IoT BASED SMART JUNCTION BOX

A PROJECTREPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project titled "**IoT BASED SMART JUNCTION BOX**" is the bonafide work of **"NATARAJAN.A.V [Reg No: RA1611017010075], K.GOKUL [Reg No: RA1611017010009], ANANDAKRISHNAN.B [Reg No: RA1611017010021], RAHUL .T.V [Reg No: RA1611017010018]"** **1**who carried out the project work under my supervision.

Certified further, that to the best of my knowledge reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Our project 'IoT Based Smart Junction Box' provides a cost-effective and flexible home control and monitoring system with the aid of an integrated web server and internet protocol (IP) connectivity for access. It delivers seamless control of equipment and appliances remotely using Android– based application. This system can provide live tracking and monitoring electricity consumption. This system make home automation dream of easy to use, economical, smart, wireless, sensor networks to become a reality to very commoner. Our project make physically Challenged people to control the home appliances remotely with the aid of voice control and text recognition. The Smart junction box is a wireless home automation system that can be implemented in existing home environment, without any changes to switches, sockets and home infrastructure. This IoT based smart junction box let the users to control their homes from their computer or mobile devices. This system works using Wi-Fi modules which are basic amenity in modern world. The Support Application provides reminders and alerts for payment of utility bills and provides seamless integration for payment of the same using mobile browser.

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We would like to express our gratitude to our Director **Dr. C. Muthamizhchelvan** and our Head of Department **Dr A. Vimala Juliet** for their kind co-operation and encouragement which helped us in completion of this project.

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My thanks and appreciations also go to our entire colleague in developing the project and people who have willingly helped us out with their abilities.

LIST OF FIGURES:

LIST OF ABBREVIATIONS:

1. API – Application Program Interface
2. CMOS – Complementary Metal–Oxide–Semiconductor.
3. COM – Common Connection point
4. DC – Direct Current.
5. GND – Ground Connection.
6. GPIO – General Purpose Input/Output.
7. IC – Integrated Circuit.
8. IDE – Integrated Development Environment
9. IO – Input Output Operations
10. IoT – Internet of Things
11. IP – Internet Protocol
12. MATLAB – Matrix Laboratory
13. MQTT – Message Queuing Telemetry Transport
14. NC – No Connection.
15. OS – Operating System.
16. PCB – Printed Circuit Boards.
17. TTL – Transistor Transistor Logic.
18. URL – Uniform Resource Library
19. USB – Universal Serial Bus
20. WiFi – Wireless Fidelity.

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CHAPTER 1

INTRODUCTION

In the modern world the internet of things is creating whole new era that which we have never experienced before. With the rapid emergence of smartphones, the internet of things is evolving to meet our needs and rising to the challenges of our changing world. The latest Internet of Things (IoT) devices has changed our home spaces like never before. Virtual Assistants such as Amazon Alexa and Google Home, allow us to dive into smart devices including thermostats, door locks, light bulbs, security cameras, and more. Without getting out of bed or our favorite reclining chair, we can control the environment around us with merely a finger tap on our smartphones. But this technology is not access to very common people in the world.

1.1 OBJECTIVES

The objective of the proposed system is

1. To make low cost-effective and flexible home control system.
2. To monitoring system with the aid of an integrated web server with internet protocol connectivity for access and to control of equipment and devices remotely using Android – based application.
3. Also, to make this home control system easy to operate for physically challenged people like visually impaired.

CHAPTER 2

LITERATURE SURVEY

2.1 IOT BASED SMART HOME DESIGN USING POWER AND SECURITY MANAGEMENT

This paper presents the design and implementation of an Ethernet-based Smart Home intelligent system for monitoring the electrical energy consumption based upon the real time tracking of the devices at home an INTEL GALILEO 2ND generation development board, which can be used in homes and societies. The proposed system works on real time monitoring and voice control, so that the electrical devices and switches can be remotely controlled and monitored with or without an android based app. It uses various sensors to not only monitor the real time device tracking but also maintaining the security of your house. It is monitored and controlled remotely from an android app using the Internet or the Intranet connectivity. The proposed outcome of the project aims as multiple benefits of saving on electricity bills of the home as well as keep the users updated about their home security with an option of controlling the switching of the devices by using their voice or simple toggle touch on their smartphone, and last but most importantly, monitor the usage in order to conserve the precious natural resources by reducing electrical energy consumption.

