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# IoT Based Interactive Smart Mirror Using Raspberry Pi

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**Abstract -** *In the recent days Internet is the most common and often used one in our life. It is connecting everyone in the world virtually. There are lots of transformations like keypad phones to smart phones and wrist watches to smart watches and etc. Since then the concept of IoT (Internet of things) has come into existence. IoT is a global network infrastructure where the things (objects) that are connected together have self-configuring and self-adapting capacity. So the normal objects are turning into smart day-by-day. Like Mirrors play an important role in our life, we have many mirrors around, turning them into smart makes our life easier and time saving. A smart mirror is a fictional object that provides various kinds of information anytime. Whenever the system is turned ON, the Smart mirror displays various information such as current weather forecast, time, date, compliments based on time and news feed automatically. The mirror can also display some other information like COVID-19 tracker, Calendar which includes Indian Holidays, Weekly schedules and activities, Weekly weather forecast, Random quotes, and Random YouTube videos provided with playlist ID along with Random background images which are all inserted into an on screen menu to hide and display when needed with just One-click. Also the modules are provided with API (Application Programming Interface) keys so as to maintain the personal information. So, integration of different modules to the two-way mirror transforms a normal mirror into an Interactive modular Smart mirror.*

***Key Words*: API, Display, Information, Internet of Things, Smart mirror, Two-way mirror**

## 1. INTRODUCTION

In the recent days technology is leading our lives and also has adapted our daily life schedules. It is playing an important role in our lives. With an increase in technology, humans are seeking for more and more efficient, advanced, smarter and most useful objects and things in this machine running era. There are many smart devices available now-a-days like watches, smart TV's, phones etc. Even though the things are becoming smarter, it is occupying lots of human's time. For example, when a person wants to check weather while going out, he/she has take out their phone and then check the weather forecast. This takes at least 2 minutes of time. If the person forgets to check the weather, what if the day has a bad weather conditions? The person may get wet. So to reduce these problems, Smart mirror concept has been introduced. It is actually a concept under the area of IoT.

IoT is a global and dynamic network infrastructure where the things or objects have their own identity and unique numbers. Here the things adapt and configure themselves to the environment and integrate the information onto the network and often communicate the data with other users in that network also. They not only connect and communicate but also exchange the data.

The smart mirror is a 2-way interactive mirror with a display behind a normal mirror that is capable of reflecting real-time object as well as displaying some additional information. It can display any type of info according to the user's choice. So, whenever the user wants to check weather, they can check while brushing their teeth or while getting ready also. This saves lots of time and also very useful object in our daily life and mainly in this era. In this pandemic, the user can also check the live updates of Covid-19 of the top 4 countries along the cases present and rate of death etc. The user can also check the holidays present along with duration of it.

## 2. RELATED WORK

U. Chaitanya, et al. designed a smart mirror that activates using voice and camera to displays basic information. Using voice assistant, this system also activates Google services like search engine, notifications & Google calendar according to the commands given by the user [1]. The normal camera which is attached acts as a surveillance camera. The goal of this system is to use as a hands free system.

P. Anand, et al. developed a smart mirror that tends to display all the basic information with Raspberry Pi [2]. The key is to manage time by involving technology to do multitasking without the usage of any phones, tablets and PC's. This is developed to increase the interactions between the virtual world and humans. The possibility of the information to display on the mirror is endless so the functionality of our device is quite flexible.

K. Mayuri, et al. presented the design & development of smart mirror using AI for commercial uses in different industries and also for ambient home environment [3]. This system actually collects the system info and transmits it to the Raspberry Pi. This system is designed as a personalized device that displays most common amenities like city's weather, news updates and headlines along with time according to the location.

## 3. PROPOSED SYSTEM

This proposed Smart mirror is designed to perform various activities i.e., it displays time & date along with current weather, compliments and news feed spontaneously whenever the system is turned ON. Despite of displaying the information that is already in the existing system, this system is advanced enough to provide the latest information like Real-time COVID- 19 tracking, Calendar along with Indian holidays, Weekly schedule and activities, Weekly weather forecast, Random Quotes, Random YouTube videos which are included in playlist, Random Background images. These all features are again included in an on screen menu so as to Hide and Show the information whenever needed on just One-click. It can be used as a normal displaying mirror when the system is turned OFF. This system allows the users to use even if their hands are dry or wet or dirty, daytime or night.

