Smart Mirror with Home Automation using Raspberry Pi

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***Abstract*—Thisproject describes the design and development of an interactive multimedia futuristic smart mirror using Internet of things for the ambient home environment as well as for commercial uses in various industries. Every morning our day begins by watching ourselves atleast once in a mirror before leaving our homes. We interact with it psychologically to find out how we look and how our attire is. Smart mirror or Magic mirror is one of the applications of Raspeberry Pi.A computer screen embedded in mirror looks very futuristic. The Raspberry Pi stays at back scenes and controls the data displayed on mirror. While looking at the mirror you can look at various notifications from social sites as well as news, weather forecast and more things. Such mirrors can be programmed to work as AI and control home appliances by voice input or touch screen. The Raspberry Pi is connected to monitor via HDMI as well as it also has inbuilt Wi-Fi and Bluetooth interfaces so we can just swipe music and videos to mirror.**

Keywords—Smart mirror, RaspeberryPi, Home automation, Python,Internet of things.

I. INTRODUCTION

Smart mirrors are straight from science fiction. Basically, the mirror looks like normal mirror but when someone stands in front of it the scene changes. An innovative framework used to convert a normal utility mirror into a smart interactive device. The mirror provides a functional, user friendly and interactive UI to its user for accessing their social sites, messengers, etc. It has widgets for displaying the current weather conditions, time, events, and Latest news headlines. Activation of smart mirror, convert a section of normal mirror into touch interactive display. It has its own Graphical user Interface (GUI) that creates a visual of UI display on mirror surface has full internet connectivity using Wi-Fi.

With the advancement in both science and technology, people are moving towards a more automated lifestyle. Some of the automated areas like smart cities, smart cars, Smartphone, and smart homes, and to survive in this automated world, we need many home automation systems using the Internet of Things (IOT) devices. IOT is an integrated system used for the running of task autonomously. It is the connection of Wireless Sensor Network devices. Many real-world applications exist for the home automation like closing and opening of doors/windows automatically when a person enters or exists, turning on and off the light and fan in the home, organization from anywhere and anytime through mobile. This paper mainly focuses on the Smart Mirror using IoT which works with the help of Raspberry Pi.

The usage of Smart Mirror provides many advantages, it makes life easier i.e. we do not need 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.

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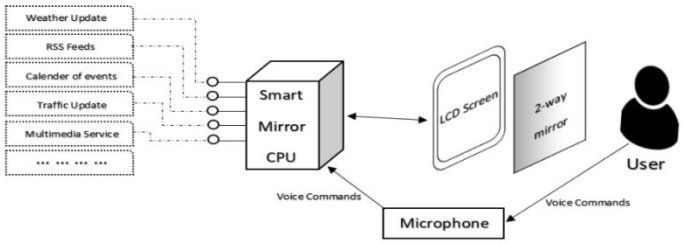
II. SYSTEM ARCHITECTURE AND DESIGN



The mirror interface is decorated with several widgets. A widget is a simple window frame that contains an embedded browser. Unlike a window, widgets do not overlap nor do they contain complex interface elements. The mirror interface contains two categories of widgets, one that enables remote device control (e.g. light on/off, and home temperature control), and the other enables access to various information services (e.g. news feeds, weather updates, etc.).

The widgets in the mirror UI instruct the Raspberry Pi of the Smart Mirror system to control a requested device or to access other personalized information services.
The Raspberry Pi is configured to always listen for a voice command and perform the task associated with it. The Smart Mirror is powered by the Raspberry Pi and the output is seen on a monitor that's connected to it, which in turn is placed behind a two-way acrylic mirror with the same dimensions as

that of the monitor. This system of devices implements the Smart Mirror and can be used in home, work, or public environments.

The Smart Mirror widgets are customizable to meet the user's requirements. They have been implemented in a building block manner, thus, the user can choose the widgets they wish to have displayed and functioning on the Smart Mirror at any point in time.

Since the Smart Mirror is voice activated and controlled, there is a lot of chance for false positives and true negatives when the user gives a voice command. In order to overcome these challenges, we have developed and designed a custom Remote Configuration Tool (RCT) that the user can use to customize the settings of the widget as well as input commands through a text input interface.

The RCT is designed keeping simplicity and high functionality in mind, along with ease of use for any user of the Smart Mirror. It enables the user to customize the functionality and visibility of the Smart Mirror's widgets with ease and also to adjust the microphone sensitivity. All this is done through a web page with various options and interfaces for the user to interact with and make the changes they desire.

