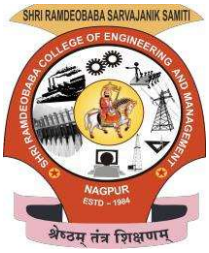
DACE
Device Automation & Connection Using ESP8266

Dissertation submitted to
Shri Ramdeobaba College of Engineering & Management, Nagpur
in partial fulfilment of requirement for the award of
degree of

Bachelor of Engineering
In
Computer Science and Engineering

By
Akshay Chopra
Ankita Singh
Piyush Keswani
Isha Bahendwar
Rishabh Gupta
Ruchit Bhardwaj

Guide
Prof. R. R. Welekar



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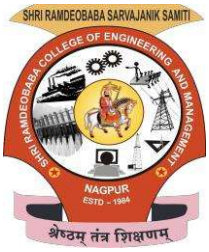

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Thesis on **"Device Automation & Connection Using ESP8266"** is a bonafide work of **Akshay Chopra, Ankita Singh, Piyush Keswani, Isha Bahendwar, Rishabh Gupta, Ruchit Bhardwaj** submitted to the Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur in partial fulfilment of the award of a Bachelor of Engineering , in Computer Science and Engineering has been carried out at the Department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur during the academic year 2017-2018.

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Principal

DECLARATION

I, hereby declare that the thesis titled **"DACE : Device Automation & Connection Using ESP8266"** submitted herein, has been carried out in the Department of Computer Science and Engineering of Shri Ramdeobaba College of Engineering & Management, Nagpur. The work is original and has not been submitted earlier as a whole or part for the award of any degree / diploma at this or any other institution / University.

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This thesis/dissertation/report entitled **"DACE : Device Automation & Connection Using ESP8266"** by Akshay Chopra, Ankita Singh, Piyush Keswani, Isha Bahendwar, Rishabh Gupta, Ruchit Bhardwaj is approved for the degree of Bachelor of Engineering in Computer Science and Engineering.

Name & signature of Supervisor(s)

Name & signature of External. Examiner(s)

Name & signature of HOD

Date:

Place:

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ABSTRACT

In a world where technology is showcasing incessant development and advancements, people are trying to cope up with it. People are getting smart, and devices are getting smarter. The need of the hour is automation and Internet Of Things (IoT) is a foundation stone for this. IoT can basically be defined as interconnectivity for various devices and gadgets. Thus, IoT is slowly becoming an indispensable part of our lives.

This new wave of connectivity is going beyond laptops and smartphones, it's going towards connected cars, smart homes, connected wearables, smart cities and connected healthcare. So, in our project, we aim to establish automatic connectivity of all devices connected to the same network generated by the ESP8266 Wi-Fi module along with controlling the devices from the server. Further, the concept of 'smart' devices has been demonstrated and achieved by controlling it with voice commands given to Amazon's Alexa.

This project report starts with introducing our project need and objective. It covers the information about existing projects in this field. We later talk about all the technical terms and explain briefly about Arduino UNO, LM35, DC Motor along with the voice assistant Alexa. In the later part of the report, dataflow of the module is explained along with the database schema. The report then talks about the working of our project followed by results and conclusion.

DACE is an approach to minimize and reduce human effort and intervention that is, it gives an insight into Internet of Things (IoT) by automating and controlling the devices and things.

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CHAPTER 1. INTRODUCTION

We believe that humans as of today are much more reliant to gadgets and technology as they are on each other. The time that an average person spends on their mobile phones is roughly over four hours a day. Almost every activity today can be controlled by smartphones thus it is paving the way for what can be called as Internet Of Things. In a world where technology is showcasing incessant development and advancements, people are trying to cope up with it. People are getting smart, and devices are getting smarter. The need of the hour is automation and Internet Of Things (IoT) is a foundation stone for this. IoT can basically be defined as interconnectivity for various devices and gadgets. Thus, IoT is slowly becoming an indispensable part of our lives.

This new wave of connectivity is going beyond laptops and smartphones, it's going towards connected cars, smart homes, connected wearables, smart cities and connected healthcare.

So, in our project, we aim to establish automatic connectivity of all devices connected to the same network generated by the ESP8266 Wi-Fi module along with controlling the devices from the server. Further, the concept of 'smart' devices has been demonstrated and achieved by controlling it with voice commands given to Amazon's Alexa.

1.1 OBJECTIVE

- To design a device that connects all devices in the network created by the ESP8266 Wi-Fi module, automatically without any external intervention.
- To access, manipulate and process data received from sensors
- To create a network, such that the data generated by the sensors connected to the router in that network is recorded for the user, analysed and displayed to them, along with the ability to update the state of the device by the user.

1.2 NEED OF YOUR PROJECT

DACE can be useful for automatically connecting devices in a network created and generated by ESP8266 Wi-Fi module. The project also aims at providing hands free control on devices such as light bulbs and various other devices using Amazon's Alexa. Voice based assistants are the need of the hour and are in rise today which makes our project module more acceptable in the technical world that is.

1.3 FEATURES

- ***Easily Accessible Data*** : The temperature data that is hosted on a local server can be accessed from anywhere around the world since it is also available on an open IOT Platform i.e. www.thingspeak.com
- ***Efficient Data Management*** : The temperature data can be easily accessed and controlled anytime, anywhere.
- ***Control System :*** The devices connected in the module can also be controlled locally through a server which in this case is the speed of a DC Motor.
- ***Hands Free Control*** : Devices are connected to Amazon's ALEXA which is Amazon's voice assistant and the light bulb that is connected can be controlled just by a simple voice command.
- ***Authorized Connection*** : The sensor data and all the analytics are secured behind a login ID and Password thus restricting any unauthorized user, access to your private home data.

1.4 BENEFITS

- ***Accessibility*** : The device that is connected to the Module (in this case, a DC Motor is connected to the driver board) can be controlled from a local server. Also, the devices connected and synchronised from Amazon's Alexa can be controlled from anywhere in the world.
- ***Authorized Connectivity*** : The server hosted on WAMP has a dedicated login ID and a password without which your devices and appliances cannot be modified or manipulated by anyone.
- ***Voice Assisted Commands*** : A hands free approach is imbued has been integrated into the model which allows the user to give commands to a device synchronized with Alexa. It also gives the characteristics of a smart device to an ordinary one thus making the whole system economical and financially stable.
- ***State Of The Art*** : IOT and Smart Home networks are on the rise today and our module just binds itself to those technologies thus making the module state of the art.

CHAPTER 2. REVIEW OF LITERATURE

2.1 EXISTING SYSTEMS

Many Smart IOT Devices such as Smart Lights/Bulbs exist as of yet. But the cost of those devices is extremely high. They are certainly not meant for every pocket out there. One Philips Hue Bulb can cost somewhere between Rs. 8000 to Rs. 9000. On the cost of one bulb, our project will be able to control many devices and can provide the features of smart devices into conventional appliances thereby making the module financially feasible and cost efficient.

2.2 OVERVIEW ON IOT PROJECTS

Internet of Things (IoT) is a sprawling set of technologies and use cases that has the main motto to achieve maximum automation. IoT is the network of physical devices, vehicles, home appliances, and other items with electronics, software, sensors, actuators, and network connectivity which enable these objects to connect and exchange data.

These devices, or *things*, connect to the network to provide information they gather from the environment through sensors, or to allow other systems to reach out and act on the world through actuators. They could be connected versions of common objects you might already be familiar with, or new and purpose-built devices for functions not yet realized. They could be devices that you own personally and have on your person or in your home, or they could be embedded in factory equipment, or part of the fabric of the city you live in. Each of them is able to convert valuable information from the real world into digital data that provides increased visibility into how your users interact with your products, services, or applications.

The specific use cases and opportunities across different industries are numerous, and in many ways the world of IoT is just getting started. What emerges from these scenarios is a set of common challenges and patterns. IoT projects have additional dimensions that increase their complexity when compared to other cloud-centric technology applications, including:

- Diverse hardware
- Diverse operating systems and software on the devices
- Different network gateway requirements

This guide explains the elements you can combine with Google Cloud Platform to build a robust, maintainable, end-to-end IoT solution on Cloud Platform.

