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IoT Based Signal Violated Vehicle Detector

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Abstract: ***The number of new vehicles on the road is increasing rapidly, which in turn causes highly congested roads and due to the long awaiting red signals, few vehicle drivers ignore traffic rules by violating traffic signals. This leads to a high number of road accidents and hence it is essential to detect the signal violated vehicles automatically. Traffic violation detection systems using IOT technology can able to send violated vehicle information to the concern traffic police station automatically by which the vehicle can be penalized immediately.***

The proposed system can be implemented using vehicle ID card installed in the vehicle itself such that if the vehicle moves further during presence of red signal, automatically, vehicle information in the form of vehicle registration number, type of vehicle (weather it is two-wheeler, car, truck, auto, etc.), owner name, vehicle colour, etc, can be forwarded to the concern authorities through concern mobile phones. To prove the concept practically, all vehicles must be equipped with these low-cost wireless ID cards such that the vehicle data can be transmitted continuously. The demo module contains a mini automatic traffic signal post along with simulated road. The system is designed such that when red signal is energized and during this period, if any vehicle crosses the zebra lines, the system receives the vehicle data and transmits the same through Wi-Fi module. If anybody violates the traffic signal, immediately alarm will be energized to alert the nearest traffic police. The main processor must be installed near the traffic signals, which regrets to acquire vehicle information during the presence of yellow and green signals. The demo module contains one toy car which will be equipped with its wireless ID card.

Major building blocks: Simulation of single lane road constructed with traffic signal post & zebra crossing, main processor designed with Arduino MCU, wireless ID card designed with 89C2051 controller chip, IR signal decoder (TSOP1738), Wi – Fi module, Alarm, IR LED, 5v Power supply unit, Toy car, etc.

I. INTRODUCTION

Traffic lights, also known as traffic signals, are signalling devices used to manage traffic flow at road junctions, pedestrian crossings, and other sites. With a succession of three standard colours of lighting bulbs or LEDs, traffic lights follow a global colour code.

1) Green light; Allows traffic to proceed in the direction denoted.
2) Red light; Prohibits any traffic from proceeding.
3) Amber light or yellow light; Warns that the signal is about to change to red.

These are the three main traffic lights used all over the world and it is a universal standard. Some people they neglect to follow the signals due to the many reasons, one main cause is hurry, losing patience due to the long weighting over the busy roads and other important reason is negligence. In such condition, when the red light remains in energized condition, if anybody crosses the zebra line, the signal violated person may face serious accident due to the opposite coming vehicles. To avoid this kind of accidents, it is essential to detect and catch the signal violated vehicles on the spot. Therefore, this system is developed to transmit the violated vehicle information automatically to the nearest traffic police who is guarding the road near the signal post.

Because the number of new cars on the road is rising every day, roads are becoming increasingly crowded, and people are becoming increasingly annoyed as a result of traffic jams and long waits at signal posts, which is the primary motivation for breaching traffic regulations. The majority of accidents are caused by those who disregard traffic signals at intersections. Traffic violation detection systems that use IoT technology are a very effective technique for reducing traffic offences by tracking and punishing cars.

To detect the signal violated vehicle, it is essential to install a vehicle ID card in each and every vehicle and similarly it is also important to install a passing vehicle ID card reader wirelessly at or near the traffic signal post. The vehicle ID card is a simple device designed with 89c2051 microcontroller IC & the vehicle information stored in the card will be transmitted through IR LED. The detailed description of entire system will be described in next chapter.

The project's purpose is to automate the traffic signal violation detection system, making it easier for traffic police to monitor traffic and take action against violators in a timely and effective manner. The system's top goal is properly detecting the vehicle. Traffic infraction detection systems are required to remedy the problem and avoid such serious repercussions. For which the system is constantly enforcing correct traffic restrictions and apprehending individuals who do not comply.

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Because the authorities are always monitoring the roadways, a real-time traffic infraction detection system is required. As a result, traffic enforcers will be at ease not only in precisely implementing safe roadways, but also in efficiently doing so, because the traffic rule breaking detection technology identifies infractions faster than people. In real time, this technology can identify traffic signal violations.

The ESP8266 from China is a self-contained SOC (System on a Chip) with an inbuilt TCP/IP protocol stack that can offer WiFi connectivity to any microcontroller. This device can either host an application or offload all WiFi networking functionality to a different application processor. The ESP8266 consists of 32-bit microcontroller unit and a WiFi transceiver. It has 11 GPIO pins and an analog input as well. These devices operate over 2.4GHz band to reach up to 150feet distance. The detailed description of this device is provided in following chapters.

IOT technology offers mutual information sharing among various smart devices has been facilitated anywhere in the world. In this environment, studies on smart application services mentioned in this project work offers to display the violated vehicle through smart phone of traffic police by which the particular vehicle can be caught red-handedly. The vehicle information in the form of vehicle registration number, owner name, etc, can be transmitted through WiFi module. Here IoT 8266 WiFi module is used and it is interfaced with Arduino processor, since this device is designed to operate at 3.3V DC and whereas Arduino offers the same voltage through its internal regulator, the same supply source is used to activate the WiFi module.

