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# Electric Tricycle for Handicap Person

**S. B. Pawar[1], S. P. Lawhate[2], A. D. Saste[3], R. B. Pawara[4], N. M. Kadam[5], P. R. Ghodake[6], P.J. Dhalwade[6]**

[1]Lecturer of Parikrama College of polytechnic, Kashti, Maharashtra, India

[2]Hod of Automobile of Parikrama College of polytechnic, Kashti, Maharashtra, India

[3,4,5,6.]Student of Parikrama College of polytechnic, Kashti, Maharashtra, India

## ABSTRACT

The goal of the Electric Tricycle Project is to bring increased mobility to disabled persons in Burkina Faso, West Africa. Presently, hand-powered tricycles are used by many of the disabled in this community, but some current users of the hand-powered tricycles do not have the physical strength or coordination to propel themselves on the tricycle with their arms and hands. The aim of this project is to add an electric power train and control system to the current hand-powered tricycle to provide tricycle users with improved levels of mobility, facilitating freedom in travel and contribution to the community. The design objectives required a simple and affordable design for the power train and controls, a design that needed to be reliable, sustainable, and functional. In response to the request from an SIM missionary at the Handicap Center in Mahadaga, Burkina Faso, Daimio Ergate (DE) committed to designing and supplying a kit to add electric motor power to the current tricycle design, and we, David Sandberg, Trollope Organdie, and Daniel Duarte partnered with DE in their commitment

**Keywords :** Electric Tricycle, Handicap, BLDC motor, MCU ADC, Battery Technology, Brushless Direct Current

## I. INTRODUCTION

Hand-powered tricycles are presently being used to provide mobility for disabled persons in a rural community in Mahadaga, Burkina Faso. Below is a photograph of a boy in Mahadaga on his hand-powered tricycle. The map on the right shows the location of Burkina Faso (in green). With this project we designed and manufactured a system to convert the hand powered tricycle to an electric motor powered version. We essentially created an affordable, rugged electric wheelchair for use in a developing country. We have worked to make our design appropriate to the culture where it will be used. This meant designing for the use of locally available parts and manufacturing capabilities. The result is a system that can be almost entirely replicated, with the exception of the motor and motor controller, with familiar parts, tools, and processes. Using the hand-powered tricycle as the basis for our design made the Electric Tricycle more of an appropriate technology because it uses a familiar, locally available platform as a starting point. In Mahadaga there are currently four potential users of the Electric Tricycle.

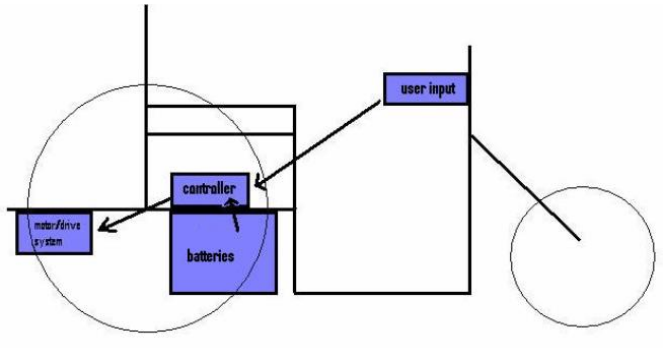
Disease or old age has left these members of the community dependent on others for their mobility. Though they own hand-powered tricycles, they are being used like conventional wheelchairs with the motive force coming from a person pushing from behind. Our first user is named Yempabou. He is a 12 year old boy from Burkina Faso who has cerebral palsy. Yempabou is pictured below: Cerebral Palsy limits his dexterity and severely limits the used of his

lower limbs. Currently, he is learning to use a modified type of hand-powered tricycle, but has not been able to power himself consistently. The Electric Tricycle should enable Yempabou, and others in the future, to be independently mobile. Dokimoi Ergatai, a Messiah College service- learning organization that works to improve living conditions for people in developing nations, was an important resource in this project. DE is responsible for the origin of the project, through their partnership with those in the community in Mahadaga, and much of the information gathering that was required to complete the project.

