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Voice Assistant and Security based Smart Mirror

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Abstract: ***Now-a-days the internet has become more common in our lives. It can connect us more easily to information and other people in a virtual world. Mobile phones turned into smart phones and since then this concept has erupted and morphed into Internet of Things (IOT). IOT is a network of objects or things that are embedded and enables the objects to collect and exchange data. So the objects can become even smarter day-by-day. For example, mirrors provide a large surface to display information and to interact with. Everyone have mirrors at homes, schools, offices etc., thus the concept of smart mirror can be attractive and also been fantasized in futuristic movies. A smart two-way mirror is a science fiction and a part of optimistic vision of future and imagines a world which has screens and data that are available everywhere, ready to provide whatever information is needed at any moment. The main purpose of the system is to use it as a hands free product with an electronic display. When voice or camera is enabled, the smart mirror is used to view different kinds of information such as weather, time, date and news feed automatically. Voice assistant system is used to enable Google search engine, Google calendar and notifications based on user's commands. Camera controlled system is used as a security surveillance camera. So, the voice assistant along with camera is integrated to the two-way mirror converts the functionality of normal mirror into an Interactive Smart Mirror.***

Keywords: Smart mirror, Security surveillance, Voice assistant

I. INTRODUCTION

In the past few years technology has become more important and also a part of our lives. With the increasing technology, people are expecting more productive and efficient tools in their daily activities. We got many smart devices like smart TV's, watches, phones etc which have various applications. The usage of these smart devices helps them stay productive but there is lack of time efficiency. Imagine a person is being busy and wishes to listen to a song, at that time using a phone takes at least 2 minutes of time. Also when a kid wants to use a phone for a Google search, accessing phones may become an addiction. So as to avoid problems like these the introduction of smart mirror has made.

The smart mirror is an interactive two-way mirror with an inbuilt display behind the glass which is used as a real-time reflective object along with an additional capability of displaying information. It can display any kind of information that we want using a voice assistant. The purpose of this smart is not only to display the information we require but also provide the security using a camera that detects motion and sends information to the registered email.

IOT is a network of objects or "things" inserted together with hardware and software components for collecting information, creating and sorting items, processing and distribution of information. It not even connects things but also allow collecting and exchanging of data. It also allows things to sense and control remotely across existing network

infrastructure and creates opportunity for a direct interaction between physical and virtual world. The systems and objects configure and dynamically adapt to the environmental changes by themselves. It has various interoperable communication protocols and unique identity for every object used.

II. RELATED WORK

Y. Sun, et al. proposed a mirror which is designed using Raspberry pi and microcontroller [1]. It displays time, date and weather based on voice control assistant. The user can interact with the mobile using APP mirror and speech synthesis module. The system proposed displays clothing index according to the climatic conditions and also can display schedules. Muhammed M, et al. proposes a smart mirror which controls and monitors home based system to ease up human tasks [2]. It mainly develops interaction between people and virtual world. The mirror uses sonus technology that is a voice to text library which can easily add VUI.

K Aishwarya, et al. proposed a smart mirror mainly for home environment and commercial purposes [3]. For the face recognition, Eigenfaces, Local Binary Pattern Histogram (LBPH), Fisherface and OpenCV are used. For the conversion of speech to text, sonus technology has been used that is also used in offline. Once it detects a word hotword, it streams to cloud recognition service. It interacts with user and displays widgets of time and date, weather forecast, news and schedules. It also provides some security that the schedules are displayed only to the user. It is developed to reduce human efforts. Now-a-days we can see every information in our phones but during rush hours, it is difficult to check the feed so during that time, we can make use of smart mirror so as to complete the daily tasks along with checking date, time according to the location, scheduling if any, news and weather only using face recognition.

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U Javid, et al. proposed system that allows the users to access information such as news, weather and personal feeds and some other pragmatic details accessed with camera [4]. It detects whether a person is in front of a camera or not so as to interact with it. The main features are the system is light weighted and extensible. This system supports plugins which can be written in different programming languages. It consists of a touch screen connected to raspberry pi which controls the thing that is to be displayed.

