

Home Automation in Client-Server Approach with User Notification along with Efficient Security Alerting system

Brundha S.M.,Lakshmi P. and Santhanalakshmi S.
Dept.of Computer Science and Engineering
Amrita School of Engineering, Bengaluru
Amrita Vishwa Vidyapeetham
Amrita University
India

Abstract—Internet of things(IoT) is evolving to a vast extent.It involves collaboration of different devices and ultimately achieving efficient home automation as one application . Some of the key challenges in adopting IoT for mainstream life style varies from device diversity, security , connected services of IoT devices to add newer use case value proposition. This paper proposes a Client-Server service and device friendly approach for Home automation. A typical home automation workflow consists of 4 stages.Understanding the user environment by sensing, reporting the events to a centralized entity, centralized entity analyses and triggers the workflow, workflow will execute and update user by any interactive channels or even exercise over a home device (actuating). The physical condition of the device can also be altered based on the user request. The Home automation can be made efficient by including security factor by alerting user about an unknown person in the house. This IoT project implements a Client-Server based home automation with intruder alert to the user mobile phone. The user can also retrieve the image of the person entered in to the home.

Index Terms—IoT,Home Automation,PHP,SSID,Wi-Fi, NodeMcu,Client,Server,PIR,Instapush.

I. INTRODUCTION

This is an enhancement to the regular Home Automation approaches such as usage of Bluetooth as per [8] and using Android mobile application as per papers [1] and [6] .The proposed method involves Client-Server interaction and user gets the notification without any distance criteria, the application considered for the project is brightness adjustment of light by connecting the client to one sensor and posting the data to the server. The server performs the required task of notifying to user. Security is another important function need to be considered in the automation system. The security system captures the image of person entered and compares with facial features of the database by using facial recognition algorithm [9] via Matlab, if person is found as intruder then the alarm is triggered and notified about the intruder presence. The user can retrieve the image of the person entered as well.

II. RELATED WORK

[3] deals with home automation using Zigbee and Wi-Fi. At the home level the interaction between sensors happen via

Zigbee forming a mesh and for transferring the notifications to the user it uses client-server approach. Further the user controls the devices in the home via internet by using a mobile application from any area. Server allows for transmission of data to and from the mobile IP. So overall it involves a Zigbee and Client-Server based interaction for Automation. The security system proposed in this following paper is an enhancement to [4] . Paper [7] talks about using a PIR(Passive Infra-Red) sensor to take the snaps from the camera module whenever it detects the user presence and transfers it to user using GSM. The above approach is modified where user gets notification regarding the person entered and then he/she can retrieve the image of the person entered via internet. [5] talks about the way the facial recognition can be used in order to avoid unauthorized human entry in surveillance video.

III. IMPLEMENTATION SETUP

A. HARDWARE REQUIREMENTS

1) *NodeMcu,Arduino Uno*: NodeMcu is a development board which has inbuilt Wi-Fi module so it can act as server,client or as an access point. This is with XTOS OS and 128KB memory. It is 3.3V device. It has one analog pin for connection to sensor. Arduinio Uno has Atmega328P,it is with 14 input and output pins which are digital, some supporting PWM(Pulse Width Modulation) functionality as well and it has 6 Analog pins. This Board can be used for basic processing. It is a 5V device.

2) *PIR and Brightness Sensor*: PIR sensor is used to detect the user presence and the brightness sensor measures the brightness, it can be used for adjusting the brightness of the device.

3) *Arducam Mini 2MP Camera*: The camera is with FIFO, this supports a resolution of 1600*1200. It is with CMOS image sensor OV2640.

B. SOFTWARE REQUIREMENTS

1) *Arduino IDE*: The libraries required for the NodeMcu and Arducam mini 2MP can be imported in to the Arduino

3) *InstaPush Application*: This is required at the user end for attaining the notifications.

C. OVERALL HARDWARE SETUP OF PROPOSED SYSTEM

The Figure 1 is the overall hardware setup of the proposed system. This is the combination of the home automation and the security alerting system.

