

Smart Mirror: A Technological Innovation in Reflective Display By using Raspberry pi 4

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Abstract— A smart mirror combines traditional reflective surfaces with cutting-edge technology, turning it into an interactive display that shows real-time information, digital content, and personalized features. It incorporates a two-way mirror, display screen, computer, and sensors, providing functionalities such as weather updates, news, calendar events, virtual fashion advice, interactive workouts, and augmented reality applications. Smart mirrors are utilized in retail, healthcare, hospitality, and smart homes, transforming daily life by integrating aesthetics with digital interactivity

Index Terms—magic mirror, reflective display, advance display, technical display.

I. INTRODUCTION

The advent of smart mirrors signifies a revolutionary amalgamation of traditional mirrors with advanced technology, heralding a paradigm shift in human-computer interaction. These sophisticated devices, also known as interactive or magic mirrors, combine the familiar reflective surface with an integrated display. Through the seamless integration of real-time data, digital content, and personalized services, smart mirrors transcend their conventional role as mere reflective tools. At the core of smart mirrors lie essential components: a two-way mirror that allows light to pass through while displaying digital information, a high-resolution display screen, a powerful computing system, and a suite of sensors



Fig 1: Smart Mirror

and cameras for interactivity. This technological ensemble empowers smart mirrors to offer a myriad of functionalities that cater to diverse sectors items. Hence, in the cloud, the safety of the resources does not do exclusively lean on a personal security protocols. The nearby substances including personal wellness, retail, healthcare, and hospitality. In personal wellness, for instance, smart mirrors provide users with real-time updates on weather, news, and health metrics during their daily routines. They also serve as virtual advisors, offering personalized fashion suggestions and enabling users to virtually try on different outfits. In retail environments, smart mirrors transform the shopping experience by acting as virtual fitting rooms where customers can visualize themselves wearing various garments without physically trying them on. Across by highlighting these multifaceted functionalities and applications, it becomes evident that smart mirrors are not just technological novelties but essential tools that integrate seamlessly into modern lifestyles. Their ability to merge aesthetics with functionality redefines our interactions with mirrors, promising to enrich daily routines and elevate user experiences across various domains

The Raspberry Pi 4

The Raspberry Pi 4 is a robust platform for various applications, from education and DIY projects to professional and industrial uses. Its powerful hardware, extensive connectivity options, and thriving community of developers and enthusiasts make it an excellent choice for anyone looking to explore the possibilities of a single-board computer. The Raspberry Pi 4 is a powerful and versatile single-board computer that offers significant improvements over its predecessors Processor and Memory. it has Processor of Quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz, Memory Available with 2GB, 4GB, or 8GB

LPDDR4-3200 SDRAM ,Ethernet of Gigabit Ethernet, Wi-Fi upto 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth range Bluetooth 5.0, BLE USB establish 2 × USB 3.0 ports, 2 × USB 2.0 ports, Video quality 2 × micro HDMI ports supporting up to 4Kp60, Audio has 4-pole stereo audio and composite video port, Camera Interface and Display Interface 2-lane MIPI CSI, Micro SD Slot For loading the operating system and data storage, it has a Power Input USB-C power supply. It is Versatile enough for DIY projects, including robotics, home automation, and more. Supports various sensors and peripherals for customized projects.

