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# AI POWERED SMART MIRRORS

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***Abstract:*** Smart gadgets have revolutionized daily life by simplifying tasks such as scheduling, energy conservation, and device control, while also promoting proactive health management through fitness tracking and health monitoring. These appliances enhance communication, increase personal safety through real-time monitoring and alarms, and offer personalized experiences tailored to user preferences. By integrating isolated functions into interconnected ecosystems, these devices make life easier, promote sustainability, and contribute to creating a safer world. This paper proposes an advanced smart mirror system as an innovative tool to enhance daily routines. Equipped with modular components, the mirror functions as a reflective surface and a digital interface, providing practical features like displaying time, weather, and date through touch or button controls. AI advancements further elevate its utility, introducing facial recognition and NLP (Natural language processing) for personalized interactions, proactive suggestions, and hands-free engagement. The smart mirror exemplifies the seamless integration of practicality and sophistication in modern technology. Combining magic mirror with Mixtrals Ai chatbot via hugging face on a raspberry pi makes for a cutting-edge smart mirror platform integrating natural language processing for both text voice interaction allows users to effortlessly communicate with the mirror bringing personalization to a whole new level utilizing tools like porcupine for hot word detection speech recognition and Rhvoice for response vocalization ensures smooth intuitive voice functionality this project has the potential to redefine the way we interact with everyday technology blending convenience intelligence and interactivity seamlessly

***Key words*** **– Internet of things (IOT), Mixtrals, Natural Language Processing, (NLP), Raspberry Pi**

## INTRODUCTION

In the backdrop of swiftly progressing technological development, the concept of the Internet of Things (IoT) has become a major force in shaping the future. The Internet of Things (IOT) refers to the design of connecting physical devices to the internet, enabling them to work together and communicate across long distances. This connectivity allows devices to be remotely controlled, monitored, and automated, making them more intelligent and responsive.

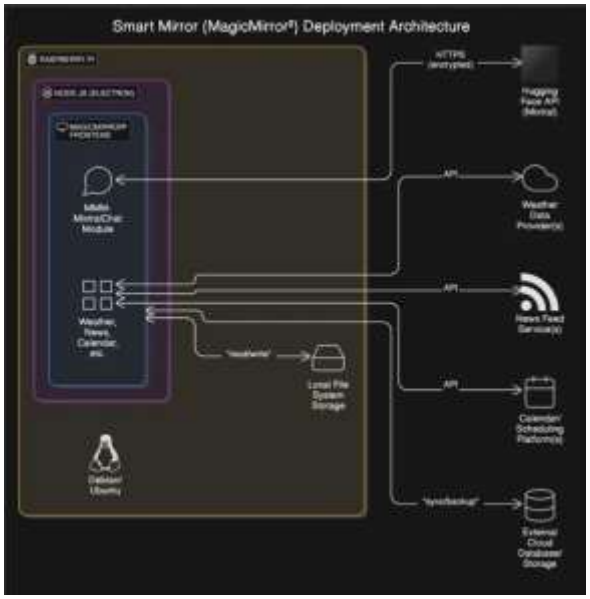
A wide range of devices—from smart homes and wearable technology to those used in industrial and agricultural sectors—are being upgraded to operate through internet-based interactions. This transformation is helping to drive efficiency and innovation across various fields.

The integration of digital technology into daily life has led to the development of smart systems aimed at enhancing user experiences and simplifying routine tasks. One such innovative idea is the **magic mirror** (smart mirror) – which combines a reflective surface with a digital display to deliver real-time, reliable information and integrated features. Unlike traditional mirrors, the smart mirror offers more than just a reflection.

It functions as an intelligent interface that displays current time, date, weather forecasts, major news updates, compliments, and more. Additionally, it includes a chatbot for interactive conversations. This paper presents the design and implementation of a magic mirror that not only shows time and date, but also provides live weather updates, the latest news, and motivational messages— aimed at improving both functionality and the user's emotional well-being. The system includes a chatbot that allows users to interact with the mirror, set reminders, request additional information, and receive personalized responses. All these features are embedded in a sleek and minimalistic design. The smart mirror seamlessly integrates into daily life as a practical and interactive assistant, helping users stay informed, motivated, and productive. This paper explores the architecture, functionality, and potential applications of the smart mirror, highlighting its role as a tool for enhancing personal efficiency and improving daily routines.

