Home Security with Voice Recognizing Smart Mirror Using Raspberry Pi

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***Abstract*: The demand for intelligent systems in everyday activities has been on a rise recently. The project aims on incorporating such a system into a one-way mirror which is lynched onto a screen. The mirror displays contents like the date, weather, and current news keeping the user updated. An additional feature of voice recognition is coded using python into the mirror for easier access. The user has to just give voice commands that the mirror recognizes. The mirror has motion sensors and gas leakage sensors embedded in it as a part of home security. Home security has always been an issue of a common man, equipping sensors to the mirror allows the user to monitor the house when not present in the house. The smart mirror is built on a Raspberry Pi 3 enabled with wifi for internet connectivity. The whole project is solely based on the Internet of Things (IOT)**
Concepts.

***Keywords*: Raspberry Pi 3, Voice Recognition, Home security, Internet of Things (IOT), Python.**

I. INTRODUCTION

In the past few years mankind has seen a huge rise in the utilization of smart products like Smart TV, watches, Assistants like Alexa and Google home, etc., Such a system is now being incorporated into a mirror making it more user-friendly and more intelligent. These smart mirrors have many application such as a saloon for playing videos or in a mall for displaying the layout and also prove to be an assistant. These applications are just the tip of the iceberg as they can be used in households, restaurants, hospitals, airports, etc., The effective application is in a regular household. Imagine being busy in a household chore and a person wishes to play any video or listen to music, in such situations a smart mirror is useful. The user has to just command using his voice which the mirror acknowledges and acts accordingly. Performing the same action using a phone would probably take 2 minutes whereas the smart mirror can do it in less than 10 seconds. Thus it is far more effective in terms of speed and reliability. The user also has the easy access to the mirror as he needs to command using voice compared to the exhaustion caused by typing on a small screen. User can control all the other functions such as reducing volume and decreasing brightness from these commands [1].

Voice recognition is known to be in use since 1976, it is a program or algorithm which converts analog audio into digital signals, These signals are then sent to the memory where it interprets with the database which consists of common phrases and various syllables, the speed process is completely dependent on the RAM of the computer. Voice recognition is basically used in a lot of devices other than just computers, these days voice recognition is been used very promptly in fields like artificial intelligence, machine learning and Internet of things.

Internet of things is a field which is very hard to explain perfectly. In simpler words it can be put as giving internet access to devices and machines that we come across everyday life to make them easier to access and controlling them remotely or even handsfree using voice access [3]. Internet of things has been growing vastly in recent times in every field and aspect of science and electronic devices. In the market there are automated devices for home security and house help which work on the principles of internet of things, Devices like automated speakers are which could control household appliances and do basic operations on them with a voice command are current trends in the electronic market and IoT fields.

II. SMART MIRROR IMPLEMENTATION

This Chapter explains about the method of implementation of the project. The main aim is to give a gist about the workflow of the entire project. Since the key component of the project is display, a one-way mirror is attached to an LED screen which in turn uses a Raspberry Pi as its main component. The complete project follows a set of steps i.e. recognizing the Hotword and recording the statement given by the user and display it[3]. If the particular command needs a speaker then the device uses an insult bluetooth speaker. The feature of voice recognition is obtained by the use of python code in the Raspberry Pi.

In recent time home security has always been an issue with crime increasing at a high rate, hence with the introduction of new and advanced safety system this crisis can be overcome. The paper implements three major concepts - voice recognition, sensing gas leakage and also home security. Voice recognition is a computer technology being used in variety of applications that recognizes a human's voice and reacts accordingly. The feature of voice recognition is done by using open source softwares such as google voice api, sonus, magic mirror.Voice recognition is currently being used in products like alexa, google home. The particular feature is incorporated into the smart mirror for making it easily accessible for the user. These voice recognition softwares freely available

for everyone. The configuration of the Raspberry Pi to recognize a voice command is done manually. The following Flow diagram shows a complete picture of the inputs and the outputs for the mirror and the languages used for the coding purposes. According to the flow diagram all the other components are somehow connected to the crucial device i.e. Raspberry Pi. The project uses a latest version of Raspberry Pi which is the Pi 3. The figure 1.1 depicts a workflow diagram for implementing the system. The python instructions for the voice recognition are stored in an sd card that is mounted on the Pi 3. There are sensors and an audio board connected to the Pi which are present for sensing any motion or gas leakage. The whole system is attached to a mirror for a better display.

