Monitoring Emotions using Smart Mirror: An Application of Ambient Intelligence.

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***Abstract*— This paper outline the expansion of the cutting edge technology ambient smart mirror. The system configured with a handy user interface with prominent aspects like facial recognition, voice search, and weather updates. For the determination of facial reorganization, the Harr like feature algorithm is used. Determine the emotional condition of a person is the main features of the system using a model created based on the Support Vector Machine algorithm. A model-driven structure has been used to flourish the system with ambient machine learning techniques. The designed smart mirror has a superiority of user-friendly interface, advanced technology, psychological scrutiny, befitting for household purpose and has comprehensive potentiality. The smart mirror operation has been illustrated by designing an advanced automation system that offers the incorporation of smart techniques for the smart well-being of the home.**

Keywords*— *Ambient Intelligence, Smart Mirror, User, Weather forecast, application programming Interface (API), Facial Recognition, Emotional Recognition.

I. Introduction

In recent years, Ambient Intelligence (AmI) is incorporating its elegant role as a new emerging technology and driving force within computer science that makes the most opportunities to establish intelligent systems, supported with new technologies. Ambient intelligence does allow devices to work in a package to support people, in carrying out their everyday life activities.[1] [6]

In this paper, we have given one of the recent and innovative uses of the Internet of Things, the smart mirror. This version of our system has added features like a voice search assistant, event or study planner for the day, email notification, face reorganization for security and authentication purpose with a user-friendly interface for a comfortable and seamless user experience. Considering the security and privacy of the user we have programmed the system so that when the official person appears in front of the mirror, only the email of that person is shown. Also mental health is one of the main concerns, maintaining it is tuff nowadays, thus our system that will continuously monitor the emotional states of a person throughout the time as long as he is present in front of the system. The system is so designed that it can be placed at different locations in user residence or locations such as the study room, kitchen room, dormitory, and lavatory, with a different user interface according to the area of action.

II. Relevent Work

Recommended Smart Mirror expresses a familiar interface, that facilities access to personalized assistance as per user. In the following, we briefly illustrate associated preexisting work, with the observation we made to overcome fault possible

A. Aware Mirror

It uses an acrylic sheet in front of the LCD to display useful context to user like weather forecast, News, Time, Importance of day, etc. acrylic sheet act as a reflecting surface for the user. Sentient Toothbrush, a specially designed toothbrush with co-ordination to the proximity sensor calculates the position of the user and show feed on display. Although it has some drawbacks like its hard to get an accurate location of the user based on collected data from three sources i.e. two proximity sensor and the Sentient Toothbrush. [2]

B. Medical Mirror

The system calculates electrocardiograph (ECG) using detecting a deviation in human face captured by an existing camera which also captures a blend of the reflected plethysmography signal pass on to an Independent Components Analysis (ICA) show electrocardiograph on the mirror, tho the approach is innovative but due to presence of ambient light reflection error occurs also this approach need apple of data to get an accurate prediction. [3]- [5]

C. Mirror 2.0

A one-way reflector in headed LCD aid to display data like weather forecast, timer, etc. A camera for face reorganization and gesture reorganization for mirror control like to play or pause a playing video which can be searched by giving voice command using a mic used. It provides basic functionality to control household application. Conceptually our work has the same objects like Mirror 2.0 but with addition, functionality to make it personalized as per area of action. [7]

D. Abyss Glass

Interactive mirror display which adapts as per suitable application like in entertainment industry, fitness industry, Retail industry, Salon industry, etc. User can try an outfit to get a perfect match based on the body type including accessories suggestion based on the matching outfit some more enhanced feature are health indication based on the workout with a diet plan for the user when used at the gym. The main feature of this mirror in advertising leads to investing a large sum of money for the mirror. [8]

E. Augmented virtual mirror

Provides augmented reality experience to the user using a high definition video camera. Tho the system is very futuristic but lack in establishing a perfect region of application which is solved by our system.[10]

F. Memory Mirror

Medical mirror works as drug alarm for user assisting him/her keep track of drug usage in 24 hours period of time removed from the medicine cabinet and record history. Data is collecting base on RFID tags, which requires attaching RFID tags to household application. The main drawback is it can't work like a traditional mirror and not any interface for personalized use. [9]

In comparison to the work mention above proposed system differs with aim to develop a system, which can help user to get valuable data in cluster form with the use of Off-the-shelf technologies like web feeds, information services, facial reorganization, voice search, etc.

