Durgesh Kolte
BEE13

Student Internship Program (SIP)

Off-Grid Solar Powered System

MIT | Academy of Engineering
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

CopperCloud IoT
Sense | Control | Automate

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Contents

CopperCloud IoTech!

Abhijit Deogirikar

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 IoT

Sense | Control | Automate

Problem Statement

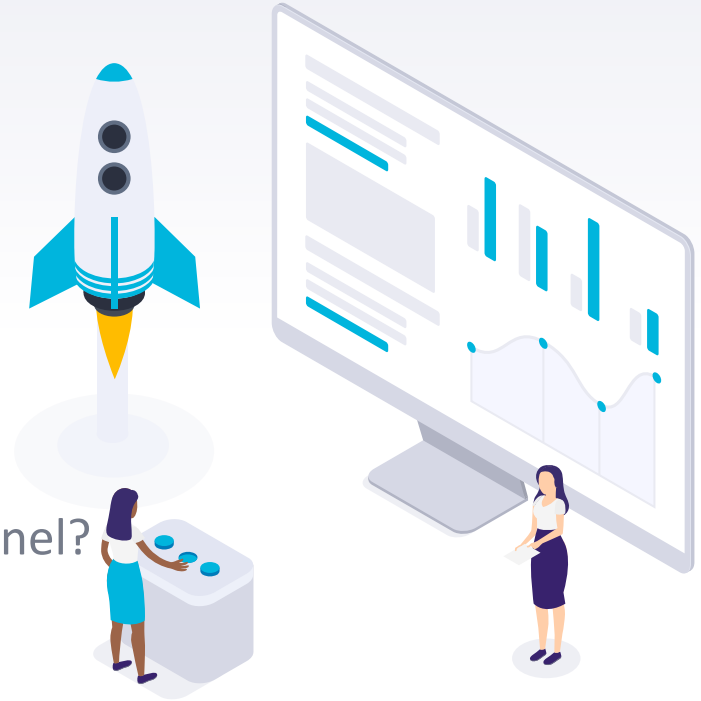
Deploying IoT Solution in hard-to-reach terrain, or where AC Power grid isn't easily available. The main outcome was to design a standalone solar-powered system.

