

# Home Automation using Smart Mirror

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**Abstract:** *The smart mirror which will be controlling home appliances such as lights, fans, TV, and other electronic equipment's. along with controlling it will be useful for security purposes such as fire detection, unauthorized entry and provides overall security for home. This system provides alert and notification messages to users about home equipment's status. The smart mirror is consisting raspberry pi and firebase cloud technology along with micro controllers and relays. This system leads to the best method to home automation and security with high accuracy and at low cost.*

**Key Words:** *smart mirror, firebase cloud, raspberry pi*

## I. INTRODUCTION

The Smart Mirror aims at augmenting the basic reflective mirror with embedded intelligence to combine daily routine tasks like reading newspaper, getting stock updates, weather updates etc. and providing all that data to the user while he/she gets ready. The Smart mirror will help in automating our work and development of smart houses. Along with the development of technology, various information can be found easily and the emergence of the concept of Smart Mirror Smart Home has become increasingly widespread. This magic mirror is easily allowed to access and control the home automation and security system. And we will be controlling music system, along with controlling it will be useful for security purposes such as fire detection, unauthorized entry and provides overall security for home. The user needs to put their respective fingerprint to unlock the device. The smart mirror is consisting raspberry pi and firebase cloud technology along with micro controllers and relays.

Day by day all are moving towards a more automated and interconnected world because of various wirelessly connected embedded devices. These are responsible for changing and improving the standards and quality of living. Many devices are being developed which use concepts of multimedia communication, artificial intelligence, internet of things (IoT) to revolutionizing the way we perform our various day to day tasks in our home, offices or even industries. Most of them use mirrors every day to look at themselves, they psychologically interact with the mirror every day to check how they look and how their attire is while getting ready for their work or colleges.

So, the idea of having an interactive mirror that can respond to one's commands can excite anyone.

A Smart Mirror can display the weather, time, date and traffic conditions on the mirror. These all features can be implemented by using the Raspberry Pi and the data from the internet. Raspberry Pi runs with Raspbian Jessie PIXEL Operating System (OS). The common procedure of building a Smart Mirror is by using an acrylic sheet covered over the LCD monitors. The Web browser and JavaScript or Python are used for the UI display. The usage of Smart Mirror provides many advantages, it makes life easier i.e. one need not to check mobile for notifications, weather updates etc., This can be advanced by introducing the motion sensor to detect the motion of the objects and can be able to watch the movies, read news and also all our home appliances can be controlled with Smart mirror.



**Fig 1.1 – overview of smart mirror**

This system which is based on the concept of Internet of Things (IoT) is developed specifically to allow users to manage and control house appliances through voice recognition. In this case, managing house appliances has been identified as the main problem faced by most people. There are just too many things to be done at one time and at certain point, users are not

able to multitask such daunting chores. For example, when a to-do list with a number of house chores has been recorded on a paper, but the paper is lost because it is misplaced. Another example is when users are too busy managing their daily activities until some trivial-yet-critical things are forgotten such as switching off the lights in a room, which can eventually lead to energy wastage. To deal with this situation, Smart Mirror is developed to provide convenience for users in managing things and control the usage of electrical appliances in the house with network connection between the lamp and the device. Users are required to give instructions to the system orally, and the system's sensors will recognize the voice of the consumer to receive instructions and respond to users' needs.

## II. PROBLEM IDENTIFICATION

The world we live in today has become a place of the fiercest competition, whether it is in sports, entertainment, or the job market. In order to be the best, one needs to allocate an extraordinary amount of time to their goals with little distraction. However, the advent of information technology tends to act like a dual-edged sword when it comes to work productivity; sometimes one can use the ease of information to help them complete a task, but it can also provide significant distraction. Ultimately one strives to be their best, but the interruption of keeping up with the daily news, or preparing for incoming weather can hinder one's progress. Taking time throughout the day for these various activities can be extremely distracting and greatly cut into performance. By the survey, we found that Peoples ignorance leads to waste of natural resources and inappropriate use of power, lights and electronic appliances. And also, there is no status and no alert messages from the already existed automation technologies or models. Security is not maintained when the owner is out of home and no intimation of thief entering the home in absence of owner. And also, Air Gesture's feature and functionality is not recognizing in existing system. Hence, we come with the smart mirror which functions as a mirror with additional task of displaying weather, time, date and schedule user tasks and also provides high security to home.

