

Smart Mirror Using Raspberry PI

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Abstract : The design and the development of an interactive multimedia futuristic Smart Mirror with artificial intelligence for the ambient home environment as well as for commercial uses in various industries. The project which would collect real world machine data and the data would be transmitted from the machine and would be managed by the Raspberry Pi. The Smart Mirror implemented as a personalized digital device equipped with peripherals such as Raspberry PI, microphone, speakers, LED Monitor covered with a sheet of reflective one way mirror provides one of the most basic common amenities such as weather of the city, latest updates of news and headlines and local time corresponding to the location. Using speech processing techniques the Smart Mirror therefore interacts with the user through verbal commands, functions and listens to the user's question and responds them adequately.

IndexTerms- Component, Raspberry pi, Mirror, LCD display, Frame.

I. INTRODUCTION

A smart mirror is a two-way mirror with an electronic display behind the glass. The display can show the viewer different kinds of information in the form of widgets, such as weather, time, date, and news updates. This product would be useful for busy individuals that want to multitask and stay informed while on the go. Instead of constantly pulling out a device, one could get informed while finishing daily grooming tasks. A pane of glass with a mirror film on one side is encased in a frame and placed on top of a monitor. The mirror acts in a similar way that a two way mirror works. When there is nothing displayed on the monitor (i.e., the monitor is black), users can see their own reflection in the mirror. When a non-black colour is displayed on the monitor, that colour appears to come through the glass from the monitor. This modification was made to demonstrate the capability of Smart Reflect to access external hardware interfaces a task that is currently not possible with other similar smart mirror platforms that use a web browser as the display method.

II. EXISTING SYSTEM

A smart mirror is to use a pane of two-way glass, a monitor, a frame to hold the glass and monitor, and a web browser with JavaScript to provide the software features and drive the display. The main limitation of this setup is related to the use of a browser as the display's method of information presentation. A browser creates a sandbox for the code that runs within it, that is, all interactions and processes are isolated from other running processes and hardware interactions on the computer. Furthermore, web applications are typically driven through user events generated on a web page (e.g., mouse clicks). This feature poses limitations in smart mirror applications. First, user events cannot be generated naturally in a browser when one interacts with the browser as one would with a mirror. Second, a sandbox limits the use of external hardware to generate events based on typical user-mirror interaction. Third, only JavaScript runs natively in a browser.

Smart Reflect is designed to meet the requirements for creating a real-time display device. Our platform follows the Model-View-Controller (MVC) design pattern. The Model refers to plugins that manage data to be displayed. A plugin may retrieve data from third-party data resources (e.g., weather data API). The View is the screen/mirror that displays the data. The Controller is the server component that controls the execution of each plugin. This design decision allows for the separation of concerns and defines the user space for each plugin with regard to each other contributing to an overall modular design. Communications between plugins, the server, and plugin clients in the browser are all handled through the Web Socket protocol.

Web Socket allows for real-time transmission of data as opposed to traditional servers that have the overhead of establishing and closing connections for each unit of data transferred or requested. This allows for plugins and the server to make rapid and multiple API calls that are necessary for a real-time dynamic display. Plugins are responsible for providing information to display, as well as determining how the information is displayed. Using our platform, people can customize what information to display in their smart mirrors by writing their own plugins. Smart mirrors usually allow users some customization. To provide a personalized service, a smart mirror needs to identify the user who is standing in front of it, so that it can access and display the

user's personal information, such as his/her schedule, to-do list, and appointments. Automatic methods for recognizing users include tag-based identification, voice command and personal belongings. To select the most appropriate method, one should consider the location of a smart mirror and its intended uses. For example, the use of a camera may not be suitable for a smart mirror installed in a washroom due to privacy reasons.

III. PROPOSED SYSTEM

A smart mirror is basically a mirror with a screen behind it. That screen can be an LCD display or a computer monitor. Naturally, a monitor will make for a larger mirror. It's also a great way to repurpose an old LCD monitor. But you can't cram a full computer in there, unless you use a Raspberry Pi. Design and development of a futuristic Smart Mirror on Raspberry Pi 3 for the ambient home environment as well as for commercial uses in various industries. Most people have mirrors at home, so the concept of a smart mirror that you can interact with is attractive and can be fantasized by anyone. If a mirror serves to this purpose, one can imagine the amount of time it will save and be of such a great use. The device was to look like a regular mirror but would have a screen inside. The project which would collect real world machine data such as location based latest news. The data would be transmitted from the machine and would be managed in a central database. We have also worked on including Artificial Intelligence in the Smart Mirror wherein a Voice enabled assistant will cater to the needs of the user.

