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Design & Development of Smart Mirror Displaying Real-Time Sensor Data

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***Abstract*— People in the world today must be connected and ready for easy access to information. The Internet of Things means that computer devices that are integrated in everyday objects can be connected to send and receive data via the Internet. It is an interactive, futuristic multimedia Smart Mirror with artificial environmental intelligence and commercial applications in different industries. The research that would collect machine data and data from the machine in the real world would be transmitted. In this research work implemented a customized digital device with peripherals such as RPi, temperature sensor, LED monitor and offers modules such as university campus notice board updates, holidays, emails, local temperature and humidity corresponding to the location etc, that device is called smart mirror. This paper describes the design and development of smart mirror that makes our daily life easier and time efficient.**

Keywords-Smart Mirror; IoT; Raspbian; Artificial Intelligence; Python

I. INTRODUCTION

Day after day, due to various wirelessly connected embedded devices, people are moving towards a more automated and connected world. They are responsible for changing and improving living standards and quality. Many devices are being developed that use concepts of multimedia communication, artificial intelligence, Internet of Things to revolutionize the daily work at home, in offices or even in industries[1]. Smart home is a connected home that connects all types of digital devices through the Internet. Our lifestyle has developed so that optimizing time is the most important thing. This research paper is based on the idea that people's look at the mirror when they leave, so why not make the mirror smart.

This paper describes an idea of making home smart to save time. The Internet has transformed user lives by connecting us more easily to information and other people in the virtual world. The state of innovation is to provide more information with less interaction to achieve it. The device being researched and designed is called "Smart Mirror". Smart Mirror is a wall-mounted mirror that displays relevant user information such as time, weather forecasting, temperature, news updates, e-mails and other areas of interest.

The Internet of Things (IoT) is a term used to describe "technologies, systems and principles of design relating to the emerging wave of connected things based on the Internet physical environment". It refers to a network of unique identifiable objects and their virtual representations in a network-like structure that can collect and exchange data and are remotely controlled through existing network infrastructure. It consists key elements such as sensing, security, privacy, applications and services.

Artificial Intelligence (AI) is the computer science branch that emphasizes the development of machines for intelligence, thinking and working like humans. For example, speech recognition, problem solving, voice to text features, learning and planning. Smart Mirror offers some basic AI features, such as real- time user interaction, etc[2].

Smart mirrors can also be useful to quickly view Google feeds or access Gmail accounts. The Smart mirror would help to develop intelligent houses by using artificial intelligence and finally finding a place in industries[3].To create the display page, the mean stack method and JavaScript is used on both the client and the server side[4].

Finally, the mirror must be sufficiently clever to protect against the wet and humid conditions in each bathroom. It will have a moisture protection system that monitors the temperature and humidity levels in the area of the hardware. If the temperature or humidity level is outside the safe range of operation, a fail-safe system will either correct or shut down the system to prevent damage. In this way, the research paper proposes an intelligent mirror as a solution to optimize people's time before starting their day. Provide relevant information to connect them to today's world. The smart mirror provides an almost effortless experience that allows the user to simply walk up and receive information [5].

II. LITERATURE REVIEW

The projects and products of our smart mirror project cover a wide range of functions and goals. The design of a 'smart mirror' is designed to implement technology into a traditional home mirror and make it smart, leading to a new definition of an intelligent mirror: "a smart mirror is a mirror with additional features and functions to introduce human interaction capabilities"[6].

The project that would retrieve real world machine data and data from the machine would be transmitted and managed by the Raspberry Pi[7].Users will be able to obtain minute updates of the latest news and public headlines, weather reports and receive reports of their interests for personalized information services[8].

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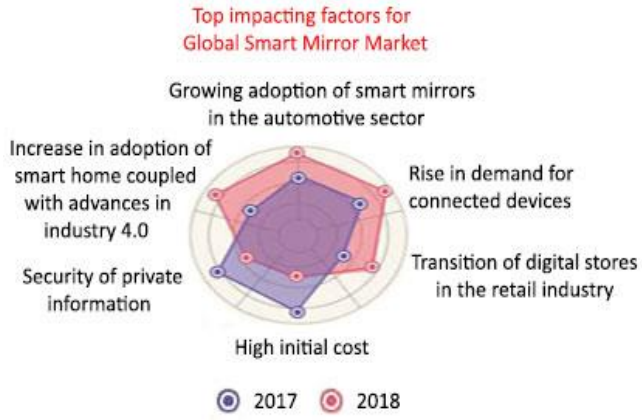

Figure 1. Global Smart Mirror Market[9]

A. Related work

Interactive Mirror is the functional mirror created by Alpay Kasal and Sam Ewen based on touch and gesture. The user can touch the mirror and control the services. Basically, the mirror is lower in data and high in art. Some of the functions are also handled by the mouse, but the Smart Mirror is used daily to know the date, time, and news[10].

NEOD Framed Mirror TV is a standard LCD screen (up to 50 inches), covered by a mirror, and specifically designed for the screen. The screen provides some TV functionalities, but it does not provide more interactive features[11].