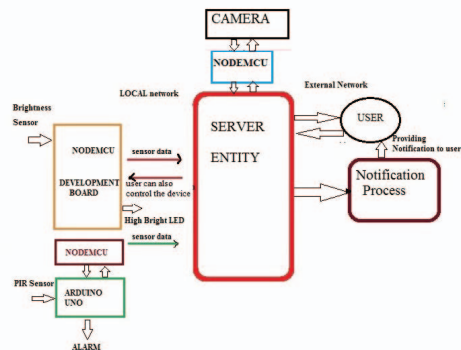


Figure 1. The Overall Setup of the Proposed system

D. WORKING OF CLIENT-SERVER MODEL BASED HOME AUTOMATION SYSTEM

1) *Client-Server Interaction:* This is better approach when compared to [2]. The Client and Server are provided with internet based on SSID(service set identifier) and password, once the SSID and the password match they are active and ready to operate, client constantly monitors the sensor value and then posts the data attained to the server. Server gets the data from different sensors. The client can request for data from server if required. The bulb brightness adjustment is considered as activation part with the PWM(Pulse Width Modulation) circuit based on user presence measured by PIR sensor. The brightness of bulb varies based on external environment brightness measured by brightness sensor. The client-server interaction is clearly shown in the Figure 1.

2) *Role Of Host Server for Notification at user end:* The user is informed about the device status. When the activation happens, client makes a request to server for notification. The Host server is created with Hostinger official site. The PHP(Personal Home Page) files are stored in FTP folder of the host server via File-Zilla client. The site with PHP files is as shown in Figure 2.

3) *Role Of Instapush Application:* InstaPush is the official application used. This application need to be installed on the user mobile so during installation an authentication token is being provided. PHP files are being developed by creating events in the Instapush official site. The Figure 3 is the Instapush dashboard.

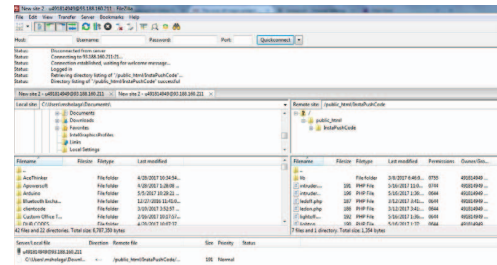


Figure 2. Host server with PHP files

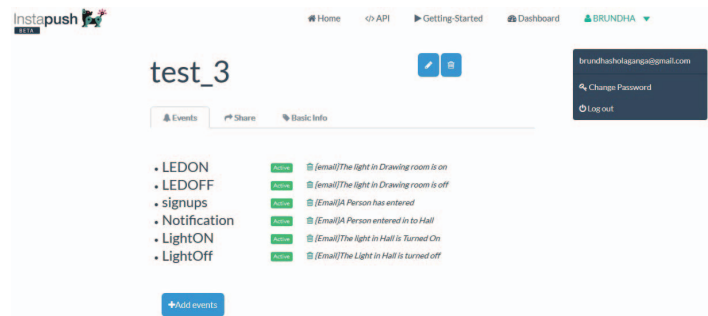


Figure 3. Instapush Dashboard

4) *PHP files of the application:* The PHP file contain the application id, authentication id which invokes the message that need to be sent to the user. These PHP files are being placed in the host server FTP folder. The Figure 4 is the PHP code for Light on.

```
<?php
require("lib/instapush.php");
$ip = InstaPush::getInstance
('58c0bb1fa4c48a729a368e49','aafaf37801de8115e65e0b48e886ba');
$ip->track("LEDON", array("email"=>"Notification"));
?>
```

Figure 4. PHP code for Light on

E. WORKING OF THE SECURITY ALERTING SYSTEM

In certain case an unknown person might enter the room. So when an unknown person enters, the security alerting system sends notification to the user and triggers alarm as well.