The key component of the augmented interaction device is a raspberry pi. A monitor with HDMI is used as a screen for the smart mirror. A SD card can be inserted to store the user customized data. For web service we can either use Ethernet (IEEE 802.3) or a Wi-Fi Adaptor. But in case of modem we need USB Ethernet converter. By means of web services we can access location based news, time and weather conditions. And a camera is used for user identification and fetches daily reminders once you have gained access. A microphone is used for voice recognition and for voice commands. Interactive touch screen module is used to access data and give inputs based on which the mirror works. A detached infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light transmitting from items in its field of view. They are frequently utilized as a part of PIR-based movement identifiers. An individual PIR sensor recognizes changes in the measure of infrared radiation impinging upon it, which fluctuates relying upon the temperature and surface qualities of the items before the sensor. At the point when a protest, for example, a human, goes before the foundation, for example, a divider, the temperature by then in the sensor's field of view will ascend from room temperature to body temperature, and afterward back once more.

The sensor changes over the subsequent change in the approaching infrared radiation into an adjustment in the yield voltage, and this triggers the recognition. Objects of comparable temperature yet extraordinary surface qualities may likewise have an alternate infrared emanation example, and consequently moving them as for the foundation may trigger the finder as well. This sensors makes the screen now and again as indicated by the individual comes nearer. If the individual draws close to screen gets on and the other way around. Wi-Fi is utilized to get the news and climate refreshes.



Fig.1 Smart mirror Setup

The main appeal of this approach is that people can access personalized information effortlessly while doing their daily activities, such as washing hands and brushing teeth. Smart mirrors can also be used to monitor, notice board and control home appliances. Smart mirrors usually allow users some customization. To provide a personalized service, a smart mirror needs to identify the user who is standing in front of it, so that it can access and display the user's personal information, such as his/her schedule, to-do list, and appointments. Compared to existing systems, Smart Reflect is designed to be simple, lightweight, and extensible. It does not require a lot of computational resources and can run on a Raspberry Pi. Our platform allows users to interact with a smart mirror through two interfaces. First, users can use a touchscreen mounted on top of a Raspberry Pi to write notes or control the smart mirror through a menu on the screen. Second, users can also use their mobile devices to access a web interface to configure the available plugins.

IV. HARDWARE

Raspberry Pi

Raspberry Pi is a credit-card sized computer which is a series of small single-board computers manufactured and designed in the United Kingdom by the Raspberry Pi foundation with the intention of teaching basic computer science to school students and every other person interested in computer hardware, and programming. The Raspberry Pi has a Broadcom BCM2837 system on a chip, which includes 4 ARM Cortex-A53 1.2 GHz cores as the processor, Video Core IV GPU and with 1 gigabyte of RAM. It does not include a built-in hard disk or solid-state drive, but it uses a micro SD card for booting and persistent storage. It also includes Bluetooth 4.1 Low energy and a 2.4 Ghz 802.11n Wi-Fi. The Raspberry Pi computer has come out with various versions over the years. Our project employs the use of Raspberry Pi 3 Model B. 10. A micro SD card is used to store the operating system and all the software related code for the project. The GPU provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode and is capable of 1Gpixel/s, 1.5Gtexel/s or 24 GFLOPs of general purpose compute. What's that all mean? It means that if you plug the Raspberry Pi 3 into your HDTV, you could watch Blu-ray quality video, using H.264 at 40MBits/s.