The primary processing unit is built with an Arduino Uno module, which uses an ATmega328 microcontroller chip. The ATmega328 is a single-chip microcontroller from Atmel that belongs to the Mega AVR family. Its 8-bit RISC processor core is based on Harvard architecture. RSIC (Reduced Instruction Set Computer) is a CPU design technique based on the idea that combining a smaller instruction set with a microprocessor architecture that can execute the instructions using a limited number of microprocessor cycles per instruction results in better performance. ATmega-328 supports the data up to 8 bits and it has 32KB memory internally.

Also, it is having 1Kb EEPROM (Electrically Erasable Programmable Read Only Memory) such that this feature provides by which the special data stored in EEPROM will not be erased due to the power failures. Furthermore, the AT Mega 328 includes a variety of characteristics that make it the most popular smartphone on the market today. Advanced RISC architecture, good performance, low power consumption, programming lock for software security, real-time counter with independent oscillator, support for PWM principles, Built-in-with-ADC, and so on are some of these characteristics.

Arduino is an open-source electronics platform that uses minimal hardware and software to make it simple to use. Arduino boards may convert inputs such as light from a sensor, a finger on a button, or a Twitter tweet into outputs such as turning on an LED, starting a motor, or posting something to the internet. It features 20 digital input/output pins in total (of which 6 can be used as PWM outputs and 6 can be used as analogue inputs). It may be programmed using the Arduino computer software, which is simple to use.

The Arduino Uno R3 is the third and most recent iteration. A 16 MHz quartz crystal, 14 digital input/output pins, a USB connector, a power jack, an ICSP header, and a reset button are all found on the ATmega328P. The Arduino language is nothing more than a collection of C/C++ functions that may be used as code. A programmer can build modular chunks of code that execute a stated purpose and then return to the region of code from where the function was "called" by segmenting code into functions. When you need to do the same action numerous times in a programme, you should create a function.

For a variety of reasons, including the need of a specialised programmer, the large range of accessible libraries, and the ease of use of its IDE, the Arduino is a great prototyping tool (Integrated Development Environment). The following chapters offer a full explanation of this gadget.

Any Micro-controller works according to the program written in it. The program is written in such a way, so that the Micro controller can read and it can store the information received from the vehicle. According to the received information, the Micro controller displays the signal violated vehicle information through LCD. Micro-controllers are "embedded" inside some other device so that they can control the features or actions of the product. As a result, "embedded controller" is another term for a microcontroller. Microcontrollers are committed to completing a single job and running a single programme. The software is stored in read-only memory (ROM) and does not change in most cases. The majority of microcontrollers are low-power devices. A Micro controller that is powered by batteries might use up to 50 milliwatts. A microcontroller contains a dedicated input device and a tiny LED or LCD display for output (but not usually). A microcontroller also receives input from the device it is regulating and controls it by sending signals to various components. The next chapters give a full discussion of the controller chip utilised in the Arduino board.

II. DESCRIPTION

The process begins with the vehicle data transmitting card, this card is supposed to be installed in the vehicle is designed with 89C2051 microcontroller. As this chip is a tiny device having 20 pins, it occupies very less space. Therefore, the data transmitting card is designed as compact, & it is arranged in a small toy car. The controller used in the car generates digital information that is proportionate to the vehicle, this is a pre-programmed chip always generates the same information. The digital data produced by the controller is modulated at 38 KHz frequency. Modulation is important here, because the data produced by the controller cannot be travelled as it is as a modulated wave, there by this data is super imposed over this frequency. The frequency produced by the timer chip is performing the function of carrier oscillator; the digital data produced by the controller is mixed with this frequency & transmitted through Infrared LED as a modulated wave. Means the digital information generated by the controller is transmitted through IR LED.

III. IR COMMUNICATION SYSTEM

Infrared sensors are used in the communication system, and the digital data produced by the data transmitter is modulated at 38 KHz before being broadcast through an IR LED. TSOP 1738, a sensor package, is used to design the data receiving portion of the project. The data transmitter card, which is powered by an 89C2051 microcontroller, creates digital data containing the vehicle number, which is then communicated via optical sensor. The optical sensor is an infrared LED, and the digital data generated by the Arduino is communicated using a modulated frequency of 38 KHz generated by the 555 timer IC. Like a laser beam, the optical sensor delivers information in a single direction. The information is received via the data receiving circuit, which was developed with an Arduino board. TSOP 1738 is used as data receiver, which receives the data and demodulates the signal. This information is fed to the Arduino. Since it is prototype module, only one toy car equipped with its data transmitter is used. But in practical approach all vehicles should and must have these tiny cards by which the digital information produced by the vehicles varies from vehicle to vehicle.

As it is a demo module, & narrow passage is considered as a road and the range between the IR signal transmitting LED and IR signal detector should not exceed more than 20". In fact, the range can be increased to a maximum distance of 20 feet, but here it is not required to increase the range, there by the range is restricted through current limiting resistor connected in series with the IR LED that generates & radiates IR signal. In other words, the range can be increased or decreased based on the current flowing through the junction of IR LED. The function of this device is to translate the digital data produced by the controller in to infrared light. The sensor on the other end (TSOP 1738) detects the infrared light and reacts appropriately.

