Project Report On

ARDUINO PEDELECS

Submitted in the partial fulfillment of the requirement for the award of degree of

Bachelors of Technology

in

Computer Science & Engineering

the Guidance of MITHU SADHU.(CSE)

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at any university or any other institutions.

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Certificate

Certified that this project entitled "**Arduino Pedelecs"** submitted by ***Susmit Jana*** *(20600114016),* ***Rahul singh*** ***(****2060011401****),Deep Mukherjee (****20600115020****),Atmaprakash Das*** *(20600115018*) students of Computer Science & Engineering Department, Seacom Engineering College, Howrah, West Bengal in the partial fulfillment of the requirement for the award of Bachelors of Technology (Computer Science & Engineering) Degree of West Bengal University of Technology, West Bengal, is a record of students own study carried under my supervision & guidance.

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Name of Co-Ordinator

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Name of HOD

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Abstract

For human being travelling has become vital. In order to sustain in this fast forward world he must travel from place to places safely. This paper presents the development of an associate degree 'Electric Bicycle System' with an innovative approach. The aim of this paper is to show that the normal bi-cycle can be upgraded to a electric one by some means- that including the development of a regenerative braking system and innovative BLDC motor control – but also user real-time scanning and the power of crowd sourcing to improve the cycling experience. It is very important that time taking for travelling should be less, also it should be economical and easily available. With the fast depleting resources of petrol and diesel, there is need to find intermittent choice. Electric bike which will be driven with the help of the battery and thus provide required voltage to the motor. The system is modified in a such way that rider can make choice of which mode he/she prefers i.e. he can either choose the bicycle to be driven completely with the electric motor or he can choose it to be driven manually by himself. Although there is little empirical evidence, electric bike could be feasible, depending on demand and battery management and can potentially improve the utility of existing bike systems. The hope is that this design can become very efficient, cost effective, and one day mass-produced, especially in developing countries where automotive transportation is an impossibility as a tribute to the “GREEN ENERGY”.

Table of Contents

Contents **Page No.**

List of figures

Figures

List of tables

Tables

1. Introduction

1.1Overview

Global warming and scarcity of traditional resources are becoming major problems in current scenario. People try to move towards “Clean” energies. ELECTRIC-MOTOR-POWERED Bicycles have making their way into the U.S. market for about two decades. In the united States such bicycle can be fully powered by motor. Due to economic challenges India is facing in automotive sector the hybrid bicycle market has a huge growth potential. In other countries such as Japan, Sweden electric-motor-powered bicycles are required to operate with 60% human pedal power for up to 12mi|h , and even higher percentage of human power is required above that speed. Such bicycles are commonly known as “pedelecs” (pedal electric cycle).

Head1 of vehicles pose a great danger during night driving . The drivers of most vehicles use high bright beam while driving at night. This causes a diacomfo2 to the person travelling from the opposite direction and therefore experiences a sudden glare for a short period of time. In this project, an automatic headlight dimmer which uses a Light Dependent Resistor (LDR) sensor has been designed to dim the headlight of our vehicles to avoid human eye effect. The prototype that has been designed to reduce this problem. By actually dimming down the bright

headlight of our vehicle to low beam automatically when it senses a vehicle at close proximity approaching from the other direction.

However, to use the information on road surface condition for safe cycling, information in a bit far area from the bicycle is necessary.

Bicycles with such a supporting electric engine belong to the innovative vehicles, which are wholeheartedly suitable for everyday life. In face of continuous climate discussion and permanent traffic jams, electric bikes have the potential of solving such issues and making a more energy efficient and environment friendly mobility possible.

1.2 History

- The idea of a motorized bicycle isn't a recent conception and has been around for over a century. until 1985,the electrical Bicycle created it's place in history. That year OgdenBolten was granted U.S. Patent 552,721 For a powered Bicycle with a six-pole brush-and-commutator DC hub motor mounted with the rear wheel. The bike itself has no gears and therefore the motor may draw up to 100A with a 10v battery. Since then the conception of electric bike become possible and sensible.
- The electrical bicycle offers a cleaner various to travel short-to-moderate distances instead driving a patrol/diesel-powered automotive. The E-bike could be a project which will promote each cleaner technology also as a lesser dependence on oil. It'll run on clear power with the flexibility to recharge the battery three separate ways: through the 120V AC wall supply, by generating power through the pedals of the bicycle, dynamo.

- Later in 1990's torture sensors and power controls were developed including some modified versions of bike with NiMH , NiCd and /or Li-ion batteries which offers lighter, density capacities batteries. But these bikes faced decrease in production when petrol and diesel resources came in existence.

1.3 Project aim

We are thinking of possible Senior projects, we all decided that we wanted to do something that would somehow be beneficial to the planet. Taking consideration of recent events of resources and facilities at their disposal, over increasing traffic, snags problem of parking and the need to make automobile a more environmental friendly, designers of vehicles are back with a view to open hit upon a novel concept that completely alter the conventional design. In the case of cycling at a blind road, at night or cycling by elderly people, it is helpful to prevent accidents if inform on bad road surface condition, such as brake, potholes, obstacles, bumps, is preliminary obtained.

An extra benefit to building the electric bicycle is that it can also show the general public how much cheaper it would be to convert their regular bicycle into an electric bicycle rather than driving solely in their gas-powered vehicles. The greater importance of the environment in the world leads to an opportunity for students in our position.

1.4 Project Goal

Today, we are going to plan to continue on with the concept of the electric bike and look for new ways of making a more efficient and practical with the help of some technologies. By interfacing the power source with additional power charges

while in u se, it can influence and increase the duration of use and the distance travelled. Ultimately ,this system Will results as the first Cal ”E-bike model” . It is desired that for the future, all components will be designed and miss produced in house by different project group and later interfaced together to reproduce our original system model. By reverse engineering our components , through modern innovations, and more revolutionary techniques it will result in a much more efficient electric bike system.

Beside this We design and implement a road surface condition monitoring using an off-the-self node ARDUINO, an ultrasonic distance sensor, and a typical bicycle.

