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COMPUTER VISION GUIDED DIGITAL SMART HOME SECURITY

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Abstract - The development in the IoT sector is increasing day by day, and a good idea leads to great innovation. We are introducing a Wireless home automation system. Wireless home automation as a part of this Ideology uses the cloud services such as a website to control the home functions and features automatically through the internet from anywhere around the world. Automation is a way of conservation of energy, the home lighting is controlled by the BLYNK IoT and the Augmented Reality without the need for their physical presence. The proposed system includes a smart door unlocking system using Face recognition and Radio Frequency Identification (RFID) card. DHT11 is used to measure the humidity and temperature, which notifies the users to turn the appliances according to user convenience, these are controlled by the Blynk IoT which can be linked using an ESP8266 chip to the kit. This system is user-friendly and energy efficient.

Key Words: ESP8266, Blynk IoT, Virtual Reality Mobile Application, DHT 11, RFID card & reader, Buzzer, IoT.

1. INTRODUCTION

The Internet of Things (IoT) is one of the most talked about research topics in recent years. The IoT-based home automation system is getting more popularities day by day. Home automation is the controlling of different home appliances using smart devices anywhere in the world without the need for physical presence in the home. Smart home system is very beneficial in everyday life as it saves electricity and reduces worries about the home security of working people. Due to the secure, easily controllable, and monitorable features, advanced home automation system design has become a core interest for many researchers.

As a part of home automation with security, the face recognition process is initiated by a Contactless doorbell. This will turn on the integrated camera and capture images. The image will be captured using the ESP32 cam module and the image captured will be compared with the one stored in the backend database and the image will be processed by LBPH Algorithm. Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, with the help of Blynk IoT the appliances in the home, can be accessed. With Blynk IoT a Mobile application is created, so that the appliances can be monitored and accessed, along with the data collected from the DHT11 sensor.

1.1 PROBLEM IDENTIFICATION

Nowadays Electricity is one of the most important sources in the life of a human. Especially now we are in the century, there is hardly anything that does not work on electricity.

However, due to the huge demand for electricity worldwide, it has become hard to produce the demand of supply. Consumption increases with an increase in population. The generation becomes complex according to the demand, so energy conservation also plays an important role. So, Home Automation is one of the best ways to the energy conservation.

1.2 OBJECTIVE

- A prototype for turning on/off room lights and measuring the temperature & humidity using a microchip via IoT.
- Home automation takes place through Augmented reality and Blynk IoT.
- A contactless doorbell system with a security access protocol.
- Unauthorized person entries will be framed on the screen to the database for futurereference.

2. THE PROPOSED SYSTEM

In this proposed system, a user-friendly mobile application is used so those who entered valid login credentials can only its use to automate the home appliances so that only authorized persons can able to operate the appliances. In addition to home automation, we are providing security with a door-unlocking system with the help of face recognition and an RFID card. The proposed system consists of an ESP32 Cam module, ESP8266 Wi-Fi module, Arduino nano, Relay module, RFID card, and Blynk IoT.

2.1. FACE RECOGNITION

A Contactless doorbell using face recognition is used for Door Unlocking. This uses an ESP32 Cam for taking pictures of the person who is standing in front of the user's door. The image will store in the database and will detect the person's identity easily and we can identify if any unauthorized person comes. The face recognition part will be done via the LBPH algorithm. With the help of this algorithm, it will store the person's picture with the name. So, whenever that enrolled person will come the algorithm will detect and recognize the face easily.

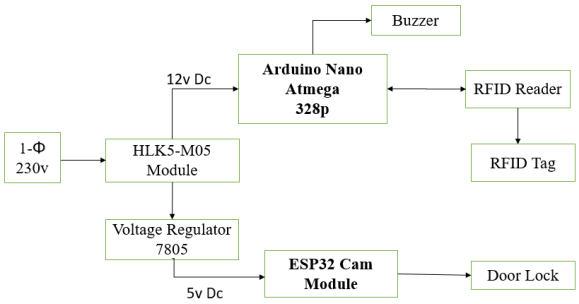

Fig. 2.1: Face Recognition

2.1.1 BLOCK DIAGRAM

From the above block diagram,

The HLK5M05 is used to change the voltage level to 5V and it is connected to Arduino nano from where the RFID reader is used to unlock the door.

