Table 2: *Testing result of automatic captioning for deaf people using vosk-model-en-us-0.22*

Voice of Sentence	Number of speeches to give correct sentence in noise free environment	Number of speeches to give correct sentence in noisy environment	Number of speeches to give correct sentence in low noise environment
Do you hear me	1	1	1
What are you doing	1	2	1
Your phone is ringing	1	1	2

Data Table 2 shows the result of automatic captioning using the vosk-model-en-us-0.22. For a complete sentence the number of given input depending on the environment is given in the above table. The accuracy of generating automatic caption depends of the environment i.e., the environment is noisy or noise free. This model is very accurate in the noisy environment. The Vosk-model-en-us-0.22 is based on a deep neural network (DNN) architecture, which has been trained on a large dataset of transcribed speech. It can recognize a wide range of English accents and dialects and it is particularly effective at recognizing speech in noisy environments.

Table 3: *Testing result of automatic captioning for deaf people using Streaming transcription*

Voice of Sentence	Number of speeches to give correct sentence in noise free environment	Number of speeches to give correct sentence in noisy environment	Number of speeches to give correct sentence in low noise environment
Do you hear me	1	4	2
What are you doing	1	3	1
Your phone is ringing	1	5	2

Data Table 3 shows the result of automatic captioning using the Streaming transcription. For a complete sentence the number of given input depending on the environment is given in the above table. The accuracy of generating automatic caption depends of the environment i.e., the environment is noisy or noise free. This model is very poor accuracy in the noisy environment. one potential limitation of the streaming transcription model is that it may be less accurate than other speech recognition systems that have the luxury of processing the entire audio stream at once.

We have used vosk-model-small-en-us-0.15, vosk-model-en-us-0.22 and Streaming transcription for converting the speech to text and shows it to the display. The accuracy of this model depends in the level of noise. We have gotten the highest accuracy in the noise free environment of 99.27% for using the vosk-model-en-us-0.22 model. In low noise environment the highest accuracy is 93% and in the high noise environment the highest accuracy is 89%. For the testing of automatic captioning using different machine learning model, we have gotten that the vosk-model-en-us-0.22 is the best model to generate automatic captioning in offline. We strongly recommended to use vosk-model-en-us-0.22 model to use in automatic captioning for deaf people. Table 4 shows the comparison of three model that we have used in automation captioning system for deaf people. Figure 12 shows the graphical representation of the model performance.

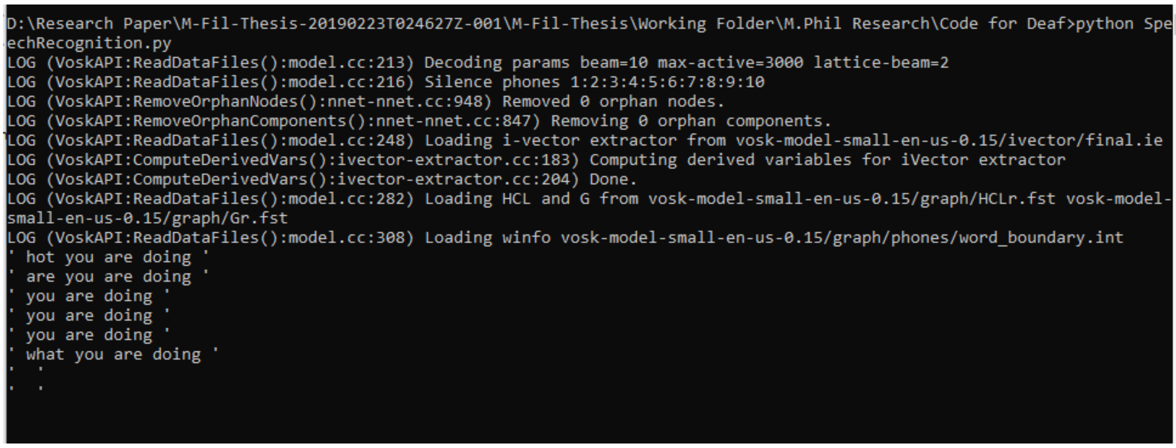

Fig 11: Automatic Captioning after getting voice or speech

Table 4*: Testing result of automatic captioning for deaf people for various machine learning model*

Name of the Model	Accuracy in the Noise Free Environment (%)	Accuracy in the Low Noise Environment (%)	Accuracy in the High Noise Environment (%)
vosk-model-small-en-us-0.15	85	70	52
vosk-model-en-us-0.22	99.27	93	89
Streaming transcription	97.74	73	45

