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Traffic Signal Optimization and Vehicle Speed Control at Signalized Intersection

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ABSTRACT

The aim of this project is to promote the significant improvement of transportation efficiency and fuel economy by the cooperative method of traffic signal control and vehicle speed optimization. It formulates the optimal traffic signal timing and vehicles arrival time to minimize the total travel time of all vehicle and to optimize the engine power to minimize the fuel consumption of individual vehicles.

Keywords : Speed Control, Arduino Microcontroller, D.C Motor

I. INTRODUCTION

Vehicle is an integral part of our daily life and its growth incremented day by days. The scenario of increased vehicle density in India from 2001 to 2015 is shown in Fig.1.Increased vehicle density and over speed driving causes more accidents. The statistical reports of occurred accidents are shown in Fig.2 [1]. There are lot of reasons behind it. These are increased rate of vehicle density, the Indian roads are not changed up to897 the expecting level excluding the national high way, multiple functioning at the time of driving the vehicle that is like use of mobile, drink while driving, disobey of traffic rules and regulation, crossing speed limits which is dangerous for our own safety and that of others and many more. Out of them speed limit at specific areas are very important and it is displayed by traffic control system in sign form. For example, in residential areas and market places ideal speed should be maximum up to 20 km/hr to 30 km/hr. Secondly in the regions of school and hospital speed limits are kept up to 30 km/hr to 40 km/hr and so on. However, unfortunately most of the drivers are not following the rule of speed limit at specific areas and causes the accidents. These accidents are going on increasing because the whole control of the speed of the vehicle is in driver hand. They do not reduce and control the speed in restricted areas as per rules.

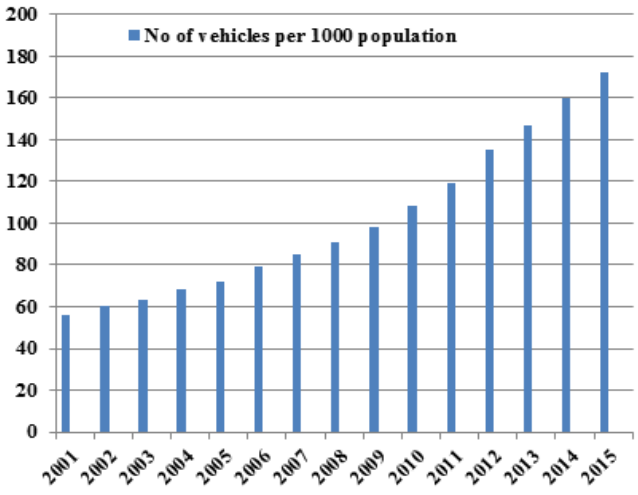

Figure 1. Number of registered motor vehicle acrossIndia from 2001 to 2015 (per 1,000 populations)

