Multi-Source Electric Cart

Group Members

Muhammad Abdullah	18I-1572
Hasher Naeem	18I-0765
Qazi Mansoor ul Haq	18I-0869

Project Supervisor

Dr. Muhammad Jafar

Department of Electrical Engineering

National University of Computer and Emerging Sciences, Islamabad

2022

Developer's Submission

"This report is being submitted to the Department of Electrical Engineering of the National University of Computer and Emerging Sciences in partial fulfillment of the requirements for the degree of BS in Electrical Engineering"

Developer's Declaration

"We take full responsibility for the project work conducted during the Final Year Project (FYP) titled **"Multi-Source Electric Cart"**. We solemnly declare that the project work presented in the FYP report is done solely by us with no significant help from any other person; however, small help wherever taken is duly acknowledged. We have also written the complete FYP report by ourselves. Moreover, we have not previously presented this FYP (or substantially similar project work) or any part of the thesis to any other degree-awarding institution in Pakistan or abroad.

We understand that the management of the Department of Electrical Engineering of the National University of Computer and Emerging Sciences has a zero-tolerance policy toward plagiarism. Therefore, we the author of the above-mentioned FYP report solemnly declare that no portion of our report has been plagiarized and any material used in the report from other sources is properly referenced. Moreover, the report does not contain any literal citing of more than 70 words (total) even by giving a reference unless we have obtained the written permission of the publisher to do so. Furthermore, the work presented in the report is our work and we have positively cited the related work of the other projects by clearly differentiating our work from their relevant work.

We further understand that if we are found guilty of any form of plagiarism in our FYP report even after our graduation, the University reserves the right to withdraw our BS degree. Moreover, the University will also have the right to publish our names on its website that keeps a record of the students who committed plagiarism in their FYP reports."

____________________	____________________	____________________
Muhammad Abdullah	Hasher Naeem	Qazi Mansoor ul Haq
BS(EE) 2018-01572	BS(EE) 2018-0765	BS(EE) 2018-0869

____

Certified by Supervisor

____

Verified by Plagiarism Cell Officer

Dated: __________

Table of Contents

Abstract

Food carts have been in our society since the 1950s. They are used by most of the lower-class members of the community as a source of income. The first ones were designed as push carts which required much effort by the vendor in pushing. Later, in the 1990s Tricycle carts were introduced to create ease for the vendor. However, when the vendor has to move to higher ground, he again has to push the tricycle to cover the distance. To further eliminate human effort these carts were integrated with motorbikes. Motorbikes are uneconomical due to rising fuel prices and are also contributing to pollution. To address these issues, we propose a solution that will be economical and environmentally friendly. The prototype (tricycle cart) will be driven by an electric motor making it an Electric Tricycle, an environment-friendly model.

Acknowledgments

The final year project "Multi-Source Hybrid Ice-Cream Cart" was successfully completed in the Final Year Project Lab of National University of Computer and Emerging Sciences (FAST-NUCES), Islamabad Campus under the Pakistan Engineering Council (PEC) Annual Award for Final Year Design Projects (FYDPs) for the year 2022-2023. The project was supervised by Dr. Muhammad Jafar.

We would like to express our sincere gratitude to our supervisor, Dr. Muhammad Jafar, for providing his invaluable guidance, comments, and suggestions throughout the course of this project and for constantly motivating us to work hard, and for the importance of group work.

We would also like to thank Dr. Muhammad Awais for his time and the practical suggestions he gave us throughout the year.

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Tables

Chapter 1 Introduction

This chapter discusses the introduction and background and a brief overview of the problem which we are going to solve.

1.1 Introduction and Background

The history of food carts goes back to the 1950s. [1] The individuals to use this care were and are still known as “Thailay Wala”. They were the first ones to use these carts as a source of income. Be they “*gol gappay*” or ice-cream vendors, food carts have been part of our culture for over seven decades. The introduction of Wall’s ice-cream tricycles in the 90s [2] further revolutionized the food cart industry.

The food carts were first introduced as *push carts*. The vendor had to push carts to cover the required distance to earn his daily bread. Clearly, this method requires a lot of effort from the individual. This increases the stress on the health of the individual who has to push heavy weights for long periods of the day over several years. Later *tricycle carts* were brought into the field which required pedaling. Pedaling somewhat reduces the effort of pushing but a major problem arises when the vendor has to drive to higher ground. Now pedaling, being more strenuous, the vendor has to push the tricycle cart again to cover the required distance. This fails the purpose of the tricycle cart. To further reduce the human effort in driving these carts, *bike carts* were introduced. A motorcycle was integrated into the front end of the cart. As fuel prices are increasing day by day, and prices of motorcycles are also rising making bike carts highly uneconomical. There is another problem, these motorcycles are a source of carbon emissions as well as noise pollution and thus are not friendly to the environment. *“The average motorcycle is 10 times more polluting per mile than a passenger car, light truck or SUV”*. [3] Due to these reasons more and more tricycles and push carts have been seen on the road.

Keeping all these problems in mind, we have developed the prototype of an electric tricycle cart. The cart will be driven by pedaling as well as with an electric vehicle mechanism thus making it a *Hybrid Tricycle*. This will be a more economical and environment-friendly solution as compared to bike carts. [4] This will enable the vendor to cover more distance with less human effort which is the main motivation for selecting the project.

