"Towards Global Technical Excellence"

A
Project Report on

"IoT BASED THEFT DETECTION SYSTEM"

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CERTIFICATE

This is to certify that the project entitled, "**IOT BASED THEFT DETECTION SYSTEM**", which is being submitted herewith for the award of B.Tech. is the result of the work completed by Mr. Vinay Thote, Mr. Omkar Masram, Miss. Pranjali Chavhan, Miss. Vishakha Huse, Mr. Sunil Vyavhare under my supervision and guidance within the four walls of the institute and the same has not been submitted elsewhere for the award of any degree.

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Guide and HOD

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Examiner

Principal

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DECLARATION

I hereby declare that the project entitled, "**IoT BASED THEFT DETECTION SYSTEM**" was carried out and written by us under the guidance of Prof. P. P. Bedekar Professor, Department of Electrical Engineering, Govt. College of Engineering, Amravati. This work has not been previously formed the basis for the award of any degree or diploma or certificate nor has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

The Internet of Things (IoT) has revolutionized the way we interact with everyday objects by enabling them to be connected and controlled through the internet. One application of IoT technology is the development of theft detection systems that utilize sensors and smart devices to monitor and detect suspicious activity. In this system, various sensors are installed in homes, offices, and other locations to detect and alert against potential theft.

The IoT-based theft detection system comprises of several components such as sensors, cameras, microcontrollers, and a cloud-based platform. The sensors are placed at strategic locations to monitor and detect unusual activity. The data collected from the sensors are processed and analyzed by microcontrollers, which trigger an alarm or notification to alert the user of potential theft. Additionally, the system can integrate with security cameras to capture footage of any suspicious activity.

The system's cloud-based platform allows users to remotely monitor and control the system, view real-time data, and receive notifications. The platform also enables the user to set up rules and triggers that will activate the alarm or notification when certain conditions are met. This system provides an effective and efficient solution to prevent theft, as it allows for real-time monitoring and quick action against potential theft. It can also reduce the need for physical security personnel, making it an affordable and scalable solution for homes and businesses alike.

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List of Abbreviations

1. IoT - Internet of Things
2. PLC - Power Line Carrier
3. GPRS - Global Packet Radio Service
4. GPS - Global Positioning System
5. GSM - Global System for Mobile
6. IC - Integrated Circuit
7. UART - Universal Asynchronous Receiver Transmitter
8. LCD - Liquid Crystal Display
9. FeCl - Ferrous Chloride
10. CuCl - Copper Chloride
11. CV - Capacitance Voltage
12. PCB - Printed Circuit Board

CHAPTER 1
INTRODUCTION

In utility distribution system, electricity play's important role, as it measures the electricity consumption of users and generates bill, which is a source of revenue. Robbery is one of the rapidly increasing threats worldwide. With advancements in technology, tools to bypass security measures are also advancing. It was discovered that this system also faced much problems including incompetent monitoring of consumption, theft detection, wrong meter reading, unproductive revenue collection and useless energy use. In the developing countries, electricity theft has raised as a serious problem in power sectors. A great number of profits lost due to electricity theft. In some areas it has become such a severe problem. Due to this financial loss the shortage of funds occurs for investment to expand the existing power capacity and due to which governments become failed to satisfy the ever-enhancing demand of electricity.

To overcome the such problem of tempering and to ensure a cost-effective operation, we have introduced the IoT based Theft Detection Electricity System. Also smarter home management systems are developing to counter this problem. In these systems, the concept of Internet of Things (IoT) is used to make devices smart and connected. The increment in the use of IoT devices. Mobile phones are widely used gadget in the world. Hence there are many mobile applications such as Blynk, NETPIT which support Internet of Things (IoT). We used Blynk mobile application to acquire updates on real time movement of the Theft. This system mainly focuses on making a low-cost product with portability and practical application. The portability feature focuses on the device being easy to remove and implement anywhere as and when required. As per the initiative taken by Government of India to convert cities into smart cities, this system plays a crucial role of smart surveillance. The user receives message on their mobile phones about the units they purchased via GSM technology. The Alert message was sent to user mobile. The primary objective of this study is to develop a cost-effective Internet of Things (IoT) based electricity theft detection.

1.1 Need:

1. Electricity theft is one of the biggest problems damaging the power sector of India, so to control the such unwanted things from being loss distribution system must be protective.
2. As the electricity made a place in the humans basic need it becomes necessary to fulfill the all demands of consumer.
3. To overcome electricity consumption problem beyond consumer's budget, to overcome electricity theft problem, to avoid bill dues, and to avoid mistakes while taking the meter readings.
4. To recover the great number of profits lost due to electricity theft.
5. Necessity of electricity increasing day by day due to which most of developed countries are facing many problems, regarding supply.
6. To improve the standard of distribution system.

1.2 Motivation:

The motivation for this project came from the developing countries having, electricity theft has raised as a serious problem in power sectors. A great number of profits lost due to electricity theft. Due to this financial loss the shortage of funds occurs for investment to expand the existing power capacity and due to which governments become failed to satisfy the ever-enhancing demand of electricity.

In "IoT based Theft detection System" system using controller Node MCU (ESP-8266), The most significant advantage is that the power supplied through the transmission lines is monitored under well security from theft. This avoids loss of Electrical Energy.

1.3 Theme:

In Indian Development is dependent on the Industrial and Automization sector which can cause the Economic loss to the Utility in absence of Electric power. Therefore, there is a need for a continuity in supply 24*7. In our country such things are quite difficult.

Nowday's Distribution system facing many problems due uncertainty of actual location of power theft also power load shedding problem, labor problem, Lack of knowledge regarding irrigation. So, this project is the effort to give the solution on above mention problem by 'Theft detection system using IoT.

1.4 Organization:

There are so many problems associated with distribution system like theft of power, load shedding, occurrence of fault due to short circuit, decrease in the profit. To reduce all these factors such technique has been designed which is named as 'IoT based Theft detection System'.

The Organization like "Energy Central Corporation" in India works on projects like as Theft detection.

Also, there are many private companies are taking interest in such programs for better load Management.

Organization of this report has been mentioned by following way:

1. Chapter 1 content the introduction of “IoT based Theft detection System”. It focused on the need of Theft detection, objective of Theft detection using IoT system.
2. Chapter 2 gives the information about the present IoT based Theft detection System, history of IoT based Theft detection

3. Chapter 3 proposed basic concept of “IoT based Theft detection”, proposed methodology, system plan and use of cache component.
4. Chapter 4 gives the result analysis of proposed methodology which includes Circuit Board designing, result, experimental result at various inputs.
5. Chapter 5 gives conclusion of “IoT based Theft detection” which includes conclusion, advantages, disadvantages and future scope.

CHAPTER 2
LITERATURE SURVEY

2.1 Literature Survey:

The Internet of Things (IoT) is a technological concept that connects things to the Internet for data exchange. It is used in this study to connect the electricity meter to the Internet in order to prevent the meter from being tampered with.

A tamper proof system for the smart meters using IoT technology was developed. Although this system is applicable to both the green field and brown field approach of the Internet of Things, it utilized two separate boards, one as a controller and the other as network interface. The cost associated with the procurement of the Arduino Mega 2560 and Arduino Wi-Fi Shield 101 boards is high, relative to the cost of a single board, hence; there is need for a cheaper and effective system.

A tamper proof electricity meter with IoT technology was developed with Raspberry pi embedded system module. This system is costly because of the cost of the Raspberry pi board relative to other embedded system boards like the Wi-Fi Module. Also, the Raspberry pi is not an open-source platform.

An IoT based embedded system that checks electricity theft and enables the remote control of appliance. In this system, reference energy consumption is set and once the energy consumption rises above the threshold, the system considers the activity as electricity theft. It can be seen that most of the electricity theft prevention systems are targeting the smart meter while neglecting the electromechanical meter. Also, most of the existing electricity theft prevention systems (at the meter level) have to do with the development of new smart meters with theft prevention except the device developed in . Meter tampering has been neglected by most of the works not minding the fact that it is a delicate form of electricity theft. [8] Therefore, there is need to develop a cost-effective system that will prevent meter tampering.