The biggest change that has been enacted with the Raspberry Pi 3 is an upgrade to a next generation main processor and improved connectivity with Bluetooth Low Energy (BLE) and BCM43143 Wi-Fi on board. Additionally, the Raspberry Pi 3 has improved power management, with an upgraded switched power source up to 2.5 Amps, to support more powerful external USB devices. Built specifically for the new Pi 3, the Broadcom BCM2837 system-on-chip (SOC) includes four high-performance ARM Cortex-A53 processing cores running at 1.2GHz with 32kB Level 1 and 512kB Level 2 cache memory, a Video Core IV graphics processor, and is linked to a 1GB LPDDR2 memory module on the rear of the board. The Raspberry Pi 3 features the same 40-pin general-purpose input-output (GPIO) header as all the Pi 3 going back to the Model B+ and Model A+. Any existing GPIO hardware will work without modification; the only change is a switch to which UART is exposed on the GPIO's pins, but that's handled internally by the operating system. The Raspberry Pi 3 shares the same SMSC LAN9514 chip as its predecessor, the Raspberry Pi 2, adding 10/100 Ethernet connectivity and four USB channels to the board. As before, the SMSC chip connects to the SOC via a single USB channel, acting as a USB-to-Ethernet adaptor and USB hub. There's no need to connect an external antenna to the Raspberry Pi 3. Its radios are connected to this chip antenna soldered directly to the board, in order to keep the size of the device to a minimum. Despite its diminutive stature, this antenna should be more than capable of picking up wireless LAN and Bluetooth signals – even through walls.

PIR sensor

The term PIR is the short form of the Passive Infra-Red. The term "passive" indicates that the sensor does not actively take part in the process, which means, it does not emit the referred IR signal itself, rather passively detects the infrared radiations coming from the human body in the surrounding area. When the Sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

LCD Display

A LCD is a flat-panel display or other electronically modulated optical device that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight/reflector to produce images in colour or monochrome. An LCD panel or Monitor placed behind the mirror is used to present to the user the desired interface. A monitor with HDMI-in. This will be the screen for the smart mirror, so whatever size we choose is how big our mirror will ultimately be. It should also power a USB device, so we won't need a second plug for the Pi.

Mirror

A special mirror known as a two way mirror or observation mirror is used in this project. A two mirror is special as compared to an ordinary household mirror. Unlike a household mirror, the two way mirror is not painted with an opaque colour on the back, instead its left untouched. This gives the property of the mirror being reflective one side and transparent/translucent from the other. Hence the two way mirror acts as mirror as long as there is no light send from the back of mirror. The glass is coated with, or has encased within, a thin and almost-transparent layer of metal (usually aluminium). The result is a mirrored surface that reflects some light and is penetrated by the rest. Light always passes equally in both directions. However, when one side is brightly lit and the other kept dark, the darker side becomes difficult to see from the brightly lit side becomes it is masked by the much brighter reflection of the lit side.

Frame

An enclosure is used to cover all the hardware behind the mirror so that the mirror looks as close as possible to a normal mirror. It provides the support for the mirror and all the other Components. It frames the glass and provides away for hanging the mirror on a wall. It has two parts: the front is painted. The back has two wooden bars on the sides that are used to hang the front part. IN the centre there is a support for the display and at the bottom there is the Raspberry Pi.

Microphone

One mode of interaction with the smart mirror is through microphones. Two microphones are used to power the voice recognition capabilities of the device. USB microphones has to be used because the Raspberry Pi does not have regular microphone input. The first microphone is a cheap simple one connected through a USB sound card to the Pi. The second microphone is actually a PS3 Eye camera that I had at home and that connects directly through the USB. However, only the microphone part of the PS3 Eye is being used. The voice recognition system works by listening for someone to clap with the first microphone and once that happens the second, higher quality microphone is triggered to listen for a voice command.

Power chord cable

A power cord, line cord, or mains cable is a cable that temporarily connects an appliance to the mains electricity supply via a wall socket or extension cord. The terms are generally used for cables using a power plug to connect to a single-phase alternating current power source at the local line voltage—(generally 100 to 240 volts, depending on the location). The terms power cable, mains lead, flex or kettle lead are also used. A lamp cord (also known as a zip cord) is a light-weight, ungrounded, single-insulated two-wire cord used for small loads such as a table or floor lamp.