1.2 Problem statement

Tricycle carts have been in our society since the 90s. These tricycle carts required pedaling which is better than push carts which were introduced back in the 1950s. A major problem arises when the vendor has to drive the tricycle cart up a hill. The vendor has to stop paddling and push the cart to cover higher grounds. Moreover, to reduce this effort, motorcycles were integrated into the cart but due to rising fuel prices, it is getting uneconomical day by day. These bike carts are a source of carbon emissions and noise, making them unfriendly to the environment. Our solution to it is to make the cart electric.

1.3 Literature review

Tawalbeh. [5] proposes a novel solar-powered portable car shade to eliminate the obstacles people faced while trying to find a shaded parking spot in the UAE, especially during summer. The proposed system aims at providing the needed car shading along with a power source to operate lights, electric stoves, and to charge power banks, in particular, during camping. The implementation of this project should decrease the petrol used for air conditioning and produce extra power to operate auxiliary appliances.

Kumar et al. [6], performed experimental studies on Electric Bike which has an alternative source of battery-operated cycle. They found that the design of E-bike was more efficient than normal bicycle. Electric bike was the hybridized so it was electrically operated and also pedal operated. Mahadik et al. [7], introduce the concept of electric bike. He converted the normal bicycle in to electrical one with an innovative approach. Charging of battery was provided by three ways i.e., by means of wall charging, solar charging, and by mechanical pedal. Main focus of the concept was on system architecture, operational concept and battery management.

Chapter 2 Solution Design & Implementation

This chapter discusses the complete design and implementation of the proposed cart. Section 2.1 discusses the block diagram and module specifications. The details of the flow chart are presented in section 2.2 whereas, Section 2.3 discusses the simulation model implemented in Proteus. Section 2.4 discusses the RFID security system for cart safety, whereas, Section 2.5 discusses the output values of the remaining charge of the battery. Section 2.6 discusses the application for tracking the location of the cart and nearby battery stations for replacing the draining battery. The hardware implementation is presented in Section 2.7.

2.1 Block Diagram

Figure 2.1 shows the complete block diagram of the project. The details of each block with related technical specifications are discussed below.