## II. LITERATURE REVIEW

### DESCRIPTION

The design of the Electric Tricycle is adaptable to the current hand-powered tricycles with little modification. The design consists of an electric motor, a drive system, motor and steering controls, and a power supply. See picture below for design schematic: An electric motor was chosen because high fuel costs prohibited the use of a combustion engine and because of the availability of electricity in Mahadaga. A solar array that an electric motor was chosen because high fuel costs prohibited the use of a combustion engine and because of the availability of electricity in Mahadaga.




A solar array that provides electricity for the Handicap Center provides the ideal source of electricity for battery recharging. The first aspect of our design that was addressed was the drive system or means of power transmission. Power must be transmitted from the electric motor to a rear wheel of the tricycle. Second, a method of motor control was decided on. The controls for motor speed and braking were incorporated into a simple mechanical joystick to facilitate operation by users with limited dexterity. The hand-power system was replaced with a steering system that disables the hand-power capability of the tricycle. Third, power is supplied to the motor by a battery pack.

## III. HISTORY

The earliest records of wheeled furniture was an inscription found on a stone slate in China and a child's bed depicted in a frieze on a Greek vase, both dating back to the 6th century. The first records of wheeled seats being used for transporting the disabled date to three centuries later in China; the Chinese used their invented wheelbarrow to move people as well as heavy objects. A distinction between the two functions was not made for another several hundred years, when images of wheeled chairs made specifically to carry people begin to occur in Chinese art. Later dates relate to Europeans using this technology during the German Renaissance. The invalid carriage or Bath Chair seems to date from around 1760. Harry Jennings and his disabled friend Herbert Everest, both mechanical engineers, invented the first lightweight, steel, collapsible wheelchair in 1933. Everest had broken his back in a mining accident. Manual wheelchairs are those that require human power to move them. Many manual

Tricycles can be folded for storage or placement into a vehicle, although modern wheelchairs are just as likely to be rigid framed. Manual or self-propelled wheelchairs are propelled by the occupant, usually by turning the large rear wheels, from 20-24 inches (51–61 cm) in average diameter, and resembling bicycle wheels. The user moves the chair by pushing on the hand rims, which are made of circular tubing attached to the outside of the large wheels. The hand rims have a diameter that is slightly less than that of

the rear wheels. Skilled users can control speed and turning and often learn to balance the chair on its rear wheels do a wheelie. The wheelie is not just for show a rider who can control the chair in this manner can climb and descend curbs and move over small obstacles.

## IV. METHODS AND MATERIAL

### OBJECTIVES

i. To develop a vehicle that uses renewable energy, environmentally friendly and cheap.
ii. To develop an electrical tricycle that can charge the battery when it is not in used.
iii. To develop low speed tricycle, but for a longer distance.
iv. Review various literatures about the tricycle designs, function and its components.
v. Learn to use various kind of software like Solidwork, and Algor.
vi. Model building using Solid work.
vii. Mathematical simulation using Matlab program.
viii. Failure analysis on body structure to identify the maximum loading capability (50-70 kg) using Algor program.
ix. Analysis on motor and battery performance to choose proper motor and battery.
x. Develop, fabricate and assemble all parts of the tricycle.
xi. Testing the final product

### CONSTRUCTION AND WORKING

### BATTERY

Given the current market, lead-acid is the only viable battery technology for electric vehicle conversion. The following is a list of criteria to use in selecting an electric vehicle battery.

### MOTOR (BLDC)

Brushless Direct Current (BLDC) motor is a type of synchronous motor, where mag- netic 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 energy losses. The BLDC motor can be configured in 1-phase, 2-phase, and 3-phase. Three-phase motors are the most popular among all the configurations and are widely used in e-bikes.

### THROTTLE

An electrical signal accelerator works on the principle of Hall Affect generator, which produces speed controlling signals based on the rotation of the actuator. The throttle cable has almost become redundant on today's motor vehicle. The drive-by-wire system is by no means a new concept as it was introduced by BMW on their 7 series range back in 1988.

### CONTROLLER

The battery has a positive terminal and a negative terminal. In case of correct polarity, diode D5 is turned on and it supplies the normal power. In case of wrong polarity, diode D5 is on the reverse voltage and it does not turn on. The diode can protect other devices in system including the MCU ADC input. If the ADC result is lower than a preset value, under voltage protection can occur. The battery in e-bike contains lead acid. The voltage discharge cannot be too low; otherwise, the voltage discharge will cause permanent damage to the battery.