1.5 Background

i. Working medium

The basic idea is to attach a motor to the cycle for its motion. A motor that is powered by a battery and that can be switched on during difficult terrains and switched off and pedal to get the battery recharge during motion in a flat terrain. The idea came into our mind as different stages of project planning, firstly we wanted to implement a simple moving system so the projection of cycle as a system came into our mind, second stage was adding a necessarily useful component into it that can be beneficial bin the future and for common people, falling into the current trend was that of hybrid system so we ended up planning to assemble a motor unit into our cycle drive. There was many issue came up while making such a system major one of them being the power of a motor to be used, we should go for. Second thing being the weight factor, the addition of extra weight on to the system, which can cause discomfort to the rider while normal paddling. Third was the type of battery to be used, we should go for a battery that has

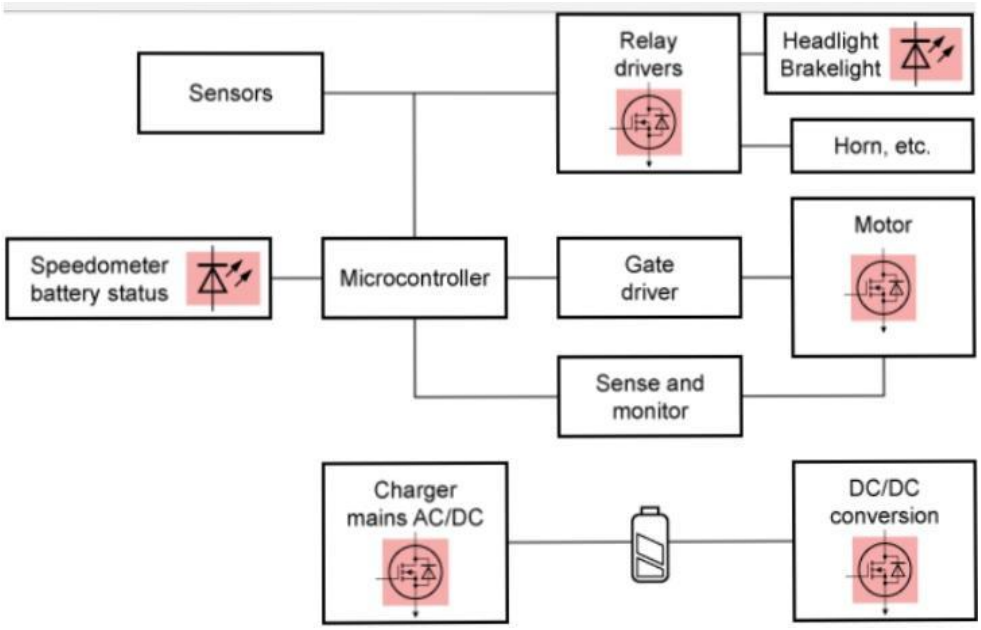
longer life, economically viable, and also has less maintenance issues. Forth issue was that self charging a battery with a motor alternator unit that too with the simple cranking motion of the cycle was not viable, we had to utilize a mechanism that can come in handy here and that was by using the freewheel rotation technique.

ii. Mechanical Design and System Integration

The main aim was to fabricate a prototype that would be very light and comfortable for the rider to handle. As the motor and other drive components would take in most of the free space in the system our design challenge was to make the motor-alternator at its minimum possible size and also at the lowest possible cost. Mounting the battery was another challenge, the location of the mounting could have been anywhere in the rest of the space available near the motor or we could have used up the empty space bar of the carrier. Keeping in mind the comfort of the rider the battery casing was mounted in the middle gap of the cycle. Looking at the complicated arrangements of the system one may easily think that the drive arrangement could have been completed in a single step ,i.e. the direct link from the motor to drive. But the real fact is that this would make the cranking for self recharging mechanism difficult, since the speed for alternator recharging can not be archived by simple cranking a flywheel has to be used to store the cranking energy and thus the rotation and cranking at normal cycling becomes easier.

2.Block Diagram

Figure 2.1 System Block Diagram of entire project



3.Block Diagram Description

Basic Configuration of an Electric Bicycle System :

basic configuration of an electric bicycle drive consist of a controller that controls the power flow from the battle to the electric motor. This power flow acts in parallel with the power delivered by the rider via the pedal of the bike .(Figure 2.1)

The rider of an E-bike can choose to

- rely on the motor completely
- pedal and use the motor at the same time
- pedal only (use as a conventional bicycle).

The basic of this project is to construct a system for an electric bicycle. These are many key components within the block Diagram for this system as shown in the figure 3.1 . They consist of a battery, a motor controller, a DC-DC converter, a brushless DC motor. The throttle controller are simple button system that are used to trigger the functions for increasing speed, keeping in the speed constant. The turning off the motor.

Proposed project have 2 main sections: automatic light dimming and automatic speed control. Voice input is given to coincidentally recogn6 application and is converted to control

codes. These control codes are given to microcontroller using Bluetooth module. Input from LDR is also given to microcontroller for dimming of light. Speed Control is done by using ultrasonic sensor. It will sense the obstacle at a particular distance and controls the speed.

