



i-Speculum: Touch Based Smart Mirror

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Abstract: i-Speculum aims to enhance the concept of smart mirrors by incorporating interactive features such as voice inputs and outputs, gesture control, and touchscreen capabilities. The smart mirror's software, powered by Raspberry Pi, recognizes users through facial recognition or voice control, allowing easy access to personalized information such as emails, smart home controls, and daily news updates. By presenting information in an intuitive and accessible format, smart mirrors improve productivity and convenience while reducing reliance on traditional computing devices. The combination of a traditional mirror's reflection and a computer display's versatility makes smart mirrors a promising technology for the future.

Keywords: I-speculum, Smart Mirror, Raspberry Pi, Interactive Features

I. INTRODUCTION

The internet has transformed our lives by connecting us more easily to information and other people. With the emergence of smartphones and the internet of things, the concept of making everyday objects "smarter" has become a reality. One such object is the mirror, which provides a large surface for displaying information and interacting with. The smart mirror functions as both a reflective mirror and a computer display, but currently, most smart mirrors are limited to displaying time and weather. The addition of interactive features such as voice inputs and outputs, gesture control, and touchscreens can enhance the smart mirror's concept.

There is an existing community of smart mirror enthusiasts who build smart mirrors and develop software for them. The MagicMirror platform is one such smart mirror that offers basic functionality like time, weather, and calendars. However, it is also extensible with "modules" that provide additional functionality, such as facial recognition, YouTube integration, and touch controls.

II. LITERATURE SURVEY

In [1] Augmented Reality is direct and indirect view of real-world elements that are augmented on computer software. Augmented Reality considers real and virtual elements. It mainly adds the software information and refines the users view to actual environment. This work is an implementation to develop Virtual trial Room application using AR which allows a user to try on different colour of clothes.

In [2] In today's world, keeping up with appointments, current world affairs, traffic schedules and many other things have become the primary focus of people's lives. At present, there is a heavy dependency of people on smartphones which is a reason why the smartphone industry is blooming. Since dependency on smartphones is there, people have to properly make time to check their phones. This is where the idea of a smart mirror comes into existence.

In [3] Object detection is often used in product quality stages in the industry. The proposed system can be applied to an industrial quality control system. Likewise, it can be utilized for various industrial systems or for security purposes. Generally, it is identifying objects in public area and measure dimensions of each of them. The competence of the proposed system has been confirmed through utilizing real videos that taken from a Raspberry Pi camera.

In [4] The paper gives an idea of a smart mirror, its design and usage in various fields. In our everyday life we groom or look at ourselves in the mirror at least once. A Smart Mirror will update us with all the daily news updates, date, time etc. The Raspberry Pi used in the prototype can control the data to be displayed on the mirror. These mirrors can be used for various purposes, as by using some programming we can add more features to it. It can be used for the security purpose or a theft alert system. It can also feature a face detection module so one can have access to individual profiles.



In [5] The mirror is further being intellectualized with the addition of an input device the ALEXA. In the scope of study, the intelligent mirror system thus developed includes features such as weather reports, date and time information, current news updates and greeting messages. Additional commands are given to the system by the input voice commander the ALEXA that can perform various tasks from playing a video of your choice to showing maps of desired location.

In [6] Voice Assistant and Smart Speakers bring a replacement dynamic into the house. Their tongue capability and straightforward use simplify tasks we perform each day, from booking a gathering, playing music, or making an internet purchase. Their convenience keeps us heads-up and hands-free.

III. SYSTEM DESIGN

The i-speculum design has two parts: designing the box and designing the application. The box is designed to hold the monitor, Raspberry Pi, and mirror securely, with compartments to prevent damage and openings for cables and USB ports. In choosing components, physical and software constraints were taken into account. The application design aims to efficiently use the mirror surface by arranging information in the corners and leaving the mid part empty for the user's reflection. This is important for applying augmented reality to display jewelry over the user's reflection.