1) *Notifying Intruder Presence and Triggering Alarm:* When PIR sensor is high Arduino interacts with the Matlab, it invokes the web-cam which captures the image of person entered. Then the face is detected from the image and then the facial features of the detected face are compared with the trained images in the database, if the subject is not in the training database then an alarm is triggered along with that notification is sent to the user by using server. Figure 5 shows the intruder alerting system flow.



Figure 5. The Intruder Alerting system Flow

2) *Intruder Image Retrieval*: The user can get the image of the intruder entered, by accessing NodeMcu server via NO-IP or DNS .The system uses a camera module along with NodeMcu Wi-Fi module as server. For accessing server from external network port forwarding done .

3) *Router Adjustments for getting the image of intruder*: From Figure 6, the way the adjustments are made in router can be understood,a static IP is created for the NodeMcu and then a local port is added. Static IP is suitable for accessing NodeMcu in local network.Then from Figure 7 the NodeMcu local port is being added in to the windows firewall for forwarding the requests of the particular port from external network to the NodeMcu.



Figure 6. Assigning static IP and making Virtual server

IV. PROGRAM FLOW

The flowchart from the Figure 8 shows the entire home automation system and security system operation.

V. EXPERIMENT RESULTS AND OBSERVATIONS

A. Result Analysis for Home Automation system

From the Table 1 the PIR sensor value 1 indicates user is present, the brightness value 255 indicates room is more dark, value 0 indicates room is bright. LED intensity 1023 indicates high intensity for LED, low intensity is indicated by