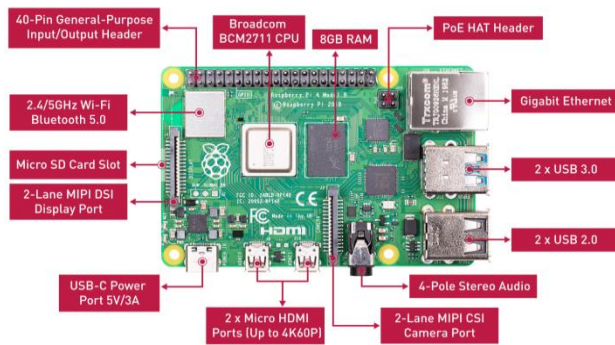


Fig 2: Raspberry pi 4 B

II. LITERATURE SURVEY

The invention of the smart mirror is driven by the desire to enhance everyday life through the integration of advanced technology into a common household item. In the early 2000s, Hiroshi Ishii and his team at the MIT Media Lab explored the concept of "tangible bits," aiming to bridge the gap between the physical and digital worlds. Their research included early versions of interactive surfaces, which laid the groundwork for smart mirror technology. Michael Teeuw is often credited with popularizing the modern smart mirror concept. In 2014, he created a widely recognized open-source project called "Magic Mirror," which detailed how to build a smart mirror using a Raspberry Pi, a pc, and a two-way mirror glass. His project inspired many DIY enthusiasts and developers to create their own smart mirrors. Hans Peter Brøndmo, an innovator in human-computer interaction, worked on the idea of interactive surfaces in the late 1990s and early 2000s. His contributions to creating intuitive, touch-sensitive interfaces influenced the development of smart mirrors. Companies like Panasonic and Philips have been

involved in developing and marketing smart mirrors for consumer and commercial use. They have created products that integrate smart mirror technology into everyday life, particularly in the health and beauty sectors. Capstone Connected, a tech company, developed smart mirrors with integrated Touchscreens and voice assistants, targeting smart home applications. Their products demonstrate the commercial viability of smart mirrors. The smart mirror community has grown significantly due to collaborative efforts and open-source projects. Developers and hobbyists share their designs, code, and experiences online, fostering innovation and improvement in smart mirror technology. The development of smart mirrors represents the cutting edge of human-computer interaction and the Internet of Things (IoT). They showcase how traditional objects can be transformed through technology to offer new functionalities and improve the user experience. Smart mirrors provide users with easy access to information and services without the need for separate devices. By displaying real-time updates such as weather, news, calendar events, and reminders directly on the mirror, users can stay informed and organized while going about Their daily routines. Incorporating digital displays and interactive features into mirrors helps consolidate various functions into one device. This reduces the need for multiple gadgets and screens, saving space and simplifying the user experience. By integrating health and fitness tracking features, smart mirrors support users in maintaining their well-being. They can display real-time health metrics, provide workout guidance, and offer tips for a healthier lifestyle, making health monitoring more accessible and convenient.

III. ALGORITHM

- 1) Installing of os in SD card(e.g., rasbian os and git clone)
- 2) Now connect SD card to Raspberry Pi
- 3) Power on the Raspberry Pi.
- 4) Start the operating system
- 5) Ensure the display is connected and configured correctly.
- 6) Set the screen to a suitable resolution.
- 7) initialize necessary software libraries and modules.

- 8) define modules for different functionalities (e.g., time, weather, calendar, news).
 - 9) *Time and Date*: Get current time and date from the system clock.
 - 10) *Weather*: Use an API to fetch current weather conditions and forecasts.
 - 11) *Calendar*: Sync with online calendars (Google Calendar, etc.).
 - 12) *News*: Fetch news headlines from RSS feeds or news APIs.
2. Replace "YOUR_WEATHER_API_KEY" and "YOUR_NEWS_API_KEY" with actual API keys.
- 13 Update the display at regular intervals
 14. Handle errors and data inconsistencies.
 15. Now run the command to display the screen
 16. cd Magic Mirror
 17. Npm start
 18. The user required display on your screen enjoy your smart mirror
 19. Adjust the display based on user interactions
 20. Ensure the system can recover from network failures or API changes.

Pseudo code: (python)

```

import time
import requests
from date time import date time
def fetch time():
    return
date time.now().strftime("%H:%M:%S")
def fetch weather(api_key, location):
url=f"http://api.weatherapi.com/v1/current.json?key={
api_key}&q={location}"
response = requests.get(url)
return response.json()
def fetch_news(api_key):
    url = f"http://newsapi.org/v2/top-headlines?country=us&apiKey={api_key}"
    response = requests.get(url)
    return response.json()
def display_data(time_data, weather_data, news_data):
    # Clear screen
    # Display time
    print("Time:", time_data)
    # Display weather
    print("Weather:", weather_data)
    # Display news
    print("News:", news_data)
    
```

```

def main():
    weather_api_key =
"YOUR_WEATHER_API_KEY"
    news_api_key = "YOUR_NEWS_API_KEY"
    location = "Your_City"
    while True:
        time_data = fetch_time()
        weather_data = fetch_weather(weather_api_key,
location)
        news_data = fetch_news(news_api_key)
        display_data(time_data, weather_data,
news_data)
        time.sleep(60) # Update every 60 seconds
if __name__ == "__main__":
    main()
    
```

IV. PROPOSED SYSTEM

The proposed system for a smart mirror integrates advanced technologies to provide a seamless, interactive user experience. Below is a detailed overview of the system's architecture, components, functionalities, and implementation steps.