2.2 EYRIE SMART HOME AUTOMATION USING INTERNET OF THINGS

This paper describes the use of various open source hardware such as Arduino, Raspberry Pi, etc. to build smart and secure homes. The hardware is open source and hence cost efficient. This home automation system allows the end user to monitor his home or office with a smartphone, tablet, or any computer. This paper also explains the use of the security system for fire hazards that may occur due to a gas leakage and can be detected using a smoke sensor. It uses a low power NRF24L trans-receiver at each node around the house to create a mesh network that connects to a Linux based central hub. Users can monitor the house from anywhere and get periodic alerts. In the proposed work, the house can also be controlled using voice commands such as Google Voice, Apple HomeKit and Alexa.

2.3 A SMART HOME AUTOMATION TECHNIQUE WITH RASPBERRY PI USING IOT

In this paper, we are presenting a proposed system for Smart Home Automation technique with Raspberry Pi using IoT and it is done by integrating cameras and motion sensors into a web application. To design this system, we are using a Raspberry Pi module with Computer Vision techniques. Using this, we can control home appliances connected through a monitor based internet. Raspberry Pi operates and controls motion sensors and video cameras for sensing and surveillance. For instance, it captures intruder’s identity and detects its presence using simple Computer Vision Technique (CVT). Whenever motion is detected, the cameras will start recording and Raspberry Pi device alerts the owner through an SMS and alarm call.

2.4 IOT BASED HOME AUTOMATION BY USING PERSONAL ASSISTANT

This work discusses the result of the work done in development of a "IoT – Personal Assistant using Raspberry Pi" on Python Platform. The work aims at the development of a personal assistant that helps users interact with household appliances using speech and gesture commands to provide a more interactive and user friendly living experience and integration of various tools and components developed during the execution of the project. The Internet of Things (IoT) can be described as a network of physical objects or “things” embedded with software, electronics, sensors and network connectivity that helps these objects collect and exchange data. The smart devices and sensors in home automation help collect (or sense) the physical experience and convert it into information data. The major element of home automation based on IoT is the Raspberry Pi. The Raspberry Pi collects data from sensors or takes in speech or gesture commands and interprets them to manage household devices like fan, light, heater, door, and opening and closing of curtains.

2.5 RESIDENCEENERGY CONTROL SYSTEM BASED ON WIRELESS SMART SOCKET AND IOT

This paper is to avoid resources on green earth being exhausted much earlier by human beings, energysaving has been one of the key issues in our everyday lives. In fact, energy control for some appliances is an effective method to save energy at home, since it prevents users from consuming too much energy.Even though there are numerous commercial energy-effective products that are helpful in energy saving for particular appliances, it is still hard to and a comprehensive solution to effectively reduce appliances' energy consumption in a house.

