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INTELLECTUAL TRAFFIC CONTROL SYSTEM USING ARDUINO

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Abstract: The problem of traffic and teen gang violence and has the goal to control traffic and violence elimination. As there is a constant increase in the number of road users, a perceptive control of traffic will become a very significant issue in the future. In our project, we propose a general definition of robustness and develop methodology using LEDs of standard colours (Red, Yellow and Green) following a universal colour code, Ultrasonic transducers (which is used for measuring distances based on transmitting and receiving ultrasonic signals), Buzzer (which gives an audio signal) and Arduino (which is used for controlling all these components). So, there is a sensor placed at the right side of the road which will detect the object. The sensor will be activated when there is a red signal and will be deactivated when there is a green signal. When detected in the sensor, a buzzer sound will alert the drivers to get back from the zebra crossing. Thus, this system can be implemented in city traffic.

Index Terms **- Traffic control, Vehicle Detection, Arduino, Ultrasonic sensor.**

I. INTRODUCTION

In this project we will use the concepts of the ultrasonic waves. An ultrasonic level or sensing system requires no contact with the target. The aim of this project is to develop prototype of traffic detection that can be viewed as a part of control the traffic. The system consists of ultrasonic sensor and Light Emitting Diodes (LEDs) and the buzzer. Ultrasonic sensor is used to detect the distance between the sensor and the object (car). Traffic detection is performed without physical contact between the sensor and vehicle. Ultrasonic sensors utilize the principle of sound reflection to measure the level of distance.

There are some objectives need to be achieved in order to accomplish this project. These objectives will act as a guide and will restrict the system to be implemented for certain situations:

- To develop a model of TRAFFIC CONTROL SYSTEM by using the ultrasonic sensor to detect the object (car).
- To alert driver using Buzzer. That Depending on which LED light is on (RED, Yellow, Green).
- To use Arduino (IDE) software to generate a computer program for the arduino in order to get signal for the real time

The aim of this project is to develop prototype of traffic control that can be viewed as a part of control system of traffic signal management system. The system consists of ultrasonic sensor and the Light Emitting Diodes (LEDs) and the buzzer.

Ultrasonic sensor is used to detect the object (car) on RED signal. Traffic control system is performed without physical contact between the sensor and object (car). Ultrasonic sensors utilize the principle of sound reflection to detect object (car).

The calculation is performed by high level language program that reside in an Arduino.

- LED with a green color means that the driver can go safely.
- LED with a yellow color means that you're allowed to drive right on through, but you should reduce your speed a little bit and be cautious as you cross the intersection.
- LED with a red color means Come to a complete stop and wait until the light turns green before you proceed.
- Then if in RED signal driver tried to break the signal, the buzzer will be activated.

II. LITERATURE REVIEW

Ultrasonic distance measurement:

The Ultrasonic distance sensor uses high-frequency sound to determine the distance to a reflecting object. Similar to how bats detect obstacles by transmitting high-pitched Sound and listening to the echoes. These Ultrasonic distance sensors emit a series of Supersonic pulses and wait for echo pulses to be detected. Since the speed of sound is constant in the air (340.29 m/s), the time elapsed between the transmitted signal and the received signal can be measured and so the distance of the object can be determined.

Ultrasonic distance measurement is based on the speed property of sound. The system transmits multiple sound waves that travel out into the air. These sound waves reflect off from any objects they impact and return back as an echo to the location from which they originated. The system detects these reflected sound waves (that is, echoes).

The time between the transmission of the sound waves and the detection of the echo is measured, as shown in Figure 3.1. At time t0, the transducer creates the sound waves. At time t1, the sound waves impact an object. At time t2, the waves have reflected off from the object and are traveling back toward the transducer. At time t3, the echo has impacted the transducer, which detects these waves. The system subtracts t0 from t3 to calculate the total travel time of the sound.

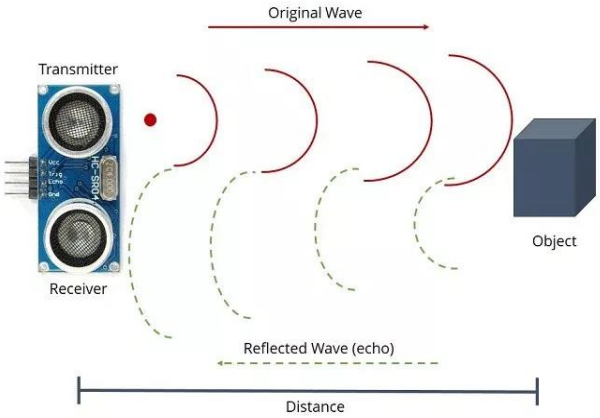

Figure 2.1 The time between the transmission sound waves and the detection of the echo

The sound's travel time is multiplied by the speed of the sound to calculate the total distance that the sound waves traveled. This distance is divided by two to calculate the distance of the object that caused the echo.

