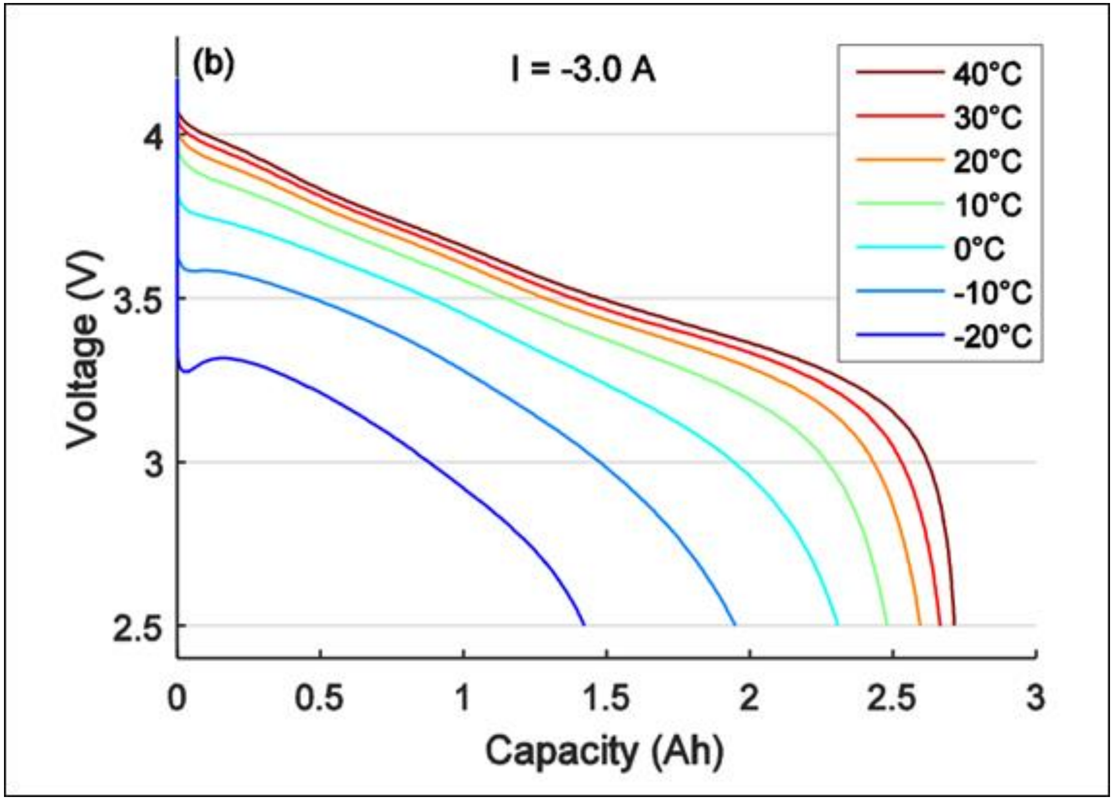
ELG4912- Progress Review Presentation

Presented By Group 7

Goal: Increase the popularity of E-Scooter during the winter



Business Case

Retail

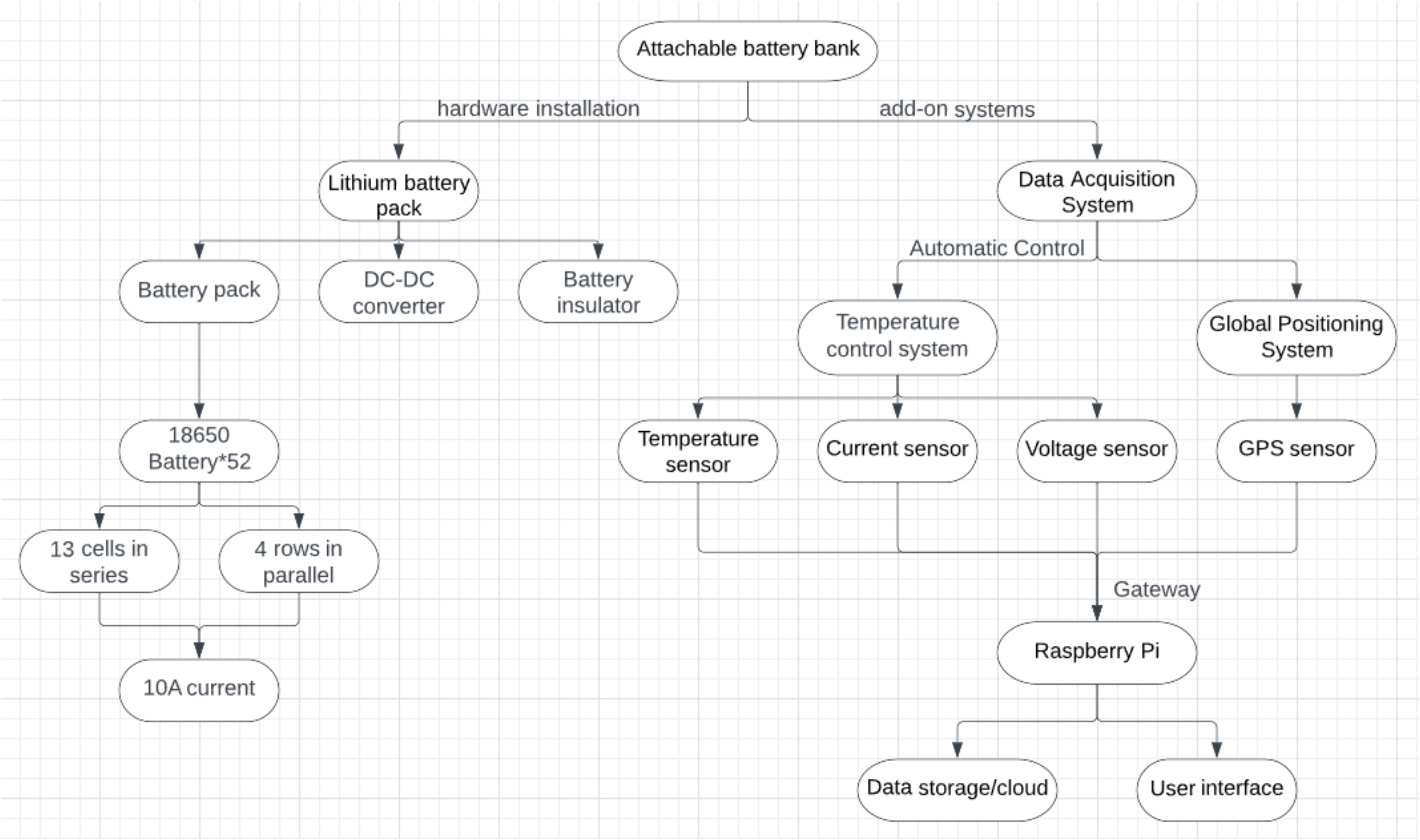
$499.9

Subscription

12.99 monthly
49.99 seasonal

System requirements

Functional Requirements



System requirements

- **Safety protection**

  - Heat Shrink Wrap

- **Temperature control system**

  - Automatic detection and control
  - Resistance Heating System
  - Prevents the battery from overheating

- **GPS system**

  - Locate lost electric scooter

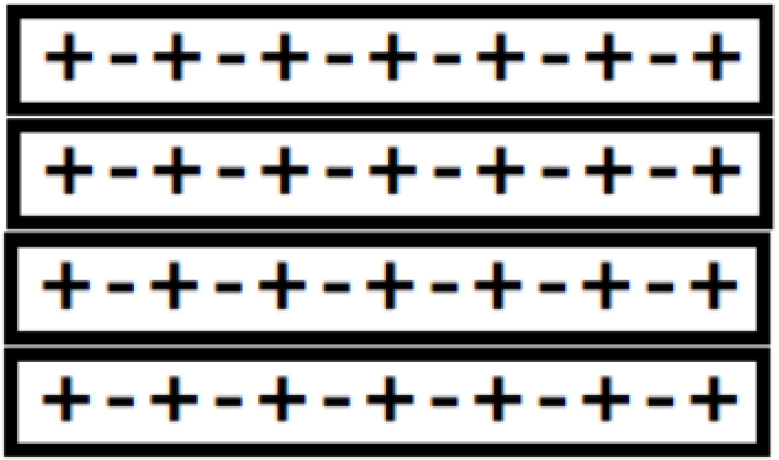
System requirements

Non-functional requirements

- Performance and scalability
- Portability and compatibility
- Reliability/Maintainability
- Localization
- Usability