The RFID Reader collects data from RFID Tag when it is placed near it and the buzzer makes sound signaling to access entry. The voltage Regulator 7805 is used to regulate the 5v to 12v, it is connected to the Esp32 cam module, and it captures images with the help of the cam and stores them in the cloud.

2.1.2 SCHEMATIC DIAGRAM

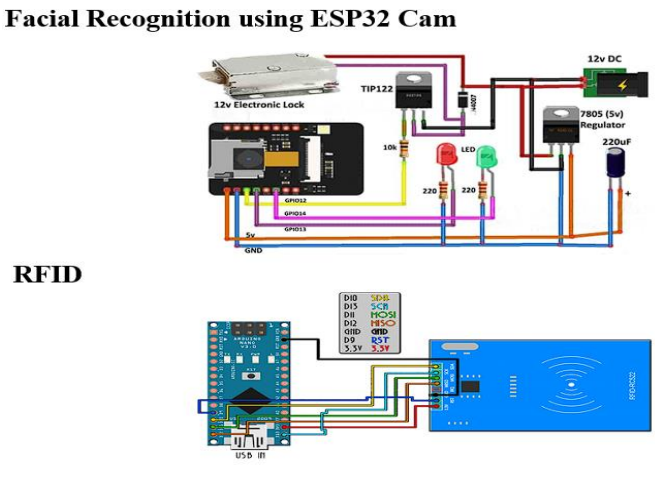

Fig. 2.2: Schematic Diagram

From the above schematic diagram

- In RFID SDA is connected to D10.
- SCK is connected to D13.
- MOSI is connected to D11.
- MISO is connected to D12
- RST is connected to D9.
- GND and 3.3v pins are interconnected to each other with Arduino nano.
- For the 12v Dc supply, we are using HLK-5M12 Module.
- By using the 7805 Regulator we can step down the supply to 5v and that 5v is again given to ESP8266 Cam Module through the 5v pin and GND pin.
- Here 12v solenoid lock is used.

2.1.3 WORKING MECHANISM

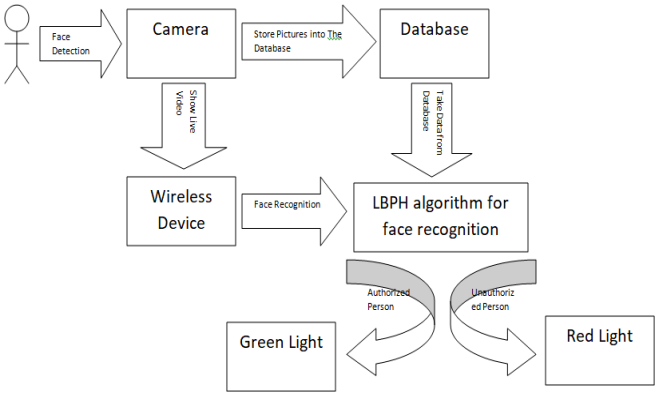

Fig. 2.3: Working Mechanism

In the above diagram, a camera is fixed in front of the door for detecting the faces of people. Whenever a person comes in front of the door by cascading image process camera senses the face of that person. Via image contouring, we are trying to avoid small animals like dogs and cats. After sensing the image, the camera will show the live video to user connected wireless device. If the person is already enrolled in the user's database, then by the LBPH (Local Binary Pattern Histogram) algorithm the face will be recognized and the green light will glow and if the person is unauthorized the red light will glow as well as a button called enroll will be shown by the wireless device ask for the enrollment of that person.