The goal of the Smart Mirror is to provide a single easy to access location for a person to receive all the information that could affect how they prepare for the day. Through the use of LCD displays and a two-way mirror, weather, time and date, and news are available at a glance. Additionally, a user-friendly interface, accessible from any Wi-Fi enabled device, allows the user to easily setup the connection to their home Wi-Fi, change the location from which they receive the weather, and select a source from which to receive the day's

headlines. By building these features into a mirror, which most people will already be using in their morning routine, it is possible to present this information in such a way that it will seamlessly blend together with the task of morning grooming.

## III. LITERATURE REVIEW

In this paper, its mentioned that mirror could offered best natural mode of interaction through by which the people could able to control their home appliances and also, they could feel the AI chat google assistant. Thus, it provides the most natural and convenient mode of interaction. It is also mentioned that it was isolated and not directly connected to any sensor or any microcontrollers; that was capable for running uniquely and independently. Their ultimate goal was to provide high security system and fire alert system. And their paper was far extending the required services [1]

According to this paper the design of a Smart Mirror is mainly for home environment. Those smart mirrors are not widely used due to cost or high requirements of hardware. It would be operated by Raspberry Pi and connected to the world through internet. Their smart mirror consists of Raspberry-Pi, LED monitor, speakers, microphone with two-way mirror and acrylic glass. Their idea of designing this project with raspberry pi using internet was much advanced and was better with low cost. [2]

This paper mainly talks about Wireless Sensor Networks which are channels where data from the physical world can be accessed and utilized by any computation device in the world. On similar lines, IoT is the basic connection to various such devices with the ability to share information across multiple platforms through a unified framework such as cloud computing. These two streams are similar such that both collect data for analysis and processing. But their approach was bit complex with IOT method and less accurate. [3]

This project provides the design and development of smart mirror that has application in important aspects. According to this paper their design approach was much similar to regular smart mirror automation which using microcontrollers and master raspberry pie model.[4]

According to this paper, design method was using microcontrollers and sonus technology. The Sonus technology which is used as a medium of interaction between people and systems. The main advantages of this model were that they had used sonus technology instead of AI chat bot which is much regular and widely used thing.[5]

Here, this model which recognizes the user facial expressions and emotions using recognition technique with its intelligence and provides services such as face recognition, health parameters, height identification. This paper did not go in-

depth to basic subjects of smart mirror but provides necessary artificial intelligence sense to smart mirror [6]

#### IV. SYSTEM REQUIREMENTS

A software requirements specification (SRS) is a description of a software system to be developed. It lays out functional and non-functional requirements, and may include a set of use cases that describe user interactions that the software must provide.

Software requirements specifications establishes the basis for an agreement between customers and contractors or suppliers (in market-driven projects, these roles may be played by the marketing and development divisions) on what the software product is to do as well as what it is not expected to do. Software requirements specification permits a rigorous assessment of requirements before design can begin and reduces later redesign. It should also provide a realistic basis for estimating product costs, risks and schedules.

The Software Requirements Specification (SRS) is a communication tool between stakeholders and software designers. The specific goals of the SRS are:

- Facilitating reviews
- Describing the scope of work
- Providing a reference to software designers (i.e., navigation aids, document structure)
- Providing a framework for testing primary and secondary use cases
- Linking features to customer requirements
- Providing a platform for ongoing refinement

##### **Performance requirements:**

Requirements about resources required, response time, transaction rates, throughput, benchmark specifications or anything else having to do with performance.

##### ➤ **Usability**

Simple is the key here. The system must be simple that people like to use it, but not so complex that people avoid using it. The user must be familiar with the user interfaces and should not have problems in migrating to a new system with a new

environment. The menus, buttons and dialog boxes should be named in a manner that they provide clear understanding of the functionality. Several users are going to use the system simultaneously, so the usability of the system should not get affected with respect to individual users.