Selection of the ultrasonic sensor:

There are numerous types of ultrasonic range sensors available with key differences in frequency and power consumption. Ultrasonic sensor with high frequency will have a sharper beam width and can detect obstacles in a longer range. Also, some of the new sensors have similar range detection as previous models but with less power consumption.

In this project, the ultrasonic sensor must be able to detect obstacles or objects from 2cm to 400cm. Since the whole system power supply will be taken from the battery supply, the less current consumption is crucial and must be able to operate at low voltage. HC-SR04 meets the criteria of this project to detect the obstacles in a short period after the long research was done between the HC-SR04 and other Ultrasonic sensors.

Figure 2.2 ultrasonic sensor

Arduino:

Arduino is a software company, project, and user community that designs and manufactures computer open -source hardware, open source, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical

devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/ O pins that can interface to various expansion boards (termed shields) and other circuits. the boards feature serial communication interface, including universal serial bus (USB)on some models, for loading programming from personal computers.

Arduino is used in automatically controlled devices such as control systems, office machines, automobile engines, power tools and so on. By reducing the size, cost and power consumption, Arduino makes it economical to electronically control more and more processes.

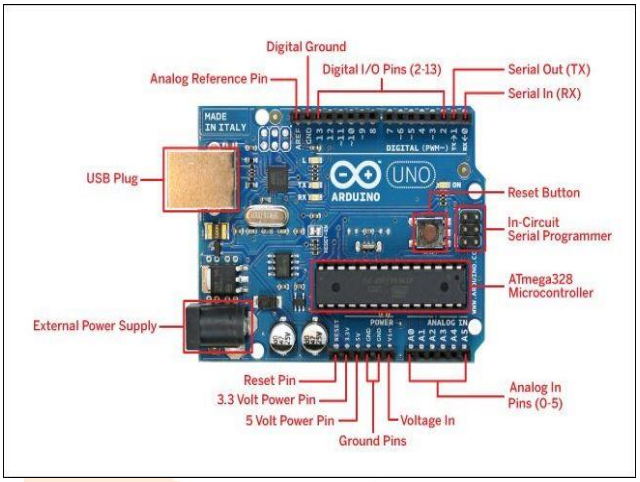

Figure 2.3 Arduino

Light Emitting Diode (LED):

A LED is a semiconductor diode that emits light when an electrical voltage is applied in the forward direction of the device. When LED anode lead has a voltage that is more positive than its cathode lead by at least the LED forward voltage drop thus current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. In this project, the LEDs will be used as indicators at the prototype; thus, we have used one green LED, one yellow LED and one red LED which indicate the water level.

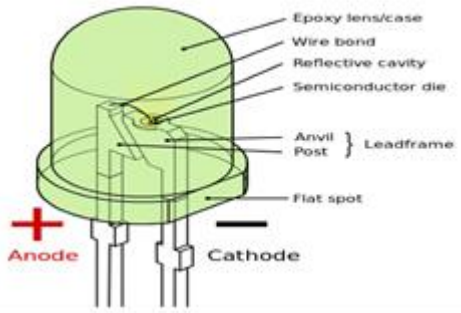

Figure 2.4 LED

Buzzer:

A buzzer is an audio signalling device which may be mechanical or electronic. It can be used as an alarm, timer or confirmation of user input. The sound output from the buzzer may be continuous or intermittent. As the output is typically at least 75dB, it will provide sufficient sound aid for the user. Thus, I have used a buzzer in my system to give an alarm if the water level changed rapidly and considerably dangerous.

Figure 2.5 Buzzer

Power Supply Module:

That we have quite a clear idea of the possible external power sources, we may see how to apply them to Arduino. Everything we will describe in this paragraph can be applied to all the kind of sources previously described, thus both power supplies and batteries. We point out again the need to pay maximum attention to the polarities: it is very important to connect properly the positive and the negative poles to the Arduino board, otherwise there is a risk to see nothing work or even to make irreparable damages. In fact, while in some cases there are some intrinsic protections on the board, in other cases the polarity inversion might cause-immediate-damages.