CHAPTER 3

SYSTEM ARCHITECTURE AND HARDWARE DESCRIPTION

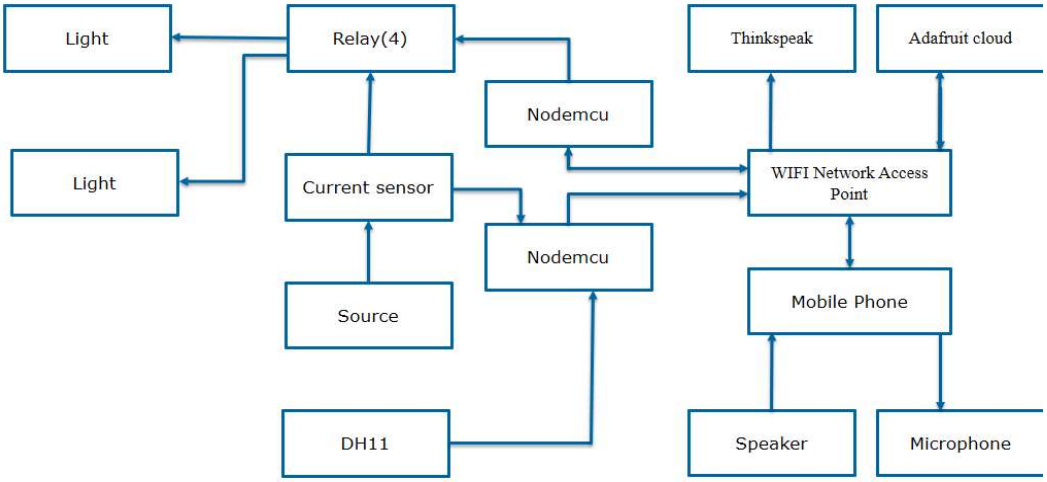

Fig 3.1: Block diagram representation of system architecture.

Our project consists of two Nodemcu, one is to control the four relays and the other Nodemcu is for collecting the current and temperature data from the sensors. Both the sensors are connected with WIFI. Through WIFI the data is sent to the THINGSPEAK servers and Adafruit servers .The Adafruit is connected with the google assistant API. Through google assistant API we can send and receive data from Adafruit server to Mobile. Current and voltage consumed through each socket is measured and monitored through mobile. Power and energy consumption through socket is also measured and monitored through mobile app. Switch operation ON and OFF of each socket is operated through voice command using a web page. All data are transmit information via cloud web server and can monitor anywhere through mobile devices.

3.1NodeMCU

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Esp8266 Systems, and hardware which is based on the ESP-12 module.

3.1.1FEATURES

- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Smart
- WI-FI enabled

3.2Arduino-like hardware IO

- Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware.
- • Code like arduino, but interactively in Lua script.
- • Greatly speed up your IOT application developing process.

3.2.1 Lowest cost WI-FI

- Less than $2 WI-FI MCU ESP8266 integrated and easy to prototyping development kit.
- We provide the best platform for IOT application development at the lowest cost.

