

Digitization of Speedometer Incorporating Arduino and Tracing of Location Using GPS in Railways

P. John Samuel^[1], P. C. Naveena Shri^[2], S. Ravikumar^[3],
S. Sreenidhi^[4] B. Sugan^[5]

Department of Electrical and Electronics Engineering, Sri Krishna College of Technology Coimbatore, Tamil Nadu

ABSTRACT:

This paper deals with the method of telemetric field which has grown exponentially in recent years. A correct characterization is to handle, analyze the signals from the sensor which switches, positions and detects the speed. Placing the sensor on the wheels of the train, a continuous pulse train of signal will be proportional to train speed and it is sent to Arduino microcontroller to analyze, process and simultaneously data will be stored in memory and displayed. In addition, GPS is used to trace the current location and it is viewed with the help of LCD placed in every compartment. Thus the simulation has been carried out using MATLAB/SIMULINK software. Both the simulation and experimental results under diverse conditions are presented to clearly describe the process of characterization of our system.

Keywords:- Arduino Microcontroller, GPS, Memory, Sensors.

I. INTRODUCTION:

A railway which is one of the major sector in our country is blossomed after the British development of steam locomotive as a viable source of the power in 18th and 19th centuries. Power is provided by locomotives which either draw electric power from a railway electrification system or non-renewable resources. Speed of the railway system is determined only by the highly sensitive electronic device called speedometer, which displays the speed instantaneously and operated by the dynamo. It was invented by the Croatian Josip Belusic in 1888 and was originally called as a velocity meter. It was started to be available in market in 1900s and it has been made as a standard equipment from 1910 onwards.

Charles Babbage has a contribution for creating an early type of speedometer. Speedometer is universally fitted to all motor vehicles, automotives but it will not produce the results not so accurate and highly precision.

Due to advancement in technology, now-a-days we are viewing digitalization all over the world. At present, we tend to use digital speedometer in railways. Our motive and new borne idea is to digitize the speedometer and trace the current location which can be implemented in railway system.

The sensor is placed on wheels of the train which produces the signal. The rotating speed of the wheel depends upon the generation of the square wave signal produced by the sensor. Then the signal is processed and converted into digital using microcontroller. The data received is displayed in

Liquid Crystal Display which is an electronically optical device. They are used to display the characters, except the arbitrary images. Simultaneously, the data is stored in memory.

The Global Positioning System is a space based navigation system that provides location and time information in all weather conditions helps in military, civil, commercial users around the world. The GPS module is used in our project to trace the current position of the train which is also displayed and stored in memory.

II. DESCRIPTION

Hall effect speed sensor is suited in motinary wheels of the train. When the locomotive starts to move, the vibrations will be produced. This vibration produces a square wave signal which is in the form of analog signal. Arduino board consists of six analog input & output pins and 14 digital input & output pins. These analog signals read by the analog pins of the Arduino board (A4,A5) whereas other pins are left free. This Arduino board here functions as the convertor i.e it converts the analog signals to digital signals. The digital signals from the digital pins (D1) & Serial pins (SCL & SDA) of Arduino board after digitalizing the signals, they are sent to the LCD for displaying the speed which are sensed by the hall effect speed sensor.

Alternatively, digital pin (D10) is connected to the external memory then the numerical value will get stored in EEPROM (record all the values which are sensed). GPS is used to trace the location where it is currently moving & this will also get displayed in LCD. Digital pin D2 is

connected to the backlight switch which performs the controlling function and further it improves the intensity and magnitude of light.

