



ARTIFICIAL INTELLIGENCE EMBEDDED MIRROR

Rohith C M¹, Tijo Sebastian²,
Unnikrishnan S³, Vishnu Vinod⁴
Gayathri R Krishna⁵

¹Student, Mangalam College of Engineering, Kottayam, Kerala, India, rohithcm101@gmail.com

²Student, Mangalam College of Engineering, Kottayam, Kerala, India, tijos3938@gmail.com

³Student, Mangalam College of Engineering, Kottayam, Kerala, India, unnikrishnans060@gmail.com

⁴Student, Mangalam College of Engineering, Kottayam, Kerala, India, vishnukulathinal11@gmail.com

⁵Assistant Professor, Mangalam College of Engineering, Kottayam, Kerala, India, gayathri.krishna@mangalam.in

ABSTRACT

A Smart Mirror is a device that is an extended and enhanced version of conventional mirror, which serves more features than what a conventional mirror could perform. It allows the user to access and interact with various features that can be found in smart devices, like smart phones. A Smart Mirror can display text, image, videos and all kinds of data supported by a device. The main advantage of a Smart mirror will be its capability to work as a conventional mirror, as well as a Smart Home device. This device can replace a wide range of household utilities like Clocks, Calendar, External voice assistants like Amazon Echo and Google Home, Temperature monitors and even a Music player. In this paper, we discuss about the design and implementation of a Smart Mirror.

Key words: Smart Mirror, Artificial Intelligence, Internet of Things, Voice assistants

1. INTRODUCTION

Implementation and developments on Smart devices have reduced from industrial level to DIY, with the introduction of System on Chip (SoC) devices like Raspberry Pi and Arduino. Developments can be done on these SoC's, which lead to the development of a community of DIY developers. The Smart Mirror, is a Smart Home device, that can replace a wide range of household devices and office devices. A Smart Mirror can also work as a controller for the household devices, with IoT enabled in it.

Moving on to the assembling of a Smart Mirror, requires a frame, a Monitor, Raspberry Pi Module, Relay module, Web Camera, Microphone and Speakers. With the availability of small sized Web cameras and Speakers, the size of the mirror will not be bulky. The Mirror will require an always active power supply and internet service in order to function various modules. This could never be a problem these days since internet is available almost everywhere and the device uses only very low amount of data and power. The Mirror is focused to have the same size of conventional mirrors used in homes, but serves more than what those mirrors can do.

The Smart Mirror include features like Face detection, Voice Assistant like the Google Assistant [4][5]. The Web Camera is used to detect face of the registered user. This feature is given in order to maintain privacy to the events or other data that the user have saved in the mirror. Each user who want to access the mirror should register their face and voice with the Mirror as the first step. Later on, the mirror identifies them with this training data and interacts with the user. This facility ensures the privacy factors, and user can store their events and alerts in the mirror safely.

Another feature added with these are Home Automation facilities. A Registered user can use the voice assistant, in order to turn on/off the devices in the room, or the entire building. This feature is purely based on the Raspberry Pi, and hence, communication with the internet is not necessary if the user is interacting with the mirror. When the user wants to check the status of the devices when he/she is away from the mirror, Internet access is mandatory.

The Smart Mirror also comes with a notification system and many other widget systems like Weather, Calendar, Clock, Map and News headlines [3]. The notification system alerts the user about the weather forecast, if the user has an event stored at a particular time. It also sends notification to the user, once the status of any of the device connected to the home automation system changes, if there is internet service active on the mirror. With the help of the calendar widget, the user can store events, and the mirror can keep the user updated about the upcoming holidays and other events. The Clock widget helps the user to check the Time, as well as set an alarm or remainder to a particular time. The Maps service can be used to check the traffic status and check on the satellite map of an area. The user just has to ask the voice assistant to fetch the map of an area for this. The News headline widget fetches the latest headlines from the web and keeps the user updated about the latest happenings.

2. LITERATURE SURVEY

A Mirror being an imperative household utility serves a lot in our day to day lives. There was no replacement for a mirror till these years. But with the low cost, miniature size, and

portability, SoC's has taken over control of many devices, and now, mirrors can also be termed to be one among them. With Raspberry Pi, we can build a Smart Mirror, which serves the same utility as of conventional mirrors, and more than a conventional mirror.

The Raspberry Pi [1] Computer is a System on Chip (SoC), a design where a single board carries all the essential circuits, such as the Central Processing Unit (CPU), the Graphics Processing Unit (GPU), and several input, output and processing circuits. The availability of features such as the General-Purpose Input Output (GPIO) pins make the computer amenable to programming hardware, as well as driving electronic circuitry and collect data through various means. The Pi can run the official Raspbian OS, Ubuntu Mate, Snappy Ubuntu Core, the Kodi-based media centers OSMC and LibreElec, the non-Linux based Risc OS. It can also run Windows 10 IoT Core, which is different to the desktop version of Windows.