2.2 Objective:

1. For improvement in the power sector. There will be reduction in electricity tariff and the electricity companies (Distribution, Transmission and Generation) will make enough profit and begin to plan for expansion of their businesses.
2. To overcome the problem of overbilling, meter tempering and to ensure a cost-effective operation, we have introduced the Smart Electricity System.
3. To reduce the human interference to collect the monthly reading and to minimize the technical problems regarding the billing process.
4. To make system capable of measuring the energy consumption, storing it to memory and sending it to the utility via SMS after specific intervals of time

2.3 Review:

To understand the present condition, we survey some areas and found the following drawbacks regarding project.

1. There is more a wastage of electricity due to old used Metering system.
2. The existing model is a time-consuming process and it needs a lot of labor.
3. Human error cannot be avoided for the manual meter reading.
4. Always there is no cross checking or recheck of human readers for energy utilization.
5. High chance of stealing and bribery always high to misuse it especially during events.
6. More number of meter reading employees is extra expenses to the company for hiring them and their expense on traveling too expensive one.
7. High cost in billing because of theft of power.
8. Less profit in the income of distribution system.

2.4 History of Theft detection System:

On the basis of various platforms, researchers have proposed many technologies in the literature for automatic meter reading of energy as a solution to the traditional approach of collecting meter readings manually. These include Power Line Carrier (PLC), Telephone Line, Bluetooth, Zigbee, Wi-Fi, GPRS and GSM [2, 3, 7, 8, 9, 10, 11]. Depending upon the mode of transmission. Electric-powered electricity theft wastes approximately 30-35 percent of the earnings generated by the electric board. So, how are we going to find the best possible solution. Typically, there are two main methods of stealing power:

Power Tapping: Power theft is frequently committed during transmission by illegally tapping power lines to divert power to the required destinations. It is also done through illegal connections to power grid stations, which are cut during billing.

Meter fraud: In many areas where meter readings are done manually, the person is frequently bribed to give false readings, and thus the amount paid is for less power than is actually consumed. Meters are also tampered with by obstructing the movement of the disc (usually electro-mechanical consists of slowly spinning discs to record the power consumed).

CHAPTER 3
PROPOSED WORK

3.1 Component used in the system:

IoT based Theft detection system uses following Hardware components:

Table No. 3.1 List of Component

Sr. No.	Components
1	Controller (ESP-8266)
2	Current Sensor (ACS712)
3	Transformer (230 to 12-0-12)
4	Power supply circuit
5	Bulbs (60W load)
6	I2C Module
7	LCD (16*2)
8	Switch button
9	Heat Sink
10	Diode
11	Capacitors (1000uF)
12	Resistors (330ohm, 1k)
13	Light Emitting Diodes (2V)
14	Transistors (BC548)
16	Voltage Regulator (7812, 7805)
17	Printed Circuit Board

3.1.1 Node MCU ESP-8266 (Controller):

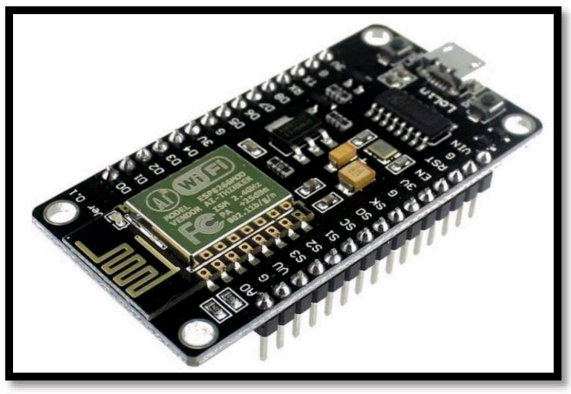

Figure 3.1.1 Node MCU ESP-8266

What is Node MCU?

Node MCU is an open-source development board and firmware based in the widely used ESP8266 - 12E Wi-Fi module as shown in Fig 2. It allows to program the ESP8266 Wi-Fi module with the simple and powerful LUA programming language or Arduino IDE [8]. With just a few lines of code can establish a Wi-Fi connection and define input/output pins according to needs exactly like Arduino, turning your ESP8266 into a web server and a lot more. It is the Wi-Fi equivalent of ethernet module [9]. With its USB-TTL, the Node MCU Dev board supports directly flashing from USB port. It combines features of WIFI access point and station + microcontroller. These features make the Node MCU extremely powerful tool for Wi-Fi networking. It can be used as access point and/or Node MCU Blynk application Relay Bulb Buzzer LCD Message Power Supply IR sensor PIR sensor 9V battery station, host a webserver or connect to internet to fetch or upload data [10].

This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro-USB cable, you can connect Node-MCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

3.1.1.1 Device Summary:

- Voltage:3.3V
- Wi-Fi Direct (P2P), soft-AP.
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- Analog to Digital: 1 input with 1024 step resolution.
- +19.5dBm output power in 802.11b mode.
- Maximum concurrent TCP connections: 5.

3.1.1.2 Features of Node MCU ESP-8266:

Here are few of its features which must know if we are thinking to work on this great Wi-Fi Module board:

- 802.11 b / g / n
- Wi-Fi Direct (P2P), soft-AP
- Built-in TCP / IP protocol stack
- Built-in TR switch, balun, LNA, power amplifier and matching network
- Built-in PLL, voltage regulator and power management components
- 802.11b mode + 19.5dBm output power
- Built-in temperature sensor
- Support antenna diversity
- off leakage current is less than 10uA

3.1.1.3 Architecture:

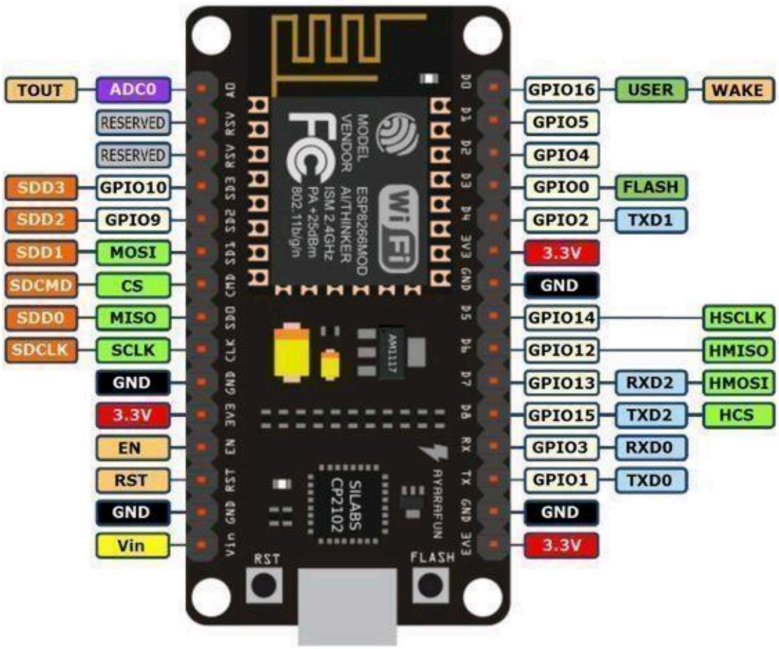

Figure 3.5.1.3 Architecture of Controller

The ESP32 chip comes with 48 pins with multiple functions. Not all pins are exposed in all ESP32 development boards, and there are some pins that cannot be used. The ESP8266 uses a 32bit processor with 16-bit instructions. It is Harvard architecture which mostly means that instruction memory and data memory are completely separate. The ESP8266 has on die program Read-Only Memory (ROM) which include some library code and a first stage boot loader. All the rest of the code must be stored in external Serial flash memory (provides only serial access to the data - rather than addressing individual bytes, the user reads or writes large contiguous groups of bytes in the address space serially).

