PES UNIVERSITY

Connected Living Spaces

Chirag N Vijay,Dhanush Ravi,D G Sudheer

PES University, Banashankari 3rd stage,Bengaluru,India
2020

Abstract

Home automation systems are one of the most happening vibrant technologies that are being developed in this decade,with the automation and the digital revolution it was the time that our homes and industries become digital also, there have been vast significant achievements in industrial automation in the past 6-7 years.We are going to discuss about a new self-developed industrial automation system.It consists of important modules like automatic door locks,facial recognition,mood-detection and rejuvenation,monitoring of potentially dangerous appliances,leakage detection,remote appliance control,surveillance and enhanced security measures.

Keywords: Home automation:Home Security;Internet Of Things;MQTT;Smart Home;ESP;Node-Red;Industrial IOT;Smart Home

Introduction

With the advent of internet everything has migrated to the internet and with it arose the need to manage and run our houses digitally .Home automation and home security has been an important focus in this decade.It allows us to monitor our houses/working spaces and control it even when we are away with the use of computers,smartphones and tablets.

Automation systems consists of a single controller through which we can communicate and control the devices such

aslights,fans,airconditioners,heaters,boilers etc.

First we make all the devices in the house communicate with each other and the main controller through the MQTT protocol ,then we isolate the devices in a local network for enhanced security.The users are provided with a website and login credentials through which they can login and monitor and control the devices and the house as a whole.The users can switch on/off the lights,fan,heaters,they can set the room temperatures,automatically lock and unlock doors all with a click of a button.Our automation system also provides unique features such as automatic access control with facial recognition ,mood detection and rejuvenation ,surveillance and leakage detection.It aims at giving the users a user friendly effective seamless home automation solution.It is not only designed for homes,it can be used by educational institutions and corporate offices also.

Modules

Access Control

This modules deals with the automatic access controld imparted to the doors/entrances/exits of the user's respective living spaces.

The users are provided with a Web User Interface (compatible with both PC and mobiles) to control their locks . The User interface provides a GUI of all the locks pertaining to their living spaces in the form of switches. Users can also monitor and view the number of locks and unlocks of a particurlar lock and can also monitor and view the times it was last locked/unlocked.The counters and time are reset every week.

The Web GUI was built using node-red - a javascript compatible flow based software for creating web flows and processes.

In this the ESP32 board communicates with the locks and controls the various locks,it communicates with the Nodered

server running on the raspberry pi via an mqtt connection running on the raspberry pi. It then stores important data like the number of locks ,unlocks,time the particular lock was locked or unlocked on a local ubuntu server and is sent as a response back to the web graphical user interface.MQTT is a protocol used for communication between the various servers ,boards and devices.
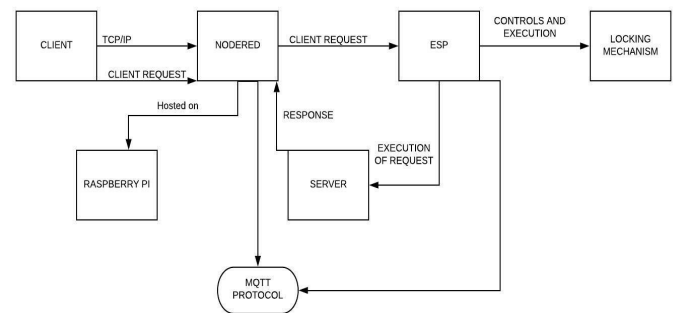
LOCKS GUI
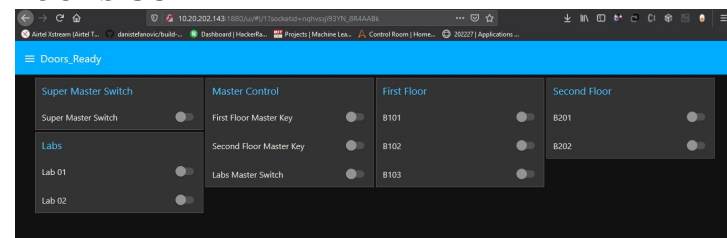
LOCK STATUS
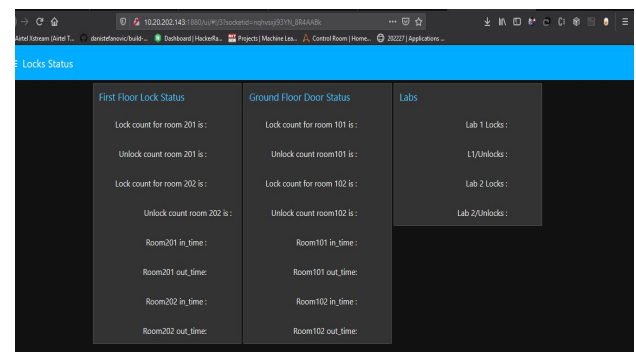
Implementation

