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E-Tricycle

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Abstract: *In most of the Educational/Industrial campuses, travel-ling from one department to another becomes a very hectic and time consuming task, as they are situated distance apart and using our personal vehicles just adds on to the pollution around the cam-pus. To cut off the pollution as well as reduce human efforts we have come up with an E-tricycle. This is totally Eco-Friendly.*

The purpose of this project is to introduce an E-tricycle that can be used as a mode of transport within the cam-pus. Mainly, to as-sist/guide the new visitor to successfully reach the destination without misleading the path. The E-tricycle will be initially parked at the entrance of the campus gate and each cycle will have its spe-cific ID.

The request for vehicle through a web page is done followed by the authentication procedure. Once the ac-knowledgement is re-ceived, E-tricycle will arrive in the autonomous mode at the re-quested location anywhere within the campus using GPS technol-ogy and Networking technology. On successfully reaching desti-nation then the user will switch it back to an autonomous mode.

I. Introduction

The era of technology is changing with a very rapid phase. The idea that was once just an illusion is now easily trans-formed into a reality. The locomotive vehicles once upon a time could move from one location to another using the physical man power. Later, one of earth resources called fuel were used for mechanical drives. The phase has evolved where in the drive is replaced by electrical supply called as an electrical drive system.

The inconvenience faced by the common man when he/she visits a new institutional and industrial campus like universities and colleges and does not know the exact lo-cation and the directions to follow to reach the depart-ments and different blocks which are situated distantly. Thereby, consuming a lot of time. This prob-lem led to the innovation and implementation of smart E-Tricycle.It is difficult to locate the destination irrespec-tive of the person travelling by vehicle or by walk. E-tricycle help cut congestion, affordable transport action.

It also helps the user to choose whether the E-tricycle has to be operated in the manual or automated mode depend-ing on his or her convenience.

We also got inspired by the digital India and Green India campaign to contribute to the causes to reduce the amount of pollution in our environment.

II. Problem Statement

The E-tricycle is the best option for intra campus move-ment.

- With the help of the android application (app.) the user needs to check for the availability of tricycle, send re-quest (current location) and determine the destination.
- Once engaged with the user it automatically travel to the user as well as on inserting the destination it travels from current location to destination location using GPS technol-ogy.
- User can ride in either of the two modes.

III. Methodology

The campus based E-tricycle includes mechanical struc-ture and electronic circuitry design. The mechanical and electrical components of the vehicle were tested through various testing experimentations.

A. E-Tricycle Components

There are various components which we had used in our E-tricycle. E-tricycle basically works in two modes, auton-omousmode and manual mode. Various components used in both the modes are given in Fig 1

B. Drive System Design

The drive of the E- tricycle is possible into automatic mode and the manual mode.

i) Autonomous Mode

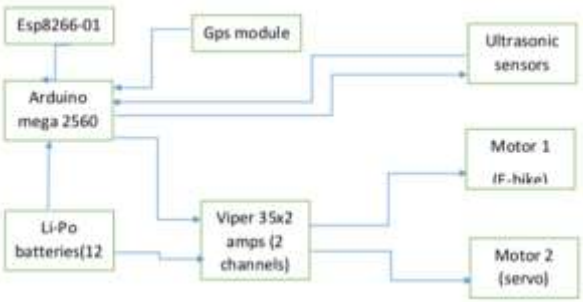


Figure 2: Block diagram for Autonomous Mode

The figure 2 gives the overview of an autonomous mode. The E-Tricycle travels to the user or from user to a destina-tion using set of Geo coordinates. It is popularly known as GPS Based Waypoint Navigation System. The GPS data is received by micro-controller over a Wi-Fi network.

Acoustic proximity sensors such as Ultrasonic sensor [2] are used for guiding vehicle avoiding obstacles. Motor Driver with high current capability is employed to power high current motor.

ii) Manual Mode

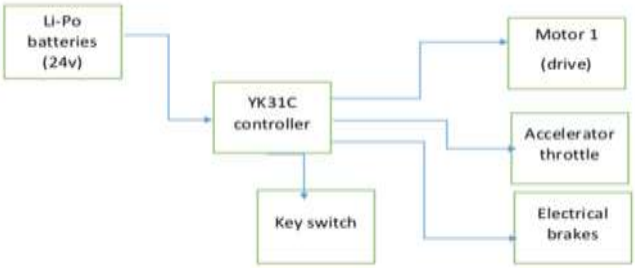


Figure 3: Block diagram for Manual Mode

Figure 2 gives description of E-Tricycle in Manual mode. YK31C controller unit [4] (Throttle, Brakes) is used to man-ually ride a Tricycle Electrically by simple adjusting throttle.