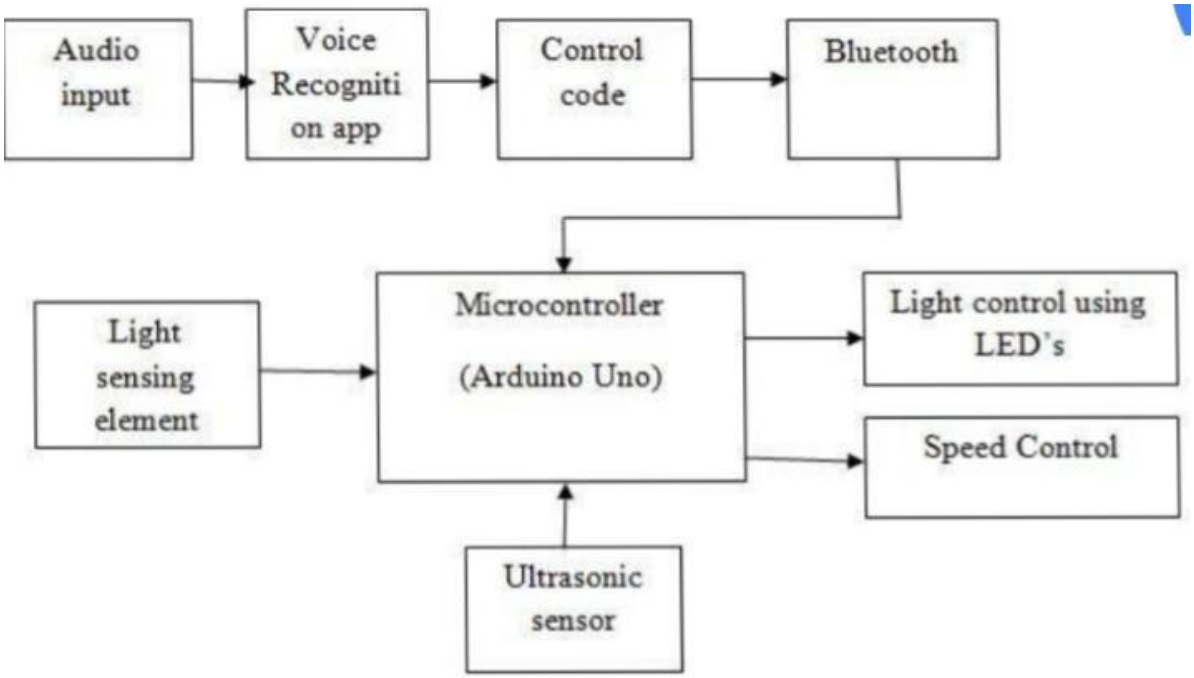


Fig 3.1 Block Diagram

- ARDUINO is the core part of the project. ARDUINO Nano is used in proposed project. Program code for ARDUINO is less compared to other controllers. Controller can accept all inputs at a time. It can produce output corresponding to each input. Controls codes from android application are given to controller

via Bluetooth. Control codes are generated corresponding to each voice input. For light dimming, a light sensing is placed in vehicle. Depending on intensity of light falling on light sensing element, light dimming is done.

- Speed Control is done with aid of ultrasonic sensor. Ultrasonic sensor will identity a obstacle by sound wave from sensor. Time taken by waves to come back to receiver of sensor after striking obstacle is calculated and motor speed is controlled if obstacle is in the range defined in program. Either motor can be stopped or speed can be controlled by PWM module when obstacle is identified.(Figure 3.1)

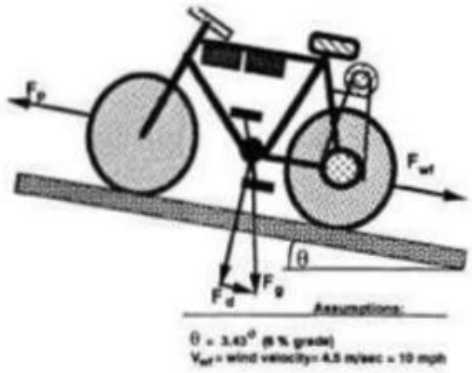
4. Features and Main Parts

An electric bicycle has a conventional bicycle frame, pedals ,cranks, chain, and freewheel assembly. Electric propulsion replaces or supplements muscle power. This adds to the bicycle an electric motor , battery, and power control. The foll2 defines the requirements of an electric bicycle:

- The complete bicycle must have the lowest partial mass. All mass must be hauled over hills with energy supplied by the battery. Lower mass gives more range between recharging of the battery.
- Bicycle stability is another important requirement. Total mass need not affect stability, but the placement of mass is important.

COMPONENT	MASS IN KG
Bicycle assembly	10
Motor and gear	6
Power control	1
Battery	6
Cyclist	80
Total weight	106

Table 4.1 – Range of Mass



F_{wf} = windage and friction drag F_d = downhill force from gravity F_P = propulsion force = $F_{wf} + F_d$

V_b = bicycle speed = 20 km/hr F_d = m sin x = 106 kg × 0.06 × 9.8 = 63 N

$P_d = F \times V_b = 63 \times 5.56$ m/s = 350 W Headwind speed = 25 km/hr, adds 30-W power to propel

Figure 4.1 Range of Mass

Hence the power required by the mot1 to propel the bicycle and the rider is 380 W.

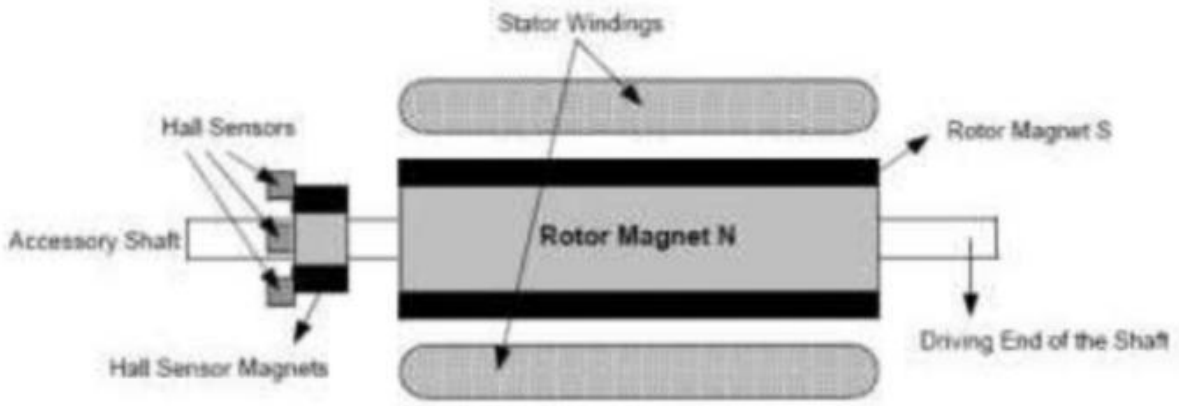
i. Motor selection

Brushless Direct Current (BLDC) motor is a type of synchronous motor, where magnetic fields generated by both stator and rotate have the same frequency. The BLDC motor has a longer life because no brushes are needed. Apart from that , it has a high starting torque, high no load speed and small enee1 losses. The BLDC motor can be onfigu2 in 1-phase, 2-phase, 3-phase. Three phase motors are the most popular among all the configurations and are widely used in ebikes.