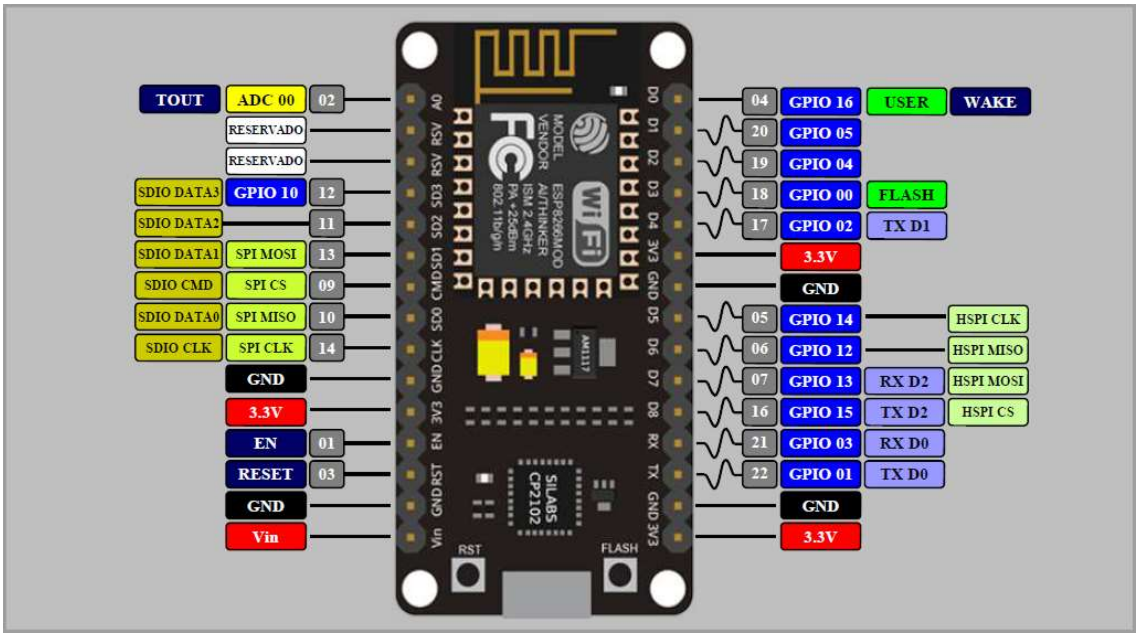

Fig 3.2 Pin configuration of NodeMCU

3.2.2 SPECIFICATION

- USB-TTL included, plug &play
- 10 GPIO, every GPIO can be PWM, I2C, 1-wire
- PCB antenna

3.3 RELAY

Relay is an electrical switch using electrical signal to turn on/off the current. It is also used to control a circuit by a low-power signal.Solid state relays consist of an input circuit, a control circuit and an output circuit. The Input Circuit is the portion of a relays frame to which the control component is connected. The input circuit performs the same function as the coil of electromechanical relays. The circuit is activated when a voltage higher than the relays specified Pickup Voltage is applied to the relays input. The input circuit is deactivated when the voltage applied is less than the specified minimum Dropout voltage of the relay. The voltage range of 3 VDC to 32 VDC, commonly used with most solid-state relays, makes it useful for most electronic circuits. The Control Circuit is the part of the relay that determines when the output component is energized or de-energized. The control circuit functions as the coupling between the input and output circuits. In electromechanical relays, the coil accomplishes this function. A relays Output Circuit is the portion of the relay that switches on

the load and performs the same function as the mechanical contacts of electromechanical relays. Solid-state relays, however, normally have only one output contact.

3.3.1 RELAY'S CONNECTIONS

There are six connections. Three of these control the state of relay, the others connect to circuit (to make circuit close or open).

Three connections control the state of relay:

i. DC+: Electrode positive. In this article, we will connect wire with 5V to this connection.
ii. DC-: Electrode positive. Connect to GND.
iii. IN: Signal connection that is used to control relay.

Fig 3.3 Relay module

Three connections connect to circuit:

i. COM (Common Connection): Connect to power supply. If it's DC, we frequently connect it to positive of power supply. If it's AC, we frequently connect it to hot wire.
ii. NC (Normally Close): Connect to COM connection when there is no trigger in relay. If we connect this connection to wire and don't trigger relay with IN connection, COM and NC will be connected. When we trigger relay with IN connection, COM and NC will be corrupted.

iii. NO (Normally Open): Only connect to COM connection when having trigger in relay. If we connect this connection to wire and don't trigger relay with IN connection, COM and NO will be corrupted. When we trigger relay with IN connection, COM and NC will be connected.

Usually, you will use either NC or NO with COM to control circuit. To understand how NC, NO and COM work, you can see the following pictures:

3.4 ACS712

The ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switched-mode power supplies, and overcurrent fault protection

The device consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilized BiCMOS Hall IC, which is programmed for accuracy after packaging.