3.1.1.4 Pin Configuration:

Table 3.1.1.4 Pin Configuration of controller

Pin Number	Pin Name	Alternate Name	Normally used for	Alternate purpose
1	Ground	-	Connected to the ground of the circuit	
2	TX	GPIO – 1	Connected to Rx pin of programmer/ uC to upload program	Can act as a General-purpose Input/output pin when not used as TX
3	GPIO-2	-	General purpose Input/output pin	-
4	CH_EN	-	Chip Enable – Active high	-
5	GPIO - 0	Flash	General purpose Input/output pin	Takes module into serial programming when held low during start up
6	Reset	-	Resets the module	-
7	RX	GPIO - 3	General purpose Input/output pin	Can act as a General-purpose Input/output pin when not used as RX
8	Vcc	-	Connect to +3.3V only	-

1. Power:

Power to the Node MCU ESP8266 is supplied via the on-board USB Micro B connector or directly via the “VIN” pin. The power source is selected automatically. The device can operate on an external supply of 6 to 12 volts. If using more than 12V, the

voltage regulator may overheat and damage the device. The recommended range is 7 to 12 volts.

- Micro-USB: ESP32 can be powered through USB port.
- 5V: Regulated 5V can be supplied to this pin which is we be again, regulated to 3.3V by on board regulator, to power the board.
- 3.3V: Regulated 3.3V can be supplied to this pin to power the board. • GND: Ground pins.

2. Enable (En):

The pin and the button resets the microcontroller.

3. Analog Pins ():

a. Used to measure analog voltage in the range of 0-3.3V, 12-bit 18 Channel ADC.

b. Although the ESP8266 -07 and -12 only have one ADC pin, However, in order to use multiple sensors, it will need to 'multiplex' the sensors.

4. DAC pins:

a. DAC1 and DAC2 used for Digital to analog Conversion.

5. Rx, Tx:

a. Used to receive and transmit TTL serial data.

6. Reset Pin:

a. Making this pin LOW, resets the controller.

3.1.2 Current Sensor (ACS712):

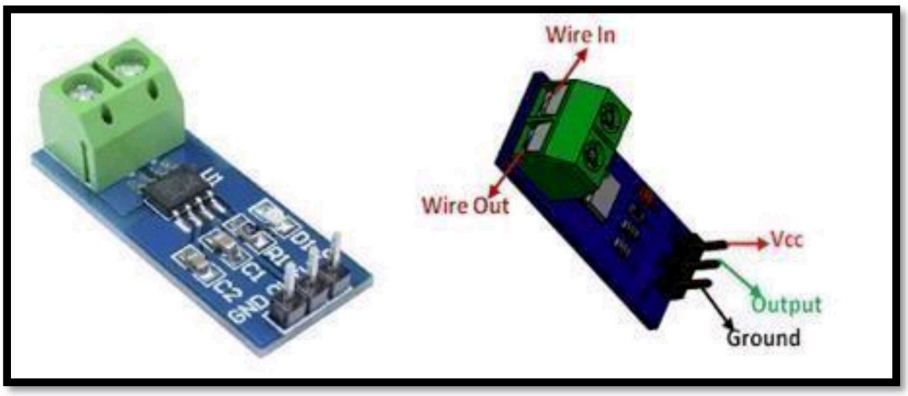

Figure 3.1.2 Current Sensor

The ACS712 Module uses the famous ACS712 IC to measure current using the Hall Effect principle. The module gets its name from the IC (ACS712) used in the module,so for you final products use the IC directly instead of the module.

These ACS712 module can measure current AC or DC current ranging from +5A to -5A, +20A to -20A and +30A to -30A. You have to select the right range for your project since you have to trade off accuracy for higher range modules. This modules outputs Analog voltage (0-5V) based on the current flowing through the wire; hence it is very easy to interface this module with any microcontroller.

3.1.2.1 Specifications:

- Measures both AC and DC current
- Available as 5A, 20A and 30A module
- Provides isolation from the load
- Easy to integrate with MCU, since it outputs analog voltage
- Scale Factor

3.1.2.2 Pin Configuration of ACS 712:

Table no. 3.1.2.2 Pin Configuration of Current Sensor ACS 712

Pin No.	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Output	Outputs Analog voltage proportional to current
3	Ground	Connected to ground of circuit
4	Wire in	The wire through current has to be measured is connected here
5	Wire out	

3.1.3 Transformer [230V to 12-0-12 AC]:

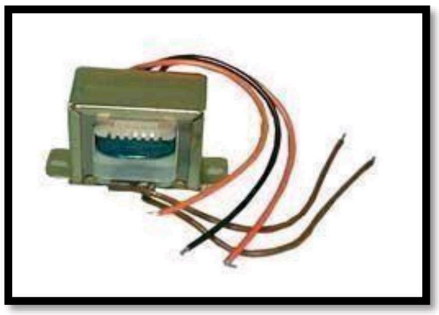

Figure 3.1.3 Transformer [230V to 12-0-12 AC]

As the control circuit of "Theft detection using IoT" prototype, requires 12V and 5V of DC for the purpose stepdown and further process transformer is introduced. Transformers are most commonly used for increasing low AC voltages at high current (a

step-up transformer) or decreasing high AC voltages at low current (a step-down transformer) in electric power applications, and for coupling the stages of signal processing circuits. Transformers can also be used for isolation, where the voltage in equals the voltage out, with separate coils not electrically bonded to one another.

A flowing current in the transformer's primary winding attempts to create a varying magnetic flux in the transformer core, which is also encircled by the secondary winding. This varying flux at the secondary winding induces a varying electromotive force (EMF, voltage) in the secondary winding due to electromagnetic induction and the secondary current so produced creates a flux equal and opposite to that produced by the primary winding, in accordance with **Lenz's law**.

3.1.4 Power Supply Circuit:

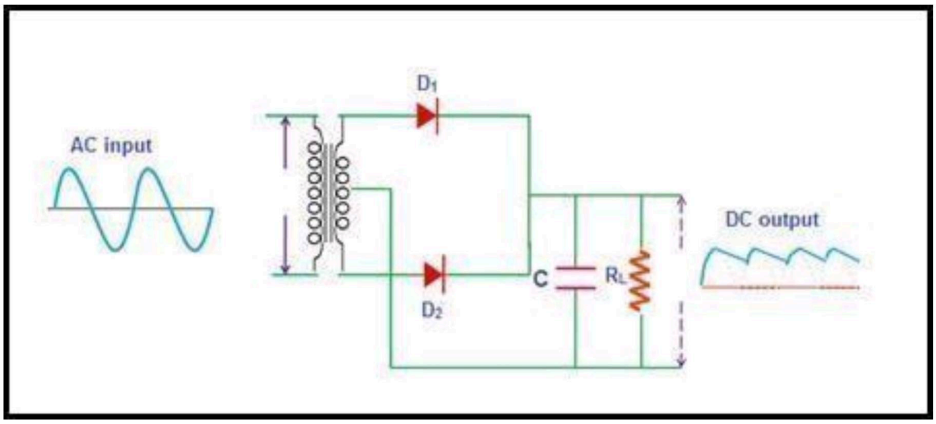

Figure 3.1.4 Full Wave Rectifier Circuit

3.1.4.1 Theory:

A Full Wave Rectifier is a circuit, which converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other conducts during the other half cycle of the applied ac voltage.

During the positive half cycle of the input voltage, diode D1 becomes forward biased and D2 becomes reverse biased. Hence D1 conducts and D2 remains OFF. The load current flows through D1 and the voltage drop across R_L will be equal to the input voltage. During the negative half cycle of the input voltage, diode D1 becomes reverse biased and D2 becomes forward biased. Hence D1 remains OFF and D2 conducts. The load current flows through D2 and the voltage drop across R_L will be equal to the input voltage.

3.1.4.2 Capacitor Filter:

A capacitor filter connected directly across the load is shown above. The property of a capacitor is that it allows ac component and blocks dc component. The operation of the capacitor filter is to short the ripple to ground but leave the dc to appear at output when it is connected across the pulsating dc voltage.