C. Other Accessories

Interfacing of other accessories like buzzer, head light, side light and tail light indication as well as the dashboard with display and control switches mounted on it. It is also equipped with the ammeter and voltmeter display indicat-ing the current and voltage values.

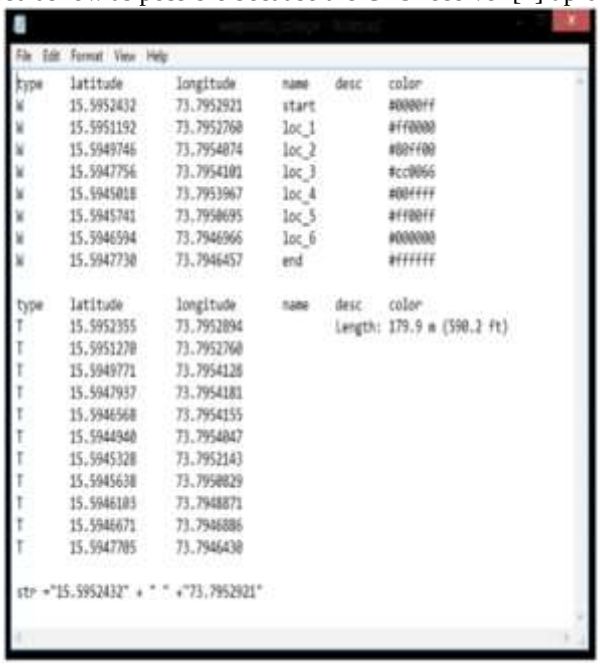
D. Gps Interfacing And String Extraction

To track the location of E-Tricycle in form of Latitude and Longitude co-ordinates we made use of GPS module [1]. GPS module is used to get GPS co-ordinates which is inter-faced with Arduino Mega 2560 [8]. ESP 8266-01 Wi-Fi module [3] is also interfaced with Arduino and it is imple-mented and tested for different modes of operation.

Waypoints [6] for different paths was derived using GPS Visualizer software. We had implemented the E-tricycle to move in autonomous mode by making use of GPS based on Waypoint Navigation System [5].

The GPS module which is basically a receiver acquires sig-nals from the satellite (transmitter) [5]. It determines the position by making use of Trilateration [7].

i) Distance Formula: We had made use of mathematical expressions to drive our E-Tricycle to the desired des-tina-tion. As the destination location is pre-defined, the algo-rithm will calculate the distance between the two locations after obtaining the current location. In our project we have implemented Have sine distance [9,13]. The significance of this formula is that it calculates spherical distance on earth using trigonometric functions. It is mandatory to keep the speed as low as possible because the GPS receiver [1] up-dates periodically.



File Edit Format View Help

type	latitude	longitude	name	desc	color
W	15.5952432	73.7952921	start		#0000ff
W	15.5951192	73.7952768	loc_1		#ff0000
W	15.5949746	73.7954874	loc_2		#00ff00
W	15.5947756	73.7954101	loc_3		#cc0066
W	15.5945018	73.7953967	loc_4		#00ffff
W	15.5945741	73.7950695	loc_5		#ff00ff
W	15.5946594	73.7946966	loc_6		#000000
W	15.5947730	73.7946457	end		#ffffff

type	latitude	longitude	name	desc	color
T	15.5952355	73.7952894		Length: 179.9 m (590.2 ft)	
T	15.5951270	73.7952768			
T	15.5949771	73.7954128			
T	15.5947937	73.7954181			
T	15.5946568	73.7954155			
T	15.5944940	73.7954047			
T	15.5945328	73.7952143			
T	15.5945638	73.7950829			
T	15.5946103	73.7948871			
T	15.5946671	73.7946886			
T	15.5947705	73.7946430			

str ="15.5952432" + " " +"73.7952921"

Figure 4: Waypoints

As the E-Tricycle moves closer to target point the GPS module [1] will update the location and the distance will decrease. The formula calculating the distance is very accurate for shorter distances. As we know the GPS location is not accurate, the logic is written in such a way that E-Tricycle stops in the radius of 5 meters.
The have sine function is defined as below.