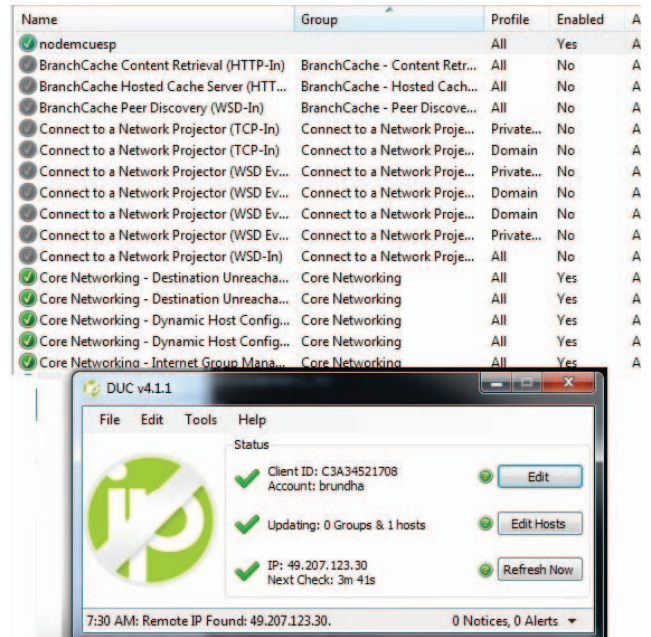


Figure 7. Public IP configuration

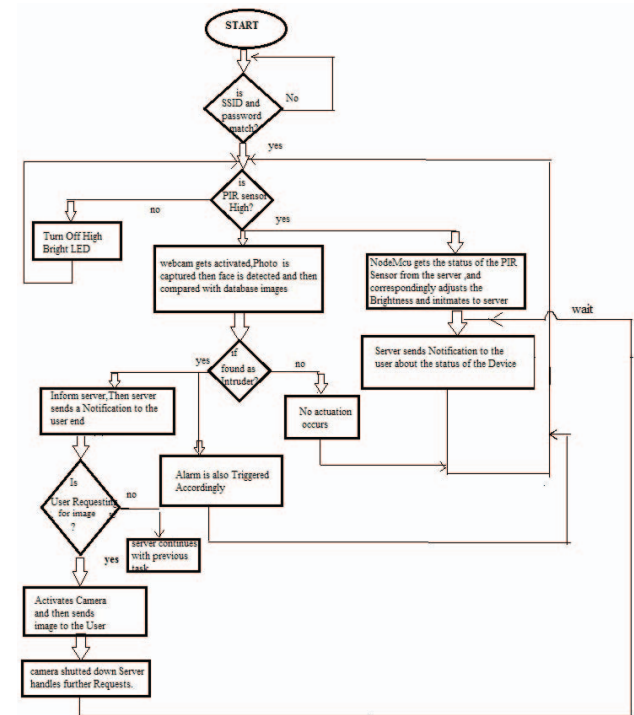


Figure 8. The complete system flow chart

Table 1. PIR values and the corresponding LED Brightness

PIR	Brightness value	LED intensity
1	255	1023
1	127	767
1	63	512
1	31	255
1	0	0

The Figure 9 shows the way the brightness value of LED is being controlled from the PWM circuit based on sensor values.

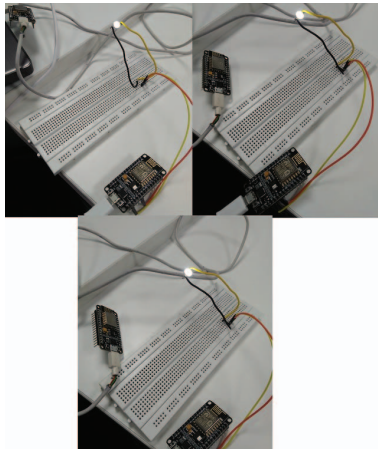


Figure 9. The LED brightness Variation based on the sensor values

Figure 10 is the notification at the user end on the Instapush application, based on the status of light In the hall.

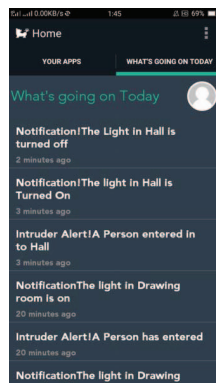


Figure 10. The Notifications at the user end

B. Result Analysis for Security Alerting system

The PIR sensor detects the user presence. So correspondingly the webcam gets activated via Matlab based on the serial buffer value provided by the Arduino to the Matlab. The face detection and comparison is done in Matlab. The database has facial features of subject one. The Figure 11 shows the images trained in the database for subject one in different conditions. The overall setup for the security alerting system to raise an



Figure 11. The Database images of Subject 1

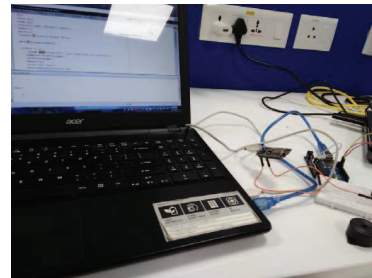


Figure 12. The Intruder Alert system

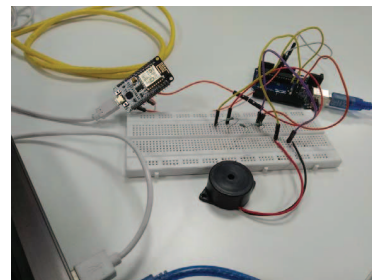


Figure 13. The Arduino,NodeMcu with the Buzzer

alarm and notification is shown in the Figures 12,13.

Assume the person is an intruder. The Figures 14,15 shows the way the image is being processed after the snapshot is captured. Generally the process of image detection and comparison occurs for all the snapshots captured, but the notification and triggering of an alarm happens only for the intruder.

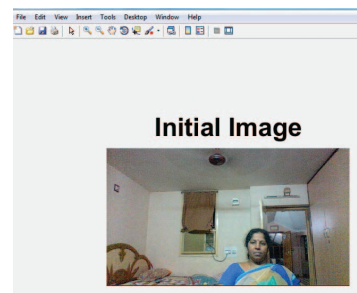


Figure 14. The snapshot captured for Subject 2

The Figure 16 shows that the image is not available in the database and there by facial recognition algorithm finalizes it as intruder and informs it to the controller. There by the controller triggers the alarm and correspondingly notification are sent to the user via server as per Figure 17. If the person