2.3 TECHNOLOGIES USED

1) Arduino Genuino UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

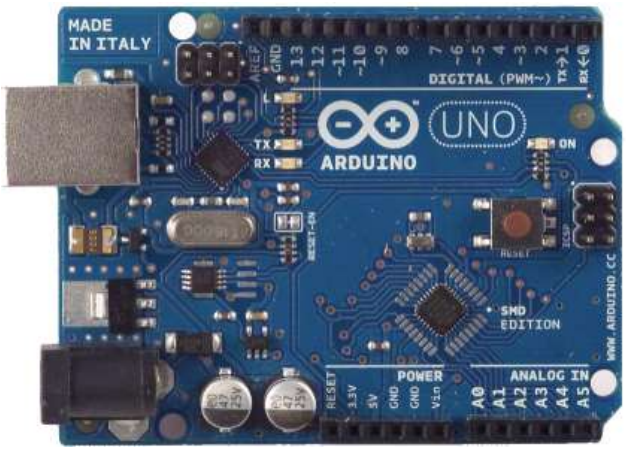

Figure 1 : Arduino Genuino UNO

2) ESP9266

The **ESP8266** is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in

volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

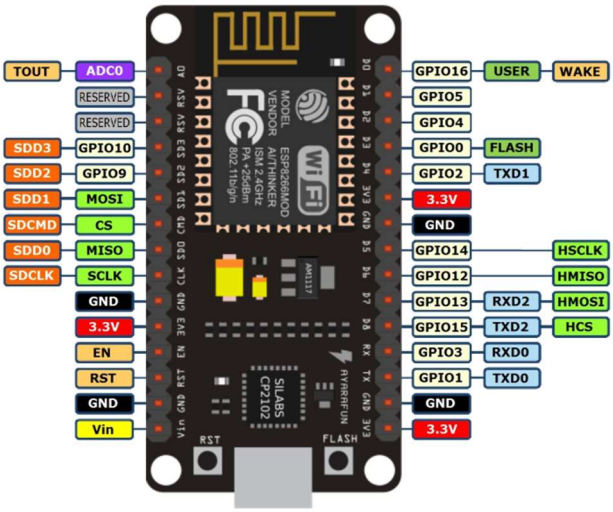

Figure 2 : ESP8266

3) PHP

PHP (PHP: Hypertext Pre-processor) is a scripting language that helps people make web pages more interactive by allowing them to do more things. A website programmed with PHP can have pages that are password protected. A website with no programming cannot do this without other complex things. Standard PHP file extensions are .php .php3 or .phtml, but a web server can be set up to use any extension. Its structure was influenced by many languages like C, Perl, Java, C++, and even Python. It is considered to be free software by the Free Software Foundation.

4) HTML

HyperText Markup Language (**HTML**) is a mark-up language for creating webpages. Webpages are usually viewed in a web browser. They can include writing, links, pictures, and even sound and video. HTML is used to mark and describe each of these kinds of content so the web browser can show them correctly.HTML can also be used to add meta information to a webpage. Meta information is information *about* the web page. For example, the name of the person who made it. Meta information is not usually shown by web browsers.

Cascading Style Sheets (CSS) and JavaScript can be included in HTML code. CSS is used to change how a webpage looks. JavaScript is used to add features to webpages and make them more interactive.

HTML was made by the World Wide Web Consortium (W3C). There are many versions of HTML. The current standard is HTML 4.01. So, it is the version the W3C recommends. A newer version, called HTML5, will become standard within the next few years. The W3C also develops XHTML. This is another mark-up language which is very similar to HTML, but stricter.

5) JAVASCRIPT

JavaScript is a scripting language for computers. It is often run in web browser applications to create dynamic content like a popup message or a live clock. It is not related to the programming language Java.

6) JQUERY

jQuery is a lightweight, "write less, do more", JavaScript library. The purpose of jQuery is to make it much easier to use JavaScript on your website. jQuery takes a lot of common tasks that require many lines of JavaScript code to accomplish, and wraps them into methods that you can call with a single line of code.

jQuery also simplifies a lot of the complicated things from JavaScript, like AJAX calls and DOM manipulation. The jQuery library contains the following features:

- HTML/DOM manipulation
- CSS manipulation
- HTML event methods
- Effects and animations
- AJAX
- Utilities

7) WAMP SERVER

WAMP Server refers to a software stack for the Microsoft Windows operating system, created by Romain Bourdon and consisting of the Apache web server, OpenSSL for SSL support, MySQL database and PHP programming language.

2.4 WHY AUTOMATION?

Automation or **automatic control**, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention, with some processes have been completely automated.

- Increased throughput or productivity.
- Improved quality or increased predictability of quality.
- Improved robustness (consistency), of processes or product.
- Increased consistency of output.
- Reduced direct human labour costs and expenses.

CHAPTER 3. SYSTEM ARCHITECTURE AND COMPONENTS

3.1 DATABASE

The project database is stored in WAMP server. All the user accounts that are created on this website are stored in it. Their details which are required for successful creation of account are first name, last name, channel id and field id. These details are then used to provide access to their information and control to temperature analysis of their area and they can also control their other devices (in this case, a dc motor) through the sever. They can also enquire the last updated temperature from Alexa. The temperature readings are continuously updated in the database. These readings are used to generate real time graph of temperature readings on the web server.

In this way, the user can create account on the website and his details will be stored in the database. These details are used later to display the analysis and also provide remote access to user to control other devices too. He can also edit his profile whenever he wants to.

