Vehicle Collision Avoidance with Dynamic Speed Governor

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Abstract- Automotive vehicles must be equipped with collision avoidance systems for predicting the potential collision sequences, such as another vehicle or a pedestrian. Upon detecting a potential collision, such systems initiate an action to avoid the collision and/or provide a warning inside the cabinet.

This system consist of a distance measuring system using ultrasonic waves utilizing the PIC 16f877A microcontroller and transmits a burst of ultrasonic waves along the vehicle's direction and then receives the corresponding echo from the objects ahead. An ultrasonic sound sensor is used to detect the arrival of the echo to the system. The time taken for the ultrasonic burst to travel the distance from the system to the object and back to the system is accurately measured by the microcontroller. It also provides a warning signal to the driver if the distance between vehicle and obstacle crosses a particular limit. It also monitors the speed of the vehicle and if the speed exceeds the limit of a particular obstacle distance, it throws a warning.

Keywords – Collision, Ultrasonic, Microcontroller

I. INTRODUCTION

This report describes a distance measuring system based on ultrasonic sound utilizing the PIC 16f877A microcontroller. Using the distance measured, the micro-controller will make the vehicle stop suddenly if the vehicle is about to hit any obstacle. With the help of this technology accidents can be avoided. The system throws a burst of ultrasonic sound waves along the vehicle direction and then receives the corresponding echo from any obstacle. An ultrasonic sound sensor is used to detect the arrival of the echo to the system. The time taken for the ultrasonic burst to travel the distance from the system to the subject and back to the system is accurately measured by the microcontroller.

Different types of vehicle speed limiters are in current use for regulating traffic especially across roads near populated areas such as hospitals, malls and schools. This project "DYNAMIC SPEED GOVERNER" is a new method by which vehicle speed is controlled externally rather than internally. The speed measurement and control is accomplished via two PIC16F877As with a RF transmitter and a receiver.

II. PROPOSED ALGORITHM

Equipment and their Specifications:
Microcontroller: PIC 16F877A
Software: MPLAB IDE
Compiler: CCS C compiler
CAD Software: EAGLE **(E**asily **A**pplicable **G**raphical **L**ayout **E**ditor**)**
RF Transmitter: U2STT-315; 433 MHz; 100m
RF Receiver: U2STR-315; 433 MHz
Display: LCD; RAM – 64B

MPLAB IDE

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on

MS Windows, is easy to use and includes a host of free software components for fast application development and supercharged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

A development system for embedded controllers is a system of programs running on a desktop PC to help write, edit, debug and program code- the intelligence of embedded systems applications in to a microcontroller. MPLAB IDE, runs on a PC and contains all the components needed to design and deploy embedded systems applications.

MPLAB IDE Programmer's Editor helps write correct code with the language tools of choice. The editor is aware of the assembler and compiler programming constructs and automatically "color-keys" the source code to help ensure it is syntactically correct. The Project Manager enables you to organize the various files used in your application source files,processor description header files and library files.

Language tools run into errors when building the application, the offending line is shown and can be "double-clicked" to go to the corresponding source for immediate editing. After editing, press the "build" button to try again. Often this write-compile-fix loop is done many times for complex code, as the subsections are written and tested.

Once the code builds with no errors, it needs to be tested. MPLAB IDE has components called "debuggers" and free software simulators for all PICmicro and PIC devices to help test the code. Even if the hardware is not yet finished, you can begin testing the code with the simulator, a software program that simulates the execution of the microcontroller.

Once the hardware is in a prototype stage, a hardware debugger, such as MPLAB ICE or MPLAB ICD 2 can be used. These debuggers run the code in real time on your actual application. The MPLAB ICE physically replaces the microcontroller in the target using a high-speed probe to give you full control over the hardware in your design. The MPLAB ICD 2 uses special circuitry built into many Microchip MCUs with Flash program memory and can "see into" the target microcontrollers program and data memory. The MPLAB ICD 2 can stop and start program execution, allowing you to test the code with the microcontroller in place on the application. After the application is running correctly, you can program a microcontroller with one of Microchip's device programmers, such as PICSTART Plus or MPLAB PM3. These programmers verify that the finished code will run as designed. MPLAB IDE supports most PICmicro MCUs and every PIC Digital Signal Controller.