III. Proposed Work

Figure 1: Three Dimensional visualization of system.

The figure 1 shows a Three-dimensional look of the real system, encapsulated in a wooden frame for mechanical support. A one-way mirror is located in front of an LCD to display data, controlled by processing unit raspberry pi Model 3B, as it provides more computational power for functionality to achieve with microphone and speaker situated at bottom frame wooden enclosure at the top a camera is a place to get visual feed shown in figure 2.

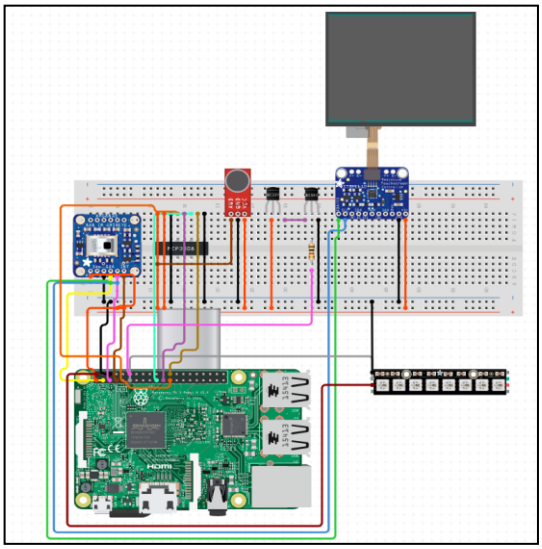

Figure 2: Circuit Diagram of system.

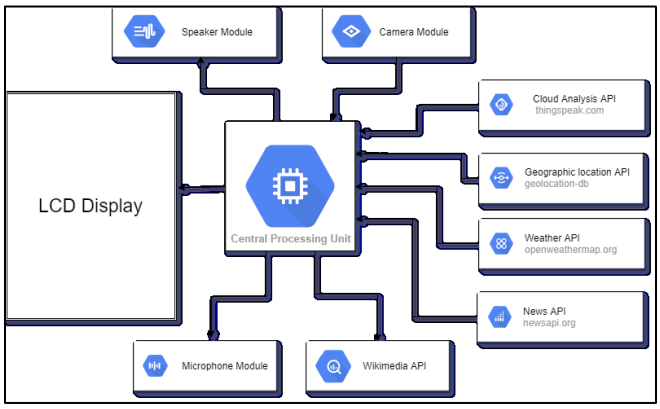

Figure 3: Block Diagram of system.

Figure 3 shows a primary block diagram where information is accumulated through numerous API's like Open Weather API, to get weather forecast based on the location that estimated by geolocation API, in addition to it, news API is used to get top local news based on the location of the system. The proposed system used facial recognition to determine the user to show relevant information based on the user's preference. In real-time continuous emotional reorganization thread works to determine the emotion fluctuation of the user, which are transmitted to the cloud using Think speak Cloud API. Data gathered on the cloud can be used by psychologist or counsellor of the user to determine the relevant method for therapy like REBT, 9PHQ, etc.

A. Functional Overview

The proposed system is designed to achieve numerous functions abstracted as follows.

1) Parody of mirror:

The one-way mirror used to mimic a natural mirror, glass is encased with thin metal makes surface translucent and allow partial reflection forming illusion like a natural mirror the user is unable to see on another side of the mirror.[12]

2) Facial recognization:

The core functionality of the system is facial reorganization. Accomplished using Open CV a python library that provides real-time computer vision designed exclusively for machine learning application, it operates best on a low power consumption system. The first step is to detect the presence of human using the Harr-Like feature algorithm (Object detection framework) proposed by Paul Viola and Michael Jones in 2001 we set a boundary limit of 75% based on the try and error method. The second is to analyses it with pre-captured user images in the database. Based on the results system present appropriate data of the user on-screen i.e. emails.[20][21]

3) Emotional detection:

The emotional detection thread is in operating continuously in the backdrop where it detects the emotion of the user based on a facial expression like in the figure 4 shown. A Model created using the FER-2013 dataset trained on the Support Vector Machine Algorithm (SVM), a conventional supervised learning algorithm, with an accuracy of 70%. Each emotion is

labelled with a unique number, after the emotion is recognized associated values are sent to the cloud which can be seen by the graph on the thing speak cloud website, shown in the figure 5. [24]-[26]

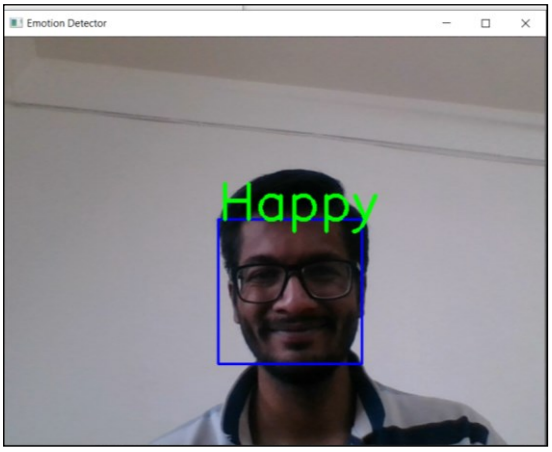

Figure 4: Happy emotion recognized by system.

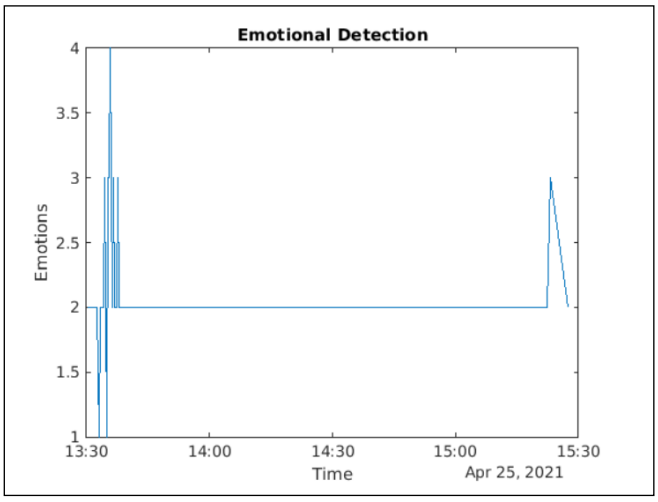

Figure 5: Recognized emotion sent to Cloud.

4) Area of action:

The SAMRT word signifies most reliable in all domain, the proposed system has three areas of action like Lavatory, Dormitory, Study Room, Kitchen room based on relative task are executed.

B. Software Implementation

The following section illustrates the actual operation of the system with the above functionality provided before. Figure 6 shows program structure where Tkinker library is at the top to as system UI with, Information collected through API, speech to text and facial reorganization thread in the second layer and emotional recognition thread is working continuously in the background.

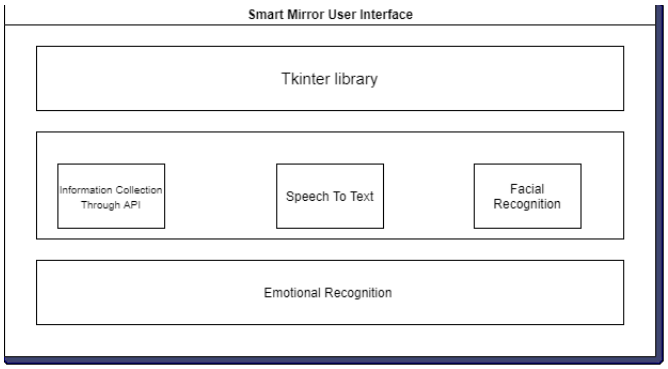

Figure 6: Software Implementation.

1) Initialize Files:

All essential python library files are initialized, including an instance of the camera and creation of database shown in figure 7 below.