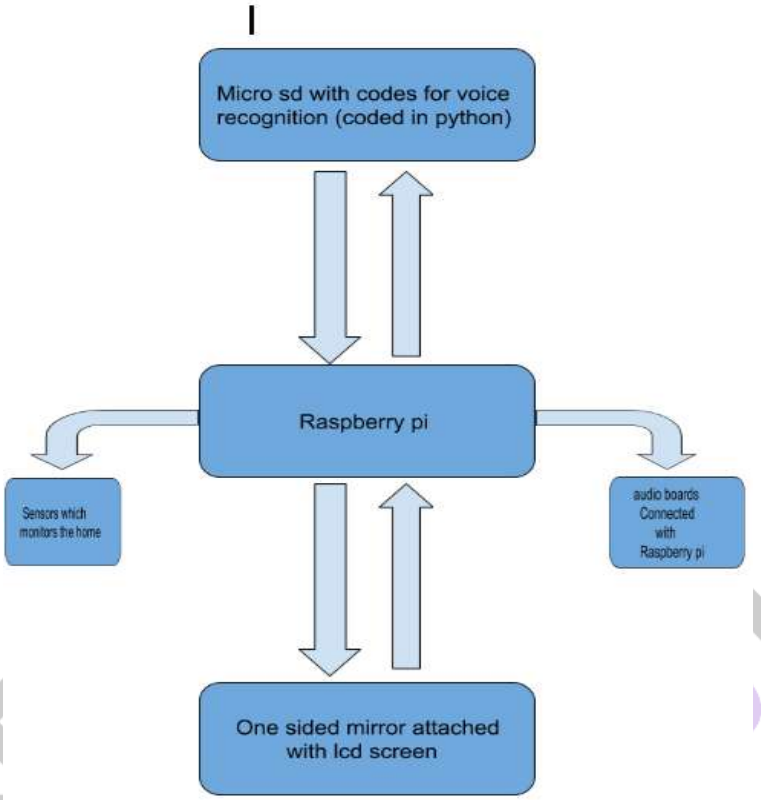

Fig 1.1 - workflow diagram

III. SMART MIRROR COMPONENTS

Hardware - A smart mirror must be available for public use at a cheap rate compared to the other smart devices like a smartphone or a tablet and perform functions that are similar to them. Therefore utilization of cheap and best components is a key in the project. Most important part is the LED screen with a USB port which is connected to the Raspberry Pi , the screen must be of a considerate size for viewing the contents better it should high aspect ratio and have a preferable 720 or higher line progressive. The screen is then attached to a single sided mirror that displays contents that are shown on the LED screen.

The one-way mirror is easily available or an alternate method of coating a normal glass pane (which is transparent) with a one-way coil that makes the pane opaque and helps in reflecting the light making it a mirror Since the smart mirror has to meet every action performed by any other smart device it should also be able to give an audio output If the device has to perform an audio output then the function is done with the help of a speaker possibly with bluetooth for better connectivity with the smart mirror. Having a bluetooth connectivity enhances the performance of the mirror. The figure 2.1 shows an audio board and its components. There are other additional components that are required to make the speaker like the woofers and the connecting wires. Woofers are basically a loudspeaker driver that are designed to produce a low frequency sounds upto a range of 500Hz. It consists of a voice coil surrounded by a magnetic coil . Connecting wires are used to connect the woofers to the audio board. An external micro SD card is also used for storing the codes required for recognizing the hotword and performing instructions based on the commands. Since there exists a lot of commands for instructing the mirror a high storage micro sd card is used preferably of 16GB or higher. This

micro sd card is also kept in the Pi model. There are sensors equipped to the Pi model like a motion sensor and a gas leakage circuit. For a motion sensor to function the mirror has a transmitter kind of device that records any unwanted motion in its range**.**

Software - The softwares used are python for coding the data into the raspberry pi. The code will be in such a way that there will be a specific keyword or key activation Word through which the voice command gets activated and command of conditional and looping statements are typed in such a way that program identifies the request uniquely and also processes request in short span of time. This is also aided by a few other applications to twerk the program and also to make the response better and efficient. The conditional codes use a principle that they compare the request given by the user with the conditions checking that they are the same as the request and is processed, else the condition checking still keeps going on. If not found the user request is given out as invalid. The looping statements is used for functions like calling a particular person and so on, in those cases we use looping statements to run through a given data. As far applications are considered they are used to make the smart mirror more responsive and more interactive in sense the voice structure the tonality of the voice and the structure of the voice pattern is also analysed inside this application only. The voice pattern of the user needs to be analysed to keep the automation more secure and this application helps in checking voice tonality , pattern of speech and other characteristics of the voice to , this helps in keeping the automation more secure. Incourse of time this applications also helps in voice identification through analysing voice frequency and running it through analysers.

