International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **05** Special Issue **01** | **2020**

The Implementation of HMI based Smart Mirror using ARM Processor

Omkar S. Vaidya[1], Gitanjali Jain[2], Sanjay Gandhe[3], Gayatri Phade[4]
[1] *Assistant Professor, Dept. of E&TC Engg., Sandip Institute of Technology & Research Centre, Maharashtra, India*
[2] *PG Scholar, Dept. of E&TC Engg., Sandip Institute of Technology & Research Centre, Maharashtra, India*
[3] *Professor, Dept. of E&TC Engg., Sandip Institute of Technology & Research Centre, Maharashtra, India*
[4] *Associate Professor, Dept. of E&TC Engg., Sandip Institute of Technology & Research Centre, Maharashtra, India*
Savitribai Phule Pune University, Pune

ABSTRACT

The Human-Machine Interface (HMI) mirror has artificial intelligence (AI) and able to interact with people immediately. The intelligent mirrors mark remarkable impact in the future technology which provides services to its users. The HMI smart mirror project consists of observable mirror, ARM processor, camera and LED screen. The ARM Processor can be connected to the cloud and take data from internet to show the information on mirror. In this paper, the HMI intelligent mirror system consists of weather prediction, date and time, clock, locus information, news feeds, user information can be taken from web browser using python which provide software attribute and operate display. For security purpose intelligent mirrors has designed with the help of face and speech recognition systems.

Keyword: *- Artificial intelligence, ARM processor, Human Machine Interface (HMI), Python.*

1. INTRODUCTION

Now a days, science and technology are more bothered about scheming and developing technology that can bring relief to human life and make it more comfortable. The internet changes our life by linking us to the information and other people to virtual world. The proposed system that has been designed and schemed is known as "Smart Mirror".

The Fig. 1 shows the different modules on the mirror.

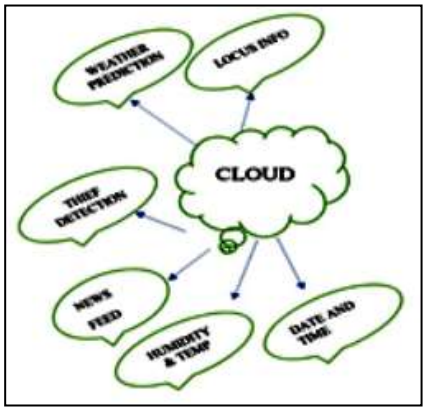

Fig -1: Modules on the Mirror

This proposed system evolves with the purpose of making homes smart to save time. It is a wall mounted and portable mirror which displays suitable modules to the user such as weather prediction, date and time, clock, locus information, news feeds, user information, temperature, humidity. For security purpose intelligent mirrors can

be controlled by face and speech recognition systems. Convolutional neural network for face recognition and robust for speech recognition are the authenticated systems used to detect multiple users.

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The HMI smart mirror consists of observable mirror, ARM processor, camera and LED screen. The two way mirror is the mirror which is reflected on one side and transparent on other side. There will be a webcam behind the transparent side so that it can capture and identify faces for security purpose. The LED monitor is used for displaying the different widgets on the mirror.

The paper is structured as follows: Section II describes the developed techniques by researchers that are relevant to topic of research. Section III gives block diagram, design of speech and face recognition and flowchart of proposed system. At the end, the paper is concluded in Section IV.

2. LITERATURE SURVEY

The related work on this proposed system has remarkable number of technologies that takes user towards artificial intelligence.

B. Cvetkoska et. al. introduced the future technology which has Intelligence in the form of Intelligent mirrors IIIwhich is an amalgamation of both the computer aided information services and mirror being provided to the user as a user interface [1]. D. Gold et. al. introduced Intelligent mirrors, which continue the works today and will take its place in the future technology, provide both mirror and computer aided information services to its users [2]. S. Athira et. al. developed the design of an interactive multimedia futuristic Smart Mirror with artificial intelligence for the ambient home environment as well as for commercial uses in various industries in [3]. Khurd et. al. introduced the term Internet of Things (IoT) is related with the connection of physical devices through Internet. The 'thing' in IoT could be anything that has the ability to collect and transfer the data over a network without any human's assistance [4]. Vaibhav Khanna presented a bilateral multimedia smart mirror with AI for the home environment as well as for business used [5]. Divyashree K. J. developed the mirror which can control lighting in the room lot a single point of control for electronic things in the room [6].