2.2 HOME AUTOMATION

In This Proposed system, we are using Blynk IoT and Augmented Reality. We are using augmented reality as a medium of virtual communication. Everyone prefers a less messy as well as user-friendly interface and hence we are moving towards augmented reality in home automation. AR allows a virtual pop-up button whenever the user points their App toward the AR Marker, which is used as a controller or switch.

Another alternative for the Augmented reality we are using Blynk IoT. With the help of blink, we can automate home appliances from anywhere. In addition to that we can measure the temperature, humidity, and light intensity. Blynk will perform the switching operation by using a relay and automating the home appliances.

2.2.1 BLOCK DIAGRAM

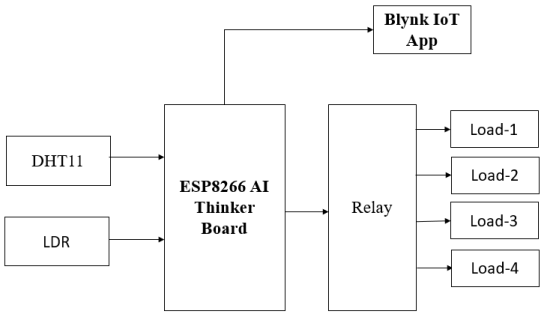

Fig. 2.4: Block Diagram

From the above block diagram, ESP8266 is connected to the Blynk IoT. With the help of Blynk, we can operate home appliances. Relays are used for the switching process in the system DHT11 and LDR is connected to the ESP8266 to measure the humidity, temperature; and light intensity. These are displayed on the Blynk Interface to the user. The login credentials are required to automate the home. So only authorized persons are only allowed to these home appliances.

2.2.2 SCHEMATIC DIAGRAM

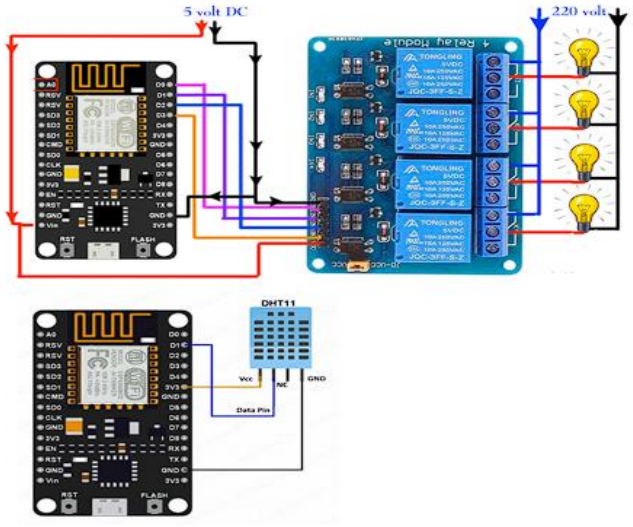

Fig. 2.5: Schematic Diagram

From the above schematic diagram,

- D0, D1, D2 and D3 are used to connect the IN1 ,IN2, IN3, and IN4 four relays which are used to access the appliances.
- A 5v supply is connected to Vcc.
- The ground is connected to the supply.
- For DHT 11 Vcc is connected from a 3v pin.
- The Data pin is connected to any pin from D0 to D8.
- The ground pin of DHT 11 is connected to the ground pin of ESP8266.