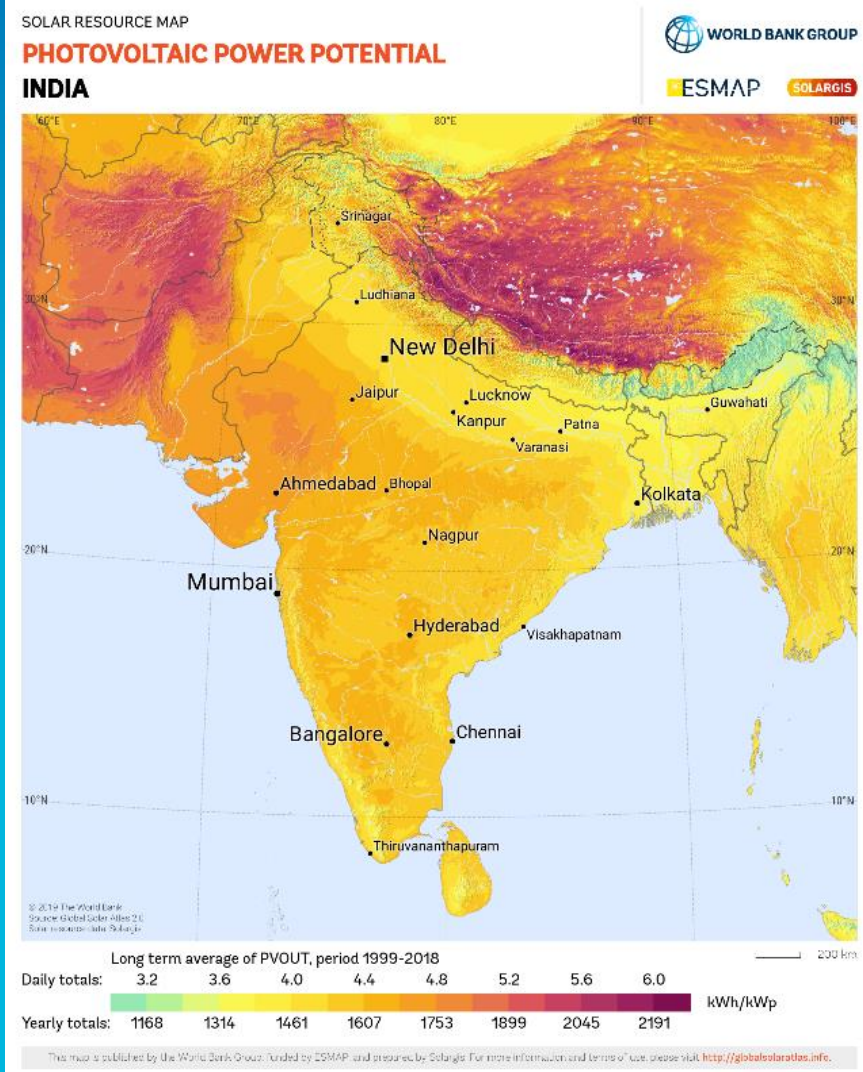
CopperCloud IoT

Sense | Control | Automate

Solar Panel Selection

How to choose size & capacity of Solar Panel?





Solar Power

(per sq. meter)

Yearly
1607 KW

Daily
4.4 KW

Hourly
183 W

(9:00 am to 5:00 pm)

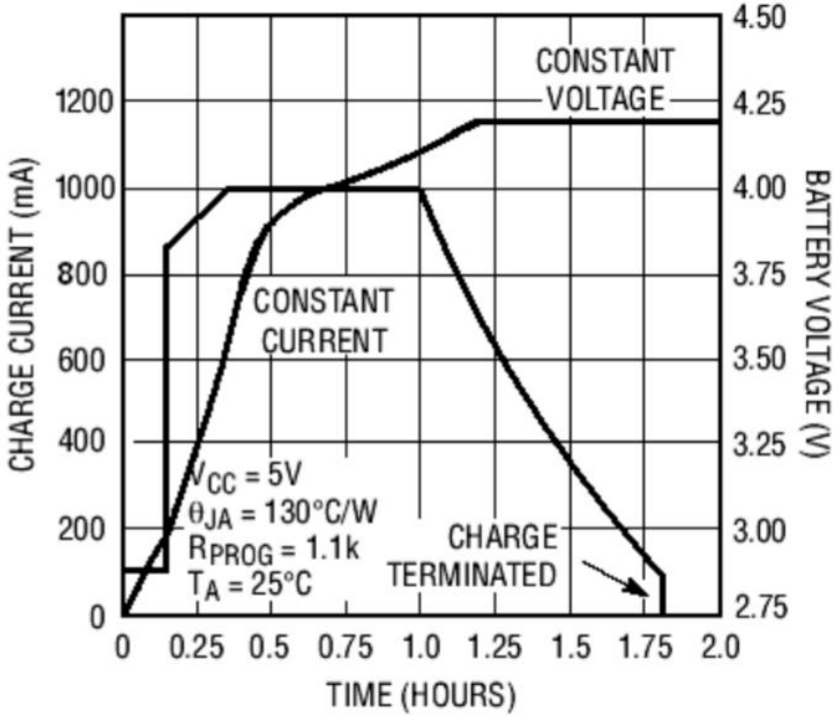
Battery Selection

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**

TP4056 Charge Controller

is a complete constant-current/voltage linear charger for single cell lithium-ion batteries.

Complete Charge Cycle (1000mAh Battery)



Current Discharge Calculations

Current Drawn:

ESP8266 + WiFi	**= 75 mA**
Sensors / Signals	**= 25 mA**
Total Current	**= 100 mA**

Battery Runtime:

Capacity / Current Drawn	**= 15 hrs**

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.

