**Chapter 1**

**INTRODUCTION**

With the introduction of system on chip (SOC), such as the Raspberry Pi, the notion of creating “smart devices” is a relatively new craze that has taken over hobbyist communities. One currently popular project using a SOC is the development of smart mirrors[1]–[3]. A smart mirror is a mirror with “smart” capabilities much like how cell phones have become smart. That is, it is a display that looks and acts like a mirror, but has the capability of displaying multimedia data through the mirror glass as if the mirror was a screen on its own accord. The major appeal of a smart mirror is that its physical design embeds a computational device in an ordinary piece of furniture that can integrate seamlessly into a home or working environment[4].

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.

Consequently, such smart mirror platforms are typically limited in the following ways. First, they are not truly modular. Plugin systems exist, but require JavaScript knowledge to en-able, disable, or configure plugins. Second, they use server-side solutions geared for web sites and RESTful (representational state transfer) API (application programming interface). The limitations of a RESTful API are inherent by the fact that users typically have no way of generating events to obtain data or to specify where on the server to obtain the requested data via natural mirror interactions. Third, the platforms are not inclusive for all programmers and programming methodolo-gies. Only JavaScript is supported, which is geared for event-driven programming. No solutions exist for supporting other programming languages with their vast libraries of features and user base, hence, fragmenting the potential pool of developers for extending smart mirror features.

That being said, a web browser is still a necessary feature for providing and displaying information, as it has built-in support for multiple media formats, such as text, images, and videos. The information presentation can be made interactive with JavaScript and is customizable with CSS (Cascading Style Sheets). Furthermore, hyperlinking and web connectivity allows for borrowing and sharing of resources.

We designed and developed SmartReflect—a smart mirror platform that offers three main benefits[5]. First, it is modular and extensible. Developers can add plug-ins to customize their smart mirror applications. Second, it utilizes a server design that allows one to sidestep a sandbox created by a web browser. In our prototype, we demonstrated this feature by enabling users to interact with a smart mirror through an external hardware interface. Third, it allows for plug-ins to be created in all programming languages in our case we use Python as the Programming Language. With these problems addressed, an extensible platform is attainable, allowing for growth in smart mirror application development.

As an everyday object at home, mirrors have great potential to serve not only as a reflective surface, but also as an interactive display as part of a smart home environment[6]–[11]. In home automation domain, a smart mirror is commonly used for displaying multimedia data, promoting healthy lifestyle, and controlling household appliances. The main ap-peal 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 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 face recognition[9], [11], [12], tag-based identification, biometric data, and personal belongings (e.g., toothbrush) [8]. 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 (for face recognition) may not be suitable for a smart mirror installed in a washroom due to privacy reasons.

**Chapter 2**

**LITERATURE SURVEY**

An advanced information society is now arising with the rapid progress of information technology. Information equipment, such as personal computers, mobile phones, and large-sized displays are essential to our daily life, and they enable us to seamlessly access various kinds of information anytime and anywhere.

1. **Smart Mirror for Ambient Home Environment.**

**Authors:** M. Anwar Hossain, Pradeep K. Atrey and Abdulmotaleb El Saddik

This paper describes the design and development of a futuristic smart mirror that represents an unobtrusive interface for the ambient home environment[9]. The mirror provides a natural means of interaction through which the residents can control the household smart appliances and access personalized services[10]. Emphasis is also given to ensure convenience in accessing these services with a minimum amount of user intervention. For example, face recognition-based authentication is used to automatically identify the user facing the mirror and provide widget-based interface to access data feeds and other services. Aservice-oriented architecture has been adopted to develop and deploy the various services, where the mirror interface, the appliances, and the news and data feeds all use web service communication mechanisms. The smart mirror functionalities have been demonstrated bydeveloping an easily extendable home automation system that facilitates the integration of household appliances and various customized information services[10].

1. **Information-Accessing Furniture To Make Our Everyday Lives More**

**Comfortable.**

**Authors:** Hiroko Sukeda, Youichi Horry, Yukinobu Maruyama, and Takeshi Hoshino

We present a concept for information equipment called information-accessing furniture[2]. We have developed an embedded module to be assembled into tables, mirrors, and walls. It can be easily assembled into furniture or other interior components because it is a package of information processing units, input/output units, and other optional units. This concept enables building information equipment designed to match a surrounding environment, and offers an intuitive interface to users, thus helping them to obtain information easily while doing routine activities[4]. We developed several different prototypes with embedded modules and studied their applications[1]. Some comments we received during interviews with end-users and interior designers are also presented.

