

CHAPTER 1

INTRODUCTION

The following document is a report on the Group Project on Smart door using facial recognition. It involved building a system for face detection and face recognition using several classifiers available in the open computer vision library (OpenCV). Face recognition is a non-invasive identification system and faster than other systems since multiple faces can be analyzed at the same time. The difference between face detection and identification is, face detection is to identify a face from an image and locate the face. Face recognition is making the decision “whose face is it?” using an image database. In this project both are accomplished using different techniques and are described below. The report begins with a brief history of face recognition. This is followed by the explanation of HAAR-cascades, Eigenface, Fisherface and Local binary pattern histogram (LBPH) algorithms. Next, the methodology and the results of the project are described. A discussion regarding the challenges and the resolutions are described. Finally, a conclusion is provided on the pros and cons of each algorithm and possible implementations.

1.1 History of Facial Recognition

Face recognition began as early as 1977 with the first automated system being introduced By Kanade using a feature vector of human faces. In 1983, Sirovich and Kirby introduced the principal component analysis (PCA) for feature extraction. Using PCA, Turk and Pentland Eigenface was developed in 1991 and is considered a major milestone in technology. Local binary pattern analysis for texture recognition was introduced in 1994 and is improved upon for facial recognition later by incorporating Histograms (LBPH). In 1996 Fisherface was developed using Linear discriminant analysis (LDA) for dimensional reduction and can identify faces in different illumination conditions, which was an issue in Eigenface method. Viola and Jones introduced a face detection technique using HAAR cascades and ADABOOST. In 2007, a face recognition technique was developed by Naruniec and Skarbek using Gabor Jets that are similar to mammalian eyes. In This project, HAAR cascades are used for face detection and Eigenface, Fisherface and LBPH are used for face recognition.

CHAPTER 2

LITERATURE SURVEY

In recent years a great deal of time and effort has been spent of developing systems to enable an autonomous robot to follow a marked path using a vision system. Not surprisingly, the majority of this research has been towards modifying, or designing from scratch, a full-sized road vehicle so that it can drive on ordinary roads without human supervision. Due to the large amount of space available in an ordinary road vehicle, high performance computers can be used to perform complex image processing and, typic ally, to maintain a mathematical model of the vehicle and the environment.

Forgetting keys is a very common problem in the entire world, to solve there has been many solutions for centuries, yet those solutions are being made smarter. A lock was first invented with a several keys, then came an era of passcode enabled mechanical locks, then those mechanical locks were given electronic abilities and were digitalized. Further RFID locks were invented to which a key was just a card, then digital locks with biometric authentication came into picture. The scope of smart locks is huge in the world.

With a smart lock Security is also concerned, antitheft and surveillance are also great market seeking.

2.1 Autonomous Robots

Autonomous robots are independent of any controller and can act on their own. The robot is programmed to respond in a particular way to an outside stimulus. The bump-and-go robot is a good example. This robot uses bumper sensors to detect obstacle. When the robot is turned on, it moves in a straight direction and when it hits an obstacle, the crash triggers its bumper sensor. The robot gives a programming instruction that asks the robot to back up, turn to the right direction and move forward. This is its response to every bump. In this way, the robot can change direction every time, it encounters an obstacle.

A more elaborate version of the same idea is used by more advanced robots. Robotics create new sensor systems and algorithms to make robots more perceptive and smarter . Today, robots are able to effectively navigate a variety of environments. Obstacle

CHAPTER 3

STEPS IN SOFTWARE AND CIRCUIT DESIGNING

3.1 Software Tools

3.1.1 Arduino IDE

After the block diagram, coding needs to be done. The software used for coding is avr studio4 and the language used for coding is “embedded c”.

The program code acts as the decision-maker embedded in the microcontroller i.e. it decides what will be the outputs for particular set of input combination. Programs for the AVR series of microcontrollers can be written in assembly C and AVR Studio etc. We are using winAVR for programming and AVR Studio for simulating (Simulation means debugging the code on software, one can virtually give the input and check the output for that code). In winAVR programmers Notepad we write our C code, after compilation it generates ‘.hex’ file that is a hardware level code.

ESP8266 espressif board is used. For this an additional Board is to be installed using .json link and adding the board from board manager.

3.1.2 Python Open CV

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.



