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SMART TRAFFIC CONTROL USING ARDUINO UNO AND RF MODULE

Syed Arshad Basha*1, Deep Rakesh T*2, Chirag V*3,
Mahesh T*4, Prof. Satish Kumar T*5
*1,2,3,4,5Department Of CSE, BMS Institute Of Technology & Management, India.

ABSTRACT

The main objective of this project is to design an adaptive traffic light signals using IR sensors and to design an effective method to overcome the ambulance delay problem by using the RF modules. Traffic light controlling becomes major issue with increase in automobiles which causes congestion and it also became a major reason for the ambulance delay. This requires a smart system to handle traffic signals and to reduce ambulance delay. Using this system development at traffic junction we need not to worry about handing the traffic manually and also consumes less time as compared to the conventional traffic system. It also reduces the ambulance delay time.

Keywords: Arduino UNO, RF Module, IR Sensors, LED, Arduino IDE.

I. INTRODUCTION

One of the biggest issues in major cities around the world is urban traffic congestion. Along with the amount of time spent in traffic, there is also the issue of carbon dioxide emissions. The longer vehicles are stuck in traffic, the longer their engines are left running at idle. Due to traffic jams in large cities, emergency vehicles like ambulances and fire trucks are also affected. As a result, many people could lose their life as a result of an ambulance delay. By resolving this problem, we not only improve the quality of life for city people but also have a positive impact on the environment.

When there are more vehicles in a lane at a junction than rest of the other lanes, then the green traffic light time is increased for that lane compared to others and red for the other sides until the other lanes are clear. which would improve traveller comfort and driving safety while also facilitating efficient traffic flow. The traffic light system has also been given an emergency mode, which gives ambulances priority to pass through traffic lights so they can get to patients and hospitals without incident.

II. LITERATURE SURVEY

Dr. r.s. Deshpande, S.Chavan and J. G. Rana [3] published a paper on a traffic control system based on embedded technology (2012). Using embedded technology, sensor nodes, networks, and communication between junctions, this paper manages traffic congestion and adjusts congestion based on data from other junctions that have come before it.

Manoj Kante Manali & Shingo Mabu [5] Evolutionary Approach for the Traffic Volume Estimation of Road Sections. The proposed technique was examined under static conditions utilizing a grid road network. Simulation results show that the suggested method can predict the unknown traffic volumes using the known traffic volumes in sections.

Dinesh Rotake Prof. and Swapnili Karmore [6] Intelligent traffic light control system uses old AT89S51 microcontroller not adaptable, with little internal memory and less efficient, utilizing the genetic algorithm to find the number of automobiles.

Zhang Yuye [4] Use the rigid AT89C51, which has less internal memory, utilizing a CAN BUS controller will raise the price. The devices' use will result in very complex designs. All of these issues will be resolved in our proposed system by utilizing an Arduino ATMEGA 328 microcontroller, which consumes less power than an AT89S51.

III. COMPONENTS REQUIRED

1. Arduino UNO
2. IR Sensor
3. RF Module
4. LED

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5. Voltage Regulator LM7805
6. Relay 12V SPST (Single pole single through)
7. Arduino IDE (software)

3.1. Arduino UNO

Based on the Microchip ATmega328P microcontroller, the Arduino UNO is an open-source microcontroller board. A variety of expansion boards (shields) and other circuits can be interfaced with the board's sets of digital and analog input/output (I/O) pins. The Arduino IDE (Integrated Development Environment) can be used to programme the board's 14 digital pins and 6 analogue pins over a type B USB cable. Although it can operate with voltages between 7 and 20 volts, it can also be powered by an external 9-volt battery or by a USB cable. There are many digital and analogue input/output (I/O) pins on the board. These link numerous extension boards (shields) and circuits. The board has serial communications ports in some of the variants.

