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REVIEW ON 'MAGIC MIRROR USING RASPBERRY PI'

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Abstract: This paper presents the design and the development of an interactive multimedia futuristic Smart Mirror for commercial uses in various industries. The project which would collect real world machine data and the data would be transmitted from the machine and would be managed by the Raspberry Pi. The Smart Mirror implemented as a personalized digital device equipped with peripherals such as Raspberry PI, microphone, buzzer , LED Monitor covered with a sheet of reflective one way mirror provides one of the most basic common amenities such as weather of the city, latest updates of news and headlines and local time corresponding to the location. A screen is placed behind a two-way mirror 1. By using a black and white graphical user interface (GUI) only the white colors will penetrate the mirror, resulting in an effect that makes it appear as if the mirror itself is a screen.

Our lifestyle has evolved in such a way that optimizing time is the most important thing. Based on the user studies and prototype implementation, we present the development of an different application that integrate interactive services of information, offered through a user interface on the surface of a mirror. Our work is based on the idea that we all looks at the mirror when we go out, so why wouldn't the mirror become smart.

The framework will offer basic services, like the presentation of personalized weather data, time, date and will incorporate some additional functionality, like reminder service by mobile synchronization and through social media. Our framework is based on detecting presence of human using Passive Infrared sensors and Wi-Fi connectivity. Once a person comes in front of the mirror, it displays the information that is being fed from the phone. This data or information includes calendar, time, weather, news feed, notifications and so on. Our framework also discusses about the face recognition and its application in control mechanism in home appliances and opening and closing of shelf. Our framework also introduces speech activated music player, and plays the music when a person gives a command.

Index Terms **– Raspberry Pi, Gas Sensor, IOT.**

I. INTRODUCTION

Everyone knows what a mirror is. It is an object found in most people's homes. In mirrors we see our reflections. But what happens when you combine the idea of a mirror with technology? What possibilities are there and how smart could a mirror be? These are some of the questions that inspired my choice of final year project, a project which aimed to develop a smart mirror and a small operating system to power it. The device was to go beyond an ordinary mirror, to have a screen inside that you would be able to interact with by using voice commands, hand gestures and smart phones or other devices.

This project has been developed within the context of a time where every day we see more and more connected devices. The Internet transformed our lives by connecting us more easily to information and other people in the virtual world. Mobile phones then became smart phones and since then this concept has erupted and morphed into the Internet of Things, things which connect us to everyday objects. There are no end of objects that could be made "smarter", some being more suited to this than others Mirrors, for example, provide a large surface ideal for displaying information and interacting with Most people have mirrors at home so the concept of a smart mirror that you can interact with is attractive and has been fantasized in many futuristic movies.

Smart mirrors, such as Magic Mirror and Home Mirror have recently started to be developed by people in the Maker community, with varying degrees of interactivity. However, so far, the features of these mirrors have been limited. This final year project describes how a smart mirror was built from scratch using a Raspberry Pi for the hardware and custom software built on top of Raspbian, a Linux distribution. The goal of the project was to create a Smart Mirror device that people could interact with but also to further develop the technology so that it would let you install and develop your own applications.

Problem Statement

In order to display a notice wirelessly on mirror display through smart phone, a Raspberry Pi module is used. This Raspberry Pi module is interfaced with a mirror along with LCD display.

For transmission of notice from smart phone to mirror is done by the special link used for text writing on the text box and display it on mirror by using the WI-FI connectivity.

A few problems arose in the construction and software side of the project, such as the glass not being reflective enough and the gesture recognition being unreliable but these drawbacks can be addressed by doing more tests and trials to further develop the Smart Mirror.

1.1 Objective

The main objective is to develop a smart mirror that wirelessly displays the notice or any text, The remote operation is achieved by any smart phone/Tablet etc. we need to overcome those tedious techniques of manually attaching the notice on board.

Here, in our project we need to simplify the concept of traditional notice boards. This avoids hardships involved in the maintenance of traditional notice boards. This mirror is also displays the time, dates, weather forecasts, calendar etc.