Authors in [7] designed fully automated smart mirror display with human computer interaction which uses mobile phone through WLAN network for different functions like home appliance control, security monitoring, leisure entertainment etc. Sun Yong et. al. developed smart mirror which is composed of STM32F030C8T6 microcontroller, plasma display and raspberry pi which is connected to network through WiFi in [8] which realizes functions like voice playback, room lightning control at remote location, speech and face recognition.

Researcher in [9] developed human machine interaction using Sonus Technology as part of smart mirror and tested various cases such as running the system, configure the PI, configure the sound, configure the voice and control the lights and allow enabling motion detection. Fatma Ok et. al. designed Raspberry Pi3 controlled hardware with software for smart mirror application which received audio signal with commands from the internet display of received data (weather, news etc.) and camera application in [10].

3. SYSTEM DEVELOPMENT

The smart mirror is an assembly of ARM processor, two way mirror, LED monitor, camera and microphone. The block diagram of proposed system is shown in Fig. 2.

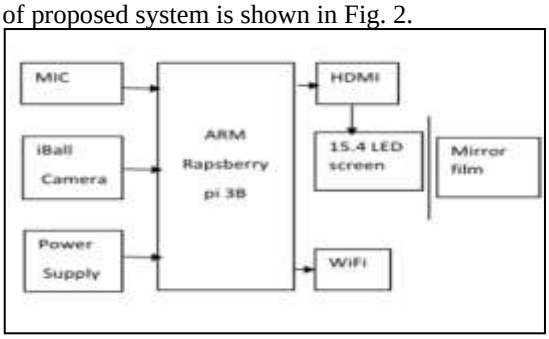

Fig -2: Block diagram of proposed system

There are two-way mirror which is reflective on one side and transparent on the other side. There is a webcam behind the transparent side mirror so that it can capture and identify faces for security purpose. The LED monitor is used for displaying different widgets on the mirror. The LED monitor is connected to the Raspberry pi. The Raspberry pi 3B [11], [12], [13] is used as controller which controls all functions of smart mirror and used for programming of different widgets using Python language. The Raspberry Pi 3 is powered by + 5.1V micro USB supply.

3.1 Design of Hardware System

1. Raspberry Pi Processor: The Raspberry Pi 3B is more powerful processor, ten times faster than the first generation raspberry pi. Wireless LAN and Bluetooth connectivity is used as apt for powerful connected designs. The Raspberry Pi 2 uses a 32-bit 900 MHz quad-core ARM Cortex-A7 processor while Raspberry Pi 3 uses a Broadcom BCM2837SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache. The Raspberry Pi 3B boasts a 64 bit quad-core Cortex-A53 processor running at 1.4 GHz, dual band 2.4GHz and 5GHz wireless LAN and faster Ethernet [14], [15] and [16].

2. Web Camera: A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. A simple Webcam setup consists of a digital camera attached to computer, typically through the USB port. The webcam has finest CMOS sensor, sensor resolution is 300k pixels, 5500 x 3640 pixels is maximum image resolution and 1600 x 1200 pixels is maximum video resolution.

3.2 Design of Software System

1. Convolutional neural network for Face recognition:

The procedure of face recognition starts with two image sets: gallery and reference set as shown in Fig. 3. The reference-based descriptor for the probe image is created by calculating the similarity between the probe and reference set images. The gallery images are catalogued based on the similarity scores between reference-based descriptors of the probe and gallery images.