III. BLOCK DIAGRAM:

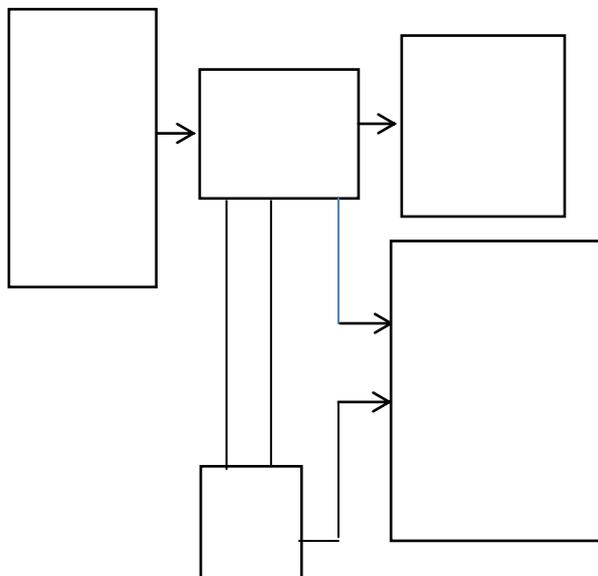


Fig.1 Block diagram

IV. COMPONENTS:

A. HALL EFFECT SENSOR:

Hall sensors are used to calculate time and the speed of wheels and shafts. It is also used in applications such as for internal combustion engine ignition timing, tachometers and anti-lock braking systems. They are mainly used in brushless DC electric motors to detect the position of the permanent magnet.

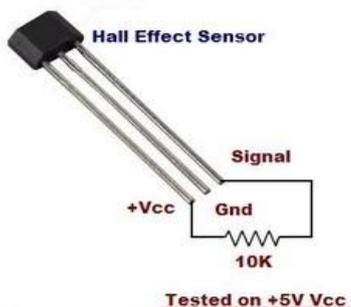


Fig.2 Hall effect sensor

In our project, hall effect sensor is implemented in the wheels of the train and when train starts to move, wheels rotate. This rotatory motion produces a magnetic field in which a beam of charge particles is passed through it. This results in a production of hall voltage which is the difference between the positively and negatively charged particles.

B. ARDUINO:

Arduino is a open-source electronics platform based on flexible, easy-to-use hardware and software. It is a tiny computer system that can be programmed with our instructions to interact with various forms of input and output. It can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motor and its actuators. The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. There are various types of Arduino boards namely

1. Arduino uno
2. Arduino Due
3. Arduino Leonarde
4. Arduino Mega
5. Arduino Nano

The current model, the uno, is quite small in size compared to the average human hand.

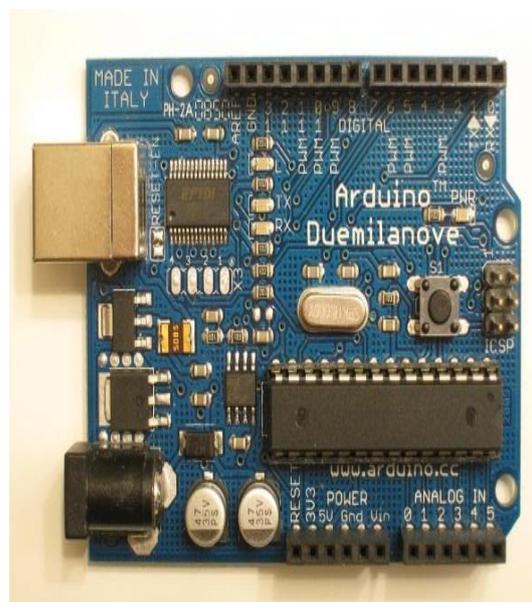


Fig.3 Arduino board

Hardware:

Microcontroller:

The microcontroller used in Arduino is ATMEGA 328. It is a tiny computer that contains a processor to execute instructions, includes various types of memory to hold data and instructions & provides various avenues of sending and receiving data.

Fig.4 Schematic diagram

Software:

Arduino can be installed and used in any operating system platform. Arduino projects can be simulated with a tool called an Integrated Development Environment(IDE).

