SMART MIRROR

A PROJECT REPORT

Submitted by

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Under the guidance of

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Yash Tandon

ABSTRACT

A Smart mirror is an electronic device that can be a daily use device. The proposed system describes the design and implementation of a speech-controlled and interactive mirror known as “Smart Mirror”. The proposed system has two key features: facial recognition which increases the security of the mirror and also increases personalisation within the mirror with the help of user profiling. Second, speech recognition which makes communicating with the mirror easier. The proposed system applies local Binary patter histogram facial recognition. The system uses a microcontroller called ‘Raspberry Pi’ which integrates all the modules such as news, weather, date, time, sports updates etc. Experiment results show that the proposed system outperforms the existing systems and achieves a success rate of 91.2 percent.

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CHAPTER 1

INTRODUCTION

1.1 About The Smart Mirror

A smart mirror uses a two way reflective mirror as a basic panel to display data. 'Raspberry Pi' is the microcontroller that is being used in the system being proposed.The major concepts involved in the system is Local binary pattern histogram which is an Artificial Intelligence algorithm. Local Binary Pattern Histogram is a simple and efficient text description operator which labels the pixels of an image by thresholds the neighbourhood of each pixel and which produce the result as a binary number. Artificial Intelligence is a computer system that has the ability to do human like tasks such as speech recognition, facial recognition and also make decisions. The smart mirror being proposed will help you navigate through your day better by showing you all the necessary information on the mirror. The smart mirror will be able to save you a significant amount of time by doing multiple task you demand it to do. The mirror will be able to display all the information that you need to plan your entire day, it will include important information such as your notifications, reminders, weather updates, news briefing for the day as well as countless other features and modules.

The major concepts involved in the system include 'Internet of Things' and 'Artificial Intelligence'. 'IoT' or internet of things can be defined as an interconnection of devices that allows them to collect data and be responsive. Artificial Intelligence is a computer system that has the ability to do human like tasks such as speech recognition, facial recognition and also make decisions. The smart mirror being proposed will help you navigate through your day better by showing you all the necessary information on the mirror. proposed will help you navigate through your day better by showing you all

the necessary information on the mirror.

1.1.1 Idea Of The Project

The proposed system explains the design and implementation of a speech-controlled mirror known as “Smart Mirror”. A smart mirror is a device which has the ability to function as a regular mirror as well as an interactive mirror which can display various types of content such as date, news, weather, time all at the same time. The user can interact with the mirror with great ease using voice commands.

Smart Mirror includes multiple functionalities which include, real time collection and display of data and information updates, speech recognition, facial detection and recognition and uses, LCD display, mic as well as webcam respectively.

Most of us have a wish to be efficient in our everyday lives. We want to accomplish tasks easily; we want to manage our schedules, and most of all we simply want to feel in control of our lives as they unfold.

The household mirror is often taken for granted in our daily routine, but really it is one of the products that stand to gain the most functionality out of a tech upgrade. Mirrors are a focal point of our attention almost every single day, and yet we rarely physically touch them.

The Raspberry pi stays hidden behind the mirror and controls the data being displayed on the mirror. With just a glance at the mirror you can look at various notifications, temperature, current events and much more.

These mirrors can be programmed in a way that they function as an artificial intelligence and hold the power to control house appliances such as lights, TV, fan, fridge etc by voice input through speech recognition. The Raspberry pi is connected to LCD screen via HDMI port. The raspberry Pi also has Wi-Fi and Bluetooth interfaces built in.

Over this screen a two-way reflective mirror is placed,this mirror acts as a reflective surface. Which enables the data displayed on the monitor to be visible on the mirror.

CHAPTER 2

LITERATURE SURVEY

2.1 Smart mirror Design Powered by Raspberry Pi

The design of smart mirror using Raspberry Pi. This mirror looks similar to any normal mirror, though there are significant differences between a regular mirror and this mirror. This mirror can display weather, time, current temperature, and a web application for college.The smart mirror is implemented and designed with the help of raspberry pi. There are other major components, which include an LED monitor that is covered by a two way mirror. The raspberry pi is able to actively connected to the world wide web and can retrieve data upon the user's request. This product is able to retrieve weather based on the current location of the user.

2.2 Voice Controlled Smart Mirror with Multi factor Authentication

Internet of Things, There has been significant development in these areas due to multiple reasons. The biggest reason being, the continuous development of new smart devices such as smart lights, smart TV, smart fridges. This paper describes how a Raspberry Pi device can be used to enhance such mirrors to make them a smart mirror with intelligence and security. The final aim is to create an efficient and affordable intelligent smart mirror system. This mirror will have the capability to work not only as a regular mirror but also as an interactive mirror which can display information such as temperature, time, and trending events. The mirror also provides security across the entire system.

2.3 Smart Mirror- Digital Magazine for University, Implemented using Raspberry Pi.

The design of smart mirror using Raspberry Pi. This mirror can seem like any conventional mirror, but in reality, it is quite unconventional. The mirror has the ability to display multiple information, such as time, date, and temperature. This mirror uses raspberry pi, which enables the mirror to be smart. The mirror has facial recognition as well as speech recognition. The user can interact with the mirror using speech. The security of the mirror is improved with the help of facial recognition. This mirror, however, does not support user profiling.