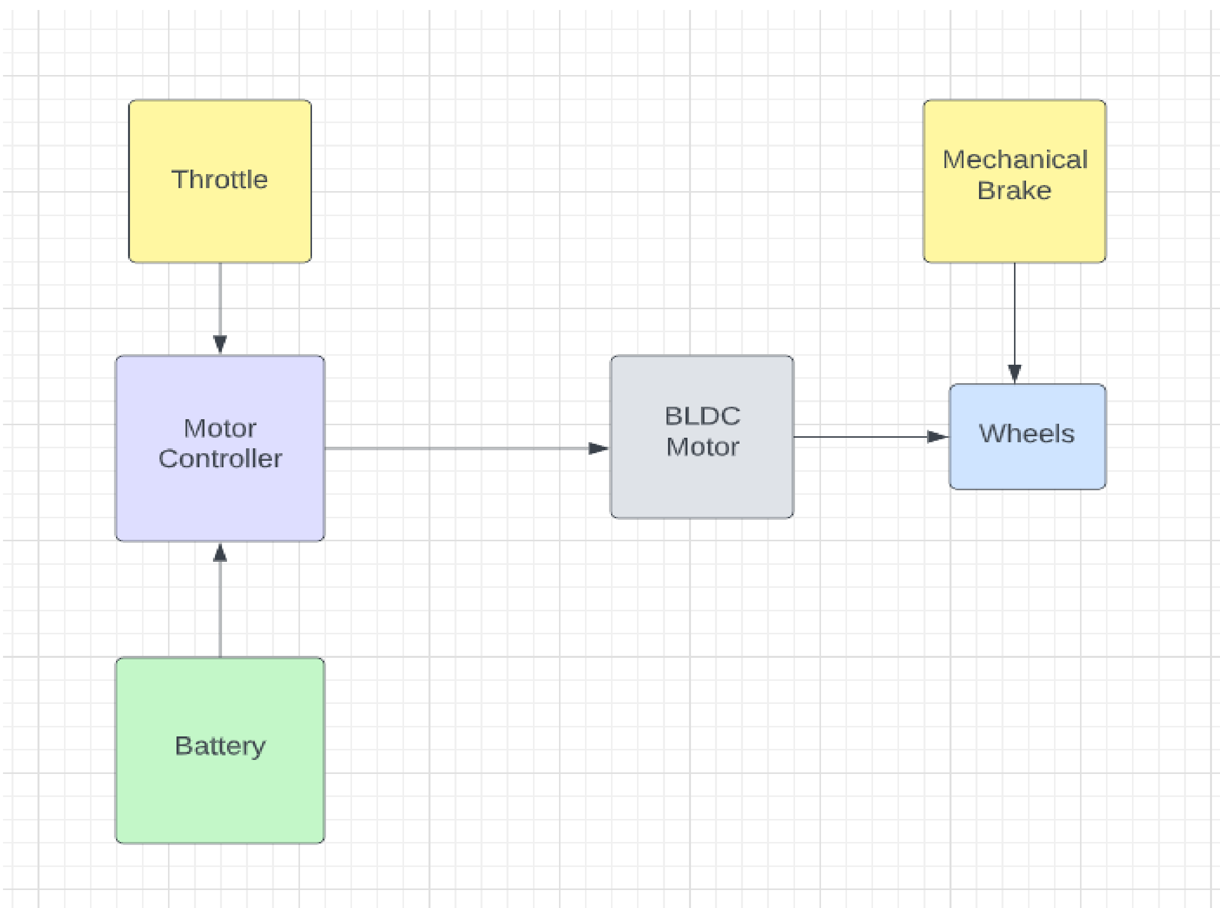

Figure 1: Block diagram of the mechanical system

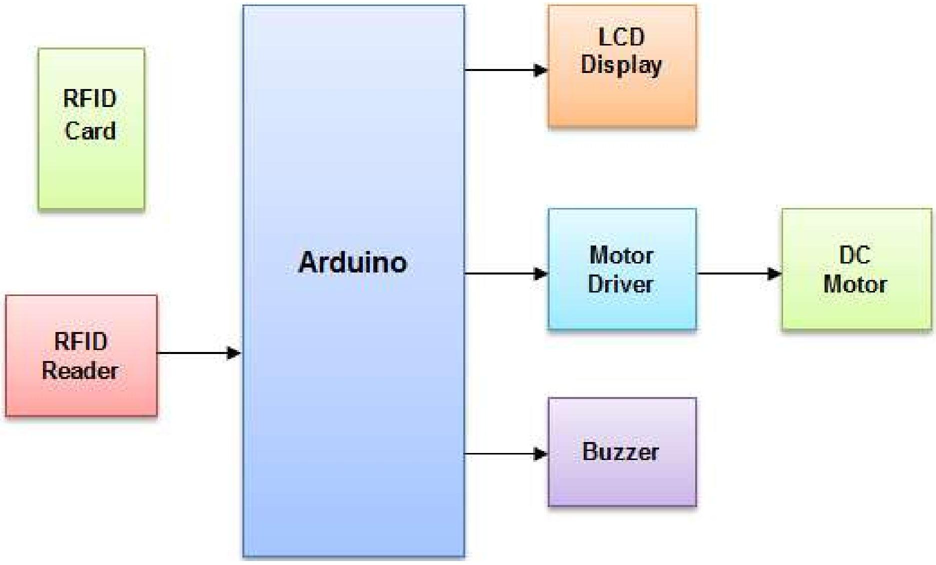

Figure 2: Block diagram of the RFID system

System Specifications

In this block diagram, we have shown the solar panel which will provide the desired voltage to the battery, The solar powered system will be at the charging stations. The motor controller is to take all the inputs from all the electric components (throttle, speed sensor, display, battery, motor, etc.) and then determines what should be signaled in return to them (motor, battery, display). The motor speed will be controlled by the throttle input. The braking system of the cart will be mechanical and we can use the pedal whenever needed. For the battery security we have added an Rfid based security system. It will be normally closed and when replacing the battery, the specific Rfid tag will be used to open the lock.

2.2 Flow Chart

Figure 2.3 shows the complete flow chart of the project. The details are discussed below.

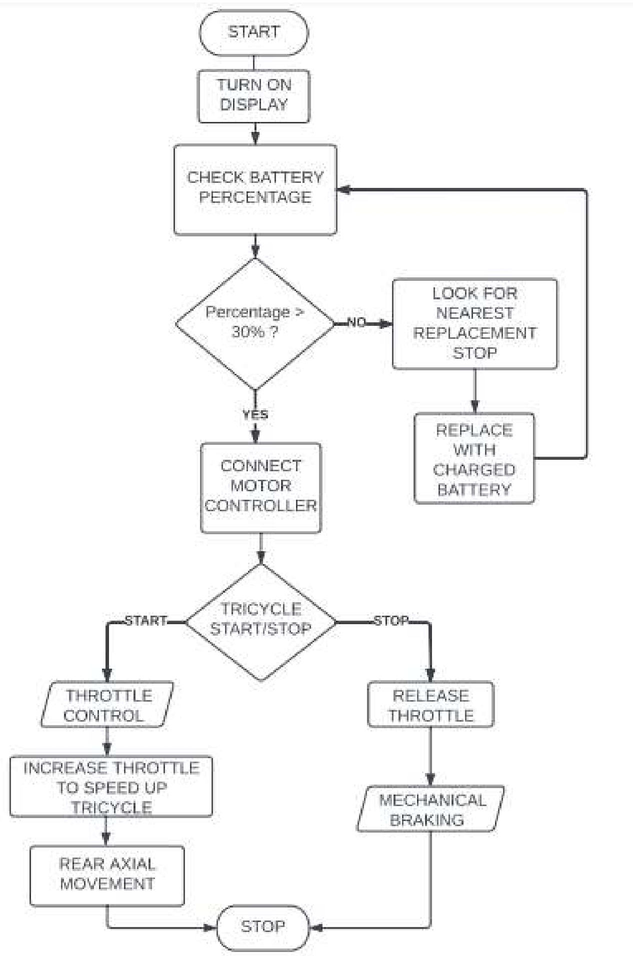

Figure 3: Flow chart of project

The Display will show all the values (Battery charging and Voltage). There are a number of Battery replacement stations from where charged battery will be replaced with discharged battery. The motor when turned ON will move the cartwheel and the speed of the motor will be controlled through the throttle (max speed 15km/h). When we have to stop the rotation of the wheel, we can apply the mechanical brake.

2.3 Proteus Simulation

The simulated model implemented in Proteus has a running motor circuitry

The motor is controlled by the duty cycle. As the duty cycle increases the speed of the motor will increase and vice versa.