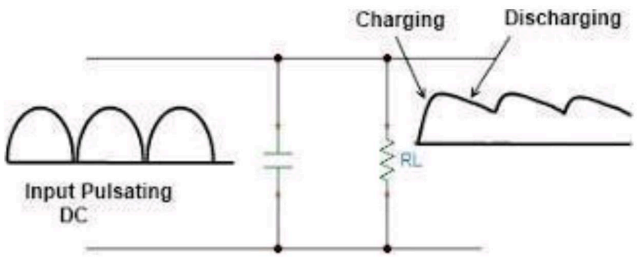

Figure 3.1.4.2 Capacitor Filter

During the positive half cycle, the capacitor charges upto the peak vale of the transformer secondary voltage, V_m and will try to maintain this value as the full wave input drops to zero. Capacitor will discharge through R_L slowly until the transformer secondary voltage again increase to a value greater than the capacitor voltage. The diode conducts for a period, which depends on the capacitor voltage. The diode will conduct when the transformer secondary voltage becomes more than the diode voltage. This is called the cut

in voltage. The diode stops conducting when the transformer voltage becomes less than the diode voltage. This is called cut out voltage.

Referring to the Figure 3.5.4.2 with slight approximation the ripple voltage can be assumed as triangular. From the cut-in point to the cut-out point, whatever charge the capacitor acquires is equal to the charge the capacitor has lost during the period of non-conduction, i.e., from cut-out point to the next cut-in point.

3.1.5 Incandescent Bulbs (load):

An incandescent light bulb or incandescent lamp or incandescent light globe is an electric light with a wire filament heated until it glows. The filament is enclosed ina bulb to protect the filament from oxidation. Current is supplied to the filament by terminals or wires embedded in the glass. Filament is made up of material 'Tungsten'.

Figure 3.1.5 Incandescent Bulbs

Incandescent bulbs are much less efficient than other types of electric lighting. Less than 5% of the energy they consume is converted into visible light; the rest is lost as heat.[1][2] The luminous efficacy of a typical incandescent bulb for 120 V operation is 16 lumens per watt (lm/W), compared with 60 lm/W for a compact fluorescent bulb or 100 lm/W for typical white LED lamps.

3.1.6 I2C Module:

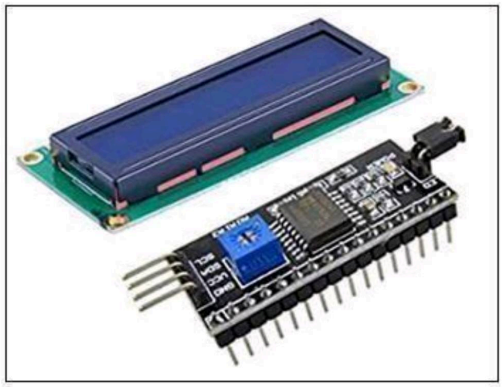

Figure 3.1.6 I2C Module

I2C Module has a inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version, you have checked the black I2C adaptor board on the underside of the module. If there 3 sets of pads labeled A0, A1, & A2 then the default address will be 0x3F. If there are no pads the default address will be 0x27. The module has a contrast adjustment pot on the underside of the display. This may require adjusting for the screen to display text correctly.

Features:

- Operating Voltage: 5V
- Backlight and Contrast is adjusted by potentiometer
- Serial I2C control of LCD display using PCF8574
- Come with 2 IIC interface, which can be connected by Dupont Line or IIC dedicated cable.
- Compatible for 16x2 LCD

- This is another great IIC/I2C/TWI/SPI Serial Interface
- With this I2C interface module, you will be able to realize data display via only 2 wires.

3.1.7 Liquid Crystal Display LCD:

LCDs are more energy efficient and offer safer disposal than CRT, using LCD. Its low electrical power consumption enables it to be used in battery powered electronic equipment. It is electronically modulated optical device made up of any number of pixels filled with liquid crystals and array in front of light source or reflector to produce image in color and monochrome.

Figure 3.1.7 Liquid Crystal Display

Here we have used 16 x 2 Alphanumeric Display which means on his display we can display two lines with maximum of 16 characters in one line.

A register of 1 K-ohm is connected between pin3 and pin of LCD 16x2 for current limiting purpose. The relative representation of data present at usable port pin of given to the relative usable pins of LCD 16x2, which reads data and **display the status of Theft Detection or not.**

The following table gives the brief idea of pin configuration of LCD display:

Table 3.1.7 Liquid Crystal Display

PIN NO.	SYMBOL	DESCRIPTION	FUNCTION
1	VSS	GROUND	0V (GND)
2	VDD	POWER SUPPLY FOR LOGIC CIRCUIT	+5V
3	VO	LCD CONTRAST ADJUSTMENT	
4	RS	INSTRUCTION/DATA REGISTER SELECTION	RS = 0 : INSTRUCTION REGISTER RS = 1 : DATA REGISTER
5	R/$\overline{W}$	READ/WRITE SELECTION	R/$\overline{W}$ = 0 : REGISTER WRITE R/$\overline{W}$ = 1 : REGISTER READ
6	E	ENABLE INPUT	
7	DB0	DATA INPUT/OUTPUT LINES	4 BIT/8BIT SELECTABLE 4 BIT : DB4 - DB7 8 BIT : DB0 - DB7
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		
15	VLED	POWER SUPPLY FOR LED BACKLIGHT (ANODE)	———————
16	VLSS	POWER SUPPLY FOR LED BACKLIGHT (CATHODE)	0V(GND)

3.1.8 Switch Button:

Figure 3.1.8 Switch Button

In electrical engineering, a switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another. The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow**.**

3.1.9 Heat Sink:

A heat sink is a thermal conductive metal device designed to absorb and disperse heat away from a high temperature object such as IC's. A heat sink without a fan is called a passive heat sink, a heat sink with a fan is called an active heat sink. Heat sinks are generally made of an aluminum alloy and often have fins.

Thus said, a bigger cooler is better, at least to some extent. As long as it is not just a solid block, more cooling fins help spreading the heat to the surrounding air. It has to be a good heat conductor (copper is better than aluminum).

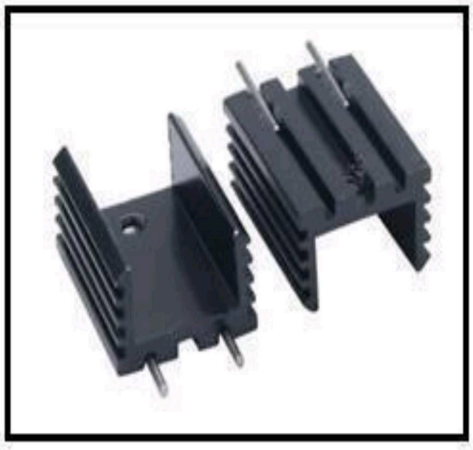

Figure 3.1.9 Heat Sink

3.1.10 Diode:

The most common function of a diode is to allow an electric current to pass in one direction i.e., in forward direction, while blocking current in the opposite direction i.e. in reverse direction.

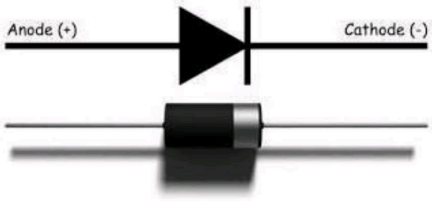

Figure 3.1.10 Semiconductor Diode

A diode is a two-terminal electronic component that conducts current primarily in one direction asymmetric conductance it has low ideally zero resistance in one direction, and high ideally infinite resistance in the other. A diode is a vacuum tube with two electrodes, a heated cathode and a plate, in which electrons can flow in only one direction, from cathode to plate. A semiconductor diode, the most commonly used type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals. Semiconductor diodes were the first semiconductor electronic devices.

3.1.11 Capacitors (1000uF):

A capacitor is passive two terminal electrical component used to store the energy electrostatically in the electric field. Capacitors are used for filtering the ripples in the dc supply.

