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ANNEXURE VIII

STUDENT INTERNSHIP PROGRAM (SIP)

REPORT

Name of Industry:

CopperCloud IoTech

Submitted by

DURGESH KOLTE

T196003

0120170036

SCHOOL OF ELECTRICAL

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ALANDI (D.), PUNE

CERTIFICATE

This is to certify that the "**Student Internship Program (SIP)**" report submitted by **Durgesh Kolte** PRN **0120170036** is work done by him/her and is submitted during 2019-20 academic year.

Faculty Mentor
Shridhar Khandekar

School – Internship Coordinator
Amit Nagrale

School Dean
Debashish Adhikari

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(Internship Certificate)

CopperCloud IOTech Pvt Ltd

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Maharashtra, India

Document: CIPL/HR/2020/48 *Dated 20 Sep 2020*

TO WHOMSOEVER IT MAY CONCERN

CERTIFICATE

This is to certify that Shri Durgesh Kolte, a student at MIT AOE Pune, has undergone Internship at CopperCloud IOTech Pvt Ltd, Pune for the duration 15 Jun 2020 to 31 July 2020.

CopperCloud is a company specializing in Internet of Things (IoT) space, with primary focus in customized IoT solutions in the Industrial sector, catering to MSMEs.

During this internship, Durgesh has worked on the following:

Designed mechanisms to power IoT devices (comprising MCU with embedded code & sensors) using LiPo Batteries and Solar Panels.

CopperCloud wishes Durgesh the best for a successful career ahead.

Abhijeet Deogirikar
Founder & CEO, CopperCloud IOTech Pvt Ltd

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ACKNOWLEDGEMENT

I take this opportunity to record our profound gratitude and indebtedness to **Prof. Shridhar Khandekar**, School of Electrical Engineering for his inspiring guidance, valuable advises, constant encouragement and untiring supervision throughout our project work.

Finally, I would like to acknowledge and express my special thanks to **Mr. Yogesh Yewale (Industry Guide)** for guiding me through the course of time and **Mr. Abhijit Deogirikar (CEO, CopperCloud IoTech)** for patience, encouragement, support during the period of this work.

Durgesh Kolte

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1. INTRODUCTION:

CopperCloud IoTech is a start-up in Internet of Things (IoT), incorporated in 2018. They primarily focus on Industrial IoT, with an objective of assisting MSMEs transition to Industry 4.0, through customized Industrial IoT solutions.

CopperCloud® offers conventional IT services involving websites, databases, cloud services, etc. CopperCloud reflects their strong training vertical, imparting IoT skills to faculty, students and working professionals.

Their leadership team has a collective experience in a variety of disciplines including automation technology, wireless technology, IT, embedded systems, data science, defence service, industrial administration and so on. They are committed to new and upcoming technologies with a vision to make affordable automation available to every MSME in India and beyond.

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2. PROBLEM STATEMENT:

Domain: Energy

Problem statement:

Deploying IoT Solution in hard-to-reach terrain, or where AC Power grid isn't easily available. The main outcome was to design a standalone solar-powered system solution without human interference.

3. LEARNING EXPERIENCE:

3.1 KNOWLEDGE ACQUIRED:

1. Solar + Li-ion battery powered IoT Device
2. In case of low battery, exception should be logged on cloud
3. Recommended equipment/platforms

• ESP8266/NodeMCU
• Solar panel 8 to 12V
• TP4056 LIPO charge controller

3.2 SKILLS LEARNED:

- Basics of solar power as applied to IoT
- Design LIPO battery charging system, and integrate it with a portable solar generation unit
- Power budgeting and management on embedded platforms
- Communication protocol between IoT Embedded Device and Cloud using MQTT and JSON
- Basics of Relational Databases
- Agile methodology to execute projects

3.3 GAINED VALUES:

- Team Work
- Working on Scrum
- Problem Solving
- Approach Finalization
- Designing System
- Analysis

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3.4 CHALLENGES:

