Home Ctrl ware: Design and Fabrication of Home Automation System

[1] **Atit Dharmendra Patel,** [2] **Ayush Kuamr Shah,** [3] **Partha Jyoti Sarmah,** [4] **Mahantesh KodaBagi**

[1] Student, Dept of CSE, NHCE, Bangalore,[2] Student, Dept of CSE, NHCE, Bangalore, [3] Student, Dept of CSE, NHCE, Bangalore, [4] Senior Assistant Professor, Dept of CSE, NHCE, Bangalore
[1]atit1970@gmail.com,[2] aks.shah1723@gmail.com, [3] parthasarma108@gmail.com, [4] kodabagi.mahantesh@gmail.com

ABSTRACT

Internet of Things (IoT) as a technology has existed for a very long time and its applications in the real world are highly impressive and helpful to the individual and the society as a whole. Home automation (HA) is an implementation of IoT technology. IoT can help make life easier to live for the people who require constant monitoring or have limited mobility, smart devices in their home can help them in doing complex task like check who is at the front door and allow them inside without getting up from their place. IoT can also be useful for normal tasks like you can check the temperature of your home and then the sensors automatically control the fan speed to manage the temperature of the room. IoT can allow a user to control, monitor, and automate the devices that user wants to. This is a paper on how to design and implement a simple but extensible home automation system. For this project we will be making use of Lolin NodeMCU v3 which uses ESP8266 module to connect to the internet. We will be making a dynamic website using HTML, CSS, JavaScript and MySQL to control and monitor the home automation devices in real-time. The website after being developed can be deployed to any of the web hosting service that the user wants. We will be using 000webhost web hosting service in this project to host our website and MySQL server. At the end of the project, we will be able to design, build and deploy a home automation system that has multiple sensors and devices connected to the internet, that can be controlled and monitored from anywhere in the world.

Index Terms— Home Automation, IoT, NodeMCU, Webpage.

I. INTRODUCTION

The networking of physical items with electronics built in their architecture that allow them to communicate and feel interactions with one another and with the outside world is known as the IoT. It is currently used in a lot of fields including, medical, home automation, agriculture, smart cities, etc. IoT has the potential to change the way we live our lives and will most likely offer more advance services in the future. In this project we will be using IoT to make a smart home system that can be controlled and monitored from anywhere in the world. Anyone with little to no experience in coding, web development and electronics can replicate this project at home. Some prerequisites for this project are that you have an account on a web hosting site, it can be free or paid, we will be using "000webhost" as our web hosting provider.

Further in this paper in Section II we will be describing the methodology used, Section III will have instruction to develop the project, Section IV shows how to check the working of the project. Section V is the conclusion and future work.

II. METHODOLOGY

The project has two main components that is the hardware that we will be controlling and monitoring, and the software that is a website which will be used as a dashboard to control all our hardware.

The hardware is then divided into four major parts the switch module, fan module, door module, and the sensor module.

a. Switch module will be used to power on and off any device that is connected to the main outlets in your

home like a light lamp, a TV, or any other device.

b. Fan module is used to control all the functions of a fan like to turn it on or off and also control the speed of the fan.

c. Door module is designed to lock and unlock the door but can also tell you when the door is open and closed.

d. The sensor module has two sensors, a temperature sensor and a gas sensor. The data from these sensors will be visible to us on our website dashboard.

The software comprises of multiple webpages, PHP scripts and a MySQL database.

a. There are four main webpages. The index page is where all the users start when they access the site, this webpage asks them for their username and their password to log in or they can choose to create a new account. If the user chooses to create a new account the sign-up webpage is where they will be taken, here they will be asked to provide an email address as a username, their name, and also will be asked to create a password for their account. The dashboard webpage, it allows you to control and monitor all the devices that are listed under the users account, from here the user can also choose to add or remove a device from their account. The device webpage, this is where the user enters the serial number of the device and gives a device a name to add it to their account, if only the serial number is provided means the user can delete that device from their account.