##### ➤ **Reliability**

The system should be trustworthy and reliable in providing the functionalities. Once a user has made some changes, the changes must be made visible by the system. The changes made by the Programmer should be visible both to the Project leader as well as the Test engineer.

##### ➤ **Performance**

The system is going to be used by many employees simultaneously. Since the system will be hosted on a single web server with a single database server in the background, performance becomes a major concern. The system should not succumb when many users would be using it simultaneously. It should allow fast accessibility to all of its users. For example, if two test engineers are simultaneously trying to report the presence of a bug, then there should not be any inconsistency while doing so.

##### ➤ **Scalability**

The system should be scalable enough to add new functionalities at a later stage. There should be a common channel, which can accommodate the new functionalities.

##### ➤ **Portability**

The system should be easily portable to another system. This is required when the web server, which is hosting the system gets stuck due to some problems, which requires the system to be taken to another system.

##### ➤ **Maintainability**

The system monitoring and maintenance should be simple and objective in its approach. There should not be too many jobs running on different machines such that it gets difficult to monitor whether the jobs are running without errors.

**Hardware requirements:**

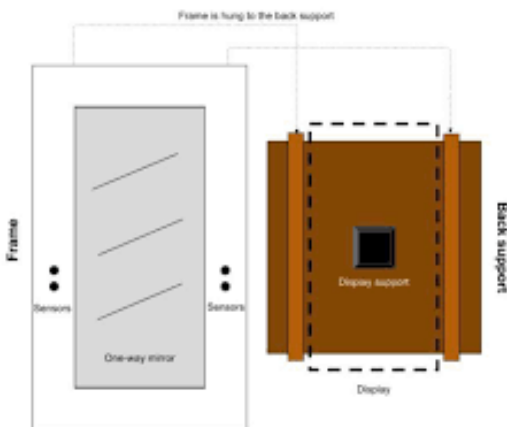
➤ **Wooden frame and mirror**

For the hardware a 24” LG computer monitor, a 50x90x0.5cm one-way mirror a Raspberry Pi 3 model B, two USB microphones and two ultrasonic sensors are

used. Everything was put together in a wooden frame. These are the final sketches for the hardware design:

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 and it has four holes, two on each side, that contain the ultrasound sensors.

As shown in fig 4.3, the frame can be attached and detached from the back part so it’s easy to change the glass or even the whole frame. See appendices 1 and 2. A breakdown of each of the main parts of the smart mirror (the one-way mirror glass, display, Raspberry Pi 3 Model B, microphones, ultrasonic sensors and frame) and how they were used is described in the following sections:

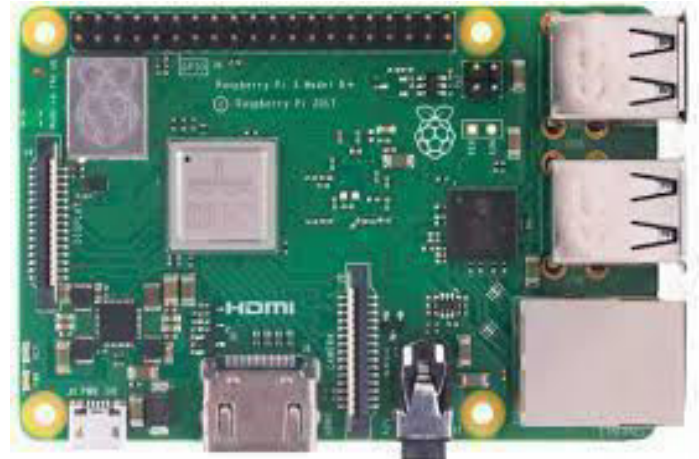


**Fig- 4.1 - hardware design required for the smart mirror**

➤ **Raspberry Pi 3 Model**

Raspberry Pi 3 Model features a 1.4GHz 64-bit quad-core ARM Cortex-A53 CPU Broadcom processor. This single board computer provides dual-band 2.4GHz and 5GHz wireless LAN and Bluetooth 4.2/BLE. The Raspberry Pi 3 Model offers faster Ethernet (Gigabit Ethernet over USB 2.0) and Power-over-Ethernet (PoE) capability via separate PoE

HAT. This single board computer also provides improved Pre boot Execution Environment (PXE) network, USB mass-storage booting, and improved thermal management.



