

**DESIGN AND IMPLEMENTATION OF MICROCONTROLLER BASED
SPEED DATA LOGGER**

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ABSTRACT

In this project, a data logger for specific application has been designed. This paper discusses a vehicle speed measurement and display/recording system using IR sensor as speed sensor. The system mainly consists of two parts namely Tachometer based on IR Sensor and recording display system using Arduino microcontroller. A battery operated RTC chip keeps the track of real time clock information and speed is displayed on LCD and written on the SD Card which is interfaced to the microcontroller. Later, SD card can be extracted and excel sheet can be generated of the recorded data.

KEYWORDS – ATmega328, Audino, Data Logger, SD Card, Speed.

INTRODUCTION

A data logger is an attractive alternative to either a recorder or data acquisition system in many applications. Data logging is the measuring and recording of physical or electrical parameters over a period of time. The data can be temperature, strain, displacement, flow, pressure, voltage, current, resistance, power, and many other parameters. Its only task is to acquire data and save the data into its memory. It can be connected to a computer at any time to allow its collected data to be transferred, processed and analyzed whenever required.

Speed is the indispensable traffic safety issue, probably due to cleared perceived relationship between vehicle speed, human capabilities and their limitations. The cases of rash driving and accidents due to over speeding are increasing day by day and require serious concern. After any incident, the police doesn't have exact proof of the speed of the vehicle at that time.

So, it becomes necessary keep a track of speed of vehicles. One solution for this is to design a microcontroller based system which will do this task automatically without any human involvement or interference. The main applications of this system will be: It can be used as a method to verify the driving skills of a driver by Driving License Authorities. It can also be used in cases of vehicle accident investigations.

1. COMPONENTS OVERVIEW

1.1 Arduino Uno

The Arduino Uno is a ATmega328 microcontroller based board which has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. The ATmega328 has 32 KB flash memory and also has 2 KB of SRAM and 1 KB of EEPROM. It supports I2C communication using I2C bus and SPI communication using SPI library[1].

The Arduino Uno can be powered via the USB connection or with an external power supply. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12V [2].

1.2 IR Sensor

An Infrared Sensor is used to detect obstacles present in front of it and can also used to differentiate between the different colors depending on the configuration of the sensor. Its circuit consists of two parts- the emitter circuit and the detector circuit. The sensor emits IR light and gives a signal when it detects the reflected light [3].

We calculated speed of the rotating disc using a mechanism that uses an infrared (IR) light emitting diode and a photo detecting diode. The IR LED transmits an infrared light towards the rotating disc and the photo detecting diode receives the reflected light beam. A tiny piece of white paper glued to the rotating disc is just enough to reflect the incident IR light when it passes in front of the sensor, which happens once per rotation.

1.3 RTC

A real time clock is just like a watch- it runs on a battery and keeps time for you even when there is a power outage. It can keep track of long timelines, even if you reprogram

your microcontroller or you disconnect it from USB or a power plug. The RTC we will be using is DS1307 because of its low cost, quick to assemble, can run for years on a very small coin cell and works best with 5V- based chips such as the Arduino [4].

1.4 SD Card

A memory card (flash card) is a solid state data storage electronic device. SD cards keep the saved data even after the memory device is disconnected from its power source. SD Cards are available in three different sizes: normal SD, mini SD, micro SD card [5]. The communication between the microcontroller and the SD card uses SPI mode. The SD card is used to save the collected data and data is stored in a file on the SD card with time stamping. The data is Excel compatible and we can select the data logging interval. We have used SD card module in this project.

1.4 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. LCD is basically used to display something during the working of the system. The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. We interfaced LCD with microcontroller to display the speed, date and the time on LCD screen during the working of the system, so as we can make clear that the system is working properly by comparing the displayed data with the data saved in the SD card.

2. ARCHITECTURE

2.1 Block Diagram

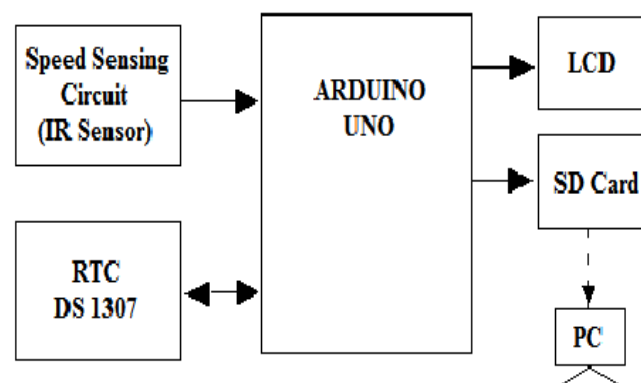


Figure 1. Block Diagram

The complete system for speed measurement using microcontroller can be explained with the help of block diagram as shown in Fig. 1. It consists of five main blocks: Arduino microcontroller, Speed Sensing Circuit, RTC, SD Card and LCD display [6]. The Speed sensing circuit will count the number of rotations of the rotating disc and generate a pulse for every rotation and these pulses are given as input to the microcontroller. The microcontroller converts these pulses into rpm using a specific procedure. RTC chip keeps the record of real time information during the sensing period that is the present date and time at which the speed is being measured. Microcontroller now receives date, time and speed as the quantities to be saved. The speed is written on SD card with real time clock stamp [7]. At the same time the saved data is displayed on the LCD screen for instant monitoring. We have set the data logging interval to be 1 minute. The collected data can then be imported to a spreadsheet package such as Excel and statistical analysis can be carried out or graphs of the collected data can easily be drawn [8].