b. There are nine PHP scripts, six of which are user specific and three which are device specific. The user specific scripts do functions like authenticate a user, add a new user to the service, get a list of devices under the users account, add or remove devices from the users account, and get the users' name. The device specific scripts perform functions like get the data from the server for a specific device, update the data of a specific device on the server, and fetch the name of the device.

c. The MySQL database is used to store the data from the devices and this data is accessed by the user from the webpage. The database has two tables user and data. The user table stores the user information like username, name of the user, and password. The data table stores information from the devices like serial number of the devices, username associated with the device, name of the device, value 1 data and value 2 data.
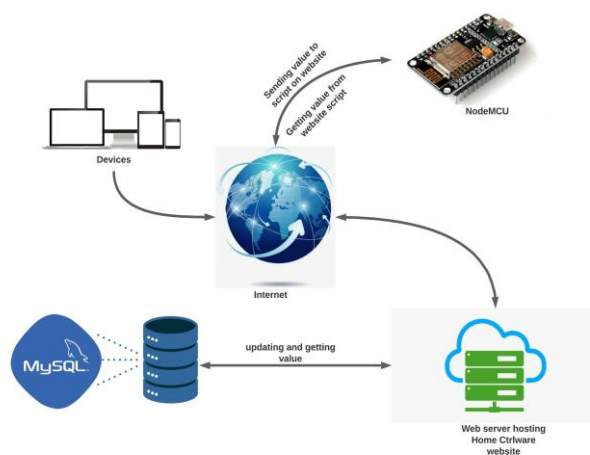

Fig 2.1: Overall working scheme of home ctrlware

III. DEVELOPMENT

All the necessary code, scripts, circuit diagrams, sketches for NodeMCU (node) and queries required to replicate this project will be available on home ctrlware git hub repository [2].

first the website is developed and tested on a local xampp server running on a desktop before we can deploy it to a web hosting service so that our site can be accessed from anywhere in the world. All the PHP scripts written in the project are called in an Asynchronous JavaScript and XML (AJAX) method using JavaScript from the webpage.

The index page is the main page where the user will access the website when, here the user will enter the username and password if they already have an account, these credentials are passed on to the authenticate PHP, the script will then connect to the MySQL database and check if the user is present and they have entered the correct password, if they have then the script will return good or else bad, depending on the response website will advance the user to the dashboard. If the user does not have an account, then they can click on the sign-up button and they will be taken to the sign-up page, here the input from the user will be taken and using the script new_user the details provided are entered into the database. From the sign-up page the user will advance to the dashboard.

The dashboard will get the username as an argument in the URL and with this username the dashboard will first get the users name and display it on the header. Then the dashboard will get the list of serial numbers of devices that belong to the given username. In the widgets folder there is a webpage for each type of device that is door, fan, switch, and sensor. These webpages for widgets are called by the dashboard when it is iterating through the list of devices to be inserted into an iframe tag on the dashboard webpage. For each device serial number, the following happens, first the starting three letter are checked if it is "swt" switch webpage is called, for "fan" fan webpage is called, for "dor" door webpage is called, and for "sen" sensor webpage is called. In the URL that calls the webpage to be inserted into the iframe tag the serial number is sent as an argument in the URL itself. From the dashboard the user can also go to the device webpage to add or remove device from their account.

The device webpage takes two inputs from the user, the serial number and the name of the device which the user gives, to add the device to the user's account. If the user wishes to remove a device, they only need to input the serial number and then click the remove device button.