With Sleep Mode

Current Drawn:

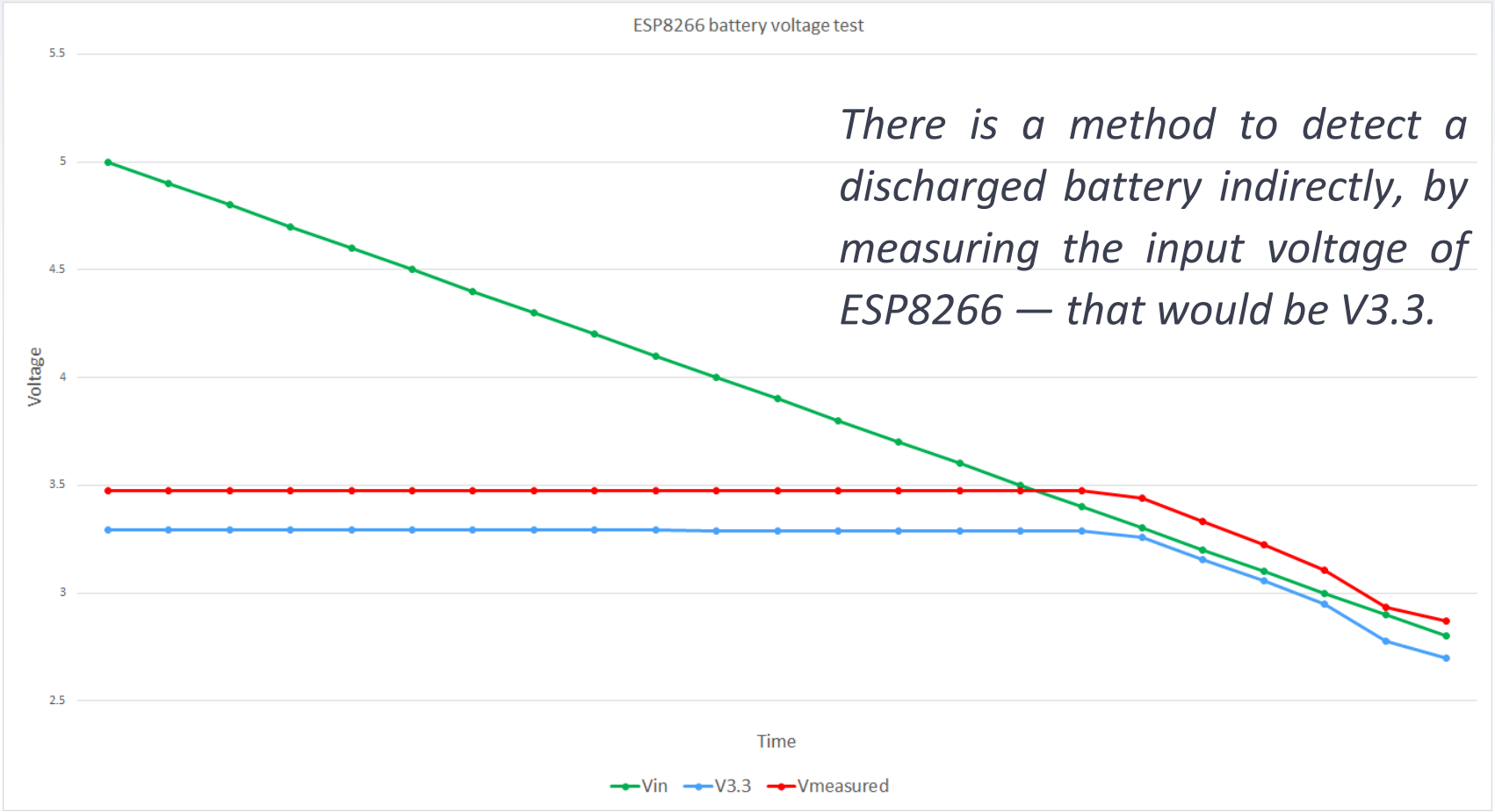
Wake Mode	**= 100 mA**
Sleep Mode	**= 0.25 mA**
Average Current (every 5 min)	**= [100*10 + 0.25*290] / 300** **= 3.575 mA**

Battery Runtime:

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

ESP.deepSleep(sleepTimeInSeconds * 1000000);

Volatge Regulation



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

Battery Voltage Check

```
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());
 }
```

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

References

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  Solar Powered Smart Irrigation System using Internet of Things

