Prince Mohammad Bin Fahd University
College of Engineering
Department of Electrical Engineering

Efficient Electric Bicycle with Rechargeable Battery

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Advisor: Dr. Adil Khan

May 17, 2022

Outline

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- Project Architecture
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Project Definition

Design a long-range electric bicycle with BLDC motor connected to unit controller. Powered by 48 V rechargeable lithium-ion batteries

Project Objectives

- Reduce power consumption
- Reduce environmental pollution
- Increase public awareness about alternative energy

Project Specifications

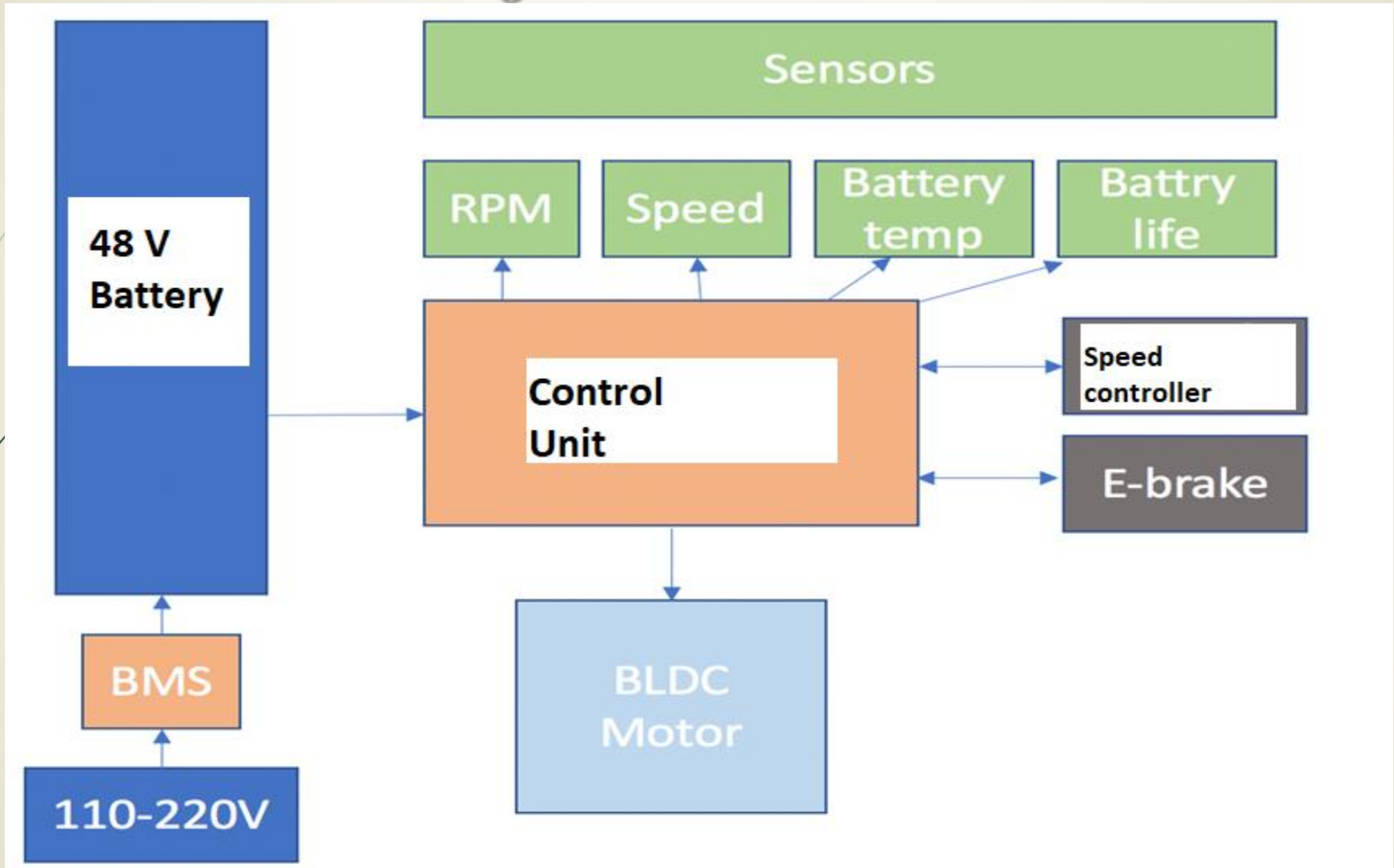
- **The main components of this project are motor, battery, battery management system BMS, control unit, display and throttle. These components will be divided into many subsystem groups.**

1. **Assumes battery power system 48-52 V, 12-14 Ah, 576-728Wh**
2. **DC rear hub motor 50 to 60 volt & 2-3 kw continues power**
3. **Measures power consumed and range while traveling by calculating the gears ratio, motor RPM.**
4. **Communicates (sends) data to display that shows the power consumption and battery life.**
5. **BMS to measure current and voltage needed during charging to avoid overheating.**
6. **Biomedical sensors such as heartbeat, temperature and blood pressure.**

Project Constraints & Engineering Standards

- Environmentally friendly
- Economic and low maintenance cost
- Easy and safe to use

