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IoT Based Smart Mirror

Shalini Sahay[1], Nandini Thakur[2,*], Nisha Gour[3]

Abstract

The Internet of Things (IoT) has transformed our lives by seamlessly linking physical objects to the digital world. From smartphones to everyday devices, the concept of IoT continues to evolve, opening new frontiers in technology. One intriguing application is the development of smart mirrors, which combine the traditional functionality of a mirror with the ability to display real-time information. In this research project, a smart mirror from scratch using a Raspberry Pi was designed and built as the hardware platform and custom software based on Raspbian. The primary goal was to create an interactive Smart Mirror that enhances the user experience by providing a versatile interface for accessing real-time information. The mirror can display live weather updates, local time, current news headlines, and other customizable information. By leveraging IoT technology, the smart mirror ensures that every minute of the user's day is optimized, offering a seamless blend of functionality and convenience. Additionally, the smart mirror incorporates voice recognition and gesture control, making it an intuitive and user-friendly device. This innovation not only serves as a practical tool for everyday use but also exemplifies the potential of IoT in transforming mundane household items into intelligent, connected devices. The project demonstrates the potential of IoT in enhancing daily life through innovative applications and sets the stage for future advancements in smart home technology.

Keywords: Smart mirror, home automation, internet of things, raspberry Pi, python

INTRODUCTION

These innovative devices combine traditional mirrors with modern technology to create interactive and connected experiences.

A smart mirror is essentially a two-way mirror with a built-in display positioned behind the glass. It appears like a regular mirror but has a screen inside. Users can interact with the smart mirror using voice commands, hand gestures, and even their smartphones.

***Author for Correspondence**
Nandini Thakur
E-mail: nandinithakur7773@gmail.com

[1]Assistant Professor, Department of Electronics and Communication Engineering, Sagar Institute of Research & Technology, Bhopal, India
[2-3]Student, Department of Electronics and Communication Engineering, Sagar Institute of Research & Technology, Bhopal, India

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RESEARCH PAPER OVERVIEW

Here's an overview of five research papers related to IoT-based smart mirrors:

1. This paper [1] introduces an IoT-based smart mirror system that displays various details based on user recommendations. Features include weather information, date, time, calendar, to-do lists, updated news headlines, traffic updates, and COVID-19 case status. The mirror also implements face detection for enhanced security. Success rate: Nearly 87% for face recognition and voice input.
2. The paper [2] describes an IoT-based smart mirror system using a Raspberry Pi board, a two-way mirror, a camera, and various sensors. Detailed components include the IoT platform for data

collection, analysis, and control.
3. The paper [3] demonstrates the functioning of a smart mirror.
4. Features of the smart mirror include displaying the calendar, current weather conditions, date, time, and outside temperature. It is implemented using a Raspberry Pi
5. The paper [4] envisions a future where smart mirrors are part of a world filled with screens and data, providing instant information everywhere.

IOT-BASED SMART MIRROR SYSTEMS

Several studies have explored the potential of smart mirrors, emphasizing their multifunctionality and user-centric design. A prominent feature of these systems is the ability to display various types of information, which transforms an ordinary mirror into an interactive display. Wan Muamad et al. [1] introduced a comprehensive smart mirror system that presents weather information, date, time, calendar events, to-do lists, updated news headlines, traffic updates, and COVID-19 case status. The system employs face detection technology to enhance security, achieving a nearly 87% success rate for both face recognition and voice input. This integration of facial recognition ensures personalized content delivery and secures access to the mirror's features.

Building on this foundation, another study by Mohd Ashiq Kamaril Yusoff et al. [2] describes the construction of a smart mirror system using a Raspberry Pi board, a two-way mirror, a camera, and various sensors. This system utilizes an IoT platform for data collection, analysis, and control, showcasing the adaptability of IoT devices in smart home applications. The detailed architecture of this system highlights the importance of using robust hardware and software integration to achieve seamless operation and user interaction.

Further, Shuangquan Fu and Pritesh Chandrashekhar Bhavsar [3] demonstrate the functionality of a smart mirror, emphasizing its capability to display essential information such as the calendar, current weather conditions, date, time, and outside temperature. Implemented using a Raspberry Pi 3, this system exemplifies the use of accessible and cost-effective technology to create advanced IoT solutions. The study focuses on the practicality and usability of smart mirrors in everyday life, providing insights into their potential for widespread adoption.