We have used python as the scripting language because of its diversity and open source virtue.

3.1.3 Kodular

Kodular (formerly Makeroid) is an online suite for mobile app development. It mainly provides a free drag-and-drop Android app creator without coding, based on

CHAPTER 4

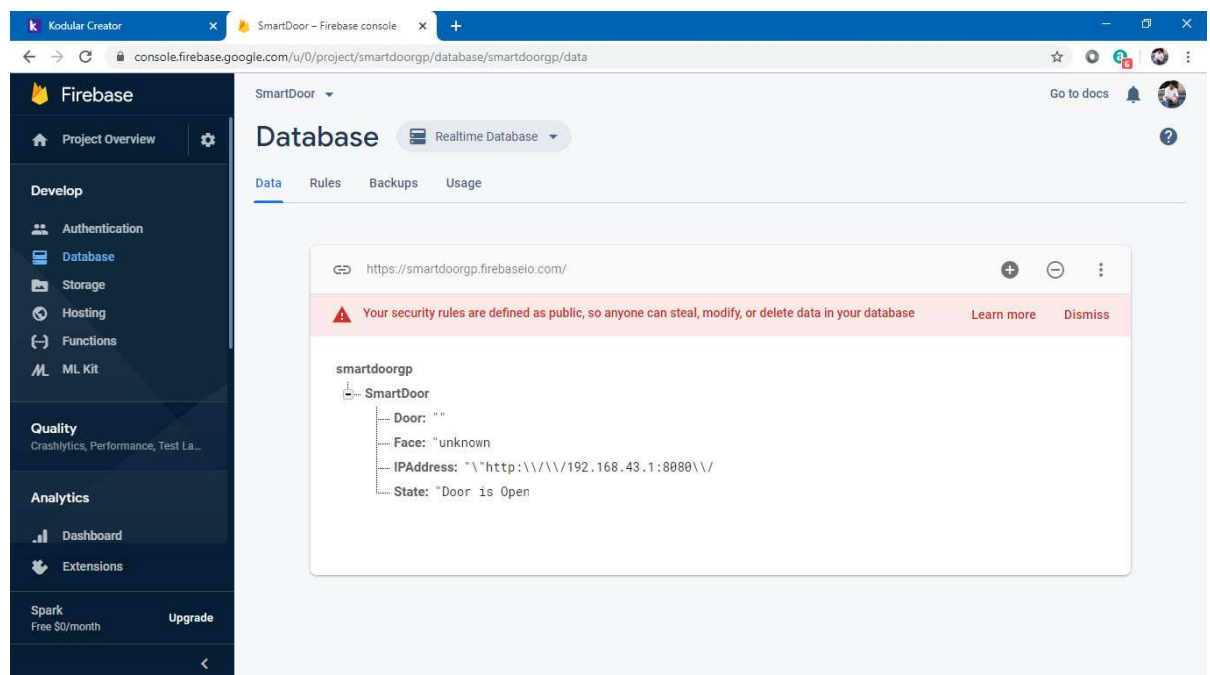
RESULT & DISCUSSION

Our project is an innovative idea of intelligent system which has basically face detection feature and will provide help in various places.

1. The battery activates the circuit.
2. The laptop is switched on and the program runs, it sends the information to the cloud. Or The application in the android can toggle the door state.
3. Esp8266 receives the data using internet connected hotspot.
4. Servo motor rotates in accordance to the signal given by the microcontroller

4.1 Result

The objective of the Smart door is to provide security at ease. We have been successful in providing the same. The door is successfully designed and built, the product is efficient and works best with a good internet connectivity.



4.1 Output Firebase Database

```

when Firebase_Database1 . Data Changed
  tag value
do
  if
    get tag = "Face"
  then
    if
      length get value ≥ "2"
    then
      call Text_To_Speech1 . Speak
      message join
        get value
        "Has come Home "

```

```

when Screen1 . Back Pressed
do
  close application

```

```

when Button2 . Click
do
  call Fingerprint1 . Authenticate

```

```

when Fingerprint1 . On Authentication Succeeded
do
  if
    Label1 . Text = "Door is Open"
  then
    set Label1 . Text to "Door is Closed"
    set Button2 . Text to "Open Door"
    call Firebase_Database1 . Store Value
    tag "Door"
    value To Store "Close"
  else
    set Label1 . Text to "Door is Open"
    set Button2 . Text to "Close Door"
    call Firebase_Database1 . Store Value
    tag "Door"
    value To Store "Open"

```

```

when Button1 . Click
do
  open another screen screenName "Screen2"

```

4.2 Output Kodular Blocks



4.3 Output Application

4.2 Advantages & Disadvantages

Advantages

- Door movement is automatic.
- Fit and Forget system.
- Cost effective.
- Simplicity of building

Disadvantages

- Needs Internet always
- Sophisticated processors for Image processing may lead to cost increment.
- Electricity requirement is a must.