It prevents the wastage of papers used to display the notices on traditional notice board. To enable the hands free transmission of notices by using magic mirror technology.

1.2 Goal of project

The main goal of this project was to develop a smart mirror device as well as an operating system to run on similar devices and display the notice on the mirror. The device was to look like a regular mirror but would have a screen inside and you would be able to interact with it using voice commands, hand gestures and smart phones. The operating system would support running links. The main features the Smart Mirror would have would be showing basic weather and time information, calendar, holidays etc.

The software needed to be designed to be modular and responsive in order to fit different hardware. With the project we wanted to learn a lot about the Raspberry Pi as it was the first time we used it.

II. BASIC IDEA

This project was inspired by a "Magic Home Mirror" device. The "Magic Mirror" is a Android phone attached to a one way mirror. The device has a display with a webpage that shows time and weather information and it looks very futuristic. We liked that project a lot and we thought we could improve on it by adding some means of interaction to the device. We also found a similar project that was built using a Raspberry Pi, minicomputer, but again it was a static panel with no interaction. This inspired me to begin this project and develop a Smart Mirror with an operating system that would let you install apps that anyone could develop just like on Android or iOS. The project has a very broad scope covering some current popular topics in the IT sector such as the Internet of Things.

2.1. Block Diagram:

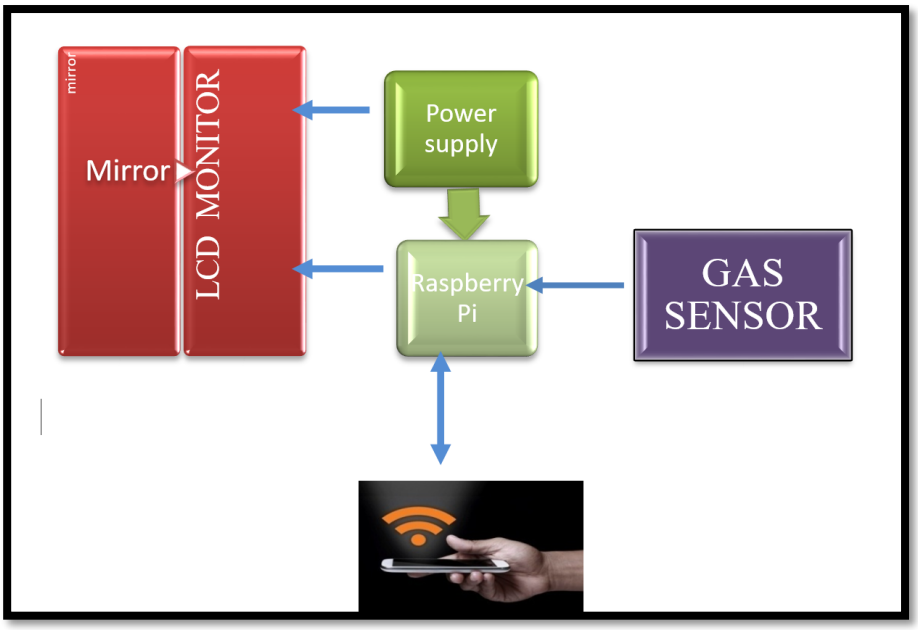

Figure: Block Diagram Of Magic Mirror

Name of the Blocks:

1. Mirror and Monitors
2. Power Supply
3. Smart Phone
4. Raspberry Pi
5. Gas Sensor

1. Mirror and Monitor:

The Monitor is the primary display that the device uses and it is the only end of interaction for the user. The user remains unaware of the rest of the functionality and therefore interacts primarily with the monitor itself. An acrylic sheet is placed on top of the Monitor to turn it into a reflective surface. Apart from being inexpensive, the sheet may also be replaced in the event of any damage, thus making it a more feasible option as compared to a double-sided mirror.

2. Power Distribution:

Power distribution helps separate the Modules from the Pi itself which helps in programming, testing, and debugging. The power supply is given to the LCD monitor and Raspberry Pi to start the devices.