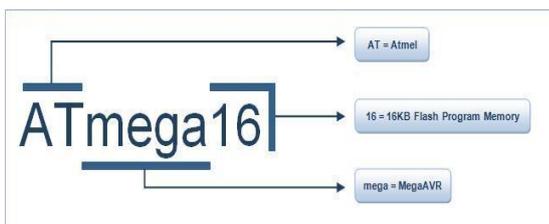
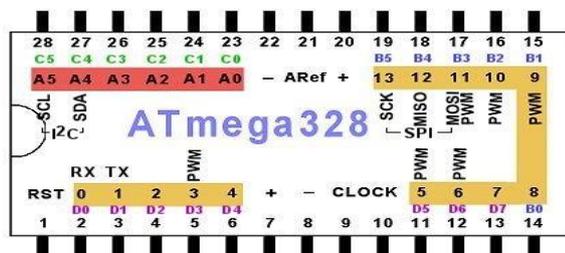


Fig.5 Pin diagram of micro controller

C. LCD:



Digital Input/Output
 Analog / Digital

Lcd modules that display characters such as text and numbers are the most inexpensive and simplest to use all of LCDs. A liquid-crystal display (LCD) is a flat panel display, electronic display that uses the light modulating properties of liquid crystals. This crystal donot emit light directly.



Fig.6 LCD Display

LCD is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. LCD works under electro-optical modulation technology.

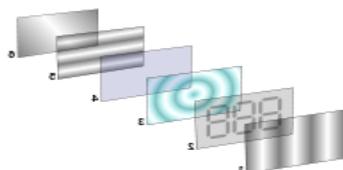


Fig.7 Reflective twisted nematic liquid crystal display

D. EEPROM:



Fig.8 Memory chip

Serial Electrically Erasable PROM is capable of operation across a broad voltage range(1.7V to 5.5V). It has been developed for advanced, low power applications such as personal communication or data acquisition. This device also has a page write capability of upto 64 bytes of data. It is self time erase/write cycle. Functional address lines allow upto 8 devices on the same bus, for upto 2M bit address space. In our project we use I²C protocol.

E. GPS:

The GPS (Global Positioning System) is the space-based global navigation satellite system that provides reliable location and time information in all weather and at all times and anywhere on or near the earth when and where there is an unobstructed line of sight to four or more GPS satellites. It is a space based navigation system that sends data from satellites orbiting earth to GPS receivers on the ground that can use that data to determine position and the current time anywhere on the earth. It is maintained by the United states government and is freely accessible by anyone with a GPS receiver.



Fig.9 GPS Shield

VI. CIRCUIT DIAGRAM:

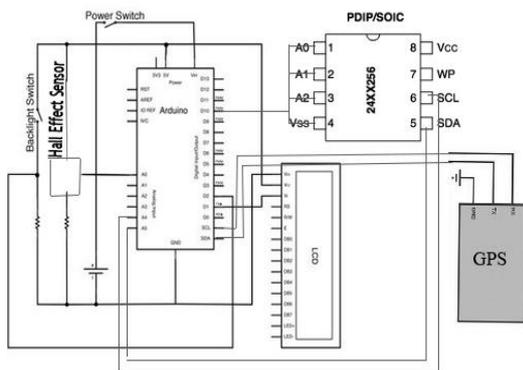


Fig.10 Circuit diagram

VI. WORKING:

Hall effect speed sensor is suited in motionary wheels of the train. When the locomotive starts to move, the vibrations will be produced. This sensor senses the vibration which is in the form of analog signal.

The analog signals are read by the analog pins of the Arduino board(A0). Analog pins (A4,A5) are connected to the SCL &SDA pins of the memory. This Arduino board here functions as the convertor (i.e) it converts the analog signals to digital signals.

After digitalizing the signals, they are sent to the LCD for displaying the speed which are sensed by the hall effect speed sensor. Digital pin (D1) of the arduino board is connected directly to the display whereas (D2) is connected to backlight switch and then crystal display. Alternatively, this numerical value will get stored in EEPROM (record all the values which are sensed) by connecting digital (D10) pin of the board to analog pins of the memory. GPS is used to trace the location where it is currently moving & this will also get displayed in LCD.