2.4 Design of a Smart Mirror based on Raspberry Pi.

The Smart Mirror based on traditional household mirror belongs to home automation system to meet consumers' needs towards intelligent life. It provides occupants with a series of intelligent experiences such as home appliance control, information acquisition, environmental monitoring, entertainment and remote operation. The intelligent home control platform - The Smart Mirror is designed to solve the problem of smart home communication and information integration in the family. Based on the development of Raspberry pi, unidirectional mirror and the infrared frame and other hardware devices, the smart mirror, as a mirror display screen, offers a kind of safer, more comfortable, more conveniently, more swift and open intelligent, information-based living space to household in the intellectual district.

2.5 Single-Sample Face Recognition Based on Feature Expansion

Facial recognition with a single sample per person is a massive and very challenging problem in computer vision. To address this issue, this paper puts forward a alternative solution combining transfer learning and sample expansion in feature space. It is a difficult task to predict facial differences such as the lighting conditions, the posture of the user, change in look such as glasses, beard, etc. Due to the inadequate amount of training samples. We intended to increase the accuracy of facial recognition even with a few numbers of samples. It also trains softmax classifiers with expanded face features. In comparison to existing expanding sample methods in the image field, the proposed method of expanding the samples in the feature domain is one of a kind and is also simple to implement.

CHAPTER 3

PROPOSED SYSTEM

The major purpose of this project is to simplify the daily life for us even more than it is at the moment.The mirror can give you different type of information just at a glance without having to spend much time to search for a specific detail or information. The mirror will also be a benefit in the health point of view, with the phones emitting large amounts of blue light the smart mirror will be a major improvement as the mirror coating will reduce the amount of blue light emitted.We can also say that the amount of strain that is caused by looking at a small screen is much more than the amount of strain looking at the mirror.

3.1 Description of Project Work

The smart mirror is a device which takes one step closer in making you home a truly smart home. The smart mirror allows the user easier access of data, with a single glance you can get a lot of information such as news, time, date, weather and more it also provides personalised data to meet the users needs. The system also provides health benefits by reducing/filtering the amount blue light emissions, it also reduces strain on the eyes of the user since the size of the screen is much larger than a regular smart phone. Security enhancements are made with the help of facial recognition. Each user has their own profile making the experience truly unique and personalised. To implement facial recognition we use local binary pattern histogram algorithm. It is easier to converse with the system with the help of voice commands using speech recognition.

CHAPTER 4

SYSTEM DESIGN

4.1 Architecture of the system

The basic requirement is the Raspberry pi, With Raspberry pi we will be able to run multiple programmes and custom modules that we can display on the mirror. So the bare minimum needs are the the raspberry pi, a monitor and custom codes for each modules.The block diagram shown in figure 4.1 consists of five main modules, Smart Mirror CPU (raspberry pi microcontroller), LCD screen and a two way acrylic sheet. The modules of the smart mirror include all the capabilities of the mirror which include calendar updates, multimedia services, traffic updates, news alarms and more. The raspberry pi is the CPU of the device which handles the data and convert's it into necessary signals which enable the device to function coherently as a whole. The LCD screen allows all the information to be displayed in a graphical format and is placed behind the two way acrylic sheet.There will also be Microphone, Speaker and camera present which will enable communication between the user and the device. The raspberry pi will be hidden behind the acrylic sheet which will display any multimedia information.The mirror must also be connected to a main power supply outlet, the necessary wires which will be used will also be hidden behind the acrylic sheet. Other components such as the camera and the mic will be placed on to top and the side respectively. All these components will be enclosed within a frame which will give the mirror a solid shape and cohesiveness as a single until and a finished product.

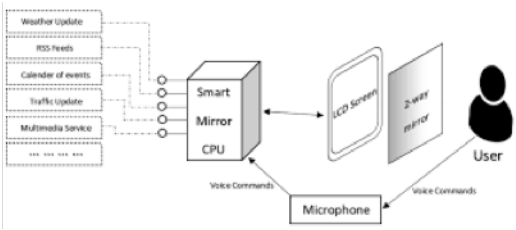

Figure 4.1: Architecure of the Smart Mirror

4.2 Speech Recognition

The speech recognition module shown in figure 4.2, is the foundation of the system further interaction with the smart mirror. In order to communicate with the device the mirror must first be able to understand data and information being sent. For the scope of this project, we have used Amazon/Google API for the world knowledge process of the project.Apart from just basic communication the speech recognition module also helps us differentiate between each person to fit the user/customers personal requirements. For the implementation of this module we have written a code in python and requires raspberry pi to be integrated to function with the smart mirror. In order to carry out the process of extraction, we need to fulfil the following requirements: Install Python 3 and Pip Install multiple Packages