Project Architecture

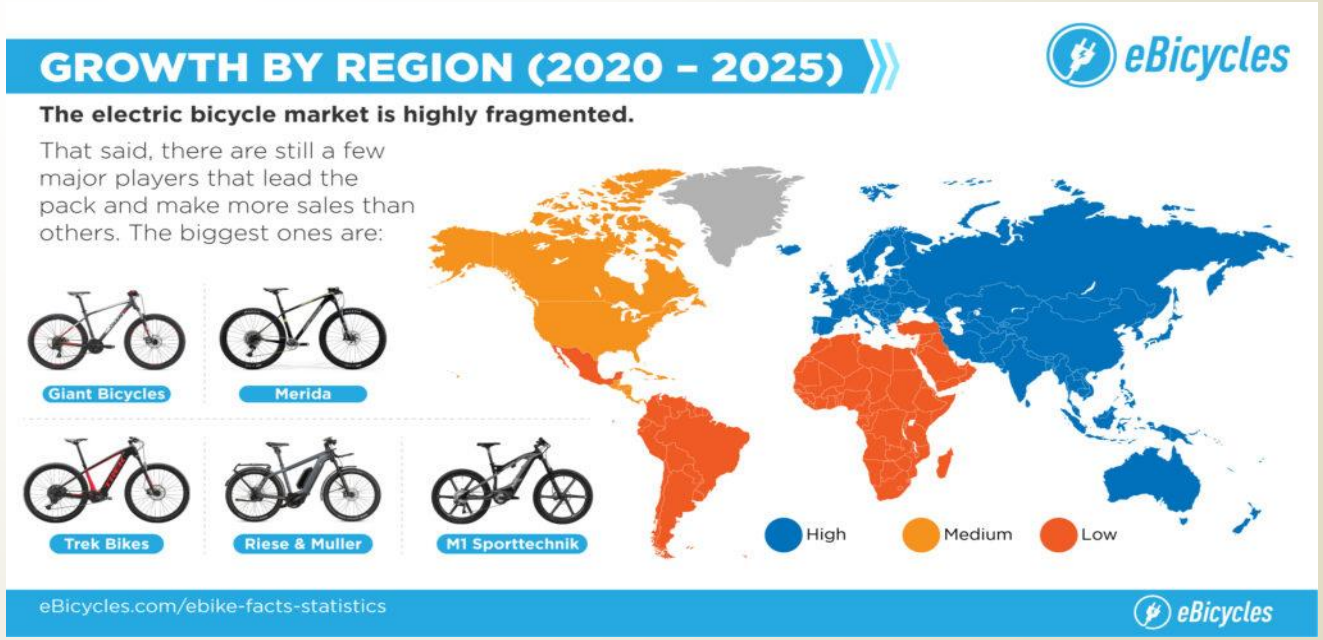


Planning

- Based on research and previous reports, this project is feasible.
- A decent percentage of parts were required to be ordered from outside but some were found locally.
- Testing could be done anywhere but preferably outdoors. A wall socket has to be provided to test the charging capabilities.
- Help has been provided by PMU instructors and faculty

Background

- The depletion of fossil fuel and increase of environmental pollution caused by internal combustion engine vehicles are big issues worldwide that need to be solved. One of promising solutions to address energy security and environmental pollution is utilization of electric vehicles. Electric bicycle is one of the electric vehicles attracting significant attention because of its many benefits. Many review papers showed potential of electric vehicles for wide application in future, but very few of them solely focused on electric bicycles