An electrolytic capacitor is a polarized capacitor whose anode or positive plate is made of a metal that forms an insulating oxide layer through anodization. This oxide layer

acts as the dielectric of the capacitor. A solid, liquid, or gel electrolyte covers the surface of this oxide layer, serving as the cathode or negative plate of the capacitor.

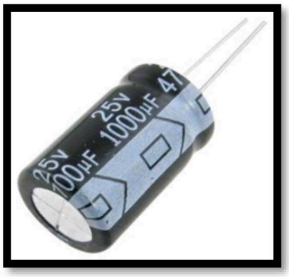

Figure 3.1.11 Capacitor

Due to their very thin dielectric oxide layer and enlarged anode surface, electrolytic capacitors have a much higher capacitance-voltage (CV) product per unit volume than ceramic capacitors or film capacitors, and so can have large capacitance values. Thereare three families of electrolytic capacitor: aluminum electrolytic capacitors, tantalum electrolytic capacitors, and niobium electrolytic capacitors.

3.1.12 Resistor:

A Resistor is a passive two terminal electrical component that implements electrical resistance. Resistor is used to reduce the current flow and the same time to lower the voltage level within the circuit.

Resistor is an electrical component that reduces the electric current. The resistor's ability to reduce the current is called resistance and is measured in units of ohms (symbol: Ω). If we make an analogy to water flow through pipes, the resistor is a thin pipe that reduces the water flow.

Figure 3.1.12 Resistor

3.1.13 Light Emitting Diode (LED):

A Light Emitting Diode is a two-lead semiconductor light source. It is a p-n junction diode which emits when activated. Early LED is often used as indicator lamps for electronic devices. In the simplest terms, a light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material. Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices.

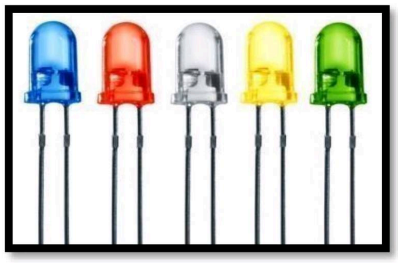

Figure 3.1.13 Light Emitting Diode

3.1.14 Transistor (BC548):

A transistor is a semiconductor device used to amplify and Signal and electrical power. It is composed of semiconductor material with at least three terminal for connection

to an external circuit. A voltage or current applied to one pair of the transistor's terminal changes the current through another pair of terminals. Because the allied power can be higher than controlling power. A transistor can amplify a signal.

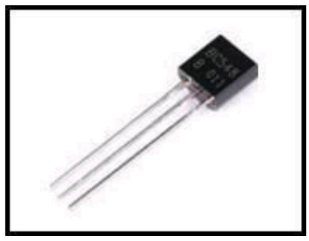

Figure 3.1.14 Transistor BC548

3.1.15 Voltage Regulator:

IC 7805 is used to convert the 12 volt de supply into 5 volt de supply. This 5-volt supply is given to the microcontroller. A Voltage Regulator is designed to automatically maintain a constant voltage level. It may use as an electronic component.

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value.

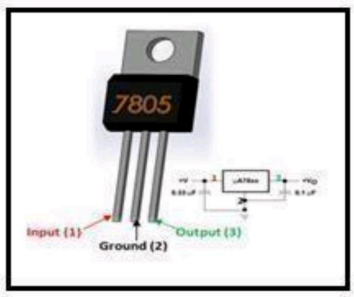

Figure 3.1.15 Voltage Regulator

3.2 Framework

Basically, the framework and development of this system are divided into two main parts: software architecture and hardware architecture. In the hardware architecture, the

design of the circuit was constructed and the prototype of the system was built. While in the software development, the whole complete prototype was operated via programming codes.

3.2.1 Software Architecture:

3.2.1.1 Blynk Application:

Blynk was designed for the Internet of Things as shown in Fig 4. It can control hardware remotely, It can display sensor data, it can store data, visualize it and do many other cool things. There are three major components in the platform:

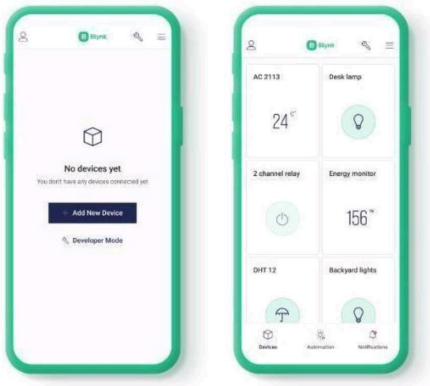

Figure 3.2.1.1 Blynk Application

- Blynk App - allows to create amazing interfaces for researches using various widgets.
- Blynk Server - responsible for all the communications between the smartphone and hardware. Our Blynk Cloud can be used or your private Blynk server is locally run. It's opensource, could easily handle thousands of devices and can even be launched on a Node MCU.
- Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

Every time it is pressed a Button in the Blynk app, the message travels to space the Blynk Cloud, where it magically finds its way to hardware. It works the same in the opposite direction and everything happens in a Blynk of an eye.

3.2.1.2 Development of Project on Blynk App:

1. A Smartphone:

- Android OS version 4.2+
- iOS version 9+

2. IoT Hardware:

Blynk can run on over 400 hardware modules. Most popular are:

- ESP 32s
- ESP 8266
- Arduino
- Raspberry-Pi

3. Internet Connection:

To connect your hardware to the Internet, you can choose almost any module either built-in, or external shields Supported connectivity.

- Wi-Fi
- Ethernet
- Cellular (GSM, 2g, 3g, 4g, LTE)
- Serial
- USB via your PC

CHAPTER 4

PCB PREPARATION

The several boards of the same design are to be made of a complicated layout therefore, it is worth considering photographic methods. There are several ways of transferring a layout into copper laminated board photographically, the clean copper laminated board is then coated with a positive photo resist such as fotolack according to the manufacturer's instruction, the master artwork is placed in contact with the resist and exposed to light.

The exposed part is then placed in a developer path. The board is then wash and each in normal wave negative photo resist are also available, these are used and then unexposed portions of the resist are developed away of course negative photo resist in tail the use of a negative master, that is a black background with transparent area for the track pattern. This must be produced by making a contact point of the positive master on the photographic film.

4.1 Etching:

Final copper pattern is formed by selective removal of all unwanted copper, which is not protected by an each resistor. Under etching and over etching complicate the matter. Etching can be obtained by two methods: [1] Over hang & [2] Spray etching.

Figure 4.1 Etching

4.2 Etchants:

Number of etchants available, foil was the earliest one use on a major scale with availability of etching which can be regenerated and which are compatible with the common metal. Etch resist foil is still use for small PCB facility where etching is occasionally carried out for small boards.

Following reactions takes place in the period of etching process

$$FeCl3 + Cu = FeCl2 + CuCl \downarrow$$

Cuporous chloride further oxidized in etching solution to cupric chloride

$$FeCl3 + CuCl = CuCl3 + FeCl2$$

The buildup cupric chloride itself reacts also with copper and forms cuprous chloride.

$$CuCl2 + Cu = 2\ CuCl.$$

Due to high corrosive FeCl3 the etching is faster and little under etching over the ferric chloride ntaminates the surface which can be cleaned by water.

4.3 Drilling:

Drilling of component mounting holes into PCB is most important mechanical machining operation in PCB production process. Holes are made by drilling whenever a superior hole finish for plated through whole is required and where the tooling cost fit a punching tool cannot be justified. Therefore, drilling is applied by a professional grade PCB manufacturer are generally in at smaller PCB production plants and labs.

The important of hole drilling into PCB has further gone up with electronic component miniaturization and its need for smaller hole diameter. Diameter less than half the board thickness where hole punching is practically rules out.

Figure 4.3 Drilling

4.4 Component Mounting:

Mounting of component goes along way in enhancing the reliability of PCB special provision should be for holding a large component. Noisy component should be properly shielded. The mounting of all components has to confirm to accept practices. Smaller component do not need special provision. The solder joint provides the mechanical fixation. Bigger and heavier components are adequately secured with clamps or clips and suitable space has to be provided in the layout. A guideline to avoid mechanical over tracking of solder joint is a maximum of ten a load per solder joint in a board without plated through holes for a reliable and easy assembly, all components of the same type should be-mounted in the same direction and same orientation.