HDMI cable

HDMI (High-Definition Multimedia Interface) is an exclusive sound/video interface for transmitting uncompressed video information and compacted or uncompressed computerized sound information from a HDMI-agreeable source gadget, for example, a show controller, to a good PC screen, video projector, advanced TV, or advanced sound gadget. HDMI is an advanced swap for simple video models. HDMI actualizes the EIA/CEA-861 models, which characterize video arrangements and waveforms, transport of packed, uncompressed, and LPCM sound, helper information, and executions of the VESA EDID. CEA-861 signs conveyed by HDMI are electrically perfect with the CEA-861 signs utilized by the advanced visual interface (DVI). No flag change is essential, nor is there lost video quality when a DVI-to-HDMI connector is utilized. The CEC (Consumer Electronics Control) ability permits HDMI gadgets to control each other when fundamental and permits the client to work different gadgets with one handheld remote control gadget. A few adaptations of HDMI have been produced and sent since beginning arrival of the innovation yet all utilization a similar link and connector. Other than enhanced sound and video limit, execution, determination and shading spaces, fresher forms have discretionary propelled components, for example, 3D, Ethernet information association, and CEC (Consumer Electronics Control) augmentations.

If road sign is detected, the RFID transmitter tag sends the data to RFID reader, then the RFID receiver receives **no entry sign** and it will be shown in the LCD display. This test experimental setup and results are shown in figure 5.