The frequency produced by the modulator circuit is used as carrier and the carrier frequency of such infrared signals is typically around 38 kHz. Usually, the transmitter part is constructed so that the transmitter oscillator, which drives the infrared transmitter LED, can be turned on/off by applying a TTL (transistor-transistor logic) voltage on the modulation-controlled input. On the receiver side, a phototransistor or photodiode takes up the signals.

The approach used in this project work is the modular approach where the overall design was broken into functional block diagrams, where each block in the diagram represents a section of the circuit that carries out a specific function. The system was designed with different functional blocks.

A. IR Signal Modulator

The 555 timer IC is used to modulate infrared light in this block; modulation is required to make the infrared signal stand out above the noise. The modulation approach causes the IR light source to blink at a certain frequency, allowing it to disregard all other signals. This timer IC will produce the pulse when a trigger signal is applied to it, here the trigger pulse can be obtained from the Microcontroller. The output of Microcontroller is fed to reset pin of timer IC; depending up on the resister and capacitor (timing components) connected externally to the timer IC, the pulse length is determined. Irrespective of trigger pulse, since the timer IC is configured as astable, depending up on the values of resistor and capacitor, it produces 38 KHz, which is used as IR signal transmitter. The modulated signal obtained from output pin of timer IC is driving the IR LED through its drive transistor.

Many circuits are designed to be used as IR transmitters, in this project work 555 timer IC is used as IR transmitter, which consumes very less power. The data to be transmitted through IR LED is obtained from output pin of microcontroller, this digital data is fed to pin no.4 of 555 timer chip as a modulating signal. Since the timer IC is configured as Astable mode of operation, as a self-oscillator it is delivering perfect square pulses of 38 KHz (approximately) continuously. The output of the timer IC is fed to infrared LED which is used as data transmitting LED. Since it is a commercial IR LED, the current flowing through the LED is restricted by

connecting a current limiting resister of 150 ohms in series with this LED. Depending up on different ratings of IR LED's, the current through the LED can vary from 10 milliamps to 300 milli amps. The LED currents must be as high as feasible in order to achieve an appropriate control distance. Because the pulses driving the LEDs are so brief, LED currents can be rather high. However, the average power dissipation of the LED should not exceed the maximum value specified on the data sheet given by the manufacturer. Another essential consideration is that the LED's maximum peak current should not exceed. Peak to peak amplitude value is also important that it should not exceed more than 1.5V.

A simple transistor circuit may be used to drive the LED and magnify the current. For this, a transistor with an appropriate HFE and switching speed should be used. Using Ohm's law, the current and voltage limiting resister values may be easily computed. The voltage drop across the LED must not exceed 1.2V.

The frequency can be set to 38 KHz approximately by varying the value of 50K variable resistor. The timing capacitor connected between pin No.2 to ground is a fixed value capacitor of 0.1Mf, this can be a metalized polyester capacitor, otherwise if we use any ordinary capacitor, value may be differed due to the environmental conditions. When the circuit is energized initially, the discharge pin (pin no.7) is disconnected from ground and output pin is set high because the trigger pin is below 33% Vcc voltage. The capacitor C (.1MF) starts to charge through resisters 1K and 50K. The threshold pin (pin No.6) is used to detect when the voltage across the capacitor reaches 67% Vcc voltage approximately. When the voltage across the capacitor hits 67 percent, the output pin is pulled low, and the discharge pin is reconnected to ground; the capacitor then begins to discharge through a 50K variable resistor. The cycle repeats again when the voltage across the capacitor hits 33%, resulting in a sequence of output pulses. A monostable circuit requires an externally provided trigger, whereas an astable circuit triggers from the preceding output pulse. A sequence of output pulses are generated as the output pin oscillates from high to low.

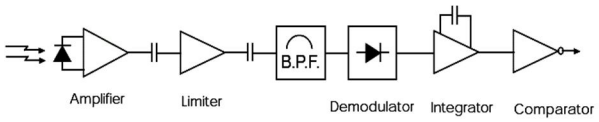
B. Data Receiving Module

The data receiving module, i.e. the IR emitter needs to be modulated by a frequency of 38KHz since the detector used in this project work only detects 38KHz modulated IR signal, the modulator circuit in the transmitter generates the same frequency. The detector is set to only see 38 KHz modulated IR because there are random IR sources such as overhead lights, the sun, heaters, etc. in most environments that can cause interference if using un-modulated IR.

The circuit is designed to operate at 5V DC, in general the photo diode used in the sensor package conducts at specific voltage applied through a potential dividing network. The reference voltage produced internally varies according to the conduction and non-conduction modes of IR sensor, whenever infrared light falls on the IR sensor, the device conducts. The device saturates fully when proper light falls on it. During the non-conduction mode, means as long as the sensor doesn't receive any infrared signal, the diode output remains in zero state.

