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Over Speed Vehicle Marking System Using Arduino UNO Controlled Air Cannon

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ABSTRACT:
Though we have speed limit regulations in every places, accidents are being happened everywhere due to the violation of speed limit. Speed limit regulation is set up based upon the quality and dimension of the road and the population density around the area. In this research paper, we propose a system that automatically detect and mark down the vehicles that violate the speed limit regulation. In addition, it is the most economical and simplest method of over speed vehicle marking system which makes it easy for implementation. Also the manual process of over speed vehicle warning is completely eliminated. This paper shows us the methodology to interface ultrasonic sensor with the microcontroller. A Solenoid valve is controlled by a 5volt relay switch connected to the Arduino UNO microcontroller. Solenoid valve acts as the trigger of the air cannon marker.

KEYWORDS: Speed limit, Population density, Solenoid valve, Relay, Air cannon, Arduino UNO

1. INTRODUCTION:

Rash driving is the major cause for road accidents. In 2015, around 1,46,000 people were killed in highway road. This translates into 11 deaths per one lakh people or one live snuffed out every 3.6 minutes. The traffic population has increased considerably in India as there is no means to control or monitor the speed of vehicles running on roads. This system proves highly effective in detection of over speed driving and marking it. It is not at all necessary that such accidents are results of driving under the influence of alcohol as even a person who hasn't consumed alcohol can drive in a reckless manner. To overcome this problem and decrease death rate due to accidents, introduction of new and innovative speed enforcement technology is necessary.

2. OBJECTIVE OF THE PAPER:

- To detect the over speeding vehicles.
- To mark them with a paint mark.
- To make the system simple, precise and economical.

3. PROPOSED SYSTEM:

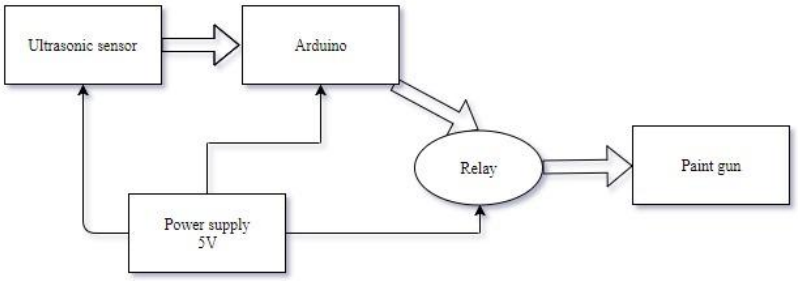

Figure 1: Block Representation

The Ultrasonic Sensor senses the passing vehicles and sends the data to Arduino. The Arduino analyze the data and gives its response to the solenoid valve operated paint-gun through the relay mechanism. The Arduino is programmed in such a way that it gives more precise result as possible.

4. COMPONENTS REQUIRED:

- Arduino microcontroller
- Ultrasonic sensors
- PVC pipes
- Solenoid valve
- Breadboard
- 6V Batteries
- 5V Relay
- Tire tube valve
- Compressor

5. HARDWARE SPECIFICATIONS:

5.1 ARDUINO UNO

The Arduino UNO is a microcontroller board based on the ATmega328. Arduino is an open-source electronics prototyping platform and it is intended for designing, creating interactive objects or environments. Arduino boards are relatively inexpensive compared to other microcontroller platforms.

FEATURES

- Cross-platform The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems.
- Simple and clear programming environment.
- The Arduino programming environment is easy-to-use for beginners and flexible enough for the advanced users.
- Source and extensible software The Arduino software is published as open source Open tools, available for extension by experienced programmers.
- The language can be expanded through C++ libraries.
- Open source and extensible hardware.

