



Smart Mirror using Internet of Things

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Abstract: The Internet of Things (IoT) is a system of interconnected devices linked to the internet for functioning and it allows the devices to communicate with each other in different and important places at the same time. IoT products are gaining traction in the market due to their known reputation for making daily life easy for people. IoT based smart home products have appealed to the general public, thus initiating research worldwide to make them smarter and accessible. People are leaning towards the prospect of futuristic digital devices to optimize time and home or workspace. The smart mirror is one such important application of IoT where one can look at the mirror as well as be updated through the interactive screen simultaneously. The system is made mainly using components like Raspberry Pi, a one-way mirror and an LED monitor. The mirror will be connected to the wi-fi through the inbuilt wi-fi module of Raspberry Pi, which will ensure that it gives us the latest updates of what's going on around us by fetching the real-time data from the internet.

Index Terms -Raspberry Pi, Smart Mirror, Internet of Things, smart home technology, speech interaction.

I. INTRODUCTION

The world nowadays is advancing technologically ahead which has accelerated the growth of the Internet of Things domain. The concept of the Internet of Things is basically the connection of devices over the Internet. Many devices are being adapted to connect to the internet and work over the distance thus enabling them to be remotely controlled.

The Internet of Things (IoT) is a term used to describe “technologies, systems and principles of design relating to the emerging wave of connected things based on the Internet physical environment”. It refers to a network of uniquely identifiable objects and their virtual representations in a network-like structure that can collect and exchange data and are remotely controlled through the existing network infrastructure. It consists of key elements such as sensing, security, privacy, applications and services.[3]

Smart Mirror is one such application of IoT, which has been marketed and integrated as a smart home product. A smart mirror is an intelligent device that works as a mirror with the ability to interact with users and display various responses and information such as date, time and weather on the screen all behind a reflective surface as a mirror.[5] The concept of a smart mirror was derived from utilizing a normal mirror to digitize it and to help one get updated while getting ready as all the required information would be at the eye level. Technological developments in recent decades have increased young people's engagement with screen-based technologies (screen time), and a reduction in young people's contact with nature (green time) has been observed concurrently. This combination of high screen time and low green time may affect mental health and well-being.[6] This system would contribute to decreasing the average screen time of a user by encouraging them to glance at the information displayed in the mirror, rather than wasting time surfing on their phones.

The system fetches modules such as time, date, alerts, notifications, calendar, weather, weather updates, and real-time news updates, and consists of Google Assistant to help search using voice command. The data is displayed on the LED monitor which is succeeded by the two-way mirror which is our main screen surface where the user's partial reflection is seen along with the data. The mirror with such features guarantees an effortless and pleasurable user experience while simultaneously aiding technological advancements.

II. LITERATURE SURVEY

The smart mirror being proposed by K. P. Vijaykumar, Yash Tandon, and Vennam Prahasth will help the user, navigate through the user's day better by showing the necessary information on the mirror. The objective of this paper is to devise a smart mirror device which has the ability to function as a regular mirror as well as an interactive mirror and display various types of content such as date, news, weather, time all at the same time and it includes multiple functionalities such as collection and display of real-time data, information updates, speech and facial recognition through Microphone, LCD display and webcam respectively. This paper describes how a Raspberry Pi device can be used to enhance such mirrors to make them a smart mirror with intelligence and security.[1]

The proposed smart mirror by Kun Jin, Xibo Deng, Zhi Huang, Shaochang Chen owns so many modules, which include Raspberry Pi external imaging control, wake-up touch, voice conversion, image capture module and built-in portraits recognition processing, voice recognition and other interactive programs, in order to realize the function of information display, voice interaction, human perception, intelligent security, entertainment and so on. This smart mirror can connect the user's mobile phone through the WLAN

network to synchronize memos, change the word board content, monitor the mirror image, or even can direct touch interaction directly into the network of the smart home, take a selfie in front of the mirror, browse the family built-in photos and other functions. When a user comes in front of the smart mirror, the smart mirror automatically turns on the face recognition service, and the contents of the mirror jump to the face recognition page.[2]

The intelligent mirror system proposed by Preeti Rani, Indra Thanaya aims to provide users with an interactive interface for simplified and personalized services in the comfort of the home of the user. It is a smart and user-friendly solution in the form of a mirror that also acts as a gateway to interactive services, especially information-oriented services, such as multimedia and news feeds, among others. The aim of this model is to create an interactive interface that can be conveniently used in the home and commercial space. [3]