The proposed system is further divided into two modules. They are:

- Hardware configuration module
- Smart mirror display module

### 1.1 Hardware Configuration module

The two-way mirror is positioned in front of the whole setup, facing non – reflective side (dark side) to the front and the display made of LED is positioned at the reflective side (bright side) of the mirror. Speakers which are connected to Raspberry pi using USB connector provides voice output to the user. Mouse and Keyboard are also connected to Raspberry Pi so that they provide commands to run the MagicMirror and also to control the modules present in the mirror. Raspberry pi which works as a CPU connected to the whole setup is provided with power supply using a cable so as to supply power to every component. Raspberry pi is also connected with Ethernet / Wi-Fi to receive Internet that is used to update information every minute. To work in raspbian OS, it is installed and dumped onto SD card, which is inserted in a Raspberry pi. This whole setup is settled down in a wooden frame to safeguard.

### 1.2 Smart mirror display module

Whenever the system is turned ON, the Mirror displays the information like time, date, compliments, current weather information and News feed [5]. The system contains and on screen menu that contains accessibility over other modules like whenever the user clicks on show Quotes, the mirror displays the random quotes along with the epigrammatist and stops displaying when the user clicks on hide Quotes. Also it displays other modules. It also displays random YouTube videos which are added into a playlist and it can also be viewed in a Full-screen mode hiding all other modules. It also has a COVID-19 tracker which displays the top 4 countries in the list along with the updated date and time.

The modules that are displayed on the interactive modular smart mirror are: Time, Date, Current weather, Weekly weather forecast, Compliments based on time, News feed, COVID-19 tracker, Calendar with Indian holidays, Weekly schedule and activities, Random quotes, Random YouTube videos, Random background images, on screen menu.

Advantages of the proposed system:

- A 2-way mirror displays like a real-time reflecting mirror (i.e., normal mirror).
- The mirror will automatically sleep whenever there is no action.
- As the system is enabled with various No. of modules, the usage of phones and all electronic gadgets are reduced.

## 4. SYSTEM DESIGN

### 4.1 Block Diagram

The system architecture of an Interactive modular based Smart mirror is shown in Fig - 1. The 2-way mirror which is main object placed at the of front whole setup acts as both for reflection and transparent purpose. Then an LED display which shows the information to a user is placed just behind the mirror. The other physical devices i.e., Power supply cable to supply power to whole setup from Raspberry pi, Speaker to give the Audio output when we watch YouTube videos, Mouse and Keyboard to provide input/exit commands to the mirror. The user can choose any of the modules from an On-screen menu present in the mirror that can be accessed using Keyboard/ Mouse. The whole code is dumped onto an SD card and inserted into Raspberry pi. The whole data is taken down by raspberry pi using internet connection i.e., connected using either Ethernet (LAN) or wireless (Wi-Fi) connectivity.

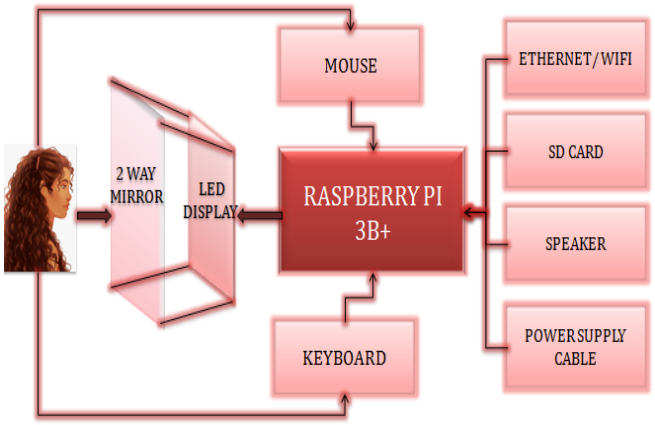


**Fig - 1:** Block diagram of Interactive Modular Smart Mirror

### 4.2 Arrangement of components

The components arrangement is as shown in Fig - 2. The 2-way mirror is positioned at the front of the setup right after the front frame which places every component right. Behind the mirror, LED display is placed i.e., at the reflective side. At the same side, it also has speakers to provide the voice output when we use YouTube to watch videos along with the keyboard and Mouse. These components are directly connected to the Raspberry Pi along with the power supply [4], [6]. Then this is positioned in a back frame.