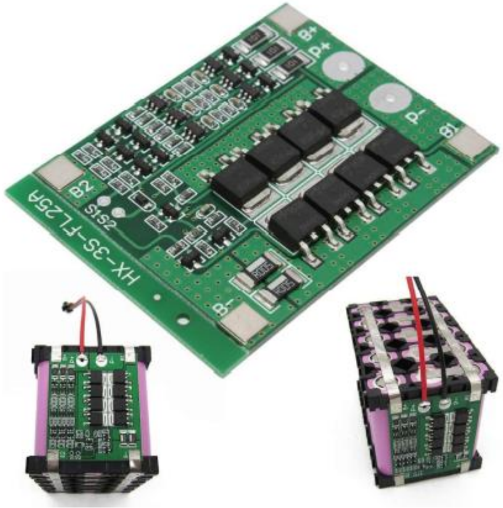
Hardware Design

- 48 V, 10 A battery Pack
- 13 cells in series
- 4 rows in parallel



Hardware Design

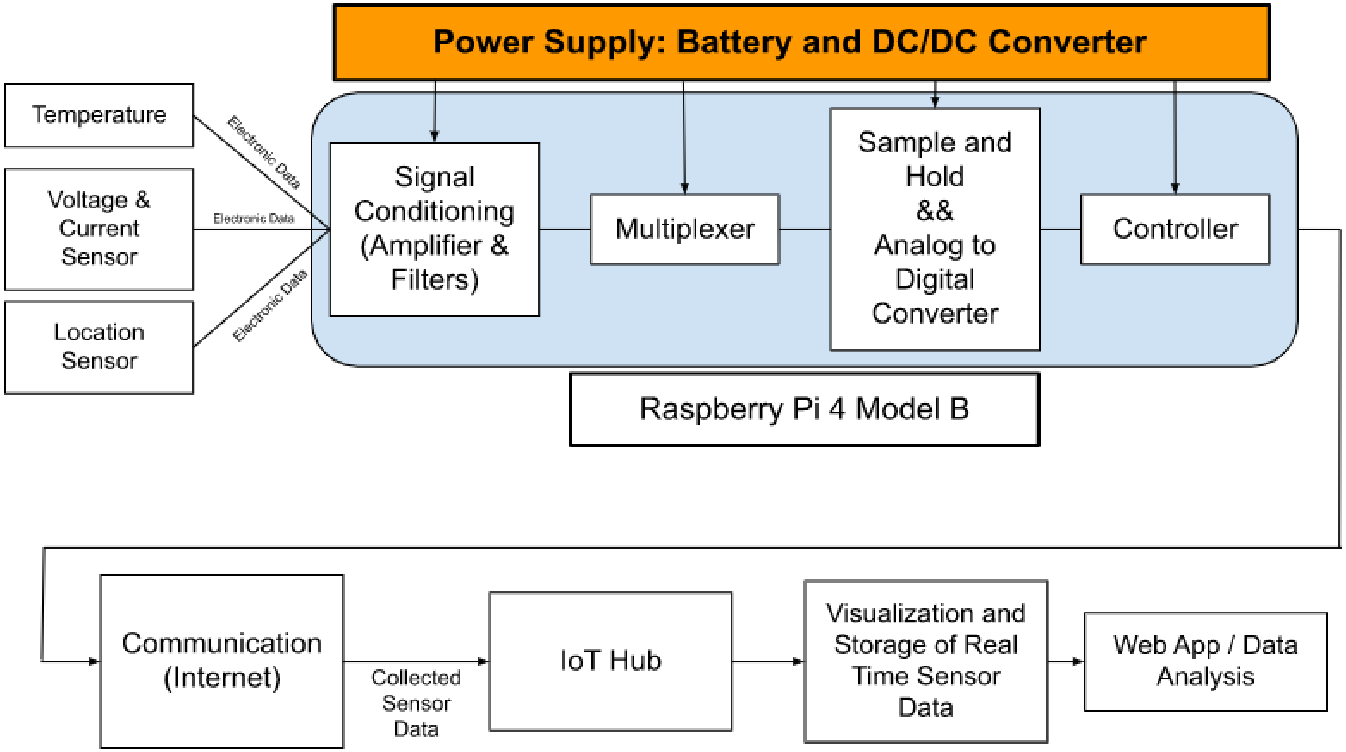
- Battery Management System



- Insulation Layer

Data Acquisition

- Sensor -> Signal Processing -> Cloud -> Web



Power Supply: Battery and DC/DC Converter

Temperature

Voltage & Current Sensor

Location Sensor

Electronic Data

Electronic Data

Electronic Data

Signal Conditioning (Amplifier & Filters)

Multiplexer

Sample and Hold && Analog to Digital Converter

Controller

Raspberry Pi 4 Model B

Communication (Internet)

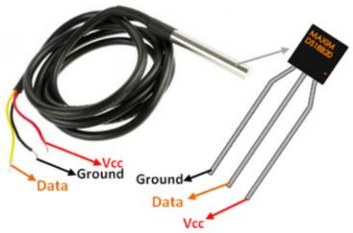
Collected Sensor Data

IoT Hub

Visualization and Storage of Real Time Sensor Data

Web App / Data Analysis

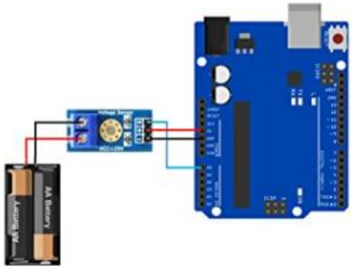
Sensors



Parameters	Specifications
Supply Voltage	3.3 V or 5.0 V
Temperature Range	$-55^{\circ}C$ to $+125^{\circ}C$
Accuracy	$\pm 0.5^{\circ}C$