III. REVIEW FINDING

This section presents a review and a qualitative analysis of some Traffic Control System (tcs) found in the literature. This focuses on improving traffic efficiency, decreasing overall travel time, fuel consumption and greenhouse emissions. Therefore in order to reach these goals, they need to control the traffic by detecting traffic congestion and suggesting alternative routes to vehicles by adjusting the speed.

Traffic Control System (tcs) presents the fully distributed cooperative congestion detection, congestion avoidance, decreasing number of accidents and warning. Infrastructure-based Traffic Control System (tcs) includes traffic light management.

IV. HARDWARE DESIGN

Hardware implementation of the project will be divided into various parts which are essential to complete the project. The following is the list of the hardware components used in this project. The hardware design and its implementation for these hardware components will be discussed in details in the subsequent sections. The whole Hardware Design and Implementation:

The whole design mainly includes the following parts:

1.The HC-SR04 Ultrasonic sensors.
2.Arduino uno: to program and control devices.
3.Power Supply: to supply voltage power to the whole system.
4.Buzzer and LEDs: alert panel (to give a signal to the operator or driver).

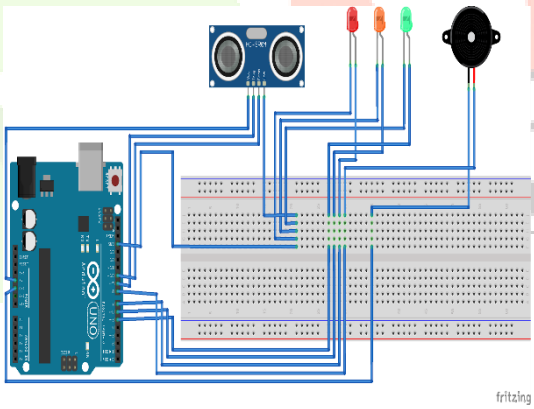

Figure 4.1 Schematic circuit diagram of project

The HC-SR04 Ultrasonic sensors:

In this project, the ultrasonic sensor must be able to detect obstacles and objects from 2cm to 400cm. Since the whole system power supply will be taken from the battery pack, the less power consumption is crucial and must be able to operate at low voltage. SR04 meets the criteria of this standard to detect the obstacles in a short period after the long research work was done to select between the SR04 and others Ultrasonic sensors.

HC - SR04 features:

The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It's ideal for any robotics projects your have which require you to avoid objects, by detecting how close they are you can steer away from them!

The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high frequency ultrasonic sound, which bounce off any nearby solid objects, and a receiver listens for any return echo. That echo is then processed by the control circuit to calculate the time difference between the signal being transmitted and received. This time can subsequently be used, along with some clever math, to calculate the distance between the sensor and the reflecting object!

We have this sensor, and along with our Ultrasonic mounting kit, you can easily attach this sensor to your project and get measuring distances! The HC-SR04 sensor works best between 2cm – 400 cm (1" - 13ft) within a 30 degree cone, and is accurate to the nearest 0.3cm [9].

Figure 4.2 HC-SR04 Ultrasonic sensor [10]

Table 4.1 HC-SR04 Specifications [9]

Working Voltage	DC 5V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10µS TTL pulse
Echo Output Signal	Input TTL level signal and the range in proportion
Dimension	45 * 20 * 15mm

HC - SR04 Timing diagram:

We need to transmit trigger pulse of at least 10 us to the HC-SR04 Trig Pin. Then the HC-SR04 automatically sends Eight 40 kHz sound wave and wait for rising edge output at Echo pin. When the rising edge capture occurs at Echo pin, start the Timer and wait for falling edge on Echo pin. As soon as the falling edge is captured at the Echo pin, read the count of the Timer. This time count is the time required by the sensor to detect an object and return back from an object.