P.S. Tondewad, Harshada Parate, Poonam Awalkonde & Aishwarya Mule proposed a smart mirror that combines the use of a traditional mirror with digital aspects to bring up-to-date information to the user directly on the mirror surface. The interactive mirror consists of a Raspberry Pi, two-way mirror, acrylic glass, monitor (LED), and motion Sensor and is a development effort to augment the mirror with proper fixed information for offering better features that provide personalized data such as date, weather, and regional time corresponding to the location, Google headlines, music and our daily schedule. Additionally, when a person appears in front of the mirror, the motion sensor is activated and the mirror will display the welcome message to the user.[4]

III. PROPOSED SYSTEM

The proposed smart mirror aims to provide an interactive and smart interface for simplified, personalized and customized services to the user [3]. It can work in two modes: online mode as well as standalone mode. In standalone mode, it acts as a normal reflecting surface where the user can use it just like a usual mirror. In online mode, it fetches the information from the integrated modules, when the power supply is switched on, over the internet and displays it to the user all at the same time while they can check themselves.

The system does various tasks like giving alerts and compliments, updating date and time, showcasing the public calendar according to the location, displaying weather information and updates, daily news feeds and other such general information gets displayed on the mirror using IoT based technology. The IoT technology makes this simple reflective surface an attractive as well as an intelligent prototype that can be easily used in home and in commercial spaces too.

Additionally, it provides us with an insight into a new way of communication and interaction with smart systems [1]. The Pi model runs on the operating system called Raspbian Operating System with its configured wi-fi through which the monitor is connected through the internet. The internet access is provided by the inbuilt wi-fi module of Raspberry Pi 3B+ which helps to fetch the third-party API's so the user will be able to interact with the mirror and access the required data. The user can interact with the mirror in real-time and search the specific information through Google Assistant and after fetching the results, it will get displayed on the monitor's screen. The main benefit of using a Pi connected system is that it allows users to develop and customize the system, personalize it and test the interface accordingly.

The prototype consists of a two-way mirror, LED monitor for the display screen, a single board Raspberry Pi 3B+, power supply, keyboard, mouse, USB microphone and speaker. Basically, the smart mirror system is a monitor as a display mounted behind a two-way reflective glass surface cased within a wooden frame (i.e. casing) connected by HDMI cable to the Raspberry Pi which in turn is powered by a power supply.

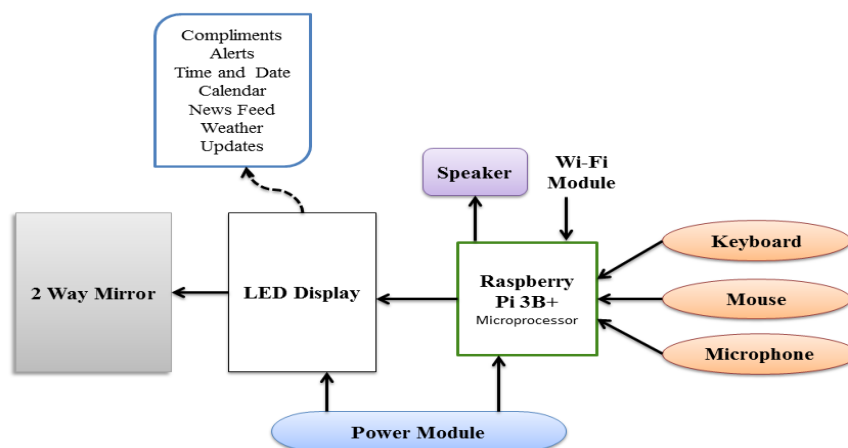


Fig. 3 Proposed System Architecture

The modules that we have implemented in this prototype are time, date, calendar, weather notifications and updates, real-time news feed, alerts and compliments, and MMM Google Assistant.

- The alert and compliments module will show the notifications from different modules upon starting as well as show a set of inputted compliments that vary according to the time.
- The calendar module will show the occasions from a public calendar which have been set according to the location of the user so as to ensure that they are in sync with the public holidays and festivals of the particular area.
- The clock module will show the current date and time according to the set location of the user.
- The news feed module will show the information headlines primarily based on an RSS feed set according to the user's location for optimal results. Here, for configuration, an array of feed URLs has been used as a supply so one can show the headlines in a listing manner.

- The weather updates and forecast module can be used to showcase the current climate conditions and to see the forecast.
- The Google Assistant module will process the input through the voice command of the user and will then search for the answer to the query and display it. This module makes the smart mirror more user interactive.