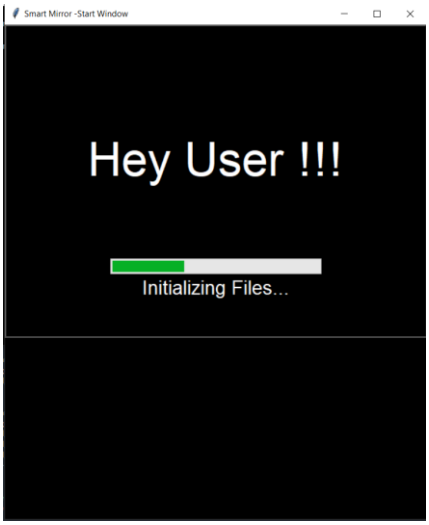

Figure 7: File initializing window.

2) Family Login:

The login window is being created where the user is deemed to add his/ her name and click pictures for the creation of a model for facial reorganization functionality as shown in figure 8 below.

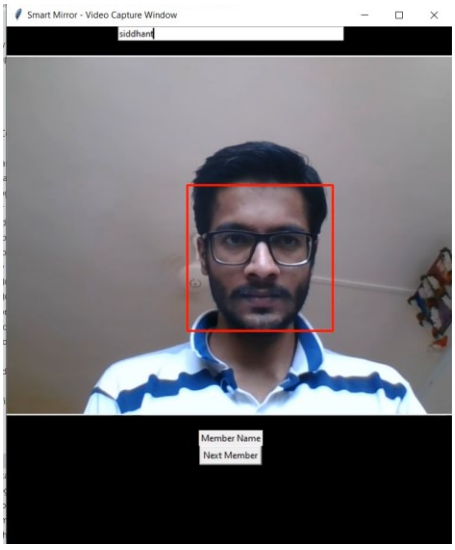

Figure 8: Family Login window

3) Model Creation:

Model is generated based on images captured by the camera also pre-trained emotional recognized trained model is initialized as shown in the figure 9 below.

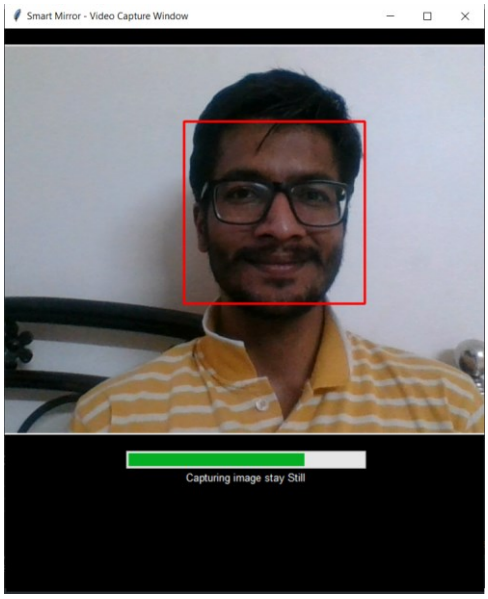

Figure 9: Model creation window.

4) Selection Window

As discussed above our system try to resemble the complete meaning of the word SMART we try to achieve it by allowing the system to be used in every part of the house shown in the figure 10 below based on the chosen place of user the mirror functionality changes.

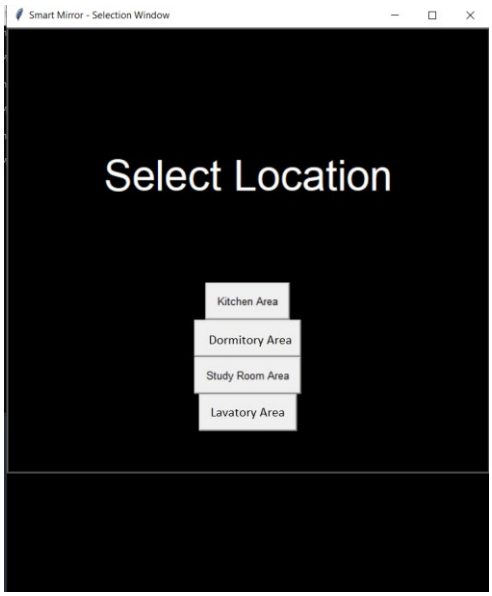

Figure 10: Selection window.