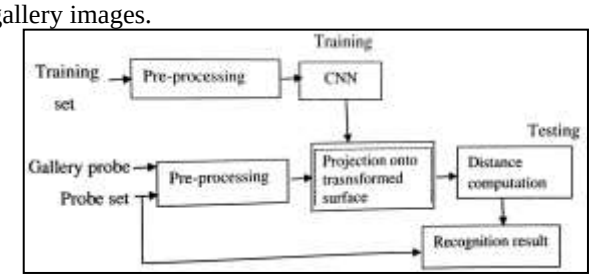

Fig -3: Block diagram of Face Recognition

Each probe image is matched against those in a gallery, and the catalogued matches can be analyzed to produce recognition. Projections are drawn out from all the samples in the gallery and the probe set. The scores between each gallery sample and probe is known as the distance between two projections after alignment.

2. Robust Speech Recognition:

The block diagram of robust speech recognition system is shown in Fig. 4.

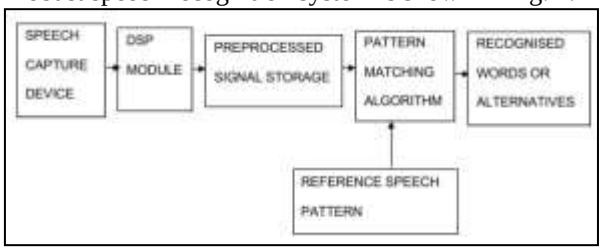

Fig -4: Block diagram of Speech Recognition

To capture speech signals, microphone is used which transform the sound wave signals to electrical signals. The Digital Signal Processor (DSP) is used to perform the processing on raw speech signal such as frequency domain conversion and restore the required information [17]. The pre-processed speech is stored in the memory to

carry out further task of speech recognition. The computer or the system consists of predefined speech patterns or templates already stored in the memory, to be used as the reference for matching. The unknown speech signal is compared with the reference speech pattern to determine the actual words or the pattern of words.

3.3 Flowchart of proposed System

The flowchart of proposed system is shown in Fig. 5.