IV . SMART MIRROR DESIGN

The Smart mirror has a basic model of an LED Screen i.e. the model used is the DELL S2240L. It has an aspect ratio of 16:9 and also has a 1080p full HD display. Apart from the LED screen a TPA3110 DC model audio board is used with a feature of Dual Channel Wireless Bluetooth For 4/6/8/10 Ohm Speaker. This particular audio board has bluetooth connectivity and has a range of 10M beyond which it can't be accessed(since the audio board is attached to the mirror it will always be within the 10M range). A very basic model of woofers are also used for an audio output - GSA2Z Hifi Woofer of 4 ohm 60 watt.

Raspberry Pi 3 - The main device used is a Raspberry Pi 3 which is a enhanced model of its previous models. The early models were first developed in the great britain. Basically it is a combination of different small computers on a single circuit board. The raspberry Pi has always been a crucial and reliable component of the IOT based projects. The fact that it is small and portable and since it doesn't consist of any peripheral parts such as a monitor, keyboard, and a mouse makes it useful. Various operating systems are compatible with the Pi like Windows 10, Ubuntu core, RISC OS. out of all the available models of the Pi, Pi 3 has been used solely because it has an on board WiFi and bluetooth capabilities. It has a 64-bit quad core processor with a 1.4GHz processor this allows the Pi 3 to have far more better performance compared to its previous models.[5] The figure 3.1 depicts the connections between the internal components of a pi 3.

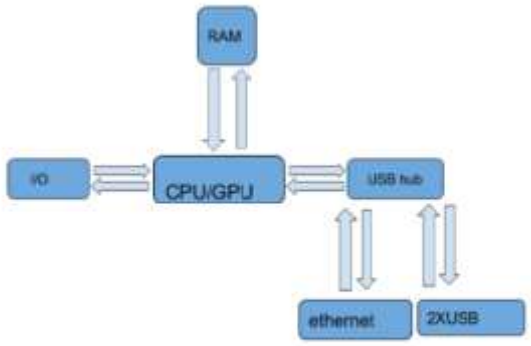

Fig 3.1 - connections in a PI 3

Audio board and woofers - Audio board is the system which is connected to the raspberry pi, the audio board uses digital to analog conversion. The audio board is used to give the audio output from the raspberry pi. What it does is that it connects the output signal from the pi model to either an amplifier or any other external device. Connection between the audio board and raspberry pi is done using usb port or bluetooth connectivity. The audio board used in this setup is TPA3110 DC audio board For 4/6/8/10 Ohm Speaker. This board is a dual channel board means dual output can be given which makes it more powerful. An audio board's basic principle is that it sends current through a coil of wire inside a cylindrical magnet, producing a magnetic field, this makes it move to and fro in a particular frequency which changes with the variations in current. The coil is in turn connected to a light paper membrane, which give out a sound. If the membrane is more stiffer the better the speaker gives the output. The more heavier in weight the

magnet is and the closer the speaker coil is present to the speaker magnet, the output can be expected to be better. Serious fire hazards may occur if the magnet touches the coil. Converting sound back into an electrical signal is the same process, but in reverse: a membrane is present which vibrates and moves a coil, which generates current as it progresses in and out of a magnet. The materials used inside the audio board are transducers these transducers help in converting sound into electric signal and vice versa.The oscillator provides the signal at whatever frequency you require.