The widgets webpage work in the following way, they take the serial number from the URL arguments and then fetch the device name from the database and then the buttons and display area of the webpage will correspond to the value 1 and value 2 fields from the database having that serial number given. This data on the webpage is refreshed every second.
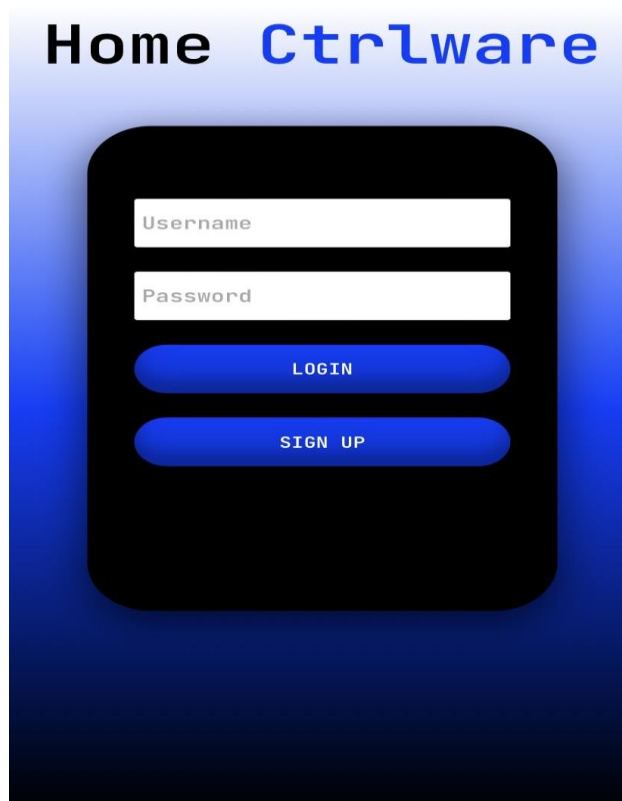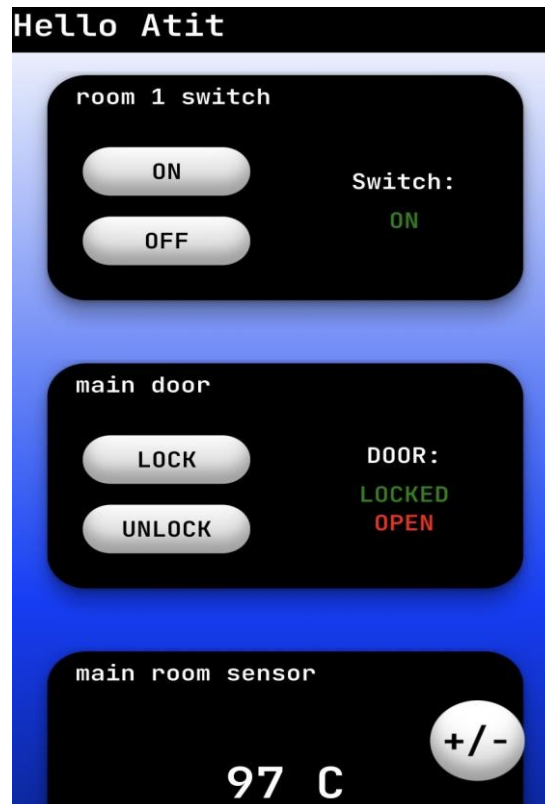