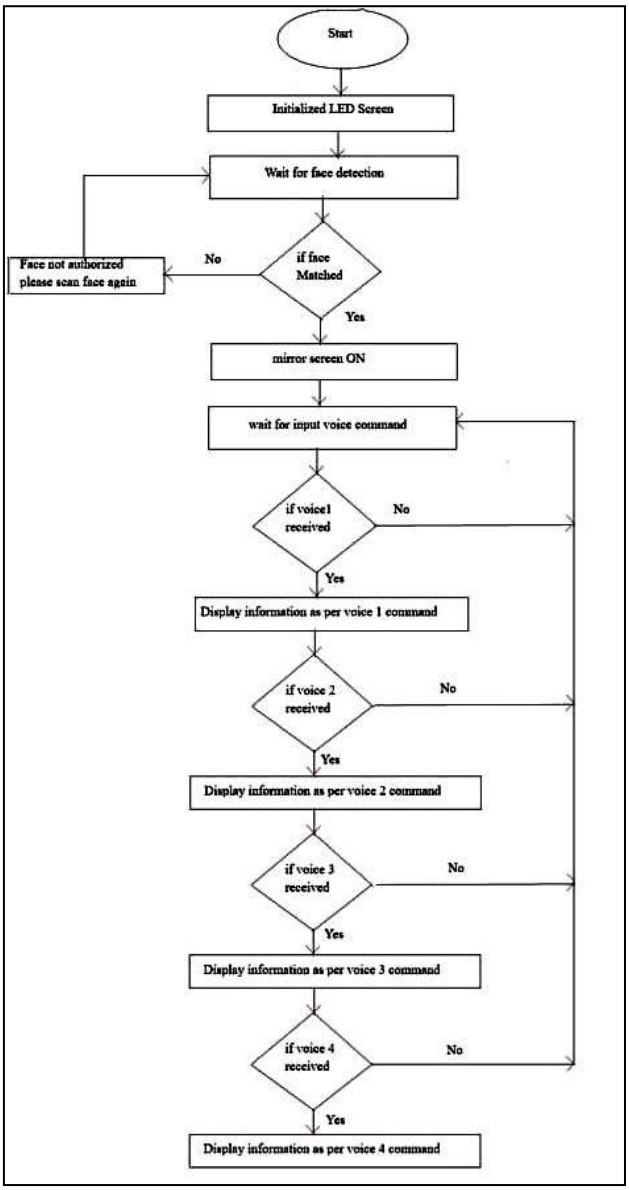

Fig -5: Flowchart of Proposed System

The HMI smart mirror can be controlled by face and speech recognition system for security purpose. The LED screen on behind the mirror is ON only when the face is detected otherwise screen is turn OFF. If the face is matched then the mirror screen is ON which gives the different input voice commands like whether prediction, date and time, clock, locus information, news feed, user information, temperature, etc. The voice commands shows the output on the LED screen

4. IMPLEMENTATION OF SMART MIRROR

Smart mirror is a wall mounted and portable mirror which displays suitable modules to the user such as weather prediction, date and time, clock, locus information, news feeds, user information, temperature and humidity. A simplified working model is shown in Fig. 6 which depicts various functionality of mirror using voice raspberry pi 3B, camera, microphone and speaker. The interconnectivity among various parts is established using flat cables. The system makes use of Wi-Fi access through Raspberry pi to obtain real time temperature and humidity through internet.

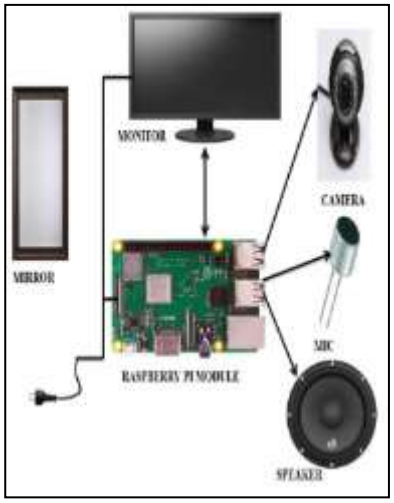

Fig -6: Arrangement of Hardware for Smart Mirror (Rear-side)

Once the user stands in front of the mirror, it first identifies the face based on CNN based face recognition algorithm. Then the smart mirror communicates with user and similarly the message is displayed on the screen which is shown in Fig. 7 (e.g. "Hii Gitanjali …"). Based on voice commands of user, the system tries to respond the user by using robust speech recognition algorithm. For instance if user asked about the schedule of the day, then mirror provide the prominent activities of the day to be undergone.

Fig -7: Design of Smart Mirror (Front-side)

5. CONCLUSIONS

The HMI based smart mirror is influenced by the raspberry pi 3 and the result is in form of real time data feeds which are displayed on LED screen. The HMI is established by using CNN based face recognition and speech recognition algorithm. The design of smart mirror gives an arrangement that can be extended in future to indulge even more functionality. We have schemed an smart mirror keeping in mind the future evolution in the field of automotive system as well as commercial purpose.

6. ACKNOWLEDGEMENT

The authors would like to thank Mr. Vipul P. Bumb, Director - Pandya Consultant, Nashik, Maharashtra, India to provide financial support to implement this project.

7. REFERENCES

[1]. B. Cvetkoska, N. Marina, D. C. Bogatinoska and Z. Mitreski, "Smart mirror E-health assistant - Posture analyze algorithm proposed model for upright posture", IEEE EUROCON 2017 -17th International Conference on Smart Technologies, pp. 507-512, 6-8 July 2017, Ohrid, Macedonia. DOI: 10.1109/EUROCON.2017.8011163.

[2]. D. Gold, D. Sollinger and Indratmo, "SmartReflect: A modular smart mirror application platform", IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 13-15 October 2016, Vancouver, Canada. DOI: 10.1109/IEMCON.2016.7746277.

[3]. S. Athira, F. Francis, R. Raphel, N. S. Sachin, S. Porinchu and S. Francis, "Smart mirror: A novel framework for interactive display", International Conference on Circuit, Power and Computing Technologies (ICCPCT), 18-19 March 2016, Nagercoil, India. DOI: 10.1109/ICCPCT.2016.7530197.