CCS C COMPILER

The compiler contains Standard C operators and built in libraries that are specific to the PIC registers. Access to hardware features from C. The compiler includes built-in functions to access the PIC microcontroller hardware such as READ_ADC to read a value from the A/D converter. Discrete I/O is handled by describing the port characteristics in a PRAGMA. Functions such as INPUT and OUTPUT_HIGH will properly maintain the tri-state registers. Variables including structures may be directly mapped to memory such as I/O ports to best represent the hardware structure in C.

The microcontroller clock speed may be specified in a PRAGMA to permit built in functions to delay for a given number of microseconds or milliseconds. Serial I/O functions allow standard functions such as GETC and PRINTF to be used for RS-232 like I/O.

The compiler runs under Windows 95, 98, ME, NT4, 2000, XP, Vista or Linux. It outputs hex and debug files that are selectable and compatible with popular emulators and programmers including the MPLAB IDE for source level debugging.

Cad soft – EAGLE

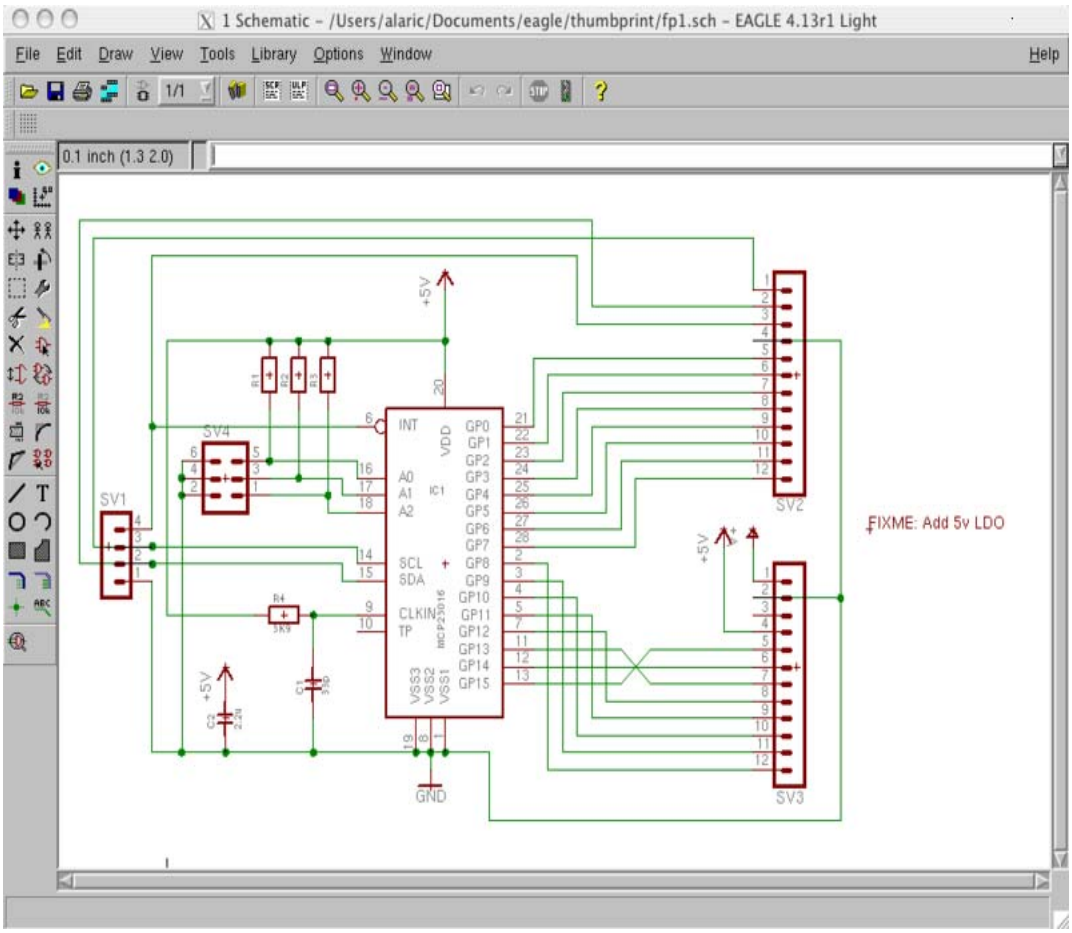


Fig.1.1: Cad soft-eagle

EAGLE (**E**asily **A**pplicable **G**raphical **L**ayout **E**ditor) is a proprietary ECAD program produced by Cad Soft in Germany (American marketing division: Cad Soft USA). It is very commonly used by private electronics enthusiasts, because there is a free limited version for non-profit use and it is available in English and German. Cad Soft has released versions for Microsoft Windows, Linux, and Mac OS X.