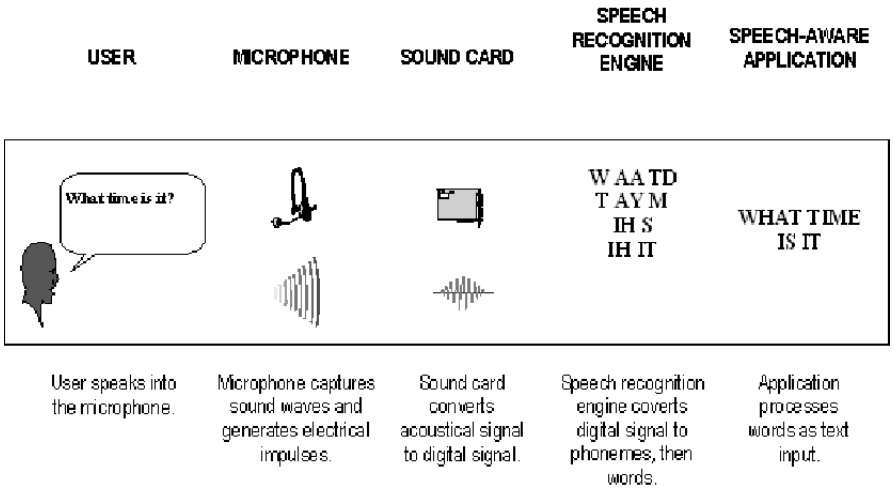

Figure 4.2: Speech Recognition Architecture

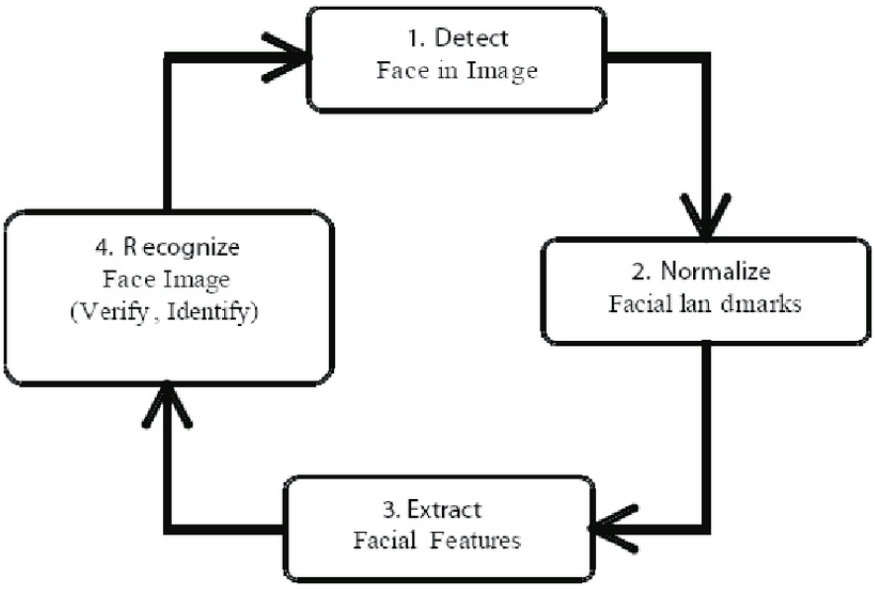

Figure 4.3: Facial Recognition Architecture

4.3 Facial Recognition

Facial recognition as shown in figure 4.3 can have multiple utilities including security, personalisation etc. The smart mirror is integrated with facial recognition for both security as well and personalisation. The data must be fed into the mirror's data base for the first time like any other smart mirror after which the data will be saved in the mirror for future use. Data goes through a series of steps during this cycle.

4.4 Weather and Notifications

The main features and attraction points of the smart mirror are is notifications and display, with the help of the mirrors surface we can do multiple things which include the following - Represent the data clearly. Represent and showcase the weather data for today, tomorrow and day after tomorrow as shown in figure 4.4. Designed to work with MMM Weather-now and uses weather now API. You can personalise it to fit your needs, if you are into business and stocks you can make it display stocks data with alpha advantage API. There are multiple sports leagues that you can follow and display

on the smart mirror like football, cricket etc. You can make the mirror display news so that you can go through daily news at a glance. You can play youtube videos on the minor to catch up with your daily activities in a glance.These are few of the many personalisations that you can do with your smart mirror.

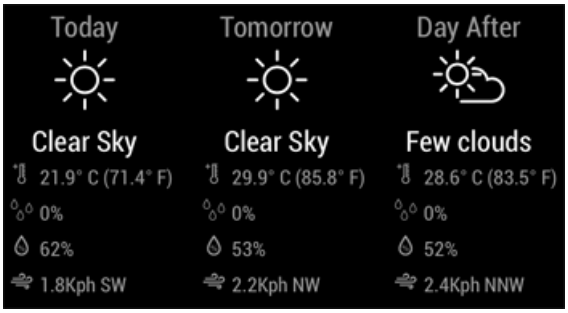

Figure 4.4: Weather notification

CHAPTER 5

RESULTS AND DISSCUSSIONS

5.1 Experimental Set Up

The simulation begins with facial recognition, which is the first step to login to the mirror. The facial recognition is done with the camera which is present at the top of the mirror. This camera is connected to the raspberry pi which helps to process the image and grant access to the user. There are many other components which are hidden behind the mirror as shown in figure 5.3. The components include speakers, raspberry pi, microphone, camera, LCD monitor, power cable. These hardware components work together to provide the hardware necessary for the mirror to function.