Ground Pin	Connect to the ground of the circuit
Vcc	Powers the Sensor (5.0 V)
Data	This pin gives output the temperature value which can be read using 1-wire method

Table 5.1 - DS18b20 temperature sensor specs

Temperature Sensor



Parameters	Specifications
Voltage detection range	0.02445 - 25V DC
Voltage Analog Resolution	0.00489V
Product Dimensions	16 x 10 x 2 cm; 20 Grams

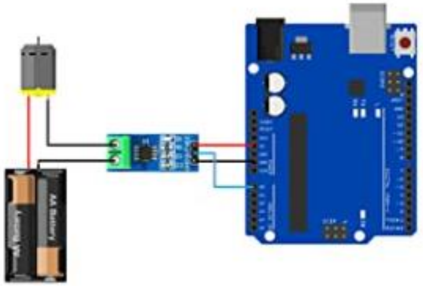
Table 5.2 - WayinTop DC0-25V specs

Voltage Sensor

Parameters	Specifications
Supply Voltage	3V - 5.5 V (typically 5V)
Current Output	50 mA
Operating Temperature	-40 to + 85 °C
Max Altitude	50,000 m
Max Velocity	515 m/s

Table 5.4 - Geekstory BN-220 sensor properties

GPS Sensor

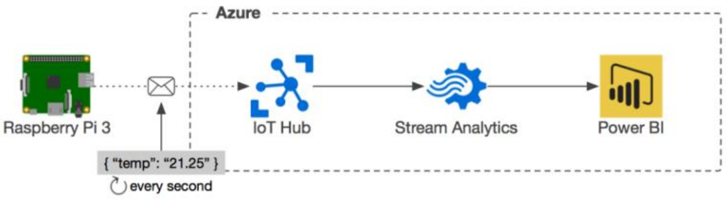


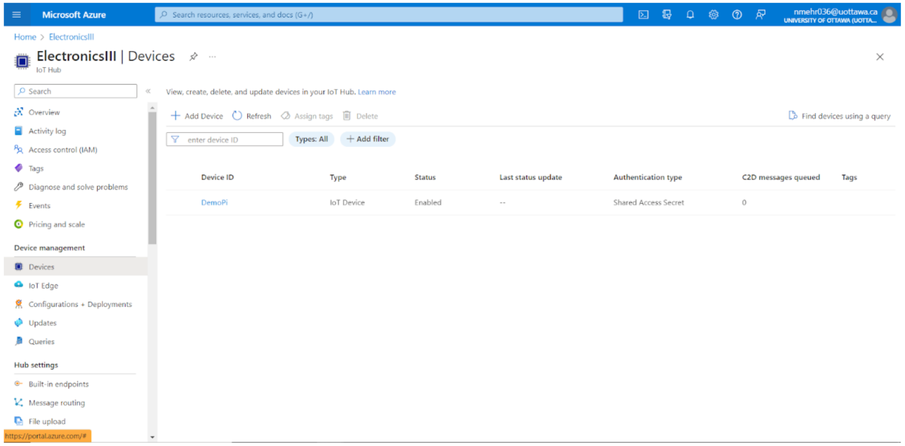
Parameters	Specifications
Chip	ACS712ELC-30A
Range of current detection	-30A to 30A DC
Analog Output	66mV/A
Product Dimensions	16 x 10 x 2 cm; 20 Grams