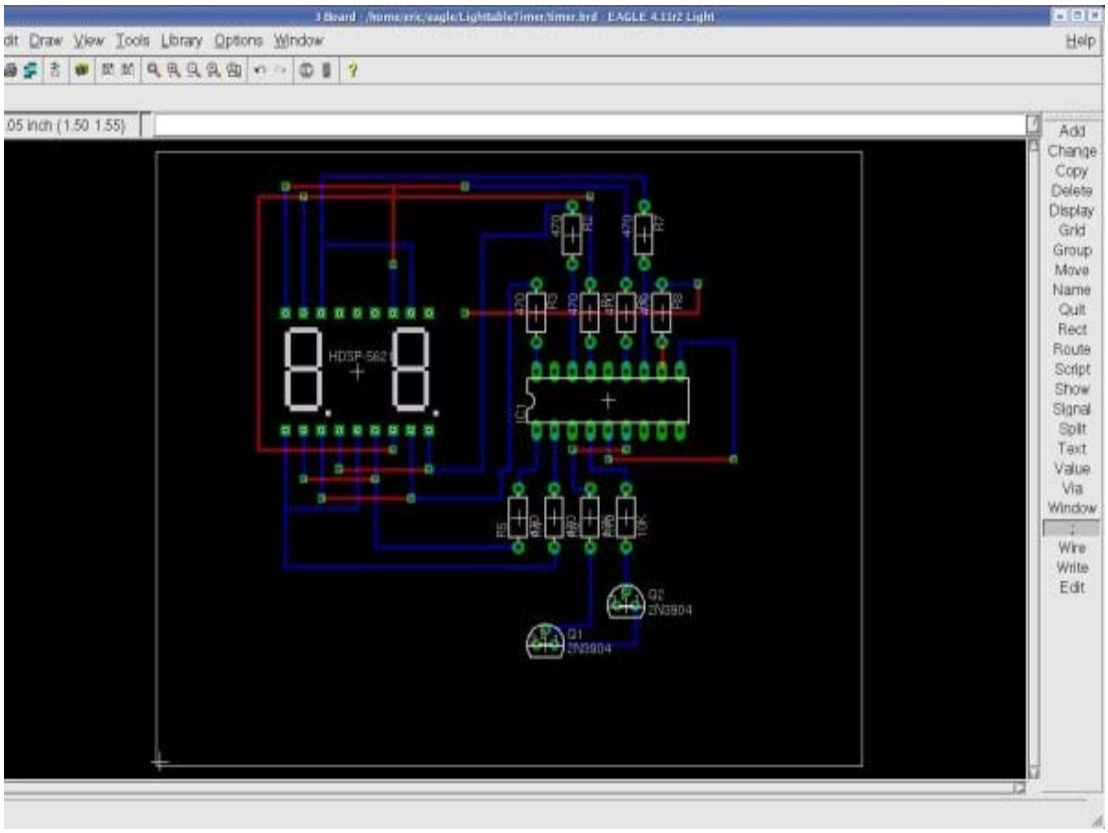


Fig.1.2. Eagle soft

EAGLE contains a schematic editor, for designing circuit diagrams and a PCB layout editor, which allows back annotation to the schematic. EAGLE includes a basic but functional autorouter, or alternatively manual routing can be performed. PCBs designed in EAGLE are accepted by a large amount of PCB fabrication houses without the need to export. EAGLE is very popular with hobbyists because both a basic free edition (with a lower feature set) and a low cost non-profit edition are available.

II. LITERATURE REVIEW

The new speed limiting system presented in this project combines several pioneering techniques that integrate wireless technologies in order to implement a reliable speed control system. This proposed system can be easily implemented near different populated areas. The power of the proposed system lies in its flexibility and capability of development with little hardware changes such as changing the speed limits and speed control methods using the software of the base station in negligible amount of time.