There is a wide range of software which has been created to work flawlessly with the hardware of the product. Multiple modules have been created such as the weather module which displays the weather, news module which displays news, speech recognition module which allows the user to communicate with the smart mirror.

Once the user logs into the smart mirror, the home page of the mirror will display the time, weather and news are shown in figure 5.4. The user is now free to communicate with the smart mirror using speech recognition. There are thousands of commands which the user can I've the mirror, examples of a few commands are, What is the weather in delhi? , What is the time in Chicago? , Tell me todays top news. , Tell me the latest football news. and many more.

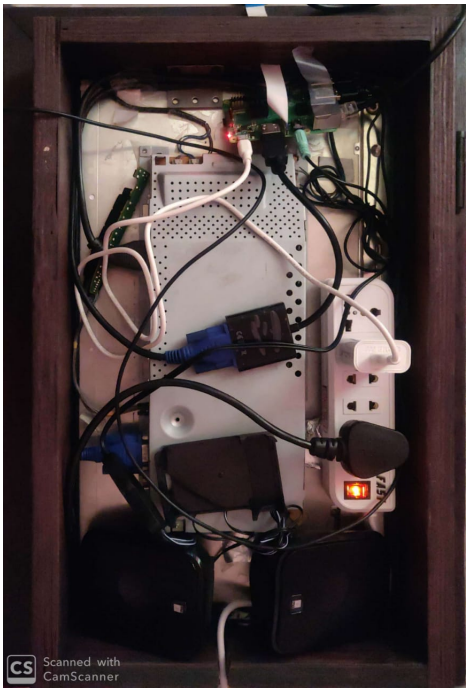

Figure 5.1: Components of the smart mirror which stay hidden in the back of the mirror

5.2 Facial Recognition Accuracy

The two most important modules which are, facial recognition and speech recognition were tested for success rate and the result were as stated below. For testing facial recognition a sample space of 40 attempts were taken out of which 36 attempts were successful therefore the total success rate for the facial recognition module was 90 percent.

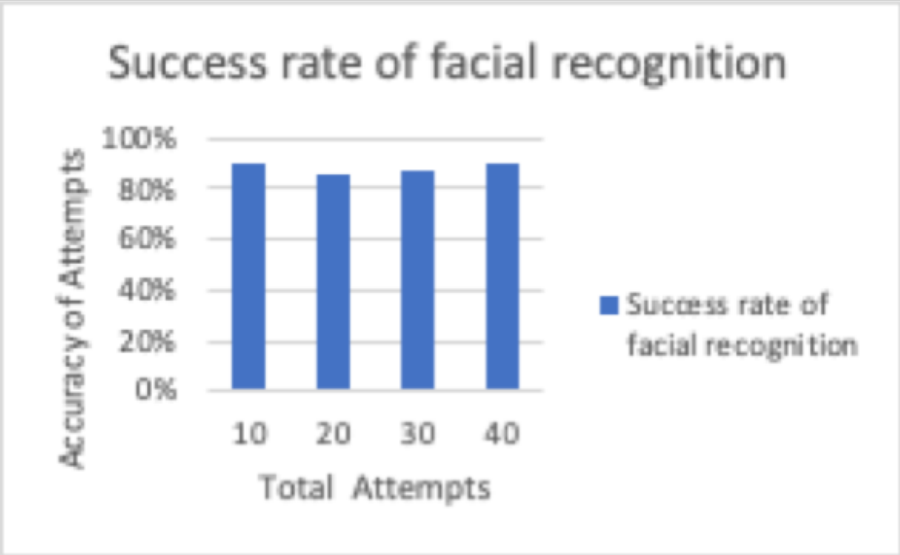

Figure 5.2: Facial Recognition Graph

5.3 Speech Recognition Accuracy

For testing the speech recognition module a total of 40 attempts were taken out of which 37 times the system successfully identified the voice command given by the user. For speech recognition we framed sentences which had the same root meaning in different ways to test how well the statement is being understood by the device. Example - (1) Please tell me the weather in Delhi. (2) what is the weather in Delhi. This process of testing gave us a success rate of 92.5 percent.

We have also compared our test results with the accuracy of existing systems and mentioned the results in table 5.1. When compared to the other existing systems our accuracy rate is higher.