Table 5.3 - WayinTop ACS712 sensor specs

Current Sensor

Raspberry Pi + Azure Cloud

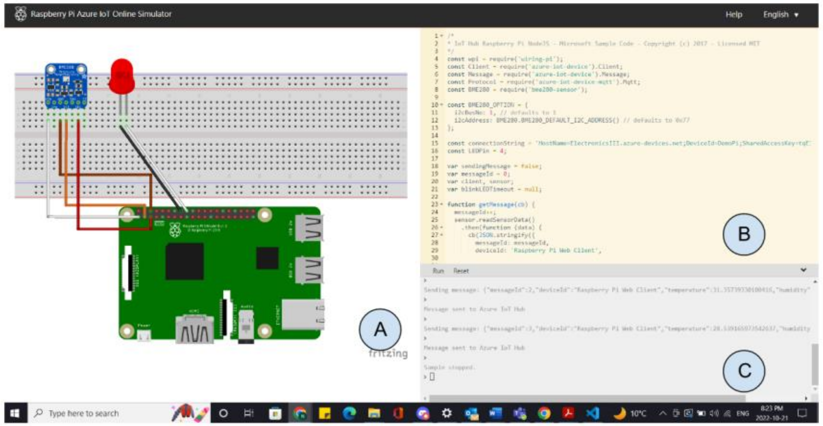




View, create, delete, and update devices in your IoT Hub. Learn more

Device ID	Type	Status	Last status update	Authentication type	C2D messages queued	Tags
DemoPi	IoT Device	Enabled	--	Shared Access Secret	0	

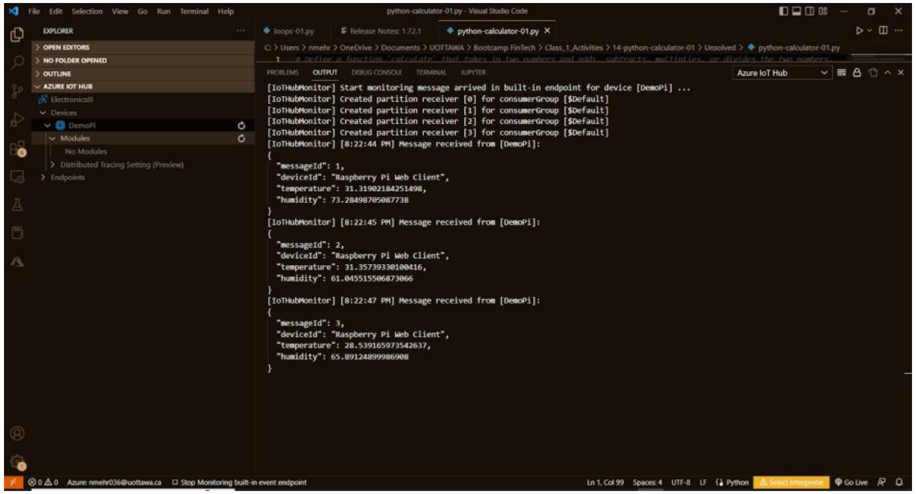
Figure 5.10 - IoT Hub Devices Window



```
/*
* IoT Hub Raspberry Pi NodeJS - Microsoft Sample Code - Copyright (c) 2017 - Licensed MIT
*/
const wpi = require('wiring-pi');
const Client = require('azure-iot-device').Client;
const Message = require('azure-iot-device').Message;
const Protocol = require('azure-iot-device-mqtt').Mqtt;
const BME280 = require('bme280-sensor');

const BME280_OPTION = {
  i2cBusNo: 1, // defaults to 1
  i2cAddress: BME280.BME280_DEFAULT_I2C_ADDRESS() // defaults to 0x77
};

const connectionString = 'HostName=ElectronicsIII.azure-devices.net;DeviceId=DemoPi;SharedAccessKey=tqE
const LEDPin = 4;

var sendingMessage = false;
var messageId = 0;
var client, sensor;
var blinkLEDTimeout = null;

function getMessage(cb) {
  messageId++;
  sensor.readSensorData()
    .then(function (data) {
      cb(JSON.stringify({
        messageId: messageId,
        deviceId: 'Raspberry Pi Web Client',
```

```
>
Sending message: {"messageId":2,"deviceId":"Raspberry Pi Web Client","temperature":31.35739330100416,"humidity"
>
Message sent to Azure IoT Hub
>
Sending message: {"messageId":3,"deviceId":"Raspberry Pi Web Client","temperature":28.539165973542637,"humidity
>
Message sent to Azure IoT Hub
>
Sample stopped.
>
```