Table- I: Literature survey

AUTHOR	*Y. Sun, et al. [1]*	*Muhammed M, et al. [2]*	*K Aishwarya, et al. [3]*	*U Javid, et al. [4]*
YEAR	2018	2017	2018	2019
TECHNOLOGY	Raspberry Pi and Microcontroller	Raspberry Pi and Sonus (Speech To Text Library)	Raspberry Pi	Raspberry Pi and Touch Screen
VOICE ASSISTANT	Yes	Yes	Yes	No
DISPLAY APPLICATIONS	Time, Date and Weather	Time and Date, Weather, Warning, Traffic and Location Map	Time and Date, Weather Forecast, News and Schedules	News, Weather and Personal Feeds
DESCRIPTION	The system is connected to the internet, obtains information through the API interface.	The system designed is a prototype based with voice recognition and testing possibility of the smart mirror with raspberry pi.	The system recognizes users face and displays personal information using various algorithms.	The system is of light weight and modular which can be extendable.

Compared to the existing systems, a mirror is designed that does smart activities like displaying time, date and weather whenever a person comes in front of the mirror with the help of motion detection through the camera or by recognizing voice with the help of a voice assistant. Also by using voice commands, the mirror must display notifications, news feed and to access Google search engine and also to give voice response.

III. PROPOSED SYSTEM

The system architecture of a smart mirror is shown in **Fig. 1**. The two-way mirror acts as both transparent and reflection purpose. Whenever a user comes in front the mirror, the motion is detected with the help of camera. The camera sends this data to raspberry pi, which further sends a command to the mirror to display time and date along with weather information. If a user gives a command like "Jasper" (Jasper – voice assistant) to mirror through voice, then voice assistant is activated and displays time, date and weather information. The voice assistant intakes various commands which are included by default like "what's the time?", "who has birthday today?" etc., [3]. These commands can also be modified by user. The system not only displays the information require but also replies through voice with the help of speaker. The complete data is being collected by raspberry pi through internet which is connected using wireless or LAN connectivity.

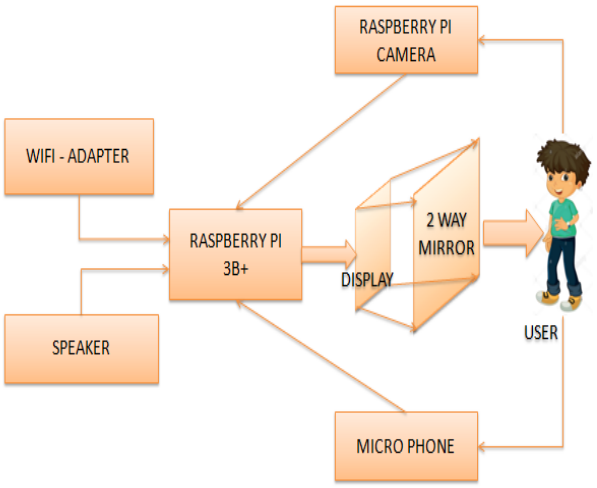

Fig. 1. Smart mirror architecture

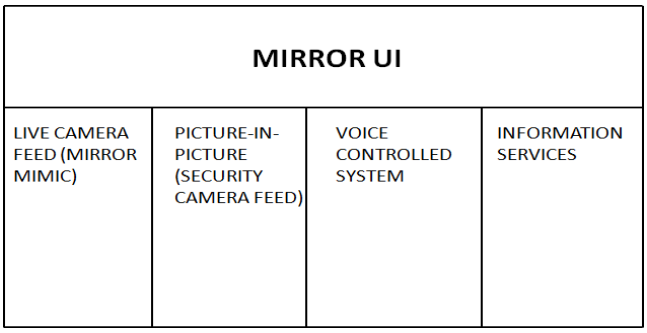

Fig. 2. Smart mirror user interface

The above figure (see **Fig. 2**) shows mirror's user interfaces which of high-level. Firstly the live camera streams as a normal camera that displays real-time image [5]. Secondly the images are clicked for security purpose and thirdly the voice control system is accessed using voice assistant. Fourth are information services to gain access over personalized service to the user.