V. SYSTEM ARCHITECTURE

The smart mirror system architecture comprises hardware and software components working together to deliver various functionalities

Software Components: Operating System: Raspbian OS (or similar) on the Raspberry Pi. MagicMirror² Framework: An open-source modular smart mirror platform.

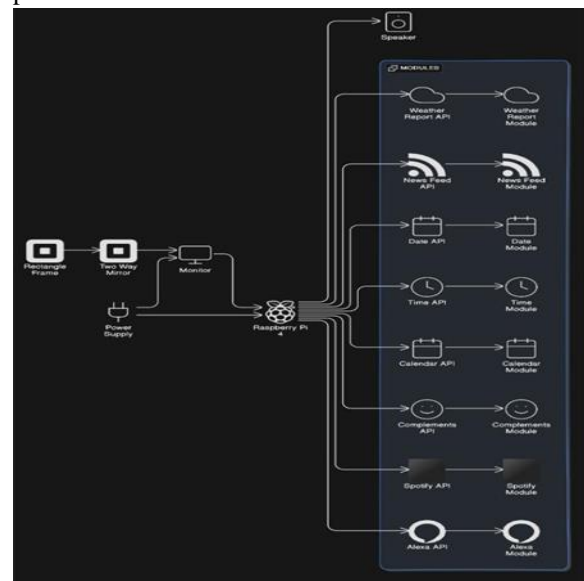


Fig 3: System architecture

Hardware Components:

- *Rectangular Frame:* Holds all the components together.
- *Two-Way Mirror:* Allows light from the display to pass through while reflecting the user's image.
- *Monitor:* Displays digital information behind the two-way mirror.
- *Raspberry Pi 4:* Serves as the primary computing unit, handling data processing and communication.
- *Speakers:* Connected to the Raspberry Pi for audio output.
- *Sensors and Cameras:* Enable user interaction through touch, gestures, or voice commands.
- *Power Supply:* Provides power to the monitor, Raspberry Pi, and other peripherals.

Modules and APIs:

- Weather Report
- News Feed
- Date and Time
- Calendar
- Compliments
- Spotify Integration
- Alexa Integration

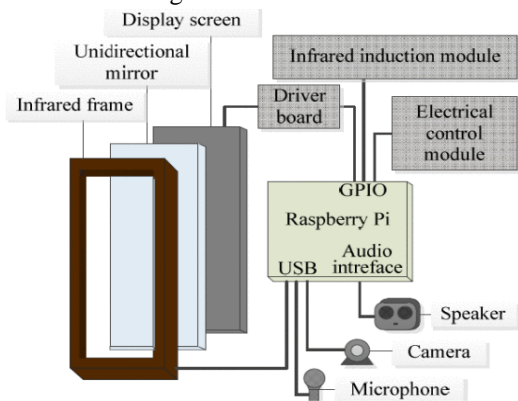


Fig 4 : smart mirror establishment

Modules and APIs

1. Weather Report API:

Provider: OpenWeatherMap, WeatherAPI

Functionality: Displays current weather conditions and forecasts.

Example API Call

<https://openweathermap.org/apiNews> Feed API:

2. News Feed API:

Provide: NewsAPI

Functionality: Displays the latest news headlines.

Example API Call:

<https://www.thehindu.com/news/national/feeder/default.rss>

Date and Time Module :

Functionality: Displays the current date and time.

Integration: Built into the MagicMirror² framework.

3. Calendar API:

Provider: Google Calendar API

Functionality: Displays upcoming events from the user's calendar.

Example API Call:

<https://github.com/phw198/OutlookGoogleCalendarSync>

4. Compliments Module :

Functionality: Displays random compliments to the user.

Integration: Built into the MagicMirror² framework.

Spotify Integration:

Table 1: smart mirror validation

Provider : Spotify API

Functionality : Controls music playback and displays current track information.

Example API

<https://developer.spotify.com/Alexa> Integration:

5. Alexa Integration:

Provide: Amazon Alexa API

Functionality: Voice-controlled assistant for various tasks.