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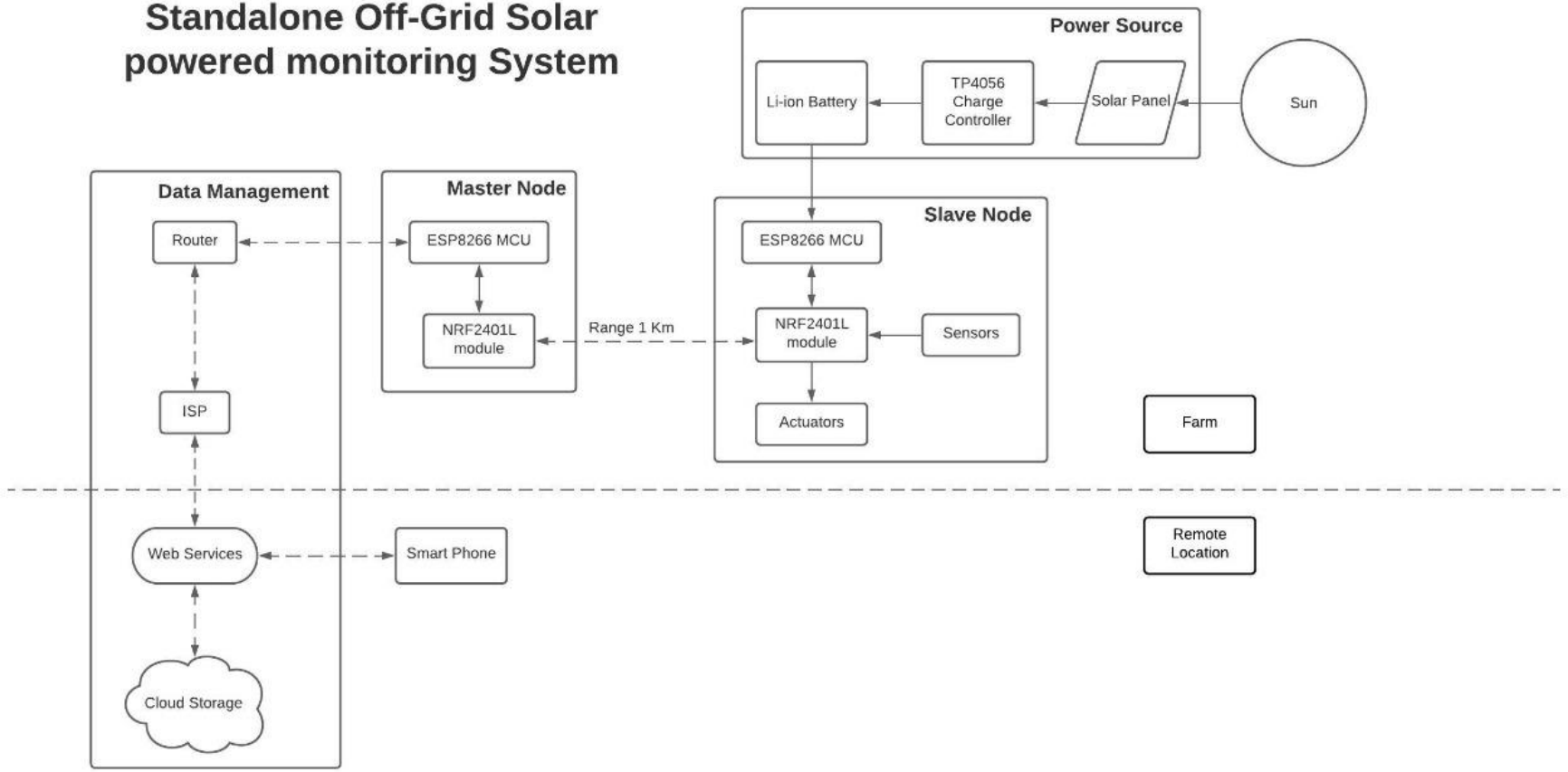
  Data Centre Temperature Monitoring with ESP8266 Based Wireless Sensor Network and Cloud Based Dashboard with Real Time Alert System

- 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

Standalone Off-Grid Solar powered monitoring System



THANKS!

Any questions?

You can find me at:

- dakolte@mitaoe.ac.in