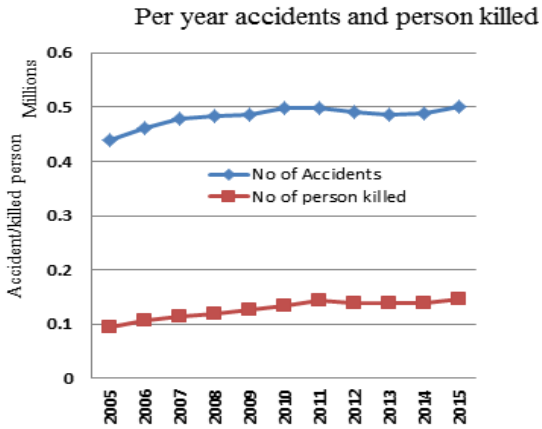

Figure 2 : Number of accidents occurred and dead

II. SYSTEM DESCRIPTION

1.Microcontroller

Arduino is a great tool for developing interactive objects, taking inputs from a variety of switches or sensors and controlling a variety of lights, motors and other outputs. Arduino projects can be stand-alone or they can be connected to a computer using USB. The Arduino will be seen by the computer as a standard serial interface. There are serial communications APIs on most programming languages so interfacing Arduino with a software program running on the computer should be pretty straight forward. The Arduino board is a microcontroller board, which is a small circuit that contains a whole computer on a small chip the microcontroller. There are different versions of the Arduino board: they are different in components, aim and size. Some examples of Arduino boards are: Arduino Diecimila, Arduino Duemilanove, Freeduino, Arduino NG and lot more. Arduino schematics are distributed using an open license so anyone is free to build his own Arduino compatible board. The Arduino name is a registered trademark so you won't be able to call your hacked board Arduino.

It is an open-source project, software/hardware is extremely accessible and very flexible to be customized and extended. It is flexible, offers a variety of digital and analog inputs, *SPI* and serial interface and digital and *PWM* outputs. It is easy to use, connects to computer via USB and communicates using standard serial protocol, runs in standalone mode and as interface connected to PC. It is inexpensive and comes with free authoring software.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and VIN pin headers of the POWER connector.

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 12 volts.

2.ZigBee Tx/Rx

The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band.

The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 kB aud. ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, ZigBee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters' line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128-bit symmetric encryption keys.) ZigBee has a defined rate of 250 k bit/s, best suited for intermittent data transmissions from a sensor or input device.

ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive

3. LCD display

In this project, the LCD module and Arduino are interfaced in the 4-bit mode. This means only four of the digital input lines (DB4 to DB7) of the LCD are used. This method is very simple, requires less connections and you can almost utilize the full potential of the LCD module. Digital lines DB4, DB5, DB6 and DB7 are interfaced to digital pins 5, 4, 3 and 2 of the arduino. The 10K potentiometer is used for adjusting the contrast of the display. 56ohm resistor R1 limits the current through the back light LED. The arduino can be powered through the external power jack provided on the board. +5V required in some other parts of the circuit can be tapped from the 5V source on the arduino board. The arduino can be also powered from the PC through the USB port.A Liquid Crystal Display commonly abbreviated as LCD is basically a display unit built using Liquid Crystal technology. When we build real life/real world electronics based projects, we need a medium/device to display output values and messages. The most basic form of electronic display available is7 segment displays – which has its own limitations. The next best available option is Liquid Crystal Displays which comes in different size specifications. Out of all available LCD modules in market, the most commonlyused one is 16×2 LCD Module which can display 32 ASCII characters in 2 lines (16 characters in 1 line). Other commonly used LCD displays are 20×4 Character LCD, Nokia 5110 LCD module, 128×64 Graphical LCD Display and 2.4 inch TFT Touch screen LCD display. There are many different LCD modes.

Block diagram

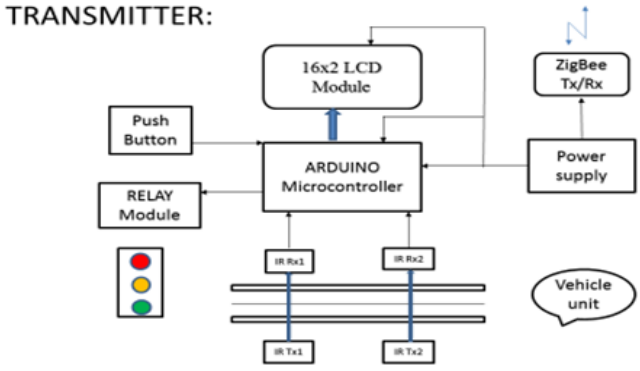

Fig .1 Transmitter Block

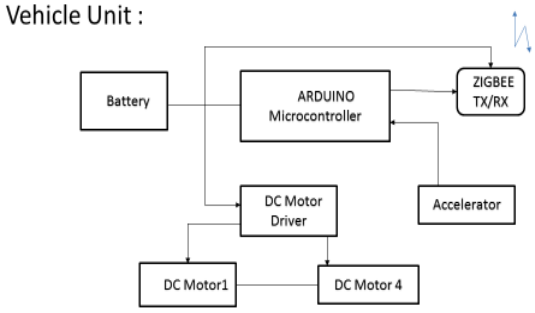

Fig 2. Receiver Block

4.D.C Motor

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

Keep the force finger, middle finger and thumb of the left hand mutually perpendicular to one another. If the fore finger indicates the direction of magnetic field and middle finger indicates direction of current in the conductor, then the thumb indicates the direction of the motion of conductor.