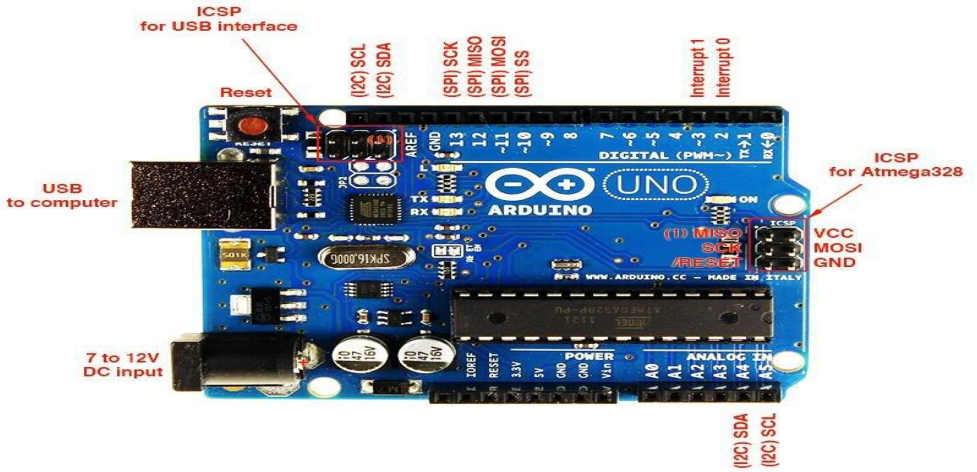

Fig 1. Arduino UNO

3.2. IR Sensor

The IR sensor, also known as an infrared sensor, is a type of electronic component which emits or detects IR radiation to identify particular characteristics in its environment. The heat and motion of a target can also be detected or measured using these sensors. It also used to detect the object using in the Infrared radiation. The IR sensor circuit is a crucial component in many electronic devices.

The IR sensor contains a transmitter section that continuously transmits IR rays to be received by an IR receiver module. Depending on how well the receiver receives IR rays, its IR output terminal changes. The IR sensor uses the operational amplifier (Op-Amp), LM339, as a voltage comparator. Comparator will evaluate the threshold voltage between the set using the preset (pin2) the photodiode series resistor voltage (pin3).

The LED at the Op amp output terminal turns ON when the Op amp's output is high (Indicating the detection of Object). The potential at the inverting input of the comparator IC is higher than the non-inverting input when the IR receiver is not receiving a signal (LM339). As a result, the comparator's output decreases, but the LED does not light up. When an IR signal is received by the IR receiver module, the potential at the inverting input drops. As a result, the comparator's (LM 339) output increases and the LED begins to glow.

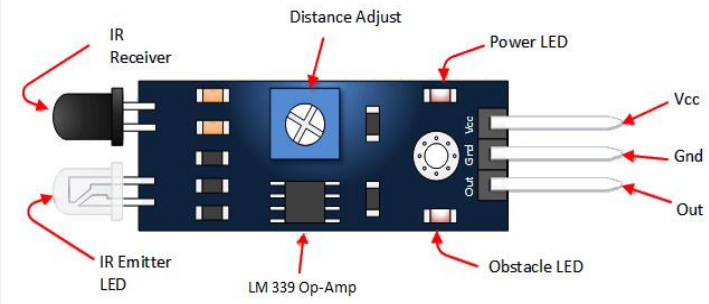

Fig 2. IR Sensor

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3.3. RF Transmitter and Receiver Module

RF module operates at Radio Frequency. Using an RF transmitter and receiver, two devices can easily communicate over radio waves. The corresponding frequency range for the RF communication system ranges between 30 kHz and 300 GHz. The carrier wave's amplitude changes to represent the digital data. The Amplitude Shifting Key modulation is what it is called (ASK). These radio frequency (RF)-transmitted signals have a long range. As a result, it can be applied to long-distance communication. A specific frequency range is used in RF communication to connect two devices. The below figure 3. show as the both transmitter and receiver used for the project. The transmitter, and receiver (TX-RX) in the RF module are used in the proposed system's emergency mode to create a wireless remote connection that can be used to drive an output from a long distance.

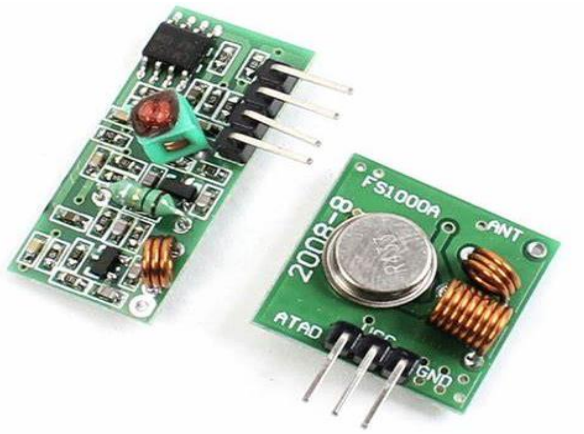

Fig 3. RF Transmitter and Receiver Module

3.4. 7805 voltage regulator

The voltage regulator is one type of electrical part used to keep the voltage across any electronic device stable. Voltage fluctuation can lead to an unfavorable outcome in an electronic system. Based on the system voltage requirement, we are going to use 7805 voltage regulators in the project. They provide a constant output voltage for a varied input voltage. The name 7805 signifies two meaning, “78” means that it is a positive voltage regulator and “05” means that it provides 5V as output. So, our 7805 will provide a +5V output voltage.