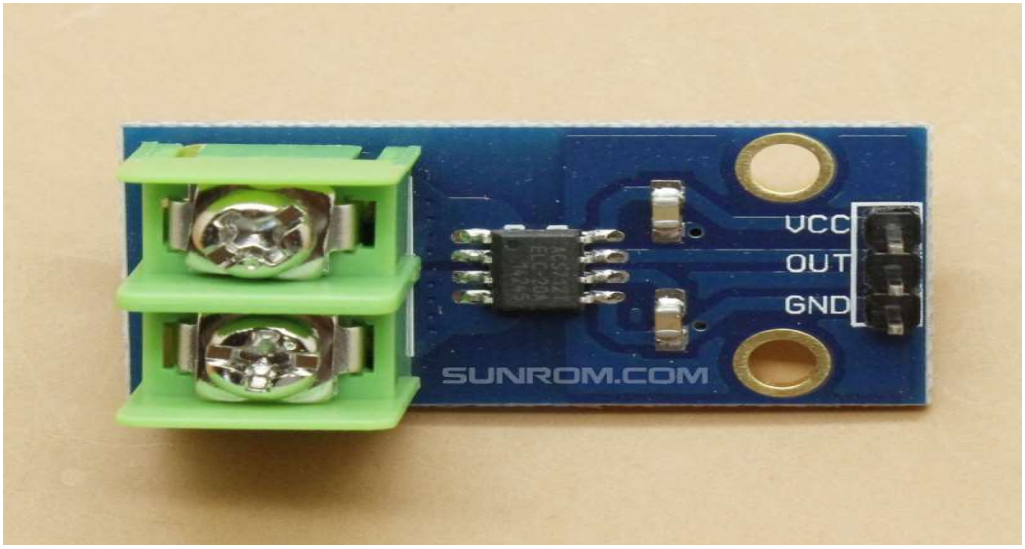

Fig 3.4 Sample image of ACS712 sensor.

3.5 DHT11 TEMPERATURE-HUMIDITY SENSOR

This module can be applied to environmental temperature & humility measurement.

3.5.1 INTERFACES

PIN NO.	SYMBOL	DESCRIPTIONS
1	DOUT	Communication port
2	GND	Power ground
3	VCC	Positive power supply (3.3V-5.5V)

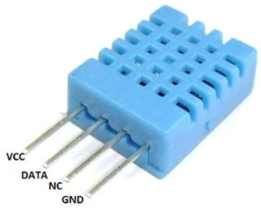

Fig 3.5 Pin out configuration of DHT11 sensor

3.5.2 FEATURES

SensorDHT11 (Temperature & humidity sensor)

Operating voltage3.3V-5.5V

Humility measuring range20%-95%（0℃-50℃）

Humility measuring error+-5%

Temperature measuring range0℃-50℃

Temperature measuring error+-2℃

Dimensions29.0mm*18.0mm

Fixing hole size2.0mm

CHAPTER 4
SOFTWARE DESCRIPTION

4.1 ARDUINO IDE

Arduino is a micro-controller development board series - Uno, Mega, Nano, Mini etc. are a few examples. Now, any micro-controller(here it is the Atmega 328 IC on the Arduino Uno or Atmega 1280 on arduino Mega) that needs to be programmed is basically fed with a hex code version of the code written in high level (English) language. So, arduino development boards are fed with the code via their Arduino IDE.

Now, IDE (Integrated Development Environment) is basically a software that enables better and assisted code editing, compiling and debugging. The Arduino IDE runs on the Java Platform. You can co-relate this to Eclipse, which is another IDE for Java. So the language java has different IDEs that ease the usage of the language for a particular purpose. However, Eclipse doesn't support the functions and commands that work on arduino board. So, this Arduino IDE basically has inbuilt functions and commands that though work on Java platform, are customized to run on the arduino dev. board. Thus Arduino IDE serves for code editing, its compilation, debugging and then burning the code into the arduino dev. board.

4.1.2 OVERVIEW OF ARDUINO IDE BENEFITS

I. **Multi-Platform Application**

Arduino IDE works on the three most popular operating systems: Windows, Mac OS, and Linux. Aside from that, the application is also accessible from the cloud. These options provide programmers with the choice of creating and saving their sketches on the cloud or building their programs locally and upload it directly to the board.

II. **Board Management**

Arduino IDE comes with a board management module, where users can select the board they want to work with at the moment. If they wish to change it, they can do so easily from the dropdown menu. Modifying their selection also automatically updates the PORT info with the data they need in relation to the new board.