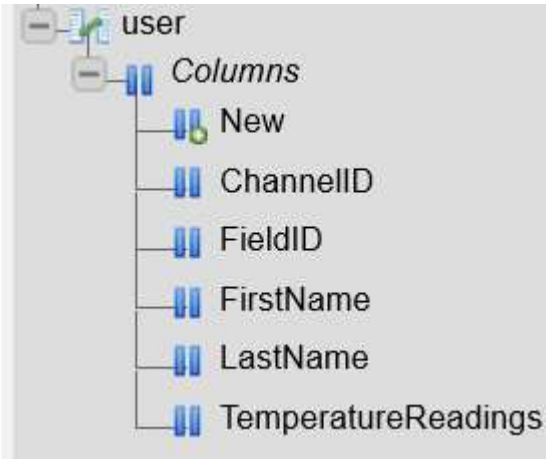

Figure 3 : Database table Overview

3.2 METHODOLOGY

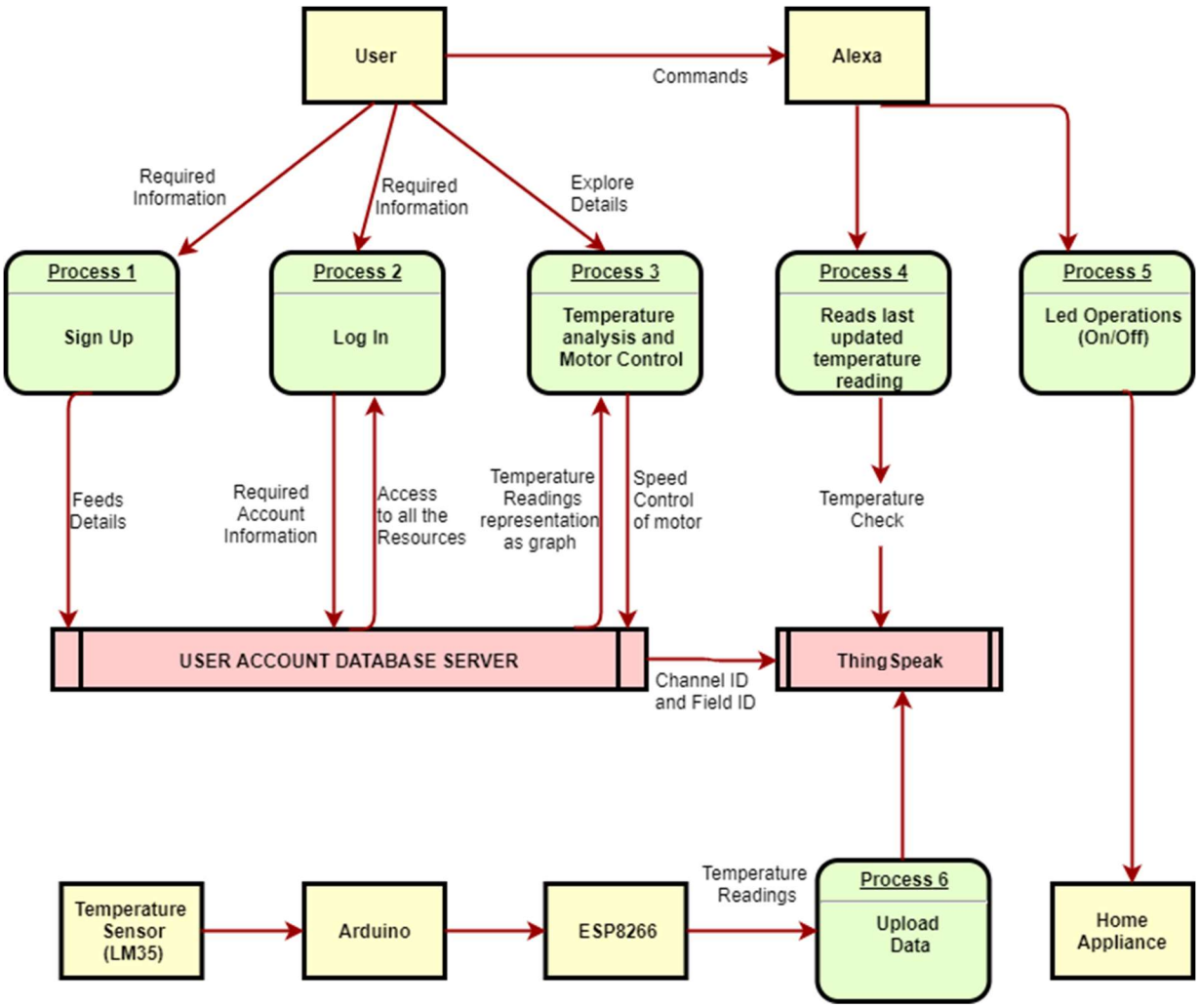

Figure 4 : Methodology

The module consists of 6 processes : Sign Up, Login, Temperature Analysis and Motor Control, Reading the last recorded temperature, LED Operations and Uploading of data.

The module consists of the following actors : User, Alexa, Temperature Sensor (LM35), Arduino, ESP8266, Home Appliance

3.3 MODULES

- ***Sign Up/ Log in Module***

This is the first module through which a user can create a unique account to access to his data. To create account, one must enter his first name, last name, channel id and field id. The account will be created successfully only if the user has entered a unique channel id. After creation of user account, he can log in from anywhere and anytime over internet.

- ***Welcome Module***

After logging in, the user is redirected to a welcome page where he is given several options like profile settings, view statistics, control motor and many more.

- ***Temperature Analysis Module***

Here, the user can view the chart generated after analysis of temperature readings. This module updates the chart in real time. It takes values from database. This is the page from where the user can monitor the statistics over the internet and control motor accordingly.

- ***Motor Control Module***

In this module the user is given several options to control motor at different speeds. On a single click, he can switch on, switch off, and control the speed of motor (in this case, DC motor of fan) as per his choice.

- ***Profile Settings Module***

Using this module, the user can view his current profile details and also update his profile. To do so, he just needs to enter his new details and click on the save button. This leads him to the log in page from where he can log in again using his new details.

- ***About Device Module***

In this module, the user can view detailed information about his device. It also gives an introduction to the internal structure and features of the device.

- ***Help / Contact Module***

Help module helps the user if he is unable to create account or log in. it provides a set of instructions to the user using which he can solve his problem and move further. If he still cannot solve his problem, he can contact us. In the contact us space, we have provided an email id.

- Arduino Module
- Alexa Skill

CHAPTER 4. SYSTEM DESCRIPTION

4.1 WORKING OF THE PROJECT

When this device is installed, it starts taking temperature readings. These temperature readings are then sent to the server and also displayed on the LCD screen attached to the device. This LCD display is visible to the people present at the place where the device is installed. When the device is installed, the user has to create an account on the server by filling all the necessary details on the Sign-Up form. To Sign-Up, the user must enter his first name, last name, channel id and field id. Once his account is created successfully, he can log into the server over the internet from anywhere anytime.

As soon as the user log in into his account, he has the access to the temperature recordings and he can also control the motor. He can also view device information and edit his profile if he wants to.

When device starts, it sends the temperature readings to the server, where all the readings are stored with the account information of that particular user. These readings are then used further for generation of graph by retrieving readings from the database. This graph is displayed on the webserver to user. He can monitor the temperature and control the motor according to his choice.

The motor (in this case, DC motor-fan) can be controlled over internet. The webserver provides a web page to the user, using which he can switch on, switch off and set the speed of fan. In this way, the user can control many devices over the internet.

User can also user Amazon Alexa to retrieve information about device by giving voice commands. User can also give commands to Alexa and control a large number of devices. This makes users' job more convenient and easy.

In this way, user can access his device (take information and control devices) over internet by webserver and by voice commands using Alexa too. It is a convenient and affordable way to convert simple device into smart devices.

4.2 PROJECT FLOW

- ***ESP8266 In Sender Mode***

  The room temperature data is collected by LM35 Temperature sensor and is stored in the database. The reading are then uploaded and displayed in a graphical format for easy and quantitative analysis. The website hosted updates the temperature readings and values in real time with a minimum amount of delay.

- ***ESP8266 In Receiver Mode***

  After 3 temperature readings have been successfully registered in the database, the serial monitor of the Arduino IDE prompts to configure ESP8266 in receiver mode. Once configured, it can control a device or an appliance connected to it, from the server or website locally. In our module, the speed of a DC Motor is controlled via a server. The speeds are High, Low and Stop.

- ***ALEXA Functionality***

  Devices connected to ALEXA (in our case, a conventional light bulb) is given properties of a smart bulb. With complete hands free operations and voice assisted functionalities, the light bulb can be switched on and off. Along with the light bulb, many other home appliances can be connected and automated depending upon the type and channels of relay that is being used to connect the device. Also, ALEXA can read out the last recorded temperature.