We then scaled it up to control a floor which consisted of 10 doors and were divided into zones and access was given to the people responsible for the functions pertaining to their respective labs or rooms.One of the first issues we encountered was in the naming,since all the ESPs had the same name espclient,we

placed a lot of data inconsistency and this was rectified by giving a different name for each ESP.The next roadblock ahead was the failure of NTPServer to provide the right time,due to library issues the NTPServer gave the time corresponding to January 1,1970.Forceupdates and updates were not possible due to inconsistency of libraries,then we changed the library so as to make the client to connect to the nearest indian time server but it still faltered depending on the server.So we had no option other than to remove NTPServer and instead we connected a RTC Module which hives us the correct time and date without the delay.

The final snag we faced was the failure of MQTT Protocol after a certain point of time,the reasons this happened was the configuration of DHCP servers of our institution's network.MQTT used to fail after a period of 30 minutes or so,we could get it to work by manually trigerring the m reset switch on the ESP.Then we found out that the college network automatically blocks the protocol after the interval of 30 minutes,so we took the permission and altered it and also increased the keep-alive of the MQTT Broker.But still we faced the problem,then we injected a 4 lines of code which forces the ESP to restart itself when it's unable to connect to the MQTT broker

Temperature Control

This module is about viewing the temperature of each and every zone in our living space and providing means to monitor and control it.Later we developed automatic cooling and heating systems to facilitate the users.Whenever the temperature drops below a certain threshold the heater gets activated and the air conditioner gets activated whenever the current temperature exceeds the upper threshold limit.At first we used the DHT-11 and then the DHT-22 sensors but they proved to not be reliable over a longer course of time,the sensors started giving

faulty readings and hence could'nt be the primary choice for measuring the temperature.Then we switched over to the DS18B20 sensor which is a more reliable,efficient temperature sensor being used by various industries.Four sensors are located in the four corners of a room and the mean of those gives us the temperature of the room,the temperatures of the four zones and the central temperature is being displayed dynamically on the screen.The data regarding the temperatures,the number of times both the heater and the air conditioner has been used are logged in the database.A failsafe mechanism has been also developed incase any of the sensors fail.

Mechanism

The room is shaped to fit that of a square's dimensions and then the room is divided to four zones- Zone A,B,C and D.

Room
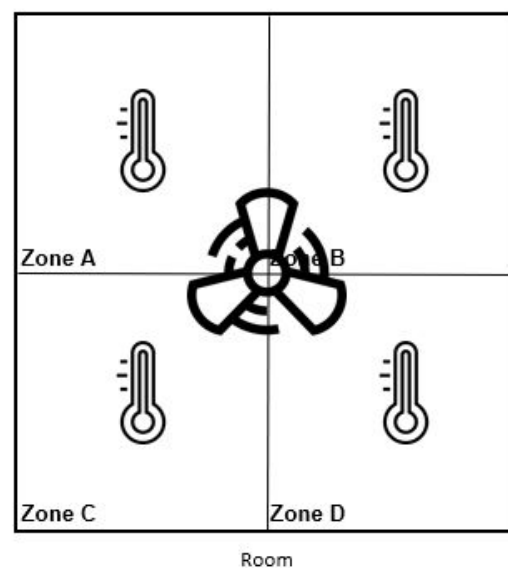
Then we monitor the temperatures across the zones and calculate the mean temperature and display it on the UI.
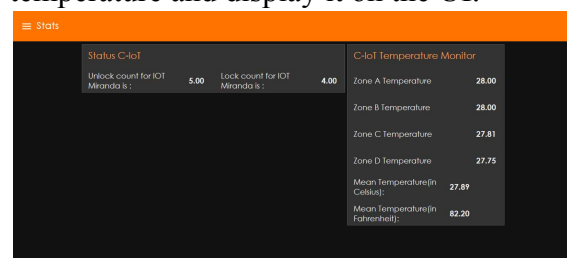
When the temperature goes above the upper threshold, the cooling system is activated and when it goes below the lower threshold the heating system is activated.

Facial Recognition

A facial recognition system is developed parallely with the access control system .Authorized personnel have their face encodings stored on the main server and a webcam recognizes the faces in front of it and gives access if it detected it to be an authorized user ,if not it captures the photograph of the person and sends it to the admin for authorization.
face_recognition package was used in building the above mentioned system.