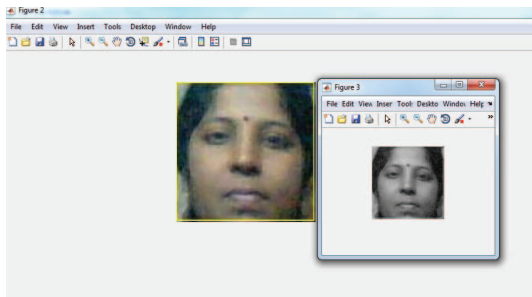


Figure 15. The face detection for the image

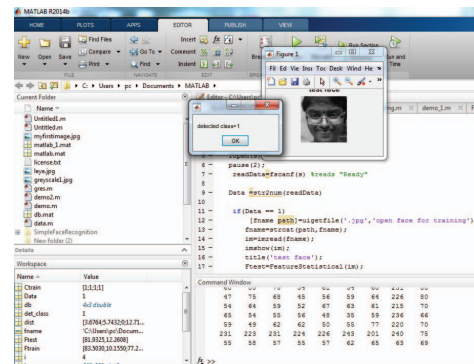


Figure 18. The Detected Person as per Database

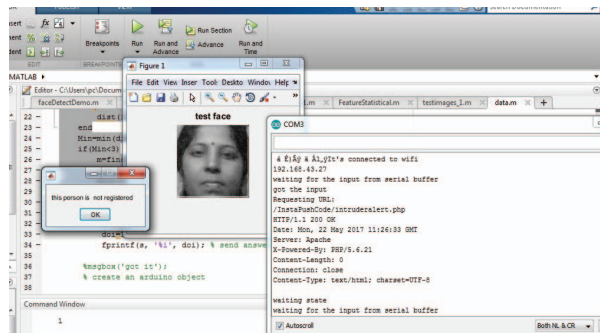


Figure 16. Database Comparison and Intruder Identification



Figure 19. The overall image retrieval system

the camera module is shown in the below Figure 20. The Figure 20 shows the access via No-IP using DNS(Domain Name Service).

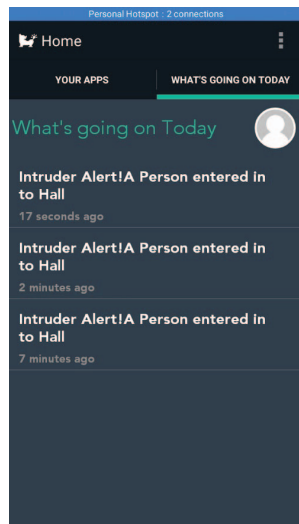


Figure 17. Then Notification for Intruder Entry

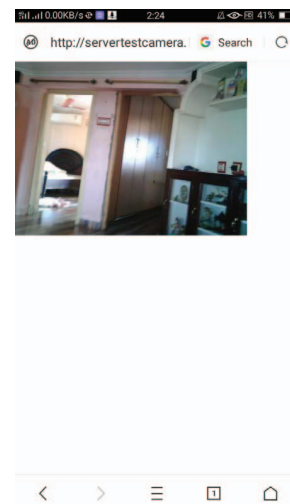


Figure 20. The image attained by DNS

is not an intruder then there will not be any alert.

If the person is recognized it shows as detected person as per the Figure 18.

C. Result Analysis for getting image of intruder

The Figure 19 indicates the complete setup required to get the image of the person (via internet) entered in to the room. The camera and Wi-Fi module can be placed at the entrance so they can capture the image. The snapshot attained from

VI. CONCLUSION

In this paper we proposed an efficient Home Automation System along with security using low cost Wi-Fi modules. The security system alerts the user about the condition in the home by giving the notifications to the user mobile phone. A camera module is connected to the Microcontroller which captures the image of the intruder. The prototype of our proposed system

does a facial recognition and raises an alarm if an intruder is present. As a future scope for this project the image captured can be sent to the police station for further actions. Also more number of sensors and actuators can be added for the home actuation part to make a smart home.

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