Fig 4. Voltage regulator

3.5. Arduino-IDE:

Arduino IDE is an open-source software program that allows users to write and upload code within a real-time work environment. Operating systems like Windows, Mac OS X, and Linux are all compatible with the IDE application. It supports the C programming language. The Arduino IDE (Integrated Development Environment) is the software used for Arduino. It is a text editor with various features, similar to a notepad. It is used to create code, compile that code to see if there are any errors, and upload that code to the Arduino.

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IV. BLOCK DIAGRAM

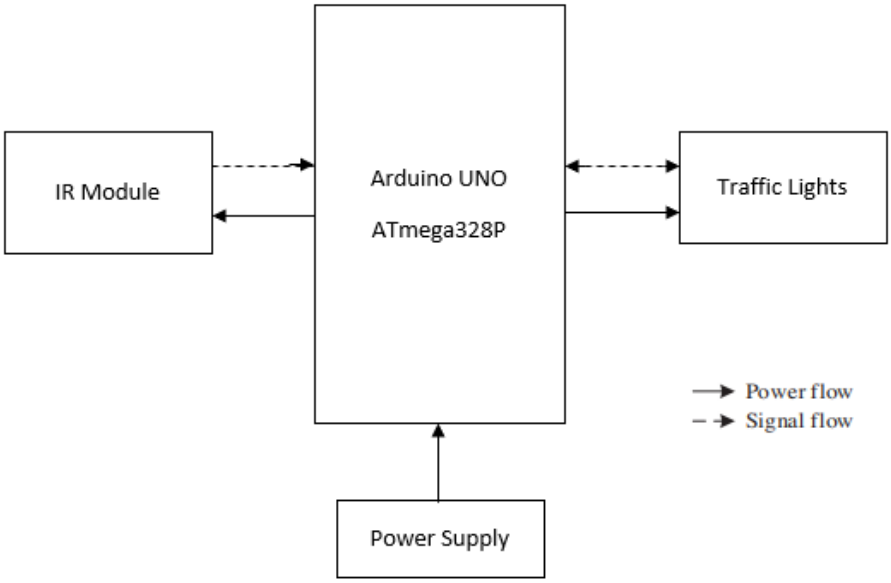

Fig 5. Block Diagram of smart traffic light control system

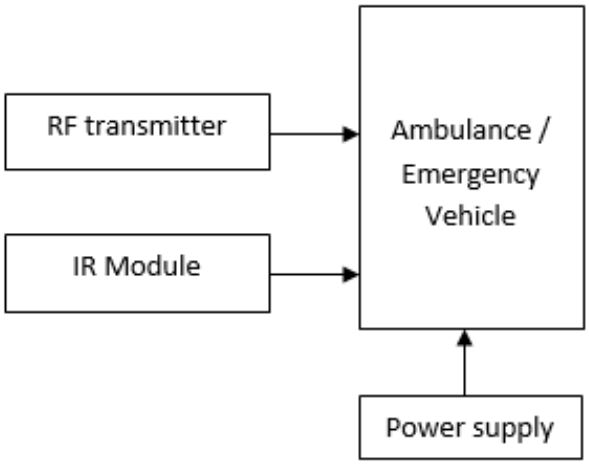

Fig 6. Block Diagram of Emergency Vechile Detection

V. WORKING PRINCIPLE

5.1. Density based traffic control

The primary objective of the smart traffic control system is to control traffic signals according to lane traffic density. It is intended to detect traffic and regulate it based on density by correctly operating the traffic signals. Digital IR sensors are used to monitor the traffic. Based on the light reflected from the vehicles, the IR sensors can identify them. To be able to detect traffic, they are positioned next to the road and facing the lane. Additionally, we will position them far enough away from the junction so that they won't detect stopped traffic until a certain threshold is reached. Fig. 4.1 displays a fundamental block diagram of the Smart traffic signal system.

Fig. 7 represents the design of the four-way intersection with an IR sensor module. Here, the roads A, B, C, and D are represented, and the arrows in each lane show how traffic moves along each road. The IR transmitter and the photodiode receiver of the IR sensors, designated as IR 1 and IR 2, are facing road D. In the same way, IR 3, IR 4, IR 5, IR 6, IR 7, IR 8 are for Road A and Road B and C, respectively.