In 2017, a company called the **New Kinpo Group** launched their take on the intelligent mirror called Hi-Mirror. This intelligent mirror has a camera for monitoring the health of the skin. The mirror scans the skin and let's know what to improve. The mirror uses facial recognition to record the skin firmness, texture, clarity, luminosity and health of a user every day[12].

At the 2017 CES convention, **Griffin Technologies** unveiled their take and it serves as the smart home hub for a number of Griffin Technologies smart home appliances. The mirror can display local time and weather, phone notifications their take on the smart mirror. The mirror does not use any user recognition, but the interface can be customized via a smartphone app to control any other Griffin smart home devices[12].

V. Ramya et al. talked about a secure and energy - efficient wireless industrial automation system based on Raspberry Pi technology. It handles industrial equipment, manages power utilities, and supervises employee activities. All of these are done with the help of the PC server via Wi-Fi network. This server PC is protected by password and can be opened only by the authorized person. They focused primarily on reducing the consumption of electricity and informing people to critical industry situations. This system protects further accidents and provides greater security and privacy for organizations like industry, education, and hospitals[13].

B. Existing Systems

Smart mirrors can take user commands into consideration. Smart mirrors are mainly developed for the purpose of displaying time, date and weather forecasts[14].Some also contains news, weather forecast, etc. It can therefore be customized according to the requirements.

III. PROBLEM FORMULATION

In our rapidly growing world, information is always right on the phone, computer and maybe even on watch. Keeping connected with new information is important both for entertainment and daily life.

TABLE I. COMPARISON OF EXISTING SMART MIRRORS [15]

Feature	Microsoft's Magic Mirror	Ekko Smart Mirror	Apple Mirror Rafael Dymek	Nuovo Smart Mirror	Perseus Smart Mirror	Nakes 3D Fitness Tracker
Platform	Windows 10	Customized	iOS 10	Android	Customized	No
App Requirement	No	Yes	Yes	Yes	No	No
Voice Recognition	Yes	No	No	No	Yes	No
Touchscreen	No	No	Yes	No	No	Yes
Gestures	No	Yes	No	No	No	Yes
Fitness	No	No	No	No	No	No
Music Support	Yes	Yes	Yes	Yes	Yes	No
Video Support	Yes	Yes	No	Yes	Yes	No
Automatic Sleep	No	No	No	No	No	No
Weather	Yes	Yes	Yes	Yes	Yes	No
Map	Yes	Yes	No	Yes	Yes	No
Social Networking	Yes	Yes	Yes	Yes	Yes	No

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TABLE II. COMPARISON OF RASPBERRY PI AND MICROCONTROLLER

S.No.	Microcontroller	Raspberry Pi
1.	Simple computer that are application specific	Minicomputer or mini-CPU, which works with Linux Operating System
2.	One program can be run at a time	It can handle multiple programs running simultaneously
3.	Internet connectivity is difficult	Internet connectivity is easy as there is built-in Wi-Fi and Ethernet port
4.	1 USB port	4 USB ports
5.	Programming language C is mostly used	Programming language used C, C++, Java, Python, PERL, etc.

IV. PROPOSED SYSTEM

The proposed intelligent mirror system aims to provide users with an interactive interface for simplified and personalized services in the comfort of the home of the user. It is a smart and user friendly solution in the form of a mirror that also acts as a gateway to interactive services, especially information oriented services, such as multimedia and news feeds, among others.

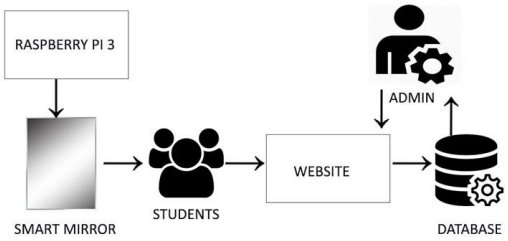

Figure 2. Flow Design

The mirror is ultimately a technologically increased interaction device. The aim of the mirror design is to provide a natural interface for access to various services in the home environment[16].The aim of this model is to create an interactive interface that can be conveniently used in the home and commercial space. Different services can be accessed, such as time, date, calendar, emails, news updates, temperature, etc., as well as access to YouTube videos, maps, etc. Many devices are now emerging on the basis of this technology and offer comfortable, secure and convenient personal services everywhere with this intelligence.

In general, they are still simple reflective surfaces we use to toilet, decorate and occasionally interrogate the room[17].