Design: Subsystems and Component Selection

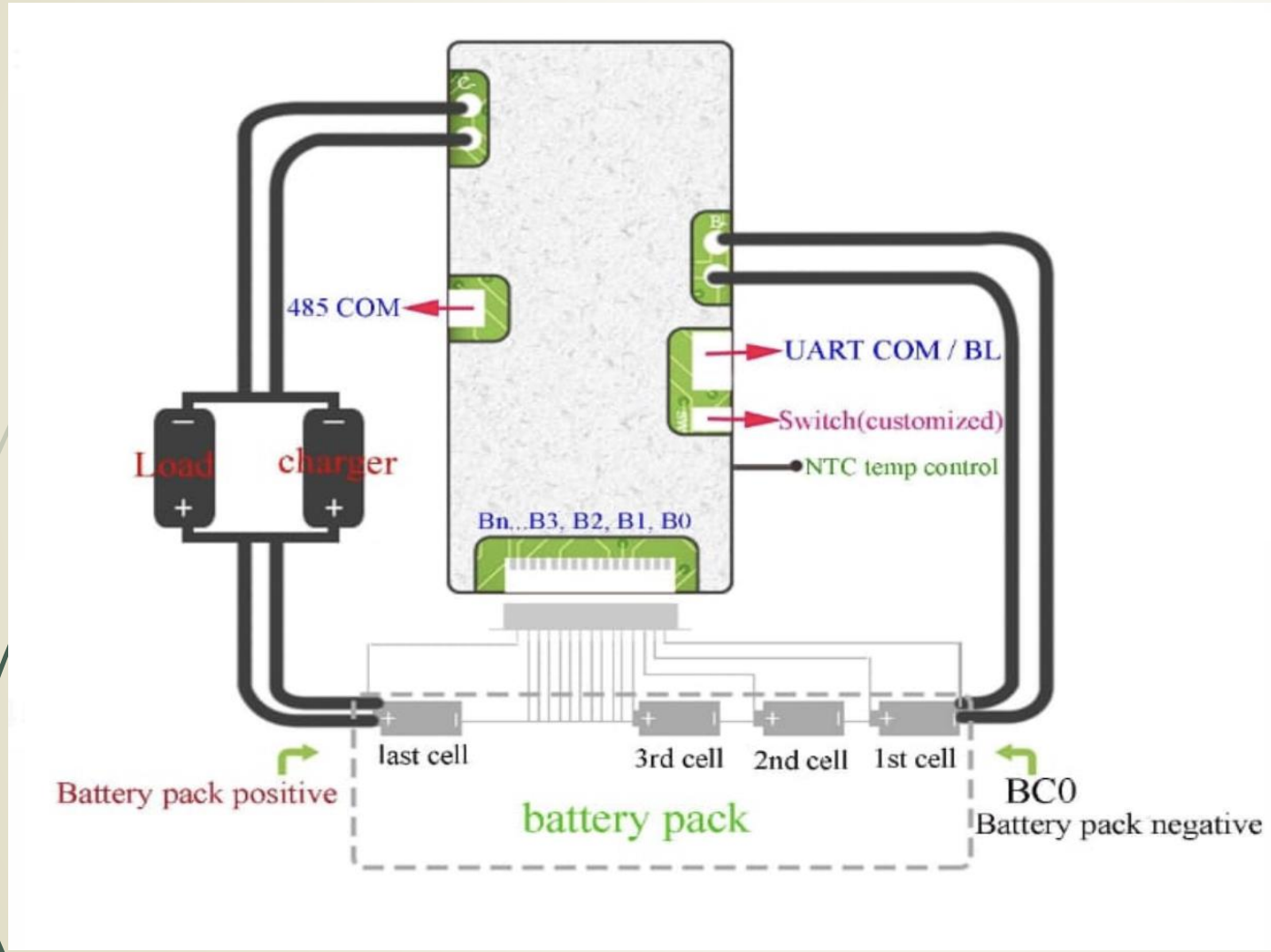
1- Power source Subsystem

- **Total of 52 cells of 3.6 V lithium-ion batteries**
- **Four batteries in parallel will make one group of 13**
- **Produce 48 V**
- **BMS will manage each group charging process**
- **Temperature sensor to monitor batteries overheating**