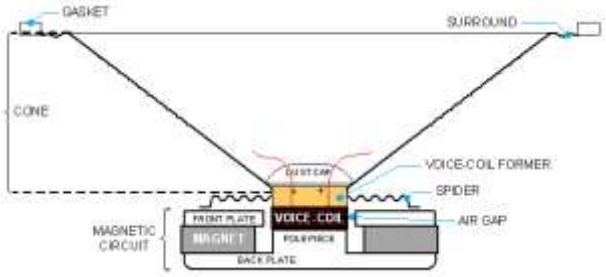

Fig 3.2 - principle of a speaker

Motion sensors - motion sensors or detectors are useful for detecting any moving objects especially people in its range and alerts the system to which it is connected. In this case the motion sensor is connected to the raspberry Pi 3 and it immediately pops up an alert message on the screen and gives out an alarm through the connected speaker. The mirror has a microwave sensor. That has a low range of 25 feet which can be increased with equipping a sensor that costs more. The principle on which the sensor works is that it uses electromagnetic radiation. The sensor gives out waves which get reflected back to the receiver.These waves that are bounced back are analysed by the receiver. In case there is an object/person moving in the room, the waves sent out earlier will surely be altered. The detector is capable of identifying such disturbances in the returning waves. In ideal conditions there should be no disturbances in the waves.[8] The advantages of using a microwave detector is that it can give accurate results even in high heat environments and can also penetrate the walls and doors.[8] The figure 3.3 shows the working principle of a microwave motion detector.

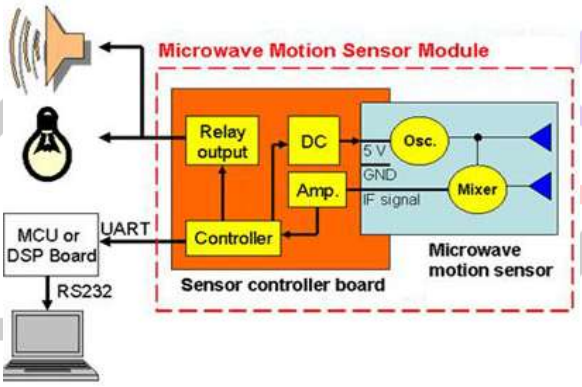

Fig 3.3 - microwave motion sensor

Gas leakage sensors- gas sensors or detectors are devices that detect any particular gases that are extensively released in an area. Many gases are proven to be harmful for humans, therefore this device is used for detecting if there is any leakage of gases especially cooking gases as they can cause hazards. As a part of home security gas sensing can be crucial as some gases are inflammable. Any abnormal release of gases are immediately reported to the Pi 3 and an alert is shown on the screen and an alarm is given off. Through the speaker. These sensors can also be used to check the air quality of the house. There are different types of gas sensors nut an electrochemical sensor. They work by allowing different gases present in the air to diffuse through a porous membrane which is connected to an electrode where it is chemically oxidized or totally reduced. The concentration of the gas present in the air is determined by the amount current produced at the electrode. Since the barrier is physical it is more dependable compared to the other types. Fig 3.4 shows the working model of electrochemical sensor connected to a raspberry pi[4].

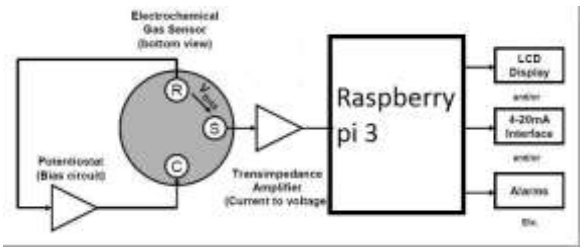

Fig 3.4 - electrochemical sensor

V. FUTURE WORKS

This IOT based project can be developed in a various ways not just home automation but also factory and powerplants can be automated. Electricity can also and other activities can also be monitored by this setup. To certain extent this can be implied in vehicles to where the car can be controlled by voice automation. We can connect a person's total life using this setup by linking everydata to this automation setup. So in near future you can handle every work from home itself. Artificial intelligence and machine learning can also be incorporated to make the smart mirror to make it more interactive and efficient. Security can also be increased due to incorporation of artificial intelligence and machine learning. Various sensors and also augmented reality could make smart mirror more efficient in use and also maps and streets can be monitored closely using voice commands and augmented reality. Health monitoring could also be done using smart mirror we could connect sensors from a person's body to the smart mirror which could keep a track of a person's physical conditions at all times. So in case of an emergency the smart mirror sends alert to the user and ambulance to. A baby's day-to-day activities can also be monitored. Using AI and machine learning the user can be notified when the baby is hungry or needs any other necessities.

VI. CONCLUSIONS

Thus, the project aims to provide a more efficient way for the users to utilize the intelligent machines for their daily based activities. The smart mirror is supposedly faster compared to the old fashioned way of unlocking a phone and opening an app and typing the required need compared to giving just the voice command to the smart mirror. The smart mirror is also an efficient way to secure one's home from theft or unwanted intruders. The project also aims to ensure safety by protecting from any gas leakage in the home.

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