Fig 3.1: Index page of website
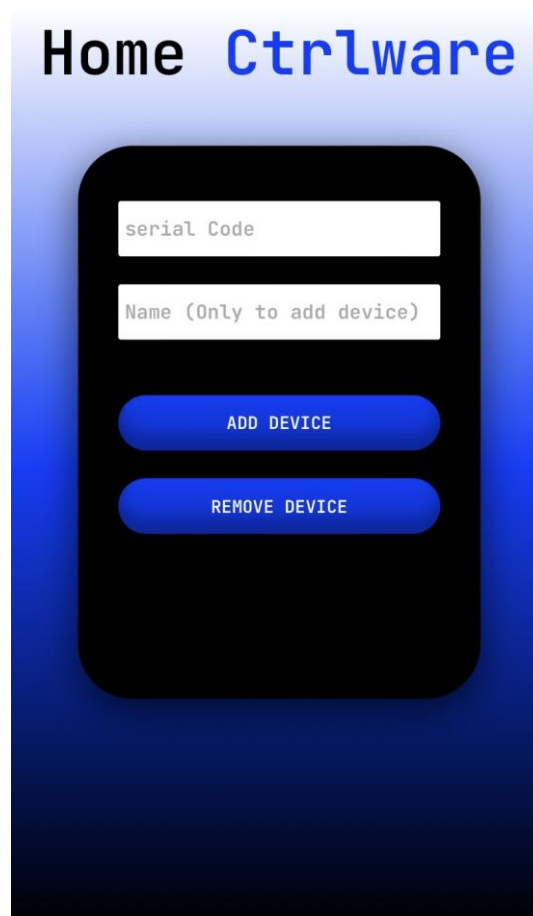
Fig 3.2: Dashboard page of website
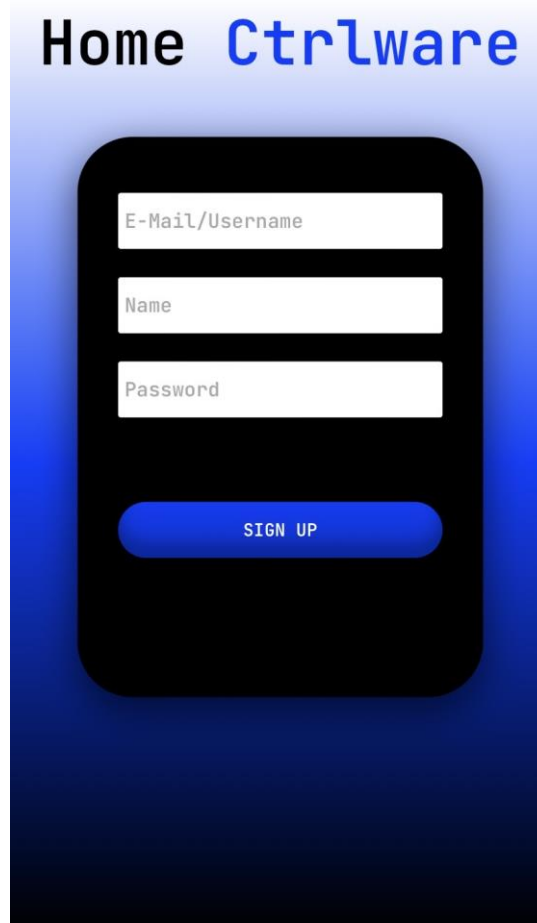

Fig 3.3: Device page of website

Fig 3.4: Signup page of website

Fig 3.5: Components used in hardware implementation

Now coming to the hardware side of the project. The following components are used to build the hardware side of the project NodeMCU, 5V relay, door sensor, servo motor, DC motor, LEDs, LM35 temperature sensor, MQ2 gas/smoke sensor, buzzer, LM7805, 9v battery and clippers, L293D and jumper cables. The node is the main component that is use, the esp8266 chip in the board allows it to connect to the router wirelessly and send http requests to websites.

The node has a sketch running on it that works in the following manner, it takes the SSID and the password of the local network to connect to the router, on successful connection it goes into a loop. This loop sends a http request and based on the value returned it acts on the it's digital pins to control the physical devices like LEDs and relay modules.

If there is a certain event detected by the node at one of its pins it will also send an email to the username attached to the serial number that the node device is given. The node can be
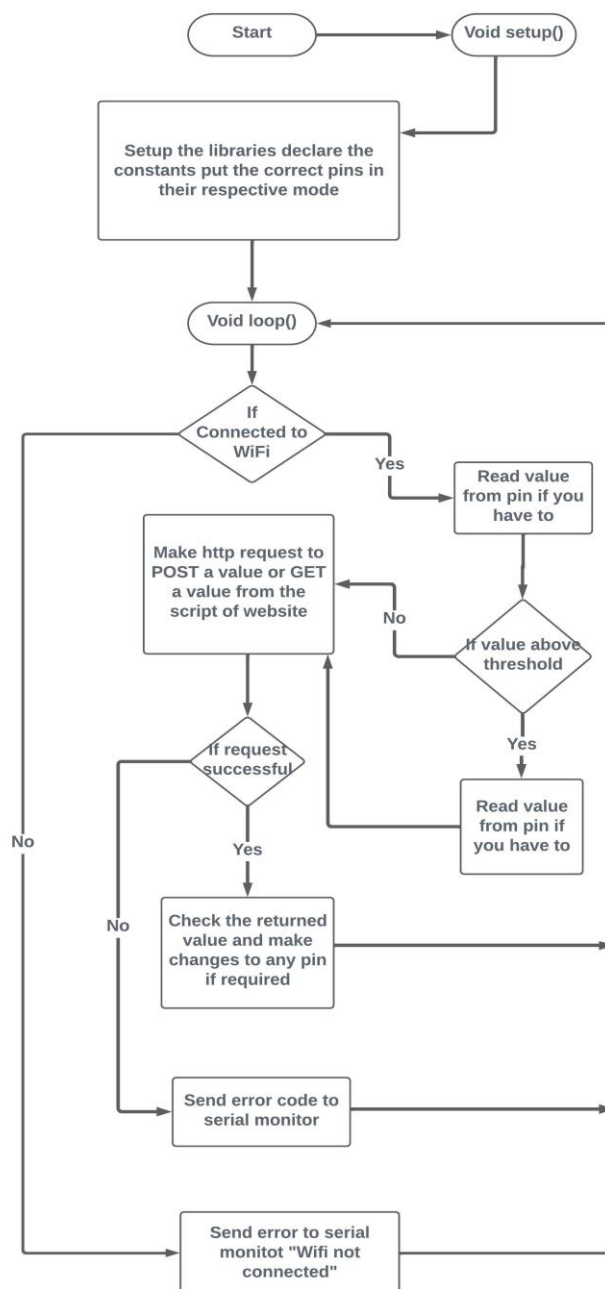