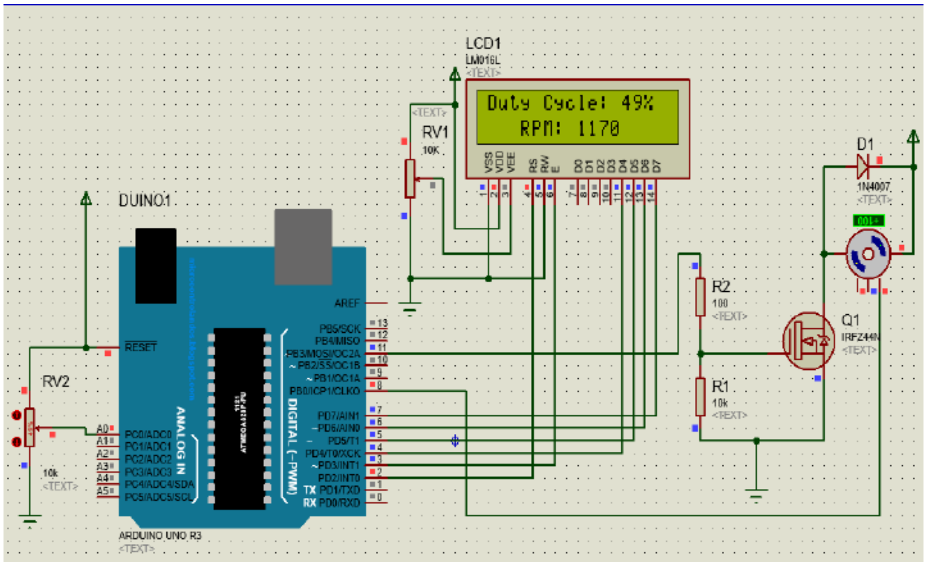

Figure 4: Simulated model of the project

The results obtained from the proteus simulation are enumerated in table 2.1

S. No	Duty Cycle (%)	Speed (rpm)
1.	49	1170
2.	67	930
3.	94	1230

Table 1: Results obtained from simulation of the proteus model

2.4 RFID Security System for the Cart

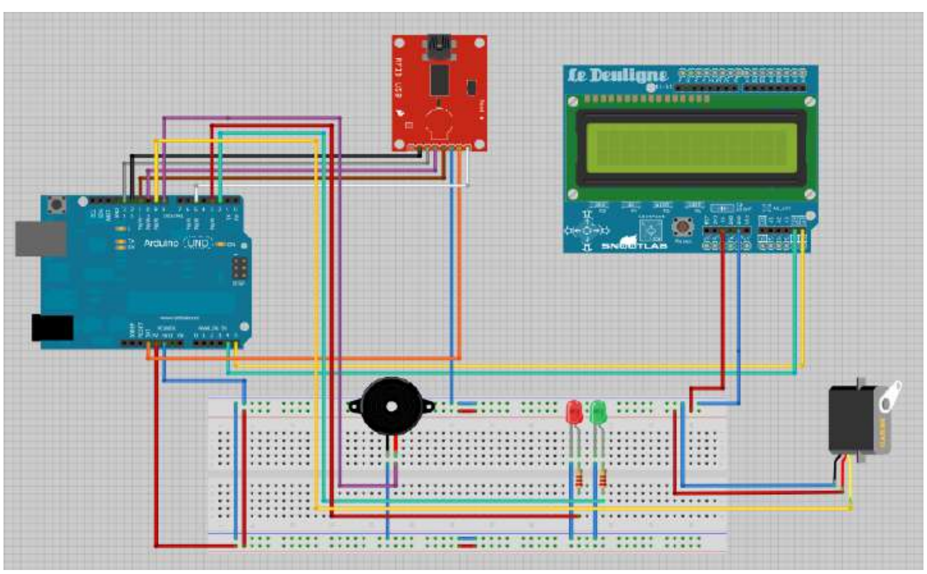

Figure 5: RFID system for the cart

2.5 Displaying Output Values for Remaining Battery Charge

Figure 6: Output values for remaining battery charge

2.6 Application for Tracking Location of the Cart and Nearby Battery Stations

We can add a new way point which will make a new pin on the map (blue) also the red map pin shows the location of charging stations and rider can also search for nearest station using the nearest station button. The data is then saved in the database which can be later accessed.