**Fig 4.2: Raspberry Pi 3 Model**

➤ **Web Camera**

Web Camera feeds or streams its image in real time to or through a computer to a computer network. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

➤ **Monitor**

A computer monitor is an output device that displays information in pictorial form. A monitor usually comprises the display device, circuitry, casing, and power supply. The display device in modern monitors is typically a thin film transistor liquid crystal

➤ **Computer microphone**

A microphone is a device that captures audio by converting sound waves into an electrical signal. This signal can be amplified as an analog signal or may be converted to a digital signal, which can be processed by a computer or other digital audio device.

➤ **Computer speakers**

A device that converts analog audio signals into the equivalent air vibrations in order to make audible sound. When CRT monitors were the norm, speakers designed for computers were shielded to avoid magnetic interference with the CRT's magnetic coil. Getting Smaller All the Time.

➤ **Channel relay**

Relay acts as a digital switch. It helps for the Home Automation. The relay connects directly to high voltage input source of power and low power GPIO pins on Raspberry Pi. The GPIO pins cannot control the home appliances directly as they have very less output power that is about 5V, so it requires a relay circuit board which closes the circuit of home appliances when given a voltage of 5V.

1. Simplicity
2. Consistency
3. Identity
4. Visual appeal
5. Compatibility

**V. SYSTEM ANALYSIS AND DESIGN**

System Architecture is a conceptual model that defines the structure, behavior, and more views of the system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behavior of the system. A system architecture can comprise system components that will work together to implement the overall system.

Implementation is the stage/phase of the undertaking where the hypothetical outline, dreams and plans are changed over to a working framework. Along these lines it is considered as a standout amongst the most imperative stage in building another framework effectively and giving certainty to the client that the new framework fabricated will be viable and works faultlessly. The major steps involved in implementation stage are analyzing the problem, planning, and careful investigation of implementation constraints, evaluating and optimizing the design.



**Fig- 5.1 – working model of Smart mirror**

The proposed smart mirror device gets activated when the authorized user unlocks it using authentication methods such as face recognition or using bio metric finger sensor. Once the user unlocks it display the home menu screen on mirror along with basic multimedia texts and whether, time and date, user schedule.

The home screen displays the control panel and the music system control such as volume, pause and play using air gesture technology. IR touch overlay screen technology is used to the display which is on the bottom, next to mercury mirror, the IR Touch Overlay is on top. From there we will cover the overlay with a frame to hide it from view and to hold the smart mirror together tightly. Time, Date, weather details and news are fetched from online websites as well as from live news channels.

**Design goal:**

The following are the design goals that are applicable to every application regardless of application domain, size or complexity.