2.2.3 WORKING MECHANISM

In this proposed method there are two ways for controlling appliances. They are

A. Blynk IoT
B. Augmented Reality

A. BLYNK IOT

a. Flowchart

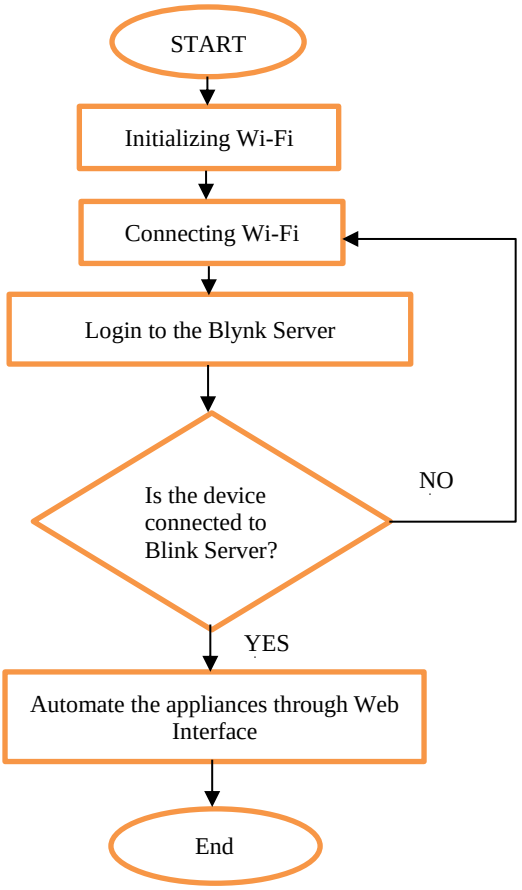

Fig. 2.6: Flow chart for Home Automation by using Blynk IoT

This flow chart shows the work of the project. The process starts by initializing the Wi-Fi, then the Node MCU is connected to the network by using credentials in the code. Then Login to the Web Server or Android application. The Blynk server is set up and a connection is made, the devices are identified in the Blynk server using the generated authentication token.

The command for controlling the appliances is given by the

web server or android application, and this command, over the Wi-Fi network, is sent to the Node MCU through which the appliances will be controlled.

b. Working Interface

Follow the below steps for controlling the home appliances

Step 1:

Login to https://blynk.cloud/dashboard/login portal. The below image shows a login portal of Blynk IoT

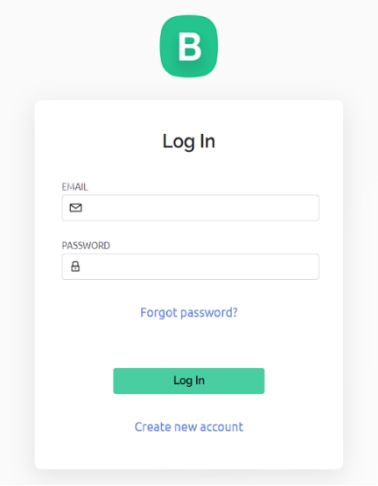

Fig. 2.7: Interface of login panel in Blynk IoT

Step 2 :

We have to create a new account to access it. In case the user provides invalid details. It will automatically throw an error.

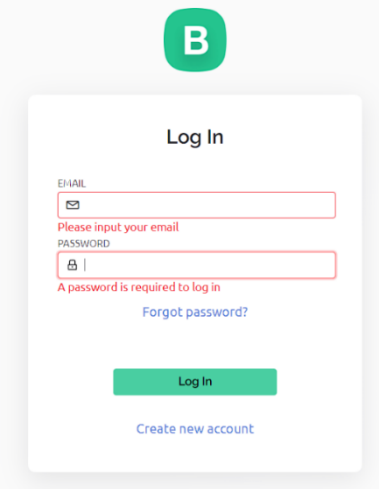

Fig. 2.8: Invalid login credentials

Step 3 :

After providing the correct login credentials only the user will be able to login into the interface of Blynk IoT. Through this interface we can control the home appliances, also we can monitor the temperature, humidity, and light intensity.