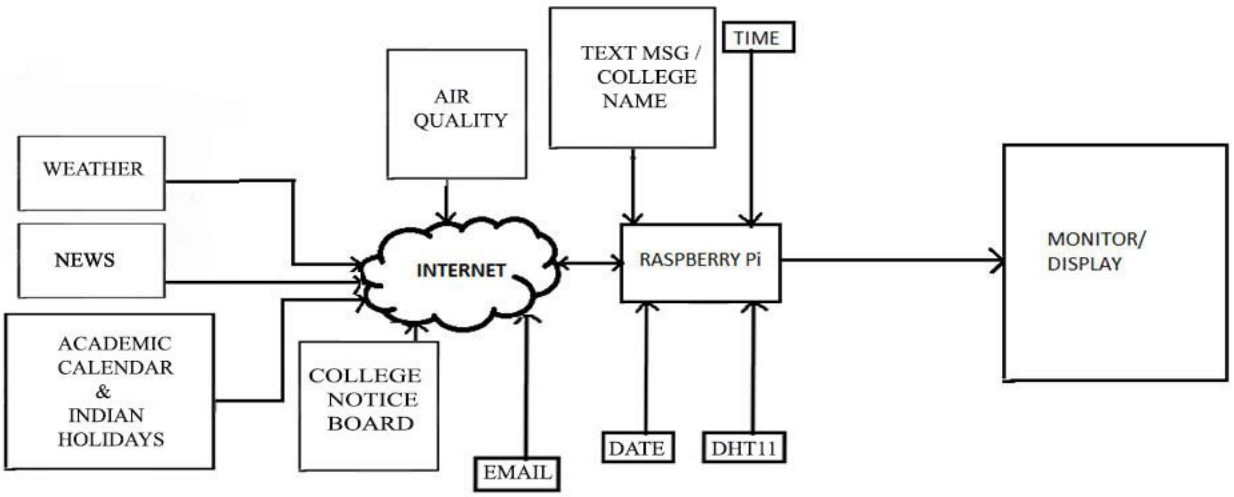

Figure 2. Architecture of Smart Mirror

V. PLATFORMSELECTION

Platform Selection basically deals with the selection of the following two major categories involved:

A. *Component Selection*

Component Selection basically deals with choosing the best component for the project as per the requirements. This is done in order to avoid the unnecessary problems due to bad choice of component selection. Thus, component selection for a project may include selection of:

- *Soc:* A system on a chip or system on chip (SoC or SOC) is an integrated circuit (also known as an "IC" or "chip") that assembles all components of a computer or other electronic systems.
- *OS:* The OS for such projects must be customized according to the requirements of the project and must be compatible to the Soc selected.
- *Sensors:* A sensor is a device with the purposes of detecting events or changes in its environment and sending the information to other electronic devices, eg. DHT11, PIR sensor, etc.
- *Communication Modules:* Various communication modules are available to provide communication capabilities to the Soc like Bluetooth, GSM, Wi-Fi, etc.
- *Display:* Display may include devices as a part of I/O peripherals to show output which may include monitors, LCD, Two-way acrylic mirror, etc.

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- *Programming language:* A programming language is an important part while developing a project as its ease of development makes the project as per needed.

TABLEIII.COMPONENTSELECTION

Components	Selected Component
Soc	Rapberry Pi 3
Os	Customized Raspbian OS
Communication	GSM, Bluetooth, Wi-Fi
Display	Two-way acrylic mirror, LCD
Programming	Python
Sensors	DHT11, PIR

VI. DEPLOYMENT AND RESULTS

The proposed system was deployed at Embedded Lab in Department of Computer Science, IGDTUW under the supervision of Mr. Indra Thanaya. For testing and validation purposes, testing was performed in the college premises with all the project staff and interns of Embedded System Lab itself.

It was showcased at the campus for visiting students to take valuable feedback regarding its effectiveness in learning purposes and found to be quite efficient in terms of its usability. Also, it has been showcased to several other places, where it was greatly appreciated.

For analysis of implementation two major things are being considered while deploying the smart mirror.

- **Hardware Design:** It is a very significant issue to be considered while analyzing a hardware device. In front of an LCD monitor, a two-way mirror is placed. Thus, when not currently in use, the system can act as a mirror, while when in use, the LCD projects through the mirror. The heart of the product, the Raspberry Pi, is located behind the LCD panel, connected to the LCD for visual display. The Raspberry Pi runs our software and we can also connect for web services to the Internet.
- **Software Design:** The project's goal is to create an open development platform, and all software components must fit that goal. The software is designed to run on multiple platforms and fit many types of displays.

VII. CONCLUSION

The hardware is simple and elegant enough to show our structure of the widget. Our real focus was on designing our overall class widget structure. Our final project has some widget class demonstrations like the weather widget and the RSS feeder widget. While these widgets are simple, they do demonstrate the feasibility of creating most JavaScript ideas. Our platform can now support simple JavaScript applications and can be run on more than just our current hardware model due to its scalability.

We originally aimed to create a mirror that would serve both developers and general consumers as a personal assistant. However, together with the vagueness of such a complex concept, the sheer scope of the idea forced us to rethink our idea into a more viable option. We hope that maybe more work and more effort can be added in the future, either by us or others, to improve our platform further.

VIII. FUTUREWORK

We can add a number of modules like traffic updates, flight updates, etc. to make it more efficient. Also, one can add any number of sensors and modules to increase the functionality of the Smart Mirror. Work could be done to minimize its hardware components and make it as compact as possible, so that it is easily portable and efficient in terms of performance as well.

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