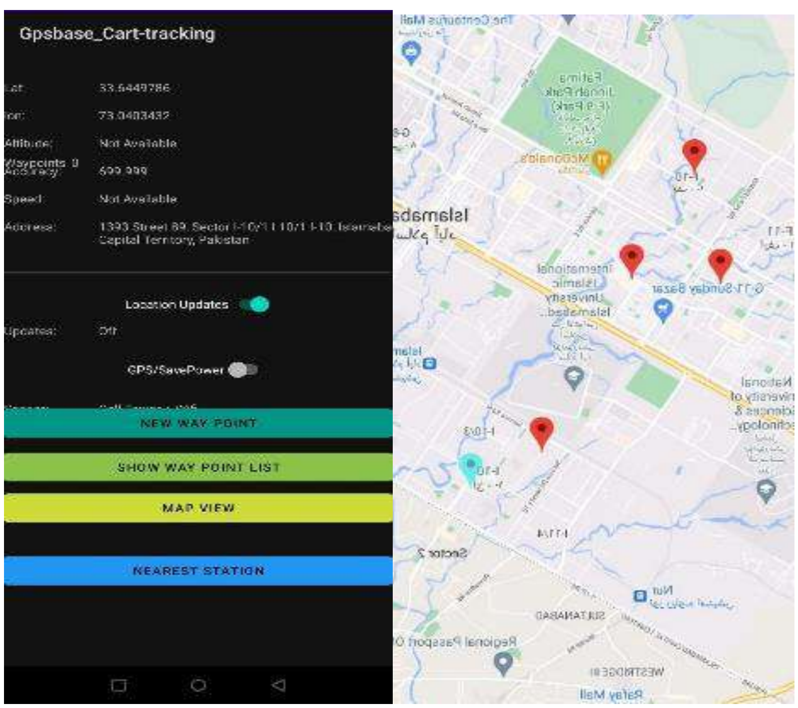

Figure 7: Application tracking the location of the cart and nearby battery stations

2.7 Hardware Implementation

Figure 8: Designed prototype

Chapter 3 Results and Recommendations

In this chapter, we'll show the calculations which prove that our electric cart is better in many ways than fuel carts. Section 3.1 discusses the calculations were done for proving that electric bikes are cheaper than the gasoline bikes over the period of 25 years. Then to prove it is environment friendly we have to show that less carbon emissions occur from electric bikes as compared to conventional gasoline bikes.

3.1 Economic Comparison of Gasoline and Electric Bikes

Gasoline Bikes:

Honda CD-70 price $= 106{,}900\ PKR$

The average distance covered daily $= 35\ km$

Distance covered in 25 years = $35 \times 330 \times 25 = 288{,}750\ km$

Bike engine price $= 12{,}500\ PKR$, it is replaced every 8-10 years, so it will be replaced twice.

Engine replacement future price (1st replacement) $= F = P(1+i)^n$

$$= 12{,}500(1+0.095)^8 = 25{,}835\ PKR$$

Engine replacement future price (2nd replacement) $= F = P(1+i)^n$

$$= 12{,}500(1+0.095)^{16} = 54{,}000\ PKR$$

Where $i = inflation\ rate\ in\ Pakistan = 9.5\%$. [8]

Oil change price for CD70 $= 700\ PKR$

Oil needs to be changed after every 2000 miles i.e., after every 4 months.

So, oil will change 3 times in a year.

Oil change in a year $= 700 \times 3 = 2100\ PKR$

So, total oil change in 25 years $= \Sigma[2100(1+i)^n] = 191{,}608\ PKR$

Where $i = inflation\ rate\ in\ Pakistan = 9.5\%$ and n varies from 0 to 24 indicating number of years.

Air filter price $= 150\ PKR$

Air filter changes after every year.

So, total air filter changes in 25 years $= \Sigma[150(1+i)^n] = 13{,}678\ PKR$

Where $i = inflation\ rate\ in\ Pakistan = 9.5\%$ and n varies from 0 to 24 indicating number of years.

The fuel average for CD70 $= 50\frac{km}{L}$

Total liters used in 25 years $= \frac{288{,}750}{50} = 5{,}775\ L$

Petrol price today $= 215\frac{PKR}{L}$

Petrol price is increasing day by day.

So, petrol price for 5,775 L $= 5{,}775 \times 215 = 1{,}241{,}625\ PKR$

Now, total price in 25 years = $(CD70 + Petrol + Engine\ replacement + Oil\ change + Air\ filter\ change)\ Price$

$$= 106{,}900 + 1{,}241{,}625 + 25{,}835 + 54{,}000 + 191{,}608 + 13{,}678 = 1{,}632{,}746\ PKR$$

Price per km $= \frac{Total\ Price}{Total\ distance\ covered} = \frac{1{,}632{,}746}{288{,}750} = 5.65\frac{PKR}{km}$

So, a gasoline bike costs $\mathbf{5.65\ PKR}$ for $\mathbf{1\ km}$.

Electric Bikes:

DC Motor has a lifetime of 10000 hours, so it is repaired every 10 years approximately. [7]

So, computing the Future Price of the motor in 25 years.

Motor Future Price (After 10 years) $= F = P(1+i)^n$

$$= 15{,}000(1+0.095)^{10} = 37{,}173\ PKR$$

Motor Future Price (After 20 years) $= F = P(1+i)^n$

$$= 15{,}000(1+0.095)^{20} = 92{,}124\ PKR$$

Where $i = inflation\ rate\ in\ Pakistan = 9.5\%$

The lifetime of a lithium-ion battery if taken care of is 5 to 6 years. [9]

So, we find the Future Price of the battery in the next 25 years.

Future Price of Battery (After 6 years) $= F = P(1+i)^n$

$$= 55{,}000(1+0.095)^6 = 94{,}808\ PKR$$

Future Price of Battery (After 12 years) $= F = P(1+i)^n$

$$= 55{,}000(1+0.095)^{12} = 163{,}430\ PKR$$

Future Price of Battery (After 18 years) $= F = P(1+i)^n$

$$= 55{,}000(1+0.095)^{18} = 281{,}719\ PKR$$

As we've shown that the proposed budget in Table 3.1 that it is 115000 PKR

Total Price $= Budget + Future\ Price\ of\ Battery + Future\ Price\ of\ Motor$

$$= 115{,}000 + 37{,}173 + 92{,}124 + 539{,}957 = 784{,}254\ PKR$$

Distance covered for an average speed of 7 km/h in 5 hours

$$= 5 \times 7 = 35\ km$$

Distance covered in 25 years = $35 \times 330 \times 25 = 288{,}750\ km$

Price per km $= \frac{784{,}254}{288{,}750} = 2.71\frac{PKR}{km}$

So, an electric bike cost $\mathbf{2.71\ PKR}$ for $\mathbf{1\ km}$.