- Study room:

If the user selects to place the system in the study room a weekly study timetable will be displayed to the user base on data collected by him as shown in figure11, after choice of the window in addition to it sketch area for ruff work, it can be used using a pointing device like a wired mouse or stylus.

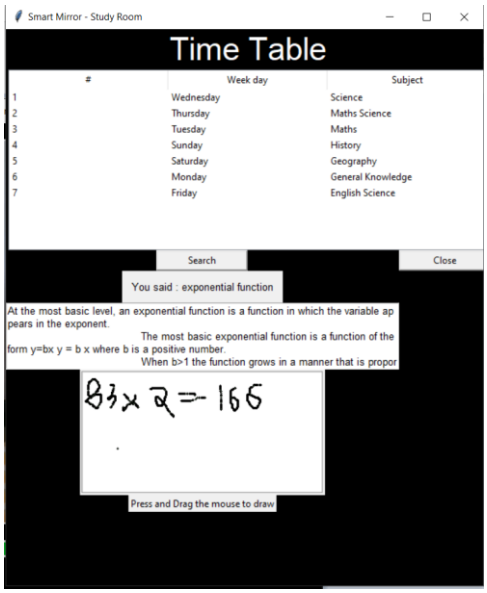

Figure 11: Study room window.

- Kitcehn room:

If the user selects to place the system in the kitchen room a weekly dinner menu will be displayed to the user based on data collected by him as shown in figure 12 after choice of the window in addition to it voice search is provided for the searching recipe.

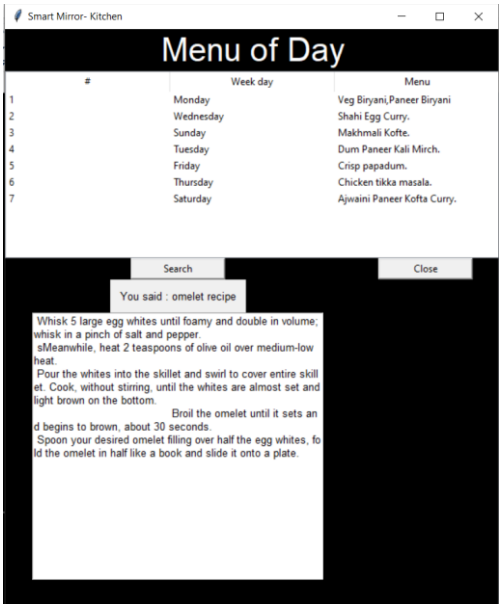

Figure 12: Kitchen room window.

- Dormitory:

If the user selects to place the system in the dormitory weather forecast, a personalized email of the user based on the facial reorganization done by the system with clock and importance of day will be displayed on the screen as shown in the figure 13 below.

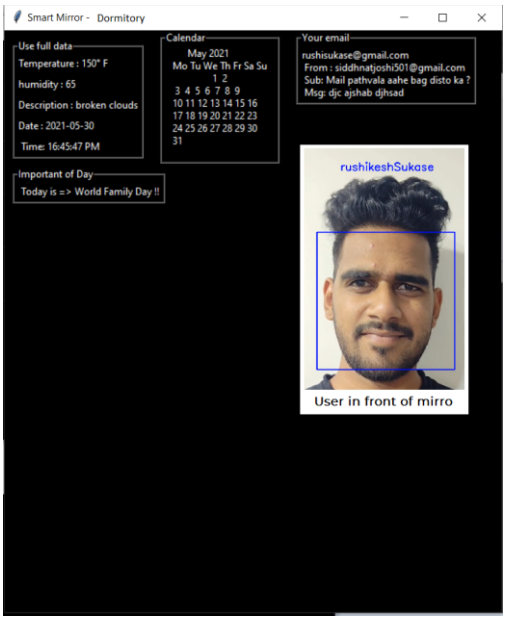

Figure 13: Dormitory window.

- Lavatory:

If the user selects to place the system in the lavatory weather forecast, a personalized email of the user based on the facial reorganization done by the system with clock and local news will be displayed on the screen as shown in the figure 14 below.