The 230 volts ac power supply is given to the LCD monitor by using power supply cable which is connected to the power supply port of LCD and 5 volts is given to the Raspberry Pi by using adapter at

3. Smart Phone:

Smart phone as any android mobile they are used to send notice and event to magic mirror by using a link which is used to transfer the text.

4. Raspberry Pi:

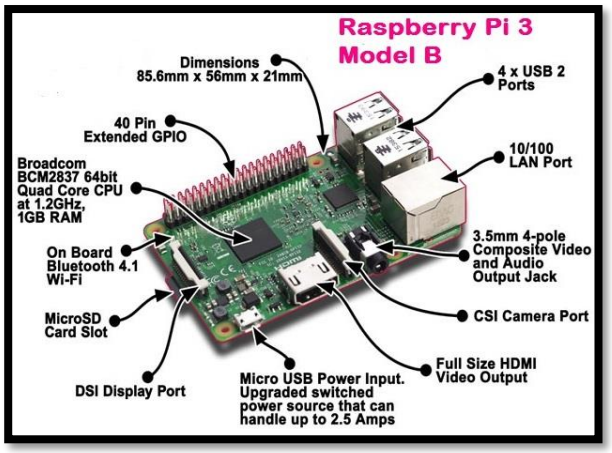

Figure: Raspberry Pi 3

5. Gas Sensor:

The gas sensor is used to detect Liquefied petroleum gas (LPG). The break out board is easy to use .In this project we use MQ6 gas sensor connected with Raspberry Pi module**.**

2.2. Internet of Things (IoT):

The **Internet of things** (**IoT**) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure.

III. 1. HARDWARE:

For the hardware we have used a 14" LCD monitor, a 50x90x0.5cm one way mirror a Raspberry Pi 3, two USB microphones and gas sensors. Everything was put together in a wooden frame. These are the final sketches for the hardware design.

Figure: ***The hardware design required for the smart mirror***

The device has two wooden parts. The back part holds the display and the Raspberry Pi and is used to support the device so that it can be hung on a wall. The frame is attached to the glass by two small wooden slats. The frame can be attached and detached from the back part so it's easy to change the glass or even the whole frame.

A breakdown of each of the main parts of the smart mirror (the two way mirror glass, display, Raspberry Pi 3, microphones, gas sensors and frame) and how they were used is described in the following sections:

3.1.1 Two Way Mirror:

This is probably the most important part of the hardware because it's responsible for creating the futuristic effect and is the biggest part of the smart mirror. Wikipedia provides the following:

Definition:

A one way mirror, sometimes called two way mirror, is a mirror that is partially reflective and partially transparent. When one side of the mirror is brightly lit and the other is dark, it allows viewing from the darkened side but not vice versa.

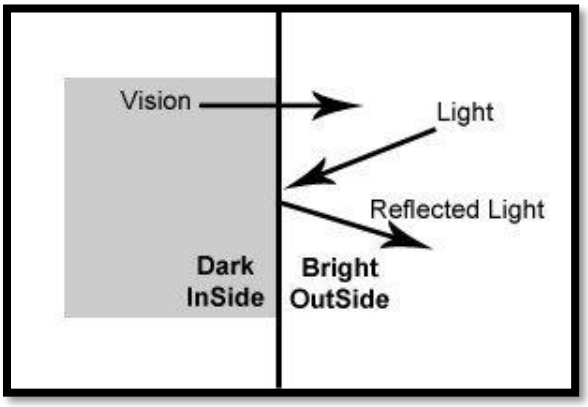

Figure: Schematic diagram of light reflection on a one way mirror.

In the case of this project this essentially means that the dark or black parts of the screen will be seen as a reflection and the light parts will be seen normally. This was the most difficult component to find because of these technical requirements, but a one way mirror was eventually found at a nearby glass store. The one that was bought was unfortunately not very reflective so sometimes you can background the white text will be seen as an overlay with the user reflected in the background see the interior of design. A two-way mirror1 is a mirror that is partially reflective and partially transparent.

