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Research Paper

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A Comparative Study and New Model for Smart Mirror

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Abstract- This paper shows a comparison and design of a smart device – Smart Mirror. The smart mirror discussed here is mainly for home environment. This paper highlights some of the smart mirrors from different companies. These smart mirrors are not widely used due to cost or high requirements of hardware. The proposed smart mirror will be operated by Raspberry Pi and will be connected by real world through internet. The smart mirror will consist Raspberry Pi, LED monitor, speakers, camera, microphone with two-way mirror and acrylic glass. With the help of voice recognition api the mirror will communicate with the user through voice commands and responds them accordingly. The mirror could also support human gestures. The mirror will highlight some basic amenities like time, local news, weather. The mirror will also perform some advance functions such as booking a ride on Uber, face recognition, etc. This mirror with artificial intelligence will provide an extraordinary experience to the user.

Keywords- Artificial Intelligence, Raspberry Pi, Smart Mirror, Machine Learning, Home Automation

I. INTRODUCTION

Heterogeneous computing devices with wireless connectivity which embeds everyday objects are being used in different activities are providing a whole new experience. The interactive computing, voice technologies, artificial intelligence [12] are providing ease in the life in very secured and convenient way. In every house there is a mirror and we look at the mirror everyday and find out how we look. The smart mirror is a modification over a normal mirror with interconnected smart devices and technologies with embedded intelligence which offers advance functionality such as time, news, weather, booking an Uber ride, displaying maps. This mirror will help in developing smart homes and provide a unique environment to the users. Machine Learning [5] will provide self-learning and self-adapting features to the mirror which will keep the mirror updated and more responsive. The mirror will
also consist some sensors which help mirror to activate and to display some animations during and ideal condition. The live facial recognition will be helpful for live zoom in and zoom out. This will also perform some live editing with the pictures.

Rest of the paper is organized as follows, Section I contains Introduction for the smart mirror, Section II contains Related Work for the smart mirror, Section III contains Methodology for the proposed smart mirror, Section IV contains Results of the comparative study and Section V concludes research work with future directions.

II. RELATED WORK

In the late 1990s, Eli Zeikha and his team at Palo Alto Ventures presented a vision for the future known as Ambient Intelligence (AmI) [1]. This vision is for the time frame 2010-2020. This vision leads industry for developing smart environments. The vision is that to develop an environment and natural interface which consists unified heterogeneous computing devices connected with everyday objects. This environment can recognize and responds to the user's actions. This environment uses different types of smart technologies like networking, voice recognition, facial recognition, artificial intelligence, machine learning, sensing, reasoning, etc. [12]

This AmI environment provide security, convenience and efficiency to the users. The functionality that are generally used in AmI are:

1. Embedded- Heterogeneous devices are integrated in the network to form an environment.
2. Context aware: All these devices can recognize us and our situational context.
3. Customization: All these devices can be customized as per the user need.
4. Adaptive: Through machine learning these devices can adapt our nature and behavior and responds as per the need.

The technologies that can be used to enable AmI environment are:

1. Bluetooth
2. RFID (Radio Frequency Identification)
3. Sensors
4. Software Agents
5. Nanotechnology
6. Biometrics
7. Artificial Intelligence

The AmI provides home automation, socialization, entertainment, etc. Our intentions are to develop a smart mirror for AmI environment. In this paper we had proposed the design and development of the smart mirror. The whole idea has been discussed in the IV section of this paper.

Today smart homes and virtual assistant are trending among the people. Amazon, Google and Phillips are presenting their advance technology in the field of smart home or AmI. People are excited too for their amazing products and for these futuristic devices. Phillips HomeLab is a leading company for creating digital home environments. Interactive mirror is one of their project for home environments. This mirror supports playing music or videos. This mirror consists a normal mirror on a LED which performs the playback feature.

There are different kind of smart mirrors that are being proposed or available in the market. Some of them are discussed below:

1. Microsoft's Magic Mirror
This mirror is proposed by Microsoft in 2016. This smart mirror works on Windows 10 IoT Core on Raspberry Pi 3. This is powered by Windows Hello cognitive services. This was an open source project. Its web app was made open to GitHub repository so that anyone can build its own smart mirror. The mirror shows traffic updates, weather and supports voice recognition.