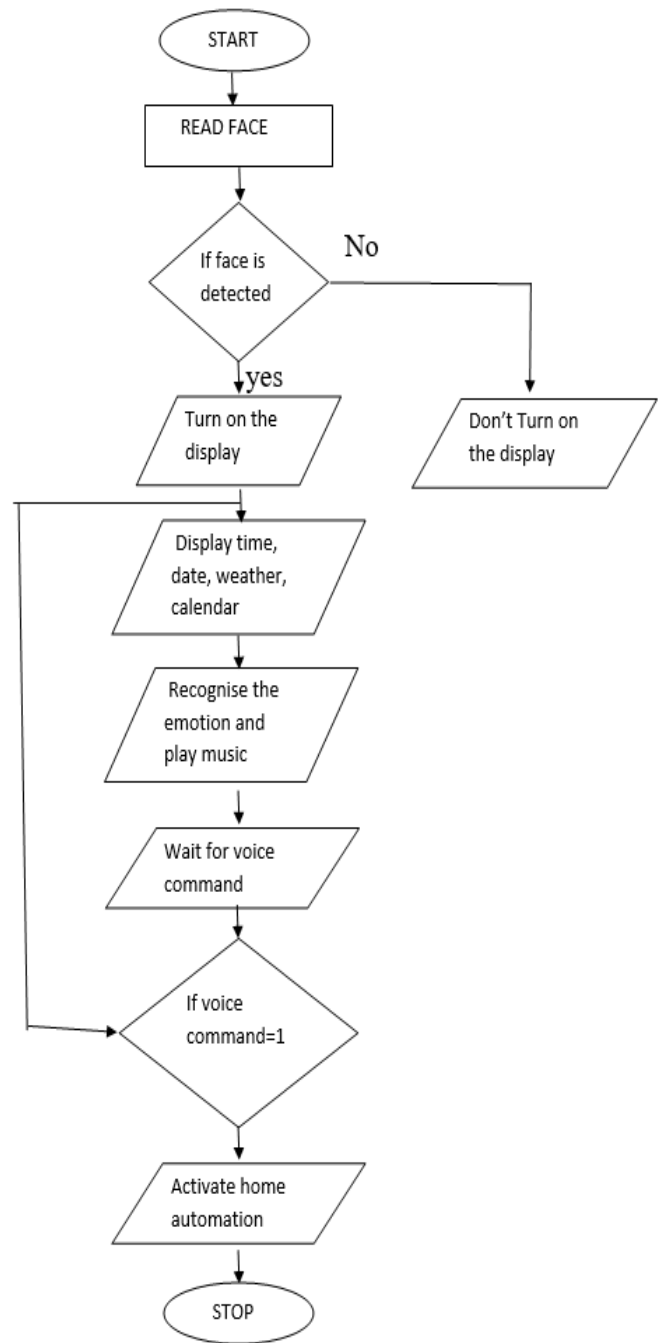


### Fig- 5.2 - Architecture of Smart Mirror System

The above fig 4.2 shows overall architecture of smart mirror, Which consists raspberry pi model and microcontroller connected to each other as a master and slave respectively. Mercury coated mirror along with led display is connected to raspberry pi model. And also, sensors and smartphones are connected to it. And other home appliances connected to raspberry pi model through relay. Microcontroller can be Arduino UNO or Node MCU.

**Flow diagram** shows the interaction between the system and outside an entity. A dataflow diagram represents flow of data through a system. Data flow diagrams are commonly used during problem analysis. It views a system as function that transforms the given input into required output. Movement of data through the different transformation or processes in the system is shown in flow diagram. The function individual entities will be explained in detail in the flow diagram.

The below Figure 5.3 shows the working process of smart mirror. It shows the description about the interaction of the components that is Monitor, Raspberry pi, PIR, DTH11, Arduino, 8 Channel Relay, Web Camera, Google assistant. First by default Date, Time, Weather, E-mail, Complimentary texts. When we give the voice command, Google assistant processes it and gives the output in voice. PIR detects the movement of the obstacle and displays the message on mirror. For the home automation, we are using a sample LED light and a mini fan. It works as we give the trained voice commands.



**Fig 5.3: Flowchart for Smart Mirror System.**

## VI. CONCLUSION AND FUTURE SCOPE

The main strengths of this project are that this is a new kind of smart device that people don't see every day and it looks very spectacular. The platform has a very simple API that makes it very easy for developers to make apps. The voice recognition is very accurate thanks to Google's services. Smart mirrors have great potential to enhance user experience of accessing and interacting with information. They allow users to see relevant information effortlessly. Our smart mirror saves time and makes it easier to access information. To keep the mirror secure face recognition technique is incorporated as a means of security. It makes sure that only authenticated users can access the information on the mirror while others cannot. A futuristic smart mirror system that provides information like time, date, accurate temperature and humidity, and latest news while looking and grooming in front of mirror.

### Future Scope:

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. 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.

In today's society security is of crucial importance. By keeping this in mind we can integrate a thief detection system into our smart mirror. Face Recognition can be used as an evidence for theft detection. In future this project can be improved by adding interactive touch screen, geo-location, Alexa and some more features Life can be made easy and enjoyable by embedding more and more features on to the mirror interface such as getting the traffic updates, emotion recognition and also tracking of our attire daily.

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