Fig 3.6: Flowchart of code for NodeMCU

acting for not only one but more than one serial number depending on the number of devices connected like the sensor module.

The smart switch module is made using by using a 5V relay connected to a node you can power the relay using the onboard USB power from pins A0 and VU, if you are powering the node using the onboard micro-USB, else you will have to power the relay and the node using an external power like a 9v battery. In the smart switch module instead of making the digital pin go high or low we are changing the
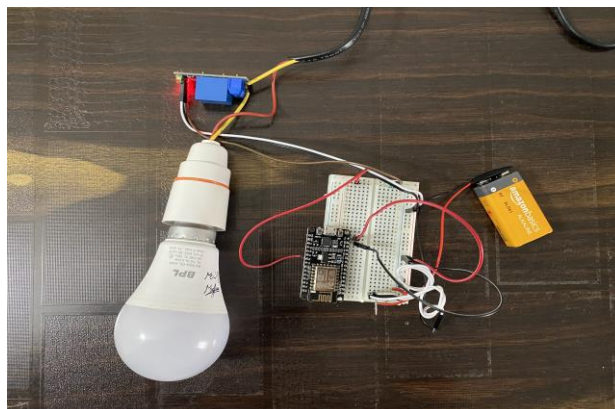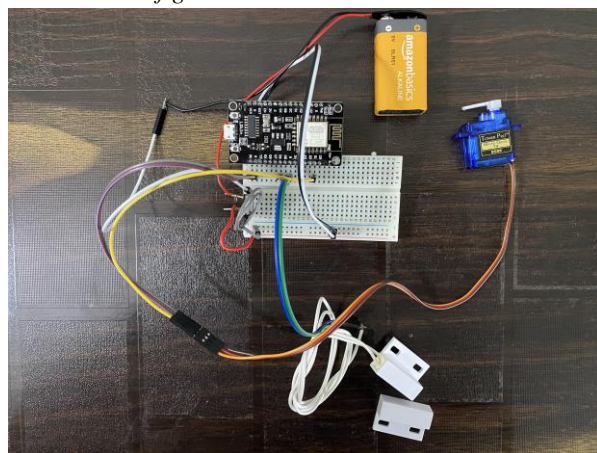
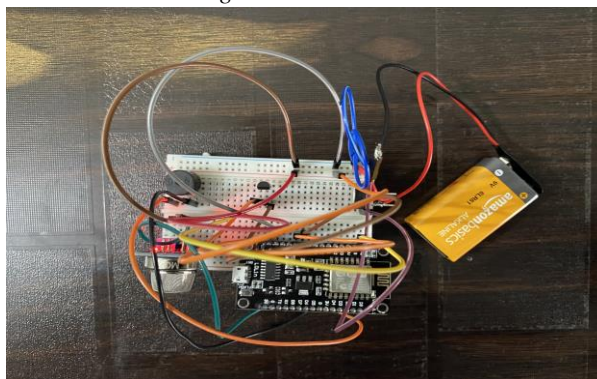*fig 3.7 smart switch module*