Comparison:

Factor $= 1 - \frac{Price\ per\ km\ for\ Electric\ Bike}{Price\ per\ km\ for\ Gasoline\ Bike}$

$$= 1 - \frac{2.71}{5.65} = 0.52.$$

So, we see that electric bike is 52% better than gasoline bike in terms of economy.

Budget:

We have proposed the following budget for the companies:

S. No	Items	Price/Unit (PKR)	Units	Price (PKR)
1.	Tricycle Cart	40,000	1	40,000
2.	48V 500W DC Motor Kit	15,000	1	15,000
3.	48V 50Ah Lithium-Ion Battery	55,000	1	55,000
4.	Others	5,000	1	5,000
	The total cost of the project			115,000

Table 2: Proposed budget

But we got the budget approved for the lead acid battery and the funding is given by Ignite National Technology Fund.

S. No	Items	Price/Unit (PKR)	Units	Price (PKR)
1.	Tricycle Cart	40,000	1	40,000
2.	48V 500W DC Motor Kit	15,000	1	15,000
3.	48V 7Ah Lead-Acid Battery	20,000	1	20,000
4.	Others	5,000	1	5,000
	The total cost of the project			80,000

Table 3: Actual budget

3.2 Comparison of Carbon Emissions by Gasoline and Electric Bikes

Shifting bikes to electric will help reduce CO_2 in the atmosphere. Now let's have a deep look at how much CO_2 is reduced.

CO_2 Emissions by Gasoline Bikes:

World CO_2 emissions in 2020 $= 35500$ million tonnes. [10]

Total CO_2 emissions by Pakistan in 2020 $= 234.75$ million tonnes. [11]

That is about 0.67% of global CO2 emissions.

25.6% of CO_2 emissions in Pakistan are through the transport sector. [12]

So, total CO_2 emissions by the transport sector in Pakistan

$$= 234.75 \times 25.6\% = 60 \text{ million tonnes.}$$

Total Vehicles in Pakistan according to 2020 $= 6{,}628{,}063$. [13]

So, CO_2 emissions $= \frac{60{,}000{,}000}{6{,}628{,}063} = 9$ tonnes/vehicle (lifetime).

Total number of bikes in Pakistan $= 4{,}838{,}486$. [14]

Total CO_2 emissions by bikes $= 4{,}838{,}486 \times 9 = 43.54$ million tonnes.

This means that gasoline bikes emit about 43.54 million tonnes of CO_2 into the atmosphere.

CO_2 Emissions by Electric Bikes:

Electric bikes don't emit CO_2 while running but the manufacturing of lithium-ion batteries, that are used in them, may result in CO_2 emissions.

If the energy source while manufacturing batteries is renewable, then there would not be CO_2 emissions.

Pakistan imports most of its li-on batteries from China. [15]

And in China, batteries are manufactured by coal and petroleum i.e., non-renewable sources of energy, which results in CO_2 emissions.

Our li-on battery pack $= \frac{48\text{V} \times 50\text{Ah}}{1000} = 2.4\ \text{kWh}$.

CO_2 emissions in manufacturing li-on batteries $= 0.14\ \text{tonnes/kWh}$. [16]

So, for a $2.4\ \text{kWh}$ battery, CO_2 emissions $= 0.14 \times 2.4 = 0.336\ \text{tonnes}$.

Now, for all bikes in Pakistan, CO_2 emissions

$$= 0.336 \times 4{,}838{,}486 = 1{,}625{,}731\ \text{tonnes}.$$

So, total CO_2 emissions in the manufacturing of li-on batteries for Pakistan would be about 1.62 million tonnes.

Comparison:

Factor $= 1 - \frac{\text{CO2 Emissions by Electric Bikes}}{\text{CO2 Emissions by Gasoline Bikes}} = 1 - \frac{1.62\ \textit{million tonnes}}{43.54\ \textit{million tonnes}} = 0.96$.

So, we see that electric bikes are 96% more better than gasoline bikes in terms of CO_2 emissions.

Global Impact:

It will save the atmosphere from $43.54 - 1.62 = 41.92$ million tonnes of CO_2.

So, total CO_2 emissions from Pakistan after switching bikes to electric

$$= 234.75 - 41.92 = 193\ \text{million tonnes}.$$

Global CO_2 emissions share from Pakistan would get to $= \frac{193\ \text{million tonnes}}{35000\ \text{million tonnes}} = 0.54\%$.

Which is very less than the current global share of 0.67%. [11]

3.3 Product Commercialization / Future Work

It is not a product but rather a solution that will be proposed to the companies. We have removed the regenerative braking and the cost can be replaced by upgrading the battery. There will be different battery charging stations around the map from where we can replace the battery of the tricycle cart. We can monitor the charging, location, range, and time traveled on the cart through a mobile application. Mounting the solar panel on the roof can lead to theft and low power output so we have proposed the above solution for a better and more efficient working model.