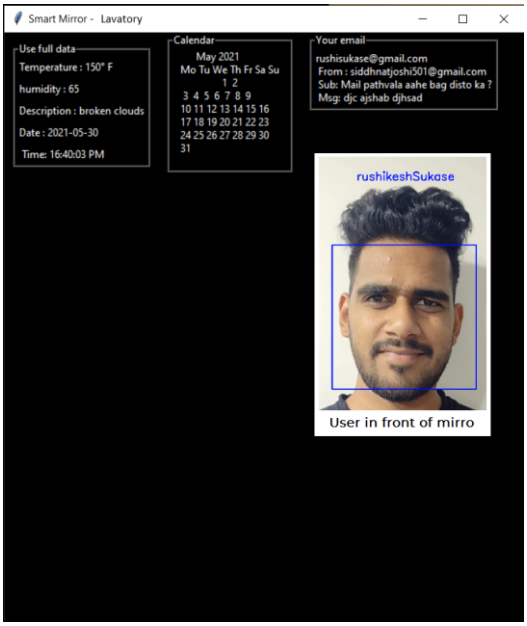

Figure 14: Lavatory window.

5) Destroy instance:

termination of the system completed by the destruction of the instance created by the camera, open cv library, etc.

C. Hardware implementation:

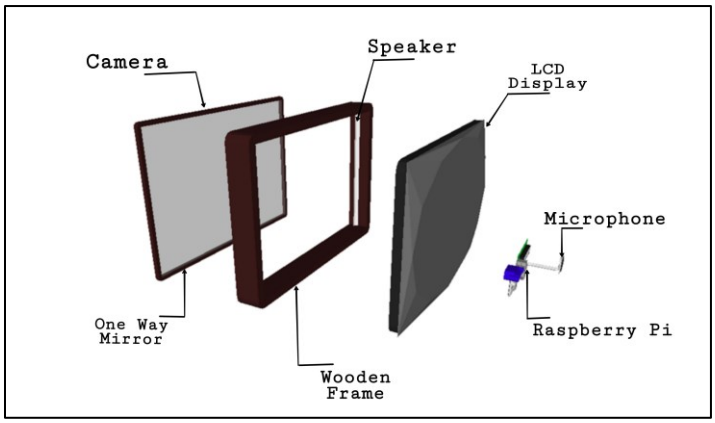

Figure 15: Hardware Implementation.

The figure 15 shows a Three-dimensional look of the real system, encapsulated in a wooden frame for mechanical support. A one-way mirror to parody real mirror, LCD to display data, raspberry pi Model 3B processing unit, microphone to get data from the user, a speaker give output also a camera to get visual feed.

The following section illustrates the actual operation of the system.

IV. Problem Occurred

Many problems occurred during implementation of the system as due to the presence of background sound system was unable to get precise output, solution for that was to relocate raspberry pi module from the microphone as the sound of rotating cooling fan of raspberry was causing malfunctioning in sound input thread

V. Test Case and Observation

The analysis on the system was performed creating ideal conditions with sufficient light source for facial recognition and emotional reorganization thread to word efficiently. System was test in place with low noise from getting proper output results in voice search functionality. Based on the following test case experiment was carried out.

1) Test Case 1: commencement of system:
   System response: Initialize file widget runs
2) Test Case 2: Family Login:
   System response: Login window appeared. Camera feed are seen at on screen. Image is captured on button pressed. Input field gets input. Data is saved in database on button pressed.
3) Test Case 3: Login user, based on facial recognization achive by model created based on data collected during family login and selction of window:
   System response: System able to recognized user face. Selection window appeared. Kitchen room selected.
4) Test Case 4: Voice search functionallity.

System response: Input taken by system print on console. Output printed on console. Output by speaker is audible.

VI.Conclusion

Based on above test case following objectives are achieved.

- System is able to detect human

- System is able to detect face using Harr like object detection method.
- System is able to recognize emotion of detected human face based on trained model on support vector machine algorithm with accuracy of 70 %.
- Information from web through relevant API are being display on LCD.
- System is able to transmit data to cloud through think speak API.

Thus we conclude that we are able to create a futuristic smart mirror that parody a natural mirror with additional machine learning features like facial recognize and emotional recognition, allowing the user to cluster up scattered data at one place on a mirror.

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