The proposed system is based on microcontroller technology for collecting data related to speed and transmitting it through a transceiver to a base station that analyzes the transmitted data and takes appropriate decisions related to speed limit and control requirements.

Speed Governor regulates the top speed and/or maximum rpm of a vehicle, whether it is electronically or mechanical. The governor is emplaced by the manufacturer to meet laws of the nation is which the vehicle will be sold, protect the drivers from operating at unsafe speed, or to protect the car from being driving beyond its physical or mechanical threshold

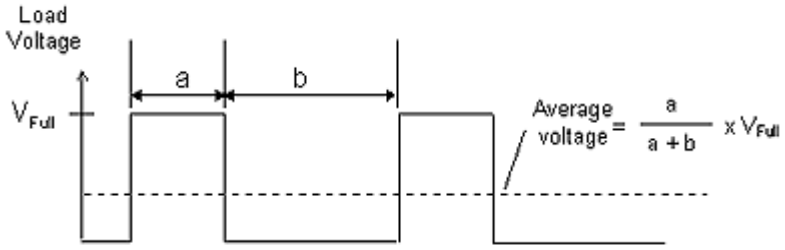
III. WORKING OF THE SYSTEM

The dynamic speed governor consist of mainly two parts:- the transmitter and receiver. The system is mainly based on micro controller technology for collecting data related to speed and transmits the data to the micro controller using RF communication. The micro controller analyses the transmitted data and takes appropriate decisions related to speed limit and control requirements.

The dynamic speed governor will be needed in populated areas such as hospitals, malls and schools for regulating traffic. The RF transmitter of the system is mounted on the signal board and the micro controller of the transmitter part always sense the speed limit of the area for that the speed limit will be stored in the micro controller. The speed limit of the vehicle will be transmitted using RF transmitter to the approaching vehicles.

An RF receiver is kept inside the vehicle and the receiver accepts the incoming signals and then feeds the limit of speed as an input to a comparator. An RPM meter is used to transform the mechanical rotational movement of the vehicle into an electrical signal and using this method the speed of the approaching vehicle can be detected. This calculated speed from the RPM meter is given to the next input pin of the comparator.

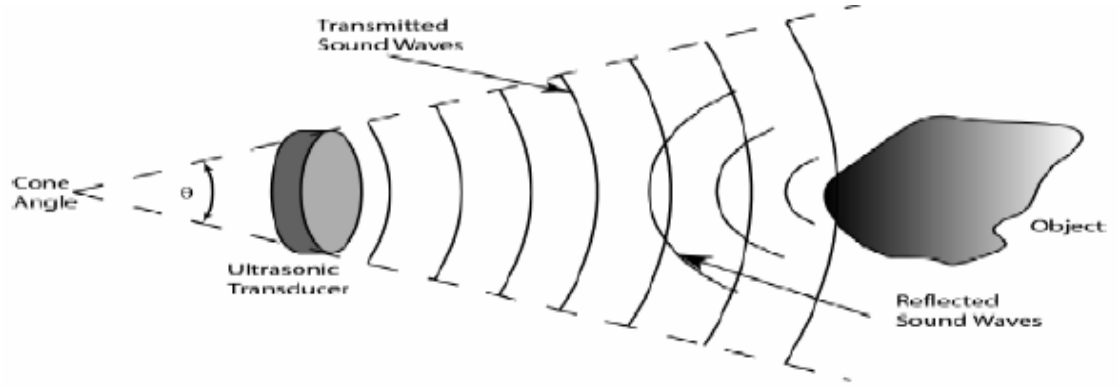
At the comparator both speed given to the both input pin is compared and if the speed of the vehicle is greater than the speed limit the controller will reduce the speed of the vehicle to the limit by using PWM characteristic of the micro controller.



ULTRASONIC SENSORS

Ultrasonic sensors are commonly used for a wide variety of noncontact presence, proximity, or distance measuring applications. These devices typically transmit ultrasonic sound toward a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound in the medium.