TECHNICAL SPECIFICATIONS

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended) : 7-12V
- Digital I/O Pins 14:PWM o/p
- Analog Input Pins: 6 DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

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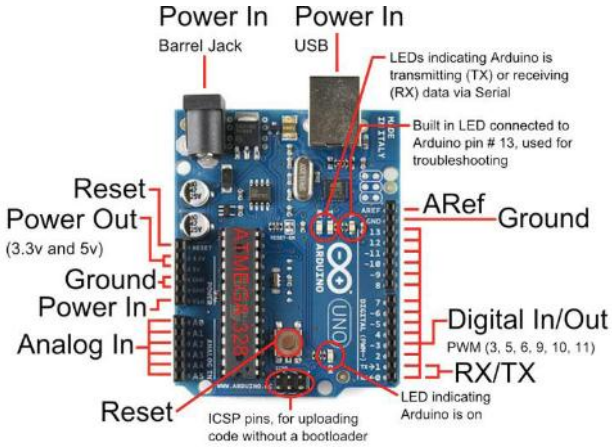

Figure 2: Arduino UNO

5.2 ULTRASONIC SENSOR (HC-SR04)

The Arduino Ultrasonic Range Detection Sensor with Arduino calculates distance from objects. The output of an LED alters with PWM according to how close an object is to the sensor. So, nearer the object is, brighter the LED. This Sensor works by sending an ultrasound pulse at around 40 KHz. It then gets the echo back and calculates the time taken in μ sec. We can trigger a pulse as fast as 20 times a second and it can determine objects up to 3 meters away and as near as 3cm. It needs a 5V power supply to run. Arduino can be added to Ultrasonic Range Detection Sensor using only 4 pins Power, Ground, Trigger and Echo. Since it needs 5V and Arduino provides 5V, we will use this to power it. There are 2 sets of 5 pins, 1 set we can use, the other is for programming the PIC chip. Supply module with 5V, the output will be 5V while obstacle in range, or 0V if not. The out pin of this module is used as a switching output when anti-theft module

TECHNICAL SPECIFICATIONS

- Working Voltage : 5V
- (DC) Working Current : max 15 ma
- Operating frequency : 40HZ
- Output Signal : 0-5V (Output high when obstacle in range)
- Sentry Angle : max 15 degree
- Sentry Distance : 2cm - 500cm
- High-accuracy : 0.3cm
- Input trigger signal : 10us TTL impulse
- Echo signal : output TTL PWL signal
- Size : (45*20*15)mm

Figure 3: Ultrasonic Sensor

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INTERFACE

- Pin:1 VCC
- Pin:2 Trigger(T)
- Pin:3 Echo(R)
- Pin:4 GND

6. DESIGN AND WORKING OF PAINTBALL GUN:

It consists of a long PVC pipe connected with the storage reservoir through solenoid valve. The storage reservoir consists of a tire tube valve through which the air is filled with air compressor (or) air pump. Air is filled with a compressor (or) air pump through tire tube valve. When the microcontroller gives the signal, the solenoid valve opens the compressed air from the storage reservoir. The compressed air pushes the paintball present in the PVC pipe. Thus the air cannon mark the vehicle with the paintball mark so that the vehicle can be easily identified by the surveillance police in the signals and further law process can be executed.

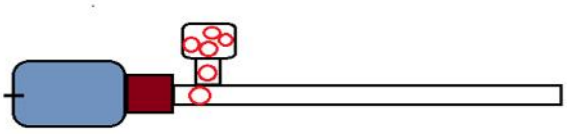

Figure 4: Air Cannon (Paint Gun) Model

7. SYSTEM MOUNTING POSITION:

The whole system can be mounted in two different positions.