Figure 5.9 - Raspberry pi Azure IoT Online Simulator Window



```
[IoTHubMonitor] Start monitoring message arrived in built-in endpoint for device [DemoPi] ...
[IoTHubMonitor] Created partition receiver [0] for consumerGroup [$Default]
[IoTHubMonitor] Created partition receiver [1] for consumerGroup [$Default]
[IoTHubMonitor] Created partition receiver [2] for consumerGroup [$Default]
[IoTHubMonitor] Created partition receiver [3] for consumerGroup [$Default]
[IoTHubMonitor] [8:22:44 PM] Message received from [DemoPi]:
{
  "messageId": 1,
  "deviceId": "Raspberry Pi Web Client",
  "temperature": 31.31902184251498,
  "humidity": 73.28498705087738
}
[IoTHubMonitor] [8:22:45 PM] Message received from [DemoPi]:
{
  "messageId": 2,
  "deviceId": "Raspberry Pi Web Client",
  "temperature": 31.35739330100416,
  "humidity": 61.045515506873066
}
[IoTHubMonitor] [8:22:47 PM] Message received from [DemoPi]:
{
  "messageId": 3,
  "deviceId": "Raspberry Pi Web Client",
  "temperature": 28.539165973542637,
  "humidity": 65.89124899986908
}
```

Assumptions

- Scooters can still function standalone is certain environmental conditions.
- Scooters can still function while being charged.
- Scooters have similar charging protocols.
- Materials and equipment will be available for this project.

Risks

- Charging below temperature
- Damaging Battery Physically
- Fire Hazard Overheating
- Over/Under voltage
- Shock risk & Dead shorts

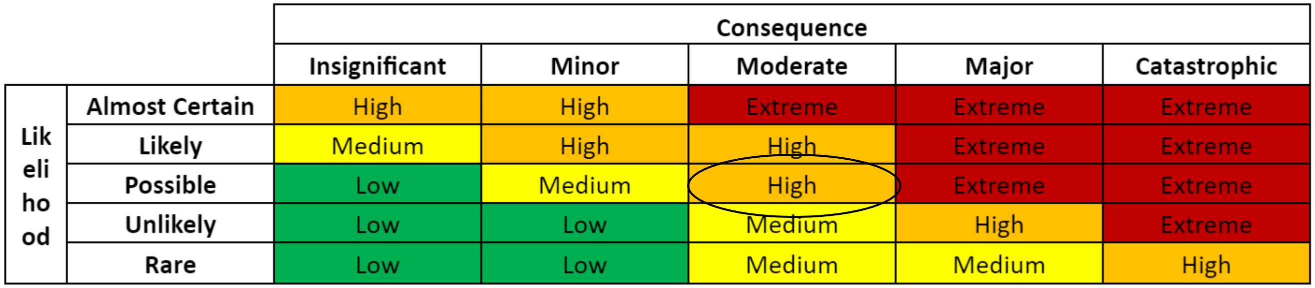
Solutions

- Battery Heater
- Battery Insulations
- Enclosure
- Voltage and Current sensors
- Battery Management System & Testing

Risk Management

Likelihood of exposure to hazard (1-5): 3 – Possible

Consequence of exposure to hazard (1-5): 3 – Moderate



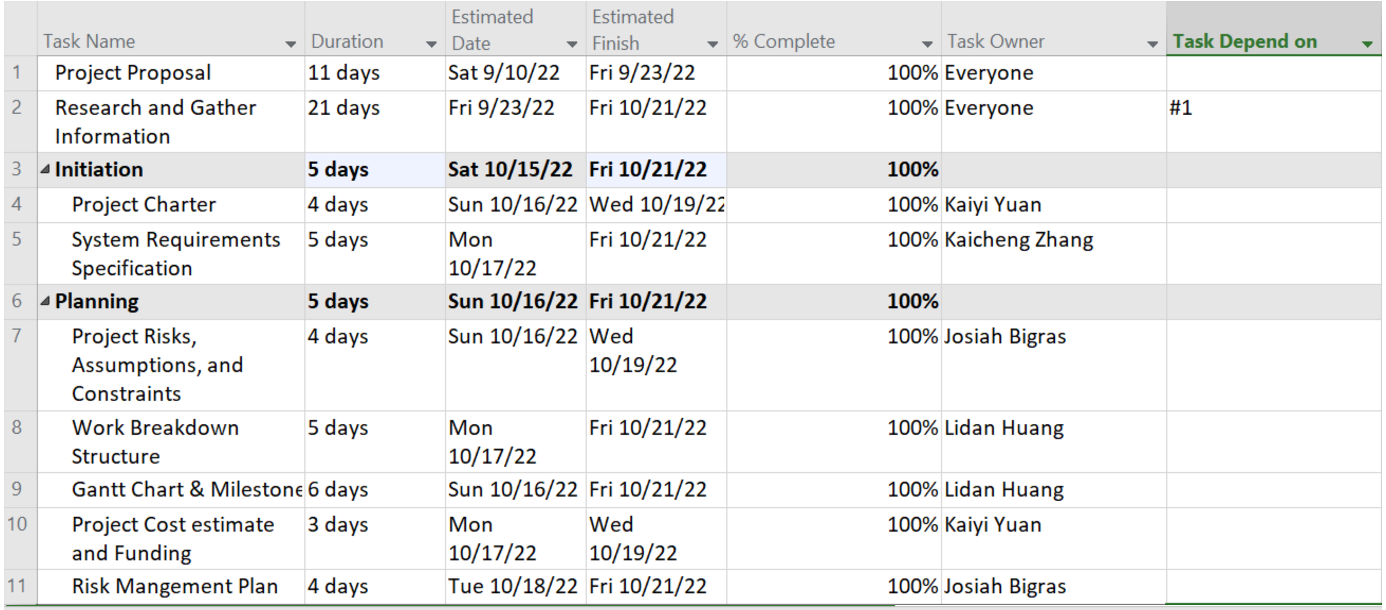
		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost Certain**	High	High	Extreme	Extreme	Extreme
	Likely	Medium	High	High	Extreme	Extreme
	Possible	Low	Medium	High	Extreme	Extreme
	Unlikely	Low	Low	Medium	High	Extreme
	Rare	Low	Low	Medium	Medium	High

- Training and proper PPE (For those working with the battery)
- Have an Emergency Plan (Bucket sand, Ventilation, etc.)