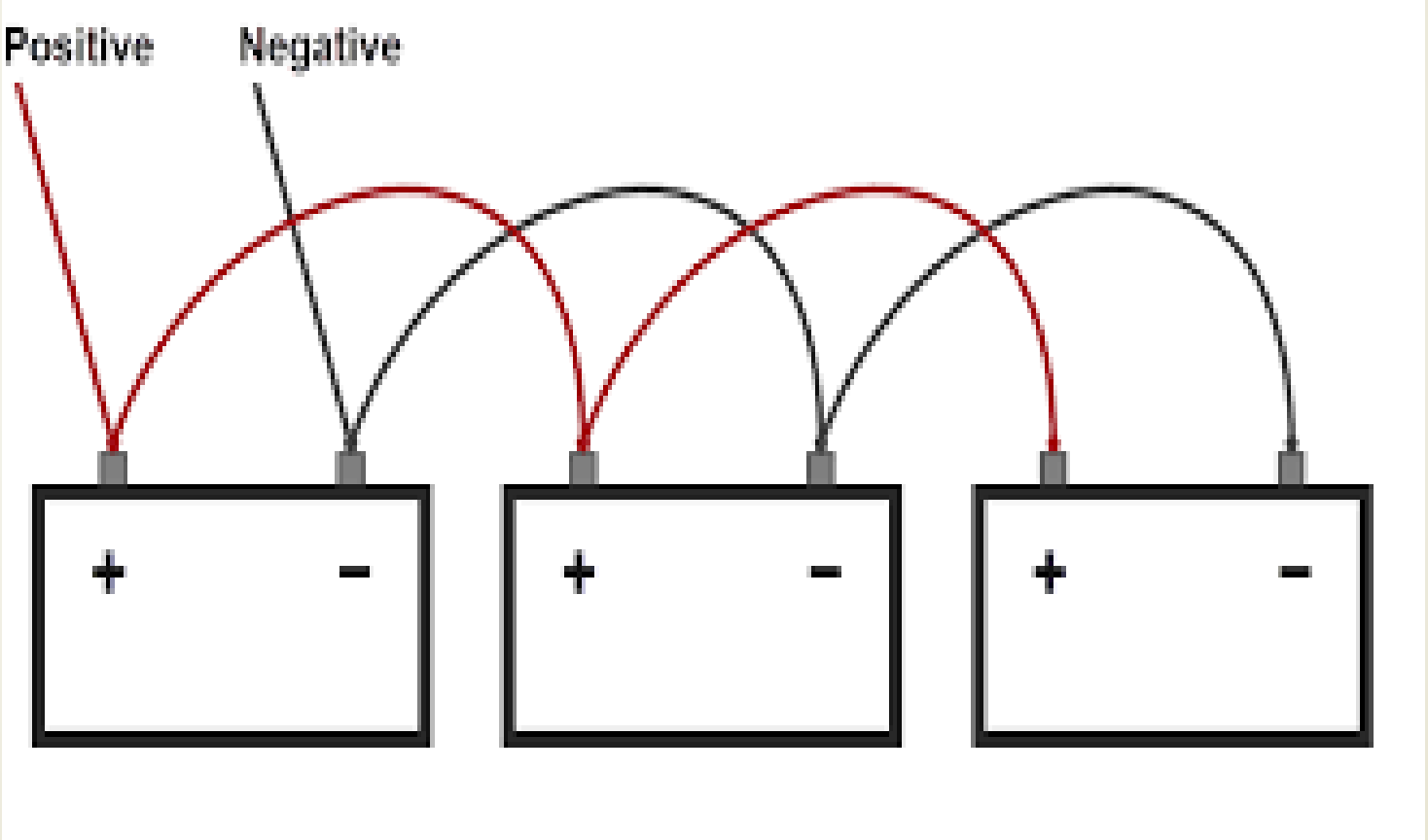
Design: Subsystem 1

- Battery testing
- Battery arrengement
- BMS programing, BT connection and LED installation