When frequencies are matched, the communication link between the transmitter and receiver will be synchronised. Infrared light is the most convenient approach to collect data remotely within a visible range. Infrared light is simply ordinary light with a distinct hue. Because the wavelength of 950nm is below the visible spectrum, we cannot perceive this hue. One of the reasons why IR is used for distant applications is because we want to utilise it but don't want to see it. Another reason is that IR LEDs are very inexpensive due to their ease of manufacture.

At the transmitting side, an ordinary commercial IR LED is used, which cannot be used for long distances, here the application is to transfer the data to a nearest sensor, there by the range is restricted. The basic concept of this LED is to emit infra red light, when a small voltage is applied to it. The signal delivered from the LED radiates in uni-direction, like a laser beam. At the receiving side TSOP 1738, which is an optical signal detector, operates at 38 KHz, is used. This is a kind of IR signal receiver package consists of IR detection diode (photo diode), signal amplifier, limiter, Band Pass Filter, Demodulator, Integrator and comparator. The block diagram of IR receiver is shown below.



The IR detecting diode on the left side of the figure picks up the receiver IR signal, according to the block diagram given by the TSOP1738 manufacturer. The signal is amplified and limited in the first two stages. The limiter works as an AGC (Automatic Gain Control) circuit to keep the pulse intensity steady no matter how far away the transmitter is. As observed, the Band pass Filter receives just the AC signal. The Band Pass filter is adjusted to the modulation frequency of the transmitter. Frequencies of 30 to 60 kHz are prevalent in consumer electronics. The phases that follow are the demodulator, integrator, and comparator. The existence of

the modulation frequency is detected using these three blocks. The comparator's output will be pushed low if this modulation frequency is present. All of these components are housed in a single electrical component. On the market, there are several producers of these components. Most devices are also available in many variants, each set to a different modulation frequency.

Because the amplifier is set to a very high gain, the system is prone to oscillation. To decouple the power lines, a big capacitor of at least 22F must be placed adjacent to the receiver's power connections. A 330-ohm resistor in series with the power supply is recommended by certain data sheets to further isolate the power source from the rest of the circuit.

IR receivers are available from a variety of vendors. The primary vendors are Siemens, Vishay, and Telefunken. The Siemens SFH506-xx series features modulation frequencies of 30, 33, 36, 38, and 40 of 56KHz, with xx being the modulation frequency. Telefunken's TFMS5xx0 and TK18xx series, where xx represents the modulation frequency the device is set to, were introduced. They are replaced by the Vishay TSOPxx product series. In this project work TSOP 38 is used, the modulation frequency of this device is 38 KHz. To synchronize this IR signal receiver, the carrier frequency produced by the timer IC, at transmitting module should generate 38 KHz.

IV. DISPLAY SECTION

The display section is designed with LCD and the main function of this display is to display the violated vehicle details. The LCD used here is having two rows and each row contains 16 characters, depending up on the availability of LCD panel 3 lines or 4 lines panels can be used for the purpose, so that more information can be displayed simultaneously. LCD Displays are dominating LED displays, because these displays can display alphabets, numbers and some kind of special symbols, whereas LED's (seven segment display) can display only numbers. These LCD displays are very useful for displaying user information and communication. LCD displays are available in various formats. Most common are 2 x 16, is that two lines with 16 alphanumeric characters.

In recent years LCD is finding widespread use replacing LED's, because of the ability to display numbers, characters, and graphics. Another advantage is, because of its compactness and ease of programming for characters and graphics, more information in the form of text message or graphics can be displayed. Generally, the LCD modules have an 8-bit interface, besides the 8-bit data bus; the interface has a few other control lines. The 8-bit data bus is connected to port '0' and the control lines are connected to port '2'. The default data transfer between the LCD module and an external device is 8-bits, however it is possible to communicate with the LCD module using only four of the 8-data lines. The R/W line is connected to ground and hence the processor cannot read any status information from the LCD module, but can only write data to the LCD.

The LCD panel used in this project work is having 16 pins. The function of each pin description with table is as followed:
Vcc, Vss, and VEE: While Vcc and Vss provide +5V and ground, respectively; VEE is used for controlling LCD contrast.

Pin No. Name	Description
Pin no. 1D7	Data bus line 7 (MSB)
Pin no. 2D6	Data bus line 6
Pin no. 3D5	Data bus line 5
Pin no. 4D4	Data bus line 4
Pin no. 5D3	Data bus line 3
Pin no. 6D2	Data bus line 2
Pin no. 7D1	Data bus line 1
Pin no. 8D0	Data bus line 0 (LSB)
Pin no. 9EN1	Enable signal for row 0 and 1 (1stcontroller)
Pin no. 10R/W	0 = Write to LCD module
	1 = Read from LCD module
Pin no. 11RS	0 = Instruction input
	1 = Data input
Pin no. 12VEE	Contrast adjust
Pin no. 13VSS	Power supply (GND)
Pin no. 14VCC	Power supply (+5V)
Pin no. 15EN2	Enable signal for row 2 and 3 (2ndcontroller)
Pin no. 16NC	Not Connected

A. RS - Register Select

There are two important registers inside the LCD. The following is how the RS pin is used to choose them. The instruction command code register is chosen if RS = 0, allowing the user to submit instructions such as clear display, cursor at home, and so on. The data register is selected if RS = 1, allowing the user to enter data for display on the LCD.