2. Ekko Smart Mirror
This smart mirror runs on their own linux based platform on Raspberry Pi and it required an installed app on the user's smartphone. It also has sensors which could recognize the gestures of the user. Other than highlighting news, weather and time, the user can also play videos and music.

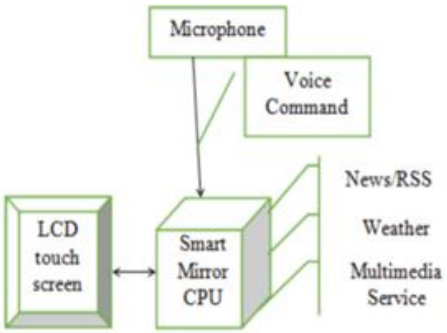
3. Apple Mirror (Rafael Dymek)
This smart mirror prototype is based on iOS 10 that mirror the iPhone display. The mirror can launch all the mobile apps desired by the user. This mirror sleeps after every 45 seconds of ideal situation. This is a touchscreen smart mirror.

4. Nuovo Smart Mirror
This android based smart mirror required an android application on the user's smartphone. The mirror supports music and videos playback. This mirror also supports features like weather, maps and the social networking like Twitter, Facebook, etc. The auto sleep mode is also supported by the mirror.

5. Perseus Smart Mirror
This smart mirror runs on the separate platform on Raspberry Pi. This mirror doesn't require any application on the smartphone. This mirror is available in different sizes. This mirror supports music, videos and social networking.

6. Naked 3d Fitness Tracker
This mirror consists a huge number of sensors which reads a 3d scan of the body and checks for any formational abnormality. It also senses the area of the body which is prone to an injury. Its also suggests workout plans to be fit.

A typical structure of a Smart Mirror



A Detailed Comparison of Mirrors

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

III. METHODOLOGY

We plan to design and develop such kind of futuristic smart mirror which provides a whole new experience to the user with the flavor of AmI. Our proposed smart mirror consists a two-way mirror, acrylic glass, monitor (LED), Raspberry Pi, Raspberry Modules, sensors.

A wooden frame will be prepared with LED attached behind the glass with all the sensors and the raspberry pi. The power supply is attached to the raspberry pi which will power the LED monitor and the sensors.

Once the mirror is activated, it will connect to the docker which contains all api and software needed to run the mirror. This will require internet access which will be provided by the wi-fi module (LAN can be also used) on the raspberry pi.

The virtual layout that will be prepared using HTML and CSS will be displayed on the mirror when it is turned on and will show calendar, weather and news headlines. The docker will contain the api of Alexa (virtual voice assistant from Amazon) that will respond to the user's voice.

The mirror will perform facial recognition which will be helpful for real time image zoom in and out. This will be one with help of OpenCV and some java programming.

The software will be programmed on java and python and Node.js will be used as a server-side language. The proposed smart mirror will perform some advance features that are discussed in the V section of this report. The proposed smart mirror will perform these tasks:

1. A normal two-way mirror and acrylic glass will display real time image.
2. After activation the mirror will display weather, time and news.
3. The mirror can play music and videos.
4. The mirror can zoom in and out real-time images.
5. The mirror will automatically sleep if a person disappears from front with the help of sensors.
6. The mirror can be used as displaying moving images and animations in case of ideal situation with the help of sensors which will detect the presence and absence of any person in front of the mirror.
7. Through Uber api, the mirror can book a ride on Uber.
8. All the social networking websites or apps can be accessed with the voice.
9. The mirror can perform real time photo editing.
10. The mirror can be synced with other devices which leads to the home automation.
11. The mirror also supports multiple user's profile.
12. YouTube videos are also supported by the mirror.

IV. RESULTS

As we had seen in the comparison table that every mirror is working on different technologies and platforms. These mirrors also differ in functionalities and users. We had

proposed a mirror which works on common architecture and also had all the required functions for users.

V. CONCLUSION

We had proposed the comparative study and a design of a futuristic smart mirror which could be great device for ambient home services. Speech recognition is one of the major advantage of the mirror. Live animations will make the bathroom more fashionable. The proposed smart can be easily extended for some other frameworks like making phone calls. In future this mirror can be used to build smart home network with devices such as lights, virtual assistant, TV, music system, refrigerators, etc. can be integrated together. This would lead to real smart home.

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