1.	Two-way glass mirror	To provide transparent and reflective surface
2.	Monitor	Forms the display of mirror
3.	Raspberry Pi	Forms the CPU of mirror
4.	IR Frame	Provide touch interface to mirror
5.	Camera	For face detection
6.	Microphone	For voice input
7.	8-Channel Relay	For connecting to home appliances

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. The Smart Mirror 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/Touch 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 user's needs.

The proposed system is developed based on three objectives:
1. To design a prototype Smart Mirror using Raspberry PI
2. To develop a voice recognition system to facilitate the implementation of Smart Mirror.
3. To carry out the testing process on Raspberry PI for usability evaluation to users.

III. SYSTEM IMPLEMENTATION

The technique for actualizing Smart Mirror is acknowledged in the accompanying advances:

1. The thought and the mirror
2. The screen
3. The packaging
4. Hardware establishment
5. Installing raspberry pi
6. Production of interface

A. The tought and mirror

Our way of life has advanced for improving time, it is the most vital thing. Our work thought was advanced from thought when we took a gander at the mirror when we go out, figuring for what reason don't that reflect improve the reflect determination.

A standard mirror would not work. The mirror ought to be semi straightforward or to be progressively precise, it needs to carry on like a mirror when the screen behind it is dark, and ought to act like a glass window when data is shown on the screen.

B. The screen

After a couple of estimations and a few tryouts by tape on the divider where we wanted to inevitably mount the mirror, we figured a suitable estimation that would give the ideal screen measure. In the long run we use LCD screens that met a large portion of the desires. They are generally modest straightforward touch catches and the correct connector introduction. This control board of screen is to be associated and mounted inside the packaging.

C. The Packaging

Estimated the measurements required for the new packaging and we chose to make a wood packaging that would make a

solid and consistent edge. This packaging goes about as a rack where the things can be kept. Since the model would presumably create some warmth, air ventilation openings were given. Additionally a pleasant and firm mounting point was included the rear of the packaging.

D. Introducing Hardware

Introducing equipment required the accompanying segments
1) The Monitor
2) A Raspberry Pi A HDMI Cable (to interface the Raspberry to the Monitor.
3) A USB to small scale USB link (to control the Raspberry Pi)
4) A power link to control the screen.

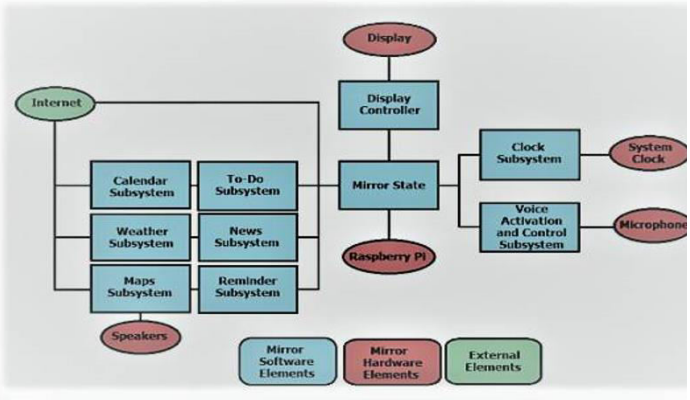
Introducing equipment is simply required to just associate every one of the segments, connected the power link and after that give capacity to the screen. The Raspberry is booted and the framework didn't make any huge warmth.
The equipment establishment part included mounting the board behind the mirror and appending the raspberry pi to it utilizing HDMI link. We make utilization of a smaller Scale USB link to control the raspberry pi.

E. Introducing the Raspberry Pi

We had picked the working framework Raspbian, because of its adaptability and completely open-source network bolster. It gives a stage to establishment. Wi-Fi availability is important since extra links would lessen the adaptability of the Smart Mirror, we favored Wi-Fi to associate the shrewd Mirror to the web.

F. Creation of thr Interface

The interface we based on top the Raspberry work area is definitely not a strange application. It is essentially a full screen web that enables us to utilize Python scripting. What's more, to sweeten the deal even further, it permits to create and test the interface on the standard PC, before pushing it to the Smart Mirror.



Data flow in the Smart Mirror

IV. SIMULATION AND RESULT

The main functional modules of the Smart Mirror were simulated and tested upon, prior to completion of the entire Smart Mirror system. Each aspect constituted a test case for simulation of the Smart Mirror. The test cases were documented in a systematic manner and each test case contained the following fields of information - A serial number, the name of the functional module to be simulated upon, the description of the simulation, the input data and conditions for the module to be simulated upon, the output of the simulations on the module based on the input data and conditions, and a results section which indicated whether the particular simulation was successful, partially successful, or unsuccessful on the module in consideration.