This property allows the mirror to be reflective from one side (if the room is bright) and transparent from the other side (if the room is dark). Typically these types of mirrors are found in interrogation chambers. This property is crucial for the project to work.

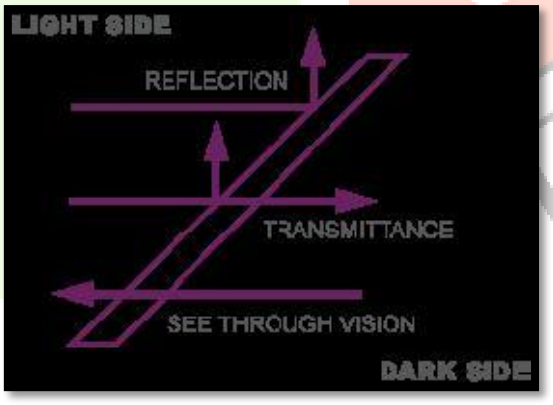

Figure: *TWO-WAY MIRROR*

A two-way mirror1 is a mirror that is partially reflective and partially transparent. This property allows the mirror to be reflective from one side (if the room is bright) and transparent from the other side (if the room is dark). Typically these types of mirrors are found in interrogation chambers. This property is crucial for the project to work.

It is exactly its ability to be transparent from one side that allows the monitor to shine through to the other side while still behaving as a mirror. Two way mirrors are made by coating the glass with a thin and almost-transparent layer of metal (usually aluminum). The effect is that some light is reflected while the rest will penetrate the glass. The mirror is bidirectional - initially it does not matter which side you are looking from. The light passes equally in both directions. However to achieve the desired effect one side must be kept dark while the other is bright. The backside of the mirror will be coated in black to simulate the darker room. Unused pixels will completely dim themselves. The downside is however that such monitors are relatively new to the market and rather expensive. For this project an older LCD laptop monitor was used. However, The mirror was designed to be highly modular - allowing replacing most of the hardware. The easiest is to simply buy an interrogation mirror that has the properties described above. These are unfortunately also quite expensive. They exists in both acrylic and glass. Acrylic is potentially cheaper and easier

to work with than glass. Alternatively there also exists two-way-film that can be used on ordinary windows to achieve the same effect.

Screen-type	Pros	Cons
Replacement screen	Thin Light Cheap	requires additional controller board for video signal and power often less than 16"
desktop monitor	24" and up integrated power supply integrated video signal	Heavy Expensive
usb-powered	Thin Light No need for external Power video and power in one cable	Expensive compatibility issues with linux systems

Table: OVERVIEW OF THE PROS AND CONS OF THE POSSIBLE SCREEN OPTIONS

3.1.2 Display:

For the display a 14 inch LCD monitor was bought, which also has built in speakers and comes with a remote control which is useful to easily turn off the device's screen. The monitor is smaller than the mirror so a black sticker was used to cover the parts of the glass which are not covered by the display. An HDMI cable is used to connect the display to the Raspberry Pi for video and audio.

3.1.3 Raspberry Pi 3:

The Raspberry Pi is a single board computer developed by the Raspberry Pi foundation in the UK. It has become the most popular computer of its kind thanks to great support and a big community behind it as well as an inexpensive price.

The Pi does not work out of the box. It lacks a hard drive and it does not come with a preinstalled operating system. To install an OS you need a micro SD card prepared with an OS image and because the software that will be running on the mirror will be coded on the same device at least a screen, a keyboard and a mouse are required.

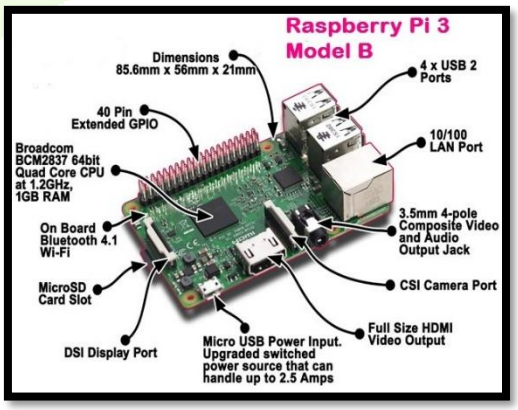

Figure: Raspberry Pi 3

3.1.4 Microphones:

One mode of interaction with the smart mirror is through microphones. Two microphones were used to power the voice recognition capabilities of the device. USB microphones had to be used because the Raspberry Pi does not have a regular microphone input. The first microphone is a cheap simple one connected through a USB.