III. **Straightforward Sketching**

With Arduino IDE, users can create programs called sketches that are built with a text editor. The process is a straightforward one though it has several bells and whistles that make the experience more interactive.

IV. **Project Documentation**

Arduino IDE offers programmers the option to document their projects. This function allows them to keep track of their advancements and any changes they make every time. Apart from that, documentations allow other people to easily employ the sketches to their own boards.

V. **Simple Sketch Sharing**

Aside from saving and archiving sketches and uploading them to the board, Arduino IDE is also capable of sharing sketches (available only on the cloud version). Each sketch is given its own unique URL that users can share with their colleagues and fellow Arduino hobbyists. The recipient then has access to the code; they can save it in the cloud sketchbook or download it for their own use.

VI. **Vast Library**

Arduino IDE has more than 700 libraries integrated. These were written and shared by members of the Arduino community that other users can utilize for their own projects without having to install anything. This enables programmers to add a different dimension to their sketches.

VII. **Third-Party Hardware Support**

While Arduino IDE is designed specifically for Arduino boards, it also supports connections with third-party hardware. This makes the use of the application more extensive rather than limited to proprietary boards.

4.2 ADAFRUIT

Adafruit IO is a system that makes data useful. Our focus is on ease of use, and allowing simple data connections with little programming required.

MQTT, or message queue telemetry transport, is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client you can publish and subscribe to a feed to send and receive feed data.

Adafruit IO's MQTT server imposes a rate limit to prevent excessive load on the service. If a user performs too many publish actions in a short period of time then some of the publish requests might be rejected. The current rate limit is at most 1 request per second (or 60 requests within 60 seconds).

4.3 THINGSPEAK

Thingspeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. Thingspeak provides instant visualizations of data posted by your devices to Thingspeak. With the ability to execute MATLAB® code in Thingspeak you can perform online analysis and processing of the data as it comes in. Thingspeak is often used for prototyping and proof of concept IoT systems that require analytics.

4.3.1 Thingspeak Key Features

Thingspeak allows you to aggregate, visualize and analyse live data streams in the cloud. Some of the key capabilities of Thingspeak include the ability to:

i. Easily configure devices to send data to Thingspeak using popular IoT protocols.
ii. Visualize your sensor data in real-time.
iii. Aggregate data on-demand from third-party sources.
iv. Use the power of MATLAB to make sense of your IoT data.
v. Run your IoT analytics automatically based on schedules or events.
vi. Prototype and build IoT systems without setting up servers or developing web software.
vii. Automatically act on your data and communicate using third-party services like Twilio® or Twitter®.

CHAPTER 5

RESULTS AND DISCUSSIONS

The results produced and the output obtained in Our project consists of two Nodemcu, one is to control the four relays and the other Nodemcu is for collecting the current and temperature data from the sensors. Both the sensors are connected with WIFI. Through WIFI the data is sent to the Thingspeak servers and Adafruit servers those images are given below. Power and energy consumption through socket is also measured and monitored through mobile app. Switch operation ON and OFF of each socket is operated through voice command using a web page.