VII. SIMULATION RESULTS:

BEFORE OPERATION:

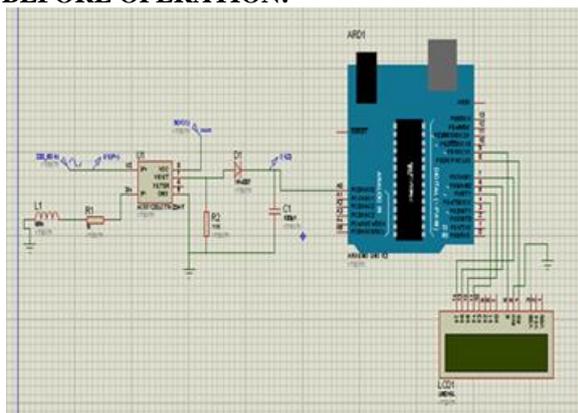


Fig.11 Kit in off condition

AFTER OPERATION:

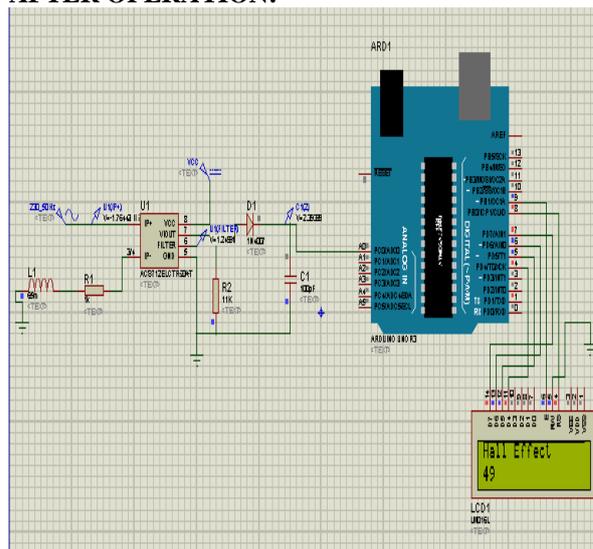


Fig.12 Kit in on condition

The hall effect speed sensor is placed on the wheels of the train. When the train starts, wheel starts to rotate, then the square wave is generated. The rotating speed of the wheel depends upon the generation of the square wave. Then the sensor output is transferred to Arduino. The Arduino receives the data from the sensor which is in analog and converted into digital form. The data received from the Arduino is displayed by LCD. Simultaneously data will be stored in EEPROM. GPS is implemented to track the current location. At last, LCD glows with the output.

VIII. CONCLUSION

In the existing system, speed of the train is determined by the highly sensitive device such as analog meters. This meter produce the result which is not so accurate and reliable.

IX. FUTURE SCOPE

In this paper, we have proposed a novel method of digitalizing the speedometer and incorporating arduino software tool possessed by the embedded system. Speed of the train is measured, digitalized and displayed by liquid crystal display(LCD). In addition, there is a special feature which is implemented in our system is tracing of current location of the train, which is done by global positioning system(GPS). The GPS module is embedded in the microcontroller placed in the train. In future, this idea could be developed with features such as accident detection and prevention with GPS tracing.

REFERENCES

- [1]. Electronic Track Map Building for Satellite Based High Integrity Railway Train Positioning – Wang Jian, Liu Jiang
- [2]. Research on Modelling and Simulation of Vehicle-on-Board Automatic Train Protection Subsystem of Communication Based Train Control System - Lei Chen, Bin Ning, Tian-Hua Xu
- [3]. Characterization and Validation of Telemetric Digital Tachometer Based on Halleffect Sensor- Jorge Antonio, Sergio Gonzalez-Duarte
- [4]. Intelligent Fatigue Detection and Automatic Vehicle Control System- Monali Gulhane,P.S.Mohod
- [5]. Efficiency Improvement for Conventional Rectangular Horn Antenna By Using EDG Technique- S.Kampeephat, R.Wongsan
- [6]. Vehicle Speed Control System Using GSM/GPRS- B.Devikiruba
- [7]. Microcontroller-based Speedometer-Cum-Odometer- Arun kumar vadla