In a broader perspective, Raj Kumar Mistri [4] discusses the role of smart mirrors within an optimistic vision of the future, where screens and data are ubiquitous. This futuristic outlook envisions a world where smart mirrors, alongside other smart devices, play a crucial role in delivering instant information and enhancing user convenience. The paper highlights the potential for smart mirrors to become an integral part of smart homes, contributing to a more connected and efficient living environment [5–13].

Figures 1–7 are described below.

HARDWARE REQUIREMENTS

Raspberry Pi

A series of compact, single-board computers developed by the Raspberry Pi Foundation in the United Kingdom. These credit card-sized boards are designed to provide a fully functional computer capability at an affordable price [12–17].

Wi-Fi Module

A Wi-Fi module is a compact electronic component integrated into various devices and equipment, enabling them to connect to a Wi-Fi network. These modules facilitate data communication between the device and the network, leveraging standard Wi-Fi protocols, such as 802.11n, 802.11ac, or the latest 802.11ax (also known as Wi-Fi 6).

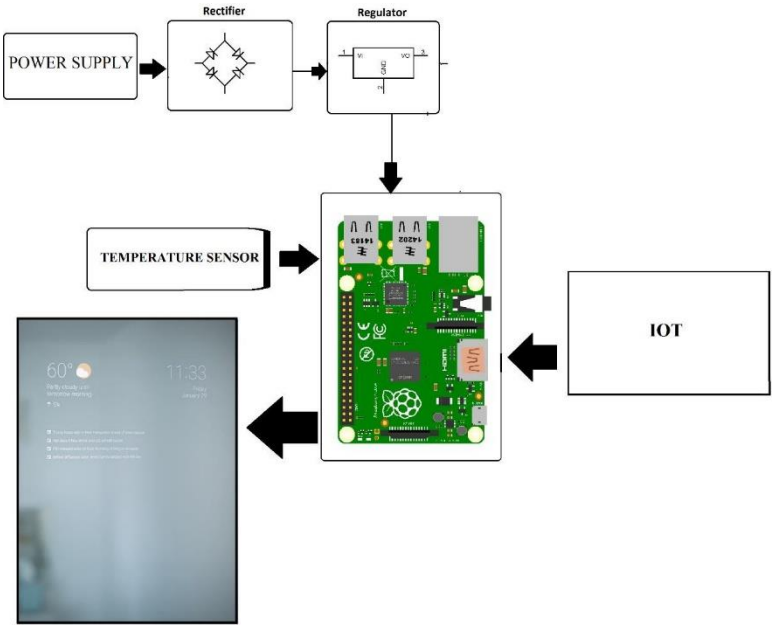

Figure 1. Block diagram.

Figure 2. Rasp berry pi.

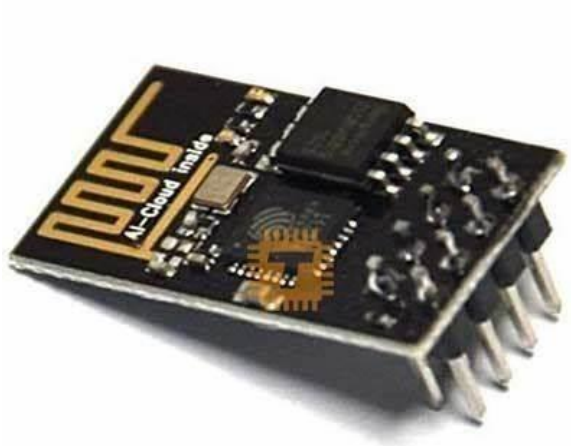

Figure 3. Wi-Fi module.

THE FASCINATING WORLD OF TWO-WAY MIRRORS

Two-way mirrors, also known as one-way mirrors or semi-transparent mirrors, are a captivating subject in both science and practical applications. These mirrors allow for one side to be reflective while the other side remains transparent, creating a unique optical illusion.

These unique reflective surfaces have intriguing properties that allow them to serve various purposes.

Figure 4. Two-way mirror.

Temperature Sensor

These devices play a crucial role in measuring temperature and are widely used in various applications. A temperature sensor measures the heat or coldness of an object. It provides temperature readings in a readable form through an electrical signal.

Figure 5. Temperature sensor.