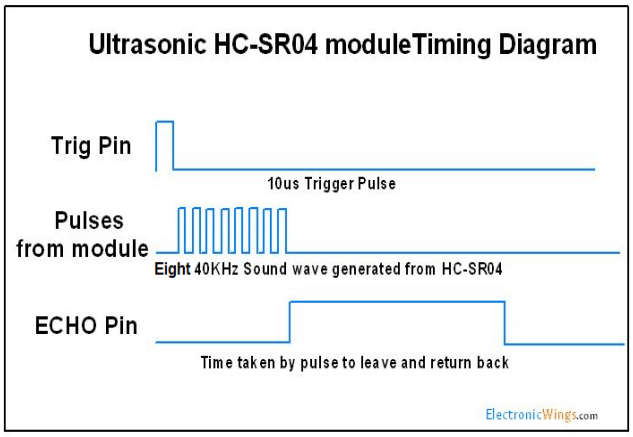

Figure 4.3 HC - SR04 Timing diagram [10]

V. PROBLEM FORMULATION

The observed errors in the measured distance are due to many factors. One important factor is the inclusion of generation and processing times of the burst pulse signals. These are as follows:

- Time period between the starting of the timer1 and actual time of the transmission of the first pulse of the burst pulse train by the ultrasonic transmitter.
- The reflected signal received by the ultrasonic receiver sensor is passed on to the receiver and generates an interrupt signal. This is applied to the microcontroller. The above time periods are also included in the measured travel time. Hence these time periods have been calculated and their sum deducted from the measured travel time. This has been shown as corrected travel time.

VI. EXPERIMENT

After building every component and modules on prototype board, it is important to test the circuit as well as the functionality of overall system the whole Integrated System has put to a functionality test to confirm that all the hardware and software coding and interfacing are working well. The whole Project mainly includes the following cases:

Case 1:- If the obstacles in front of sensor while red light is ON then, the buzzer will be activated.

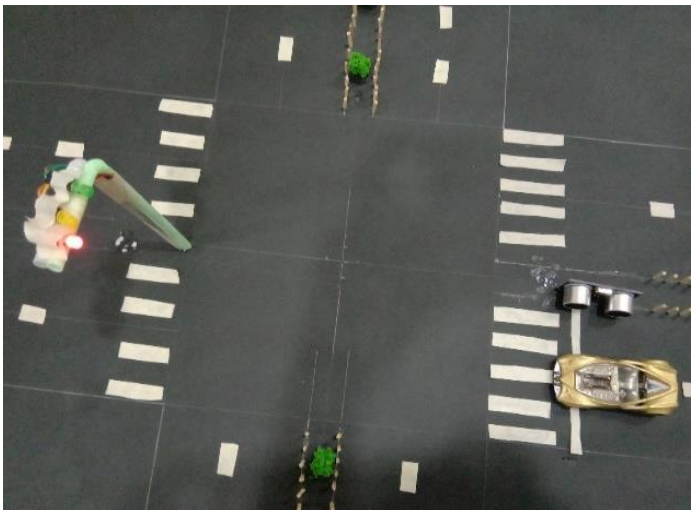

Figure 6.1 Red Signal is ON

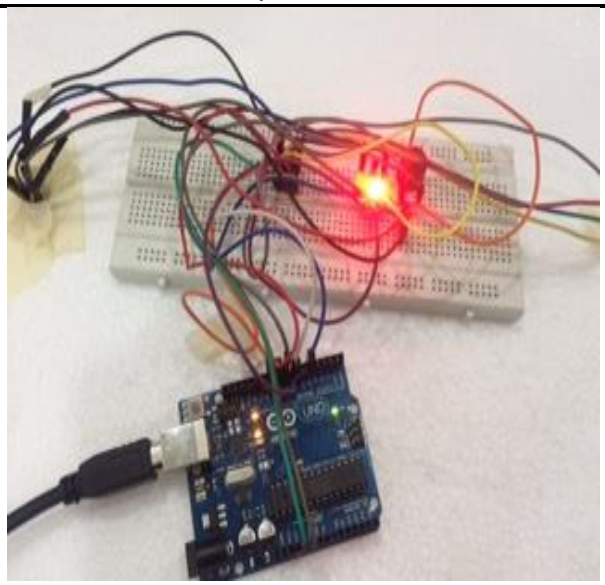

Figure 6.2 Buzzer is activated

Case 2:- If the obstacles is in font of sensor while green light is ON then, the buzzer will be deactivate.