The structure of a BLDC motor is divided into two parts:

- Moving part called the rotor, represented by permanent magnet

- Fixed part called the stator, represent by phase sidings of magnetic



circuit.(Figure 4.2)

Figure 4.2 BLDC motor mechanical structure

Unlike a brushed DC motor , BLDC motor can be controlled electrically. To rotate the BLDC motor, the stator windings must energized in a special sequence. The rotor position must be known in order to understand which winding will be energized next. The rotor position is sensed using Hall Effect sensors that are embedded in the stator.

Because of the increasing popularity of ebikes, motors designed specially

Figure 4.3 MY8029 24DC motor

for e-bike applications are now commercially available. The motors vary a great deal in how they are mounted to a bicycle and in how the power is applied to them.

The motor is having 250 watt. Capacity with maximum 2100 rpm. It's specifications are as follows . (Figure 4.3)

- Current Rating: 7.5 amp
- Voltage Rating: 48 Volts
- Cooling: Air-cooled
- Bearing: Single row ball

2. Battery selection

See the following equations to calculate the range from amperage and voltage:

Ah (Amp hours) × V (Volts) = What (watt hours)

Select a 24-V, 10-AH battery with 240 Wh.

P (power) = work / t (time)

P× t =work= Force × Distance

Force = mass × acceleration

Distance = Wh / Force

Electric bicycles are often restricted to a speed of 30 km/h across level ground. A larger wattage increases the range and can increase the uphill torque, however a larger wattage does not typically increase the maximum speed which restricted.

From the previously listed equations, a 240- Wh battery can roughly provide a range of 25 km.

We select Lead Acid battery . It is

- Inexpensive and simple to manufacturer
- Mature, reliable and well-known technology
- Low self-discharge – the rate is among the lowest in rechargeable batteries . Capable of high discharge rates.

3. Controller :

Figure shows a typical block Diagram for the comole2 control of selected motor .(figure 5)

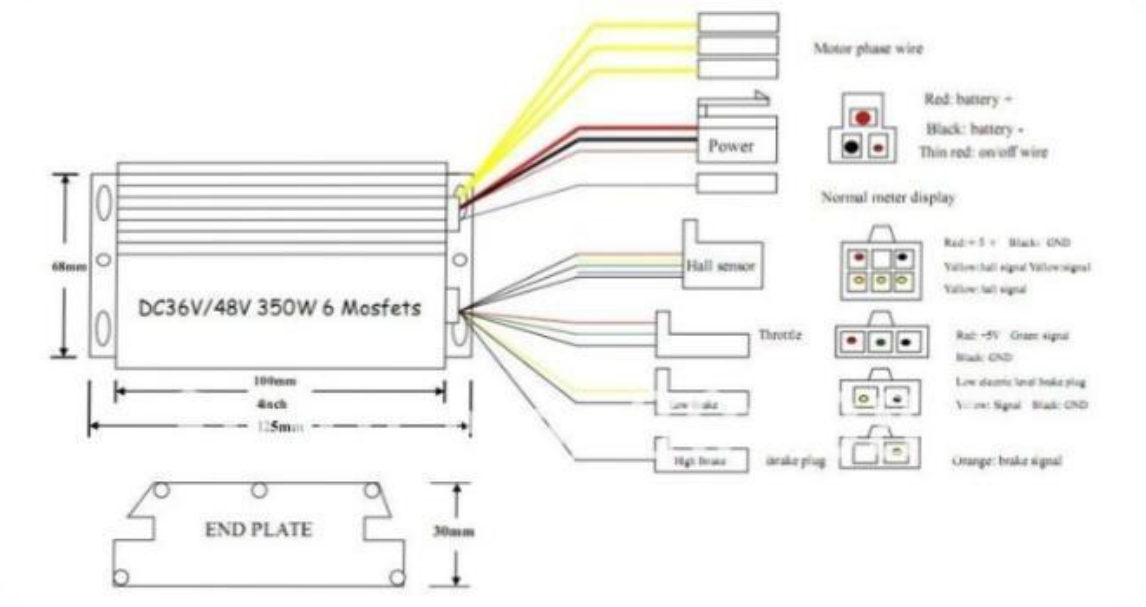
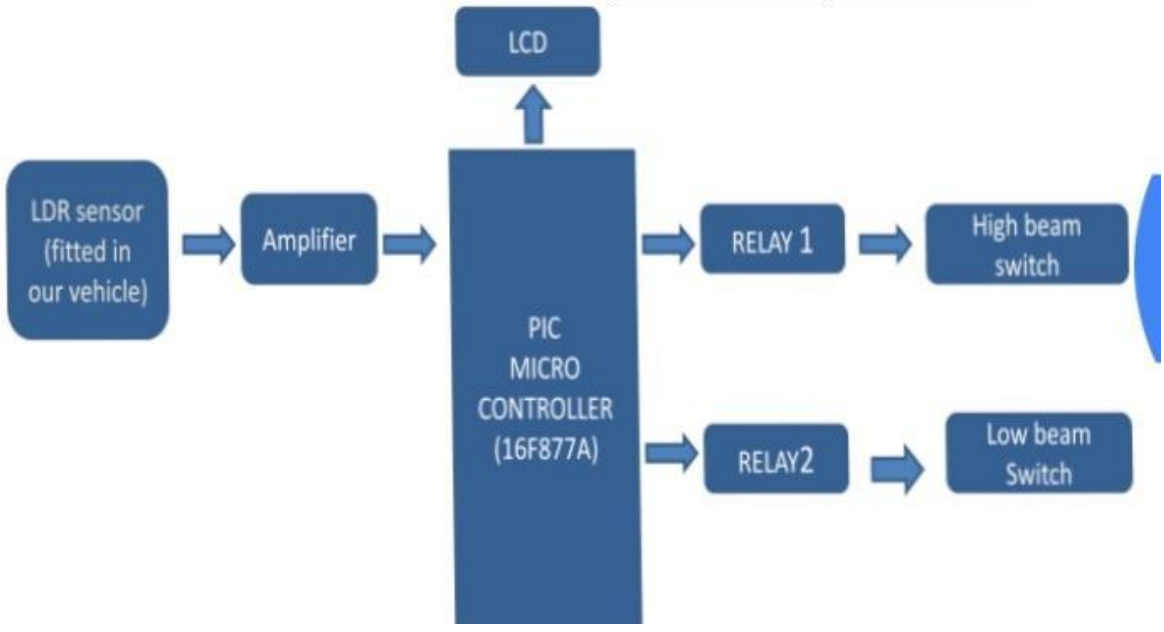