Fig 1:Raspberry pi 4

A smart mirror is an advanced interactive gadget which blends AI-powered features with reflecting surfaces, voice assistants, gesture controls and customized services. As a result of the growth of IOT and AI the goal of this effort is to create a smart mirror that employs cloud APIs for real-time updates, natural language processing (NLP) for audio conversations and machine learning for face recognition. It is powered by a compact device such as a raspberry pi and employs a screen underneath a unique bilateral screen merely helping with everyday chores. Also has the ability to play sound, show reminders and link to automated home appliances for simulated try-ones. Magic mirrors are ideal in workplaces, homes, shops…. etc. In an effort to render life easier they employ a simple screen. This mirror can assist in managing stress monitoring mental well-being and providing health recommendations.




**system design**

The Smart Mirror system, based on the MagicMirror framework, is designed as an interactive and modular platform deployed on a Raspberry Pi running a Debian/Ubuntu environment. At its core, the system utilizes a Node.js and Electron- based frontend to render various user interface modules such as weather, calendar, news, and a custom AI chatbot module (MMM-MixtralChat). This chatbot interfaces securely with the Hugging Face Mixtral API via HTTPS, enabling natural language interactions. Additional modules retrieve real-time data through APIs from external weather providers, news services, and calendar scheduling platforms. The system also supports integration with external databases or cloud storage solutions for data persistence and analytics. Local storage capabilities are utilized for managing user configurations and cached content. The architecture emphasizes modularity, scalability, and seamless integration of edge computing with cloud-based services, making it suitable for both personal and smart ambient environments.

**Hardware and software Requirements Hardware Components**

**Raspberry pi 4**

The main hardware element of the smart mirror that shows user-specific data on the monitor is the Raspberry Pi. It is a tiny single- board computer that executes code based on its installed operating system. This component comes with Raspbian OS (Operating system), a Debian- based operating system, pre-installed. Any of the supported languages can be used to write the code. Python is the foundation of this paper. With the written code deposited to the device, this enables the monitor to show the weasther forecast, date and time, calendar, email notifications, news feed, and music. This also covers the use of web-based services to show

news, weather, and other data by obtaining the data from the internet and presenting it on the screen as tokens. Using web- based services to display news weather and other information also falls under this category these services gather information from the internet as tokens and display it on a monitor for users a wi-fi module on the raspberry pi module allows it to connect to the internet in order to do the voice recognition is accomplished by accepting input from a microphone via a USB card enabling the user to speak into the mirror to initiate conversations and set up reminders.

**Magic Mirror Display**

An LCD (liquid crystal display) or LED screen inside a two-way mirror is used by a smart mirror to show content generally powered

by a raspberry pi an android tablet or other dedicated hardware. It has a processor and gauges that allow for interface through voice recognition or tracking of movement. Useful data like time, weather, scheduled events and notifications are shown on smart screens which are a futuristic addition to any smart home since they can additionally include artificially intelligent assistants such as Alexa or Google assistant, assist home automation and even feature recognition of face and monitoring of health technologies.

**Software Requirements Node.js**

Node.js is a popular runtime environment for building scalable network applications, and it is often used in projects like smart mirrors because of its event-driven, non-blocking I/O model. A smart mirror typically displays useful information (like time, weather, calendar events, news, etc.) and can interact with the user via voice or touch.

**Mixtral Chat Module**

MMM (Magic Mirror**)** is an open-source platform designed for smart mirrors and is based on JavaScript (Node.js). The Mixtral Chat Module, which is part of this setup, connects with the Hugging Face API, and this integration mainly involves two key components: capturing user input, & then sending that input to the Hugging Face API, receiving the model's output, and finally displaying that output back on the mirror screen.

When using voice input or keyboard input, that input is converted into a JSON-formatted POST request sent over the network to the Node.js backend. This request is then forwarded to the Mixtral 8x7B model hosted on the Hugging Face API. You need to have an API key from Hugging Face, and it should be securely included in your code.

The input sent to the Hugging Face API model must follow a chat format — meaning messages should be structured with roles like "user" and "assistant". Once the API call is successfully made, the model's response is returned in JSON format. From this response, the assistant's reply is extracted and displayed on the smart mirror using the DOM update method in the Magic Mirror chat module.