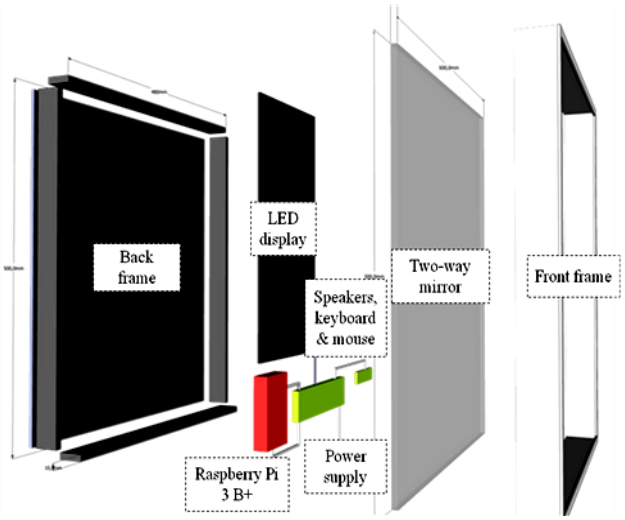


**Fig - 2:** Arrangement of components

### 4.3 Mirror UI

The figure (see Fig - 3) shows mirror's user interfaces which is of high-level. Firstly the mirror mimics as a normal mirror. Secondly the user can access the inner modules using an On-screen menu. Then the user can gain access over personalized service using the information services.

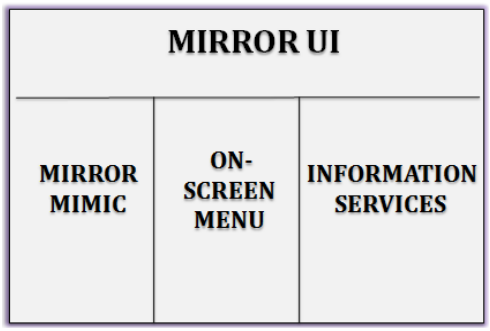


**Fig - 3:** Mirror User Interface (UI)

The proposed system functions as follows:

- **Mirror mimic:** The first and foremost function of this smart mirror is to perform its usual functionality, i.e., to perform it as a real time reflective mirror until the system is turned ON.
- **On-screen menu:** The user gains accessibility over the modules that are of non basic modules and can even be hidden or shown to the user with just One-click using either Mouse / Keyboard.
- **Information service:** The mirror performs a smart activity by displaying various kinds of information over a normal Two-way mirror. Since the system is connected to an internet, it gets Real-Time updates.

## 5. IMPLEMENTATION

The Interactive Modular Smart Mirror consists of various kinds of modules that perform over the normal Two-way mirror. Whenever the mirror is turned ON with a power supply, the Raspberry pi takes it to the Raspbian environment. Then in the Raspberry pi terminal when the command "cd MagicMirror" is run, the Raspberry pi will be working under MagicMirror operating system [7]. Then again when the command "npm start" is given, the Magic mirror will be turned ON. It directly displays the basic modules of Time of the corresponding location, Date, and Compliments based on time and are of random that are given within in the code, News feed and headlines which are updated from time - to - time and are also taken from the one of the famous News articles: "Hindustan Times" and it also displays the updated time and date. If the News was updated on same day, it displays as "updated at so and so hours or minutes ago". The system also displays Current Weather forecast along with the temperature that is felt to a human body and is based on the city which is mentioned.

This system doesn't only consist of the basic modules but also have various advanced and latest modules which are integrated onto one display screen. It has a Weekly Weather forecast module which displays the weather conditions of one whole week along with the maximum and minimum temperature conditions. But the user must register in the open weather website and provide the API (Application Programming Interface) key as well as the location ID to display the weather conditions based on the particular city. It has a Live COVID-19 tracker which displays the top 4 countries present in the statistics provided by a webpage and the data feeds are given to an authenticated user who provides the API key given by the registered website. It displays the total no of cases present all over world. Not only that but it also consists of the rate of newly confirmed cases, total no. of deaths and newly confirmed cases, recovered cases and the rate of presently active cases along with the statistics of updated date and time. It also has a Calendar with Indian Holidays along with duration and the top 5 are taken in them. Whenever we wanted to learn some quotes, my proposed smart mirror also displays some random quotes. When the user is not in mood and wants to watch some videos in YouTube, this mirror also displays videos that are in a playlist and are added by the user itself and the screen can also be enlarged to a Full – screen mode and at that time every module is hided. So as to use the YouTube onto a smart mirror screen, the user must provide the given unique playlist ID. The screen which is displayed is never a black back grounded one, but has a screen which various

images that are displayed randomly based on the specific amount of time. Whenever the user forgets some of the important meetings or any of the schedules, this smart mirror displays the schedule as per the week. My proposed system consists of weekly Household chores and the activities along with a small note written on it and that are to be performed and also the fruit to be eaten on a particular day with some image of it. So as to not make the screen clumsy, I have included an On screen menu that has various modules that can be either hided or displayed whenever I want with just One-click using a mouse or even can be operated using a keyboard. The mouse pointer doesn't interrupt the display purpose and can only be seen over the YouTube window and near the menu.