SR. NO	NATURE OF WORK/TO DO	CHALLENGES
0	Scrum	NO
1	Components	NO
2	In-depth Battery	C rating
3	Charging	Timing
4	Battery Discharge	Current drop
5	Power Calculation	Components
6	Solar Panel Energy Calculation	Budget
7	Solar Panel Size	NO
8	TP4056 Charging	Amperage
9	Solar Panel Selection	Wattage
10	LiPo Battery charging Design	Voltage issue
11	AWS cloud concepts	NodeRED
12	AWS cloud Networking	NO
13	Cloud & Embedded	NO
14	NodeMCU (ESP8266)	Sleep Mode
15	NodeMCU code	Linking Cloud
16	MySQL	NO
17	Relational Database	NO

MOST CHALLENGING:

Voltage Aspect maintenances of Battery & controller

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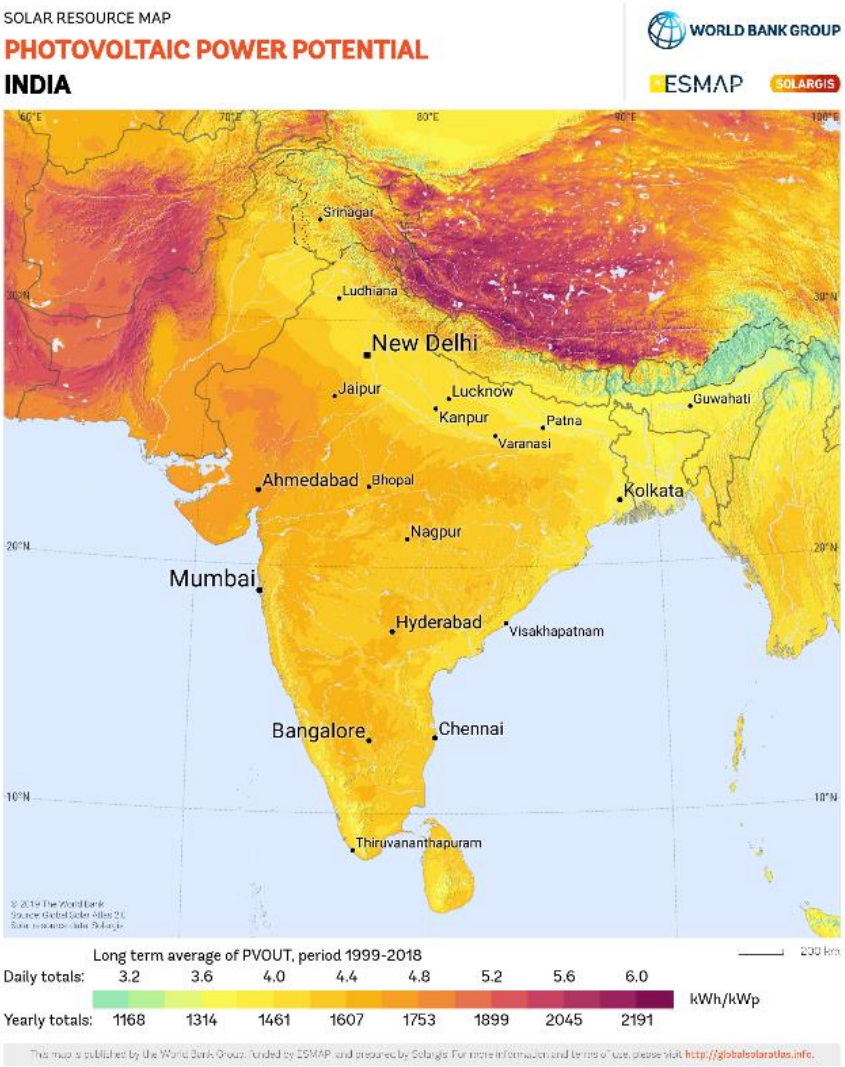
4 METHODOLOGY:

4.1 POWER BUDGETING:

SOLAR POWER:

Location: Pune



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BATTERY SELECTION:

Solar Power (per sq. metre):

YEARLY: 1607 KW

MONTHLY: 4.4 KW

DAILY: 183 W

Considering we can get solar energy from 9:00 AM to 5:00 PM, we can easily say that the Power Efficiency we expect from Solar Panel would be 75% of whatever calculated as we won't have 100% energy throughout day.