Motor theory

- There are two conditions necessary to produce a force on a conductor: - The conductor must be carrying current. - The conductor must be within a magnetic field.
- The right-hand rule for motors states that when the forefinger is pointed in the direction of the magnetic field lines, and the center finger is pointed in the direction of current flow, the thumb will point in the direction of motion.
- The function of torque in a DC motor is to provide the mechanical output to drive the piece of equipment that the DC motor is attached to.
- Torque is developed in a DC motor by the armature (current-carrying conductor) being present in the motor field (magnetic field). CEMF is developed in a DC motor by the armature (conductor) rotating (relative motion) in the field of the motor (magnetic field).
- The function of the voltage that is developed in a DC motor (CEMF) opposes the applied voltage and results in the lowering of armature current.
- The speed of a DC motor may be changed by using resistors to vary the field current and, therefore, the field strength.

5.PWM

PWM is a way of digitally encoding analog signal levels. Through the use of high-resolution counters, the duty cycle of a square wave is modulated to encode a specific analog signal level. The PWM signal is still digital because, at any given instant of time, the full DC supply is either fully on or fully off. The voltage or current source is supplied to the analog load by means of a repeating series of and off pulse.

The on time is the time during which the DC supply is applied to the load and the off time is the periods during which that supply is switched off. Given a sufficient bandwidth, any analog value can be encoded with PWM. Many micro controllers include PWM controllers. For example, Microchip's PIC16C67 includes two, each of which has a selectable on-time and period. The duty cycle is the ratio of the on-time to the period.

PWM is employed in a wide variety of applications, ranging from Measurement and communication to power control and conversion. As a concrete example consider a **PWM**-controlled brake. To put it simply, a brake is a device that clamps down hard on something in many brakes; the amount of clamping pressure is controlled with an analog input signal. The more voltage or current that's applied to the brake, the more pressure the brake will exert. The output of a **PWM** controller could be connected to a switch between the supply and the brake to produce more stopping power, the software need only increase the duty cycle of the **PWM** output.

6.SPTD relay

The SPDT Relay(30A) is a high quality Single Pole Double Throw Relay(SPDT). The Relay consists of a coil, 1 common terminal, 1 normally closed terminal, and one normally open terminal.

When the coil of the relay is at rest (not energized), the common terminal and the normally closed terminal have continuity. When the coil is energized, the common terminal and the normally open terminal have continuity. This relay's coil is rated up to 5V and the contact is rated up to 30A (@250VAC, 30VDC). You can use it to control high current devices.

III. SOFTWARE DESCRIPTION

1.Arduino IDE

Arduino is an open-source project, enabling hobbyists to easily take advantage of the powerful Atmega chips. The Arduino IDE is the software where you can write code and upload it to the Atmega chip.

The code is then executed on the chip. Most 3D-printer electronics are Arduino-compatible, they use the Atmega chip and enable the user to upload their code using Arduino. This includes megatronics, Minitronics and RAMPS.

Before you can start using the electronics you need software 'firmware', that translates machine instructions(gcode) into actual movements. There are few options here, including Marlin and Sprinter and Repeater.

IV. CONCLUSION

In this work the prototype design of a system that can deliver road sign to computer's vehicles and can control the speed of the vehicle has been demonstrated. This project is very simple which is durable and is of low cost. It consumes less power. The driver can get information without any kind of distraction. This prototype works even in bad weather conditions. This is easy to implement on present system which ensures maximum safety for drivers, passengers and pedestrians.

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