[4]. Khurd Aishwarya S., Shweta .S. Kakade and Prof. R. M. Dalvi, "Smart Mirror", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Vol. 6, No. 11, pp. 93-95, November 2018.

[5]. Vaibhav Khanna, Yash Vardhan, Dhruv Nair and Preeti Pannu, "Design and Development of a Smart Mirror Using Raspberry PI", International Journal of Electrical, Electronics and Data Communication (IJEEDC), Vol. 5, No. 1, pp. 63-65, January 2017.

[6]. Divyashree K. J., Dr. P.A. Vijaya and Nitin Awasthi, "Design and implementation of Smart Mirror as a Personal Assistant using Raspberry Pi", International Research Journal of Engineering and Technology (IRJET), Vol. 5, No. 5, 438-441, May 2018.

[7]. Kun Jin, Xibo Deng, Zhi Huang and Shaochang Chen, "Design of Smart Mirror based on Raspberry Pi", IEEE Advanced Information Management,Communicates,Electronic and Automation Control Conference (IMCEC 2018), pp. 1919-1923, 25-27 May 2018, Xi'an, China. DOI: 10.1109/IMCEC.2018.8469570.

[8]. Sun Yong, Geng Liqing and Dan Ke, "Design of Smart Mirror based on Raspberry Pi", IEEE International Conference on Intelligent Transportation, Big Data & Smart City, pp. 77-80, 25-26 January, 2018, Xiamen, China. DOI: 10.1109/ICITBS.2018.00028.

[9]. Muhammad Mu'izzudeen Yusri, Shahreen Kasim, Rohayanti Hassan and Zubaile Abdullah, "Smart Mirror for Smart Life", IEEE ICT International Student Project Conference (ICT-ISPC), 23-24 May 2017, Skudai, Malaysia. DOI: 10.1109/ICT-ISPC.2017.8075339.

[10]. Fatma Ok, Murat Can, Hakan Üçgün and Uğur Yüzgeç, "Smart Mirror Applications with Raspberry Pi", IEEE International Conference on Computer Science and Engineering (UBMK), pp. 94-98, 5-8 Oct. 2017, Antalya, Turkey. DOI: 10.1109/UBMK.2017.8093566.

[11]. Maitreyee Vaidya, Shantanu Moraskar and L.P. Nikhade, "Smart Mirror using Raspberry Pi", International Research Journal of Engineering and Technology (IRJET), Vol. 6, No. 3, pp. 6789-6790, March 2019.

[12]. Abhishek Pathak, Amitkumar Mishra, Rohit Sarate, Swapnil Bhavsar and Nirav Patel, "Smart Mirror using Raspberry Pi", International Journal of Recent Trends in Engineering & Research (IJRTER), Vol. 4, No. 3, pp. 353-358, March 2018.

[13]. Abdullahil Kafi, M. Shaikh Ashikul Alam and Sayeed Bin Hossain, "Artificially Intelligent Smart Mirror using Raspberry Pi", International Journal of Computer Applications (IJCA), Vol. 180, No. 16, pp. 15-18, February 2018.

[14]. V. E. Pawar, Pooja Sisal and Neelam Satpute, "Smart Mirror Using Raspberry Pi", International Journal of Engineering and Techniques (IJET), Vol. 4, No. 2, pp. 554-557, March-April 2018.

[15]. P. S. Tondewad, Harshada Parate, Poonam Awalkonde and Aishwarya Mule, "Smart Mirror Based on Raspberry Pi", International Journal of Research and Analytical Reviews (IJRAR), Vol. 6, No. 2, pp. 151-153, April-June 2019.

[16]. Govinda K and Saravanaguru R.A.K., "Review on smart mirror on IoT Technologies", International Journal of Applied Engineering Research (IJAER), Vol. 11, No. 4, pp. 2848-2853, 2016.

[17]. Roopa Sabri. K, Poornima Urala. A, Gayathri. P, Deepak. D, S. Pushpalatha and Neetha Natesh, "Smart Mirror using Voice Interface", International Research Journal of Engineering and Technology (IRJET), Vol. 6, No. 6, pp. 314-318, June 2019.