Figure 5. E-bike controller block diagram

The following lists the key electrical characteristics of an e-bike controller:

- Rated voltage: 48V DC
- Rated power: 500W
- Motor speed: 0 to approximately 30km/h variable-speed by handlebar
- Speed restriction: Maximum 20 km/h (by jumper)
- Battery under voltage protection: 41.5± 0.5 V

4.Headlight System: The final proposed system which is expected to reduce the problem of temporary blindness would sense the intensity of the headlight from the oncoming vehicle in analog form, which would be sent to analog to digital conver3 to convert analog signals to digital signals. The ADC would send this digital signals to the microcontroller where the threshold intensity level is set. It wou1



compare the

Figure 6. Block Diagram

receiver intensity in the digital form to the threshold intensity and send this signal to relay circuits. There are two relay circuit one for awichi1 to high beam and another one for switching to low beam. If the relay2 circuit receives the signal the high be light will go to low beam. (figure 6)

5. Monitoring Road surface conditions:

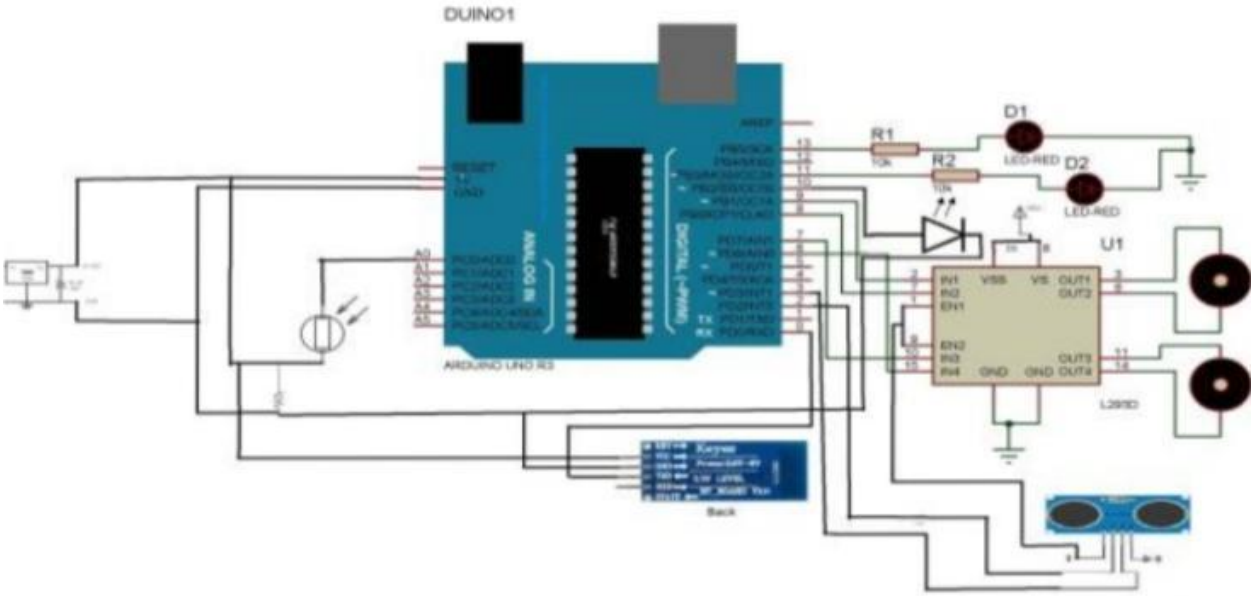
Figure 7. Overview of the road surface condition monitoring system

In this paper , we consider to use a low cost ultrasonic distance sensor for monitoring the road surface condition in the front area of bicycle. The ultrasonic distance sensor periodically measure the distance by emitting and receiving ultrasonic signals. According to the obtained information, the system detects road surface conditions such as obstacles. (Figure.7) In this paper, we evaluate the system in terms of obstacles detection capabilities through implementation and experiments using off-the-shelf devices.

5. Circuit Diagram or Layout

Arduino nano board is interfaced with LED and ultrasonic sensor. For transmission of control codes bluet is used. Transmission pin of Bluetooth is connected to reception pin of Arduino. We can give supply from Arduino or can be given externally. Trigger and echo pins of ultrasonic sensor are connected as specified in program. LDR is connected between an analogue input and 5V supply. Light dimming is done using LDR.(figure. 8)

Power supply is provided using LM7805. 12V is directly given to Arduino board.



But numbers of pins are very limited for Arduino. So for providing supply to all

Figure 8. Circuit Diagram of system

components LM7805 is used. Arduino nano is a microcontroller board based on the ATmega328. It has 14 digital input output pins, 6 analogue inputs. It contains everything needed to support the microcontroller. The Arduino software includes a serial monitor which includes data transmission to and from the Arduino board. In proposed project Arduino control all input signals and provide necessary output. LDR is light sensitive device. They are used for light dimming . For communication with controller HC 06 Bluetooth module is used. An ultrasonic sensor is used to find by using sound waves. L293D is a motor driver which is used to drive a DC motor. DC motor is used for showing demonstration of speed controlling.