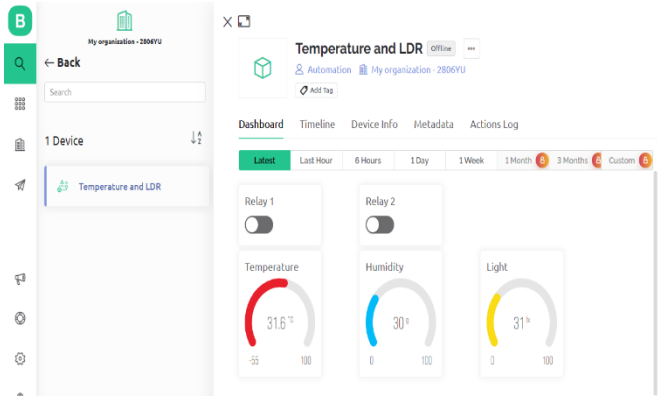

Fig. 2.9: This is the interface of Blynk IoT

B. AUGMENTED REALITY

a. Flowchart

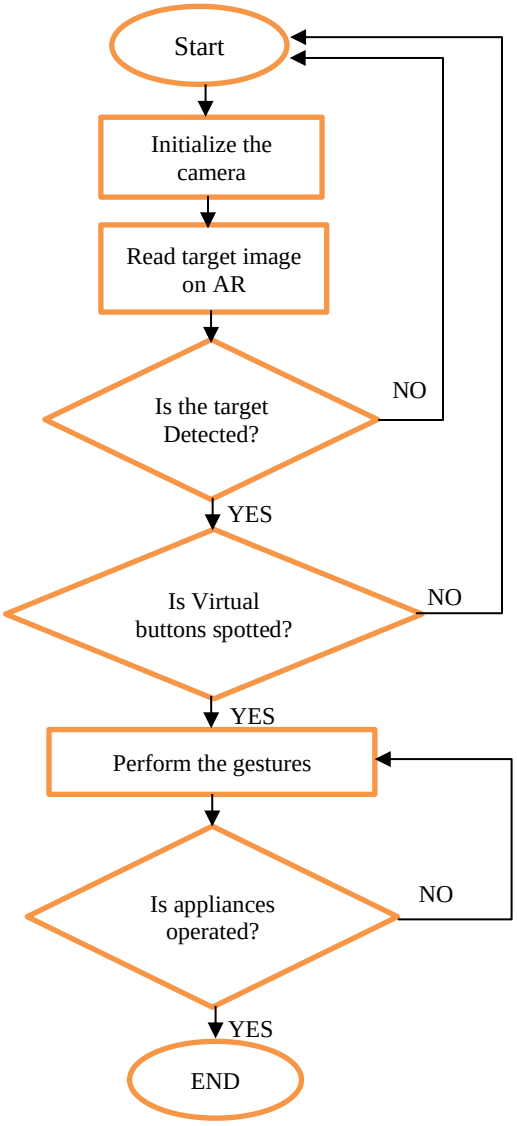

Fig. 2.10: Flow chart for Home Automation by using Augmented Reality

The following flowchart describes the working of Home Automation by using Augmented Reality. Whenever we need to automate the appliances, we need to start the app, it will initialize the camera and it has to be placed on the Target image (Marker image) then the target image will be scanned. In case the target image is relevant, then the virtual buttons will not pop up. By scanning the proper target image, the virtual buttons will pop up on the target image. Succeeding that by performing hand gestures, the appliances will be operated.

b. Working Interface

This is another way of operating home appliances by using augmented reality. This is the normal camera image. When we scan the target image it does not show any virtual buttons.