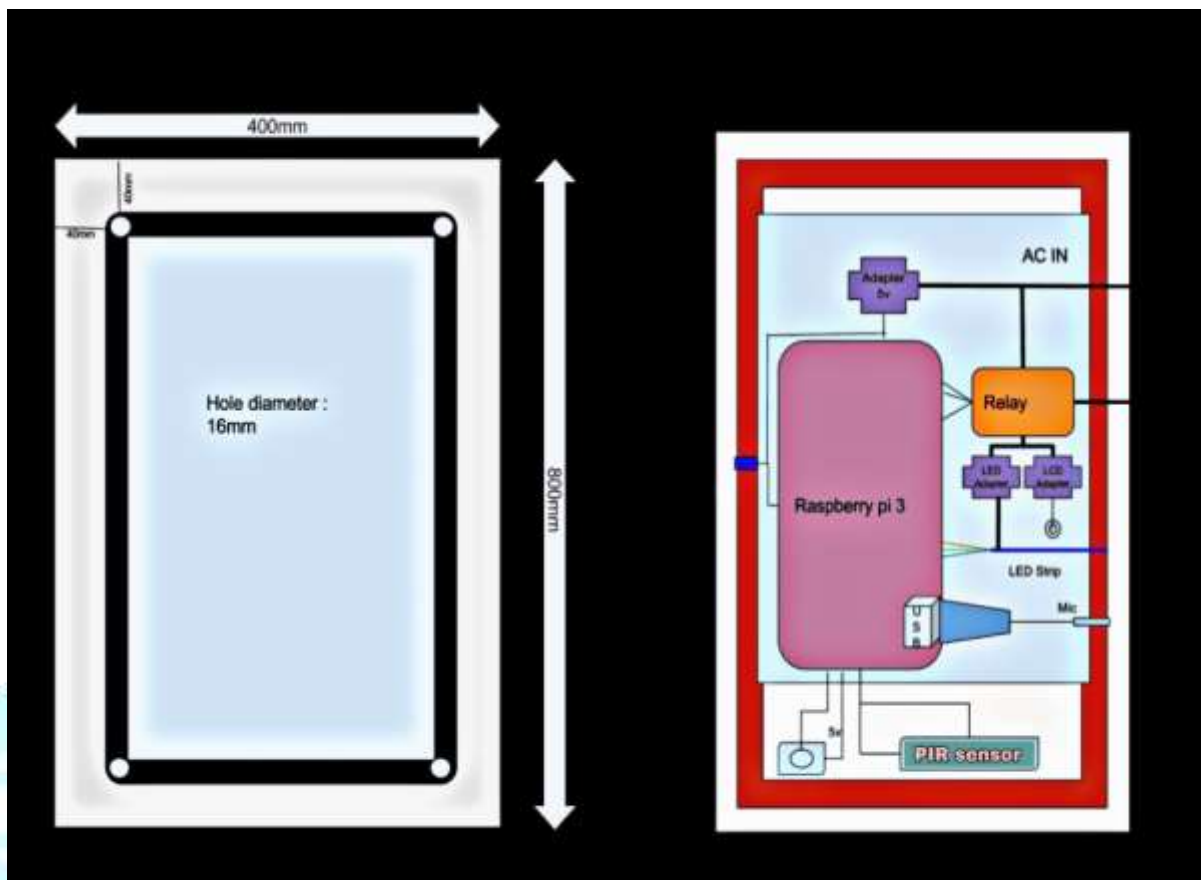


Fig.2 Hardware setup of Smart Mirror

V. SOFTWARE

Raspberry Pi

1. Download the Raspberry Pi operating system
 - a) Linux releases compatible with the Pi: <http://www.raspberrypi.org/downloads>
 - b) The recommended OS is Raspbian: http://downloads.raspberrypi.org/raspbian_latest
2. Unzip the file that you just downloaded
 - a) Right click on the file and choose “Extract all”.
 - b) Follow the instructions—you will end up with a file ending in .img
3. Download the Win32DiskImager software
 - a) Download win32diskimager-binary.zip (currently version 0.6) from: <https://launchpad.net/win32-imagewriter/+download>
 - b) Unzip it in the same way you did the Raspbian.zip file.
 - c) You now have a new folder called win32diskimager-binary.
4. Writing Raspbian to the SD card
 - a) Plug your SD card into your PC.
 - b) In the folder you made in step 3(b), run the file named Win32DiskImager.exe.
 - c) If the SD card (Device) you are using isn't found automatically then click on the drop down box and select it.
 - d) In the Image File box, choose the Raspbian .img file that you downloaded.
 - e) Click Write.
 - f) After a few minutes you will have an SD card that you can use in your Raspberry Pi.
5. Booting your Raspberry Pi for the first time
 - a) On first boot you will come to the Raspi-config window
 - b) Change settings such as time zone and locale if you want.
 - c) Finally, select the second choice: **expand_rootfs** and say ‘yes’ to a reboot
 - d) The Raspberry Pi will reboot and you will see raspberry login: Username: pi, password: raspberry
 - e) Start the desktop by typing: **startx**

f) The desktop environment is known as the Lightweight X11 Desktop Environment (LXDE)



Fig 3 Raspberry Configuration

Magic Mirror installation & configuration part I

- Rotate screen
- Autohide cursor
 - sudo apt-get install unclutter
- Disable screensaver
 - Can be difficult
 - Easy option: install xscreensaver and disable the screensaver
- Disable WiFi power save

Magic Mirror installation & configuration part II

- <https://magicmirror.builders/>
- Config files can be found at /home/pi/MagicMirror/config

Magic Mirror installation & configuration part III

- npm start
- Web view of mirror (good for remote testing)
- Update config file



Fig.4 Normal Mirror Function



Fig.5 Smart Mirror Output

IV. CONCLUSION

The Smart Mirror thus accomplishes this, by still being a mirror without all the technology inside it, making it very approachable to use and integrating seamlessly into our lives. The Smart Mirror has scope in the field of IoT and home automation. The Smart Mirror can be connected to the home appliances, mobile devices, etc. which can expand the functionality of the mirror. The facial recognition technology used can be future enhanced as a means of security. Adding security means that no one can try to access sensitive data that maybe displayed on your mirror via the use of APIs. We believe that the future of the home will be a brilliantly connected ecosystem of smart technology designed to make your life easier, more enjoyable, and efficient. Obviously there are a ton of opportunities in the home for technology integration but a mirror is one of the best places to start.

V. FUTURE WORK

As for future work, many new plugin opportunities are now available with the ability to access external hardware. It would be nice to explore various plugin ideas using motion detectors, temperature and light sensors, gesture recognition, face recognition, and some form of proximity detection, such as detecting the closest phone in range. Same way we can incorporate Google services so that we can access applications such as WhatsApp, Facebook for chatting purposes. Finally, research into the appropriate uses of a smart mirror is warranted. Mirror usage usually involves a local presence, with motion and visual interaction, and depends on the context and location of the mirror. Some locations may allow for more personal applications, while others to more generalized purposes for a large user base. People may develop different mental models about how a smart mirror works, which may shape their behaviour while interacting with it and raise issues, such as privacy and security. Understanding of user needs and expectations is key to successful deployment of smart mirrors.

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