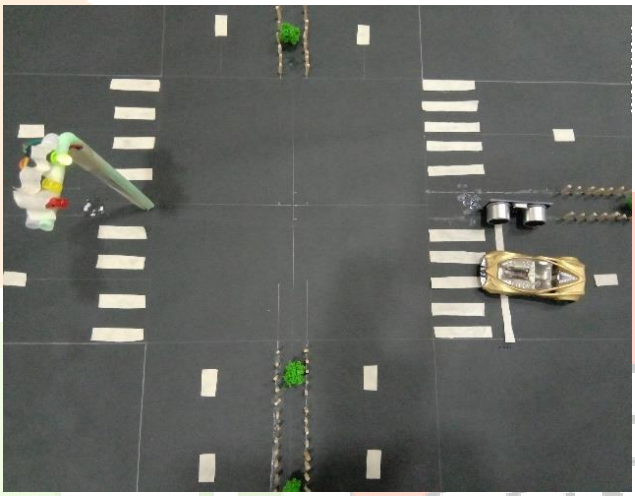

Figure 6.3 Green signal is ON

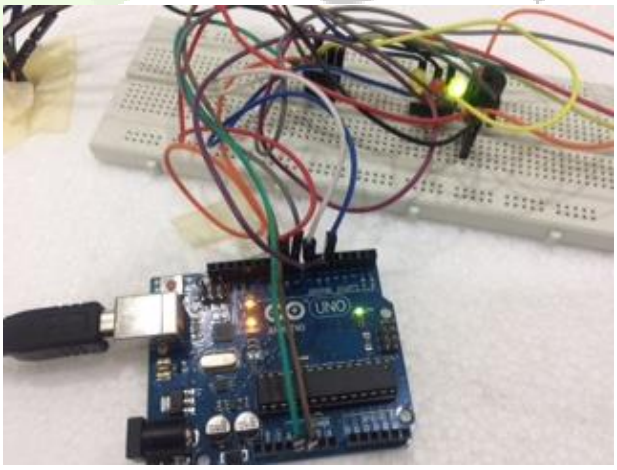

Figure 6.4 Buzzer is deactivated

Case 3:- If the obstacles is in font of sensor while yellow light is ON then, the buzzer will be deactivated.

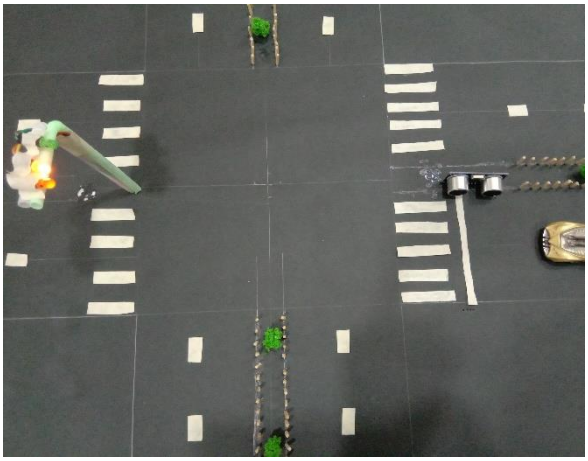

Figure 6.5 Yellow light is ON

VII. RESULT AND ANALYSIS

In this section the data collection and analysis is elaborated. Roadside recording was performed on typical working days during several traffic conditions. The initial task pertained to sound recordings without background noise to eliminate the need for filtering. After knowing about the above said hardware and using appropriate programming for the microcontroller the following results have been obtained. There is normal traffic at the junction the traffic light continues as time delay. Microcontroller and processing unit are also used. In addition, ultrasonic sensor deployed and same connected to Arduino microcontroller for controlling the traffic signal based on traffic density information received.

Objectives:

- Minimize overall delay to vehicles
- Minimize delays to public transport
- Minimize delays to emergency services
- Minimize delays to pedestrians
- Minimize reliability, i.e. Minimize unpredictable variations in journey time for vehicle users
- Energy efficiency
- Minimize environmental impact of vehicular traffic (noise, atmospheric pollution, visual intrusion)

VIII. CONCLUSION

The System of the vehicle Detection has been tested and reasonably good performance is shown based on the test results. One of the main contributions of this project is the ultrasonic sensor calibration by adjusting calculations of distance based on actual data. Testing need to be carried out for the real fluctuated condition to get the system performance in the real circumstances.

The hardware part of the project gave us a chance to understand Arduino, ultrasonic sensors, Software part helped us to have a better understanding about the embedded system programming and C programming language, circuit designing, troubleshooting and project management skills.

IX. FUTURE WORK

This system is so open to being improved to provide a better performance, and there are some suggestions to be included in any future work:

- Can be Capture photo of a car to get car number who cross the red signal using the camera.
- There will be a rod placed on the right side of the road. When there's a red signal, the rod will automatically fall down which will block vehicles from escaping/ moving ahead. And if There's green signal, the rod will get up so that the vehicles can move ahead.

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