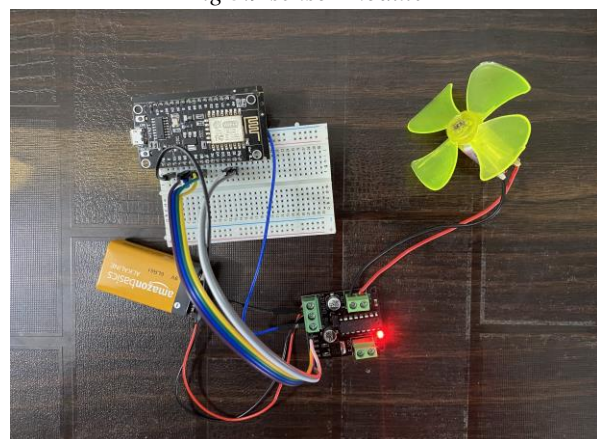*Fig 3.8 door module*

Fig 3.9 sensor module

Fig 3.10 fan module

pin mode of the digital pin, this is known to give promising results in our testing.

The fan module uses the L293D and pulse width modulation (PWM) to control the speed of the DC motor and power it. We are externally powering the DC motor, node, and the L293D using a 9v battery.

Door module uses a servo motor and a door sensor. If given a signal the servo motor will change it direction from vertical to horizontal and vice versa at a 90-degree angle to lock and unlock the door. The door sensor will close a circuit to indicate that the door is closed and will open a circuit to indicate door is open.

Sensor module has 2 sensors attached to it an LM35 temperature sensor and a MQ2 gas/smoke sensor this is done for demonstration purposes. You can keep them separate connect them to their own node. Both the sensors are externally powered. The LM35 is connected to the A0 pin and the MQ2 is connected to any of the digital pin.

Using SQL queries, we can create tables on the local machine using phpMyAdmin which is provided by default by xampp. The user table has three columns name, username and password, this table is mainly used to validate the user logging into the system and to fetch the name of the user to be displayed on the banner in the dashboard. The data table has five columns which are serial, username, name-which is device name given by the user, value1 and value2. Value1 and value 2 represent different data depending on the device. Value1 for switch tells if the switch is on or off, for door it tells if the door is locked or unlocked, for sensor they represent a value sent by the sensor, for fan it tell if the fan is on or off. Value2 is useless for switch and sensor module while it tell is door is open or closed for door module and for the fan module it represent the speed of the fan.

IV. RESULTS AND VALIDATION

After the development of the website on a local computer it is now time to host the website so that we can access our system from anywhere in the world. We are using 000webhost as our MySQL and website hosting provider. After you choose your hosting provider you will need to create a domain and a MySQL database like how you would have done on your local computer. Importing tables as files to the newly created MySQL database is an easy way to create tables and setting up your database, importing also imports your data from your PC. Before uploading your website code to the website there are some changes that are necessary to make the system work as intended. You will need to enter all the appropriate credentials in all the PHP scripts given by your hosting provider to access the newly created database. You will also have to change the SSID and the Password in the sketches for the NodeMCU. After you do this modification and upload the website code to your web hosting server then the system should work as intended.

V. CONCLUSION AND FUTURE WORK

We were successful in making a home automation system that can be controlled from anywhere in the world. This project has the ability to be further extended and improved the user that wishes to implement this system into their home need not stick to only using 4 modules they can have as many modules as they like. The project can also be implemented by scaling it down just to fit specific need of a user by just having a single module to handle it. the website can be improved by add better graphics and functions for the modules. The notifications from the sensors can be implemented in a better way to deliver the alerts or notifications much quickly compared to the email method that we have used here. In the end we can say that we were able to make a simple yet extensible home automation system that can be implemented by anyone.

REFERENCES

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[2] https://github.com/homectrlware/home-ctrlware