Flowchart: The flowchart of the prototype for distance measurement is shown in figure. 9 The prototype periodically transmits ultrasonic signals using transmitter

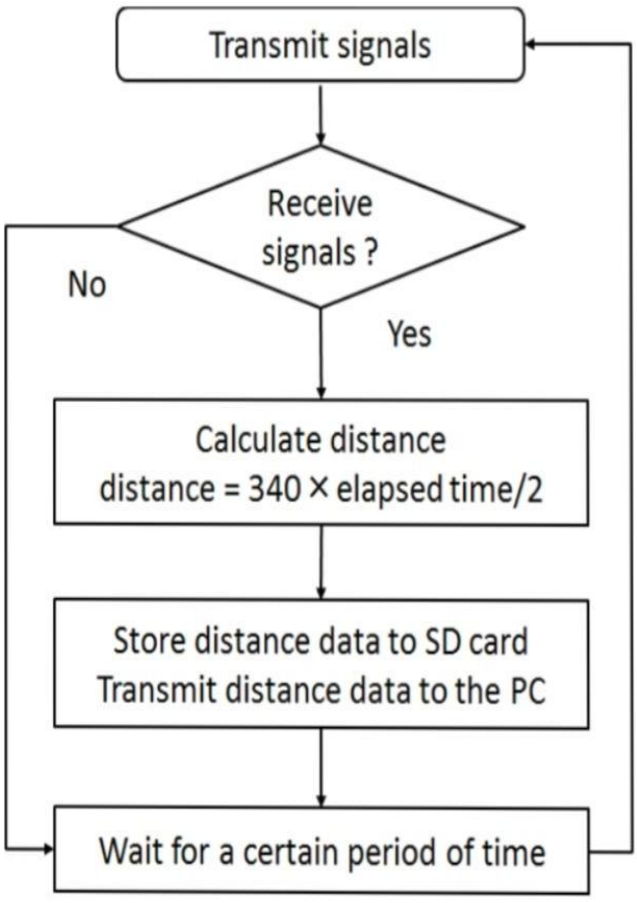


Figure 9. Flowchart of behaviour of the prototype for distance measurement

module of ultrasonic distance sensor. When the receiver module of ultrasonic distance sensor receives transmitted signals, the prototype calculates distance based on the sonic speed and elapsed time for transmission.

Then , the distance data is stored to an SD card attached at the Arduino. In addition, the distance data is transmitted to a monitoring PC by using Bluetooth communication module.

6. Different Tools Used

1. LDR sensor

A photo resistor or Light Dependent Resistor or cadmium sulfide (CDs) cell is resistor whose resistance decrease with increasing incident light intensity. It can also be referred to as a photoconductor. A photoresistor is made of a high resistance semiconductor. If high falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and it's hole partner) conduct electricity, thereby lowering resistance.

Photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carries and is not an efficient semiconductor, e.g, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap.

2. Amplifier

An electronic amplifier is device for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with a larger amplitude. In this sense, an amplifier may be considered as modulating the output of the power supply. Here we use inverting amplifier as gain amplifier.

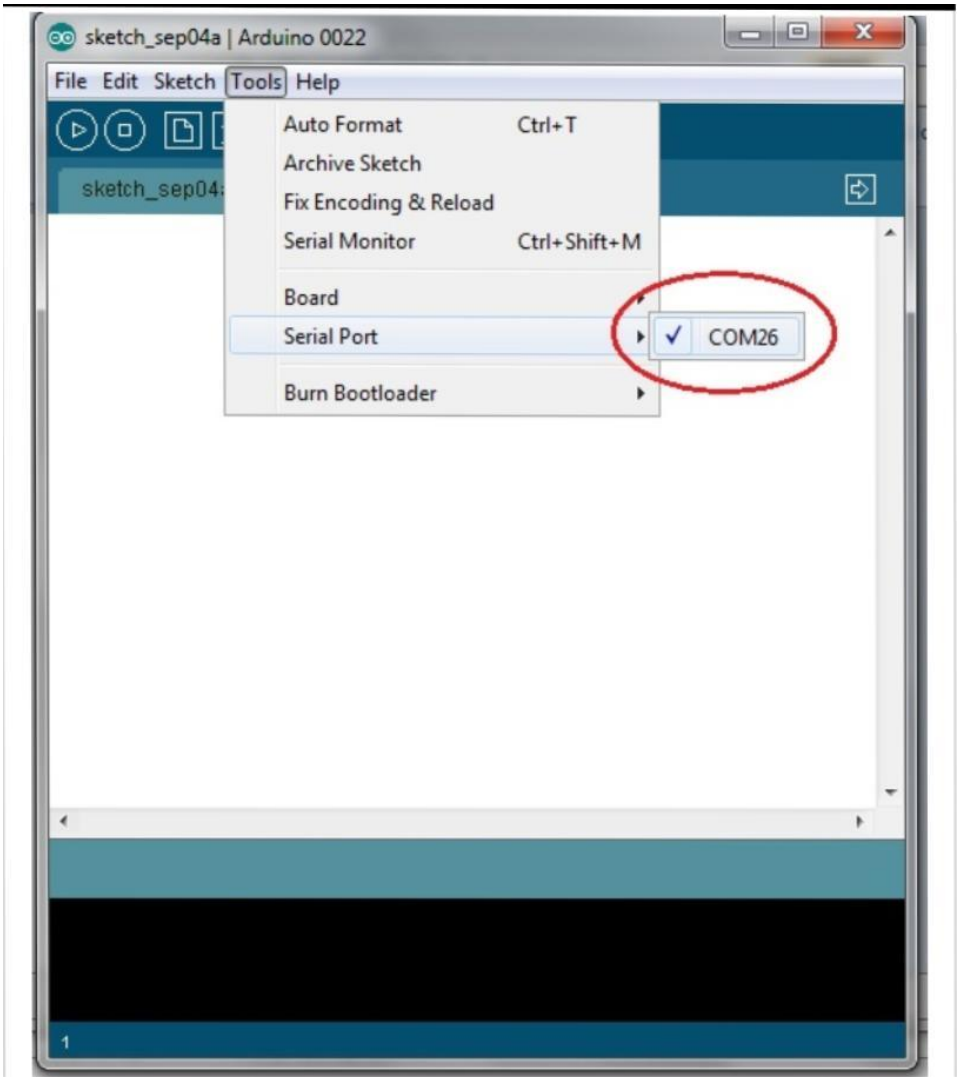
2. Relay: A relay is an electrically operated switch. Current flowing through the coil of the relay create a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relay has two switch position and they are double throw switches. For example a low voltage battery can use a relay to switch for 230v AC mains circuit. There is no electrical connection inside the relay between the two circuit; link is magnetic and mechanical .the coil passes typically 30mA for a 12V relay, but it can be as much as 100 mA for relays designed to operate from the lower voltages. Most ICs cannot provide this current and a transistor is usually used at amplify the small IC current and a transistor is usually used at amplify the small I'M current to the larger value required for the relay coil.