B. R/W - read/write

The R/W input allows the user to either write or read information from the LCD. When reading, R/W equals 1; when writing, R/W equals 0.

C. E - Enable

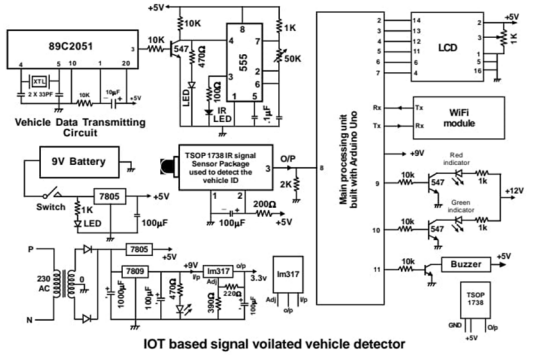
The enabling pin provides information to the LCD's data ports, which the LCD latches. In order for the LCD to lock in the data given to the data pins, a high to low pulse must be delivered to this pin. A pulse width of at least 450 nanoseconds is required.

D. D0 – D7

D0 – D7 are 8-bit data pins used to transfer information to the LCD or retrieve the contents of the LCD's internal registers. We send ASCII codes for the letters A–Z, a–z, and digits 0–9 to these pins while setting RS = 1 to show letters and numbers. There are further command codes for clearing the display, forcing the cursor to the home location, and blinking the cursor that may be transmitted to the LCD. The instruction command codes are shown in the table below.

V. CIRCUIT DESCRIPTION

The output of the energy metering circuit is sent to the pulse shaping circuit, which is calibrated at 1600 pulses per unit of electric energy consumption (therefore the display of 1600 pulses is equal to one unit of energy consumption). Steps: a) converting pulses into light pulses; b) using an LDR, the light intensity falling on it is transformed into clock pulses; and c) creating the clock pulses using a 555 timer IC. The following are the specifics: The output of the energy metering circuits (F1 and F2) is sent to a full wave bridge rectifier, which converts the frequency input into proportional dc voltage.



The high glow LED generates a dc voltage, which is fed to the light source. The input signal given by the Metering circuit determines how bright the LED glows. Low-power transistors are used in the switching circuit to provide dc voltage to the light source. Either the positive peak or negative peak produced by the energy meter will be transformed into a positive DC source using a full wave bridge rectifier with four diodes. Through a switching transistor, this source is used to energize the LED. The light intensity of this device will fall over the surface of LDR whenever the LED is turned on. Both the LDR and the LED are positioned parallel to each other The LDR is now connected to a timer chip, which is set to operate in mono-stable mode. The energization and de-energization of the light source are translated into clock pulses. Pins No. 2 (Trigger Pin) and No. 6 (Thresh Hold Pin) of the 555 timer IC are set to 1/3 and 2/3 VCC, respectively. As a result, anytime the voltage at Pins 2 / 6 is less than 1/3 VCC or greater than 2/3 VCC, state transitions occur. The resistance fluctuations of the light dependent resistor cause this voltage variation. Because of the light landing on it, this LDR variation occurs.

As a result, the timer's output generates clock pulses in response to variations in light/resistance. As a result, the pulse-shaping circuit generates clock pulses, which are required by the controller for counting and reporting energy consumption.

Pin Description

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

1) *IR Sensor:* The IR sensor, also known as an infrared sensor, is made up of two parts: a transmitter and a receiver. The infrared radiation that travels through space is emitted by the transmitter [1]. If the object is detected, waves have reflected the receiver, and the receiver sends additional signals to the electronic circuitry. A car equipped with an infrared sensor can alert the driver of nearby vehicles [1]. As a result, collisions can be avoided. Sensors that detect infrared light Vehicles, road surfaces, and other things release energy, which is detected by infrared sensors. Using an optical system, the energy gathered by these infrared sensors is focused onto an infrared-sensitive substance, which subsequently converts the energy into electric signals. To keep an eye on the traffic, these signals are suspended from the ceiling. Signal control, pedestrian identification in crosswalks, and traffic information transmission all use infrared sensors. The main disadvantages of infrared sensors are that the system's performance may be hampered by fog and that the system's installation and maintenance are time-consuming.