Design: Subsystem 1



Design: Subsystem 1



Design: Subsystem 1

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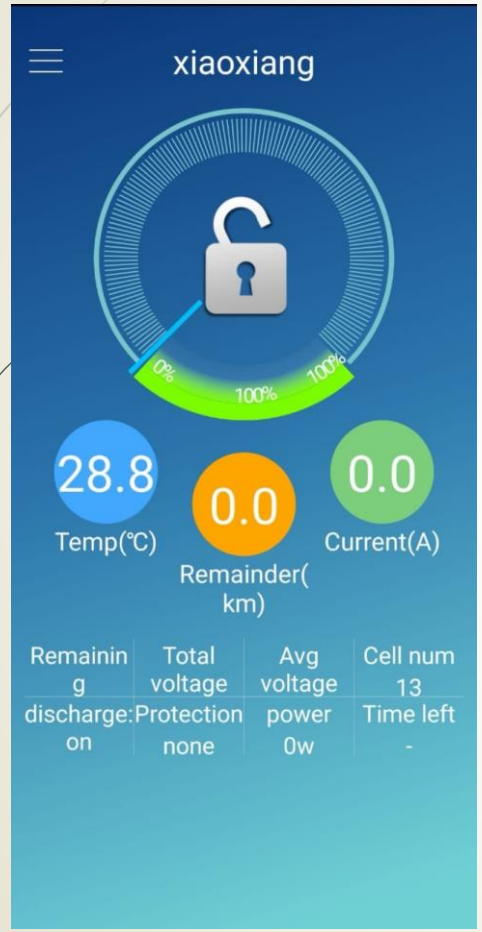
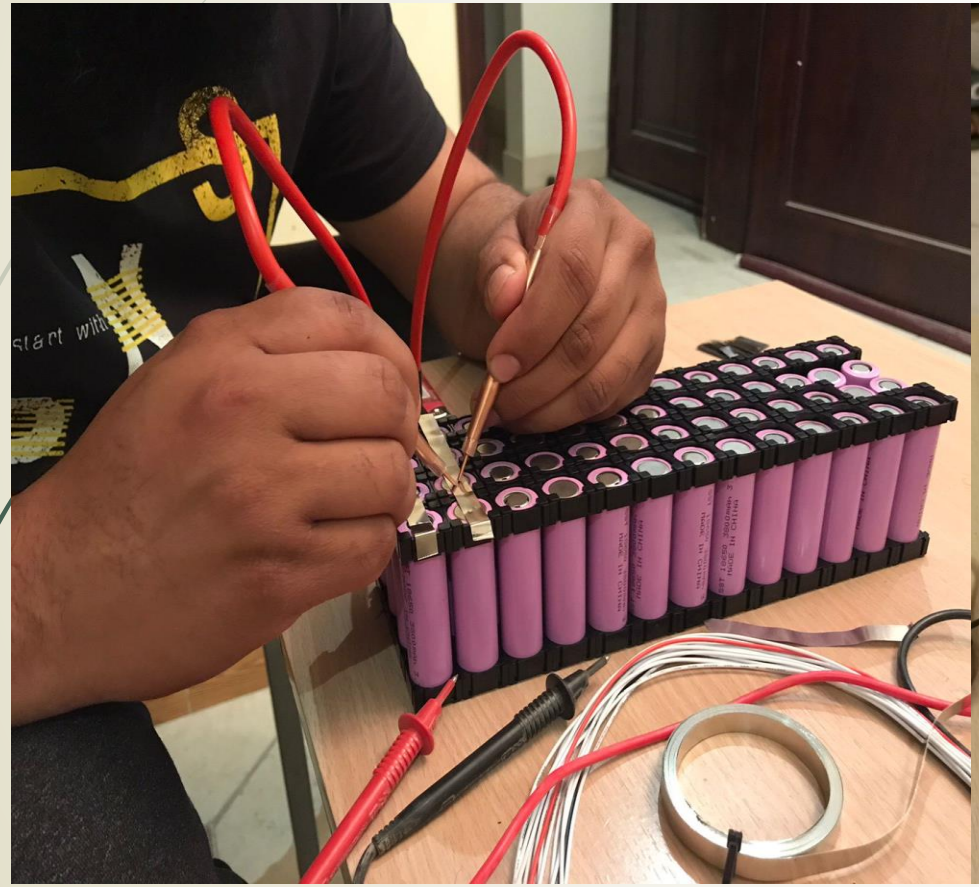
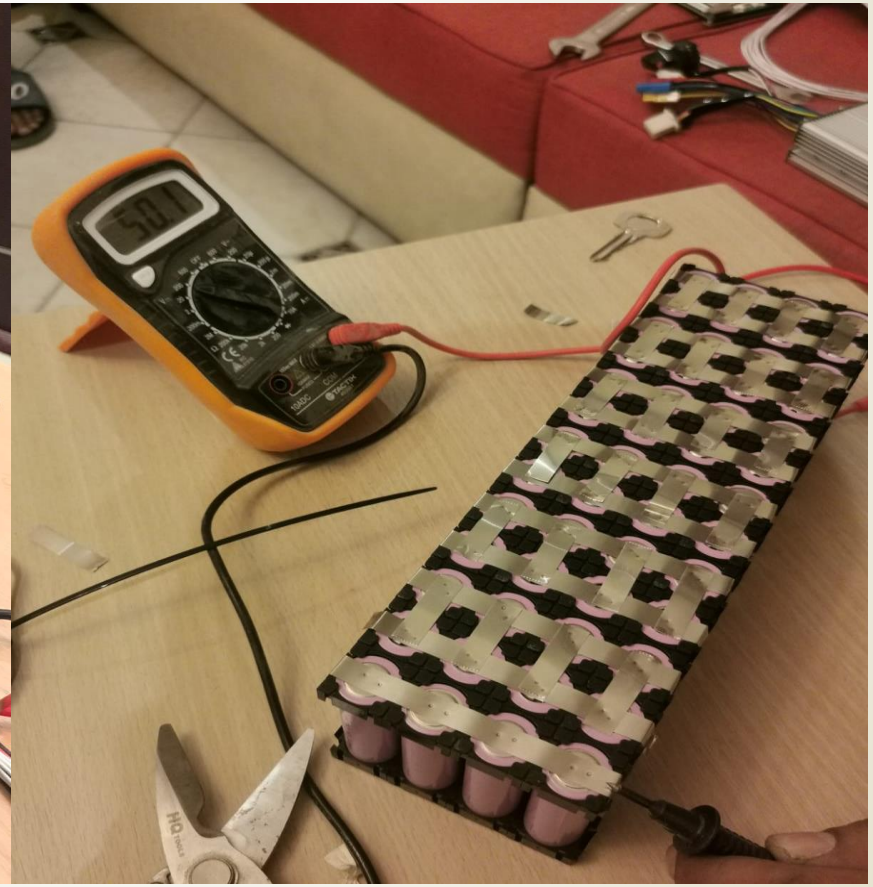
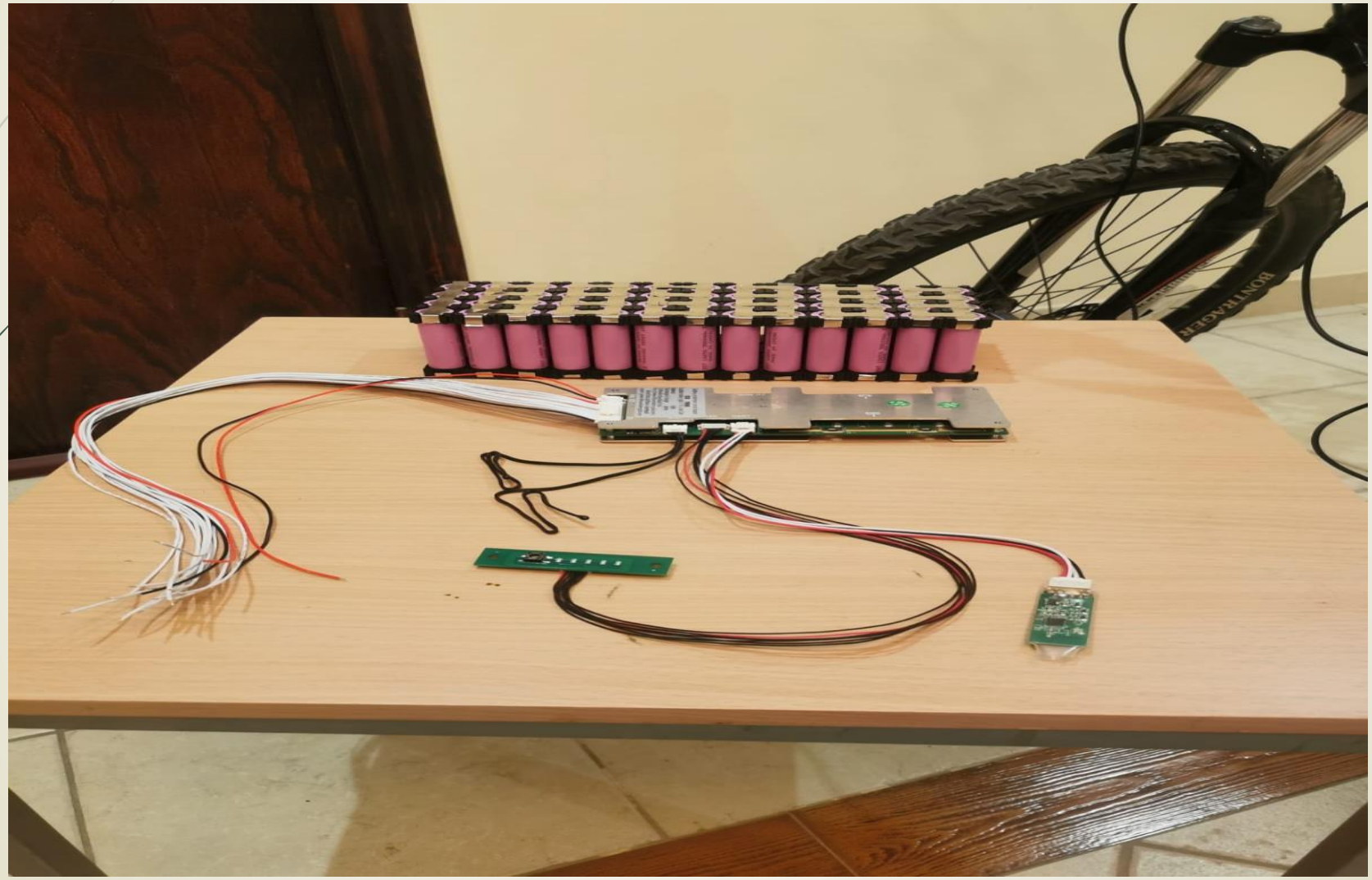