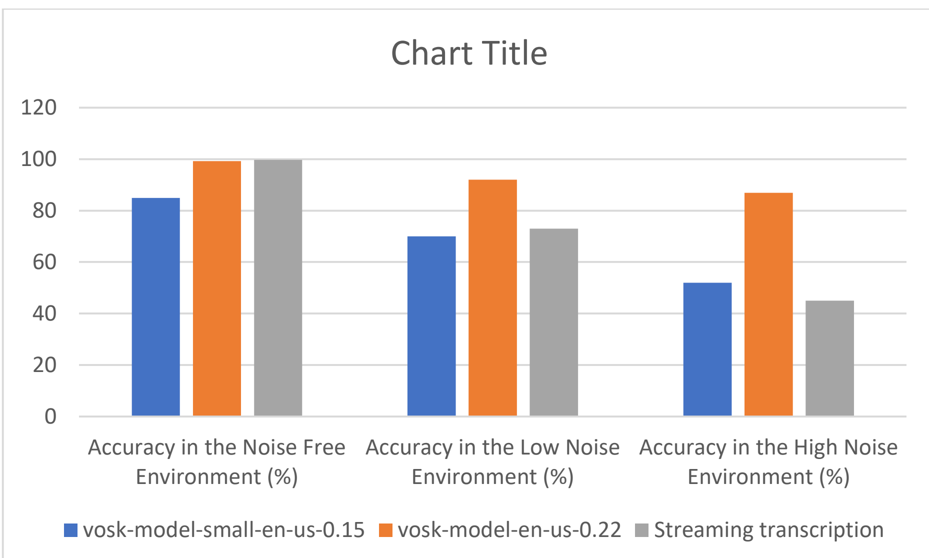

Fig 12: Graphical Representation of the automatic captioning model

From the above diagram of figure 12 is the graphical representation of the automatic captioning model we see that the accuracy of this model is decreasing with the increasing of noise. So, this model will assist the deaf people to gather information from surroundings.

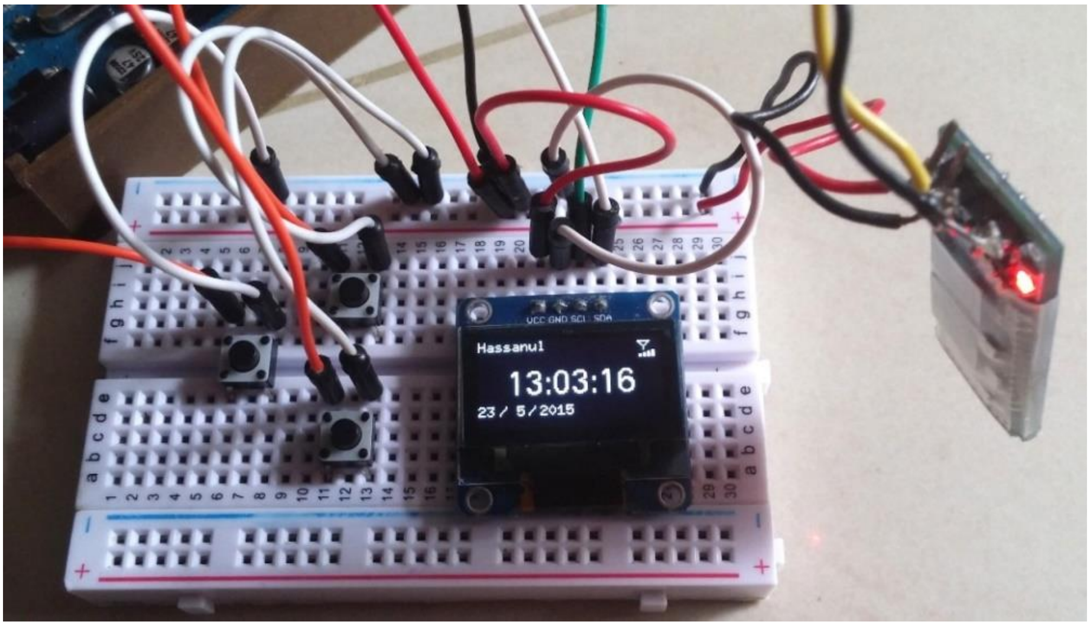

Fig 13: Smart watch for vibration alert

From the above figure 13 of smart watch, we see that this watch is Bluetooth connected with the system. When the system is required to notify the deaf people using this smart watch then the system send the notification to it and give alert to the vibration motor.