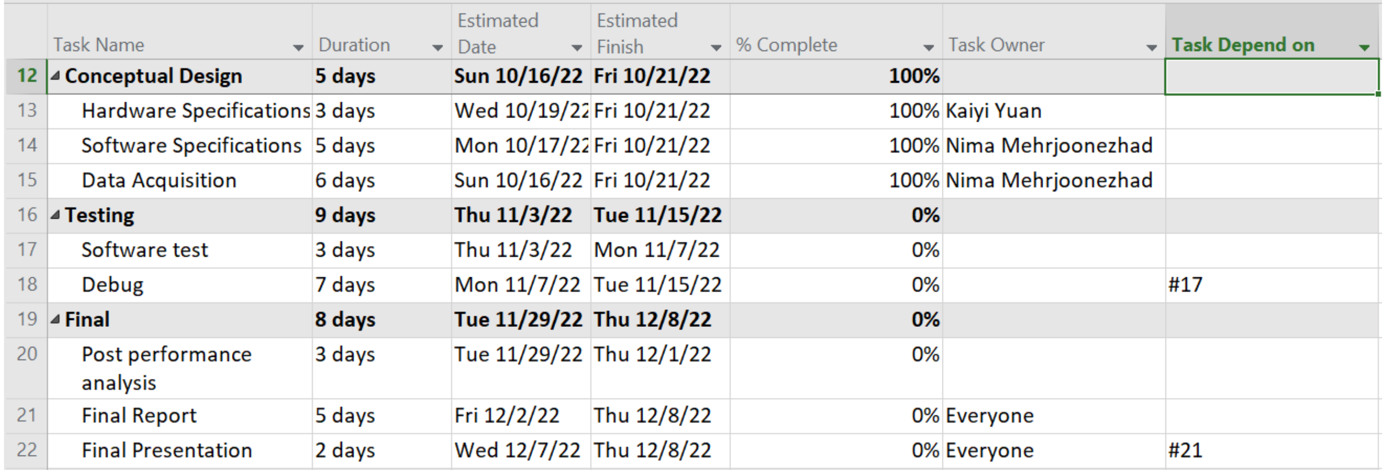
Gantt Chart

Details of Gantt chart.

- Initiation, Planning and Conceptual design were completed.
- Testing and final submitions will be done before 2022/12/22.



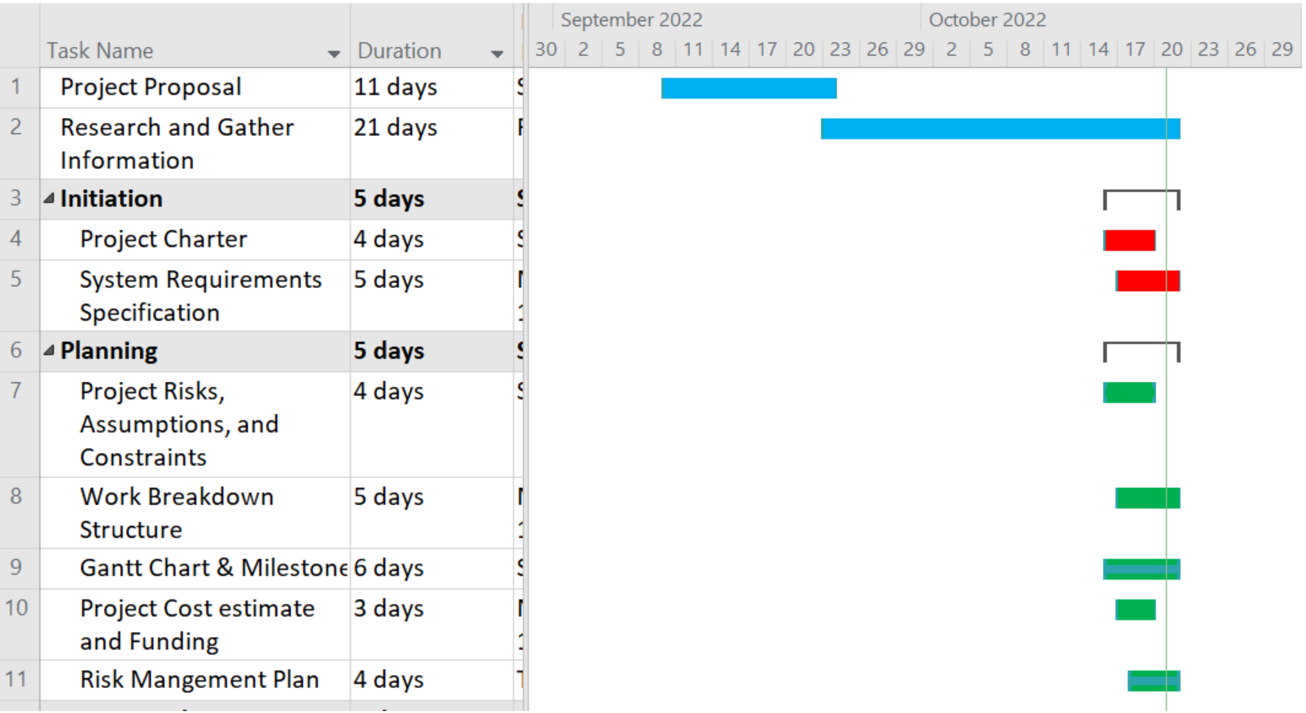
	Task Name	Duration	Estimated Date	Estimated Finish	% Complete	Task Owner	Task Depend on
1	Project Proposal	11 days	Sat 9/10/22	Fri 9/23/22	100%	Everyone	
2	Research and Gather Information	21 days	Fri 9/23/22	Fri 10/21/22	100%	Everyone	#1
3	**Initiation**	**5 days**	**Sat 10/15/22**	**Fri 10/21/22**	**100%**		
4	Project Charter	4 days	Sun 10/16/22	Wed 10/19/22	100%	Kaiyi Yuan	
5	System Requirements Specification	5 days	Mon 10/17/22	Fri 10/21/22	100%	Kaicheng Zhang	
6	**Planning**	**5 days**	**Sun 10/16/22**	**Fri 10/21/22**	**100%**		
7	Project Risks, Assumptions, and Constraints	4 days	Sun 10/16/22	Wed 10/19/22	100%	Josiah Bigras	
8	Work Breakdown Structure	5 days	Mon 10/17/22	Fri 10/21/22	100%	Lidan Huang	
9	Gantt Chart & Milestone	6 days	Sun 10/16/22	Fri 10/21/22	100%	Lidan Huang	
10	Project Cost estimate and Funding	3 days	Mon 10/17/22	Wed 10/19/22	100%	Kaiyi Yuan	
11	Risk Mangement Plan	4 days	Tue 10/18/22	Fri 10/21/22	100%	Josiah Bigras	