Design: Subsystem 1





Design: Subsystem 1



Design: Subsystem 1

1.1 Battery charging device

1. 5A Step Down Converter
2. BMS With Balance Charging
3. 24V Power Supply
4. Multimeter
5. Battery Status Indicator

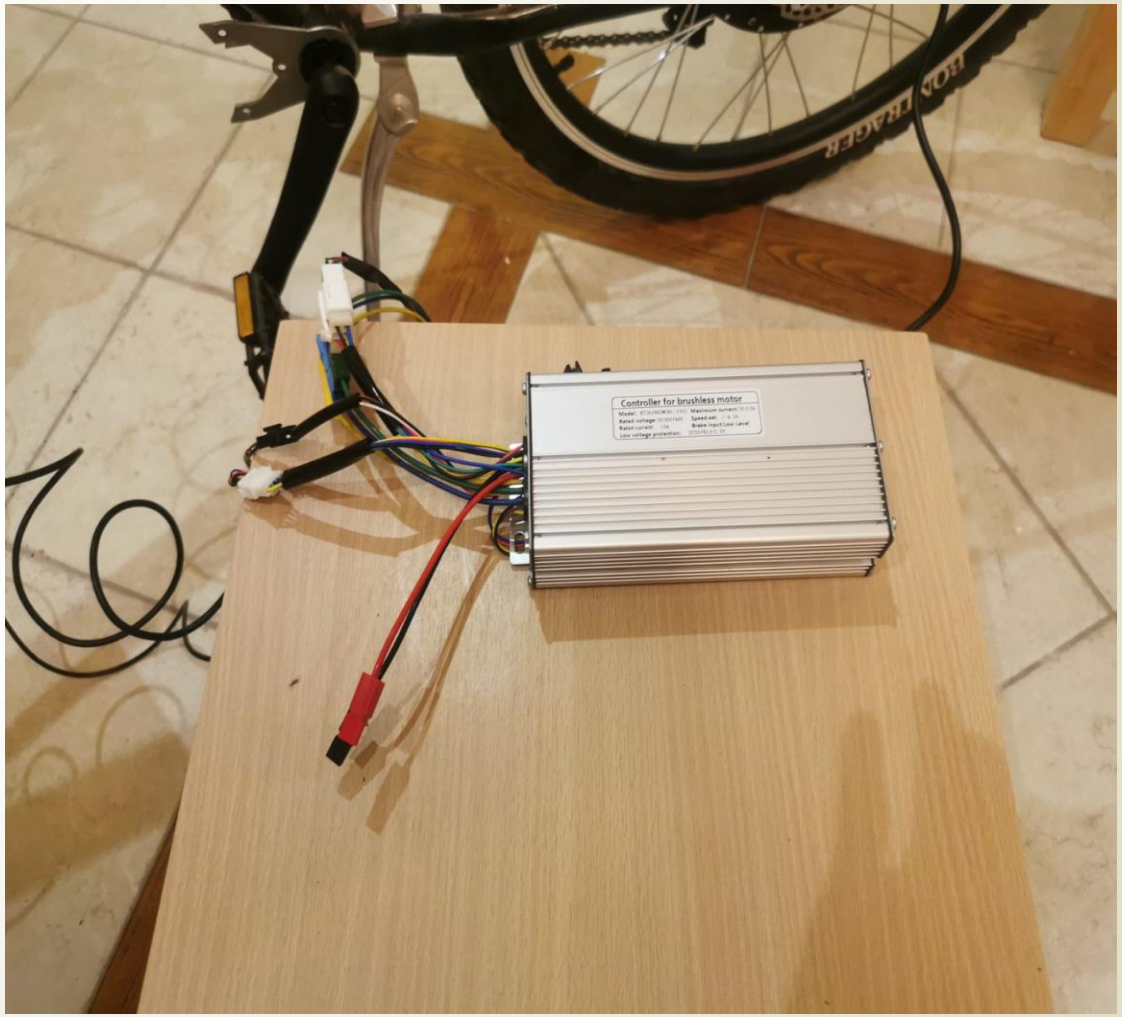
Design: Subsystems and Component Selection