- Horizontal Mount
- Vertical or Overhead Mount

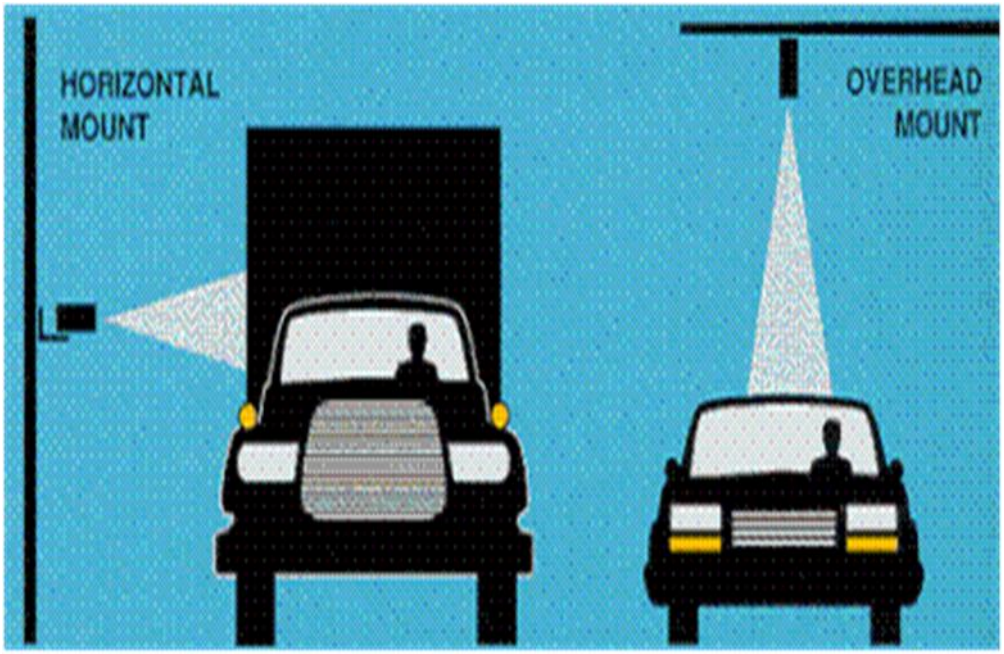

Figure 5: Mount Position

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8. FLOWCHART:

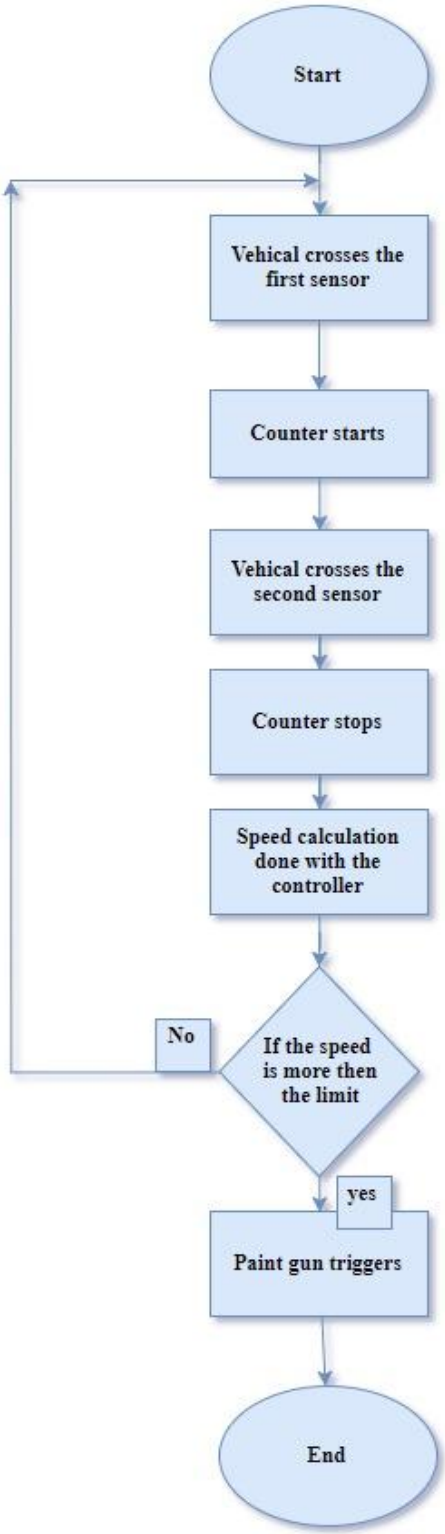

Figure 6: Flowchart of the System

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9. SPEED SENSING CALCULATION:

- When the vehicle crosses the first sensor, the sensor 1 senses and gives signal to the microcontroller.
- When the vehicle crosses the second sensor, the sensor 2 senses and gives signal to the microcontroller.
- Consider the distance between the 2 sensors is 4m.
- The speed limit of the road is 60kmph.