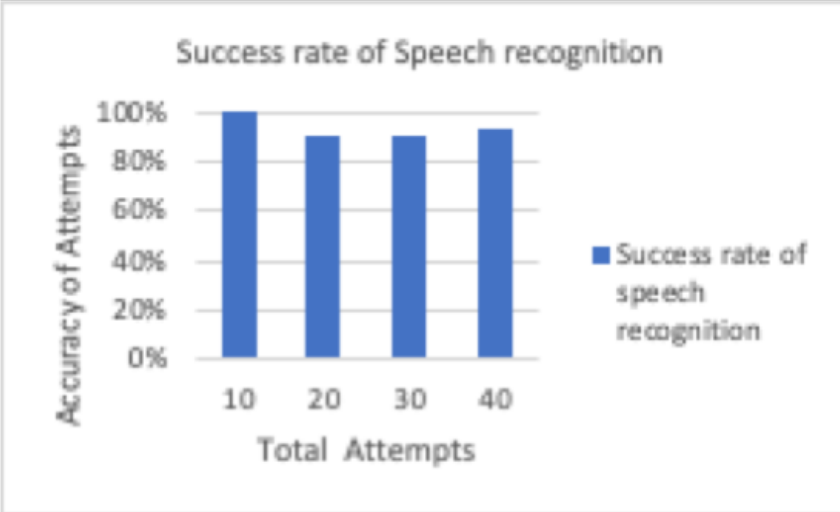

Figure 5.3: Speech Recognition Graph

Source	Facial Recognition Accuracy	Speech Recognition Accuracy
Proposed Smart Mirror	90	92.5
Smart mirror digital magazine	Not Available	Not Available
Smart mirror design powered by raspberry pi	88	Not Available
Single sample facial recognition	92.5	Not Available

Table 5.1: Accuracy comparrision table

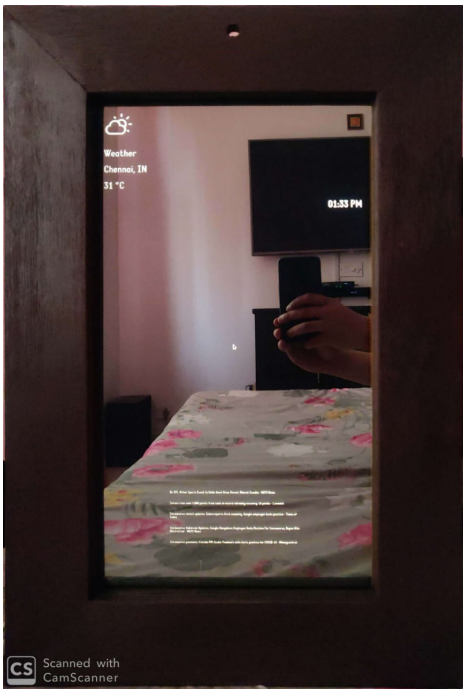

Figure 5.4: Home Screen of the mirror displaying Time, Weather and News updates.

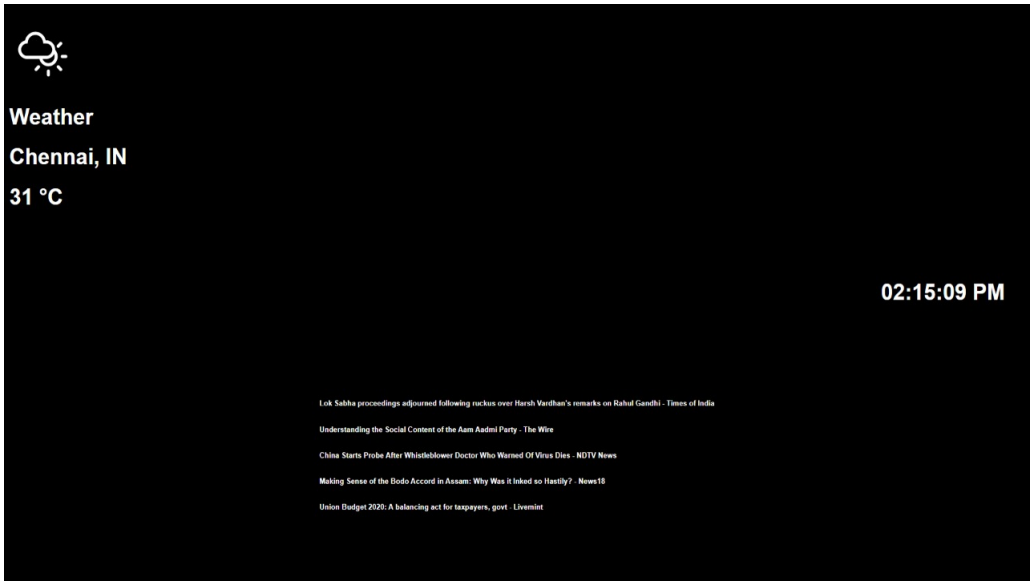

Figure 5.5: Home Screen

Figure 5.6: Sports Update module.

