STEERING AND MONITORING OF PERSONAL E-VEHICLE: STEP

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ABSTRACT
STEP is an abbreviation of Step Towards Electronic Personal transportation. It is a battery operated motorized single person device. This device is a good option for indoor transportation. It can be used in college campus, hospitals and industry to substitute walking. The device is password protected, steered by foot pressure and communicated through IoT (Internet of Things) technology. IoT helps in monitoring battery level of the device and its usage time and date from anywhere by mobile application and website. It is possible to detect anonymous handling through IoT. This paper provides specifications and working of the device.

KEYWORDS: Step, Electronic Vehicle, IoT, Personal Transport, Indoor Transport.

INTRODUCTION

Personal Transportation is an important aspect in human civilization. It affects economic, social, political and cultural fields in human life. Today's personal transportation is speedy and reliable but it has limitations like inefficient fuel consumption, high pollution and large space requirement. Nowadays there are many modern vehicles available for easy transportation. Segway Inc. has many products like Segway and Ninebot One. Hoverboard is also a renowned company in this field which produces hoverboards. But all these vehicles require self-balancing. Besides these vehicles are bulky and require space for parking. STEP can overcome these limitations.

This project brings forward the idea of developing a smart vehicle which could make personal transportation easier, safer and user friendly. It overcomes the disadvantages of bulkier devices such as the Segway or Winglet. It is small in size and not much heavy. Thus we can keep it in bag-pack. It has four wheels which reduces the requirement of self-balancing and gives it stability. STEP has connectivity to the Internet. This makes it a smart device. It can be effectively used in hospitals, malls, industries and short distance travels. With its security features it is possible to avoid anonymous handling and can get its report through mobile application. Through the data monitoring it is possible to develop the project further.

LITERATURE REVIEW

1) Personal E-Vehicles: Characteristics of today's modern personal vehicles like Segway, Hoverboard, Ninebot One and Toyota Winglet are:

A) They require self-balancing which is achieved by using tilt sensor and gyroscope.
B) These vehicles are bulky and weigh around 10-15 kg.
C) Many of them have handles. Therefore, they require parking space.

2) IoT Platforms:

In the market there are various platforms which allow multiple devices to connect to their cloud. IBM Bluemix, Thinger.io, Mosquitto and Losant are a few of IoT platforms used.

A) IBM Bluemix:
- Device is connected by token id after creating user account.
- Block programming is possible by Node Red application.
- Provides platform to create mobile application through the website.
- Free trial is only for 30 days.

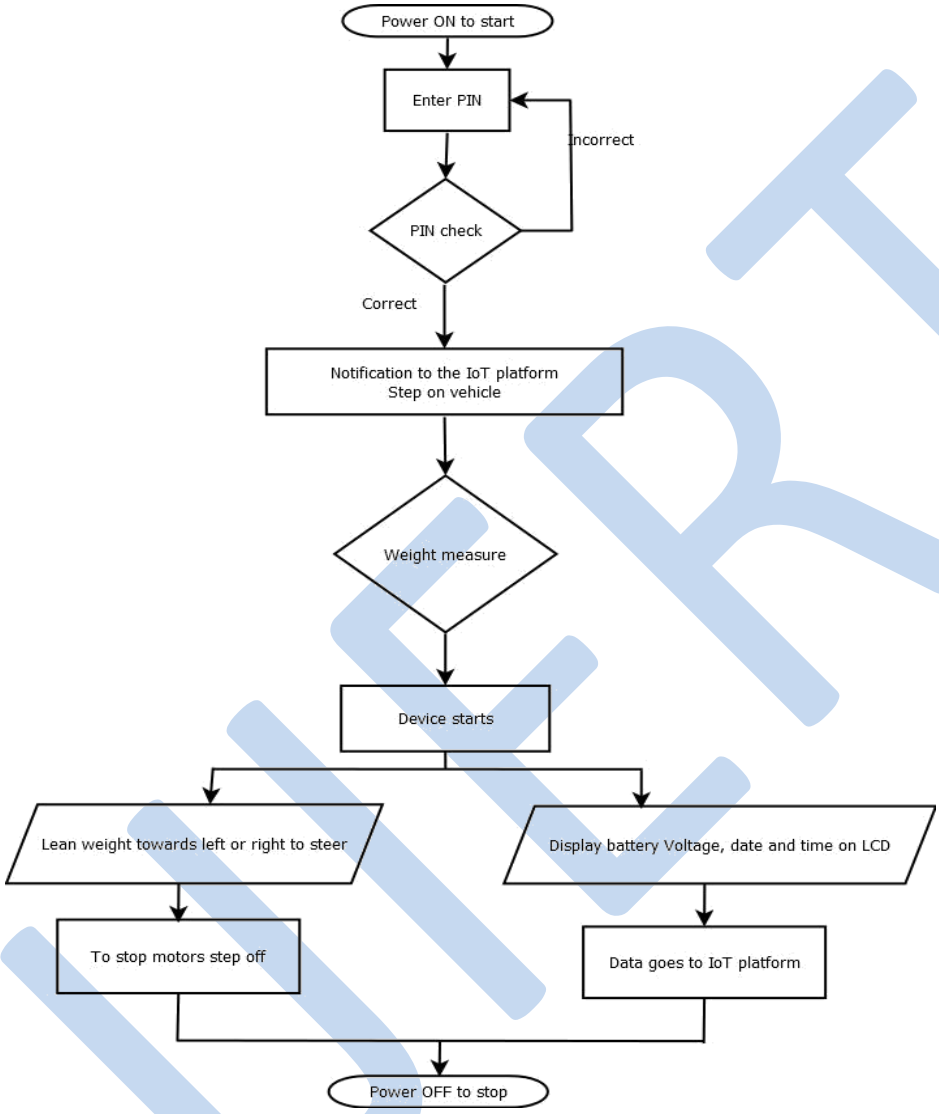
B) Losant:
- Device is connected by device id after creating user account.
- Programming is possible by Node.js.
- It is free for 10 devices from one account.
- Only wifi inbuilt boards are supported.