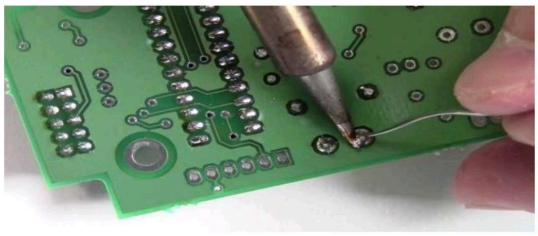

Figure 4.4 Component Mounting

4.5 Soldering Iron And Soldering Techniques:

For making reliable electrical connections between component lead and copper track soldering is essential. For electric soldering wire of lead or tin is used. This alloy wire melts at relatively low temperature that is about 200 degrees Celsius. For this purpose, soldering iron is used. It forms a molecular bond with the component track. • **Soldering Iron:**

The soldering iron is used for home construction purpose. This is typically consisting of thermally and electrically insulated handle from which protrudes a stainless-steel shaft containing a ceramic encapsulated electrical heating element. • **Soldering Techniques:**

Having chosen a suitable iron and correct bit for the job it is important to use solder of correct diameter for general purpose use 18W for fine work use 22W solder. When soldering components into PCB, following sequence should be followed:

1. Any terminal pin of component should first be inserted into the load.
2. The lead of component like resistor or diode can be bent outwards at an angle of about 45 degree. After inserting, leads can be off fairly closed to board, using wire cutter.
3. To solder components, apply tip of iron to the component lead and the pad simultaneously ran solder into both. When sufficient solder has run into joint remove the solder and the iron and callow the joint to cool.
4. To improve the appearance of the board any excess flux can then be removed with ethylated spirit.

If the component has to be removed from the board for any reason, use “Solder Sucker” before inserting a new component. It is essential that the entire hole should be free of solder.

4.6 ENCLOSURE DESIGN:

Enclosure Design Guidelines:

Proper system enclosure design can increase electrostatic discharge immunity both directly and indirectly. The guidelines for enclosure design include are:

1. Enclosure design should allow the I/O devices to remain close to I/O connector and each other.
2. Try to locate the I/O cable entry point in a central portion on each enclosure.
3. No shot or hole should have a large dimension greater than 2cm.
4. Use several small openings instead of one large opening. 5. The space between openings must be equal to the large dimension of the opening.

Need of Enclosures:

1. Safety from mechanical problems.
2. Safety from high voltages and shock hazards.
3. Safety from ingress of dust, liquids and unwanted gases.
4. Safety of the outside equipment from the enclosed equipment.
5. Prevention from problems like Electromagnetic Interferences, etc
6. Protection against pests

The easiest solution to all the problems seems to be enclose the equipment completely. But, this is practically impossible.

For using the equipment, it is necessary to have input output connections like cables, wires, pipes, etc. For servicing, the enclosure should have an arrangement of easy opening. Also in most cases, the equipment will have meters and switches mounted on it. Furthermore, proper air circulation is needed, to cure the heat dissipation problem.

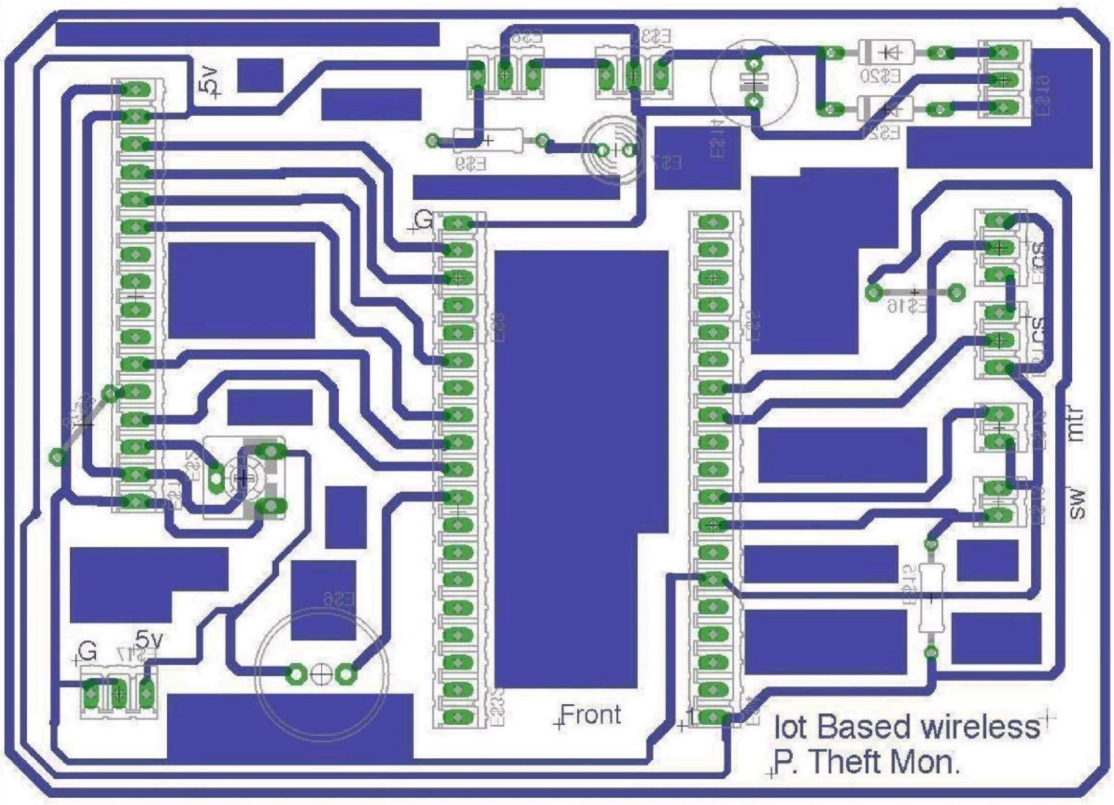

Figure 4.6 Layout of PCB design

A single-layer or single-sided PCB is one that is made out of a single layer of base material or substrate. One side of the base material is coated with a thin layer of metal. Copper is the most common coating due to how well it functions as an electrical conductor. Once the copper base plating is applied, a protective solder mask is usually applied, followed by the last silk-screen to mark out all of the elements on the board.

The circuits and components of a double-layer PCB board are usually connected in one of two ways: either utilizing a through-hole or with the use of a surface-mount. A through-hole connection means that small wires, known as leads, are fed through the holes, with each end of the leads then soldered to the right component.

4.7 Project Assembly

4.7.1 Block diagram of System:

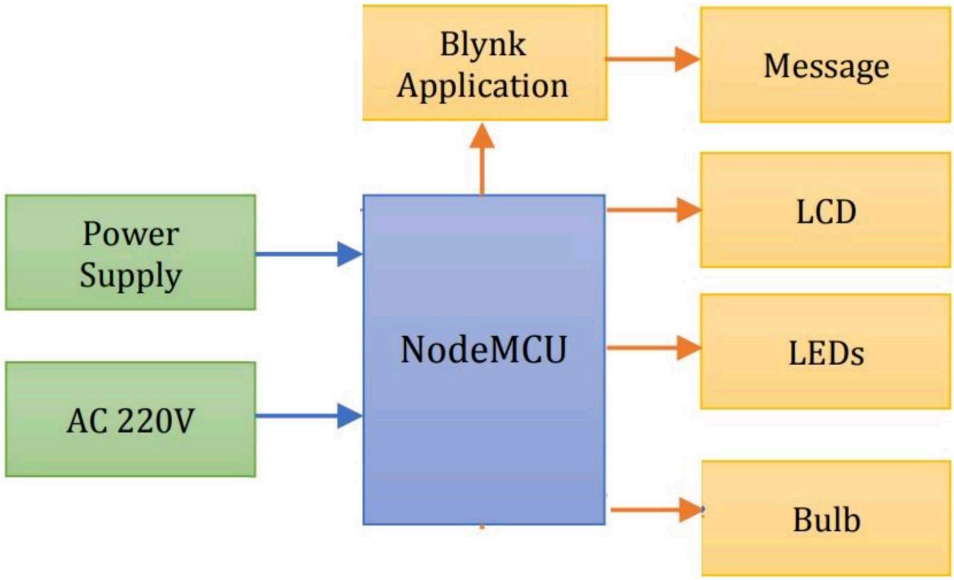

Figure 4.7.1 Block Diagram of System

This system is implemented using the Wi-Fi Module Node MCU (ESP-8266) micro controller and with a backup of Current Sensor ACS712. Esp8266 chip is the Wi-Fi module which helps in transferring the data through the internet.