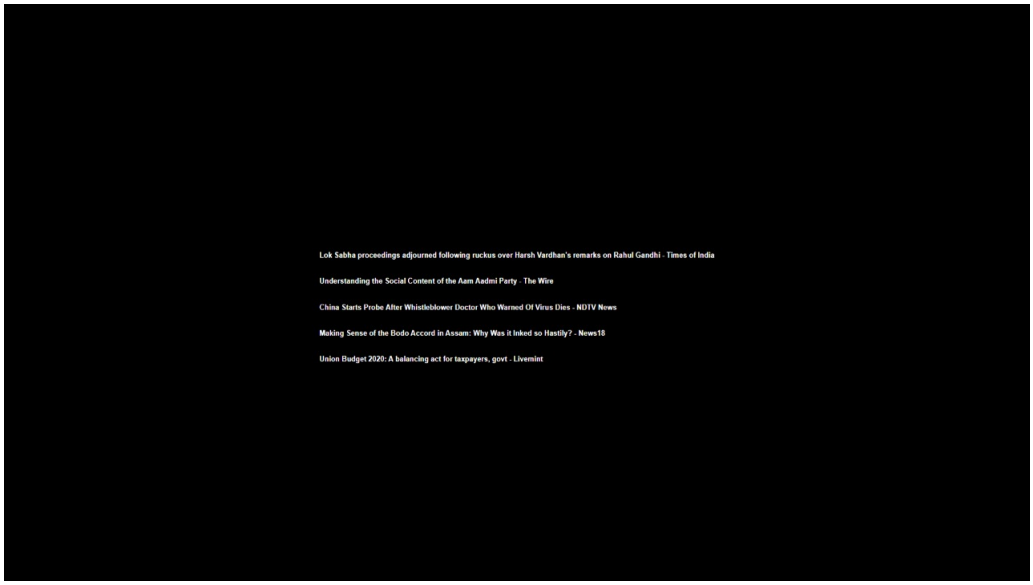

Figure 5.7: News Module

Figure 5.8: Weather Module

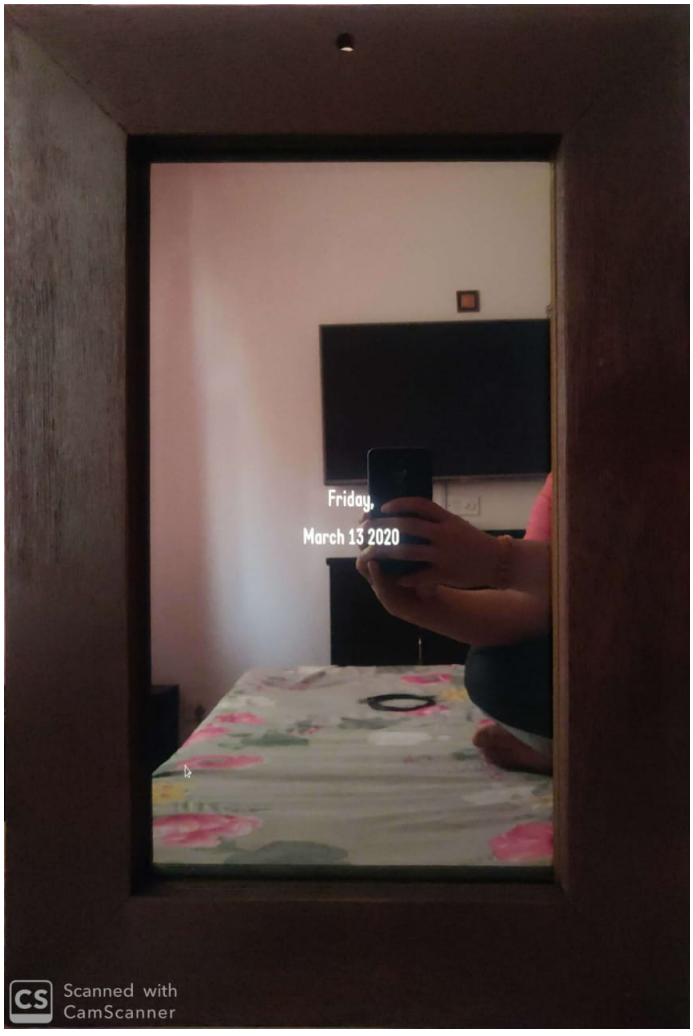

Figure 5.9: Lock Screen of mirror displaying Date and Day, to maintain privacy.

CHAPTER 6

CONCLUSION

The system proposed by us is a smart mirror which is built for the general public for day to day use. The smart mirror has multiple capabilities and applications which include, news, date, time, weather and more. The two main features are Facial recognition - This provides the security for the smart mirror. Only a registered user can log into the smart mirror. Linear Binary Pattern Histogram algorithm is used in the facial recognition. 2. Speech recognition - The main method to interact with the user is via speech recognition. When the user registers into the smart mirror a sample of the users voice is also taken which then is used to recognize the user. Which makes interaction with the mirror truly hands free.

The performance of the proposed system is evaluated by using an evaluation metric namely accuracy. The speech recognition and facial recognition of the proposed system achieve 100 percent and 90 percent respectively in terms of accuracy. A system which is compact and efficient and uses new technology for making home truly smart.

CHAPTER 7

FUTURE ENHANCEMENT

The smart mirror is in prototype stages. Future work includes, improvements in accuracy in both speech and facial recognition and GUI. The size of the device has to be reduced as small as possible to improve convenience and portability of the users. Additionally, the smart mirror can also be improved in such a way that it has the ability to work with other smart devices such as smart tv, smart lights, smart fridge etc.