3.Specification of Arduino board :- Manufacturer : ardour labs; Microcontroller : ATmega328; Operating Voltage : 5V ; Analogue Input Pins: 6; Digital I/O pins: 14(of which 6 provide PWM output); input voltage: 5-20V (limits); DC current for I/O pins: 40 ma; clock speed: 16MHz.

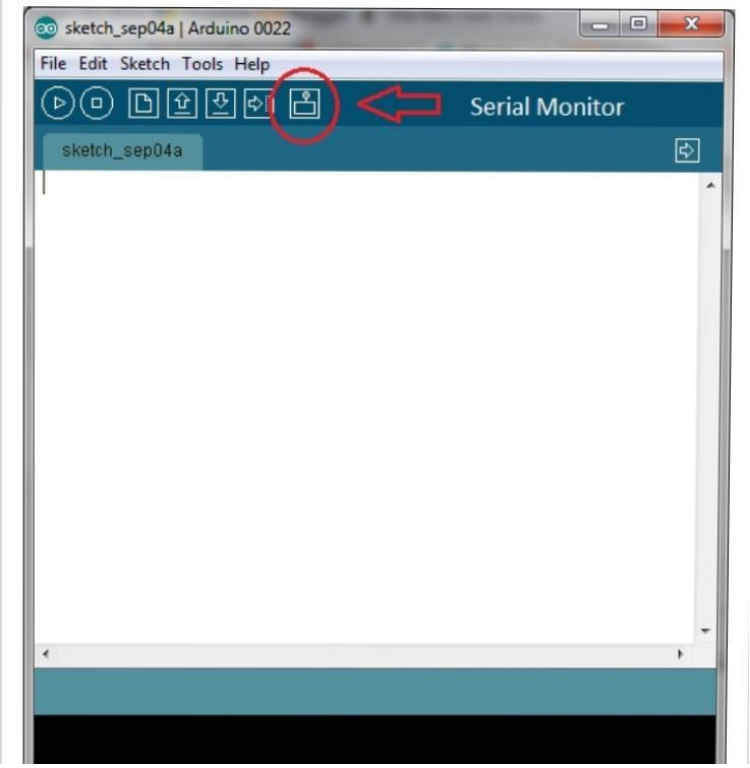
4.Bluetooth module configuration: all the commands sent to the Bluetooth must not contain a 'newline' character at the end, puTTY doesn't do well in this regards.

Hence we recommend using the ' Serial Monitor’ in the Arduino IDE to configure the Bluetooth module.

- Connect the Bluetooth to the pc, the LED should be flashing
- I’d you have an Arduino board connecting to the pc via USB , please unplug it.
- Launch the Arduino IDE (the program where you write Arduino code and download to the Arduino)
- Select the correct COM port that the Bluetooth is connected to.



Open the ' Serial Monitor'



Once the serial Monitor pops up, make sure the 'no line ending' is selected. To test the communication between the Bluetooth and the pc, send the command AT and hit the ' send' button, the Bluetooth should reply 'OK'.

If you can get the Bluetooth to reply, you are ready to configure the Bluetooth module to your preference.

5.7805 Regulators,Capacitors,12V//5V 470muF

6. Bread board and jump wire

7. ultrasonic sensor HC-SR04: It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path it will bounce back

to the module. Considering the travel time and the speed of the sound you can calculate the distance.

The HC-SR04 ultrasonic Module has 4 pins, Ground, VCC , trig and Echo. The Ground and the VCC pins of the module needs to be connected to the ground and the 5 Volta pins on the Arduino board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

The HC-SR04 **ultrasonic sensor** uses **SONAR** to determine the **distance** of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1” to 13 feet.

7. Work & Algorithms

A. For e-bike system:

- During acceleration the forces acting on the system are: Drag force; Friction from tires; Force due to gravity. There is a major change of energy from electrical to K.E+P.E
- K.E= ½m.v² where the value of 'v' keeps varying. Electrical energy= V.I.T
  Final K.E = voltage rating × current required × time to accelerate
  Voltage provided= 36v
  Maximum mass = 120 Kg
  K.E = ½× 120× (25)² = 375500 w. (Power consumed)
  375=36 × I× 20(s), I=0.52A; 375= 36× I× 40(s)=0.26A; 375=×I× 60(s), I= 0.17A
  Current drawn from the unit is more when time taken is less and vice versa. Considering that the cyclist can achieve the 25 km/h. Mark in 60(s) , the current drawn will be 0.17A. buy practically the values varies from person to person. Hence an average value is calculated to be about = 0.3166= 0.32A.

- Motor starting current (from dead start) = 3.44A.
- Motor starting current (cont. Motion) = 1.05A.

B. Software:

- Language Used

  Arduino Software (IDE) is used for programming. The Arduino Integrated Development Environment contains a text editor section, a message area, a toolbar with common functions and a series of menus. It connects to Arduino Uno and helps to upload program to controller.

Algorithm

System has 2 inputs. One is obstacle coming opposite to vehicles. Second is light coming from opposite vehicles. All these sections are working parallel. Flow chart for each module is as follows. It show the path for data flow. Once an input is received, system works in an infinite loop.

Algorithm for voice recognition section

- Start
- Input voice to voice recognition application
- Compare generated control code with control code specified in program.
- If generated code matches with codes specified in program, perform corresponding action, else maintain same state.

Algorithm for Light dimming section

- Start

- Read value on sensor.
- Compare generated value with value specified in program.
- If sensor value is less that or equal to a value specified in program, reduces brightness, else maintain same state.