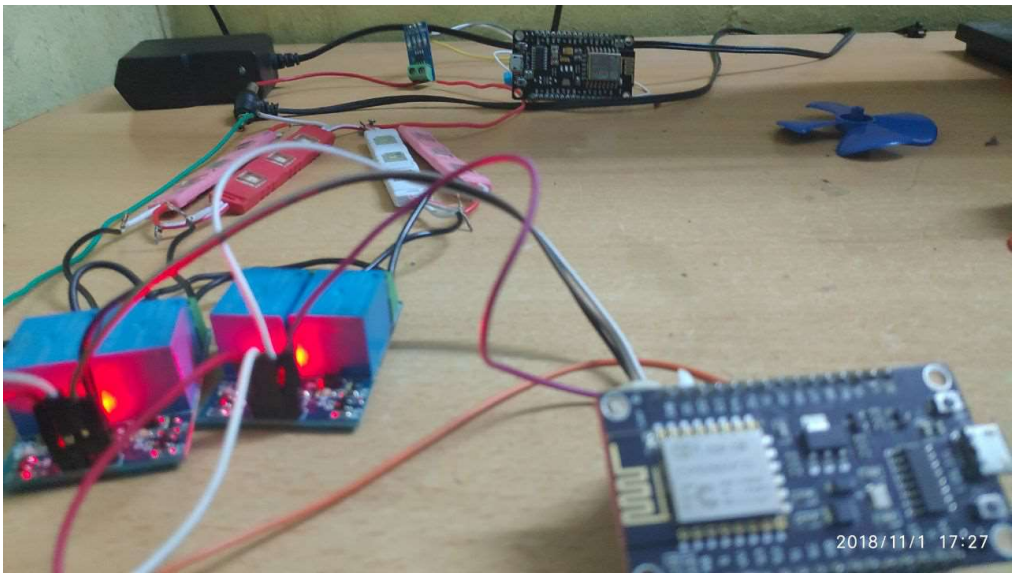

Fig 5.1: Side view of the prototype 1

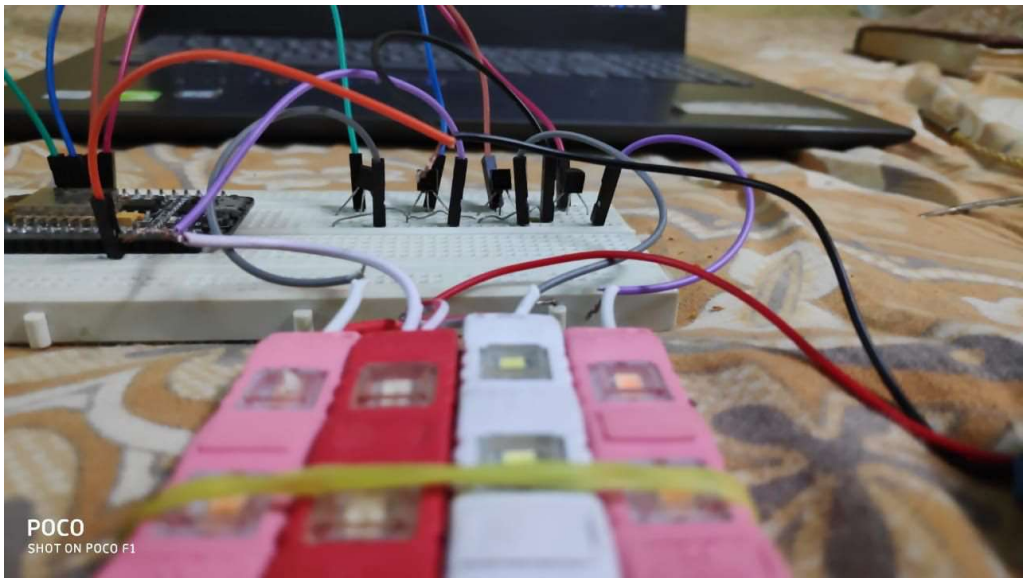

Fig 5.2: Side view of the setup

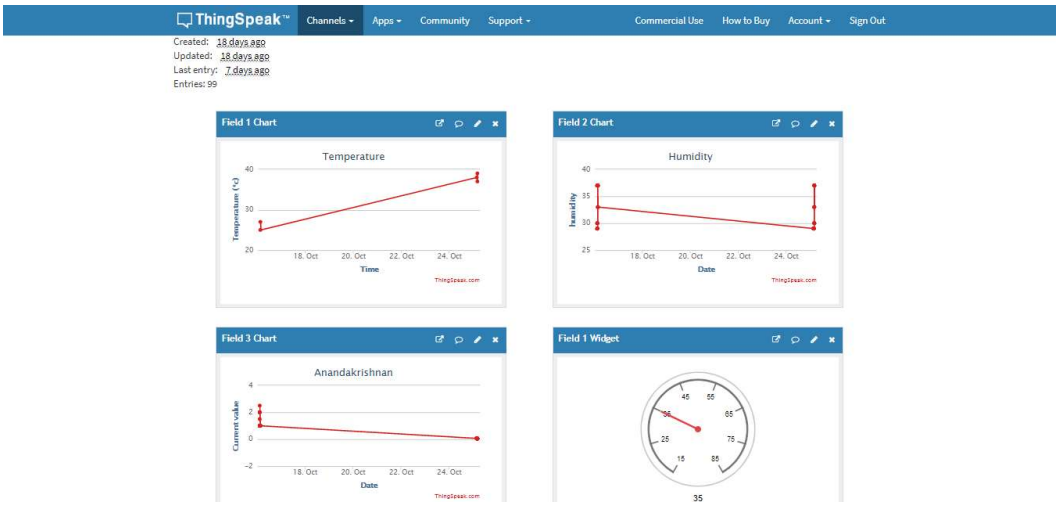

Fig 5.3: Screenshot of the Thingspeak server Data

Fig 5.4: Screenshot of the Adafruit server control

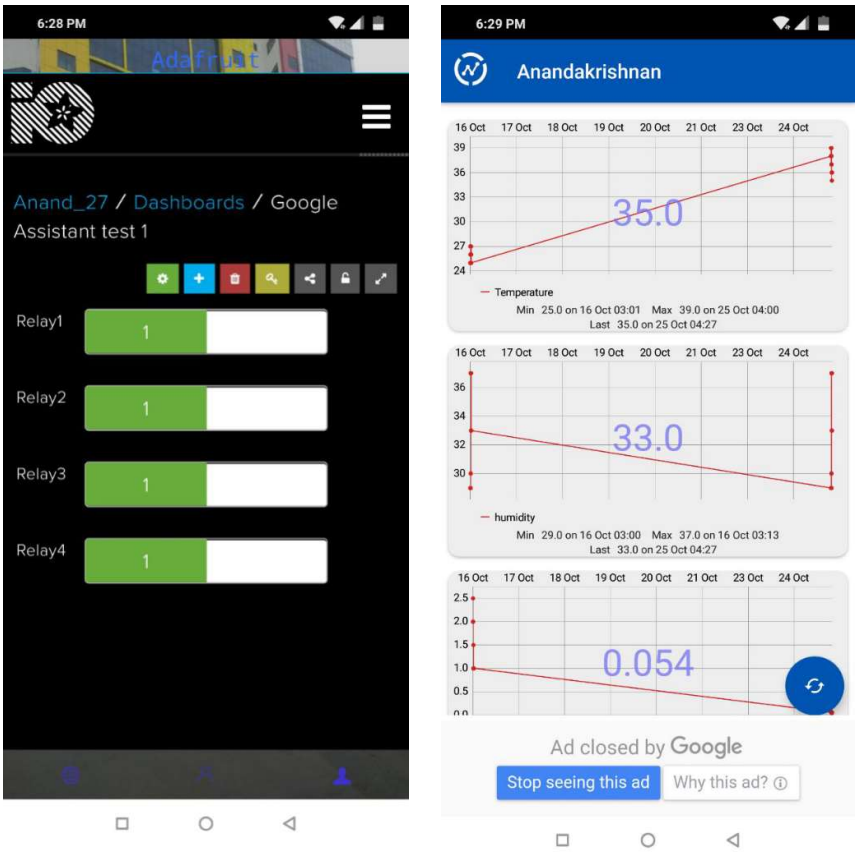

Fig 5.5 Screenshot of the Mobile App and Thing Speak mobile view

CHAPTER 6
CONCLUSION

The implementation details of a low-cost and low-power Smart Home Automation system is presented. The main idea of this system is to monitor the energy usage and security of the house in a user friendly and a mobile way so that a user can monitor the power management as well as security of their house even in the absence of the user. This system enables the user to have a remote track of power consumption and track of monetary savings.

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