IV. IMPLEMENTATION AND DESIGN

The Smart Mirror system is designed and implemented such that when the user switches on the system, the user can see themselves in the mirror while simultaneously checking the personalized data that will be displayed on the LED monitor.

Initially, the mirror will be in offline mode acting like a normal reflecting mirror. Once the power is on, the notifications from respective modules like Date and Time, Calendar, Weather, Alerts and much more information will be retrieved and displayed on the screen. The data displayed on a mirror is fetched from the internet via the in-built wi-fi module of the Raspberry.

A two-way mirror is used such that it is partially transparent and acts as a normal mirror when the monitor's screen is black and only a glass window when information has to be displayed.

This is a two-way communication system that happens between the user and the hardware. Software design includes the google assistant which takes voice input through a microphone and searches for the query. The hardware consists of a two-way mirror, LED monitor, single-board Raspberry Pi 3B+ model, HDMI cable, keyboard, mouse, USB microphone and wooden frame. A wooden frame is attached to the LED monitor and a screen is used to display the required information for the user.

Third-party API is used such that when turning on an online mode, the mirror automatically starts displaying the relative information which has been fetched from the internet. The real-time, date and weather information is picked from google and displayed on the monitor screen. The smart mirror allows users to utilize a household object as an interactive interface which will provide customized services according to one's need without using a touch screen.

Overall Design Process

The relevant work of development of the smart mirror system should be done prior to the software design which is as follows:

- The prototype uses an SD card, preferably a high-speed class 10 memory card because the card's speed directly affects the Raspberry Pi operation speed.[2]
- Install the Raspbian Operating System
- Configure the SD card, connect the keyboard and mouse, HDMI cable and power cord.

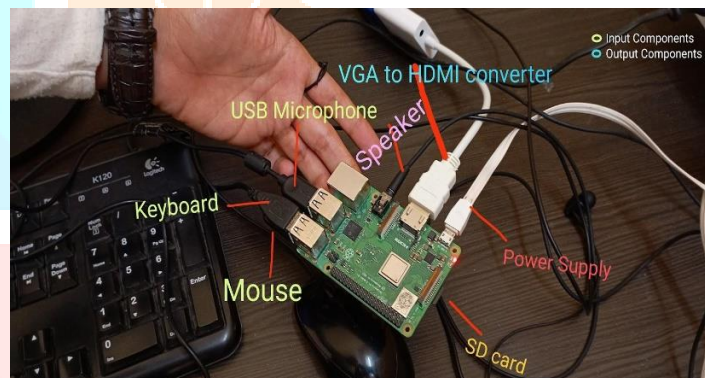


Fig. 4.1 Component Connection

Hardware components used:

4.1. Raspberry Pi



Raspberry Pi 3B+ model is the main hardware component used in the smart mirror system to display the relevant information on the screen according to one's need. This component has a pre-installed operating system called Raspbian operating system. It is a small-sized single-board computer which runs code on the pre-installed Debian operating system installed in it.

4.2. Two-way mirror



Normal mirrors have a property of reflection which reflects the entire light entering the glass and hence allows only users to view their own reflection. But the two-way mirror reflects on one side and allows light to pass through on the other side and hence allows the user to see the information which is displayed.

4.3. LED Monitor



It is a Light Emitting Diode monitor which acts as an interface between the single-board Raspberry Pi and the mirror glass to display the user-specific information on the screen.

4.4. Frame and Support



The frame is made of wood and it provides the support for the glass and all the other components. It encases the glass for protection and provides a way for hanging the mirror on a wall. The monitor is fitted inside the frame at the bottom, with the glass then covering it along with the wooden frame.

4.5. USB Microphone



The mode for voice commands to reach the Raspberry Pi is the microphone to facilitate the searching through Google Assistant.

4.6. Speaker

It will be used to get an output from the google assistant when the user asks any query.

The Smart Mirror can perform the following tasks:

1. The mirror works as a normal reflective mirror so the user can use it in a conventional manner.
2. Anyone using this mirror will get date and time, updates of news, weather updates, time, compliments and alerts etc.
3. The user will also be able to give voice commands to the mirror using a USB microphone which will be connected to the Raspberry Pi.
4. The smart mirror will display the data according to the user specifications and personalization.