4.7.2 Circuit Diagram:

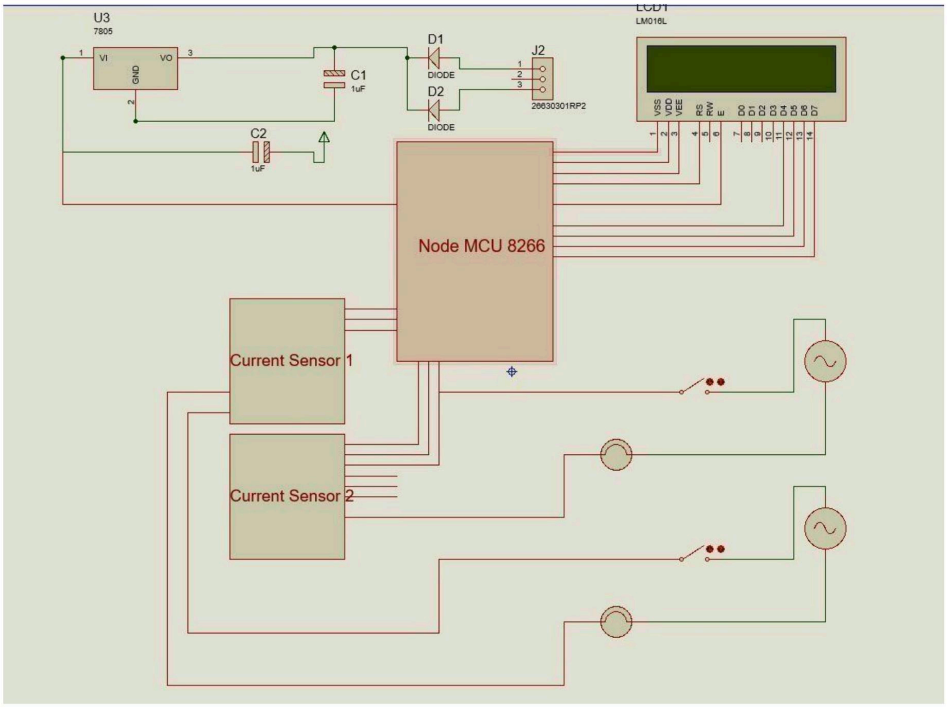

Figure 4.7.2 Circuit Diagram:

Above circuit schematic shows the circuit arrangement of prototype "Theft detection using IoT " in which all components are connected to respective interfacing pins of Node MCU 8266 (Wi-Fi Module). The working of all pins are and the components, sensors are explained below.

4.7.3 WORKING OF THE PROTOTYPE:

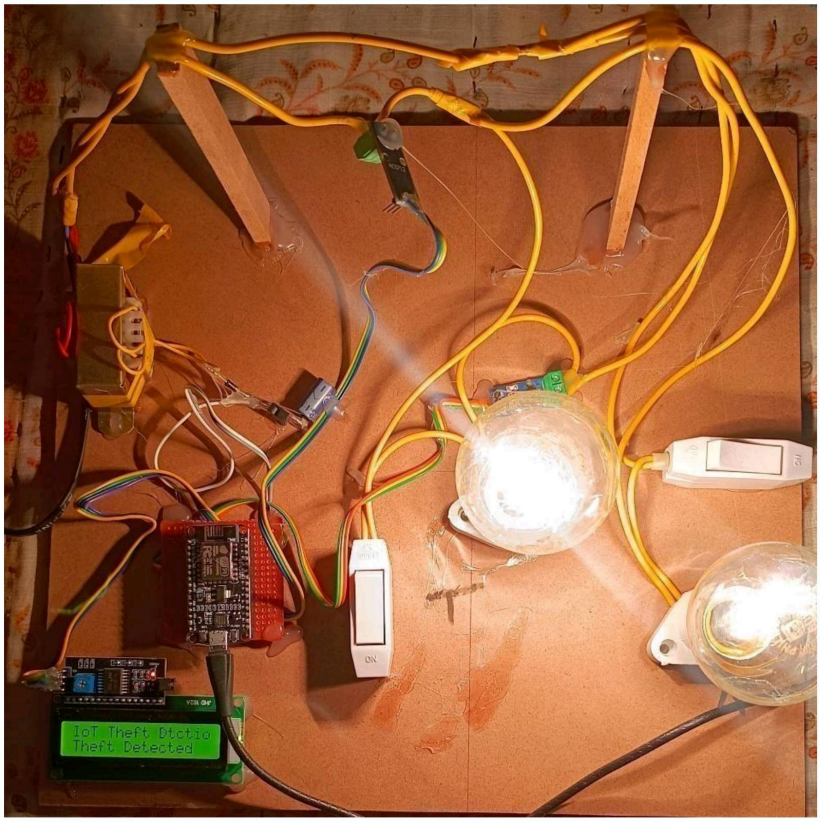

Figure 3.4 Actual prototype

In the proposed system there are two instants of working that are working of prototype in safe or initial condition and the working after theft happens those are well explained below.

Case 1 - In Safe Condition:

- All the parameters are connected as shown in circuit diagram which are in under control of controller ESP8266.
- Bulb 1 is taken as consumptional load whereas the current taken by load 1 is calculated as the sending end using the Current Sensor ACS 712.
- Dedicated output of the condition is shown on LCD Display.

Case 2 – On Theft:

- Here to detect the Theft we used Load 2 which is also connected through the Current Sensor 2 measure the increased current load at after ends.
- Controller ESP 8266 matches the both current and according to the current difference Theft Detection Alert is shown in the LCD.
- As soon as the Theft occurs Alert system will activates the and sends the Notification on the Blynk App.
- Micro controller and it is displayed in the LCD. It is also communicated to the consumer's mobile using IoT.