## 6. DATAFLOW DIAGRAM

The Interactive Modular Smart Mirror as shown in Fig - 4. When the user gives any input commands after turning ON the system from sleep mode, the Smart mirror is turned ON & displays Time & Date, Compliments, News Feed, and Current Weather Forecast. The user can select either Hide or Show the modules from an On-screen menu like COVID-19 tracker, Weekly schedules, Calendar with Indian holidays, Random quotes, random background images, Random YouTube videos or weekly weather forecast, it performs accordingly. Whenever the user gives an exit command, the smart mirror display turns OFF.

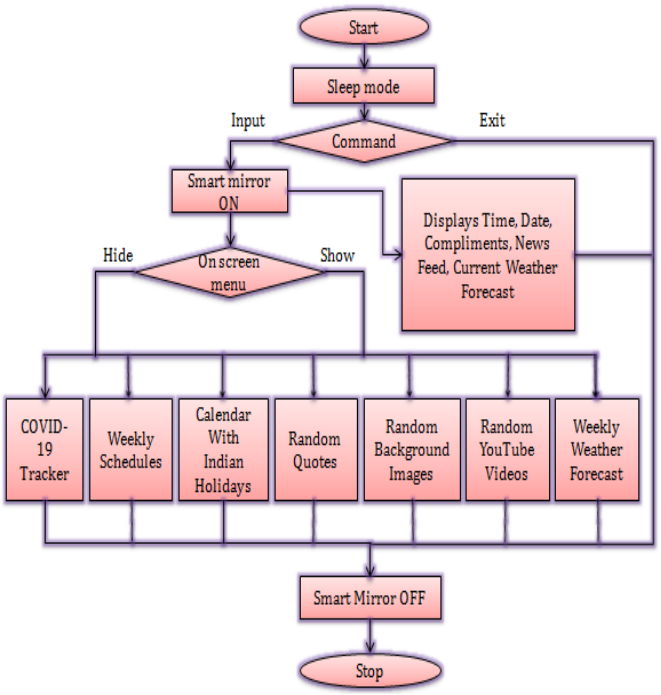


**Fig - 4:** Flowchart of an Interactive Modular Smart Mirror

*Step-1:* Start

*Step-2:* The system is in sleep mode when is no activity.

*Step-3:* When the user gives an input command, the Smart mirror turns ON.

*Step-4:* Displays Time, Date, Compliments, News Feed, and Current Weather Forecast.

*Step-5:* The user can select either Hide or Show the modules from On-screen menu

*Step-6:* The mirror displays COVID-19 tracker, Weekly schedules, Calendar with Indian holidays, Random quotes, random background images, Random YouTube videos or weekly weather forecast based on the user's choice.

*Step-7:* When the user gives an exit command, the Smart mirror turns OFF

*Step-8:* Stop

## 7. RESULTS

**Smart mirror modules:** The below figure (see Fig - 5) displaying every module in one screen i.e., Time, Date, Current weather, Weekly weather forecast, Compliments based on time, News feed, COVID-19 tracker, Calendar with Indian holidays, Weekly schedule and activities, Random quotes, Random YouTube videos, Random background images and on screen menu.


**Fig - 5:** Mirror displaying all the modules

**Table - 1:** Experimental results

| Module | Input Functionalities | Obtained results |
|---|---|---|
| - | Time, Date, Compliments, News Feed and Current Weather forecast | Displays automatically Whenever the system is turned ON and also is placed at same positions as provided. |
| | COVID-19 tracker | Displays COVID-19 tracker along with confirmed, new cases, new & total deaths, and total recovered & active cases along with the updated |

| | | |
|---|---|---|
| On- screen menu module (Hide and shows the modules) | | time. |
| | Calendar with Indian holidays | Displays Calendar with Indian Holidays along with the duration. |
| | Weekly weather forecast | Displays Weekly weather forecast along with the location. |
| | Weekly schedules and activities | Displays Weekly schedules like Household chores and also the activities that consist of fruit of the day with some logo. |
| | Random quotes | Displays Random Quotes along with the Epigrammist. |
| | Random YouTube videos | Displays Random YouTube videos and the audio output is from speakers. |
| | Random Background images | Displays Random Background images. These are displayed in a Full screen mode. |

## 8. CONCLUSION AND FUTURE SCOPE

This Interactive Modular Smart Mirror system broadens the features of a mirror into a Smart appliance which helps an individual to lead an easier and smart life. It displays lots of information based on the user's choice and interest that are chosen from the menu. The menu also helps the user to display as well as hide the information when not needed, with just One-click. In future, this Smart mirror can be equipped with Face recognition system so as to make the system as a home security system. Also Voice assistant and Voice Recognition system can also be incorporated.

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