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Futuristic Smart Mirror

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***Abstract*—** The design and development of an interactive Smart Mirror is for the ambient home environment as well as for commercial uses in various industries. The project which would display data on the mirror and the data 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, webcam covered with a sheet of reflective 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 and Alexa voice assistant using face recognition**.**

***Keywords*:** Smart Mirror, Raspberry Pi, Weather, Time, News, Face recognition and Alexa voice assistant

I. INTRODUCTION

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. The devices are embedded with technology so that they can be controlled and monitored remotely. IoT is a larger part of home automation which controls almost all the devices used for domestic purpose remotely through internet.

IoT basically emerged to ease human effort and make the device to perform the task by collecting information from surrounding environment. An example of IoT would be an alarm clock which wakes you 15 minutes late than the prior set time because it mapped the arrival time of train which would be delayed by 15 minutes. Another example of an IoT based home automation could be house walls that change its color according to a person's mood. Smart mirror is also developed to reduce human effort. Mirror is a basic thing that is available at everyone's home, taking advantage of this, technology is embedded into it to make it smart and of more use.

Now-a-days we get all the updates on our smart phone which we go through timely, but during morning rush hours it becomes a great haste to complete all morning routines. Smart mirror reduces this haste by providing you with the basic information you need to check in the morning such as today's date, time according to your location, weather updates, news feed and also provides Alexa voice assistant after face recognition. The Alexa voice assistant makes the Smart Mirror more useful by giving verbal response back to the user. The Smart mirror is another application which will help to build smart houses.

The remainder of this paper is organized as follows. The section 2 gives brief information about the different research papers which were taken into consideration for building smart mirror. The section 3 gives the design and system architecture followed by section 4 which gives details about the algorithms used for face recognition. The implementation of smart mirror is illustrated in section 5. Results and conclusion of the product is presented at last in sections 6 and 7.

II. LITERATURE SURVEY

"A Mobile-Programmable Smart mirror for Ambient IoT Environment" published at 5th International Conference on Future Internet of Things and Cloud Workshops in 2017 describes the design and development of Interactive Smart mirror that offers simplified and customizable services to the home environment[1]. The Smart mirror also controls home appliances with very less human intervention using a mobile application. For controlling home appliances the mobile needs to be paired with the smart mirror successfully. "Smart Mirror for Smart Life" published at IEEE Conference publication also describes about the monitoring and controlling of home based devices with the mirror. To ease the human tasks and develop interaction between people and system, the mirror system uses Sonus technology as a medium[2]. The Smart mirror takes voice commands as input to give response and Sonus is a speech to text library that can quickly and easily add VUI(Voice User Interface) to any hardware or software[2]. Security in IoT in developing but not much strong in order to make Smart mirror secure and to display information according to a person's choice facial recognition algorithm is implemented in it. The "Implementation and Customization of a Smart Mirror through a Facial Recognition Authentication and a Personalized News Recommendation Algorithm published at 13th International Conference on Signal

Image Technology & Internet-Based Systems (SITIS) in 2017 includes the above advancement. The daily news recommendation predictive model is implemented through the facial recognition algorithm. The "SmiWork: An Interactive Smart Mirror Platform for Workplace Health Promotion" describes about a multi-user Smart mirror that promotes wellness and healthier lifestyle[4]. Each user have personalised user-interface which can be accessed using RFID reader in ID card. "The Smart Mirror" published at International Journal of Advance Research, Ideas and Innovations in Technology and "Design and development of a smart mirror using Raspberry pi" published at International Journal Of Electrical, Electronics And Data Communication gives the design of futuristic mirror and development of mirror using Raspberry pi.

III. SYSTEM ARCHITECTURE

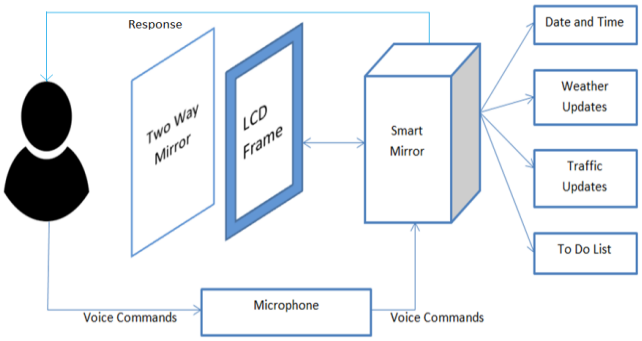

fig 1 : System Architecture of Smart mirror

The System architecture of Smart mirror is shown in above figure. The Smart mirror system mainly consist of three parts a two-way mirror, LCD monitor and Raspberry pi. The two-way mirror is the mirror which is reflective on one side and transparent on the other side. There will be a webcam behind the transparent side so that it can capture and identify faces for security purpose. The LCD monitor is used for displaying different widgets on the mirror. The LCD monitor will be connected to the Raspberry pi. The Raspberry pi will be used for programming of different widgets using Python language.