BATTERY SELECTION:

Solar Panel Efficiency (avg)	: 10% of Sunlight
Solar Panel Rating (max)	: 18 Watt
Actual Solar Panel Rating (6 volt)	: 10 Watt
Current Capacity (max)	: 1.67 amp
Power Efficiency (avg for 8 hrs)	: 75%
Battery Voltage (max)	: 4.5 V
Battery Current (max)	: 1.25 amp

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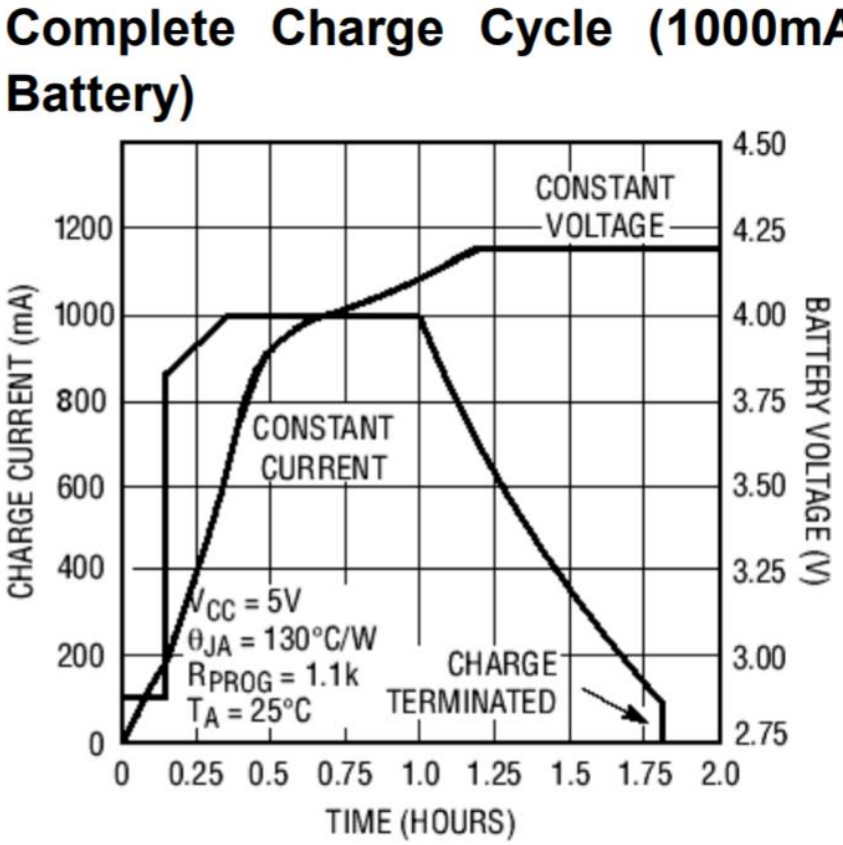
4.2 CURRENT CALCULATIONS:

TP4056 CHARGE CONTROLLER is a complete constant-current/voltage linear charger for single cell lithium-ion batteries. TP4056 Other features include current monitor, under voltage lockout, automatic recharge and two status pin to indicate charge termination and the presence of an input voltage.



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CURRENT DISCHARGE CALCULATION:

Current Drawn:	
ESP8266 + WiFi	= 75 mA
Sensors / Signals	= 25 mA
Total Current	= 100 mA
Battery Runtime:	
Capacity / Current Drawn	= 15 hrs

But since, 15hrs won't be sufficient to charge a battery fully as we might have days where we don't receive sunlight at all and then this system would fail within a day. And hence we have to take into account a longer period. For this main reason along with addition of WiFi/RF on ESP8266 it is the perfect choice for our use. Hence, we would be using the Depp-Sleep mode feature of the ESP8266 to extend the Runtime of Battery.

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DEEP-SLEEP MODE:

In this mode, the CPU and all peripherals are paused. Any wake-up such as external interrupts will wake up the chip. Without data transmission, the Wi-Fi Modem circuit can be turned off and CPU suspended to save power consumption.