	Task Name	Duration	Estimated Date	Estimated Finish	% Complete	Task Owner	Task Depend on
12	**Conceptual Design**	**5 days**	**Sun 10/16/22**	**Fri 10/21/22**	**100%**		
13	Hardware Specifications	3 days	Wed 10/19/22	Fri 10/21/22	100%	Kaiyi Yuan	
14	Software Specifications	5 days	Mon 10/17/22	Fri 10/21/22	100%	Nima Mehrjoonezhad	
15	Data Acquisition	6 days	Sun 10/16/22	Fri 10/21/22	100%	Nima Mehrjoonezhad	
16	**Testing**	**9 days**	**Thu 11/3/22**	**Tue 11/15/22**	**0%**		
17	Software test	3 days	Thu 11/3/22	Mon 11/7/22	0%		
18	Debug	7 days	Mon 11/7/22	Tue 11/15/22	0%		#17
19	**Final**	**8 days**	**Tue 11/29/22**	**Thu 12/8/22**	**0%**		
20	Post performance analysis	3 days	Tue 11/29/22	Thu 12/1/22	0%		
21	Final Report	5 days	Fri 12/2/22	Thu 12/8/22	0%	Everyone	
22	Final Presentation	2 days	Wed 12/7/22	Thu 12/8/22	0%	Everyone	#21

Gantt Chart

Bar graphs show the time, duration and progress of tasks.



	Task Name	Duration
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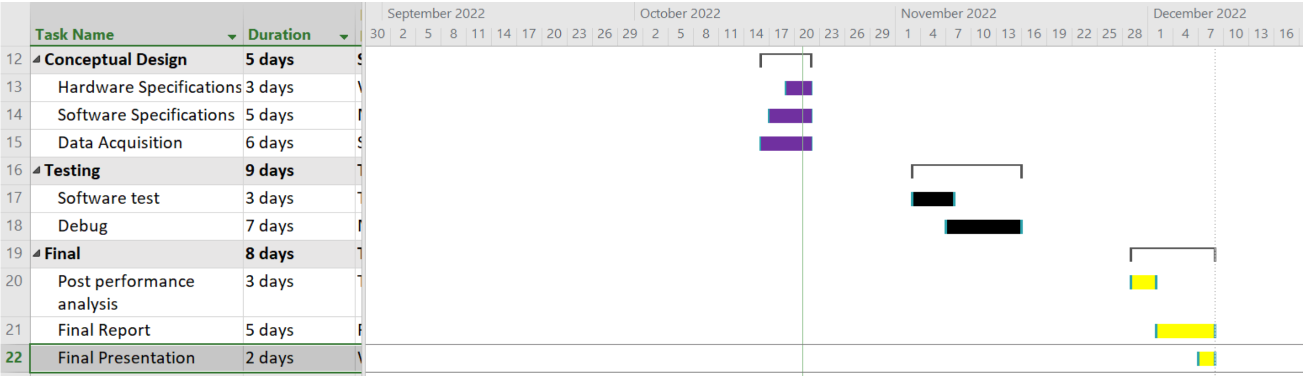
6	**Planning**	**5 days**
7	Project Risks, Assumptions, and Constraints	4 days
8	Work Breakdown Structure	5 days
9	Gantt Chart & Milestone	6 days
10	Project Cost estimate and Funding	3 days
11	Risk Mangement Plan	4 days