1. **Interactive Multimedia Mirror System Design.**

**Authors:** Jun-Ren Ding, Chien-Lin Huang, Jin-Kun Lin, Jar-Ferr Yang.

This investigation describes a novel design and implementation of an interactive multimedia mirror system, called “magic mirror.” The magic mirror implemented in a personal computer is equipped with normal peripherals such as CCD camera, infrared ray devices, microphone, speakers, and an LCD monitor, which is further covered with a piece of general reflective glass[7]. The magic mirror integrates self-developed software, which includes speech recognition, speech synthesis, video detection, and 3D graphics to provide easy video and audio interactions. With Internet connections, the magic mirror can capture the instant weather, stock information, multimedia sources, etc[5]. By verbal comments, the users can easily activate personal multimedia services to provide visual information on display and verbal message from graphical genius. The magic mirror with emotion speech recognition and synthesis can be acted as a friendly agent, who can listen to your questions and automatically response the requests for information, relaxation, and consolation[6]. Besides, the magic mirror with video detection can perceive the human gestures and behaviors to achieve possible visual interactions.

1. **Smart Mirror: A Novel Framework for Interactive Display.**

**Authors:**Athira S, Frangly Francis, Radwin Raphel, Sachin N S, Snophy Porinchu, Ms.Seenia Francis.

Our lifestyle has evolved in such a way that optimizing time is the most important thing. Based on the user studies and prototype implementation, we present the development of an innovating appliance that incorporates interactive services of information, offered through a user interface on the surface of a mirror. Our work is based on the idea that we all looks at the mirror when we go out, so why wouldn’t the mirror become smart. The framework will offer basic services, like the presentation of personalized weather data, time, date and will incorporate some additional functionality, like reminder service by mobile synchronization and through social media[10]. Our framework is based on detecting presence of human using Passive Infrared sensors and Wi-Fi connectivity. Once a person comes in front of the mirror, it displays the information that is being fed from the web[8]. This data or information includes calendar, time, weather, news feed, notifications and so on. Our framework also discusses about the speech recognition and its application in control mechanism in home appliances and opening and closing of shelf[16]. We use speech recognition to automate many tasks that usually requires hands-on human interaction, such as recognizing spoken commands to perform something like turning on lights or shutting a door. Our framework also introduces speech activated music player, and plays the music when a person gives a command.

1. **The WebSocket Protocol.**

**Authors:** Alexey Melnikov, Ian Fette.

The WebSocket Protocol enables two-way communication between a client running untrusted code in a controlled environment to a remote host that has opted-in to communications from that code[13]. The security model used for this is the origin-based security model commonly used by web browsers. The protocol consists of an opening handshake followed by basic message framing, layered over TCP[13]. The goal of this technology is to provide a mechanism for browser-based applications that need two-way communication with servers that does not rely on opening multiple HTTP connections (e.g., XMLHttpRequest or <iframe>s and long polling).

**Chapter 3**

**PROBLEM STATEMENT**

Smart mirrors can respond to user commands. Interaction methods supported by smart mirror systems include touch, voice, gestures, and physical widgets. Each method has its own strengths and weaknesses. For example, speech recognition software may perform poorly in a noisy environment. Therefore, using voice commands in a public space may not work well due to its high noise level.

* Smart Mirrors generally require a lot of computational resources, to process real time data and to transmit and receive data from the databases.
* Configuring the smart mirror each time is a long process as there is no remote access, and each time the user has to go upto the mirror to reconfigure the data which is displayed.
* Smart Mirrors use processors which lack extensibility and are big in size.

**3.1 Existing System**

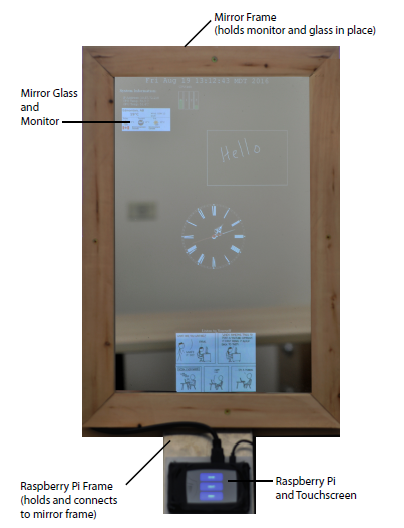
* Currently a common approach to building a smart mirror is to use a pane of two-way glass, a monitor, a frame to hold the glass and monitor, and a web browser with JavaScript to provide the software features and drive the display. The main limitation of this setup is related to the use of a browser 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.
* 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.