Here, the Raspberry Pi uses the Raspbian OS, based on Linux Debian in order to build the API for the Smart Mirror, to which the user interacts. Raspbian is chosen in order to let the API be an Open Source Platform, and Linux is found to be the best OS for Open Source development [2]. Open Source development will help in establishing a community of developers [2], which could let even the users to participate in the UX improvement Programs.

Evolution of LED and OLED Displays have proved that displays can be made as thinner and lighter as a mirror. This led to the development of converting a display to act like a mirror, as well as a display, with the help of Two-way Mirror sheets.

3. PROPOSED SYSTEM

The proposed Smart Mirror system development contain two parts.

3.1. Hardware Assembly

The Hardware assembly of the mirror is simple, as the required items are readily available and are inexpensive. It requires some basic materials like frame and glass or mirror sheet, which are used in conventional mirrors [3].

For the development of Smart Mirror, it is better to use an Aluminum or Soft wood frame. Here, we use Two-way mirror sheets in place of glass, which allows light from the monitor to pass through it. The API of the Smart mirror will possess a black background, which produces no light in case of AMOLED displays, and a very low light in case of LCD or LED Displays. This light will be blocked by the two-way mirror sheet, whereas, the textual and image contents of the API produces white or similar light colors, which can pass through the mirror sheet. Usage of glass is not promoted also due to the fact that the handling of the device will be more complex.

The Aluminum or Soft wood frame is built as given in Fig 3.3.1, 3.3.2 and 3.3.3. The front layer contains 4 slots. The largest slot to place the monitor in it. There is a circular slot at the top-center, which contains the camera module. The top-left slot is equipped with the Speaker, and the top-right slot contains the Microphone.

A middle layer is added between the front and second layer of the rear, in order to hold the monitor properly. The second layer in the rear holds the Raspberry pi and the relay module. All the device connections are given in this layer.

The Raspberry Pi is loaded with a Class 10 Micro SD card with Raspbian OS preloaded in it. The USB Web Camera and Speaker are connected to the Raspberry Pi. The Microphone can either be a USB Microphone or a 3.5mm Jack Microphone. The GPIO pins from the Raspberry Pi is connected with the Relay module to connect external device switches. The HDMI Cable from the monitor is also connected to the HDMI port of Raspberry Pi. Two power supply is required for the system. For the Monitor as well as for the Raspberry Pi.

3.2. Software Implementation

The most important and crucial part of the Smart Mirror development is the Software or API development. For this magic mirror, we use Node.js and Python as the frameworks to build the API. The widgets comprise of five parts. An HTML File which helps in partial description of the plugin's display structure within its display container. One or more CSS files contains the styling for a plugin's display container, and one or more JavaScript files fetch information or control the behavior of a plugin's display container. A Script is an external program that generates information, or controls the behavior of a plugin's client container that cannot otherwise be achieved using JavaScript. Here we use Python and Node.js along with JavaScript. The Web GUI is the interface that allows users to customize plugin-specific settings [6].

Example for a widget configuration:

```
var config = {
  port: 8080,
  language: 'en',
  timeFormat: 24,
  units: 'metric',
  modules: [
    {
      module: 'clock',
      position: 'top_left'
    },
    {
      module: 'weather',
      position: 'top_right'
    }
  ]
}
```

Fig. 3.2.1. Clock & Weather widget configuration

The Widgets created will communicate with the widget Client API, which communicates with the Server. The Server runs the widget script, fetches the data with the API Key from the client and returns the data back to the client. The return value could be either an XML document or a python script, which the client-side widget API decodes and displays on the Mirror [6]. For Example, The News headlines widget checks for the latest news from the News service providers. They return a Rich Site Summary (RSS) or XML file. The client fetches and decodes the data from the file and displays it to the mirror. [Fig.3.3.4]

The Display API is used by the server for loading and unloading plugins, and retrieving browser details. This API encompasses the global user space of the display, and is not accessible in the plugin user space. The Display API is kept locally in order to work even if there is a network failure. The widget configuration is fetched by the Display API, and displays the widgets with the given configuration at the mentioned position. The Display API is designed with Node.js for a Web Management Interface, which allows the users to configure the mirror, align widgets and add additional features using a Web Browser.