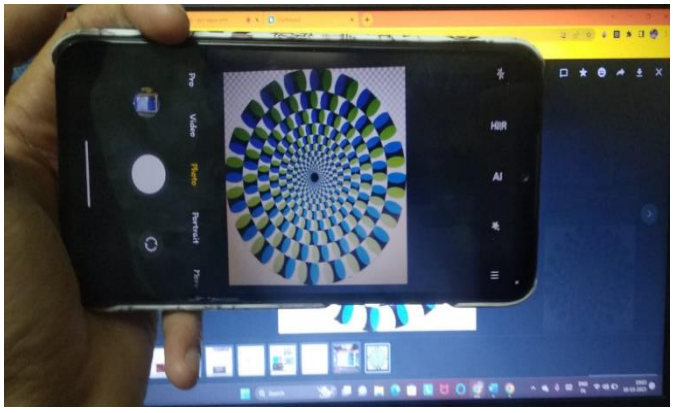

Fig. 2.11: Normal Camera image

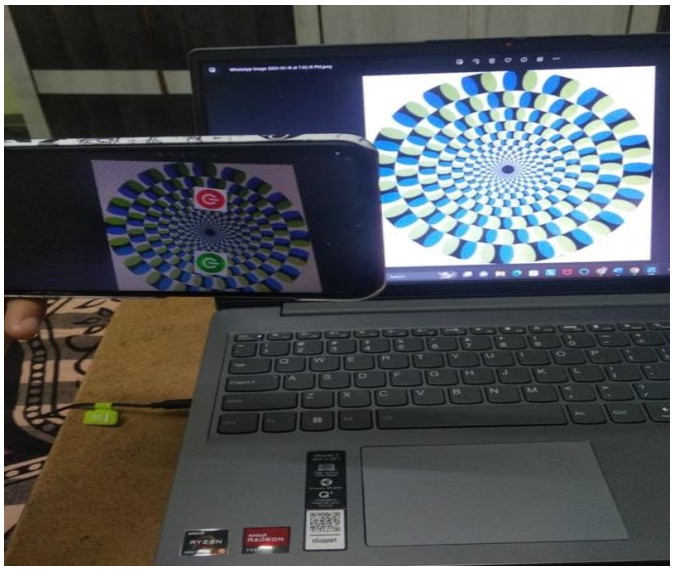

Fig. 2.12: By using Augmented Reality App

When we scan the target image with Augmented Reality App which was developed by using the Unity hub. It shows the virtual pop-up 2D buttons. By using hand gestures the appliances can be automated.

3. EXPERIMENTAL SETUP

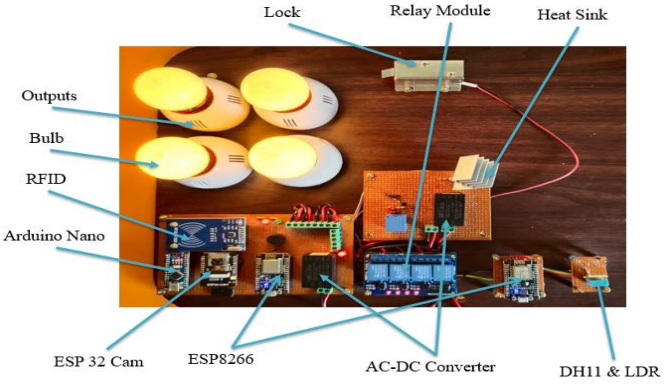

Fig. 3.1: Experimental Setup

This is our proposed hardware kit. The components are connected as shown in the above figure. The ESP 32 Cam module is used for face recognition and RFID is used for door unlocking this is controlled by Arduino Nano for home automation, we are using ESP 8266 which is connected to Blynk IoT and Virtual Reality, for measuring temperature and humidity we are using DHT 11.

4. COMPARISON TABLE

Paper Ref. No	Performance metrics					
	Real-Time Database	Control home appliances from anywhere	Monitor home appliances	User Interface	Home security	Face Recognition
[1]	No	Yes	No	No	No	No
[2]	No	Yes	No	No	No	No
[3]	Yes	Yes	No	No	Yes	Yes
[4]	Yes	Yes	Yes	Yes	No	No
Proposed System	Yes	Yes	Yes	Yes	Yes	Yes

5. CONCLUSION

In this paper, an android and web-based multi-functional advanced home automation system has been designed and implemented. The proposed system ensures easy and proper control of home appliances from anywhere in the world. This system provides more security to a home by preventing intruders. It also protects a home from thefts by the door unlocking process provided in the system with help of face recognition and RFID. This system is very beneficial for old ages, handicapped, and working people. The complete system has been tested and performed as expected. The system ensures flexibility, reliability, and energy efficiency.

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