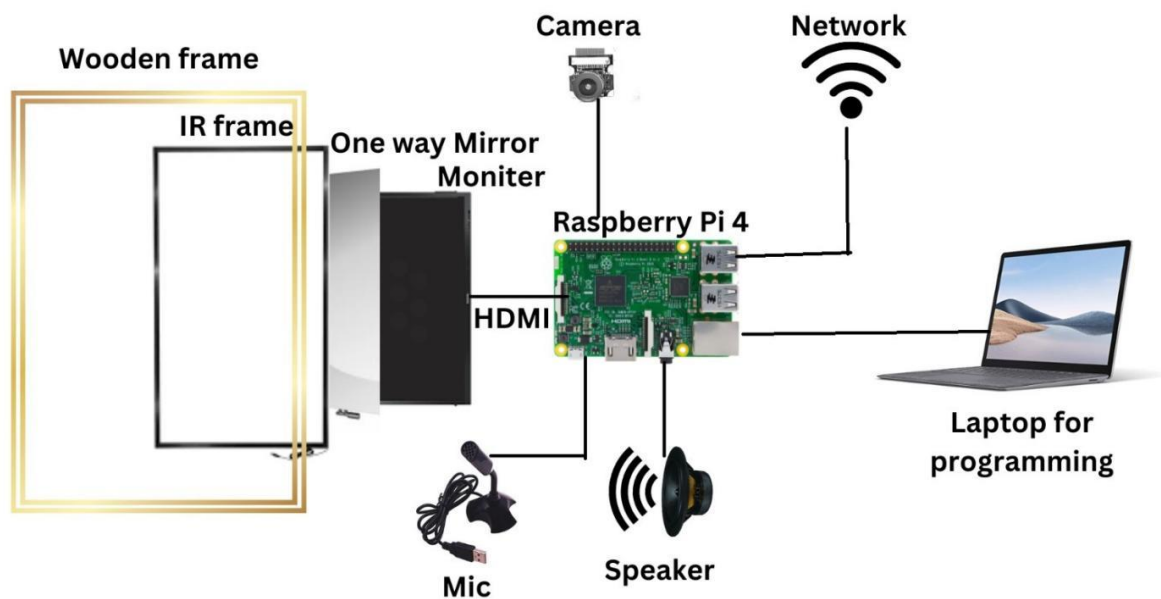


Fig 1: Components and connections

Raspberry pi 4: It is used as a minicomputer in order to make the mirror work. It is installed with Raspbian OS which supports python and other programs. All the inputs and outputs are provided by this system.

Monitor: It is the display output which will be placed behind the one way mirror. It is connected using the HDMI port from the raspberry pi 4 which will provide the visual output.

IR frame: It is used as a pointing device for the mirror it is placed in front of the one way mirror so that it will be able to detect where the user taps the mirror. It is connected to the raspberry pi 4 as an input device using USB port.

One way Mirror: It is a type of glass which allows the light to pass only from one direction and therefore the other side acts like a mirror.

Pi Camera: It is an input device for raspberry pi 3 connected in the camera port of the Pi4. It is used for facial recognition and object detection.

Mic: It is also an input device connected to pi3 using USB port. It helps for the user to give audio inputs.



Speaker: It is a output device used for audio output from the Pi3. It is connected using USB port.

Network: The Raspberry pi4 has a inbuilt wifi and a LAN port therefore it will be able to connect to the network for necessary tasks.

Laptop: It is used for installing the OS and other required software components, for the Raspberry Pi 4 to function properly.

IV. IMPLIMENTATION

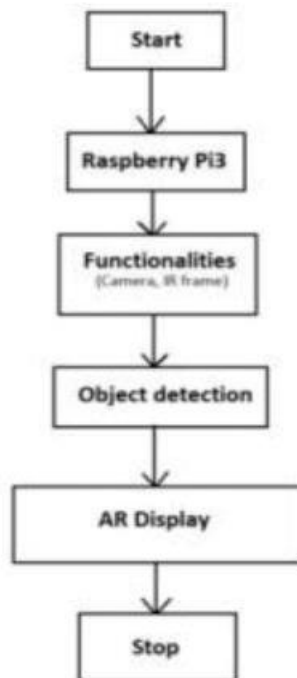


Fig 2: Flow chart of working of mirror

When the power is activated first raspberry pi 3 turns on with its OS called Raspbian OS. Then it turns on all the required components for the customer functionality of the mirror like camera and I frame. When the customer is in front of the mirror with a piece of jewellery the object detection program runs to recognize the object as well as to get the measurement details of the customer. Once the object detection is over it will run AR program so that the customer can get suggestion or check out design in real time.

Raspbian OS

Raspbian is a Debian-based operating system designed specifically for the Raspberry Pi, a single-board computer. It is the official operating system for the Raspberry Pi Foundation and is widely used in educational, hobbyist, and commercial projects. Raspbian comes with a range of pre-installed applications, including programming tools, web browsers, and media players. It also has a user-friendly graphical interface that makes it easy to use, even for those who are new to Linux. Raspbian is known for its stability and reliability, which is important for the IoT and other projects that require constant uptime. Additionally, Raspbian supports a range of programming languages, making it a versatile choice for a variety of applications. It is free to download and use and has an active community of developers who provide ongoing support and updates. Raspbian is a powerful and flexible operating system that has made the Raspberry Pi a popular choice for a wide range of projects.

Magic Mirror OS

Magic Mirror OS is a free, open-source platform designed for creating a smart mirror. It is based on the Raspbian OS and is optimized for Raspberry Pi hardware. Magic Mirror OS offers a modular design, allowing users to add custom modules for displaying weather, news, calendar events, and other information. It supports voice control, touch screens, and various sensors, making it a versatile platform for creating interactive displays. Installation of Magic Mirror OS is



relatively simple and involves downloading the OS image, writing it to an SD card, and booting the Raspberry Pi from the card. The version of Magic Mirror OS which is used in i-speculum is MagicMirror2.