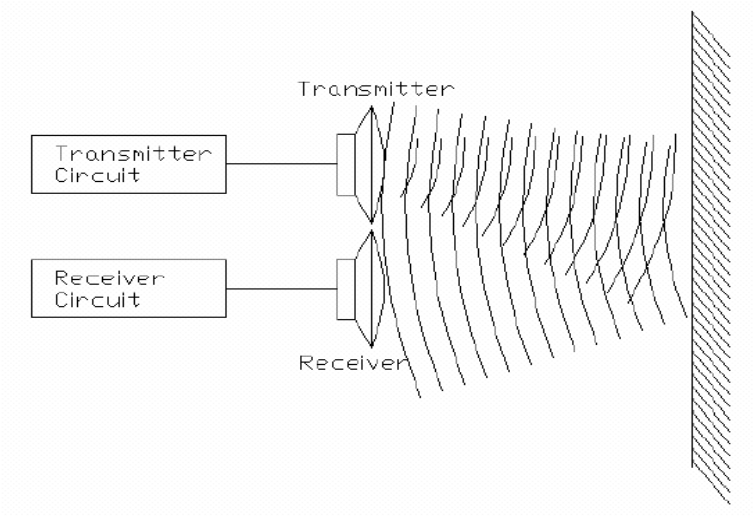
The wide varieties of sensors currently on the market differ from one another in their mounting configurations, environmental sealing, and electronic features. Acoustically, they operate at different frequencies and have different radiation patterns. It is usually not difficult to select a sensor that best meets the environmental and mechanical requirements for a particular application, or to evaluate the electronic features available with different models.



The principle of working of an ultrasonic sensor is easy. The sensor transmits ultrasonic sound waves and waits for reflected sound waves. After receiving reflected sound wave or usually named echo, sensor detects the distance in different ways. Triggered the sensor and then wait for echo pulse. Measuring echo pulse width is important for us because 30 µs means us 1 cm.

Transmitter and Receiver pair

It consists of a transmitter and receiver pair on the device. There are two different transducers for transmitter and receiver. The transmitter transmits and the receiver waits for the reflected signals. The following figure illustrates the transmitter/receiver pair.



LCD MODULE

The LCD module is a parallel interface sixteen pin module. The first three pins of LCD module are used for contrast adjusting. Here the first pin is connected to ground, second to the voltage supply and third to the variable resistor. The pins, seven to fourteen are data lines (D0 to D7). In this particular circuit the data lines D4 to D7 are used because the LCD driver available is 4 line data bus. 15th pin is connected to the 5 volt supply. Pin 4, 5, 6 are control pins, R/W, RS and enable respectively. 16th pin is connected to the ground through a transistor. The voltage from pic16f877a turn on the transistor and it in turn turns on the LCD backlight .Resistor R9 controls the voltage supplied to the transistor.