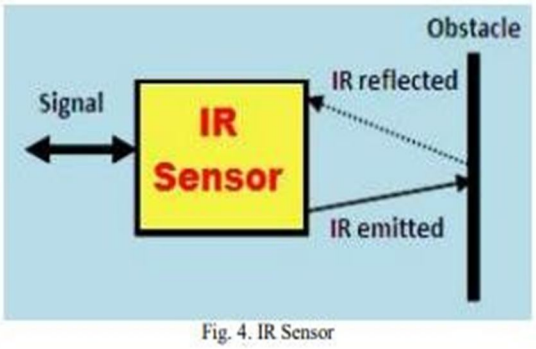


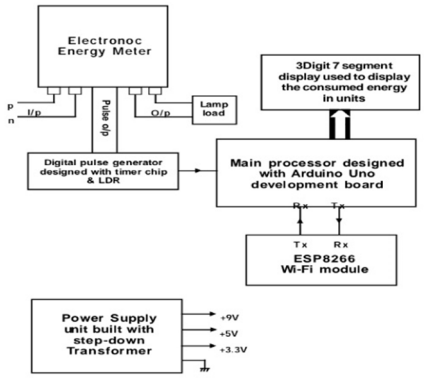
Fig. 4. IR Sensor

2) *Types of Sensors:* Different types of sensors are used for monitoring traffic as follows; Inductive loop detector, Load cell, IR sensor, RFID, Pneumatic tube, GPS based, CO2 sensor, FOG sensor, Ultrasonic sensor, Magnetometer sensor.

TABLE I. Comparison of Methods

Methods	Advantages	Disadvantages
RFID	Easy to install, security is more.	Expensive, no standardization for manufacturing.
Video data analysis	More accurate, crime rates are reduced, faster and secure.	Affected due to weather condition, proper lightening required during night, maintenance and installation cost is more.
Wireless sensor network	Greater flexibility and lower installation, maintenance cost. Consumes low energy, battery powered, small in size sensor, deployed at various locations.	Encrypted radio signals, factory default username and password, slow speed.
IR sensor	Sensors detect motion in daytime and night time reliably. secured , faster accuracy is more, good stability , Cost is less	Affected by weather condition, maintenance is more, requires line of sight between transmitter and receiver.

A. Hardware Components



Hardware is a type of electronic device. In the context of technology, hardware refers to the physical components that make up an electrical or electromechanical system, as well as anything else that can be touched. When an embedded system is examined, it includes a processing unit (often microcontroller chips are used), sensors, and control circuits that include motors, relays, and switching devices (like power Mosfets, transistors, etc). To make a system operate, hardware collaborates with firmware and software. Software is a collection of code installed into the microcontroller chip. Often LCD displays are used to monitor the system performance or results.

1) Arduino processor
2) LCD
3) Voltage regulator
4) LM555 timer chip
5) Buzzer
6) 89c2051
7) WiFi module
8) TSOP1738

a) *Arduino Processor:* Arduino is a simple software board, microcontrollers and microcontroller kits for making digital devices and interactive things with physical and digital sensing and control.

Anyone can distribute it. Commercially available Arduino boards are either preassembled or sold as DIY kits.

The microprocessors and controllers used on Arduino boards are diverse. The boards provide digital and analogue I/O pins for connection to expansion boards, breadboards (shields), and other circuits. When programming microcontrollers, a dialect of C and C++ programming features is commonly utilised. The Arduino project includes an integrated development environment (IDE) based on the Processing programming language project, in addition to standard compiler tool chains.

An IDE (Integrated Development Environment) plus a hardware programmable circuit board (also known as a microcontroller) make up Arduino.

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

b) *LCD:* It's surprising to learn that many individuals are unaware that Wi-Fi stands for wireless fidelity. Even those who do aren't always aware of the meaning of Wi-Fi. There are other theories regarding what the phrase signifies, but Wireless Fidelity is the most widely acknowledged meaning in the tech sector. Wireless technology has been quite popular in recent years, and we may connect nearly anywhere: at home, at work, at libraries, schools, airports, hotels, and even some restaurants. Because it encompasses IEEE 802.11 technology, wireless networking is referred to as Wi-Fi or 802.11 networking. Wi-Fi's main benefit is that it works with nearly any operating system, game device, and modern printer. Espress if Systems in Shanghai, China, produces the ESP8266, a low-cost Wi-Fi microprocessor with complete TCP/IP capabilities and microcontroller capability. The ESP-01 module, created by a third-party producer Ai-Thinker, first brought the chip to the attention of Western makers in August 2014. Many hackers were drawn to the module, chip, and software because of its low price and the fact that it had few external components, implying that it could someday be produced in large quantities at a low cost.

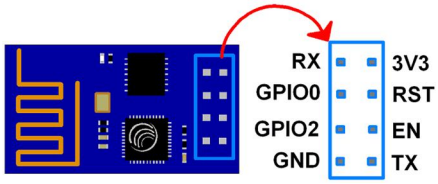
c) *Voltage Regulator:* Microcontrollers are single-chip computers that have a central processing unit (CPU), data and program memory, serial and parallel I/O (input/output), timers, and external and internal interrupts. Microcontrollers are smart electrical devices that are used to operate and monitor real-world devices. Microcontrollers are now found in nearly every piece of commercial and industrial machinery. Office automation, such as PCs, laser printers, fax machines, and other devices, account for about 40% of microcontroller applications. Consumer electronics products contain about a third of all microcontrollers. Products like. This includes CD players, hi-fi equipment, video games, washing machines, and cookers. The other application areas include the communications market, the automobile market, and the military. Microcontrollers are electronic devices that can be programmed. A program is a set of instructions that the microcontroller follows to do a certain task. Microcontrollers have typically been programmed in the target processor's low-level assembly language. This is a set of mnemonics that contain a succession of instructions. The most significant disadvantage of assembly language is that different manufacturers' microcontrollers utilise different assembly languages, requiring the user to learn a new language each time a new processor is selected. A CPU, memory, and I/O make up the most fundamental microcontroller architecture. The central processing unit (CPU) and the control unit make up a microprocessor (CU). The CPU, which handles all of the microcontroller's arithmetic and logic operations, is the microcontroller's brain. The CU controls the internal operations of the microprocessor and delivers control signals to the microcontroller's other components, allowing them to carry out the necessary instructions.