Appendix-A: Battery Level, Gear Ratio, Torque and Speed

A-1: Battery Level

	Full Load	Average Load
Battery Backup	3.6 hr.	7.2 hr.
Range of the Battery	21 km	42 km
Discharge Time	After 3 hr.	After 6 hr.

Table 4: Battery Level

A-2: Gear Ratio, Torque, and Speed

Gear ratio $= \frac{T1}{T2} = \frac{14}{38} = 0.368$

T1 $=$ input gear teeth number, T2 $=$ output gear teeth number. So, it has a larger gear ratio

Higher ratios (with a lower numerical value) give better torque/acceleration and vice versa

The maximum speed measured for our cart with load was 450 rpm.

Torque (N.m) $= 9.5488\ x \frac{Power(kW)}{Actual\ Speed(RPM)}$

$$= 9.5488\ x \frac{0.5(kW)}{450(RPM)} = 10.61\ Nm$$

Appendix-B: Project Codes

B-1 Tracking Cart and Stations' Location

```
package com.multisourcecart.gpsbase_cart_tracking;

import androidx.fragment.app.FragmentActivity;

import android.location.Location;
import android.os.Bundle;

import com.google.android.gms.maps.CameraUpdateFactory;
import com.google.android.gms.maps.GoogleMap;
import com.google.android.gms.maps.OnMapReadyCallback;
import com.google.android.gms.maps.SupportMapFragment;
import com.google.android.gms.maps.model.BitmapDescriptorFactory;
import com.google.android.gms.maps.model.LatLng;
import com.google.android.gms.maps.model.Marker;
import com.google.android.gms.maps.model.MarkerOptions;
import
com.multisourcecart.gpsbase_cart_tracking.databinding.ActivityMapsBinding;

import java.util.List;

public class MapsActivity extends FragmentActivity implements
OnMapReadyCallback {
List<Location>savedLocations;
List<Location>station_locations;
    private GoogleMap mMap;
    private ActivityMapsBinding binding;
    public Location targetLocation = new Location("");//provider name is
unnecessary
    public Location targetLocation1 = new Location("");//provider name is
unnecessary
    public Location targetLocation2 = new Location("");//provider name is
unnecessary
    public Location targetLocation3 = new Location("");//provider name is
unnecessary

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        binding = ActivityMapsBinding.inflate(getLayoutInflater());
        setContentView(binding.getRoot());
//          33.64851872605742, 73.02051412552441
        //================Stations-=====================
        targetLocation.setLatitude(33.67537025006633d);//your coords of
course
        targetLocation.setLongitude(73.00030001911847d);


        targetLocation1.setLatitude(33.676121559312264d);//your coords of
course
```

```
        targetLocation1.setLongitude(73.01449620281413d);

//        #33.691667277287394, 73.0044955324953
        targetLocation2.setLatitude(33.691667277287394d);//your coords of
course
        targetLocation2.setLongitude(73.0044955324953d);

//        33.650378566029076, 73.02897686537588
        targetLocation3.setLatitude(33.650378566029076d);//your coords of
course
        targetLocation3.setLongitude(73.02897686537588d);

        // Obtain the SupportMapFragment and get notified when the map is
ready to be used.
        SupportMapFragment mapFragment = (SupportMapFragment)
getSupportFragmentManager()
                .findFragmentById(R.id.map);
        mapFragment.getMapAsync(this);
        MyAppliaction myAppliaction=(MyAppliaction)getApplicationContext();
        savedLocations=myAppliaction.getMyLocations();
    }

    /**
     * Manipulates the map once available.
     * This callback is triggered when the map is ready to be used.
     * This is where we can add markers or lines, add listeners or move the
camera. In this case,
     * we just add a marker near Sydney, Australia.
     * If Google Play services is not installed on the device, the user will
be prompted to install
     * it inside the SupportMapFragment. This method will only be triggered
once the user has
     * installed Google Play services and returned to the app.
     */
    @Override
    public void onMapReady(GoogleMap googleMap) {
        mMap = googleMap;

        // Add a marker in Sydney and move the camera
        LatLng sydney = new LatLng(33.68941241825203, 73.0244727410369);
        /*mMap.addMarker(new MarkerOptions().position(sydney).title("Marker
in Sydney"));*/
//        mMap.moveCamera(CameraUpdateFactory.newLatLng(sydney));
        for (Location location:savedLocations
            ) {
            LatLng latLng= new
LatLng(location.getLatitude(),location.getLongitude());
            MarkerOptions markerOptions = new MarkerOptions();
            markerOptions.position(latLng);
            markerOptions.title("Lat : " + location.getLatitude()+"Log : " +
location.getLongitude());

markerOptions.icon(BitmapDescriptorFactory.defaultMarker(BitmapDescriptorFac
tory.HUE_CYAN)).alpha(0.7f);
            mMap.addMarker(markerOptions);
          //mMap.moveCamera(CameraUpdateFactory.newLatLng (latLng));
        };
```

```
        LatLng latLng= new
LatLng(targetLocation.getLatitude(),targetLocation.getLongitude());
        MarkerOptions markerOptions = new MarkerOptions();
        markerOptions.position(latLng);
        markerOptions.title("Lat : " + targetLocation.getLatitude()+"Log : "
+ targetLocation.getLongitude());
        mMap.addMarker(markerOptions);

        latLng= new
LatLng(targetLocation1.getLatitude(),targetLocation1.getLongitude());
        markerOptions = new MarkerOptions();
        markerOptions.position(latLng);
        markerOptions.title("Lat : " + targetLocation1.getLatitude()+"Log :
" + targetLocation1.getLongitude());
        mMap.addMarker(markerOptions);

        latLng= new
LatLng(targetLocation2.getLatitude(),targetLocation2.getLongitude());
        markerOptions = new MarkerOptions();
        markerOptions.position(latLng);
        markerOptions.title("Lat : " + targetLocation2.getLatitude()+"Log :
" + targetLocation2.getLongitude());
        mMap.addMarker(markerOptions);

        latLng= new
LatLng(targetLocation3.getLatitude(),targetLocation3.getLongitude());
        markerOptions = new MarkerOptions();
        markerOptions.position(latLng);
        markerOptions.title("Lat : " + targetLocation3.getLatitude()+"Log :
" + targetLocation3.getLongitude());
        mMap.addMarker(markerOptions);
    }
}
```