The Smart mirror is provided with Alexa voice assistant. For installation of Alexa voice assistant following steps were performed.

1. Initially create developer account on Amazon.
2. Once account is created navigate to Alexa Voice Service and register your product on which you have to implement Alexa.
3. You will be provided with your Device ID, Client ID, and Client Secret from your developer account after successful registration of your product.
4. After this first step is to upgrade apt-get. This ensures that you have access to required dependencies.
5. Download the installation and configuration scripts.
6. Move the **config.json** file that you downloaded when you created your Security Profile to your home directory.
7. Run the setup script with config.json and the device serial number (DSN) as arguments.
8. Run the sample app using the command : sudo bash startsample.sh
9. Wait for the sample app to display a message : NOT YET AUTHORIZED
10. Use a browser to navigate to the URL specified in the message and authenticate using your Amazon user credentials.
11. Enter the code specified in the message from sample app and select "Allow".
12. You are now ready to use Alexa.

IV. ALGORITHMS

There are two algorithms that will be needed to run the system those are for face recognition and speech to text conversion. For face recognition 'Eigenfaces', 'LBPH(Local Binary Pattern Histogram)', 'Fisherfaces' and 'OpenFace' were considered. Eigenfaces is based on statistical approach which uses principal components of face for detection. Fisherfaces is modified version of Eigenfaces. Eigenfaces does not make the difference between two pictures from different classes during the training part which Fisherfaces can do. In LBPH grayscale picture is used for face recognition. The LBPH works in block of 3x3 pixels. OpenFace is face recognition library based on Google's FaceNet system. OpenFace works using deep convolutional neutral network.

For face recognition for our system we found OpenCV as the best suitable algorithm. OpenCV was started by Intel in 1999. OpenCV is basically written in C++ but there are bindings in Python , Java and MATLAB/OCTAVE. OpenCV supports the deep learning framework TensorFlow and Torch.

In Torch feature extraction is performed using deep neural network which needs to be performed only once and results are passed to the Neutral network part for further processing. The face detection is performed by dlib's pre-trained detector, the face is detected from several images. The detected face is then passed for preprocessing and after that to Convolutional Neural Network(CNN). The CNN then uses features extracted in the first part(Torch) for predicting class of unknown person.

The conversion of text to Speech is done using Google's text-to-speech API. The text is converted into an audio file with mp3 extension. In Python the mpg321 package is needed to play the mp3 files.

V. IMPLEMENTATION

For the implementation Python language is used along with Python 3 complier. The Thonny IDE on Raspbian OS is used for coding and TK inter interface is used to display the output. Google text-to speech API and Darksky API is used for text-to-speech conversion and weather updates respectively.

The first and the most basic module i.e. date and time module displays the date and time according to the user's location. The input date and time is taken from the system itself and is dynamic in nature. The next implemented module is the weather module. The weather gets updated timely according to the user's location. The longitude and latitude of user's location is provided as input to get weather updates. The news feed module displays the top news of the country in which the user lives. The RSS feed generated by the Google news and the country code is taken as input to display news. JSON is used to retrieve RSS feeds from Google news feed. Text-to-speech module converts the predefined sentences into audio format plays the audio file through the speakers. This module basically makes the system more interactive. For the weather module the news feed module and the text-to-speech module good internet connection is required otherwise these modules are not displayed. Alexa voice assistant is provided to make the Smart mirror more useful in home environment. The Alexa voice assistant provides hands free information. The keyword 'Alexa' is used to activate the voice assistant. Using this Alexa voice assistant we can do plenty of tasks like set reminders, get information about any topic, get weather of any place, listen to a song or news and many more. Face recognition is provided for using Alexa voice assistant. The main purpose of providing face recognition for the use of Alexa voice assistant is restricting its use to limited and authorized users only. The face recognition also provides security for its use and prevents its misuse. The users can download the Alexa app for customizing its use and maintaining privacy between multiple users.

