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Next in Gate – A Smart Security Gate System

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ABSTRACT: Here, we presented an automated digital gate device with authenticity affirmation like face detection. The ultrasonic sensor detects the person and provokes the digital digicam to seize the auto photo and recognize the person. We used OpenCV and ML algorithm to recognize the faces. Pymata4 is library of python which helps us to connect the arduino with integration of python code and operate the servo motors and fetch the sensor data. Interactive voice assistant is built with help of speech recognition and *pytsx3* libraries of python.

KEYWORDS: Face recognition, Voice assistant, embedded systems, arduino, Ultrasonic sensor, Machine Learning.

I. INTRODUCTION

Accessing certain limited premises is fraught with difficulties due to security issues that need to be managed diligently. Surveillance cameras are widely used to check the activities done by humans at any location. Computer imaginative and prescient and photograph processing tactics offer an automated device for reading those photos and videos. Since the range of automobiles are growing day with the aid of using day, those technology can offer less complicated and quicker answers in such scenarios.

We humans can easily identify the faces but for machines it is very complicated even machine needs to do lots of computations to tell simply is there any face in the picture. However, by using OpenCV's Python bindings, a machine can find faces in any picture it uses machine learning algorithm to do it. Faces are so complex that a straightforward test for determining if a face has been found cannot be devised. The pattern must be matched against thousands of small characteristics. The task of identifying faces can be broken down into thousands of smaller, manageable tasks using algorithms. A classifier is a way to classify the tasks. It could be possible to have 6,000 or more classifiers for something like a face. Faces can only be detected if their classifiers match. While in face detection the algorithm looks at every stage of data and checks wheatear it is a face or not. This problem is solved by OpenCV through cascades. But what is a cascade? A cascade is what the dictionary describes: "a waterfall or collection of waterfalls." Using OpenCV, the issue of detecting faces is broken into a series of steps, like a waterfall. If the test passes, a slightly more detailed test is performed. If the test passes, a final test is performed. Towards the end of the algorithm, if all stages have been met, only one face can be detected. As a result, most of the image will go back to an awful over the first few levels, so that there is no need to test all 6,000 features. Face detection is now possible within seconds rather than taking hours. In practice, it is rather easy, even though the theory might seem complicated. You initialize your code with the cascades that you want, and then it performs the detection. XML files containing information from OpenCV are contained within them.

In this work, we propose a smart and safe electronic gate based system which has many functionalities mainly face detection and interactive voice assistant. Ultrasonic sensor helps to detect the person. Once person is detected then it is recognized by using face detection. If person is authorized if face is matched with the database then gate will open and if not then voice assistant will ask details and record the answer and he will also capture the face and lastly after recognition operator will decide to open gate or not. The GUI is built for operator to operator gate setting in the office once the person is detected by IR sensor the Voice notification is given to the operator so he can also monitor the things.



II. LITERATURE REVIEW

Paper ref No.	Learning Techniques Sensors Used	Summary
[1]	Arduinio, RFID.	system is implemented using RFID (Radio Frequency Identification) Technology and Arduinio board
[2]	Bluetooth, Arduinio.	In this project they used Bluetooth as a key to open the door they find optimal distance that when user comes within the range the door should be open.
[3]	RFID, GSM.	In this paper they talked about RFID and GSM technology to restrict fake person enter.
[4]	Arduinio, Internet of things, RFID, Bluetooth.	This project is based on IOT they used RFID tags to give access of gate.
[5]	Face Recognition, SMS, Raspberry PI, webcam, Servomotor, Ultrasonic sensor.	A face is recognized through the haarcascade technique on door using webcam and SMS is sent to owner to prevent unwanted criminal activity.
[6]	Fingerprint recognition, Radio frequency communication technology, and PIC microcontroller.	They used radio frequency to send the signal and open the gate and for recognition of person the fingerprint scanner is used.

III. METHODOLOGY

A. Materials/Components/Block Diagram/Theory

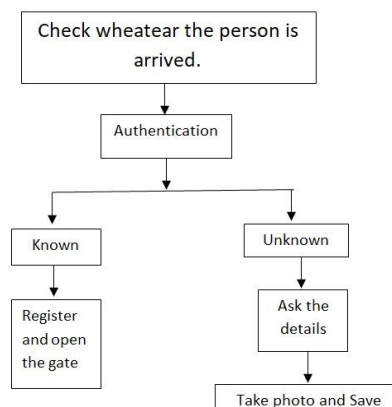


Fig.1.Block Diagram of Next In Gate.

Components:

The proposed system consists of following component which are listed below:

1. Arduino (ATMEGA 328P)
2. Ultrasonic sensor
3. IR sensor
4. Servo Motor

1. Arduino

We used the arduino for the interaction between software and hardware. It helps to send signals to motor and receive the sensor data. It is the controller of project controls all the system.



Fig.2.Arduino

2. Ultrasonic Sensor

This sensor detects the distance between a person and the gate using ultrasonic waves. It detects the distance by sending ultrasonic waves and then converts back it into electric signal. It uses accurate and fast result. So we used it to detect the presence of persons in front of gate.