The proposed system functions as follows:

- **Live camera feed:** It detects the real- time motion of any person and displays the time, date and day along with weather forecast and news headlines. Whenever the camera doesn't detect any motion, it turns off and goes to the sleep mode.
- **Picture-in-picture***:* One of the main functions of the system is to provide security. Whenever the user is not at home, if the camera detects any of the motion, the camera captures it and sends the information to the registered E-mail. This system acts as a security surveillance camera.

➢ **Voice control system***:* a user can create any number of commands that user wishes to use. The user first needs to store the information (email address) in a database. So according to the commands created and information stored, the user can access different applications.

➢ **Information service:** when the user is recognized or the identified, then the accessibility of the personalized information is provided. The user can access personal information such as schedules and notifications.

As the system is connected to the internet, it can receive minute-to-minute update.

IV. HARDWARE REQUIRED

A. 2-way mirror:

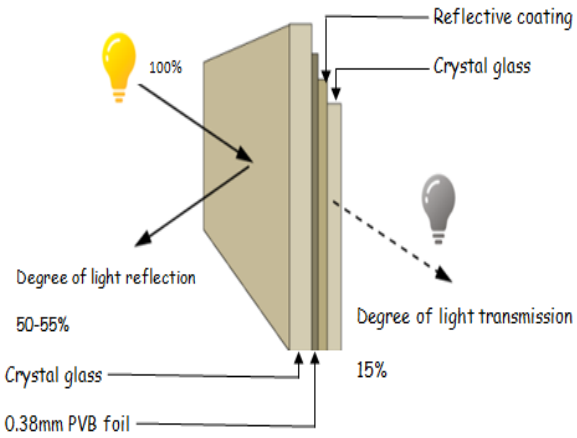

Fig. 3. Two-way mirror

A two-way mirror or an acrylic mirror is a glass that reflects from one side and refracts from other side (see **Fig. 3**) [7]. A refractive side of the glass is clear, that gives an appearance to the person from reflective as a mirror but to the person at a refractive side allows to see through. These type of mirrors are used in interrogation rooms, ballet studios etc. So as to make the mirror work, reflective side of mirror must be brighter and refractive side must be darker.

B. Display: An LED (Light Emitting Diode) monitor is used as a display component. It is flat screen with a flat panel computer monitor which has a short dept and light weight that consumes minimum power. It displays the required information by a user on the mirror.

C. Raspberry Pi *3 B+:* A Raspberry Pi is small and credit card size computer that provides power to the whole system i.e., for displaying on a smart mirror along with camera and Jasper, voice assistant. It has a Broadcom BCM2837, ARM cortex-A53 bit system on chip (SoC) and a memory of 1GB SDRAM. Pi 3 runs at 1.4GHz and consists of four 2.0 USB ports, display and camera port. It is integrated with a wireless LAN and Ethernet USB port that can be connected to internet and has Bluetooth connectivity. It also has two rows of GPIO (General Purpose Input/ Output) pins that are used to connect I/O devices.

D. Raspberry Pi V2 camera module*:* It is second generation camera module with SONY IMX219 image sensor and fixed focus lens. It has 8 megapixel of resolution with video modes of 1080p30, 720p60 and 640 × 480p60/90. It can be attached to raspberry pi onto the small sockets present on the board with short ribbon cable.

E. Microphone*:* Microphone is used to give the voice commands to the mirror that are to be performed. This microphone has a USB 2.0 plug to connect directly to the raspberry pi. Sensitivity: -67 dBV/pBar, -47 dBV/Pascal +/- 4dB.

F. Speaker: It is an output hardware device to generate sound. These speakers can be of wired or wireless. If it is a wired speaker, then it consists of either a USB plug or a 3mm jack that can be connected to the raspberry pi. If at all it is a wireless speaker, then it must be connected through the Bluetooth connectivity which is included in raspberry pi.