Display Sensor

These devices play a crucial role in visualizing data from various sensors and are widely used in different applications. LCDs use liquid crystals to produce images. They are commonly found in TVs, computer monitors, and mobile devices. Serial-enabled 16 × 2 LCD screens can be easily connected to microcontrollers like Arduino using just three wires.

Figure 6. Display sensor.

CONSTURCTION

Assembling the Mirror

- Built and acquired frame for the mirror, ensuring it fits the monitor panel and leaves space for the Raspberry Pi.
- Ensure the one-way mirror is securely attached to the frame, covering the entire display area. Then, securely mounted the monitor panel behind the mirror, ensuring it is centered and covers the entire mirror.

Setting up the Raspberry Pi

- Installed an appropriate operating system on the Raspberry Pi. -- Raspbian
- Connected peripherals like keyboard, mouse, and monitor for initial setup and added SD card.
- Settle Wi-Fi as needed.

Installing Required Software

- Installed a web browser like Chromium on the Raspberry Pi to display web-based content.
- Optionally, installed additional software for specific functionalities, such as weather widgets, news feeds, etc.

Designing the Interface

- Designed the user interface for smart mirror and widgets for time, weather, calendar, news, etc.
- Utilized HTML, CSS, and JavaScript to create the interface, and frameworks like Electron to facilitate development. Also, ensured the interface is optimized for the size and resolution of display.

Mounting the Raspberry Pi

- Then securely mounted the Raspberry Pi behind the mirror frame, ensuring it is positioned centrally and has proper ventilation to prevent overheating.
- Connected the HDMI cable from the Raspberry Pi to the monitor panel.

Testing and Calibration

- Tested the smart mirror thoroughly to ensure all functionalities are working as expected.
- Calibrate any sensors or modules to ensure accurate readings and responsiveness.

RESULT

Here is the real time image of IoT based smart mirror.

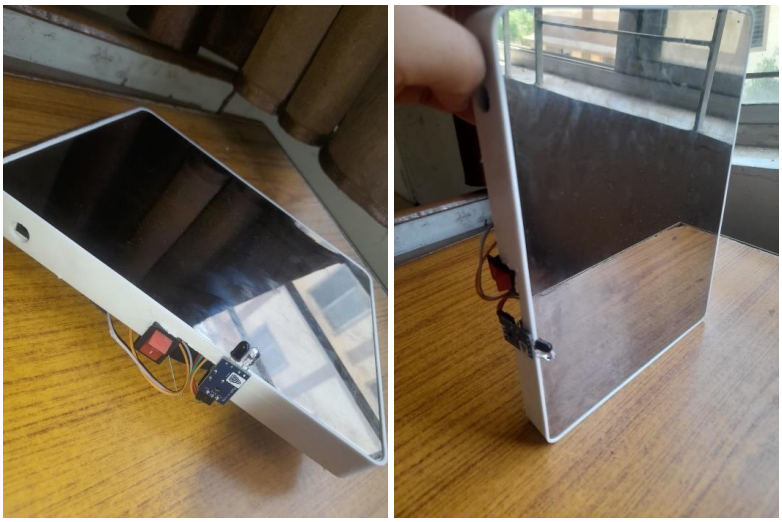

Figure 7. Real time image of IOT based smart mirror.

APPLICATION

Here are some of the applications of the IoT based Smart Mirror:

- A smart mirror can be used as an information hub that displays news, weather updates, calendar events, and more. It can also be used as a fitness tracker that displays workout routines and tracks progress.
- Smart mirrors can be used to develop smart homes with embedded artificial intelligence and can also be used in industries.
- They can be used to switch home appliances, and virtual dressing can be done using smart mirrors, making it easier to try out different fashion styles.
- Smart mirrors can be used for easy communication through text, chat, and photo sharing.

CONCLUSION

Our goal is to create a smart mirror that establishes an interactive interface between users and the internet. This device is intended to assist users with their daily tasks. Additionally, the smart mirror can be adapted for various applications in both industrial and home settings. Smart mirrors have the ability to connect to home appliances and smart phones. With the help of emerging technologies, smart mirrors can be advanced to touch screen modes. Mirrors can be significantly improved for use in beauty salons, clothing stores, hotels, and similar settings. With advancements in technology, these mirrors can also find applications in many other areas.

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