3.1.5 Frame and Support:

The frame is made of wood and it provides the support for the mirror and all the other components. It frames the glass and provides a way for hanging the mirror on a wall. It has two parts: the front is painted white and has four holes for the ultrasonic sensors. The back has two wooden bars on the sides that are used to hang the front part. In the canter there is a support for the display and at the bottom there is the Raspberry Pi.

All the software runs on the Raspberry Pi 2 and there are many operating systems to choose from. I chose to use Raspbian which is the official Linux distribution from the Raspberry Pi Foundation because it has a lot of support and documentation.

To install it, I downloaded Raspbian from the official Raspberry Pi website and I copied it on a micro SD card. Then I inserted the card on the Raspberry Pi, I started it and followed the setup instructions which are quite simple. Once Raspbian was installed, the first thing I did was to update the distribution with the latest packages, I configured the basics of the OS as for instance the keyboard layout to match my keyboard and everything was ready to go.

3.2.1 Development Tool:

Taking advantage of the fact that I already had an operating system running on the Pi, we gave my self the challenge of writing all the code for the Smart Mirror on the same device. I installed Geany, which is a very lightweight IDE, and we used it to write all the HTML, Java script, CSS and Python code.

In the end, the entire coding for the software was done on the Raspberry Pi and I only used Windows laptop to create icons and designs with Illustrator and Photoshop. It turned out to be very convenient to be able to easily test the software directly on the Smart Mirror.

Electron

Electron is a software based on Chromium, the open source version of Google's Chrome, that includes Node JS and several improvements to make it easy to develop web based software for desktop computers. The OS was built on top of Electron using web technologies.

Node JS

Node JS is a Java script engine for server side applications. It comes included with Electron and we used it to launch processes to control things that are not available in web APIs such as the gas sensors for gesture input and microphones for voice recognition. I also use it to access the file system and read the app files.

Python

Python is a high level, general purpose, interpreted programming language. It's very popular in the Raspberry Pi community and it has lots of support and libraries. In my case I used it with the microphone to detect claps and I also used it to control the ultrasonic sensors and detect gestures.

3.2.2 Mirror OS:

Mirror OS is the software we created for the Smart Mirror's interface and it runs on top of Raspbian and on top of Electron. In the following figure you can see the layers of the software stack

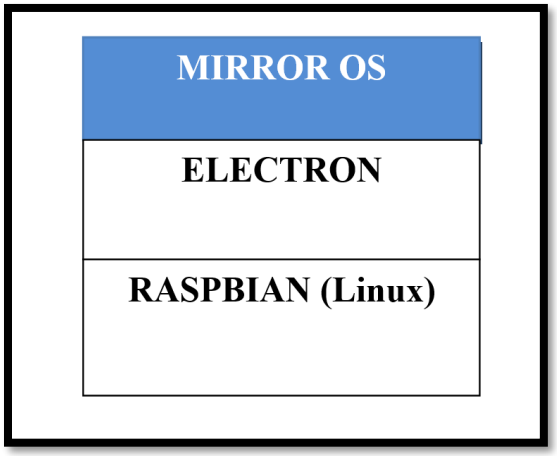

Figure: ***Layers of software stack of Mirror OS***

Architecture and features

The OS was designed to be very simple and lightweight as it already runs on top of many layers of software. It's written in HTML, JavaScript and Python and it is basically a framework for web link that provides APIs for smart phone interaction and for displaying messages to the user in a consistent way.

Almost everything in the OS is an app, even the home screen. Each app has to define some keywords to respond to input so when a keyword is recognized the OS knows which app to launch. All apps run on a different process so if an app crashes the OS continues to work as usual.