3.3 Figures



Fig. 3.3.1. Front View of the Smart Mirror



Fig.3.3.2. Build of layer 1, Rear of Smart Mirror

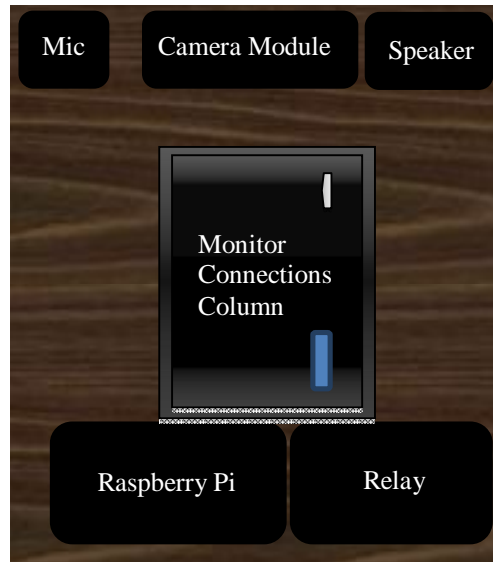


Fig. 3.3.3. Build of layer 2, Rear of Smart Mirror

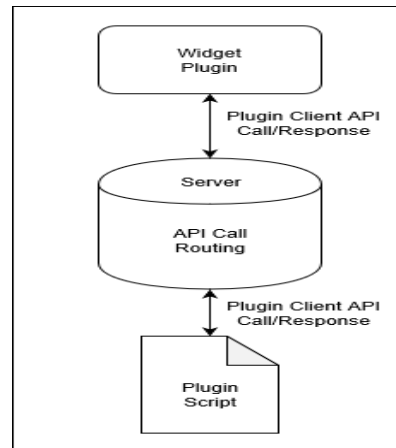


Fig. 3.3.4. Widget API - Server Communication

EXPERIMENTAL RESULTS

Test Module	Function	Result
Clock	To display the current time and set alarms	Clock functionalities executed successfully
Calendar	To display the current date and calendar	Calendar functionalities executed successfully
Headlines	To show the daily news headlines	Displayed the daily news successfully
Events	To show the upcoming events	Upcoming user’s events and upcoming holidays displayed successfully
Face recognition	To activate the mirror	Detected the user’s face and unlocked successfully
Voice recognition	To give user inputs as voice commands	Detected the user’s voice and unlocked successfully

4. CONCLUSION AND FUTURE SCOPE

The Smart Mirror is a Smart home device that helps the users to store their day to day events and reminders to keep them updated. The Smart mirror also helps the user to replace Clock, Calendar, and Smart Home Assistants with a Single device.

The Voice assistant integrated with the system helps the user to control home and office device through their Smart phone or by interacting with the Mirror. The proposed system hence possesses a huge scope towards the future. Smart homes hence move on to the use of Smart mirrors and assistants to replace other devices. Smart Mirror App developers could also find a huge scope in career. Moreover, Smart Mirror developers could also find a rich number of buyers in the upcoming years.

The Smart mirror, being user and developer friendly allows its users to experiment with the device and encourages the users to customize the device based on their needs. This could help to bring up new ideas towards reality into the device.

REFERENCES

1. N.S. Yamanoor, S. Yamanoor, **High Quality, Low Cost Education with the Raspberry Pi**, *IEEE Global Humanitarian Technology Conference (GHTC)*, Oct. 2017. pp. 1,3-4. <https://doi.org/10.1109/GHTC.2017.8239274>

2. R. Abdullah, H. Ibrahim, M. Lakulu, M.H. Selamat and M.Z.M Nor. **The Challenges of Open Source Software Development with Collaborative Environment**, *International Conference on Computer Technology and Development*, 13-15 Nov. 2009, pp. 1-5. <https://doi.org/10.1109/ICCTD.2009.161>
3. S. Yong, G. Liqing, D. Ke, **Design of Smart Mirror based on Raspberry Pi**, *2018 International Conference on Intelligent Transportation, Big Data & Smart City*, pp. 1-4
4. P. Milhorat, S. Schogl, G. Chollet et al “**Building the next generation of personal assistances**” 1st International Conference on Advanced Technologies for Signal and Image Processing – ATSSIP’2014, March 17-19, 2014, Sousse, Tunisia, pp.458–463. <https://doi.org/10.1109/ATSSIP.2014.6834655>
5. V. Kepuska and G. Bohouta, “**Next generation of virtual personal assistances** (Microsoft Cortana, Apple Siri, Amazon Alexa and Google Home)”, 2018 IEEE 8th Annual Computing and Communication Workshop and Conference 8-10 Jan. 2018 Las Vegas, USA, pp.99–103. <https://doi.org/10.1109/CCWC.2018.8301638>
6. K. Fujinami, F. Kawsar, and T. Nakajima. **AwareMirror: “A personalized display using a mirror”**. In *Pervasive*, pages 315-332, 2005. https://doi.org/10.1007/11428572_19