CHAPTER 5

PERFORMANCE ANALYSIS

5.1 Code:

```
const int sensorIn = A0;

int mVperAmp = 185; // use 185 for 5A, 100 for 20A Module and 66 for 30A Module
#include <Wire.h> int
buz = D5;

#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
#define BLYNK_TEMPLATE_ID "TMPLFqWbaa_h"
#define BLYNK_TEMPLATE_NAME "theft"
#define BLYNK_AUTH_TOKEN "0P_QepNUS1e90SWmwBCDQyMCvlvHm91S"

// Your WiFi Credentials.

// Set password to "" for open networks.
char ssid[] = "Ucnwifi"; char pass[] =
"mdb12345";                    #include
<ESP8266WiFi.h>                #include
<BlynkSimpleEsp8266.h>
double Voltage = 0; double
VRMS = 0;
double AmpsRMS = 0;
bool isconnected = false;
char auth[] = BLYNK_AUTH_TOKEN;
BlynkTimer timer;


void checkBlynkStatus() { // called every 2 seconds by SimpleTimer
  getSensorData();

  isconnected = Blynk.connected(); if
  (isconnected == true) {
  // digitalWrite(WIFI_LED, LOW); sendSensorData();
  Serial.println("Blynk Connected");
  } else{

    //digitalWrite(WIFI_LED, HIGH);
    Serial.println("Blynk Not Connected"); }
```

```
}


void getSensorData()

{ }

void sendSensorData()

{

Voltage = getVPP();

VRMS = (Voltage/2.0) *0.707; // sq root AmpsRMS = (VRMS * 1000)/mVperAmp; float Wattage
= (220*AmpsRMS)-18; //Observed 18-20 Watt when no load was connected, so
substracting offset value to get real consumption.

Serial.print(AmpsRMS);
Serial.println(" Amps RMS ");
 Serial.print(Wattage);
 Serial.println(" Watt ");
 lcd.setCursor(0,1);
 lcd.print("V=");
 lcd.setCursor(2,1);
 lcd.print(AmpsRMS);



      if (AmpsRMS > 0.40)

  {

    Serial.println("Theft Detected");
    lcd.setCursor(0,1);
    Blynk.logEvent("theft", "Theft Detected on P2");


   lcd.print("Theft Detected");
    digitalWrite(buz,0); }

else{
digitalWrite(buz,1);
lcd.setCursor(0,1);
   lcd.print("                ");


}

}
```

```
void                    setup(){
    pinMode(A0, INPUT);
    Serial.begin(115200);
    delay(10);
     lcd.init();              //Init the LCD
  lcd.backlight();          //Activate backlight
  lcd.home();
   lcd.print("IoT Theft Dtction");
    Serial.println(F("Init...      "));
    pinMode (buz,OUTPUT);


  WiFi.begin(ssid, pass); timer.setInterval(2000L, checkBlynkStatus); // check if Blynk server is

  connected every 2 seconds Blynk.config(auth); delay(1000);

}


void loop(){ Blynk.run();
timer.run();



}

float getVPP()

{


  float result;

  int readValue; //value read from the sensor int
  maxValue = 0;   // store max value here int
  minValue = 1024;   // store min value here
uint32_t start_time = millis();




   while((millis()-start_time) < 1000) //sample for 1 Sec
{

     readValue = analogRead(sensorIn);
```

```
                // see if you have a new maxValue if
                (readValue > maxValue)
                {

                   /record the maximum sensor value/
                   maxValue = readValue;


                }

               if (readValue < minValue)
{

                   /record the maximum sensor value/ minValue
                   = readValue;
                }

          /*     Serial.print(readValue);
                Serial.println(" readValue ");
                Serial.print(maxValue);
                Serial.println(" maxValue ");
                Serial.print(minValue);
                Serial.println(" minValue ");
                delay(1000); */
             }



            // Subtract min from max
result = ((maxValue - minValue) * 5)/1024.0;



              return result;

           }
```

5.2 Result:

Figure 5.1 Blynk interface

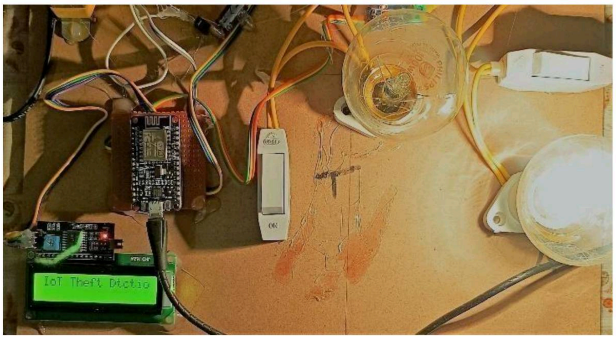

Figure 5.2 Normal condition (before Theft)

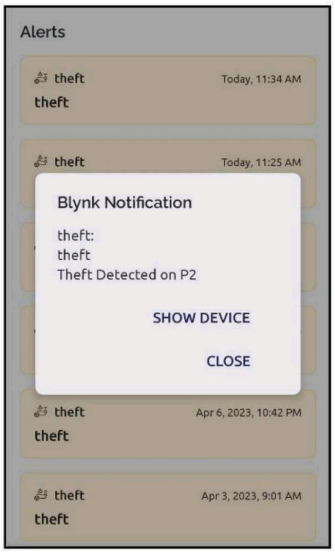

Figure 5.3 Blynk interface

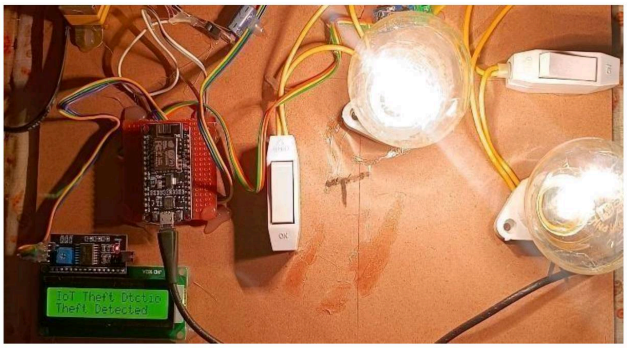

Figure 5.4 Normal condition (after Theft)

CHAPTER 6

Advantages:

- This system shows the energy consumed on daily basis; hence it helps to reduce the consumption by Comparing the daily usages.
- It reduces the human interference to collect the monthly reading and it also saves the time and money.
- The pre-announced shut down details helps to take necessary preventive measures and also helps to charge the essential Equipments.
- The alarm system helps to create awareness to the public regarding their energy consumption and the corresponding charges.
- It prevents the wastage of energy by disconnecting the power through a message when the residents are out of station.
- The LCD display, situated in the distribution board helps the residents in the apartments to be aware of the messages in the LCD display since they are far away from the energy meter.

Disadvantages:

1. Initial cost is high.
2. Require frequent maintenance after fault for efficient operation.
3. Since this entire system is mainly depends on hardware, a small failure in hardware can affects entire system.

Applications:

1. Highly applicable in Electric thefting area to maintain the continuity of supply.
2. Applicable in the areas where there is adequate supply of electricity.
3. In metro slum, areas & cities.
4. In industrial sector.

FUTURE SCOPE

This project can be extended to control each and every parameter of the power system as well as every process in the operation of power system. Thus, we can monitor and control the entire power system. This project can be further developed by adding an automatic billing system which would display the amount of power consumed by each consumer at the substation which would further reduce the labour cost and time. It requires only one time installation cost after installation this can be used with ease for lifetime which acts as a great advantage. This project can be implemented in industries and any such places which require a large amount of electricity which will ensure that no wastage or any related theft of electricity takes place. It will completely eliminate the power theft and will increase revenue for the Government and contribute to the betterment of the society. We can make this project more users friendly by introducing a Wi-Fi module and also by using other low-cost components.

CONCLUSION

In order to overcome the revenue losses due to power theft in our country, we have made a small attempt through this project. By this work we can conclude that the power theft can be effectively curbed, "**Theft detection System using IoT**", proves useful to the people who use it and helps in eliminating illegal usage of electricity by working reliably and satisfactorily, thus saving the revenue loss to the electricity supplying authority in future which incur due to power theft. The Theft detection System using IoT has been designed and developed with proper integration of both the hardware and the software. Without any human interface this system provides an effective and easy way to detect electrical theft. The use of Wi-Fi helps in achieving the numerous advantages of wireless network systems. Power theft is actually by passing the current sensor but in our project we have indicated the theft by increasing the load and this method is cost efficient.

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Appendix:

Categories	**Items**	**Values**
Wi-Fi Parameters	Certificates	FCC/CE/TELEC/SRRC
	Wi-Fi Protocols	802.11 b/g/n
	Frequency Range	2.4G-2.5G (2400M-2483.5M)
	Tx Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: -91 dbm (11 Mbps)
		802.11 g: -75 dbm (54 Mbps)
		802.11 n: -72 dbm (MCS7)
	Types of Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware Parameters	Peripheral Bus	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/PWM
	Operating Voltage	3.0~3.6V
	Operating Current	Average value: 80mA
	Operating Temperature Range	-40°~125°
	Ambient Temperature Range	Normal temperature
	Package Size	5x5mm
	External Interface	N/A
Software Parameters	WiFi mode	station/softAP/SoftAP+station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Software Development	Supports Cloud Server Development / SDK for custom firmware development
	Network Protocols	IPv4, TCP/UDP/HTTP/FTP