2.2 Circuit Diagram

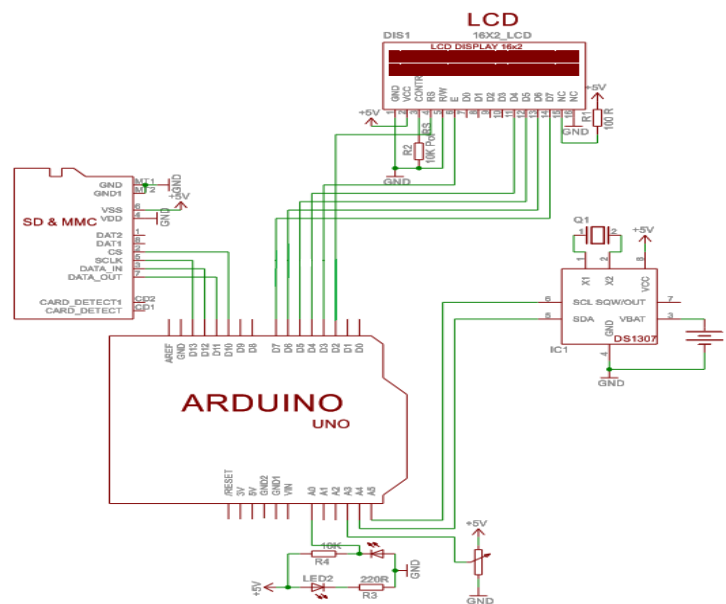


Figure 2. Circuit Diagram

The hardware connections for the above explained diagram can be explained as follows.

The IR transmitter is connected to 5V VCC and GND through 220 ohm resistor. This IR signal is received by a photodiode connected at analog input A0 pin of Arduino. Also SCL OUT and SDA pins of RTC DS1307 are connected to A5 and A4 pins of Arduino respectively. For interfacing the SD Card, the Arduino SD card module is used. The data can

be received in the controller from the memory card through data out pin 7 of SD CARD which is connected to D13 which is digital input pin of Arduino module [8]. Similarly data can be sent to the memory card through pin D12 of Arduino which is connected to DATA IN, pin 3 of SD Card module. The memory card can be selected using D10 pin connected to pin 2 of SD card. The LCD is connected using pins D2-D7. The necessary resistors required for the working of LCD are as shown in circuit diagram. All the modules are connected to GND and 5V power supply as required.

3. METHODOLOGY

The software used to write code and upload it on to the board is Arduino IDE. The open source Arduino environment makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X and Linux. The Arduino Uno can be programmed with the Arduino software. Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board)..

The ATmega328 on the Arduino Uno comes preburned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

The algorithm for how the code of the program will work is as follows:

- Step 1 Start of the main program on power up.
- Step 2 Set the initial value of LCD.
- Step 3 Set the initial value of RTC.
- Step 4 Set the initial value of SD card.
- Step 5 Check if SD card is inserted or not.
- Step 6 If not, go to Function 1.
- Step 7 Else display on LCD "SD card is inserted".
- Step 8 Start Timer1 for 1 minute.
- Step 9 Count number of pulses.
- Step 10 Stop counting when flag of Timer1 goes high.
- Step 11 Call Function 2 to convert rpm into km/hr.
- Step 12 Read date and time from RTC.
- Step 13 Save the data (Date, Time, Speed) in SD card and save the file in ".csv" format.
- Step 14 Go to step 8.

- Function 1: Display on LCD “SD card not inserted”
Go to step 5.
- Function 2: Read the value of rpm.
Speed = $2\pi r \times \text{rpm} \times 60/1000$ km/h.
Go to step 12.

At the beginning of the program port directions are configured and LCD and SD card are initialized. The program then checks to find out whether the SD card is inserted, if not, LCD displays “SD card not inserted”. When the device comes in run mode, RTC date and time are read, speed data is read and then all of this data is written to the opened file in the SD card.

4. CONCLUSION

The overall goal was to design and develop a system that can save the speed of the vehicle with date and time. The system developed achieved this goal. It was compact in size consumed little power and its only function was to save the data into SD card which can later be retrieved. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the system. The system has been tested to function automatically.

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