**Python**

Python serves is essential for smart mirrors because it allows for the insertion of amenities, like voice commands, facial recognition and internet of things (IOT) controls while permitting real-time clock, weather and news displays. Developers may build interactive and automated mirror systems with the raspberry pi and libraries like OpenCV speech recognition and flask pythons' adaptability. Robust ecosystem enhances the intelligence and usability of smart mirrors. LCD or LED display built into it provides information in real time. For hands-free engagement some smart mirrors additionally have voice assistants like Alexa or Google assistant or touch screen capabilities. The essential purpose of the mirror is maintained while the text and images remain apparent. The display interface of the smart mirrors flexible and adaptable.

**Voice controlled interaction**

In order to facilitate voice recognition and hands-free control smart mirrors usually offer Text-to-Text Speech (TTS) answers for interaction. These Mics are perfect for AI assistants since they can record sound from a distance cut down on ambient noise and enhance speech comprehensibility. They facilitate voice commands smart home device control reminder setup and smooth information access for people interacting with the mirror.

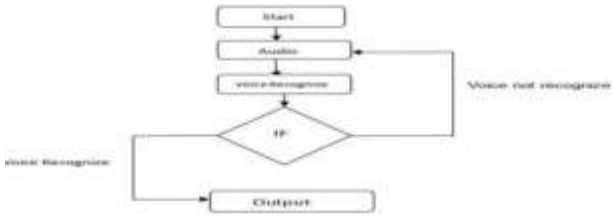



Fig 2:Flow chart of voice controlled interaction

**PRIVACY AND SECURITY**

Ensuring privacy and security for a smart mirror platform like Magic mirror, integrated with mixtrals Ai chatbot via hugging face Api on a raspberry pi, requires careful measures. Encrypting all data transmissions protects sensitive information from unauthorized access, while strong authentication methods are passwords or biometrics restrict usage to authorized individuals. Processing sensitive data locally on the raspberry pi reduces the risk of exposure to external servers. Secure Apis with authentication tokens ensure safe communication with external services. Regular software updates address vulnerabilities to maintain system integrity. Connecting the mirror to a secure wi-fi network with firewall protection enhances network security & privacy settings allowing users to manage features like camera or microphone to ensure control over data. Additionally, minimal data collection prevents unnecessary storage of personal information, creating a secure reliable smart mirror experience.

**LITERATURE REVIEW**

In recent years numerous smart mirror systems have been developed using lightweight hardware and modular software architectures one of the most familiar and widely adopted platforms is smart mirror an open-source solution built using nodejs and designed to run efficiently on affordable hardware like the raspberry pi its modular architecture allows developers to add custom modules for displaying weather news calendar events and other information.

1. S. Sahana; M. Shraddha; M. P. Phalguni; R. K. Shashank; C. R. Aditya; M. C. Lavanya" Smart Mirror using Raspberry Pi" The paper provides a comprehensive overview of existing smart mirror technologies, emphasizing the integration of Raspberry Pi as a central processing unit. The authors discuss various implementations where smart mirrors serve as interactive devices displaying real-time information such as weather updates, news, calendar events, and personal reminders.[2] The literature highlights the use of Node.js for developing modular

applications that enhance the mirror's functionality, allowing for features like voice recognition, facial detection, and gesture control.

2. Rohayanti Hassan; Zubaile Abdullah; Husni Ruslai; Kamaruzzaman Jahidin "Smart mirror for smart life" This paper explores the integration of Internet of Things (IoT) technologies into smart mirror systems. The authors discuss how IoT enables devices to collect and exchange data, facilitating remote control over network infrastructures. They highlight the evolution of smart mirrors from simple reflective surfaces to interactive devices capable of managing household appliances through voice recognition. The review addresses common challenges in home management[3], such as forgetting to switch off lights or misplacing to-do lists, and proposes that smart mirrors can mitigate these issues by providing centralized, voice-controlled interfaces. By incorporating sensors and network connectivity, smart mirrors can respond to user commands, enhancing convenience and efficiency in daily routines. The literature review sets the foundation for the development of a smart mirror prototype aimed at improving user interaction and home automation.