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CHAPTER 8

APPENDICES

8.1 Appendix 1- News Module

In this appendix the code which enables the news module to function is given. The coding is done in python. The source used to retrieve the news is google news. The news feed is an rss feed which enables the dynamic updation of news to bring the user the latest news.

CODE-

```
from bs4 import BeautifulSoup as soup
import requests
def getnews():
ndata = []
try: url = 'https://news.google.com/news/rss'
c = requests.get(url)
page = c.content
sp = soup(page, 'xml')
newslist = sp.findAll('item')
for news in newslist[:5]:
ndata.append(news.title.text)
except Exception as e:
```

```
print(e)

ndata = None

return ndata
```

8.2 Appendix 2 - Sports Module

In this appendix the code which provides the user with sports updates is given. Many different sports updates are available including cricket, football, basketball , hockey and more. This module is also coded in python. The user can simply give a command saying - tell me the latest football updates and this module will start to function.

CODE-

import sports

def sp(text):

if 'cricket' in text:

cmatches()

elif 'basketball' in text:

bkmatch()

elif 'tennis' in text:

tmatch()

elif 'hockey' in text:

hmatch()

elif 'soccer' in text:

smatch()

def cmatches():

try:

matches = sports.get$_sport(sports.CRICKET)$

cdata = matches

except Exception as exc:

cdata = None

return cdata

def bkmatch():

try:

matches = sports.get$_sport(sports.BASKETBALL)$

bdata = matches

except Exception as exc:

bdata = None

return bdata

def tmatch():

try:

matches = sports.get$_sport(sports.TENNIS)$

tdata = matches

except Exception as exc:

tdata = None

return tdata

def hmatch():

try:

matches = sports.get$_sport(sports.HOCKEY)$

hdata = matches

except Exception as exc:

hdata = None

return hdata

def smatch():

try:

matches = sports.get$_sport(sports.SOCCER)$

sdata = matches

except Exception as exc:

sdata = None

return sdata

8.3 Appendix 3 - Weather Module

This appendix provides the python code which enables the weather module to function. The weather data is retrieved from openweathermap. This module can be activated by the user when he asks the smart mirror for weather updates. This codes allows the user to ask the weather of any city around the world.

CODE-

from datetime import datetime

import os

import pytz

import requests

import math

API$_K EY =' 985789f27496b55f65d15223a55155c4'$

API$_U RL = ('http://api.openweathermap.org/data/2.5/weather?q = mode = jsonunits = metricappid = ')$

def query$_a pi(city) : try :$

print(API$_U RL.format(city, API_K EY))$

data = requests.get(API$_U RL.format(city, API_K EY)).json()$

except Exception as exc:

print(exc)

data = None

return data

8.4 Appendix 4 - Wikipedia Module

This appendix provides the code which gives a summary about any topic present in wikipedia which is the largest online encyclopaedia. If the user says a command "what is a black hole?" This module will be activated and the smart mirror will read out the summary of black holes present on wikipedia. This code is also written in python.

CODE-

```
import wikipediaapi

def getwiki(select):

wikidata = 'titlee': None, 'summaryy': None

wiki = wikipediaapi.Wikipedia('en')

page = wiki.page(select)

status = page.exists()

if status == True:

wikidata.update(titlee = page.title)

wikidata.update(summaryy = page.summary)

return wikidata

else: error = 'The could not be found.'

return error
```

8.5 Appendix 5 -Facial Recognition Module

This appendix provides the code which enables the facial recognition module of the module to function. This code is written in python. The facial recognition provides the security for the smart mirror. The algorithm used in facial recognition is "local binary pattern histogram." This module becomes active when the user says the command "login."

CODE -

```
import cv2
import numpy as np
import sqlite3
import os
from App.Modules.Speak.speakerr import spout
from App.Modules.facerecog.data_gateringimportfdata
from App.Modules.facerecog.trainer import train
def recog():
print('hello')
conn = sqlite3.connect('C:/Users/Yash Tandon')
c = conn.cursor()
fname = "C:/Users/Yash Tandon"
if not os.path.isfile(fname):
print("Please train the data first")
fdata()
```

train()

face$_c ascade = cv2.CascadeClassifier('C : /Users/YashTandon/')$

cap = cv2.VideoCapture(0)

recognizer = cv2.face.LBPHFaceRecognizer$_c reate()$

recognizer.read(fname)

ret, img = cap.read()

gray = cv2.cvtColor(img, cv2.COLOR$_B GR2GRAY)$

faces = face$_c ascade.detectMultiScale(gray, 1.3, 5)$

for (x,y,w,h) in faces:

cv2.rectangle(img,(x,y),(x+w,y+h),(0,255,0),3)

ids,conf = recognizer.predict(gray[y:y+h,x:x+w])

c.execute("select name from users where id = (?);", (ids,))

result = c.fetchall()

name = result[0][0]

if conf < 50:

print(name)

return name

else:

break

cv2.imshow('Face Recognizer',img)

cap.release()

cv2.destroyAllWindows()

8.6 Appendix 6 - Speech Recognition Module

This appendix provides the code for the speech recognition module to function. This code is also written in python. This module is activated every time the user tries to interact with the smart mirror.