G. Arrangement of components:

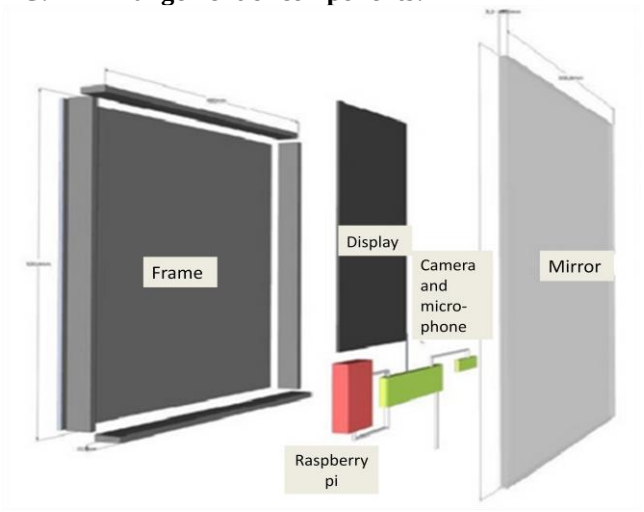

Fig. 4. Components arrangement of smart mirror

The above figure (**Fig. 4.**) shows how the components are arranged and mounted [6]. The two-way or acrylic mirror is placed in front of setup then the display is connected at the reflective side of the mirror. This reflective side also consists of camera, which clicks pictures and microphone which intakes voice commands using voice assistant. Then these are connected to the main hardware component, Raspberry pi which also provide power supply to every component. This whole setup is placed in a wooden frame to keep it right.

V. SOFTWARE REQUIREMENTS

A. Raspbian *OS**:* Raspbian is a best and recommended official operating system for Raspberry pi. This OS is based on Debian, optimized for raspberry pi hardware. It is free software with over 35000 packages bundled together. The complete OS can be dumped into an SD card that is connected externally to a Raspberry pi. This OS is a set of programs that are to be installed to run hardware.

B. Geany*:* Geany is small as well as light weighted IDE (Integrated Development Environment). This was designed to provide small - fast IDE. It supports many file types including C, Java, PHP, HTML, Python, Perl and Pascal.

C. Jasper: Jasper is open source platform that is used to develop voice controlled applications. It utilizes various numbers of Speech To Text [STT] and Text To Speech [TTS] engines. It also runs in an offline mode. It can listen to the commands from few meters away. It runs on raspberry pi and provides a handful of inexpensive off the shell components. It runs on raspberry pi by just downloading a disk image. It is a simple interface and provides facility to write own module.

VI. DATAFLOW DIAGRAMS

A. Flowchart of a camera controlled smart mirror

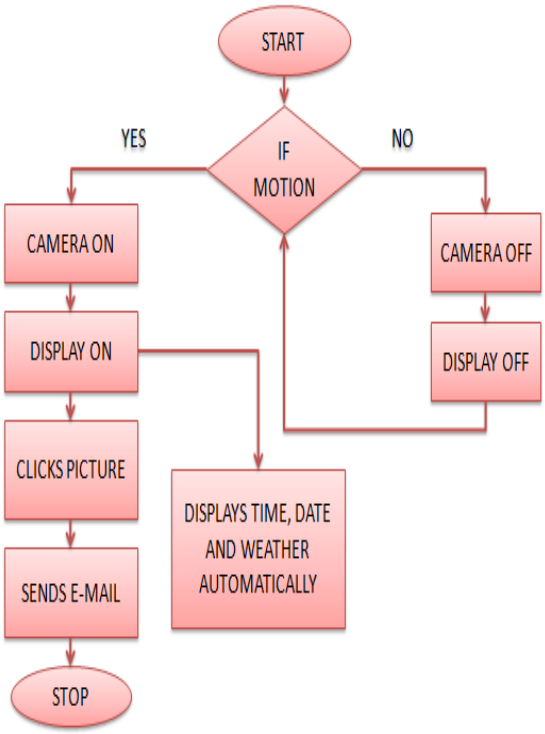

Fig. 5. Flowchart of a camera controlled smart mirror

The camera controlled smart mirror is shown in **Fig. 6**. Whenever the system detects any motion in front of the camera, it automatically turns on and displays time, date and weather information on smart mirror. It also clicks pictures parallel to displaying information on the mirror. As the system is connected to the database which consists of user's email address, it sends pictures to the mail. So whenever there is no one at home, this smart mirror acts as a security surveillance camera. If there is no motion, then the system remains off and saves power of the system and CPU.