4.3 USE CASE DIAGRAM

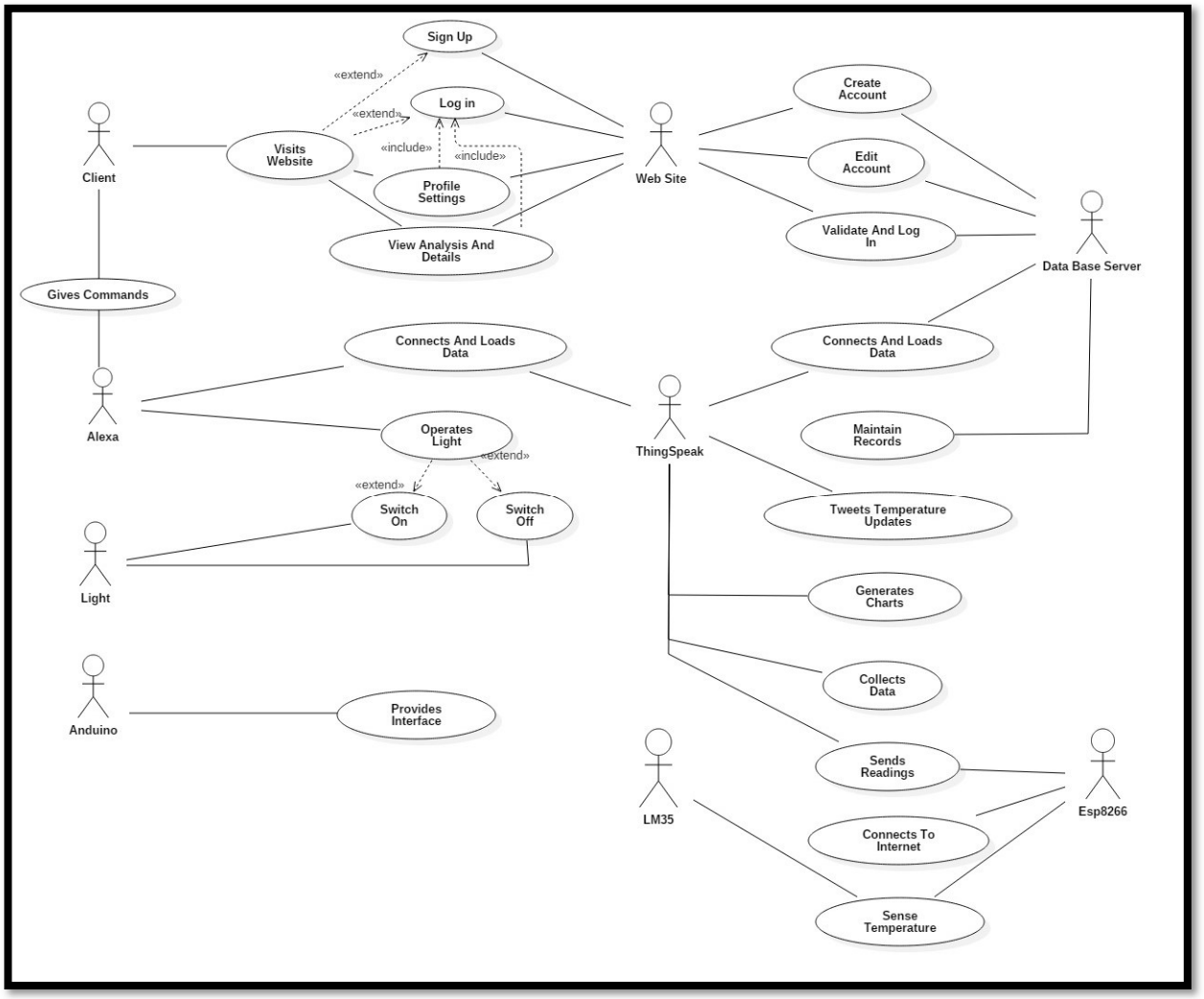

Figure 5 : Use Case Diagram

CHAPTER 5. RESULTS

SCREENSHOTS OF THE PROJECT

Home Page

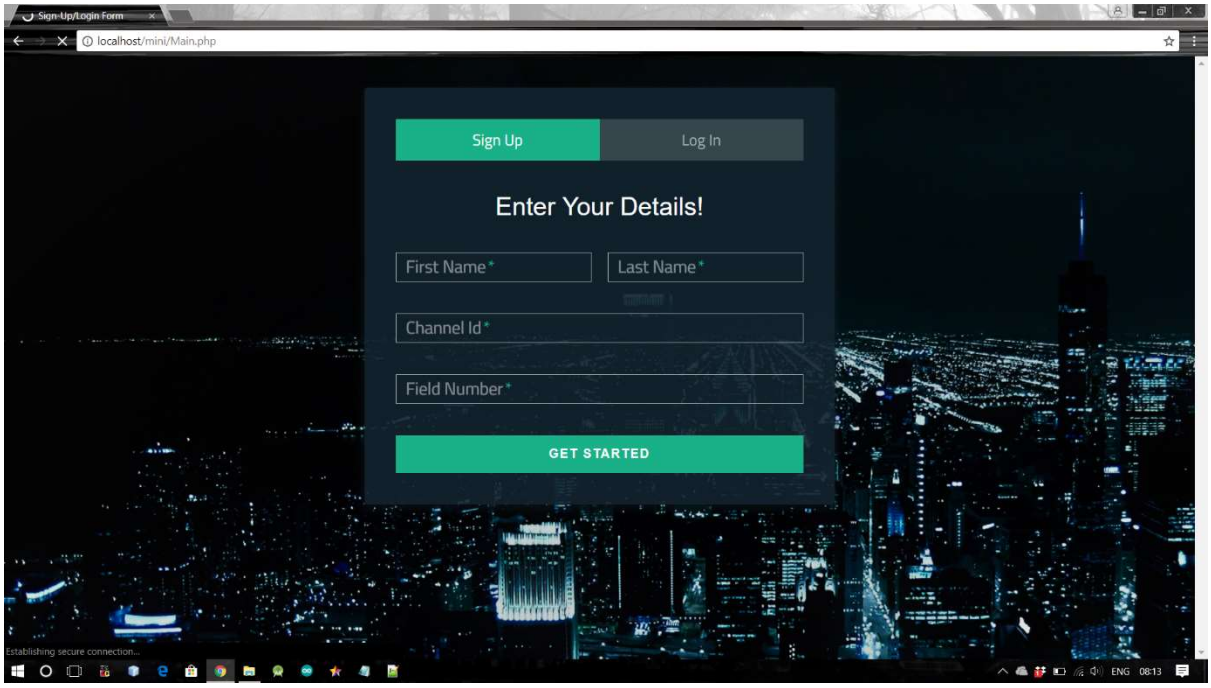

Figure 6 : Sign Up Page

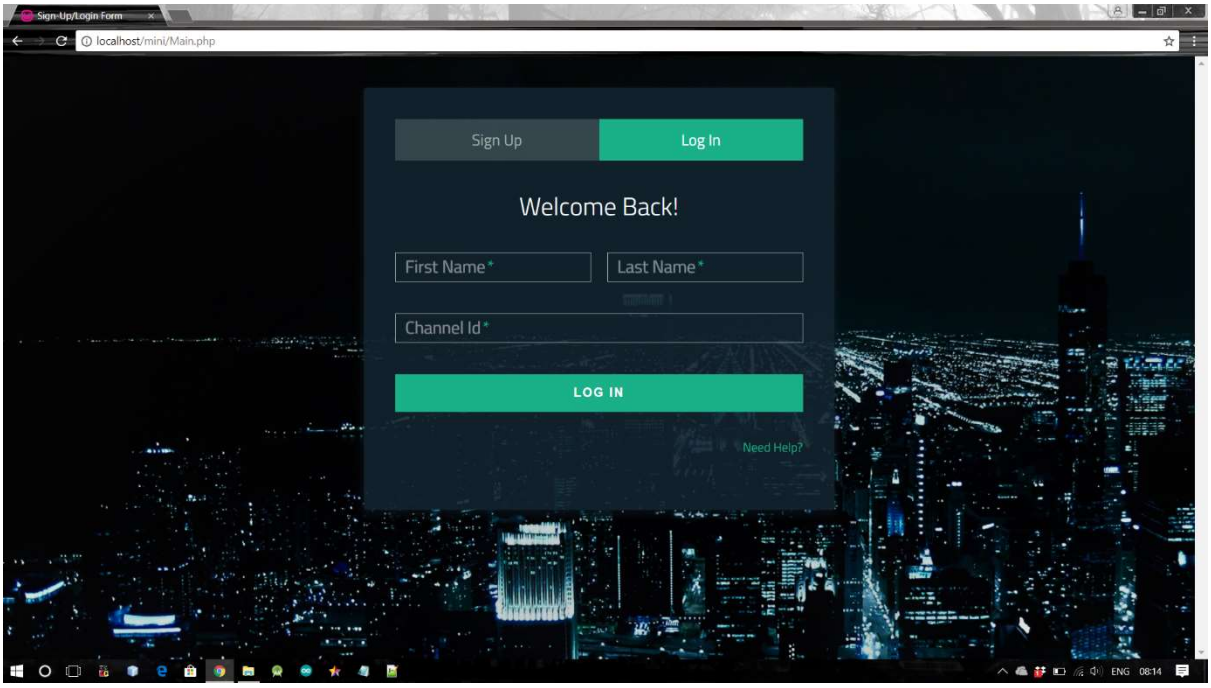

Figure 7 : Login Page

Help Page:

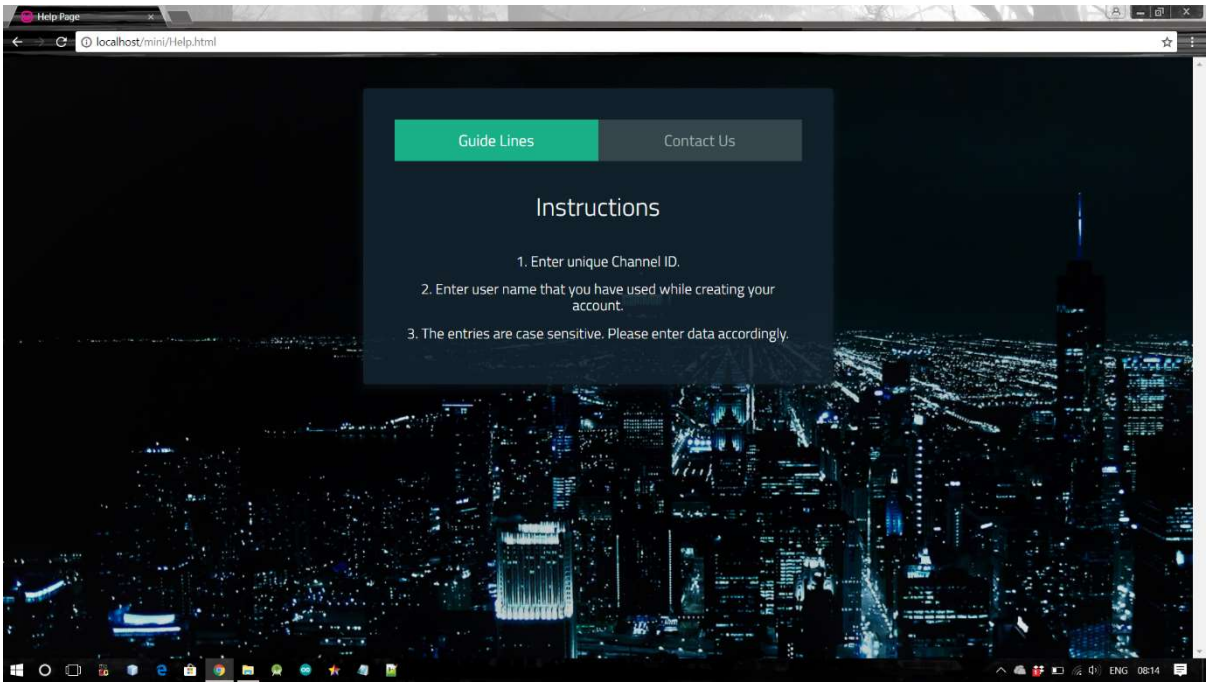

Figure 8 : Guidelines Page

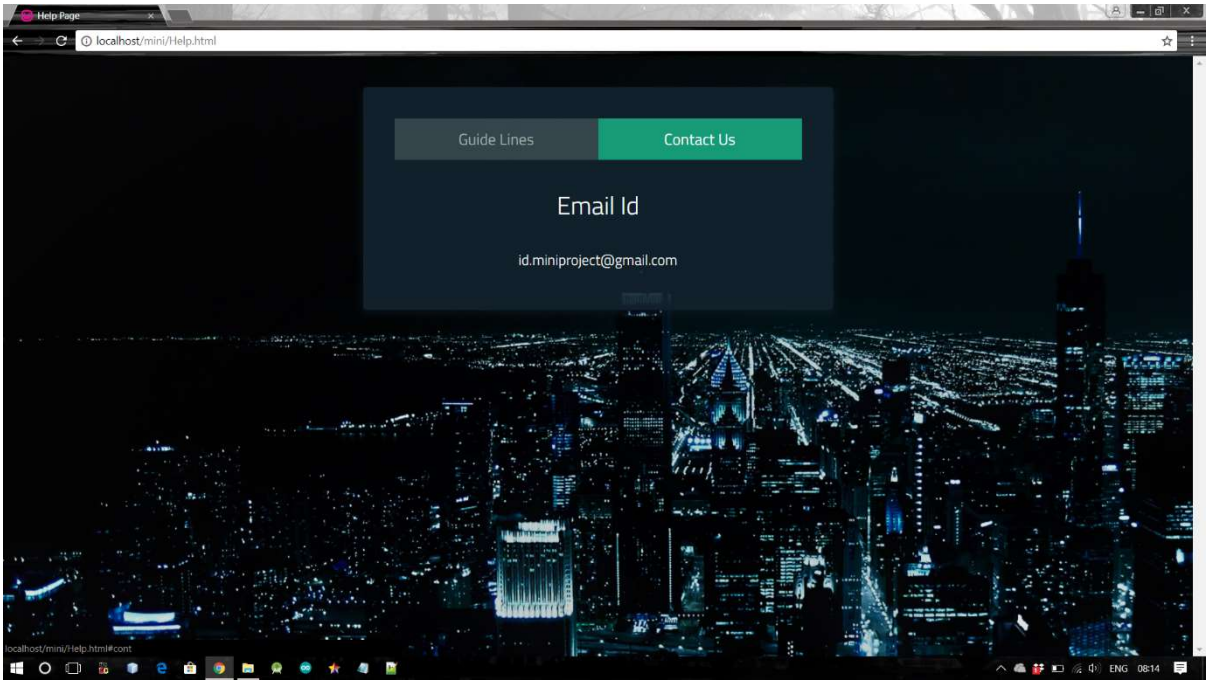

Figure 9 : Contact Us Page

Creating a new account

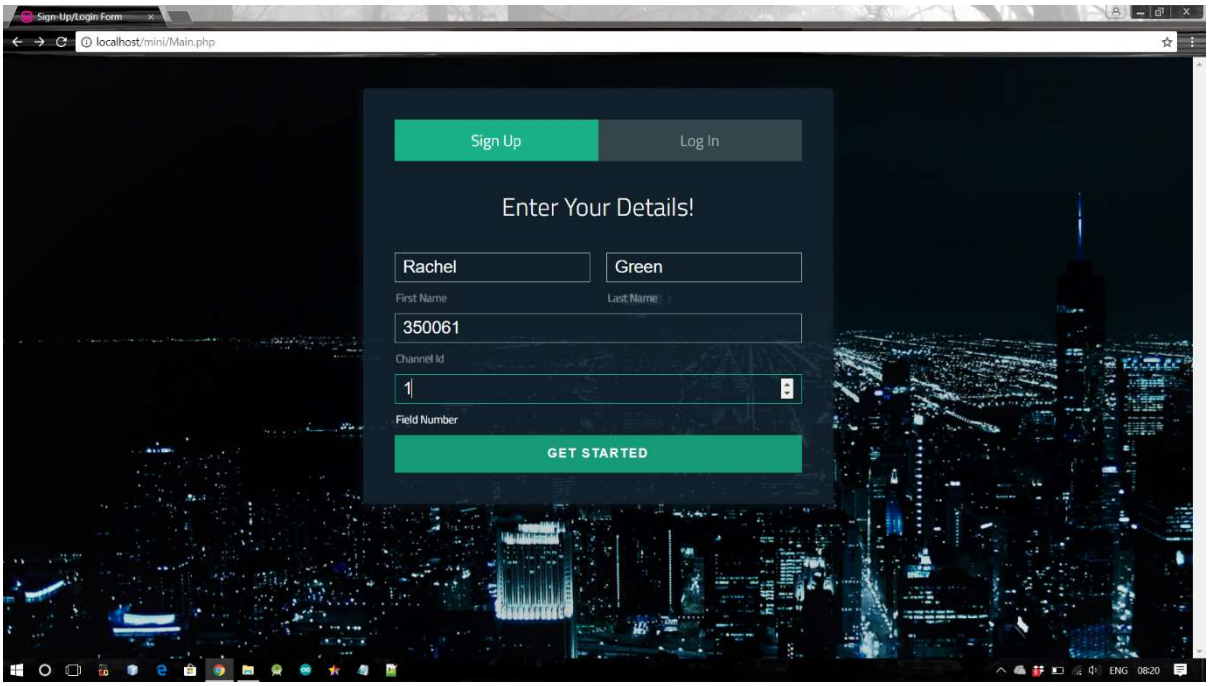

Figure 10 : Sign Up & Create a New Account

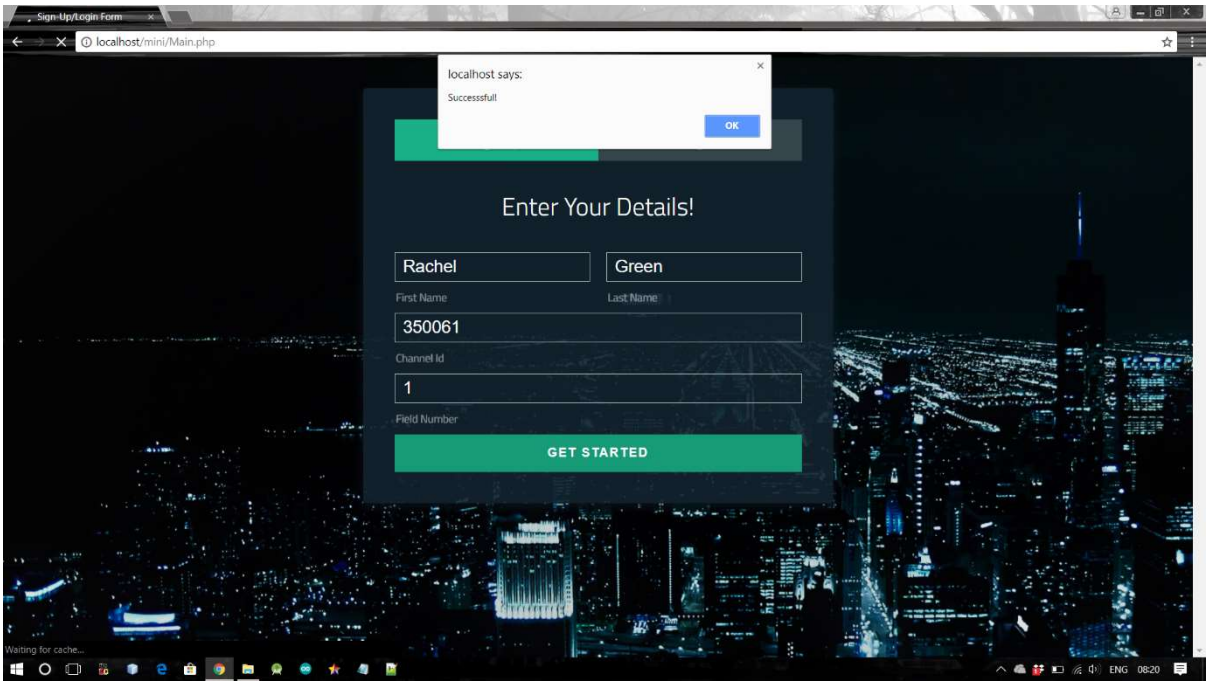

Figure 11 : Successful creation of a new account

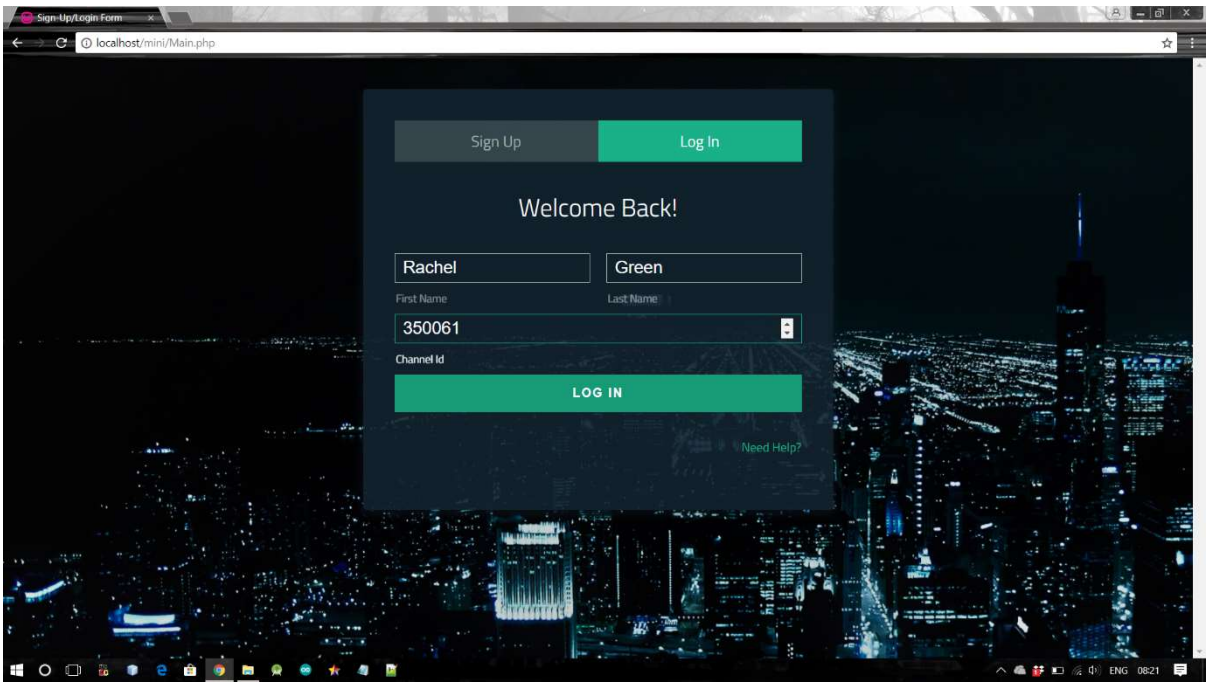

Figure 12 : Fill In Required Information and Login

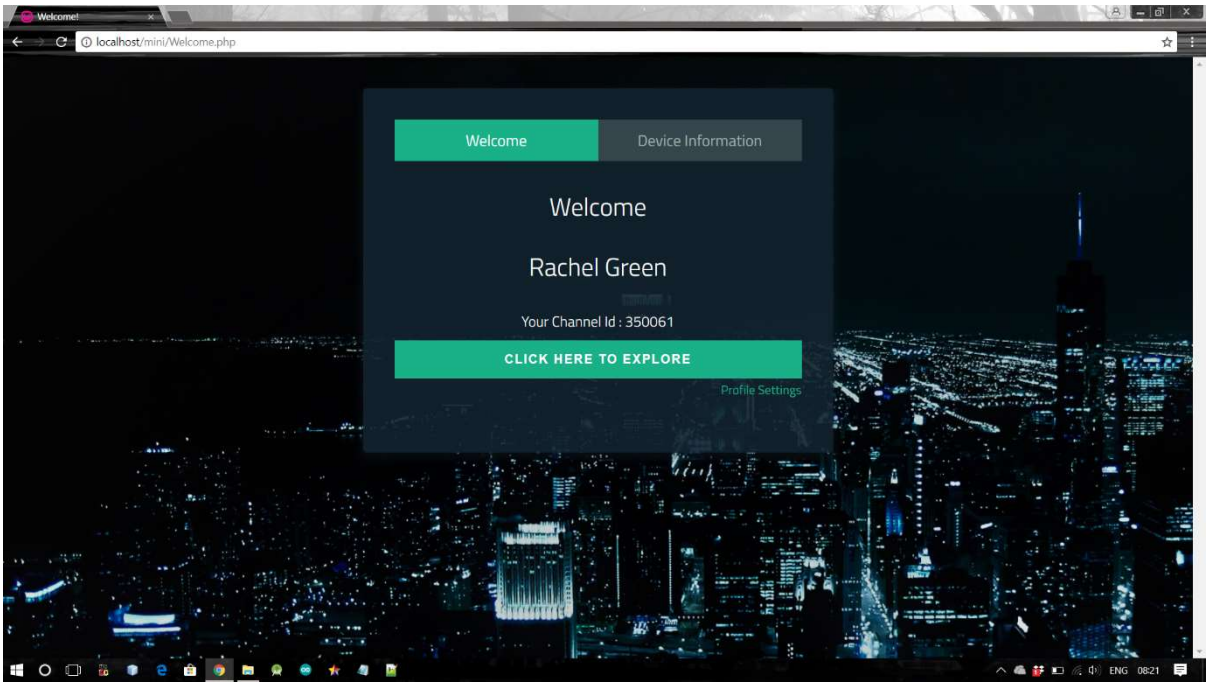

Figure 13 : Welcome Page

Details Page

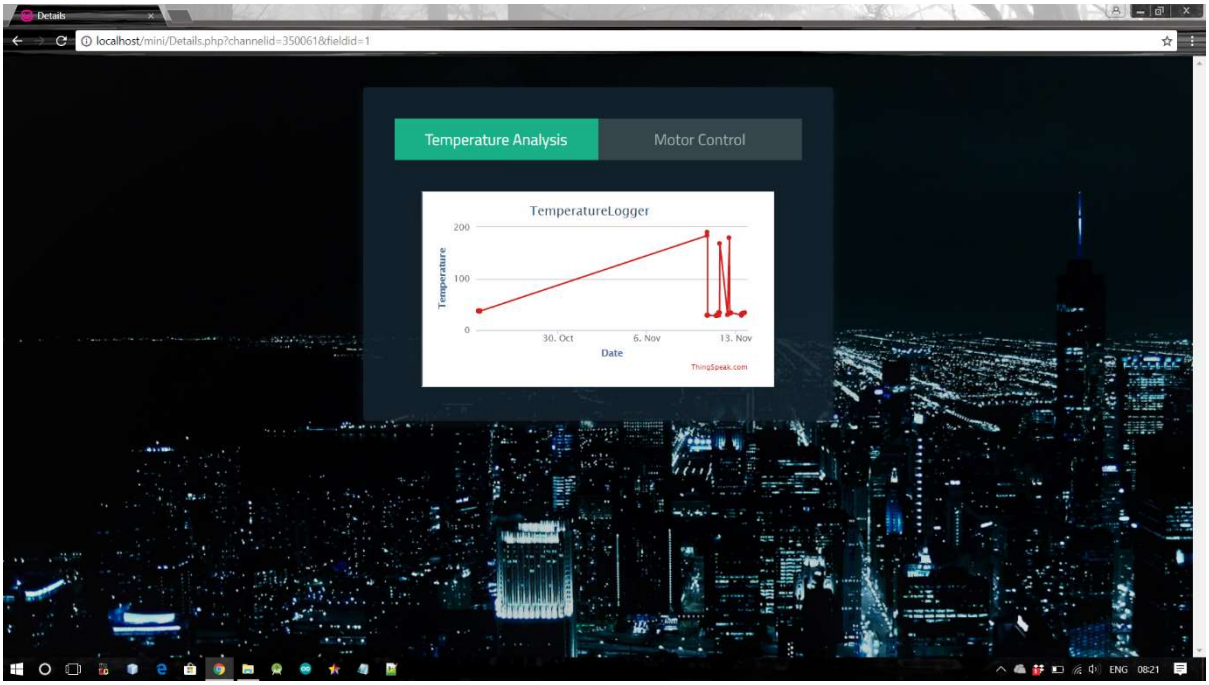

Figure 14 : Temperature Analysis Page

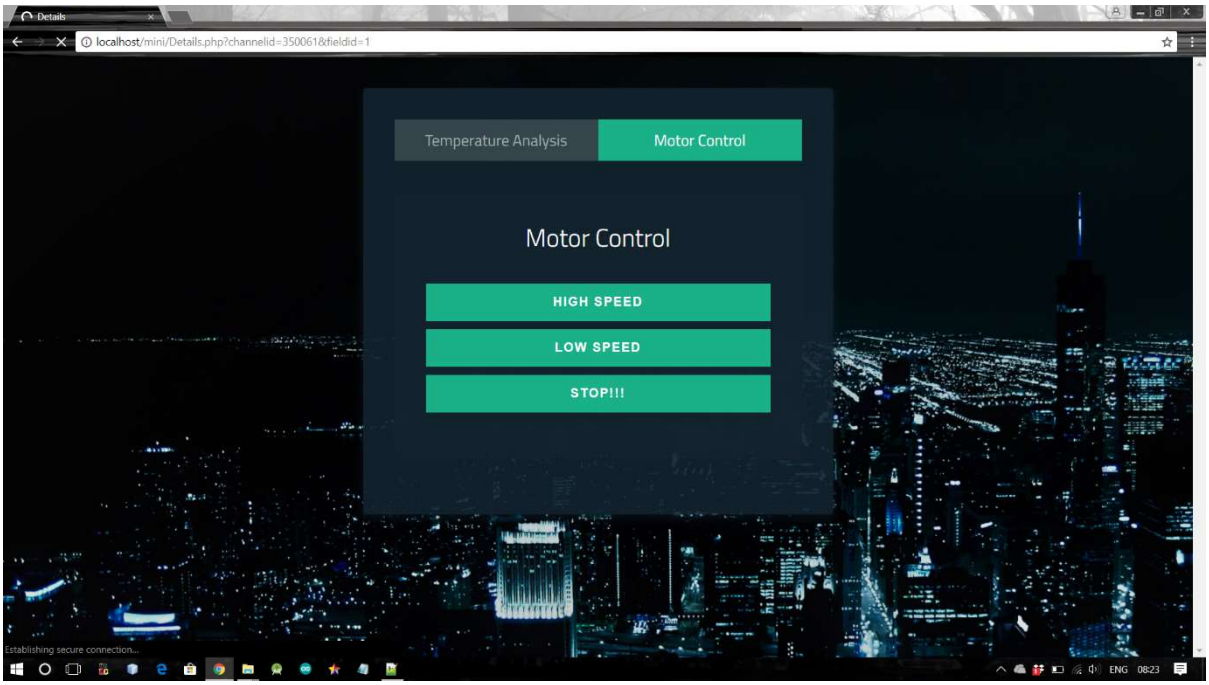

Figure 15 : Motor Control Page

Profile settings

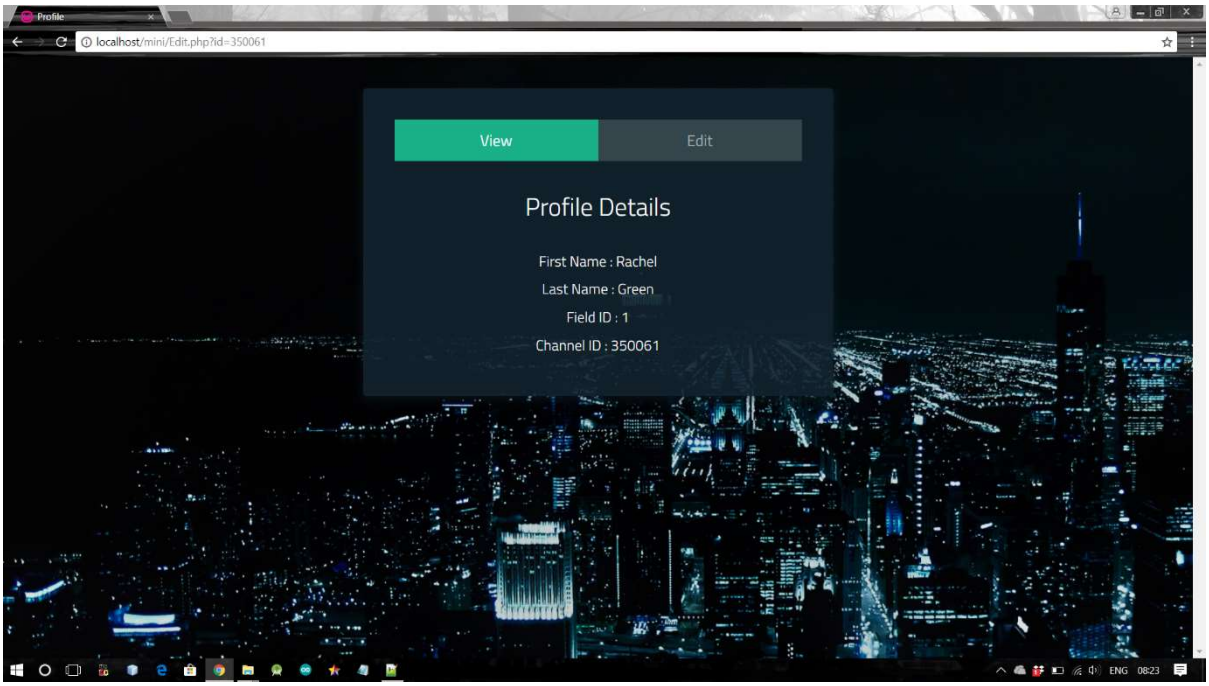

Figure 16 : View Page

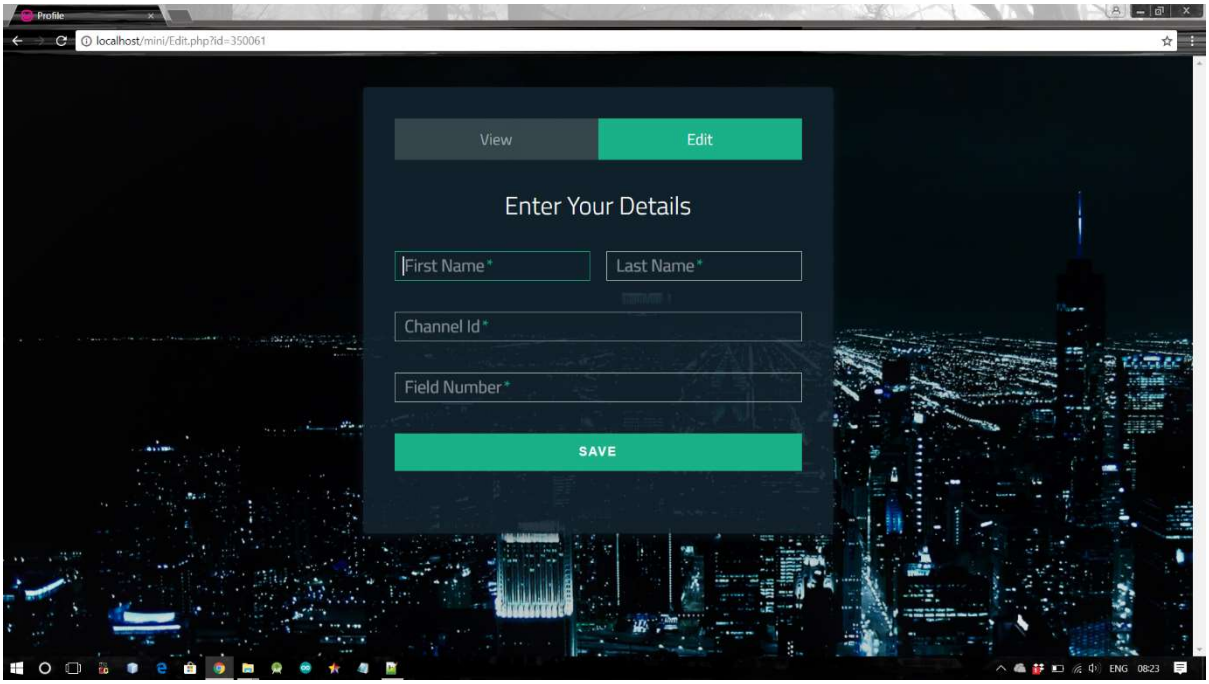

Figure 17 : Edit Page