CODE -

import pyttsx3

from ..News.news import getnews

from selenium import webdriver

from selenium.webdriver.chrome.options import Options

from ..Sports.spdata import *

from ..Weather.weather import query$_{a}pi$

from ..Wikipedia.wiki import getwiki

from ..facerecog.recognizer import recog

from ..facerecog.data$_{g}ateringimportfdata$

from ..facerecog.trainer import train

chromeOptions = Options()

chromeOptions.add$_{a}rgument(" --kiosk")$

chromeOptions.add$_{e}xperimental_{o}ption("excludeSwitches", ['enable-automation'])$

driver = webdriver.Chrome(chrome$_{o}ptions = chromeOptions)$

driver.get('http://127.0.0.1:5000/login')

sdata = None

```
wikidata = None

wedata = None

user = None

def log():

global user

user = recog()

print(user)

if user != None:

driver.get('http://127.0.0.1:5000/')

else: spout("Sorry, Couldn't recognize you")

spout("Please make sure that you are registered")

def sign():

if user != None:

driver.get('http://127.0.0.1:5000/signup')

spout('Please stand in front of the mirror and look at the camera')

fdata()

train()

else:

spout('One can only signup when a registered person is logged in!')

def spout(spdata):

mirror = pyttsx3.init()

rate = mirror.setProperty('rate', 150)
```

```
mirror.say(spdata)

mirror.runAndWait()

def newslist(text):

if user != None:

ndata = getnews()

driver.get('http://127.0.0.1:5000/news')

if 'show' or 'display' not in text:

for news in ndata:

spout(news)

else:

spout('Sorry, You are not logged in')

def hpage():

if user != None:

driver.get('http://127.0.0.1:5000/')

else:

spout('Sorry, You are not logged in')

def wpage(text):

loop to check city in text and then pass it too the function

if user != None:

global wedata

list = text.split()

with open('C:/Users/Yash Tandon/Desktop/python course/basic projects/indiancities.txt','r')
```

```
as f, open('cities.txt','w') as fo:
    for line in f:
    fo.write(line.replace('"', ' ').replace("'", " "))
    file = open('cities.txt')
    for cities in file:
    cities = cities.strip().split()
    for word in list:
    if word in cities:
    wedata = query_api(word)
    weadata = []
    weadata.append(wedata)
    driver.get('http://127.0.0.1:5000/weather')
    if 'show' or 'display' not in text:
    for we in weadata: spout('the current temprature in')
    spout(we['name'])
    spout('is')
    spout(we['main']['temp'])
    spout('degree Celcius') else:
    spout('Sorry, You are not logged in')
    def spage(text):
    global sdata
    if user != None:
```

```
if 'cricket' in text:

sdata = cmatches()

elif 'basketball' in text:

sdata = bkmatch()

elif 'tennis' in text:

sdata = tmatch()

elif 'hockey' in text:

sdata = hmatch()

elif 'soccer' in text:

sdata = smatch()

print(sdata)

driver.get('http://127.0.0.1:5000/sports')

else:

spout('Sorry, You are not logged in')

def wikipage(text):

global wikidata

if user != None:

select = text[5:]

wikidata = getwiki(select)

wdata = []

wdata.append(wikidata)

driver.get('http://127.0.0.1:5000/wiki')
```

```
if ’show’ or ’display’ not in text:

for w in wdata:

spout(w[’titlee’])

spout(w[’summaryy’])

else:

spout(’Sorry, You are not logged in’)

def exi():

global user

user = None

driver.get(’http://127.0.0.1:5000/login’)
```

8.7 Appendix 7 - Date Module

In this appendix the python code which enables the date to be displayed is present. This module is always running when the smart mirror is on the home screen. separately this module can be activated by the user when he asks for the date.

CODE -

```
from datetime import date

def day():

cdate = date.today()

data = ’datee’: None, ’wday’: None

d = cdate.strftime(’

wd = cdate.strftime(’

data.update(datee = d)

data.update(wday = wd)

return data
```

8.8 Appendix 8 - Multiprocessing

In this appendix the python code which allows the smart to do multiprocessing is present. This module is activated automatically by the mirror when the mirror thinks it has multiple tasks to do simultaneously. A command such as "Tell me the date and time." will enable this module to start functioning.

CODE -

```
import threading
from App.Modules.Speech.sr import process
from App.server import app
t1 = threading.Thread(target=process)
t2 = threading.Thread(target=app.run)
t2.start()
t1.start()
t2.join()
t1.join()
print('done')
```

8.9 Appendix 9 -Libraries used

This appendix provides the details of all the various libraries that were used to enable this project to function.

Flask>=1.0.0

Flask-RESTful==0.3.5

Flask-Jsonpify==1.5.0

sports.py==2.0.9

selenium==3.11.0

SpeechRecognition==3.6.3

beautifulsoup4==4.5.3

requests==2.22.0

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