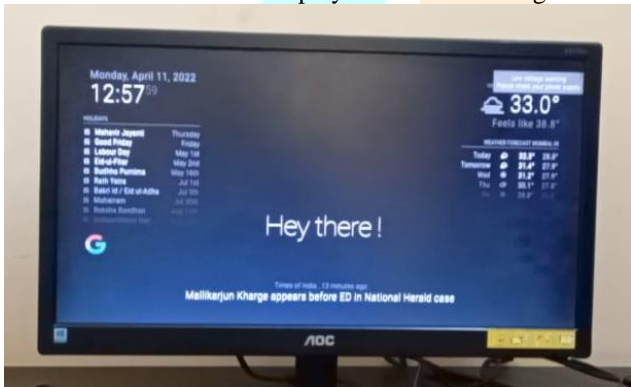


Fig. 4.2 Smart mirror screen displaying time, date, weather updates and real-time news feed.

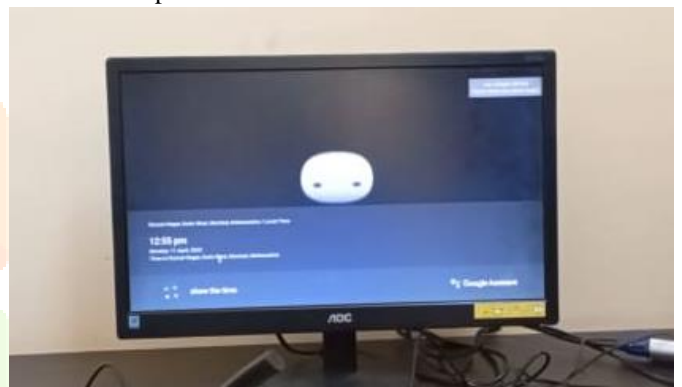


Fig. 4.3 Google Assistant searching and displaying the results.

V. FUTURE SCOPE

Nothing is ideal and complete and there's continually a scope for improvement in each and every product. Everything should be updated or upgraded on a timely basis to survive with the present technological advancements and there can be several different options likewise that may add up to the proficiency of our proposed mirror. There are several future scopes for this project like adding face recognition and integrating fingerprint sensors to increase the security measures of the project. Modules to help check the health of the user when they stand in front of the mirror or to play videos on the internet while getting ready can also be implemented in the near future to increase the range of usability of the proposed mirror. There are many types, shapes, sizes and applications of smart mirrors that can be applied in various fields such as academic, general and medical fields by using different implementation methods.[5]

VI. CONCLUSION

The smart mirror acts as a wise home management platform which may evolve into an artistic movement system that gives users an easy-to-use interface, permitting users access to customizable services in a very extremely interactive manner, while performing alternative tasks at the same time. The most significant advantages are the compact size, straightforward operation, affordable cost, and high degree of the user-friendly, personalized interface. The mirror display provided by a flat LED show monitor shows all the mandatory data that is helpful for the user and is a central platform solution for smart homes in terms of development and applications. The other unparalleled advantage is the reduction of screen time of the user which this generation is facing troubles with due to the increased transition of digital devices around them. Overall, the paradigm provides a simply futuristic framework that may be utilized to produce even additional practicality for the user in the upcoming years.

REFERENCES

- [1] K.P. Vijayakumar, Yash Tandon, Vennam Prahasth. (2020). Smart Mirror using Raspberry Pi. International Journal of Advanced Science and Technology, 29(08), 734 - 741.
- [2] K. Jin, X. Deng, Z. Huang and S. Chen, "Design of the Smart Mirror Based on Raspberry PI," 2018 2nd IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC), 2018, pp. 1919-1923, doi:10.1109/IMCEC.2018.8469570.
- [3] Preeti Rani , Mr. Indra Thanaya, 2019, Design & Development of Smart Mirror Displaying Real-Time Sensor Data, International Journal Of Engineering Research & Technology (IJERT) Volume 08, Issue 06 (June 2019)
- [4] Prof. P.S. Tondewad, Harshada Parate, Poonam Awalkonde & Aishwarya Mule. Smart Mirror Based on Raspberry Pi. International Journal Of Research And Analytical Reviews
- [5] D. A. Alboaneen *et al.*, "Internet of Things Based Smart Mirrors: A Literature Review," 2020 3rd International Conference on Computer Applications & Information Security (ICCAIS), 2020, pp. 1-6, doi: 10.1109/ICCAIS48893.2020.9096719.
- [6] Oswald TK, Rumbold AR, Kedzior SGE, Moore VM (2020) Psychological impacts of “screen time” and “green time” for children and adolescents: A systematic scoping review. PLoS ONE 15(9): e0237725.