VI. RESULTS

The output generated by the system are the modules such as Date and time, weather, and news feed are displayed on the mirror when the mirror is turned on and detects anyone in front of it. The user's face is recognized and then the user the user is allowed to use the Alexa voice assistant for performing any task.

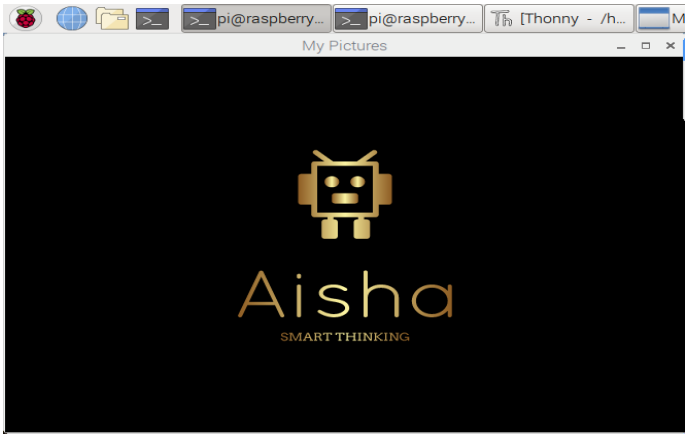

fig 2 : Logo of Smart mirror

The logo of smart mirror "Aisha" is displayed on the mirror every time it is turned on and greets the user through voice output.

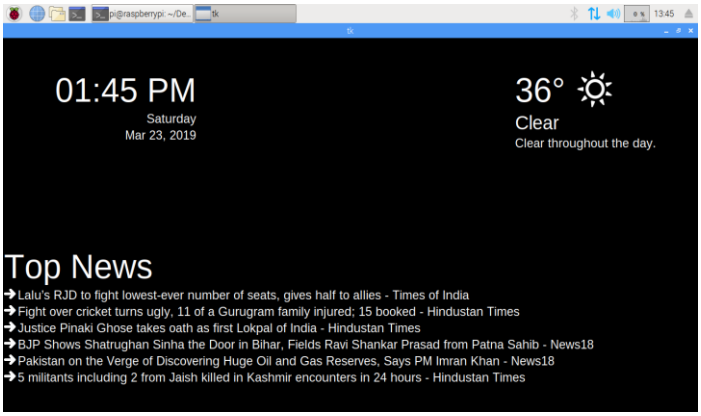

fig 3 :Output generated by the System

The above figure shows the output generated by the system when the date and time, weather and news feed modules were tested . Besides the above output the system also generated an audio output which introduced the system to the user.

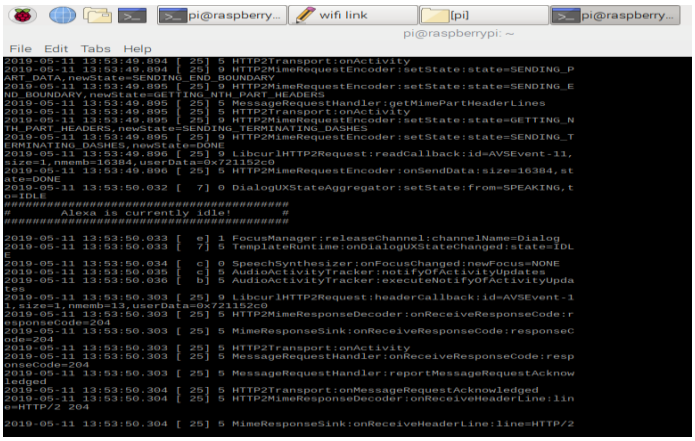

fig 4 : Alexa voice assistant

The Alexa voice assistant is ready to process requests for users when it gives signal as "Alexa is currently idle!".

VII. CONCLUSION AND FUTURE WORK

This paper proposes an interactive mirror that ease the user's task by displaying widgets such as date and time, weather updates, news feed and Alexa voice assistant according to the user. The Alexa voice assistant can be used only when the mirror recognizes the user, this also provides security to the Smart mirror. The Smart mirror greets the user each time it is switched on.

The future work on this project can be adding more widgets such as e-mails, social media applications, traffic updates etc. For security of these widgets iris detection can be used along with thumb impression for accessing mails and personal data. Artificial Intelligence can also be added as an extra feature for recommending news according to the user's choice, suggesting the best path to reach the destination according to the traffic or suggesting clothes and accessories according to the climate conditions.

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