3. Smart mirrors, integrating IoT and Raspberry Pi, have garnered significant attention due to their innovative capabilities and cost- effective deployment. A. Sharma et al. utilized Raspberry Pi 3 alongside a Node.js server to implement a smart mirror system capable of real-time information display and basic home automation functionalities. Similarly, Khan et al. (2020) developed a personalized smart mirror leveraging Node.js as the backend to integrate APIs for displaying updates like weather and news. These implementations highlight the increasing adoption of intelligent, interactive interfaces tailored for personal, professional, or commercial environments. The practical application of Raspberry Pi for affordable solutions and Node.js for real-time data processing demonstrates the efficiency of these technologies in creating versatile smart mirror systems.

4. M. Teeuw pioneered the concept of a modular smart mirror by developing MagicMirror², an open-source platform built with Node.js and designed to operate on the Raspberry Pi [13]. The framework enables developers to create and integrate customizable modules that can display real-time information such as weather updates, news feeds, calendars, and other content. This extensible and modular architecture laid the foundation for numerous subsequent smart mirror projects, significantly influencing the evolution of interactive and personalized display technologies.

5. "Alboaneen ".Conducted a comprehensive review of Internet of Things (IoT)-enabled smart mirrors, examining their applications across profuse domains such as healthcare, education, and home automation. The study highlights the importance of integrating sensors and artificial intelligence (AI) to enhance user interaction, personalization, and overall system intelligence. Their work offers a foundational perspective on the current trends and technological developments in the design and implementation of smart mirror systems[1].

6. "Muhammad Muizzudeen Yusri " representing this system allows users to access information and also control the lights in the house. Relevant information can be traced such as time and date, weather, warning, traffic, and location map. The system applies Sonus technology as a medium of interaction between people and systems.[3]. Smart mirror technology is being used to address problems like neglected duties and wasteful energy use in an effort to streamline routine household chores. With the use of voice- activated interfaces and smart home device connectivity, users may better control a variety of features, such as temperature and lighting. These solutions demonstrate the potential of IoT-driven automation in designing intelligent living environments that improve user comfort, operational effectiveness, and energy sustainability.

7. "Joseph Cumeras I khan" In this paper we explore the potential of utilizing a smart mirror as a tool for identifying health-related issues we propose a novel smart health mirror system equipped with an embedded algorithm that enables it to function as an intelligent personal assistant the system supports facial recognition for user authentication posture problem detection offers personalized health guidance along with preventive care recommendations the algorithm continuously monitors changes in the users physical posture and behaviour over time analysing patterns and adapting its feedback accordingly experimental results demonstrated that the proposed model significantly improved users posture and overall engagement with preventive health practices." In this paper various tasks are been created using number of increasing functionalities' information get by using internet on things is proper and accurate. Internets on things are created using the ideas. Internet of Things can be used in daily things also. Device is smarter and make user smarter. It shows date, time and recent update about climates". [7]

8. S. B. H. Benson, "Future IoT based on Smart Mirror", this research explores the potential applications of the internet of things through the development of smart mirrors which can significantly impact numerous sectors such as healthcare education and sports prototypes of these smart mirrors built using platforms like arduino and raspberry pi enable user interaction via voice and facial recognition technologies in addition to their personal use iot-powered smart mirrors hold vast potential for integration into smart homes and smart city solutions including systems like intelligent parking the study also highlights key challenges in deploying iot technologies such as ensuring system reliability maintaining data security and improving analytical accuracy proper management of these challenges is crucial for the successful widespread adoption of iot systems.

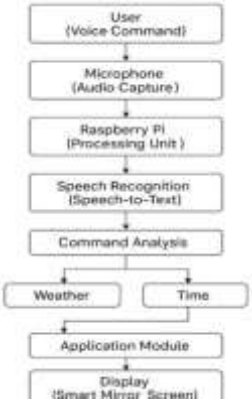
9. V. E. Pawar, "Smart Mirror using Raspberry Pi", the smart mirror concept aims to seamlessly integrate technology into daily routines by unobtrusively present essential data like calendar schedules to-do lists news and weather along its edges ensuring the mirror primary function remains intact featuring an in-built personal assistant it eliminates the need for keyboards and physical interaction making it user-friendly even when hands are wet or dirty advanced features like motion detection voice and gesture control and humidity protection enhance durability and ease of use particularly in humid environments designed to reduce time simplify routines the mirror merges intelligent applications with a sleek interface offering a practical yet futuristic solution thorough research into similar projects informed the design ensuring strategic component selection and optimized functionality[8].