Example API Call

<https://github.com/dolanmiu/MMM-awesome-alexa.git>

4. Implementation Steps

Test Case	Expected Result	Actual Result	Actual Result
Installing of os raspbian	Installed	fail	Success
Running the system	Running Smart Mirror	Success	Success
Configure PI	monitor screensaver and remove panel	Success	Success
Configure sound	Audio input and output configuration	Fail	Success
Configure voice	Setting up Speech Recognition	Fail	fail

Hardware Assembly:

1. Construct the rectangular frame to house all components.
2. Mount the monitor behind the two-way mirror.
3. Secure the Raspberry Pi, speakers, and
4. sensors within the frame.
5. Connect the power supply to all components.

Software Installation:

1. Install Raspbian OS on the Raspberry Pi.
2. Set up the MagicMirror² framework on the Raspberry Pi.
3. Configure the necessary modules and APIs in the config.js file of MagicMirror².
4. Install and configure additional software for Spotify and Alexa integration.

VI. EXPERIMENTAL RESULTS



Fig 5: Installing of Debian GNU/Linux

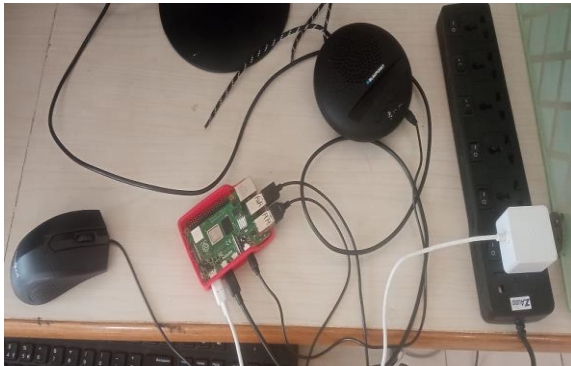


Fig 6 :connection of Raspberry Pi

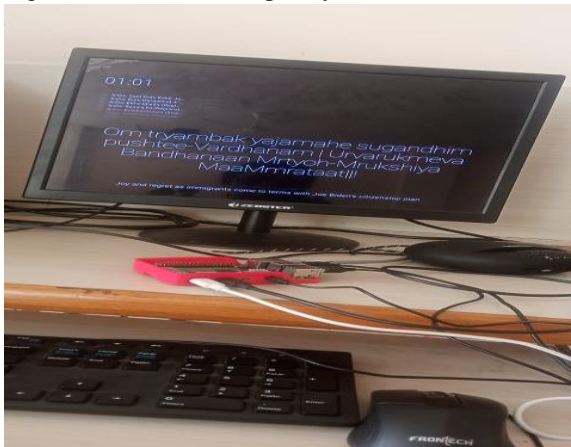


Fig 7:final output

VII. CONCLUSION

My aim is to convert a normal mirror into a smart mirror by modifying and enhancing various modules. I successfully created a smart mirror that includes features like date, time, calendar, weather reports, live news, Spotify, and Alexa. It also provides compliments and updates on the current events around me while I get ready. Through this project, I immerse myself in technology and stay informed about what is happening around me. Here I go with technological innovation!

VIII. FUTURE SCOPE

Magic Mirror has a promising future as a central hub for smart home devices, enabling control of lights, thermostats, security cameras, and more through a unified interface. Integration with voice assistants like Alexa, Google Assistant, or Siri will allow hands-free control. With facial recognition, Magic Mirror can display personalized information such as calendars, reminders, and to-do lists, adapting its interface based on user preferences, time of day, or specific events. Leveraging AI, it can provide predictive insights, suggest optimal times to leave for work, and recommend outfits based on weather forecasts. Improved NLP capabilities will enhance its understanding and response to complex voice commands. In hotels and restaurants, Magic Mirror can improve guest experiences by providing interactive menus, local information, and personalized services. Enhanced privacy settings will ensure sensitive information is only displayed to authorized users. With customizable frames, shapes, and sizes, Magic Mirror can fit various interior designs. Its future scope is extensive, driven by technological advancements and increasing demand for smart home devices, with potential applications spanning personal health, wellness, commercial uses, and educational tools. As the Magic Mirror community continues to innovate, we can expect exciting developments in the years to come different locations.

IX. REFERENCE

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