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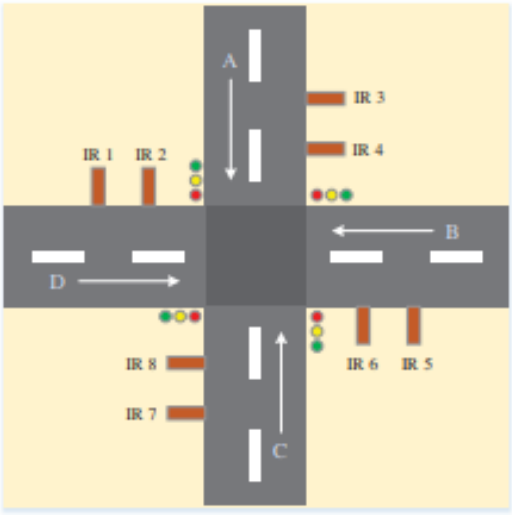

Fig 7. Four lane junction with IR sensors and traffic lights

Fig. 8 below displays a comprehensive flowchart of all the various steps involved. Using the data from the sensors, it will decide how dense the traffic is in each lane, and based on that, it will control the traffic signals, which will then take advantage of any traffic signals. LEDs were used in the creation of the system's traffic signals. Red, Yellow and green LEDs are present on each signal. A four-lane junction will have a traffic control system that we will design. Eight LEDs will serve as traffic signals for each lane along with eight digital IR sensors, two for each lane. Green, Yellow, and Red LED sets are used to indicate the GO, Ready to Go, and WAIT states respectively. The default setting for the traffic signal is 10 seconds of green light, after which all other signals turn red. Two signals will turn yellow for four seconds after ten seconds, and two more will turn red. This circumstance will continue until either all IR sensors are receiving signals or none of the IR sensors are receiving signals.

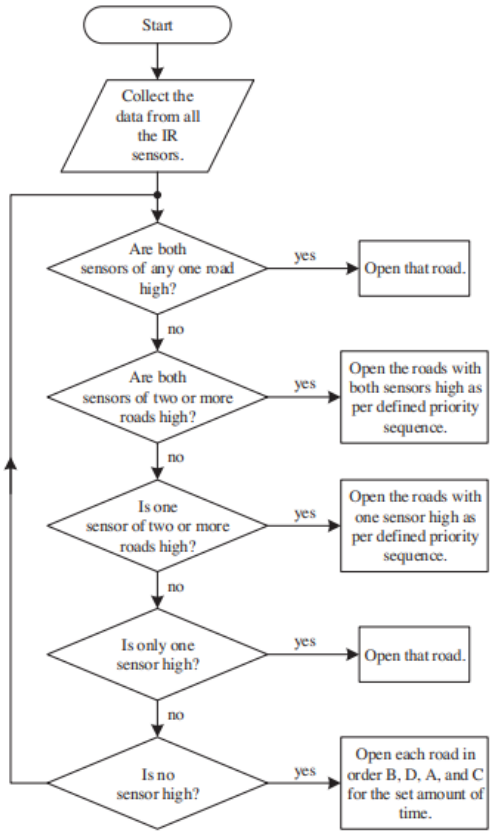

Fig 8. Flow chart of Smart Traffic signal Control System

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5.2. Emergency vehicle detection

The main methodology of the proposed model is to permit free flow of traffic to avoid congesting lanes for emergency vehicles in times of need. Because the current model is ineffective at controlling congestion for priority vehicle clearance. Therefore, this project uses radio frequency wireless communication technology. It is primarily intended to operate in two modes: normal mode, and emergency mode.

Normal Mode

In Normal mode, the system's entire operation depends on an on-chip microcontroller that is programmed to control traffic signals at set, predetermined intervals of time and based on the traffic density. As a result, signals are altered in various ways at various time intervals based on predefined time intervals. Similar to this, each central traffic control system is configured with unique functions and operating principles in response to the level of traffic congestion.

Emergency Mode

In Emergency mode, the radio frequency signal is transmitted by activating switches. When the switches are turned on, a specific voltage of signal that is generated is encoded (converting parallel data into serial data), along with a few address bits, which adds security to the transmission of data. In order to establish serial communication between the transmitter and receiver, this encoded data is finally delivered to the data pin of the RF transmitter. To detect the in which lane the emergency vehicle is coming we has used IR Transmitter when the IR receiver on the road catches the IR signal from emergency Vehicle it changes the signal to green in that particular lane. As a result, when an emergency mode is engaged, it turns that direction's signal green while turning red for all other roads or directions that are approaching the Junction. So, in emergency mode traffic lights will be controlled by received data.

VI. CONCLUSION

Since traffic is currently managed manually, our nation needs a very cost-effective and effective management system. There is exigent need of efficient traffic management system in our country, as India meets with 384 road accidents every day. We must decrease traffic jams and congestion as a result of population growth in order to decrease road accidents. In this implementation we have IR Sensors, Radio Frequency Technology. It is developed with integration of all hardware components Utilizing an IR sensor and RF technology, we have effectively reduced the delay at traffic junctions and we also reduced the delay time for emergency vehicles. With impressive results, we successfully implemented the prototype at laboratory scale. Before implementing this schema on a large scale, the next step is to test it out in a real-world setting to see how it performs. We think that if this were to be applied in a real-world setting, it might completely alter how traffic management systems operate.

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