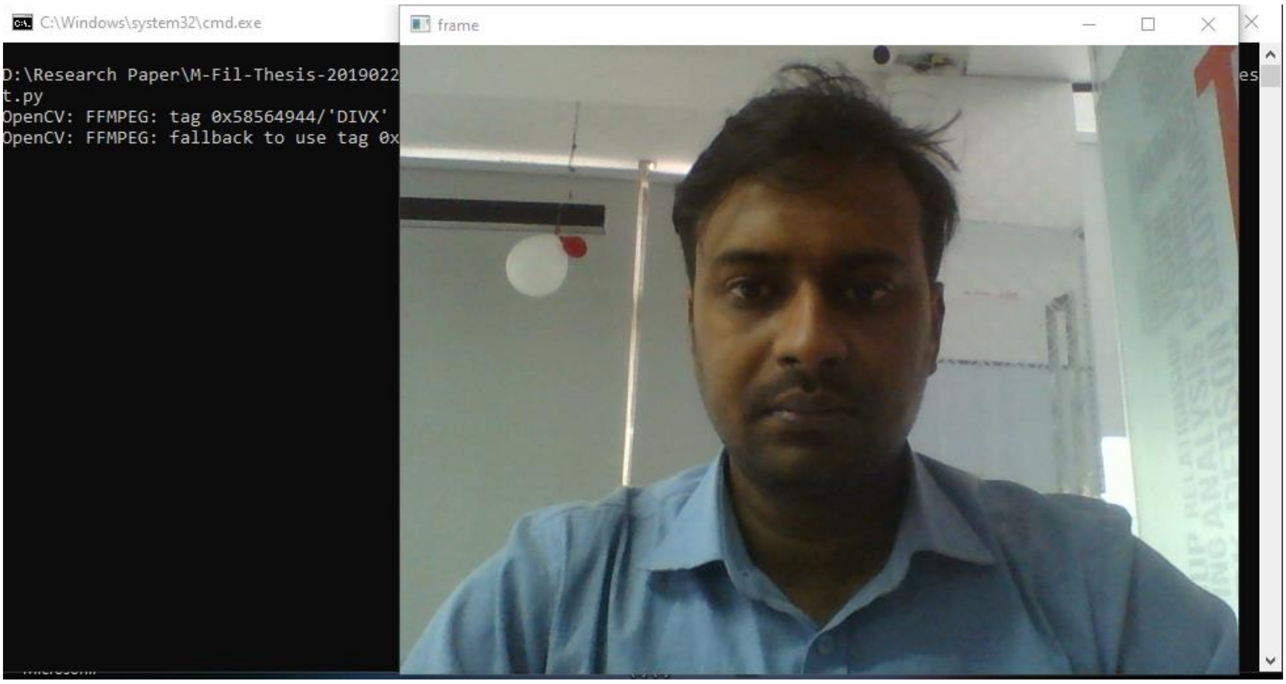

Fig 14: Real time Video Capturing

Deaf community people cannot hear, so everything should be visible to them. Using this real time video monitoring the deaf people can monitor everything inside the room using this application. After taking the video the people can help the model that ill detect the abnormal position of that video. Figure 14 shows the real-time video monitoring and capturing system for deaf people.

Fig 15: Abnormal detection using machine learning algorithm

We have used an autoencoder machine learning model. An autoencoder model is a type of neural network that is designed to learn efficient representations of input data by reconstructing it from a compressed version of itself. It consists of an encoder network that maps the input data into a lower-dimensional space and a decoder network that maps the compressed representation back to the original input space. The encoder network compresses the input data by reducing its dimensions and creating a latent representation, which is a lower-dimensional version of the input data. The decoder network then reconstructs the original input data from the compressed representation. The objective of the model is to minimize the reconstruction error between the original input data and the reconstructed output.

OCSVM stands for One-Class Support Vector Machine. It is a machine learning algorithm that is used for outlier detection, anomaly detection and novelty detection. Unlike traditional SVMs, which are used for classification problems, OCSVM is designed to handle unsupervised learning problems where the data has only one class.

The OCSVM model works by creating a hyperplane that separates the data points in the feature space from the origin. The hyperplane is created by finding the smallest sphere that encloses all the data points and then fitting a hyperplane to the surface of the sphere. Fig 15 shows the result of abnormal condition. We have used this model for detecting the abnormal from a real-time video. We have used another model for abnormal detection, that is SVM. The accuracy of SVM model is 82%. The OCSVM algorithm is more useful to detect the abnormal video. The accuracy of this model is above 89%. The accuracy of the autoencoder model is less than 80%. We have recommended to use the OCSVM model for abnormal and normal detection from real-time video analysis.

7. Conclusion

The implementation of an advanced home automation and security system for people with disabilities, specifically the deaf community in Bangladesh, has been successfully developed and tested. The system utilizes a combination of hardware and software components, including a centralized control unit, smart sensors, and mobile applications, to provide a convenient and accessible way for deaf individuals to manage and secure their homes. The system is designed to be intuitive and easy to use, providing a range of functionalities that cater to the unique needs of the deaf community. Overall, the system represents a significant step towards enhancing the quality of life and independence of people with disabilities in Bangladesh and can serve as a model for similar systems in other parts of the world.

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