B. Description of Arduino Uno Processor

Arduino boards are utilized in a variety of electronic and telecommunication applications. Arduino is a single-board microcontroller that may be used to customize applications, interactive controls, and surroundings. A board based on an 8-bit microcontroller or a 32-bit ARM is used as the hardware. A USB port, analogue inputs, and GPIO pins are all included in current models, allowing the user to connect additional boards. The acronym GPIO stands for General Purpose, Input, and Output. All of the CPUs we use have a few, and the Raspberry Pi and Arduino both have a bunch of General-Purpose Input Output that we can use to create our circuits.

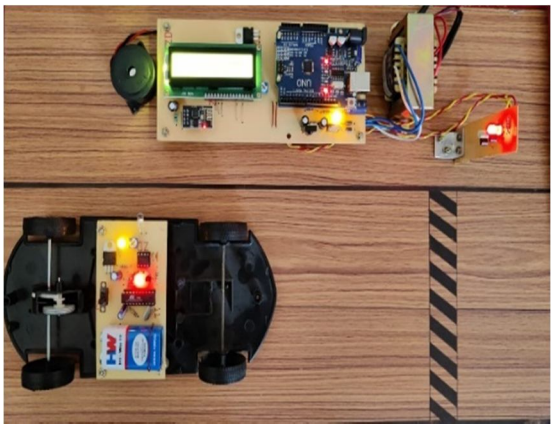
Arduino was created at the Ivrea Interaction Design Institute in Italy as a simple tool for rapid prototyping intended at students with no previous experience with electronics or programming. As soon as it gained a larger following, the Arduino board began to evolve in order to meet new needs and problems, and embedded settings. All Arduino boards are open-source, allowing users to create them on their own and customize them to meet their own needs. The software is also open-source, and it is evolving thanks to contributions from users all over the world.

1) *Discription Of Wifi Module:* Because of the convergence of different technologies, real-time analytics, machine learning, sensors, and embedded systems, the definition of the Internet of Things has expanded. IoT technology is most closely associated with items that enable the concept of the "smart home" in the consumer market, which includes devices and appliances that support one or more common ecosystems.



ESP8266-01 Module Pins
3V3: - 3.3 V Power Pin.
GND: - Ground Pin.
RST: - Active Low Reset Pin.
EN: - Active High Enable Pin.
TX: - Serial Transmit Pin of UART.

2) *Implementation*

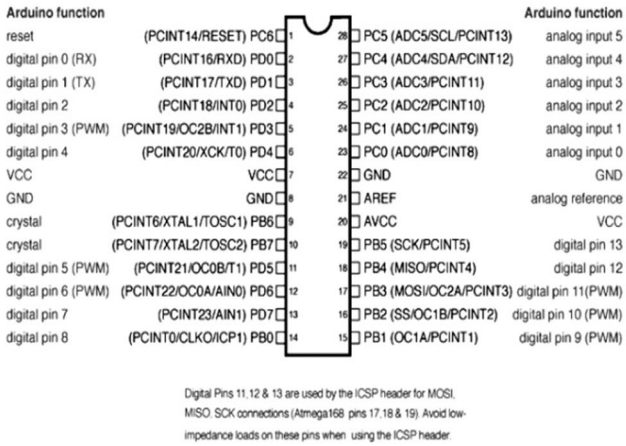


VI. WHY ARDUINO?

1) *Low-Cost:* Arduino boards are inexpensive when compared to other microcontroller platforms. Even pre-made Arduino modules cost less than $50, and the lowest version of the Arduino module may be produced by hand.
2) *Cross-Platform:* The Arduino Software works with Windows, Macintosh OSX, and Linux (IDE). The great majority of microcontroller systems are only compatible with Windows operating systems. Individuals interested in learning more about the language can utilise C++ libraries, while those interested in technical specifics can switch from Arduino to the AVR C programming language. If you want to, you may also directly include AVR-C code in your Arduino programmes.
3) *Open Source and Extendable Hardware:* The Arduino boards' plans are made available under a Creative Commons license, allowing expert circuit designers to create their own version of the module, extending and upgrading it. The breadboard version of the module can be built by even inexperienced users to learn how it works and save money.