Device Information Page

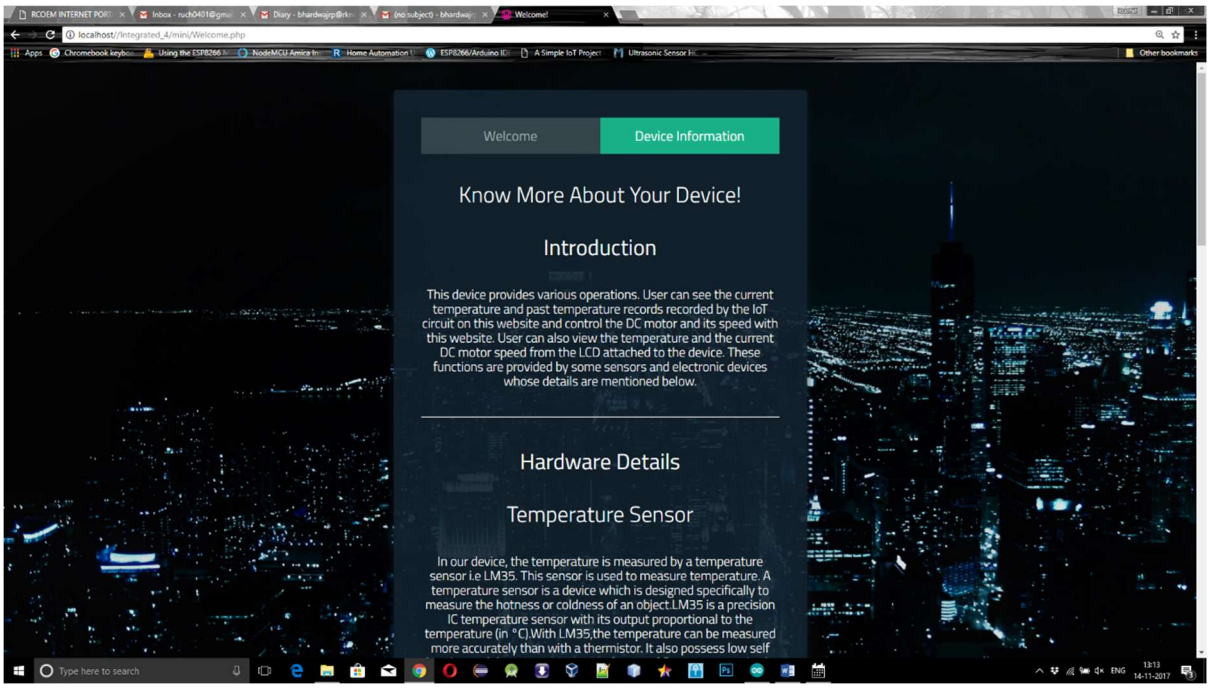

Figure 18 : Device Information

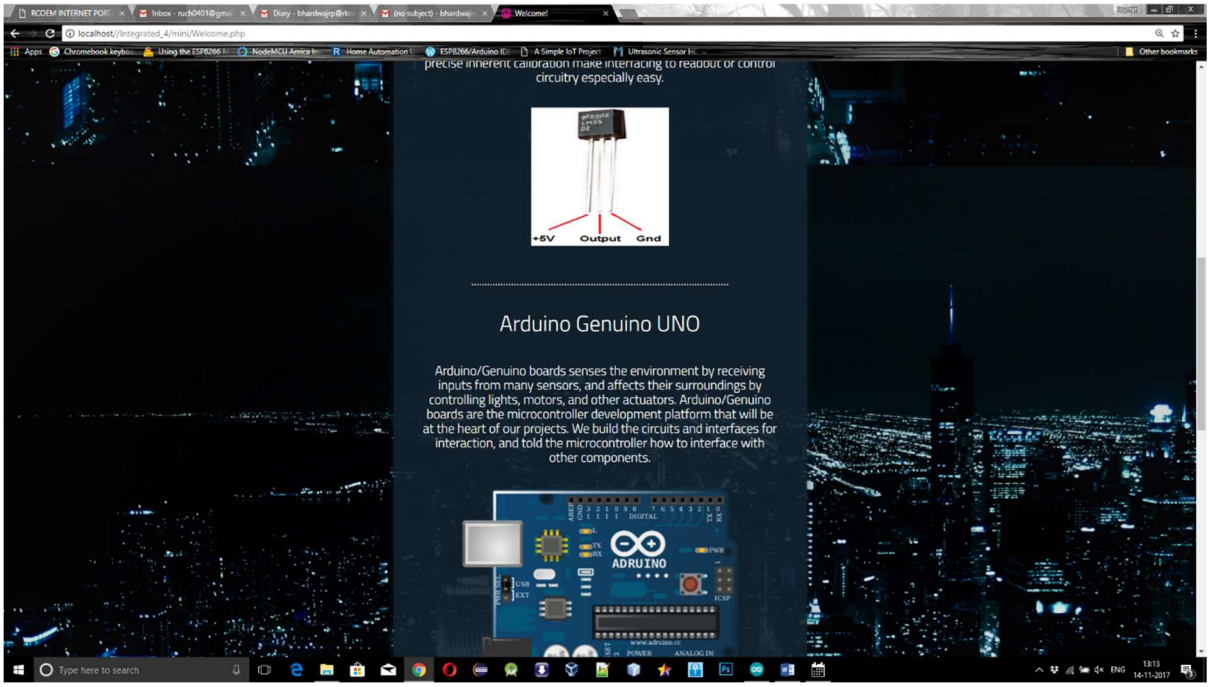

Figure 19 : Device Information

CHAPTER 6. CONCLUSION AND FUTURE WORK

6.1 FUTURE WORK

As we have presented our project in two parts, one with controlling devices with voice and the other with the website, we can integrate both the modules and can present it together from where the user can choose either of the solution to operate the devices. In this way this project can become completely hands-free.

We can also give a number of options for the type of devices that can be controlled by the user and the user can select them during creating their own account and after that they can monitor the list of devices from their account. In this way, this project can greatly in making our city smart.