### DESIGN OF ELECTRIC TRICYCLE

1. Diameter of wheels=D=64 cm
2. Peripheri of wheels
   =3.14×64
   =3.14×64
   =200.96 cm

Calculation of Torque
Distance of pedal=19cm=0.19m
Force at starting=20kg
Force at running=15kg

Torque=?

1. At starting condition
   T= f×d
   T= 20×9.81×0.19
   T=37.278Nm
2. At running condition
   T= f×d
   T=15×9.81×0.19
   T=27.9585Nm

## SPECIFICATIONS

### Motor Specification (company standard)

1. Power=250 watt
2. Voltage= 24 volt
3. Max Current capacity=5 Ah
4. Speed in rpm=336.0 rpm

### Battery Specification

Li- ion Battery with 36 V and 4.8 amp-hour rating are used .The selection of battery depends on its voltage, ampere and wattage rating etc. The total power of fully charged battery in two hours is 672 Watt-hours.

1. Power =172 watt
2. Voltage =36 volt
3. Current =4.8 Ah

## COST ESTIMATION

| COMPONENT | QUNTITY | COST |
|---|---|---|
| 1.Battery | 1 | 5500 |
| 2.Motor | 1 | 11000 |
| 3.Controller | 1 | 1500 |
| 4.Charger | 1 | 1000 |
| 5.Wheel | 1 | 300 |
| 6.Colour | 1 | 250 |
| 7.Welding | _ | 500 |
| 8.Cycle | 1 | 7000 |
| Total | | 27050 |

## ADVATAGES

1. Adding a power assist unit to a three wheel base chair will increase the weight and may offset the distribution of mass or balance and center of gravity possible making it more difficult for the user to propel when power assist is disengaged, the present innovation eliminates all these and simplify the propulsion.
2. This unit can be used for handicap and normal people also.
3. Individuals who have lower extremity weakness, paralysis, or amputation making walking unsafe or difficult, patients, can use this propulsion which is easy to operate and will be not require more effort.
4. This is inexpensive, portable unit, light weight and easy carried or shifted.
5. This becomes a best alternate to powered propulsion or hand push propulsion, which has good control with less energy expenditure.
6. Here we are using the mechanical advantage of the lever using the fulcrum, which is amplifying the input to output, using less effort the required drive.
7. Directly responsive to user force on push rims and provide most precise feedback
8. Provides propulsion options for users: push the tire, the rim, tire & rim, or one arm drive
9. technology
10. Easily understood and adaptable
11. Mechanically simple

## DISADVANTAGES

1. The propulsion lever will be swiveling even if you are not propelling it due to self-momentum during the drive, to steer it will be difficult since our hands holding the steering wheel will also swivel which is not convenient for the user.
2. The direction change or actuation in the front or back has to be practiced by the user since it will take the direction automatically which cannot be controlled, it can be controlled by stopping and pushing in that direction and then propelling

3. Does not have the clutch mechanism.
4. May not provide adequate feedback (force/travel distance per stroke) as the user gets
5. From standard push rim. For example, when the user pushes the rim ¼ cycle, the
6. wheel rotates through ¼ cycle

## V. APPLICATION

1. It can be used in the campus for the drive for the normal persons, to move within the campus in the smooth road.

2. It is best useful for the small city drive for anybody including the handicap.
3. It can be used for material transportation without using fuel propulsion.
4. It can be used by the handicap for the normal transport and even for the self-employed handicap persons for their daily livelihood

Scope of Hybrid tricycle

To convert the solar energy to the electrical energy by using solar cells, then Converting this electrical energy to mechanical energy by using dc motor to run the tricycle beside the human paddling.

- To find the alternative of fuel.
- To maintain the ecological balance.
- To form the economical tricycle.
- There is a need for a green energy.

## VI.CONCLUSION

We would say our project has been a success considering the changes we had to make in the spring once we actually found out who the electric tricycle was for. We achieved four out of five of our objectives, and we believe that we have a system that will be effective in providing mobility for persons in Burkina Faso who have disabilities. One of the major lessons we have learned is that designing an appropriate technology is a huge challenge. Appropriate is more than just availability for replication, it considers longevity, reliability, and efficiency.

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