**3.2 Proposed System**

* The proposed Smart Mirror is modular and extensible.
* Also it utilizes a server design that allows one to sidestep a sandbox created by a web browser.
* In our System we demonstrated this feature by enabling users to interact with a smart mirror through an external hardware interface. Developers can add plugins to customize their smart mirror applications.
* Interaction with external hardware interface allows for plug-in to be created in all programming languages.
* 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 mobile devices to access a web interface to configure the available plug-in.
* Our platform follows the Model-View-Controller (MVC) design pattern. The Model refers to plug-in that manage data to be displayed. A plug-in may retrieve data from third-party data resources.
* This design decision allows for the separation of concerns and defines the user space for each plug-in with regard to each other contributing to an overall modular design.
* Communications between plug-in, the server, and plug-in clients in the browser are all handled through the WebSocket protocol . WebSocket 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 plug-in and the server to make rapid and multiple API calls that are necessary for a real-time dynamic display.

**3.3 Scope of the System.**

* The Raspberry Pi model 3B is used as the computational device.
* The Raspberry Pi supports a micro SD card which can be mounted as a secondary memory device(ROM) to hold the Operating System.
* A Two-way mirror placed in front of the monitor’s display acts as a reflective glass.
* The two way mirror acts as a mirror as well as allows the user to see the data being displayed on the monitor.
* The content to be displayed on the monitor is presented in the form of plug-ins.
* Each plug-in has a directory of its name in the ROM.
* A plug-in directory will usually consist of a .css, .js, .html, and .conf files.
* Users can add/remove/reconfigure Plug-ins remotely from an external device such as a SmartPhone, Tablet etc.



**Fig 1. Diagram of our smart mirror prototype.**

**Chapter 4**

**SYSTEM REQUIREMENTS SPECIFICATION**

A system requirements specification (SRS) is a description of a software system to be developed. It lays out functional and non-functional requirements, and maybe include a set of use cases that describe user interaction that the software must provide. The software requirement specification document enlists enough and necessary requirements that are required for the project development.

**4.1 USER ROLES:**

A user role defines permissions for users to perform a group of tasks. User roles also determine the access level or permissions of a person authorized to use the particular document.

There are two types of users for the Smart Mirror,

**PROGRAMMER:** A user proficient in Programming Languages who can modify, extend or develop the code which in our case is in Python Language.

**GENERIC USER:** A user who uses the mirror for everyday activities and takes full benefit of the extra features of the Smart Mirror without having to worry about the inner functionalities of the Smart Mirror.

**4.2 HARDWARE REQUIREMENTS**

Set of requirements defined by any operating system or software application in the physical computer resources is known as hardware requirements.

* Display Device : A wifi enabled Monitor.
* Reflective Surface : A two-way mirror, fit to the size of the display.
* Frame : Thin wood to build a mirror frame.
* Processor : Raspberry Pi.
* Input device : A keyboard for initial setup.
* Other : WiFi USB dongle, HDMI cord, power supply.

**4.3 SOFTWARE REQUIREMENTS**

Software requirements is a part of software engineering that deals with establishing the needs of the users that are to be solved by given software.

* Operating System : Linux (Raspberry Pi compatible).
* Coding Language : Python(Package).
* Web Server : Apache.
* Drivers : WiFi Drivers to Raspberry Pi.

**5.3 Flow Chart**

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**DECLARATION BY THE STUDENTS**

We do hereby solemnly affirm to declare that, the contents of the project report submitted by us (like the idea, concept, diagrams, figures, videos etc.) to the Department of CSE of City Engineering College, Bangalore, Affiliated to VTU, Belgaum, Approved by AICTE New Delhi & Approved by GOK, is in majority the courtesy by the referred "National/International Journals", text-books, papers presented and published by the learned authors in the area of their research and also available in the public domain. We sincerely acknowledge all of them.

This report has been submitted by us to satisfy the academic requirement by the affiliating university for the Award of Bachelor's Degree in the discipline of our study.

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