A. *Types OF Arduino Boards*

1) Arduino Nano
2) Arduino Pro Mini
3) Arduino Mega
4) Arduino Due
5) Arduino Leonardo



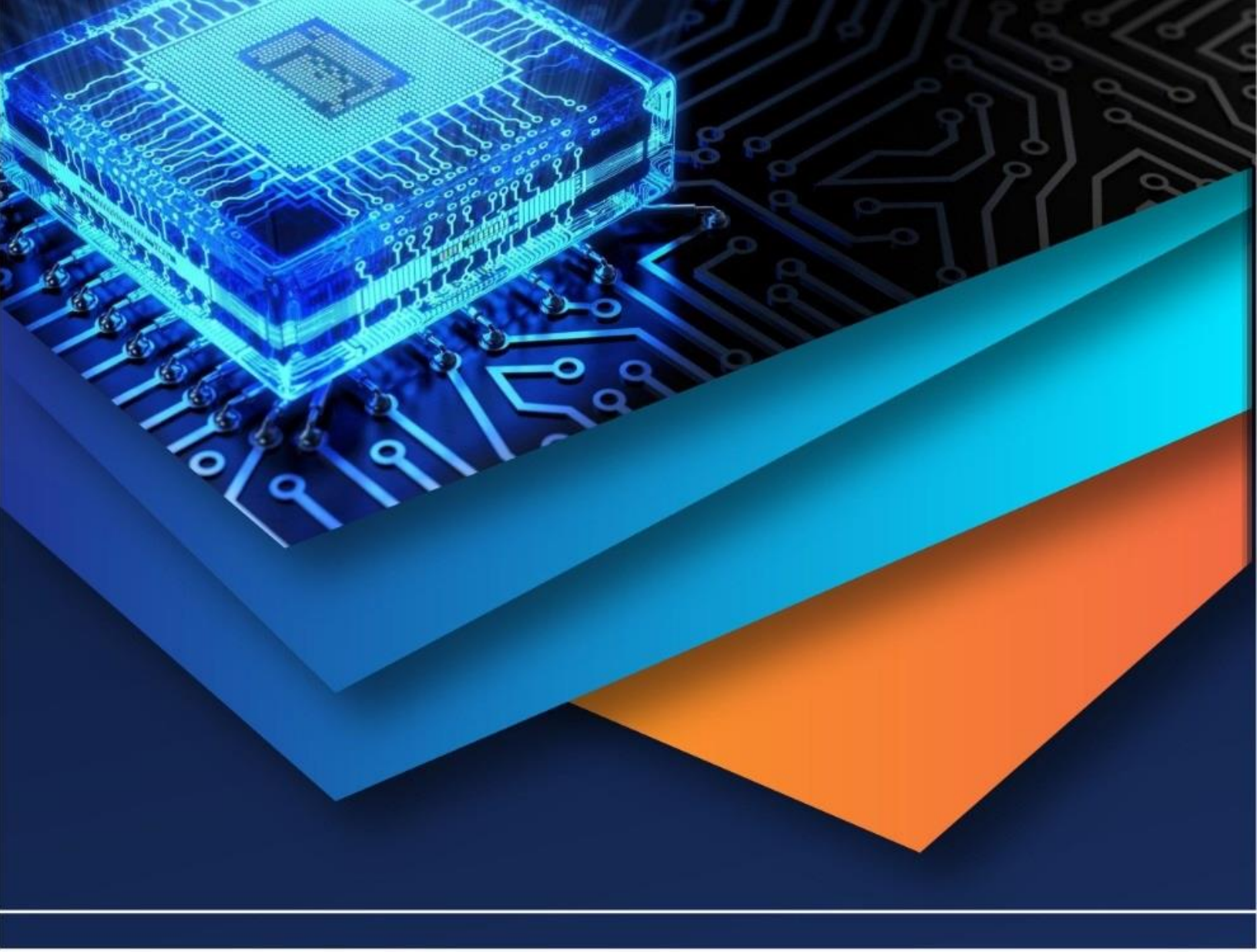
VII. CONCLUSION

The project work "IoT based Signal violated vehicle detector" is completed successfully and results are found to be satisfactory. During our trail runs we found that, sending data from the vehicle is very difficult because we won't get any suitable sensors or circuits not available. In this regard we have designed our own circuit, after conducting so many trails over different circuits and finally we could able to achieve the desired result. The ultimate goal of this circuit is to transmit the digital data produced by the microcontroller chip, initially we though to transmit the data through RF transmitter, but we found major difficulty is that the vehicle starts sending data before reaching the zebra line. Aim is to send information when the vehicle crosses the zebra line when red light is in on condition. In this regard we came to know that the data must be transmitted in uni direction not in Omni direction like as RF transmitter do, therefore IR signal transmitter circuit is constructed using IC 555.

Regarding IOT technology, it is one of the booming fields in forthcoming years and plays a major role in the field of communication. IOT helps in connecting the people by exchanging the data of various devices. Recent improvements in wireless sensor networks have created a new trend in internet of things. The main aim of this work is to provide extensive research in capturing the signal violated vehicles effectively.

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