C) Mosquitto:
- It is a MQTT broker.
- It only supports MQTT protocol.
- To get client id, device requires other client applications.
- Does not support boards like Arduino uno or Arduino mega.

D) Thinger.io:
- Device is connected by device id after creating user account.
- We can connect maximum two devices in free trial from one account.
- It has its own mobile application.
- It provides open source libraries for documentation.
- Arduino can be connected through external wifi module like ESP8266.

METHODOLOGY

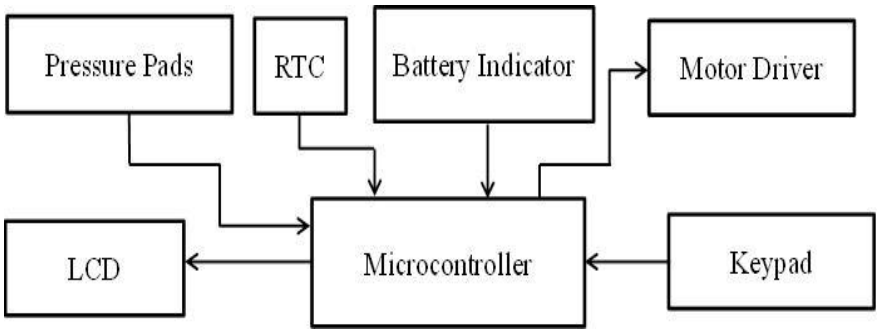
Flow chart of Operation Sequence:



STEP consists of two modules, 1) Data acquisition and steering 2) Data monitoring by IoT.

1) DATA ACQUISITION AND STEERING:

A) BLOCK DIAGRAM:



E) Specifications of Components used:

- After calculating total torque and speed required, we selected 250W PMDC motor.
- After computing the power requirement of each motor, Cytron 30A single channel motor driver is selected. Specifications of motor driver are:

a. Input voltage: 5V to 25V.
b. Peak current: 80A (for 1 sec).
c. Continuous current: 30A.

- Specifications of the microcontroller are:

a. Atmega 2560 is the microcontroller IC.
b. It has inbuilt 3 USART, 8 ADC channels, 1 I2C bus.
c. Maximum 16MHz frequency.
d. Operating voltage: 4.5V to 5.5V.

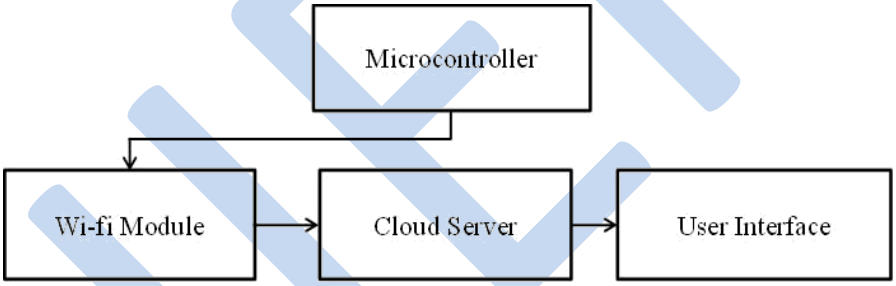
- Rechargeable Li-Po battery with ratings 6 cell and 25C are used in the device.
- Pressure operated force sensors are used as pressure pads.
- ADC from microcontroller is used with voltage divider to measure the battery voltage and it is displayed on LCD.

F) Work Flow:

- To start the device person has to unlock the vehicle by entering correct password.
- When person steps on the device, it measures the weight of person. If weight of person is more than 80 kg device will give over weight signal.
- Device will start gradually thus person will not topple though the vehicle doesn't have handles.
- Vehicle will attain its maximum speed gradually which is 5 km/hr.
- To steer the device person has to shift weight of the body towards that direction.
- After starting the device it will display battery level, date and time.
- Weight of the vehicle is 5 kg. Thus it is easy to carry it in bags and there is no need for parking space.

2) DATA MONITORING BY IOT:

A) BLOCK DIAGRAM:



B) Work Flow:

- To connect any device to the IoT platform user has to create account on the platform.
- For the STEP we are using thinger.io platform.
- Through the device id one can connect the device to the thinger.io.
- We connected ESP8266 module as Wi-Fi module to the thinger.io.
- We used Arduino Mega as our microcontroller.
- Arduino Mega communicates through USART with ESP8266.
- Microcontroller will give the battery voltage, RTC (Real Time Clock) module data to the Wi-Fi module.
- Wi-Fi module will transmit the data to the IoT platform.
- Through the website or mobile application user can monitor the data transmitted by microcontroller to the IoT platform.

CONCLUSION

This paper presents an overview of electronic personal vehicle: STEP. Step is different from other personalized vehicle due to IoT technology. Monitoring the parameters will help in further development of the device. PIN protection will help it from anonymous handling. It is not good for outdoor application and has very low maximum speed than conventional vehicles, but it is a good option for indoor transportation and pollution free as it is battery operated.

ACKNOWLEDGEMENT

We would like to thank Mr. Avinash Magdum for his valuable technical guidance and encouragement throughout this project. We would like to thank Prof. Priya Sawant for her extraordinary support in this project.

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