  Algorithm for speed controlling section
- Start
- Identify distance between vehicles and obstacles.
- Compare that distance with distance specified in program.
- If distance is less than or equal to a value specified in program, reduces speed , else restart motor.

C. <u>Code</u>:

First you have to define the trig and echo pins. In this case they are named trigger pin and echo pins. Then you need a long variable names "duration" for the travel time that You will get from the sensor and an integer variable for the distance.

Using the pulseIn() functions you have to read the travel time and put that value into the variable . This function has 2 parameters, the first one is the name of the echo pin and for the second one you can write either high or low.

```
/*
* Ultrasonic Sensor HC-SR04 and Arduino Tutorial
*
*
*/

// defines pins numbers
const int trigPin = 9;
```

```
const int echoPin = 10;

// defines variables
long duration;
int distance;

void setup() {
pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
pinMode(echoPin, INPUT); // Sets the echoPin as an Input
Serial.begin(9600); // Starts the serial communication
}

void loop() {
// Clears the trigPin
digitalWrite(trigPin, LOW);
delayMicroseconds(2);

// Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);

// Calculating the distance
distance= duration*0.034/2;

// Prints the distance on the Serial Monitor
Serial.print("Distance: ");
Serial.println(distance);
}
```

If you want to display the results from the HC-SR04 ultrasonic sensor on an LCD you can use the following source code:

```
/*
```

```
 * Ultrasonic Sensor HC-SR04 and Arduino Tutorial
 *
 *
 */

#include <LiquidCrystal.h> // includes the LiquidCrystal Library

LiquidCrystal lcd(1, 2, 4, 5, 6, 7); // Creates an LCD object. Parameters: (rs, enable, d4, d5, d6, d7)

const int trigPin = 9;
const int echoPin = 10;

long duration;
int distanceCm, distanceInch;

void setup() {
lcd.begin(16,2); // Initializes the interface to the LCD screen, and specifies the dimensions (width and height) of the display

pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
}

void loop() {
digitalWrite(trigPin, LOW);
delayMicroseconds(2);

digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

duration = pulseIn(echoPin, HIGH);
distanceCm= duration*0.034/2;
distanceInch = duration*0.0133/2;

lcd.setCursor(0,0); // Sets the location at which subsequent text written to the LCD will be displayed
lcd.print("Distance: "); // Prints string "Distance" on the LCD
lcd.print(distanceCm); // Prints the distance value from the sensor
```

```
39.lcd.print(" cm");
40.delay(10);
41.lcd.setCursor(0,1);
42.lcd.print("Distance: ");
43.lcd.print(distanceInch);
44.lcd.print(" inch");
45.delay(10);
46.}
```

D. Automatic Beam control workings:

The working of this model Will be explained detailed below:

- Our own vehicle travelling at high beam
- The vehicle coming at the end opposite side also travelling at high beam
- In our bicycle the LDR will fixed in the windshield nearer to viper system
- If the opposite vehicle comes closer to our vehicle means the LDR produce the output voltage
- This voltage is driven by to the amplifier to amplify the signal and given it to PIC
- PIC itself having in built ADC, so that the analogue form of output from LDR is converted to digital form
- This digital value is compared with the set value
- If it equals means the PIC microcontroller will send the signal to the relay circuit
- The relay circuit is acting as a switching circuit
- If the relay receives the signal from microcontroller, it change from NO to NC

- Due to this our vehicle will switch to low beam
- The opposite vehicle driver doesn’t experience any sudden glare, so that he will across our vehicles safely
- Once the opposite vehicle get crossed, our vehicle switch to high beam.

8. Future scope and applications

The project brought together several components and ideas to achieve a common goal: to prove that it is possible to build a bicycle with 3 separate charging sources. We put a lot of time into this Bicycle to make sure that it was performing the best it possibly could. Now that the project as a whole is finished, we hand it over to future generations to design and improve each component. Possibly future projects may include:

1) Design of a charge controller for the battery : the battery management system built within the battery was very hard to access, so we couldn't get an idea of how it was designed. Having a BMS with the ability to take in a wider range of voltages and currents will be ideal.
2) Design of motor controller: the current motor controller is a very nice size and weight, but the connection that it provides are not as stable and protected as it can be.
3) Construction of a separate hub motor: there are many levels to the design of the hub motor in order to have it so compact in size. The new hub motor can be placed on the front wheel of the bicycle or it can just be used to compare the speeds and efficiencies to the current motor on the bicycle
4) Design of the programming system to program the motor controller: the current program allows the user to set a current limits, which causes the motor's speed and torque to be limited as well. It also allows the user to set amount of desired regenerative braking, which determines how tough it will be to pedal the bicycle and how much charge will be provided to the battery. A new possible program will allow the user to set these changes from the

seat of the bicycle will be very convenient. A small on-board LCD screen can be used to do all the programmable functions.

The multiple opportunities with this project and we hope that within a few years this Bicycle can become very efficient and marketable.

5) In the future, we should evaluate the performance of implemented monitoring system under other road surface condition such as bumps, brakes, dips, potholes, and so on. In addition , we should improve the monitoring system by taking into account sway of bicycle. Furthermore, we plan to extend the monitoring system for sharing information on road surface condition among users.
6) Glare during driving is a serious problems for drivers and therefore caused by the sudden exposure of our eyes to a very bright light of the headlights of vechiles. This causes a temporary blindness called the Troxler effect. Eventually this has become the reason for accidents occuring at night and also during bad conditions such as rainy and foggy conditions. The driver should have turned down the bright lights immediately to avoid glare to the other person, however they find it difficult to do. Hence, the idea for the design and development of a prototype circuit called the automatically switches the headlights to low beam when it senses a vechile approaching from the opposite side. Thus , the implementation of this device in every vechile does not only avoid accidents but also provides a safe and comfortable driving.

- Conclusion:

  We understand that this bicycle can be intimidating because of its weight and it ability to go 30 mph, but whoever takes it on in the future, we ask that you have an open mind and open heart. This bicycle has become very special to all of us, and we hope that it will be well taken care of and improved upon.

  Good luck to the future recipients and remember to have fun.

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