Smartphone Interaction

The smart phone is not a mandatory accessory for the Smart Mirror but it's a very convenient way to interact with the it because it can act like a remote control. We created a companion app for Mirror OS that works through a web browser so technically it can be used in any device that has a web browser, not only a smartphone. The app connects to the socket server created by the Smart Mirror and it can send and receive messages through it.

To connect to the device the user must enter the IP Address that's shown in the Smart Mirror's status bar. The server and client code is powered by Socket.io, a Node JS module. Once connected, the user can see a list of apps to launch and he can interact with the mirror in different ways depending on the app. The app and the API for this are still in early stages of development but the core concept works perfectly.

IV. LITERATURE SURVEY:

PAPER 1:
TITLE: "DESIGN AND DEVELOPMENT OF A SMART MIRROR USING RASPBERRY PI."
AUTHER'S NAME: Aibhav Khanna, Yash Vardhan, Dhruv Nair, Preeti Pannu

DESCRIPTION: This paper presents the design and the development of an interactive multimedia futuristic Smart Mirror with artificial intelligence for the ambient home environment as well as for commercial uses in various industries. The project which would collect real world machine data and the data would be transmitted from the machine and would be managed by the Raspberry Pi. The Smart Mirror implemented as a personalized digital device equipped with peripherals such as Raspberry PI, microphone, speakers, LED Monitor covered with a sheet of reflective one way mirror provides one of the most basic common amenities such as weather of the city, latest updates of news and headlines and local time corresponding to the location. Using speech processing techniques the Smart Mirror therefore interacts with the user through verbal commands, functions and listens to the user's question and responds them adequately.

PAPER 2:

TITLE: "RASPBIAN MAGIC MIRROR-A SMART MIRROR TO MONITOR A CHILDREN USING RASPBERRY PI TECHNOLOGH."

AUTHER'S NAME: R.M.B.N. Siripala, M. Nirosha, P.A.D.A. Jayaweera, N.D.A.S. Dananjaya, Ms. S.G.S. Fernando

DESCRIPTION: It is a universally accepted truth that raising a child is an extremely responsible task. One of the major problems faced by parents/guardians nowadays is monitoring their children while they are away at work. To monitor them constantly, there should be a system that can be easily handled, user friendly and smart in accordance with the rapid advancements in technology. Though the applications of Internet of Things (IoT) are diverse, this system is based on IoT which will be implemented by using Raspberry pi technology. It is a smart mirror which will possess the ability to display advanced details and connect with the user's smart phone by using an Android application. Even though many smart mirrors have been developed previously, they had only a few features such as displaying the date, time, weather and news feeds. But the Raspbian mirror which is demonstrate in this paper is much more interactive and advanced and will primarily target working parents which will receive notifications from the users through their smart phones. The Raspbian magic mirror will display useful information such as the date, time, weather and daily reminders, but it will also help parents to monitor their children and assist them with their studies, and to organize their daily routines. In the case of teenage children, parents could use this mirror to assign them household chores as well.

PAPER 3

TITLE: "HOME AUTOMATED SMART MIRROR AS INTERNET OF THINGS (IOT) IMPLEMENTATION."

AUTHER'S NAME: Jane Jose, Raghav Chakravarthy, Jait Jacob, Mir Masood Ali, Sonia Maria D'souza

DESCRIPTION: The future of Home Automation depends on Internet of things or IoT. Though the applications of IoT are diverse, the one that concerns the common man is how it can be used to make day to do life easier and faster. This is where Home Automation using IoT comes into the picture. In this paper, we demonstrate the function and working of a smart home mirror. The mirror will possess the ability to display date and time, the current weather condition and outside temperature, reminders, to-do lists and traffic conditions. These features of the mirror will be scraped from the Internet and implemented using the raspberry pi board. The pi board is programmed with the Raspbian operating system which is part of Linux. The mirror will also be lightweight, adjustable, durable and aesthetic. This paper presents the implementation and application of the smart mirror and how it is an integral part of home automation.