It has several modules but the ones which are used in i-speculum are:

1. **MMM-3Day-Forecast:** The MMM-3Day-Forecast module is a popular weather module used in the Magic Mirror OS. It provides users with an easy-to-read, three-day weather forecast that is highly customizable.
2. **MMM-SmartTouch:** MMM-SmartTouch is a module in the Magic Mirror OS that enables touchless control of the display using hand gestures. It utilizes the Google Soli radar sensor, which can detect movements and gestures in 3D space, to allow users to interact with the mirror without physically touching it.
3. **MMM-PenPlotter:** MMM-PenPlotter is a third-party module available for Magic Mirror OS that enables users to control a pen plotter from their Magic Mirror. The module works by connecting to the plotter over a serial connection and sending commands to it. Users can create custom designs or use existing ones and send them to the plotter to be drawn.
4. **MMM-Alexa:** MMM-Alexa is a module for Magic Mirror OS that enables voice control through Amazon's Alexa digital assistant. This module allows the user to interact with the Magic Mirror through voice commands.
5. **MMM-Face-Recognition-SMAI:** MMM-Face-Recognition-SMAI is a module for Magic Mirror OS that allows for facial recognition technology to be integrated into the mirror. It uses a pre-trained convolutional neural network (CNN) model to identify faces in real-time and can be customized to recognize specific individuals or groups of people.
7. **AR:** The AR Implementation in i-speculum is done by using OpenSpace3D and Blender. First the 3D Design of the jewellery is prepared using blender and then implemented using OpenSpace3D.

V. RESULTS

i-speculum integrates a range of features to provide a personalized and convenient user experience. The mirror includes real-time weather updates, news headlines, time display, and an AR feature for an immersive experience.

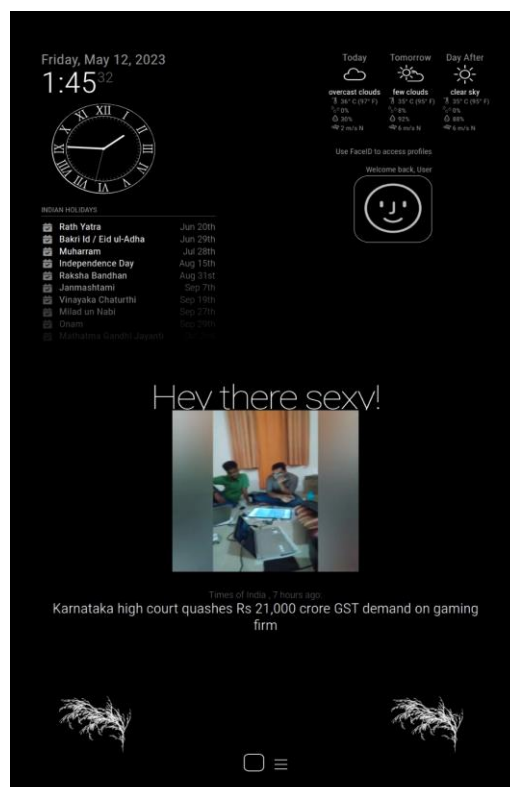


Fig 3: Modules of i-speculum

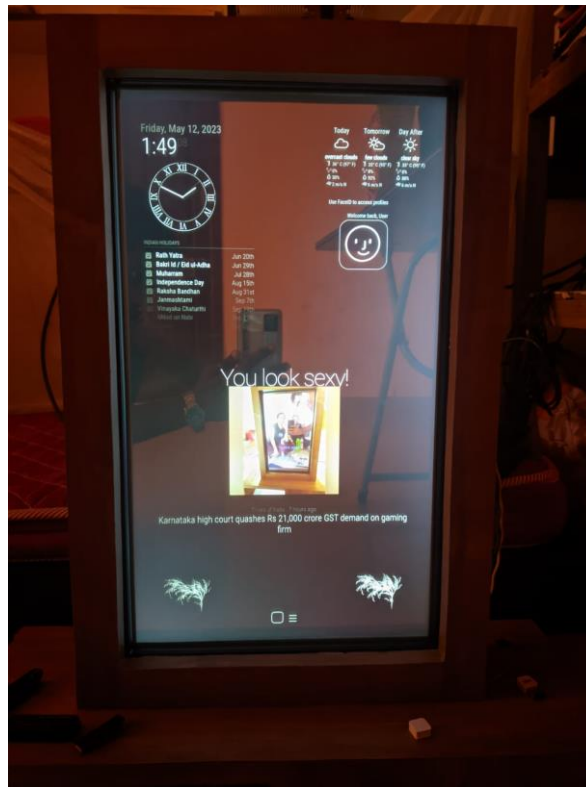


Fig 5: Final Result of i-speculum

VI. CONCLUSION

The i-speculum project aimed to provide a user-friendly interface with multiple functionalities. The mirror displayed real-time weather updates, news headlines, a greeting message, and the current time. The addition of YouTube access allowed for further entertainment options. The implementation of augmented reality for jewelry provided a unique and practical use case for the technology.

The user could see how various pieces of jewelry would look on them before purchasing, making the shopping experience more convenient and efficient. The results photos demonstrate the successful implementation of the project, with a clear and easy-to-use interface, accurate weather updates, and functional AR technology for jewelry. The smart mirror project has the potential to revolutionize the way people interact with their mirrors, creating a more engaging and efficient daily routine.

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