**Methodology**

The smart mirror system is designed to provide essential real-time information including time, date, weather, news headlines, dynamic compliments, and a chatbot interface. The hardware setup consists of a Raspberry Pi connected to an LED display placed behind a two-way mirror, allowing the display to be visible while retaining mirror functionality. The software architecture is developed using Python with modules running concurrently to handle different functionalities. The time and date are retrieved from the system clock and updated dynamically. Weather data is fetched periodically from an online weather API such as Open Weather Map, while news headlines are sourced via RSS feeds or APIs like News API. Compliments are generated at regular intervals from a predefined list using randomization techniques. The chatbot module is integrated using a natural language processing API, enabling user interaction through text input. A lightweight web interface displays all modules with a minimalist layout to ensure readability and low power consumption. All components are optimized for real-time performance and are orchestrated to launch automatically upon system startup, providing a seamless and interactive user experience. Moreover, potential

integration with robotics can enable the Smart Mirror to interact with or control smart robots within the home environment, opening up possibilities for advanced home automation and assistance.

**SYSTEM DESCRIPTION**




Voice-Controlled Smart Display System Flowchart

First, import the module and create an instance of the Recognizer class. Then, use the Microphone class to capture audio input, optionally adjusting for ambient noise to enhance accuracy. Once the microphone is ready, prompt the user to speak and utilize the listen method to capture the audio. The recorded audio is then processed by the recognizer using an API like Google's Web Speech API to convert it into text. Finally, you can print or return the recognized text for further use. It's important to include error handling to manage cases such as unclear speech or API connection issues effectively. A smart mirror is an innovative device that combines traditional reflective surfaces with modern technology to offer a seamless interactive experience. It typically consists of a two-way mirror placed over a display screen, allowing information such as date, time, weather updates, and personalized compliments to be shown without compromising its reflective functionality. Embedded with sensors, microphones, and sometimes a camera, a smart mirror can recognize voice commands., The speech recognition module processes the input audio and converts it into a language that computers can understand. This is accomplished through algorithms that utilize knowledge extraction and Natural Language Generation (NLG). The recognized speech is then transformed into text using a speech-to-text converter. Once the text is generated, it is analyzed, and based on the analysis, control is directed to the appropriate module. This module contains the code responsible for displaying the requested output. Smart mirror powered by a microcontroller like a Raspberry Pi which operates on lightweight operating systems and utilizes programming languages such as Python with features like chatbot integration and voice assistants, To implement speech-to-text functionality using Python's speech_recognition library, the process begins with importing the library and creating an instance of the Recognizer class. Audio input is captured using the Microphone class, with an optional step to adjust for ambient noise to improve recognition accuracy. The listening method is employed to record audio, which is then processed using the recognize_google method to convert speech into text via the Google Web Speech API. The recognized text is either printed or returned for further use. Error handling mechanisms are implemented to address issues such as unrecognized speech or connection problems with the API, ensuring robustness and reliability.The device ensures hands-free convenience and real-time access to various services, making it a multifunctional addition to smart home environments.

**Future scope**

To ensure the Smart Mirror remains efficient and adaptable over time, several maintenance strategies and future enhancements are planned. Remote monitoring and logging will be implemented to track system performance, detect errors, and enable remote diagnostics. This will help in identifying issues early and maintaining system stability. The Smart Mirror will also support pushing updates for new modules, allowing seamless addition of features without manual reinstallation. A user-friendly web interface will be developed to allow users to customize displayed content, adjust settings, and manage modules effortlessly. Looking ahead, the system can be expanded to include theft monitoring and baby monitoring features using integrated cameras and sensors, providing additional security and home surveillance functionality.

***Conclusion***

The smart mirror system effectively integrates essential daily-use features such as real-time and date display, weather updates, news headlines, motivational compliments, and an interactive chatbot, creating a multifunctional and user-friendly interface. By combining hardware simplicity with modular and scalable software components, the system offers both practicality and a modern aesthetic. Its minimalistic interface ensures ease of access to important information without overwhelming the user, making it suitable for personal and professional environments. The inclusion of a chatbot enhances interactivity, while API integrations ensure the data remains current and relevant. This smart mirror serves as a step towards more intuitive and ambient smart home interfaces, offering potential for future enhancements such as personalized content, voice control, and smart home integration.

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