Current Drawn:

Wake Mode	**= 100 mA**
Sleep Mode	**= 0.25 mA**
Average Current (every 5 min)	**= [100*10 + 0.25*290] / 300 = 3.575 mA**

Battery Runtime:

Capacity / Current Drawn	**= 420 hrs = 17.5 Days**

Therefore with the help of below command we can trigger the controller into Deep-Sleep Mode where it consumes 250 uA rather than 100mA which extends the Runtime upto 17 days which is much more than sufficient to charge a 1500mAh battery. Bu the maximu, sleep time is 71 minutes in a flow for ESP8266.

```
ESP.deepSleep(sleepTimeInSeconds * 1000000);
```

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4.3 VOLTAGE REGULATION:

As we know that after certain voltage level the battery won't discharge enough current so that the controller can work, for this we had to regulate the voltage of the system to limit it to a certain value so that whenever the battery voltage crosses that value we switch it into Deep-Sleep Mode into which it can run forever or collect data on hourly basis rather than every 5 minutes.

This is where things become interesting. Since on ESP8266 boards we cannot read the battery voltage that is Vin without external components. But indirectly we can detect the discharged battery through measuring input voltage of ESP8266 which is V3.3.

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There is a method to detect a discharged battery indirectly, by measuring the input voltage of ESP8266 — that would be V3.3.

Vin	V3.3	Vmeasured/1000
5	3.2904	3.475
4.9	3.2905	3.475
4.8	3.2905	3.475
4.7	3.2904	3.474
4.6	3.2905	3.475
4.5	3.2904	3.474
4.4	3.2905	3.475
4.3	3.2905	3.475
4.2	3.2906	3.475
4.1	3.2905	3.475
4	3.29	3.474
3.9	3.2899	3.474
3.8	3.2899	3.474
3.7	3.2898	3.474
3.6	3.2897	3.473
3.5	3.2897	3.473
3.4	3.2895	3.472
3.3	3.2575	3.44
3.2	3.153	3.331
3.1	3.0555	3.226
3	2.947	3.106
2.9	2.775	2.936
2.8	2.7	2.87

Battery Voltage Check (CODE):

```
Batt = ESP.getVcc();
 // If the battery is discharged don't go any further!!!
 if(Batt < 3100){
   // Deep sleep for as long as you can
   ESP.deepSleep(ESP.deepSleepMax());
 }
```

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5 CONCLUSION:

Off-grid Power System is very crucial in areas of hard to reach or where frequent maintenance isn't possible. This system is carefully crafted to suit months of runtime without any human interference. The flow of system designing started with the Thermal layout of the country or region where the system would be laid. This helped in generalizing the Solar Panel Size and its specifications. Further to which the battery selection process continued which matches up to the system requirements. And considering all the offsets and weather conditions, we can call this as one of the most robust Off-grip powered or Solar powered system for any type of work.

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6 Future Scope:

This system has a very wide Future Scope where it can be deployed in any IoT system. One such application could be affordable deploying this system into Farm/Barren Lands for Weather monitoring/sensing along with sharing wireless information through WIFI/RF in a mesh network and uploading it to cloud so that any human can visualize data or get notified of system faults if needed over his Smartphone/Website. And if deployed on large scale it can be affordable for multiple users.

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7 REFERENCES:

Research Paper:

- 2018 2nd International Conference on Data Science and Business Analytics
  Solar Powered Smart Irrigation System using Internet of Things
- 2017 Devices for Integrated Circuit (DevIC), 23-24 March, 2017, Kalyani, India
  Data Centre Temperature Monitoring with ESP8266 Based Wireless Sensor Network and Cloud Based Dashboard with Real Time Alert System

YouTube Link for guide to Sleep Mode:
https://youtu.be/QQrFxn6G97Y

Websites:

- https://bitluni.net/solar-powered-weather-station
- https://www.geekstips.com/esp8266-arduino-tutorial-iot-code-example/
- https://medium.com/electronza/esp8266-running-on-battery-power-89fc124d08a4
- https://youtu.be/QQrFxn6G97Y