It can also be used for assisting blind people in their normal day to day activities thereby making their life simple and easy.

Finally, our project will greatly help in bringing the concept of smart devices to every household due to its economic and financial feasibility.

6.2 CONCLUSION

In this way, we have created a "Device Automation and Connection System using ESP8266 (DACE)" from where a user can control his/her home devices from a remote location through a website by just creating their account on it and they can also control their home appliances through their voice. Our project gives the most cost effective way to automate the simple low-cost unautomated devices. Thus, it is an economic and a financially feasible solution.

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- Tao Beibei,Lu Yi(2015) ,"Upgraded Application of Intelligent Environment Monitoring System in IOT Smart Home", International Conference on Intelligent Systems Design and Engineering Applications (ISDEA-2015)

Hyperlinks

- Information about Arduino Genuino UNO and ESP8266

  http://espressif.com/en/products/hardware/esp8266ex/overview

  https://forum.arduino.cc/

- Tutorial files related to Database creation and WAMP

  http://www.c-sharpcorner.com/article/working-with-wampserver/

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- To refer future scope of BLE beacons

  https://ce-pro.eu/2016/08/16/transforming-automation/

- For application development tools and error solving purposes
  - www.w3schools.com
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  - www.tutorialspoint.com

GUIDE APPROVAL

Prof. R. R. Welekar

Project Guide