The input data given to the modules for simulation and testing consists of module-specific data and conditions. The input had to be relevant to the module being simulated and tested, in order for an accurate result to be obtained. The test cases were used as a means to check the correctness of the development process of the Smart Mirror system and to verify and validate that each functional module of the Smart Mirror system performs its required task independently as well as all together as one combined functional unit. The following table represents the simulation process on the different main functional modules of the Smart Mirror system as well as the results obtained from each simulation case.

Sl.no	*Module to be Simulated*	*Description*	*Input*	*Output*	*Results*
1	USB Microphone and Audio Output Jack on the Raspberry Pi	Advanced Linux Sound Architecture (ALSA) needs to be configured and explicitly notified about the input and output devices for sound. This is because manipulating sound input/output in Linux systems is complex. Hence, Raspbian needs to be explicitly informed about the audio input and output devices.	Using commands in the terminal, the hardware information of the devices are determined and used to alter the operating system files and configure ALSA.	The hardware device information was detected, the files modified correctly, and the devices were recognized and usable as required. When the hotword "Smart Mirror" was given while testing the USB Microphone in the terminal, it was detected correctly.	The simulation was successful.
2	Node Package Manager(NPM) Database Connection	When the Smart mirror program is executed, it tries to connect to NPM Database using the data source and catalogue. If the connection details are correct, the database is connected, else an error is displayed. Successful connection results in execution of the Smart Mirror application.	The command "npm start" is used to initialize the Smart Mirror application.	The connection was established and the Smart Mirror application executed and run successfully.	The simulation was successful.
3	Speech to Text and Hot ward Detection	When the user inputs a voice command, it must be recognized and interpreted. A voice training method is adopted to enable the mirror to get activated when the attached microphone picks up on a voice command. Sonus, Sound Exchange libraries, Snow boy, and Google Speech API are used to detect voice commands and convert speech to text.	User's voice is input for interpretation.	Sonus uses SoX Libraries to convert raw audio input into 16-bit binary files that are sent to the Google Speech API for conversion to text. Snow boy is responsible for the Smart mirror to always listen for an output as well as for detection of the hotword. Once the hotword is detected, the bottom of the Smart mirror screen lights up, indicating that the user can subsequently input a voice command. If the voice can be decoded, the speech is appropriately converted to its respective text format and displayed and its associated command is executed.	The simulation was successful.
4	Module and System Functionality	The functionality of individual modules as well as the combined functionality of all the modules implemented into the system are simulated and tested.	User gives voice commands to activate the functionality of the various modules implemented in the Smart mirror system.	The individual modules like Maps, YouTube videos, Countdown Timer, and others that have been implemented, display the appropriate outputs to the user based on the input commands. The entire system works correctly as one cohesive unit.	The simulation was successful.

V.Future Scope

The principle objective of this undertaking is to build up a shrewd mirror gadget. The gadget should resemble a standard mirror however would have a screen inside and you would have the capacity to collaborate with it utilizing voice directions, hand motions and face acknowledgment. The working framework would bolster running applications and would give a basic API that would assist a person with having the straightforward applications kept running on the shrewd mirror that ordinarily is available on the advanced cell. The fundamental highlights the Smart Mirror would have would demonstrate essential climate and time data, having the capacity to include cautions, updates or notes comparably we stick notes on an ice chest. We would likewise have the capacity to play music here and there and see pictures through Instagram, for instance.

The product should have been intended to be particular and responsive so as to fit the keen mirror activity. With the venture we need to take in a great deal about the Raspberry Pi as it is the first occasion when we are utilizing it. Up to now there have been numerous individuals who have constructed Smart Mirrors however as I would see it they need intelligence and innovativeness. The venture plans to change this by giving the client a chance to interface utilizing distinctive reason to meet their general needs. It will be one of the primary Smart Mirrors you can cooperate with and feel like it is on the vital piece of life as it diminishes the need of conveying the PDAs to the regions like restroom and so forth. We can without much of a stretch utilize the keen mirror to satisfy our general needs like checking the news channel or any sort of update through our voice directions or general hand signals. Single screen. Another Application is that this usefulness can be setup openly puts. The goal of the undertaking is to investigate the approaching movement in how individuals get data.

The Artificially Intelligent Smart mirror is configuration to play out a few functionalities basic used to furnish a feeling of normal collaboration with the encompassing condition and furthermore we give an effortlessly extendable structure to coordinating web administrations, for example, YouTube recordings, intuitive maps and most recent entire week's climate report too.

VI.ACKNOWLEDGMENT

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