2. **Unit Controller Subsystem**

- **Handle 48 V to 60 V and 15 A**
- **Received signal from accelerator**
- **Operate BLDC 48 V 1000 W motor**
- **E-brake assist**

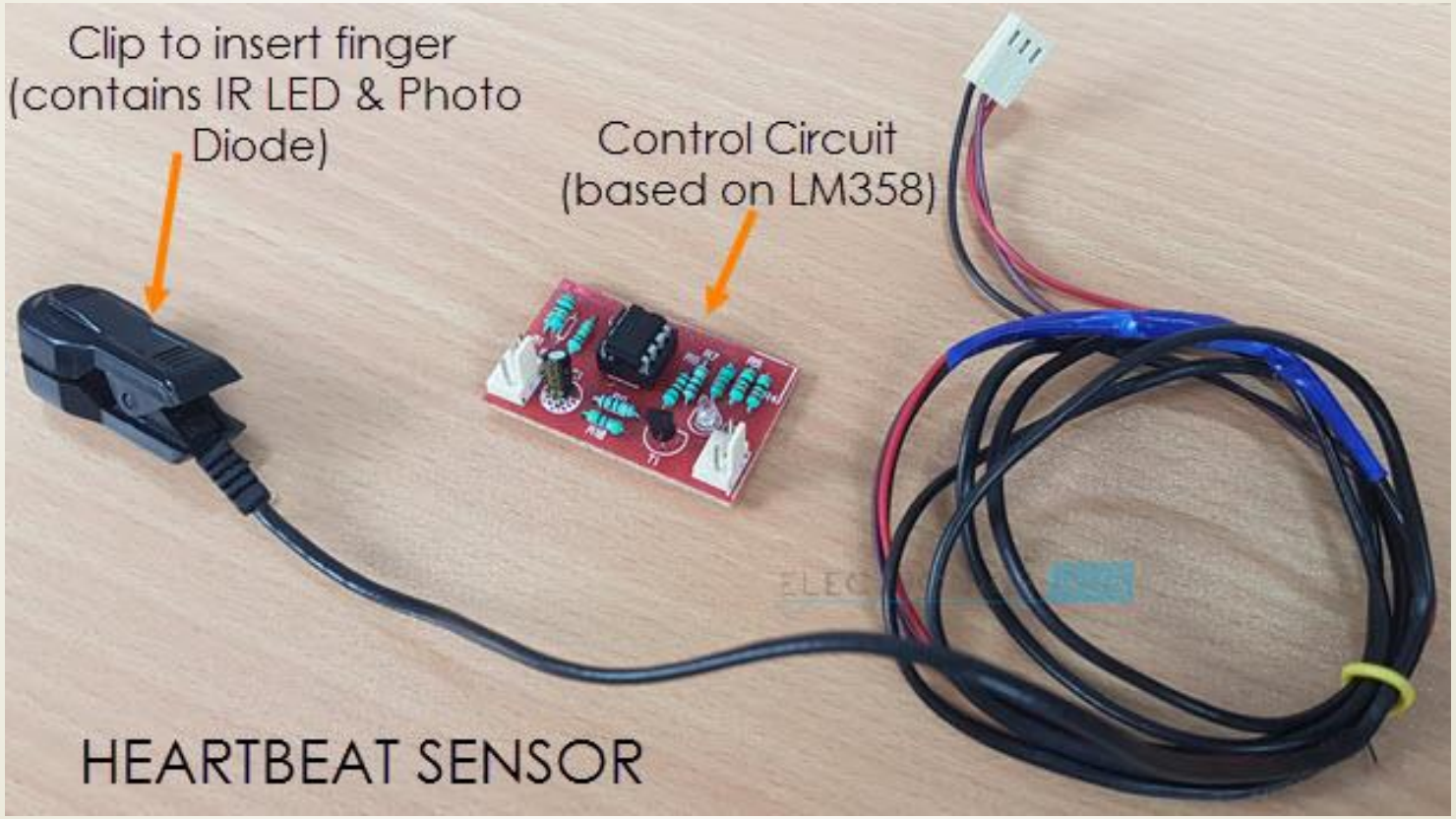
Design: Subsystem 2

- Throttle
- BLDC motor
- Screen
- E-brake assist
- Sensors



Design: Subsystem 2

Heartbeat sensor



Design: Subsystems and Component Selection

3. **Frame and design Subsystem**

- **Frame should handle the power and size of the motor**
- **Fabricated torque arm to absorb the spinning force**
- **Removable battery pack**