haver sin(θ)= 〖sin〗 ^2 (θ/2)

The have sine distance formula [27] is given as follows. haver sin(d/2R)=haver sin(ϕ_2-ϕ_1)+cos(ϕ_1)haver sin(λ_2-λ_1)
Solving for d we get the distance formula

d=2R 〖sin〗 ^(-1) (√(〖sin〗 ^2 ((ϕ_2-ϕ_1)/2)+cos(ϕ_1)cos(ϕ_2) 〖sin〗 ^2 ((λ_2-λ_1)/2)))

Apart from have sine, normal distance formula can also be used. The normal distance formula is given as follows.
d=R*√2*√(1-(cos(∅_1)cos(∅_2)cos(λ_2-λ_1)-sin(∅_1)sin(∅_2)))
ii) Heading Angle: The algorithm also calculates the heading angle. Current heading is obtained using compass module. Comparing the heading from the compass module and from the calculations, a difference of the heading will be calculated. The resultant heading is final heading on which E-Tricycle moves. The heading angle for the destination from the current position is also calculated by the algorithm with respect to geographical north. It is a common term used in air, ship and vehicle navigation. Heading angle is defined as the north-south line on earth or the meridian and the line connecting the two points on earth. The compass gives this heading information. Below is the heading formula which will calculate the desired heading of the robot to reach the target point [10].
h=a tan2(sin(λ_2-λ_1)cos(ϕ_2),cos(∅_1)sin(∅_2)-sin(∅_1)cos(∅_2)cos(λ_2-λ_1))
here h is the heading, ∅_1,ϕ_2 are latitudes of point 1 and latitude of point 2, θ1,θ2 are longitude of point 1 and longitude of point 2. The heading is normally calculated in radians and then converted into degrees. True heading is based on true north and all angles are measured clockwise with respect to through north.(0< angle< 360). After true heading is known it is compared with the current heading of the E-Tricycle given by compass. The difference between true and compass heading gives the final heading in which the E-Tricycle ought to move towards destination. After this the E-Tricycle is guided using appropriate Azimuth angles.

E. Authentication Procedure

The request for vehicle is done by opening one website followed by the authentication procedure. Once the acknowledgement is received, E-tricycle will arrive in the autonomous mode at the requested location anywhere within the campus.
For the authentication process, the web page we had designed consists of Registration Page and Login Page, as shown below.
XAMPP Server: It is a free and open source cross-platform web server solution stack package. It is developed by Apache Friends.
XAMPP stands for Cross-Platform (X), Apache (A), Mari-aDB (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for de-velopers to create a local web server for testing and de-ployment purposes. Everything needed to set up a web server – server application (Apache), database (MariaDB), and scripting language (PHP) – is included in an extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows.

Figure 5: Registration Page

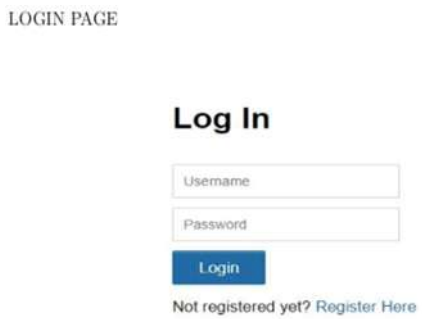


Figure 6: Login Page

IV. Conclusion

In this paper we presented how E-Tricycle works in auto and manual mode. The working of E-Tricycle in these two modes has helped many users to tackle their problems for campus movement. We had designed and implemented the circuitry for both the modes, auto as well as manual modes. The electrical components which is used in auto and man-ual modes such as the motor drivers (Viper), micro-controller (Arduino and YK31C), modules (GPS & Wi-Fi), motors, key switch, brakes, throttles, etc. were connected and placed accordingly. Even the testing of E-Tricycle in both the mode was done successfully. We added additional components like head lights, horn, tail lights, side lights. Arduino is interfaced with GPS module and the GPRMC string was successfully extracted which is required in our E-Tricycle working. Arduino is also interfaced with ESP8266-01 Wi-Fi module. It is interfaced and executed successfully in different configuration modes. GPS Visualizer [12] is used to extract GPS Coordinates. We made use of Haver-sine Principle to calculate the distance between two points.

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