4.3 Applications

- Class Room doors with automated attendance system.
- Industrial applications.
- Home applications.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE OF WORK

5.1 Conclusion

In this project we have studied and implemented a Smart Door using Facial Recognition and an application with a virtue of IoT for general people. The programming and interfacing of microcontroller has been mastered during the implementation.

Nowadays every gadget being used is turning into a smart gadget, everything we use is turning into an electronic gadget. A little bit of programming into a Microcontroller or Microprocessor will make an electronic gadget a smarter tool. The use of technology is now not just restricted to Space agencies or laboratories but also a home is now equally technically equipped right from the entrance. Our Idea of SMART DOOR is successful in its idea of making life at home more comfortable and giving our home an ability to recognize us.

5.2 Future Scope

Use of enhanced processors for processing instead of the Laptop being on forever. The present system processes the Image data and sends it to a cloud and then it is sent to the Microcontroller on the door to open it. This is a time consuming and tedious task, instead we can inculcate the entire task inside the door using the processors.

CHAPTER 6

BIBLIOGRAPHY

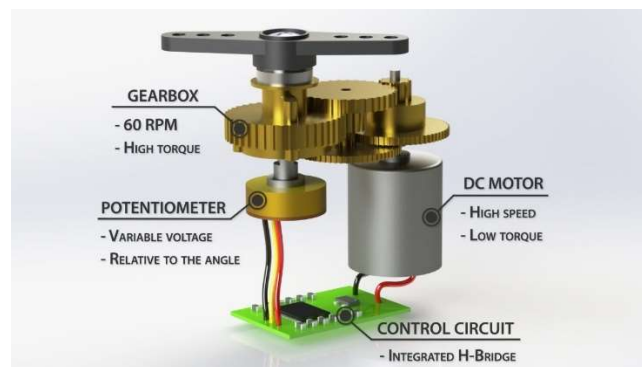
6.1 References

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APPENDIX

7.1 Servo Motor (SG90)

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which runs through servo mechanism.



7.1 Servo Motor Internal

Servo Motor Construction:

The following figure shows the construction of a standard servo motor. ISL Products offers a wide variety of servo motors to accommodate for different industrial applications. The servo motor consists of two winding stator and rotor windings. The stator winding is wound on the stationary part of the motor, and this winding is also called field winding of the motor. The rotor winding is wound on the rotating part of the motor and this winding is also called the armature winding of the motor. The motor consists of two bearings on front and back side for the free movement of shaft. The encoder has the approximate sensor for determining rotational speed and revolution per minute of the motor. Our Motor Selection Tool will help you identify your requirements.

Servo Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor

3. Feedback system

Working of servo motors :

Servo motors control position and speed very precisely. Now a potentiometer can sense the mechanical position of the shaft. Hence it couples with the motor shaft through gears. The current position of the shaft is converted into electrical signal by potentiometer, and is compared with the command input signal. In modern servo motors, electronic encoders or sensors sense the position of the shaft.

We give command input according to the position of shaft. If the feedback signal differs from the given input, an error signal alerts the user. We amplify this error signal and apply as the input to the motor, hence the motor rotates. And when the shaft reaches to the required position, error signal becomes zero, and hence the motor stays standstill holding the position.

The command input is in form of electrical pulses. As the actual input to the motor is the difference between feedback signal (current position) and required signal, hence speed of the motor is proportional to the difference between the current position and required position. The amount of power required by the motor is proportional to the distance it needs to travel.

Principle of working:

Servo motor works on the PWM (Pulse Width Modulation) principle, which means its angle of rotation is controlled by the duration of pulse applied to its control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears

Mechanism of servomotor:

Basically a servo motor is a closed-loop servomechanism that uses position feedback to control its motion and final position. Moreover the input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft .

The motor incorporates some type of encoder to provide position and speed feedback. In the simplest case, we measure only the position. Then the measured position of the output is compared with the command position, the external input to controller. Now If

the output position differs from that of the expected output, an error signal generates. Which then causes the motor to rotate in either direction, as per need to bring the output shaft to the appropriate position. As the position approaches, the error signal reduces to zero. Finally the motor stops.

The very simple servomotors can position only sensing via a potentiometer and bang-bang control of their motor. Further the motor always rotates at full speed. Though this type of servomotor doesn't have many uses in industrial motion control, however it forms the basis of simple and cheap servo used for radio control models.

Servomotors also find uses in optical rotary encoders to measure the speed of output shaft and a variable-speed drive to control the motor speed. Now this, when combined with a PID control algorithm further allows the servomotor to be in its command position more quickly and more precisely with less overshooting .

Controlling of servomotors:

Usually a servomotor turns 90 degree in either direction hence maximum movement can be 180 degree. However a normal servo motor cannot rotate any further to a build in mechanical stop.

We take three wires are out of a servo: positive , ground and control wire. A servo motor is control by sending a pulse width modulated (PWM) signal through the control wire. A pulse is sent every 20 milliseconds. Width of the pulses determine the position of the shaft.

Applications:

1. Robotics: At every joint of the robot, we connect a servomotor. Thus giving the robot arm its precise angle.
2. Conveyor belts: servo motors move, stop, and start conveyor belts carrying product along to various stages, for example, in product packaging/ bottling, and labelling.
3. Camera auto focus: A highly precise servo motor build into the camera corrects a camera lens to sharpen out of focus images.
4. Solar tracking system: Servo motors adjust the angle of solar panels throughout the day and hence each panel continues to face the sun which results in harnessing maximum energy from sunup to sundown.

1. If a heavy load is placed on the motor, the driver will increase the current to the motor coil as it attempts to rotate the motor. Basically, there is no out-of-step condition.
2. High-speed operation is possible.

ESP-12E DEVELOPMENT BOARD PINOUT

NOTES:

- ▲ Typ. pin current 6mA (Max. 12mA)
- ▲ For sleep mode, connect GPIO16 and EXT_RSTB. On wakeup, GPIO16 will output LOW for system reset.
- ▲ On boot/reset/wakeup, keep GPIO15 LOW and GPIO2 HIGH.

Pinout Details:

Left Side (GPIO Pins):

- 3V3, GND
- U0TXD (GPIO1), 22
- U0RXD (GPIO3), 21
- U0RTS (MTDO, GPIO15), 16
- U0CTS (MTCK, GPIO13), 7
- U1TXD (MTDI, GPIO12), 6
- U1RXD (MTMS, GPIO14), 5
- GND, 3V3
- U1TXD (GPIO2), 17
- SPI_CS2 (GPIO0), 18
- GPIO4, 19
- GPIO5, 20
- KPD_CDCC (GPIO16), 4

Right Side (Power and I/O Pins):

- Vin, GND
- CHIP_EN (3), CH_PD (1)
- EXT_RSTB (1)
- 3V3, GND
- GPIO6 (SIO1 CLK), 14
- GPIO7 (SIO1 DATA0), 10
- GPIO11 (SIO1 CS0), 9
- GPIO8 (SIO1 DATA1), 13
- GPIO9 (SIO1 DATA2), 11
- GPIO10 (SIO1 DATA3), 12
- RESERVED
- RESERVED
- ADC (2), TOUT (2)

Legend:

- POWER: 3V3, GND
- I/O: U0TXD, U0RXD, U0RTS, U0CTS, U1TXD, U1RXD, SPI_CS2, GPIO4, GPIO5, KPD_CDCC
- ADC: ADC
- CONTROL: CHIP_EN, CH_PD, EXT_RSTB
- N/C: N/A
- SP. FUNCTION(S): MTDO, MTCK, MTDI, MTMS
- COMM. INTERFACE: SIO1 CLK, SIO1 DATA0, SIO1 CS0, SIO1 DATA1, SIO1 DATA2, SIO1 DATA3
- PIN NUMBER: 1-22
- PHM: Pin Header Marking

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