B-2 RFID System

```
#include <SPI.h>
#include <MFRC522.h>
#include <Servo.h>

#define SS_PIN    10
#define RST_PIN   9
#define SERVO_PIN A5

MFRC522 rfid(SS_PIN, RST_PIN);
Servo servo;

byte authorizedUID1[4] = {0x37, 0x09, 0xAB, 0x29};
byte authorizedUID2[4] = {0x61, 0x2B, 0x3D, 0xD9};

int angle = 0; // the current angle of servo motor
```

```
void setup() {
Serial.begin(9600);
SPI.begin(); // init SPI bus
rfid.PCD_Init(); // init MFRC522
servo.attach(SERVO_PIN);
servo.write(angle); // rotate servo motor to 0°

Serial.println("Tap RFID/NFC Tag on reader");
}

void loop() {
if (rfid.PICC_IsNewCardPresent()) {// new tag is available
if (rfid.PICC_ReadCardSerial()) {// NUID has been readied
MFRC522::PICC_Type piccType = rfid.PICC_GetType(rfid.uid.sak);

if (rfid.uid.uidByte[0] == authorizedUID1[0] &&
rfid.uid.uidByte[1] == authorizedUID1[1] &&
rfid.uid.uidByte[2] == authorizedUID1[2] &&
rfid.uid.uidByte[3] == authorizedUID1[3] ) {
Serial.println("Authorized Tag 1");
changeServo();
} else if (rfid.uid.uidByte[0] == authorizedUID2[0] &&
rfid.uid.uidByte[1] == authorizedUID2[1] &&
rfid.uid.uidByte[2] == authorizedUID2[2] &&
rfid.uid.uidByte[3] == authorizedUID2[3] ) {
Serial.println("Authorized Tag 2");
changeServo();
} else {
Serial.print("Unauthorized Tag with UID:");
for (int i = 0; i < rfid.uid.size; i++) {
Serial.print(rfid.uid.uidByte[i] < 0x10 ? " 0": " ");
Serial.print(rfid.uid.uidByte[i], HEX);
}
Serial.println();
}

rfid.PICC_HaltA(); // halt PICC
rfid.PCD_StopCrypto1(); // stop encryption on PCD
}
}
}

void changeServo() {
// change the angle of the servo motor
```

```
if (angle == 0)
angle = 90;
else //if (angle == 90)
angle = 0;

// control servo motor according to the angle
servo.write(angle);
Serial.print("Rotate Servo Motor to ");
Serial.print(angle);
Serial.println("°");
}
```

Bibliography

[1] O.Alavi, "The resurgence of the food cart," *The News International,* no. TNS, 2021.

[2] Unilever, "Wall's," 2022.

[3] C. Squatriglia, "Motorcycles Pollute More Than SUVs," *Wired,* 2008.

[4] P. A. Matey, "Design and fabrication of electric bike," *International Journal of Mechanical Engineering and Technology,* 2017.

[5] M. Tawalbeh, "Life cycle analysis for solar powered portable car shade," *Advances in Science and Engineering Technology International Conferences (ASET),* pp. 1-7, 2022.

[6] R. Kumar, "Design and Fabrication of Electric Bicycle," no. 2278-0181, 2018.

[7] S. Anuphappharadorn, "Comparison of the economic analysis of the battery between lithium-ion and lead-acid in PV stand-alone application," *Energy Procedia,* vol. 56, pp. 352-358, 2014.

[8] "Inflation Rates in Pakistan," *Worlddata.info,* 2021.

[9] M. Schimpe, "Energy efficiency evaluation of a stationary lithium-ion battery container storage system via electro-thermal modeling and detailed component analysis," *Applied Energy,* vol. 210, pp. 211-229, 2018.

[10] I. Tiseo, "CO_2 emissions worldwide," *Statista,* 2017.

[11] H. Ritchie, "CO_2 and greenhouse gas emissions worldwide," *Our World in Data,* 2020.

[12] IEA, "Transport – Topics," *IEA,* 2020.

[13] "Pakistan number of Registered Vehicles," *Ceicdata,* 2020.

[14] APP, "Registered vehicles in Pakistan increased by 9.6% in 2018," *Profit by Pakistan Today,* 2019.

[15] "Volza," Volza, [Online]. Available: https://www.volza.com/p/lithium-ion-battery/import/import-in-pakistan/. [Accessed Jan 2020].

[16] "Analysis CO_2 footprint lithium-ion batteries," Transport Environment, 2019.