Steps:

Step-1: Start

Step-2: If there is no motion detected, the camera remains OFF.

Step-3: Display OFF

Step-4: if a motion is detected, camera turns ON.

Step-5: Display ON

Step-6: It displays time, date and weather forecast automatically on the mirror.

Step-7: It also clicks pictures until there is a motion.

Step-8: The pictures are sent to the registered E-mail ID.

Step-9: Stop

B. Flowchart of a voice controlled smart mirror

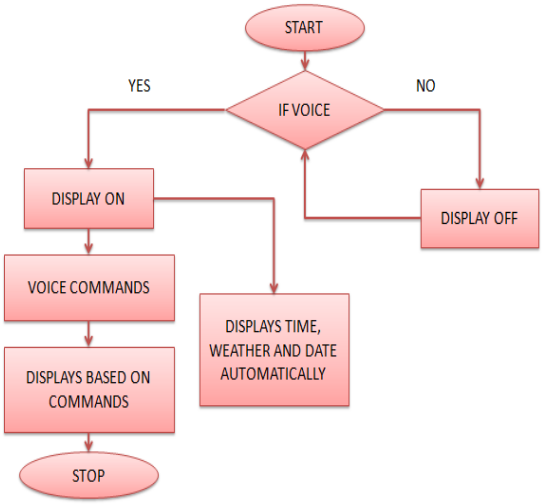

Fig. 6. Flowchart of a voice controlled smart mirror

The voice controlled smart mirror is shown in **Fig. 7**. Whenever the system recognizes any voice, it automatically turns on and displays time, date and weather information on smart mirror and also gives voice response. Then if the user gives any related commands to the mirror using the voice assistant, it performs actions accordingly. The commands that are accepted by the voice control system are: time, weather, news, email, Google search engine and Google calendar. If there is no voice recognized by the mirror, it remains off and saves power of the system and CPU.

Steps:

Step-1: Start

Step-2: If there is no voice detected, then display remains OFF.

Step-3: If a voice is recognized, then display turn ON.

Step-4: It displays time, date and weather forecast automatically on the mirror.

Step-5: It intakes voice commands of the user.

Step-6: The mirror displays information based on voice commands.

Step-7: Stop

VII. ALGORITHM

A. ALGORITHM-*1:* Initializing time, date and day

1. Firstly importing class Clock as "Clck".

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2. Declaring large text size (lrg_txt_sz) as 48, small text size (sml_txt_sz) as 18 and medium text size (med_txt_sz) as 38.

3. Time format is 12; Date format is %b %d %y (%b- month, %d- day, %y- year)

4. Anchors in python are used to declare the position of a text relative to reference point.

5. Self in python is used to represent an instance of class. It can access attributes and also methods of classes.

Algorithm-1

```
1: class Clck()
2: def_init(self, parent, *args, **kwargs);
#initializing time label
3: Self.time1= "self.timelabl1 = Label(self, font= ('Berlin', lrg_txt_sz), fgnd="white", bgnd="black")
4: self.timelabl.pack(side=TOP, anchor= NW)
#initializing day of the week
5: self.day_of_week1=" self.dayofweeklabl1= Label (self, text= self.day_of_week1, font=('Berlin', sml_txt_sz), fgnd="white", bgnd="black")
6: self.dayofweeklabl1.pack(side=TOP, anchor=NW)
#initializing date label
7: self.date1="Self.datelabl1=Label (self, text=self.date1, font=('Berlin', sml_txt_sz), fgnd="white", bgnd="black")
8: self.datelabl1.pack(side=TOP, anchor=NW)
9: self.tick()
```

Output: Time, Date and day are displayed at top left corner.

B. *ALGORITHM-2:* Initializing weather and temperature

1. Firstly declaring class Weather as "Wthr".

2. Padx in python provides space between button widgets and also between closeButton and right border of window.

3. *args are used in python to pass variable no. of args in a funct.

4. **kwargs are used in python to pass keyworded and variable length arguments list.