POWER SUPPLY

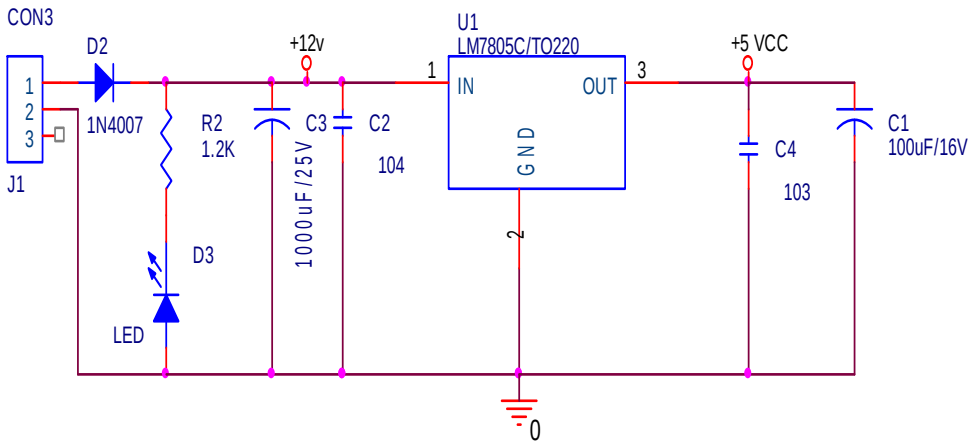


Figure 2.13 Circuit diagram of power supply

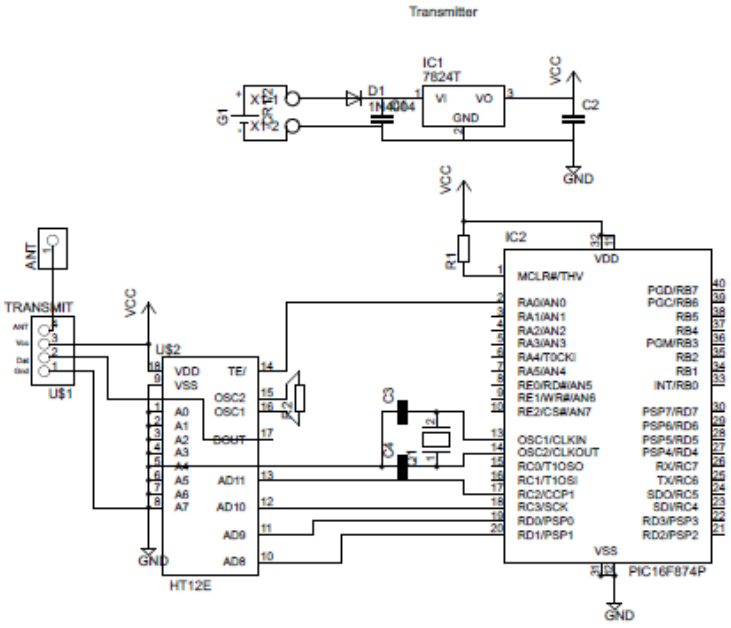
The above figure shows the power supply circuit. Input is given through DC adaptor. Diode IN4007 is to avoid the polarity inversion when plugging. LED is for displaying the status. Capacitive filters are used to eliminate ripples. 1000uF capacitor is electrolytic and 0.1uF is disc capacitor. The capacitor filter should be rated at a minimum of 1000uF for each amp of current drawn and at least twice the input voltage. The 0.1uF capacitor eliminates any high frequency pulses that could otherwise interfere with the operation of the regulator.

Voltage regulators are very robust. They can withstand over-current draw due to short circuits and also over-heating. In both cases the regulator will shut down before damage occurs. The only way to destroy a regulator is to apply reverse voltage to its input. Reverse polarity destroys the regulator almost instantly. To avoid this possibility you should always use diode protection of the power supply. This is especially important when using nine volt battery supplies as it is common for people to 'test' the battery by connecting it one way and then the other. Even this short 'test' could destroy the regulator if a protection diode is not used. Generally a 1N4004, 1 amp power diode is connected in series with the power supply. If the supply is connected the wrong way around, the regulator will be protected from damage.

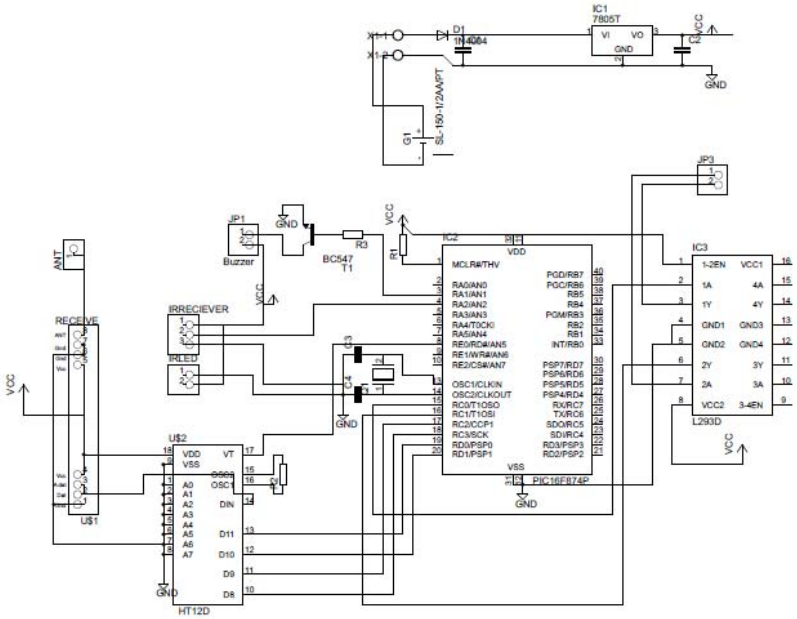
The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents. The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation.

IV. CIRCUIT DAIGRAM

TRANSMITTER



RECEIVER



V. PCB & CIRCUIT FABRICATION

PCB FABRICATION

Printed Circuit Broad (PCB) is a mechanical assembly consisting of layers of fiberglass sheet laminated with etched copper patterns. It is used to mount electronic parts in a rigid manner suitable for packaging.