PAPER 4

TITLE: "SMART MIRROR: A REFLECTIVE INTERFACE TO MAXIMUM PRODUCITIVITY."

AUTHER'S NAME: Piyush Maheshwari, Maninder Jeet Kaur and Sarthak Anand

DESCRIPTION:

There is no end of objects that could be made "smarter," some being more suited to this than others. Mirrors, for example, provide a large surface ideal for displaying information and interacting with. This paper depicts the design and development of a smart mirror that represents an elegant interface for glancing information for multiple people in a home environment. Face-recognition based authentication is used to detect the user. It provides a webpage based interface to access data feeds and other services. The data feeds use web service based communication to extract data packets available through various APIs offered by websites. All the computing required for this project is done by a Raspberry Pi 3 computer along with a webcam used for face detection and a LCD panel placed behind the mirror to display the interface.

V. FLOW CHART:

Mirror OS boots on top of Raspbian. To achieve this I modified the Raspbian boot sequence so it immediately starts Mirror OS after booting. After the initialization a socket server are all started. Then the software looks for all then the software looks for all the installed apps in a folder and it starts the default home app.

Once the home app is open, the OS waits for user input through the voice input service or the socket server. If a user sends a query through one of the possible inputs, the OS processes it and decides which app to open based on the keywords defined by each app.

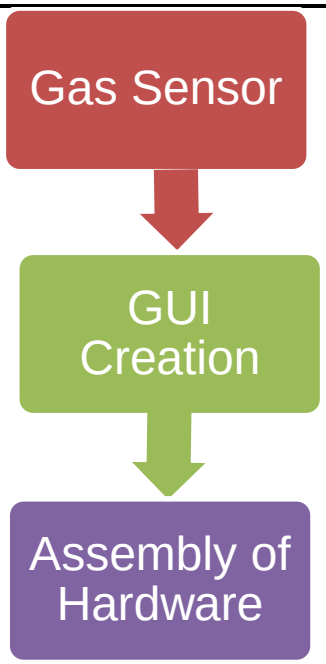

Figure: Flow Chart

VI. RESULT:

We have discussed the basic implementation of a Smart Mirror with the use of Raspberry Pi accompanied by a 14 inch monitor display to Scrape the Internet and deliver a feasible and serviceable module for Magic Mirror (Smart Digital Notice Board) to its users through IOT.

The message or notice transmitted wirelessly from mobile phone at the transmitting end is display on the mirror at receiving end as shown in figure. In this case for demonstration purpose the notice send is **"HELLO WORLD"** which is display on the mirror.

Figure: Final Output

VII. CONCLUSION

With the knowledge of new techniques in "ELECTRONICS AND IT" we are able to make our life more comfortable. One such application used in our project. Hence, our project successfully simplifies the whole concept of notice board. We have designed a futuristic smart mirror that provides natural interaction with users. The mirror display is provided by a flat LED display monitor which displays all the necessary information which are useful for the user.

The mirror also provides a picture-in-picture sub-display to facilitate the display of services whether, time, date. We have developed a functional prototype to demonstrate our work. Overall, the prototype provides an easily extendable framework that can be utilized to provide even more functionality to the user.

7.1. FUTURE SCOPE:

Future, researchers with related area of interest can deploy the proposed scheme and carryout addition performance such as procedure the system with the other language. Applying to real world context will lead to accurate scalability in accurate parenting analyzing Raspbian Magic Mirror.

The system can be made much more useful to the users by adding more functionality like integrating light settings, speech processing, etc. Future work might better application and use cases with the upcoming technology. There are many future possibilities for this project and hopefully it will be continued. For the software, It would be interesting to create an installer for it or even bundle it as a Linux distribution to be able to install it very easily on any Raspberry Pi device. It would also be good to make some changes to make it truly multiplatform. The companion app needs a new UI, may be an app repository and also the ability to easily change settings for the mirror. A community around the OS and the hardware should be created so people can help each other build and evolve these devices and create apps for them. Once polished, the software could be made open source. Finally, for the hardware part, the glass panel could be replaced for a more reflective one.

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