Algorithm-2

```
1: class Wthr(Frame):
2: def_init_(self, parent, *args, **kwargs):
3: Frame_init_(self, parent, bgnd='black')
4: self.temp="
5: self.frcst="
6: self.loc="
7: self.crntly="
8: self.icn="
#initializing degree of temperature
9: self.dgrFrm= Frame (self, bgnd="black")
10: self.dgrFrm.pack (side=TOP, anchor= NE)
#initializing temperature
11: self.templabl= Label (self.drgFrm, font=('Berlin', xlrg_txt_sz), fgnd="white", bgnd="black")
12: self.templablpack (side= LEFT, anchor=NE)
#initializing icon
13: self.iconlabl= Label (self.dgrFrm, bgnd="black")
14: self.iconlabl.pack (side=LEFT, anchor=N, padx=20)
15: self.crntlylabl= Label (self, font=('Berlin', med_txt_sz), fgnd="white", bgnd="black")
16: self.crntlylabl.pack (side=TOP, anchor=NE)
#initializing weather forecast
17: self.frcstlabl= Label (self, font=('Berlin', sml_txt_sz), fgnd="white", bgnd="black")
18: self.frcstlabl.pack (side=TOP, anchor=NE)
#initializing location
19: self.loclabl= Label (self, font=('Berlin', med_txt_sz), fgnd="white", bgnd="black")
20: self.loclabl.pack (side=TOP, anchor=NE)
21: self.get_wthr()
```

Output: Weather is displayed at the top right corner of the mirror.

C. *ALGORITHM-3:* Initializing news with headlines

1.Firstly declaring a class News as "News".

2.Pack in python packs the widgets in rows and columns.

3.Container in python arranges the widgets hierarchically.

Algorithm -3

```
1: class News(Frame):
2: def_init_(self, parent, *args, **kwargs):
3: Frame._init_(self, parent, *args, **kwargs)
4: Self.config(bgnd='black')
#'News' is more internationally generic
# initializing news and headlines
5: Self.title='News'
6: Self.newslabl= Label (self, text=self.title, font= ('Berlin', med_txt_sz), fgnd="white",
```

```
    bgnd="black")
7:  Self.newslabl.pack(side=TOP, anchor=S)
8:  Self.headlinesContr= Frame(self, bgnd="black")
9:  Self.headlinescontr.pack(side=TOP)
10: Self.get_headlines()
```

Output: News is displayed at bottom of the mirror.

VIII. RESULTS

Fig. 7. Mirror displaying Time, Date along with events and schedules

Time, date and events*:* The above fig (see **Fig. 8**) displays information of time, date and events. It retrieves the information from the computer system. It is displayed at a top left corner of the mirror.

Fig. 8. Mirror displaying Weather forecast for whole week

Weather: The above fig (see **Fig. 9**) displays the information of weather and location. It is displayed at top right corner of the mirror.

Fig. 9. Mirror displaying News headlines and complements

News: The above fig (see **Fig. 10**) displays the information of news and also a random complements. News is displayed at bottom of the mirror and complements at the centre.

Table- II: Experimental results

Module	*Input functionalities*	*Obtained result*
Voice configuration	Time, date and events	Displays automatically current time and date along with events as per schedule and provides voice output
	Weather forecast	Displays automatically weather forecast along with voice output
	News headlines	Displays news headlines
	Google search engine	Activates Google search engine with user's voice commands
	Google calendar	Activates Google calendar with user's voice commands and provides voice outputs
Camera configuration	Time, date and events	Displays automatically current time and date along with events as per schedule
	Weather forecast	Displays automatically weather forecast
	News headlines	Displays news headlines
	Security camera	Clicks picture when motion is detected when no one at home and sends information to E-mail

IX. CONCLUSION AND FUTURE SCOPE

This interactive smart mirror expands the functionality of the normal mirror and makes it as a hands free product. It displays time, date, news feed, weather forecast and complements through voice or camera by the user's voice and motion detection. It also accesses search engine, notifications and Google calendar using voice assistant when the voice commands are given by the user. This smart mirror not only displays information but also responds to the user using voice.

It provides security by capturing pictures when no one is at home and sends it to e-mail. In future, this system can be enhanced as a smart home security system.

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