The type of integrated circuit components used in the fabrication process has an important role in the design of PCB. The conductor width, spacing between the signal conductors etc, are calculated to give optimum wave impedance of the conductor's lines. Optimum wave impedance gives minimum delay or rising and trailing edge of the pulse in digital circuit.

Art Work Generation

The generation of PCB artwork should be considered as the first step of the PCB manufacturing process. The artwork is generated at 1:1:1 or 4:1 scale according to the accuracy needed. Ink drawing on a transparent drawing paper or cut up and strip method are the methods used for the art work generation.

Routing

Presently artwork generation is not used for the PCB fabrication. Instead there are many types of software available for the routing of PCBs. Mainly used software's are CAD SOFTWARE EAGLE, ORCAD, TRAXMAKER, EASYPCB, PORTAL etc. Here we make use of CAD SOFT EAGLE.

1. Manual. Traces are placed manually as done in the traditional method where you change the path of the trace every time you click the mouse.
2. Follow-me. This highly interactive method combines the power of an auto router with the control and flexibility of manual routing.
3. Auto Router. This fully automated method will auto route an entire trace by clicking on a rats net line

Then using a laser printer solution prints the routed diagram. Laser printer is very affordable, fast and good quality. The printer used must have at least 600dpi resolution for all but the simplest PCB swill require only 300DPI resolution. It is very important that the printer produces the good solid black with no toner pinholes.

When using tracing paper or drafting film, always use manual paper feed, and set the straightest possible paper output path, to keep the artwork as flat as possible and minimize jamming. The printed diagram is then converted into film by using vertically mounted cameras.

Screen-printing

Screen-printing is arguably the most versatile of all printing process. It can be used to print on a wide variety of substrates, including paper, paper board, plastics, glass, metals, posters, labels, decals, signage, and all types of

textiles and electronic circuit boards. The advantage of screenwriting over other print processes is that the press can print on substrates of any shape, thickness and size.

A significant characteristic of screen-printing is that a greater thickness of the ink can be applied to the substrate than is possible with other printing techniques. This allows for some very interesting effects that are not possible using other printing methods. Because of the simplicity of the application process, a wider range of inks and dyes are available for use in screen-printing than for use in any other printing process.

VI. CIRCUIT FABRICATION AND SOLDERING DETAIL

Soldering techniques

Soldering is an important skill for electrical technician. Good soldering is important for proper operation of equipment.

Solder is an alloy of tin and lead. The solder that is most used is 60/40 solder. This means that it is made from 60%tin and 40% lead. Solder melts at a temperature of about 400 degree Fahrenheit. For solder to adhere to join, the parts must to enough to melt the solder. Rosin flux is contained inside the solder. It is called rosin-core solder. When they are hot, solder is applied to the joint. The heat of the metal parts is used to melt the solder. Only a small amount of heat should be used sparingly. The joint should appear smooth and thin. If it does not, it could be a "cold" solder joint. This is called a “cold joint". Care should be taken not to damage PCB when soldering parts on to them. Small, low wattage irons should be used with PCB and semiconductor devices

Need of flux

Flux is needed for achieving desired clean lines of the surface. Most metals tend to form compounds with atmospheric oxygen, which leads a coating of oxide even at room temperature, react chemically with oxides and disperse the reaction products. Fluxes are applied before and during soldering.

VII.CONCLUSION

The project was really a novel experience for us. It will not be without some pride when we think that we have accomplished the programming, circuit testing, PCB fabrication, assembling, soldering, getting cabinet done, final product testing, etc. all within a short span of time. The experience that we got during this tenure will help us to handle similar projects with ease in future.

The new speed limiting system presented in this project combines several pioneering techniques that integrate wireless technologies in order to implement a reliable speed control system. This proposed system can be easily implemented near different populated areas. The power of the proposed system lies in its flexibility and capability of development with little hardware changes such as changing the speed limits and speed control methods using the software of the base station in negligible amount of time.

The proposed system is based on microcontroller technology for collecting data related to speed and transmitting it through a transceiver to a base station that analyzes the transmitted data and takes appropriate decisions related to speed limit and control requirements.

This experience has encouraged us to learn more about upcoming trends and technologies and thereby adding our bumble knowledge and experience about the vast ocean of electronics.

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