Speed=60kmph

Distance=4m

Distance =Speed*Time

Time = Distance/Speed

Time= 4/60 =0.0667 seconds

- If the time difference between the two signals is less than 0.0667secs (or) if the second sensor senses a signal less than 0.0667 seconds, the microcontroller gives signal to the solenoid valve.

10. CONTROLLER PROGRAMMING:

10.1 SOFTWARE DEVELOPMENT

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio, which can be used for programming Arduino. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It was created for people with no profound knowledge of electronics. It includes a code editor with features such as syntax highlighting, brace matching, cutting/pasting text, searching/replacing text and automatic indentation, and provides simple one-click mechanism to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons and for common functions and a series menu. A program written within the IDE for Arduino is called a "sketch". Sketches are saved on the development computer as files with the file extension .ino. Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two functions, for starting the sketch and the main programs loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool-chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

10.2 ALGORITHM

Step 1: Start.

Step 2: Vehicle crosses the Ultrasonic Sensor 1, Counter Starts.

Step 3: Vehicle crosses the Ultrasonic Sensor 2, Counter Stops.

Step 4: Speed is calculated by the controller according to the program uploaded.

Step 5: If the Speed calculated is more than the speed limit range, the paint gun located at the top (or) side of the road will trigger with the pulse given to the relay.

Step 6: If the speed is within the Speed limit Range, then the paint gun holds fire.

Step 7: Thus the loop repeats for each vehicles.

Step 8: End.

10.3 PROGRAM

```
#include <Boards.h>
```

```
#include <Firmata.h>
#include <Ultrasonic.h>
Ultrasonic ultrasonic1(12, 13);
Ultrasonic ultrasonic2(10, 11);
int dist1,dist2,i,j;
int solenoidpin=4;
unsigned long start = 0;
unsigned long endTime = 0;
unsigned long diff = 0;
void setup() {
  Serial.begin(9600);
  pinMode(solenoidpin, OUTPUT);
}
void loop()
{
  while(i!=3)
  {
  while(j!=3)
  {
  Serial.print("Distance1 in CM: ");
  dist1=ultrasonic1.distanceRead();
  Serial.println(dist1);
  if(dist1>=50)
  {
    Serial.print("sensor1:no object");
  }
  else
  {
  start=millis();
  Serial.print(start);
  Serial.print("sensor1:objectdetected");
  j=3;
  }}
  Serial.print("Distance1 in CM: ");
  dist2=ultrasonic2.distanceRead();
  Serial.println(dist2);
  if(dist2>=50)
  {
  Serial.print("sensor2:no object");
  }
  else
```

```
 {
 endTime=millis();
 Serial.print(endTime);
 Serial.print("object detected");
 diff=endTime-start;
 Serial.print("time difference");
 Serial.print(diff);
 i=3;
   if(diff<100)
 { digitalWrite(solenoidpin,HIGH);
delay(300);
digitalWrite(solenoidpin,LOW);
 }}
 delay(50);
}
```

11. CONCLUSION:

This Arduino based project will provide a competent method for Limited speed transport system. It provides a user friendly automation system with low cost and good performance. In this paper we have designed a cost effective, low-power system, which facilitate better safety standards for Roadway Transport by preventing over speed accidents. Prototype of the system can efficiently detect and mark down the speedsters on the Roads. The result shows that this new innovative technology will increase the reliability of safety systems in Roadway transport. By implementing these features in real time application, we can avoid accidents up to approximately 70%. Though it has some limitations, but by having done some modification this concept can be implemented in wide range of application. This system can reduce the accidents caused by the over speeding vehicles and rash drivers.

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