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12	**Conceptual Design**	**5 days**
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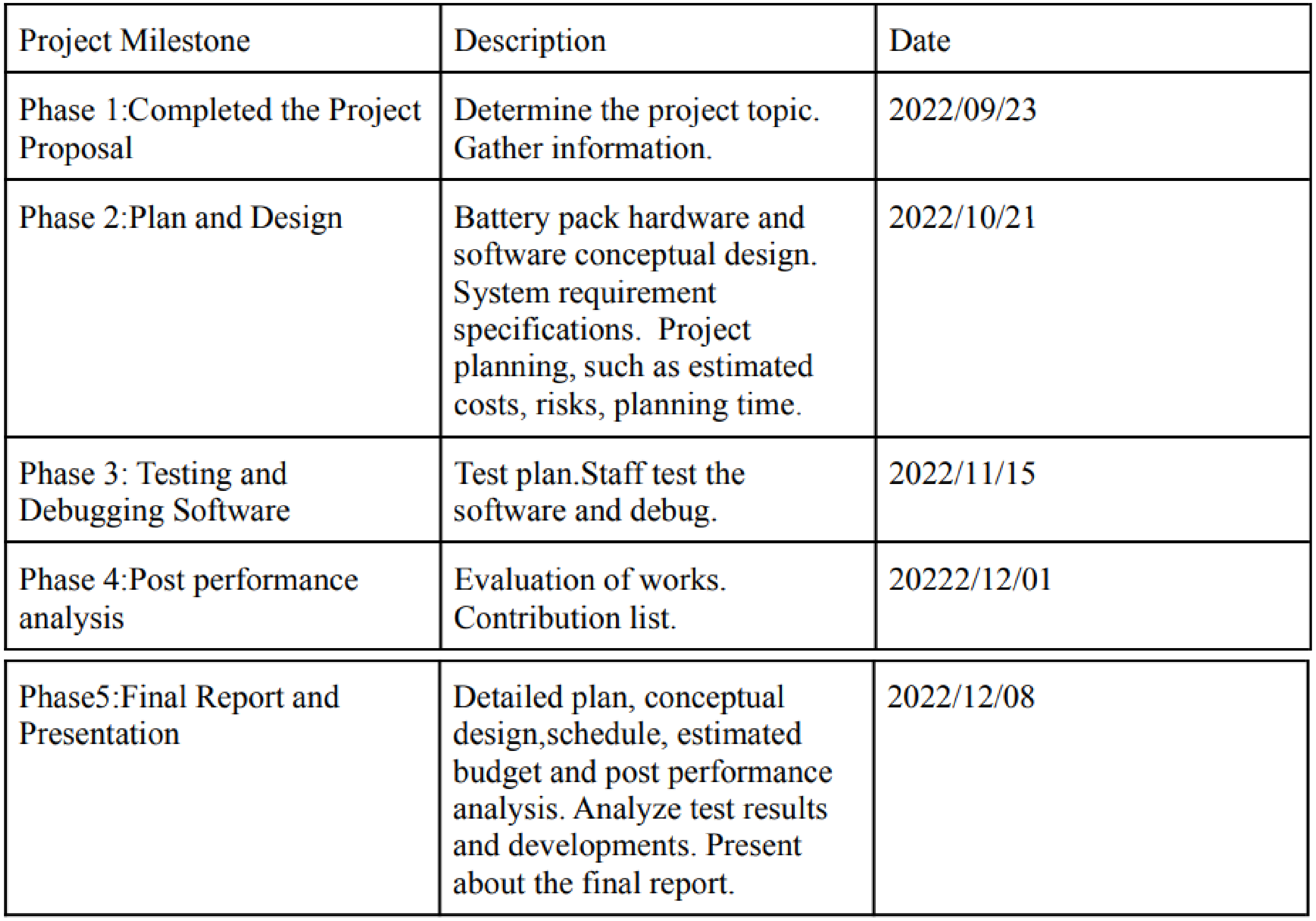
14	Software Specifications	5 days
15	Data Acquisition	6 days
16	**Testing**	**9 days**
17	Software test	3 days
18	Debug	7 days
19	**Final**	**8 days**
20	Post performance analysis	3 days
21	Final Report	5 days
22	Final Presentation	2 days

Milestones

- Phase 1 and 2 were completed.
- Dates for Phases 3, 4, and 5 are Scheduled.



Project Milestone	Description	Date
Phase 1:Completed the Project Proposal	Determine the project topic. Gather information.	2022/09/23
Phase 2:Plan and Design	Battery pack hardware and software conceptual design. System requirement specifications. Project planning, such as estimated costs, risks, planning time.	2022/10/21
Phase 3: Testing and Debugging Software	Test plan.Staff test the software and debug.	2022/11/15
Phase 4:Post performance analysis	Evaluation of works. Contribution list.	20222/12/01
Phase5:Final Report and Presentation	Detailed plan, conceptual design,schedule, estimated budget and post performance analysis. Analyze test results and developments. Present about the final report.	2022/12/08

Budgets

18650 Battery*52	$260
Battery Management System	$12.99
Battery Insulator	$21.64
Raspberry Pi	$119.86
Heat Sensor	$22.05
Current Sensor	$12.99
Voltage Sensor	$10.20

Toatal cost of materials will be $443.73.

All the budget which will be evenly split among 5 of the members.

Reference List

- "Electric Scooter Rental Ottawa: Escape Bicycle Tours & Rentals." *Escape Bicycle Tours & Rentals- Explore Ottawa By Bike*, 20 Oct. 2022, https://escapebicycletours.ca/rentals-maps/electric-scooter/.
- Battery University. "BU-502: Discharging at High and Low Temperatures." *Battery University*, 3 Mar. 2022, https://batteryuniversity.com/article/bu-502-discharging-at-high-and-low-temperatures.
- External battery for Xiaomi M365/Pro/1s. [Online]. Available: https://m365.embedden.com/article_xiaomi_m365_pro_external_battery.
- J. Heath, "Can you ride electric scooter during winter?," Electric Wheelers, 06-May-2022. [Online]. Available: https://electricwheelers.com/can-you-ride-electric-scooter-during-winter/.