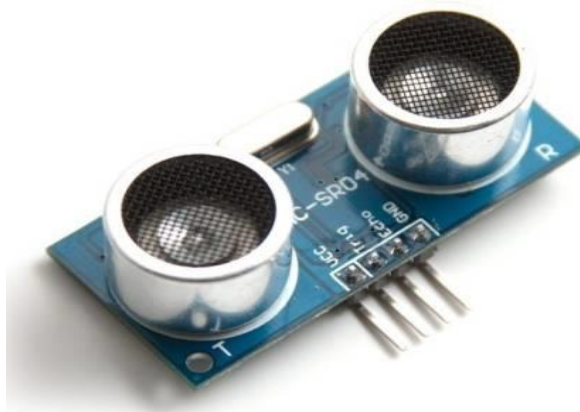


Fig.3.Ultrasonic sensor

3. IR sensor

A person can be detected by an infrared sensor if they are standing in front of the gate and open the camera to take the photo and check whether the person is authentic or not.

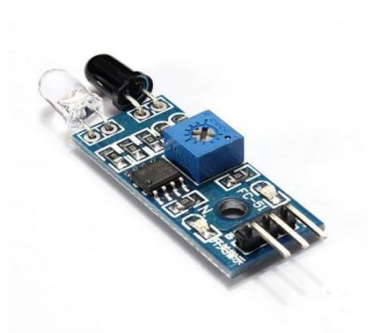


Fig.4.IR sensor

4. Servo Motor

Servomotor works as a linear actuator and gives very precise control of angular position. And it has a sensor which gives feedback of position which helps us to use this motor as a gate to open or close the gate.



Fig.5.Servo Motor

B.Face detection.

Face detection is considered as finding a face in image or video we used HAAR Cascade Algorithm to detect the face from video camera. The HAAR cascade is machine learning approach where it is trained from lots of positive and negative images. Here positive images are those which contains the faces and negative images does not contains faces. In face detection images features are treated as numerical values extracted from pictures that can be distinguish one image from another.

C. Face recognition

Faces to be recognized are first added to our system so that model can trained for those people so for this we capture 30 samples of each person and then train the model for those persons and save the faces with particular names. We used LBPH algorithm which is Local Binary Pattern Histogram Algorithm in this algorithm the data is be trained with unique ids. After training the data set the algorithm will the faces now can be recognized using LBPH algorithm.

D. Voice Assistant

The voice assistant is used to ask the details to person who is unknown for system and save information of him for this we used different python libraries like Speech Recognition, pyttsx3.

E. Interfacing arduino with python and other peripherals

We interfaced the servo motor, Ultrasonic sensor, IR sensor with arduino suing pymata4 library of python to work in python and send signals through python codes and Arduino.



IV. BUILDING THE PROTOTYPE

Hardware Design.

Laptop's inbuilt camera was used to capture images of person arriving at the gate. Inbuilt mic of laptop was used to record audio and to speak the inbuilt speak of laptop were used as a voice assistant. Ultrasonic sensor senses the person arriving at the gate and IR sensor was also used to detect the person. Arduino was used to control the gate and send signals to each of peripherals. Servo motor was used to control the movement of gate.

Software Design.

The software requirements include the arduino, python, Visual studio code Editor. GUI was built with help of Tkinter.

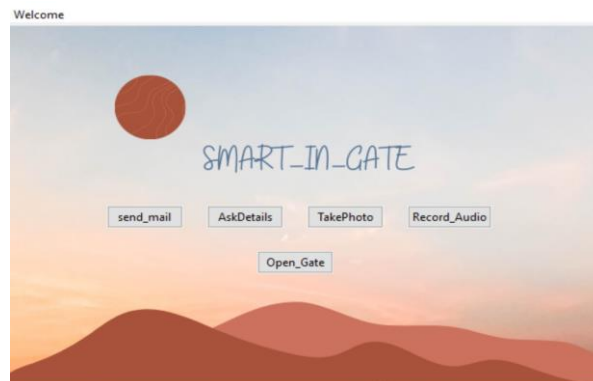


Fig.6. GUI

V. TESTING THE PROTOTYPE

The testing was done for four scenarios 1st when the person is known to the system for this case the system works good giving accurate result by recognizing the face and then welcoming the person with voice commands and finally opening the gate. 2nd scenario was when the person is not known to the system the system shows that person is not recognized and gives then the voice assistant asks the questions like What is your name and some basic questions and then the system takes photo of person and then send signal to operator, and he decides whether the person should enter or not. The operator operates system using GUI. 3rd scenario was when there is less light then the system fails to detect the person but this can be solved using lights and Ldrs to ON them when there is low visibility.



Fig.9. Hardware Implementation

VI. ADVANTAGES

1. Very feasible
2. Easy to maintain
3. Can be used for security purposes
4. Save Time



5. Minimize the human effort and increase the level of security.

The main application of the developed system are

1. This system can be used at colleges.
2. It can be used in offices and companies.
3. It can also use for a particular secured room.

VII. CONCLUSION

We proposed a smart automated gate opening system which can be used to recognise the person and open the gate automatically with integrated voice assistant which makes this system more useful and attractive. Deployment of such system can reduce human efforts and increase the level of security. The system test conducted with help of our prototype demonstrated the feasibility of the model. In this system for now we cannot recognize the faces in dark lights so in future this can be solved using night lights and better night vision cameras. In future the cars and number plates of car can be recognized.

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