Design: Subsystem 3

- Frame torque arm
- Gears
- Brake

Design: Subsystem 3

- Frame torque arm
- Gears
- Brake

Design: Subsystem 3

Design: Testing

Subsystem 1

- **Battery total voltage**

Subsystem 3

- **Frame torque arm**
- **Brake system**
- **Gear selector**

Progress Report

Title: Efficient Electric Bicycle with Rechargea	Advisor: Dr. Adil Khan	Design II (ASSE 3)	Spring 2022
Abdullah Najjar #201401380 (AN)		Project PLAN & Progress	
Bader Basaffar #201501467 (BB)		ProgRpt No. 6	
Omar Alotaibi #201600098 (OA)		Plan updated (Date): May 17, 2022	
Ahmed Elgak #201601297 (AE)		Instructor: Dr. Sadiq Alhuwaidi	

ACTIVITY	PLAN START	PLAN DURATION	Assigned To	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Write a plan	1	1	ALL	4	1	100%
Ordering parts	2	6	BB	2	6	100%
receiving parts	3	8	BB	6		100%
Design subsystem 1	2	4	AN, BB	4		100%
Test subsystem 1	6	1	AN, BB			100%
design battery charger	5	2	OA, AE			90%
test battery charger	6	2	OA, AE			90%
design subsystem 2	7	3	OA, AE			100%
Test subsystem 2	7	4	OA, AE			100%
design subsystem 3	6	5	AN, BB			100%
Test subsystem 3	8	3	AN, BB			100%
connect subsystem 3 & 2	8	2	ALL			100%
connect subsystem 1 & 2	9	4	ALL			100%
project test	10	2	ALL			95%
Implement industrial design	10	1	ALL			90%
Prepapre final report	12	2	ALL			80%
Prepapre final presentation	12	2	ALL			100%
Prepare project demo	13	3	ALL			85%
Submit Rpt/PPT/Brochure/Video...etc.	14	2	ALL			100%

Period Highlight: 1 — Plan / Actual; Actual (beyond plan); % Complete (beyond plan)

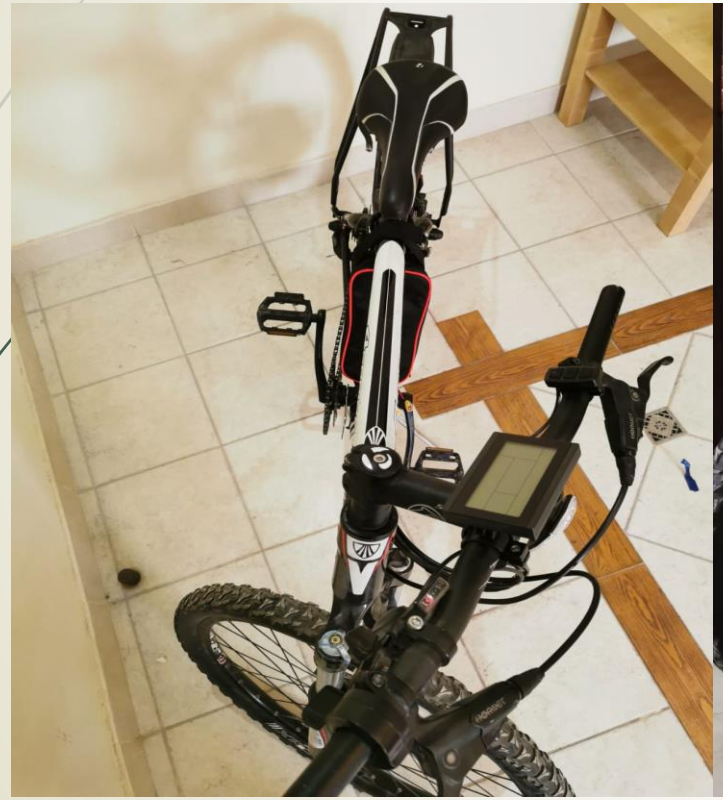
Periods (Weeks 1-15): 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Progress Details:

The project is practically complete and only minor adjustments have to parts that are considered secondary.

Issues (delay, etc.):

Work progress



Risk management

- Identify risks that may face your project and how to mitigate risks

	Source	Events	Threats	Response
1	**Battery depletion**	Total loss of power	Operational	Replacing the batteries
2	**PC/microcontroller**	Hard drive/memory failure	data and programs lost	Back up data on external memory or on cloud
3	**Team members**	Illness	Development/test delay	Delegation
4	**Covid-19**	Restriction	Quarantine	Online sources/ alternative
5	**Team members**	Work	Development/test delay	Delegation

Impact of Project

1. Improved physical health
2. Easier to ride
3. Better mental health
4. Great alternative to cars
5. Faster and safe
6. Economic transportation
7. Easy to park
8. Environmentally friendly

New Skills Acquired and Applied

1. Communication skills
2. Critical thinking
3. Working well in a team
4. Self-motivation
5. Being flexible
6. Time management skills
7. Electric soldering

Budget Estimate

No.	Description	Quantity	Unit Cost (SR)	Total Cost (SR)
1	DC motor	1	900	1200
2	Control units	2	150	350
3	Batteries	52	12	900
4	BMS	1	370	370
5	Display	1	50	50
6	Sensors (temperature, speed, blood pressure)	3	100	300
7	Speed Pedal	1	50	50
8	Spot welder	1	360	360
9	Step down converter	1	46	46
10	Laptop charger	1	100	100
				3,726

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Thank you for listening!

If you have any questions, please feel free to ask