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Density Based Traffic Light Controller using Arduino – Nano

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Abstract:
This project is aimed with the purpose of reducing the traffic tensions in the society at various cities thus moving towards a no accident prone environment which would eradicate accidents caused due to reckless or substance induced driving. Traffic Density is a serious problem in most cities therefore we need to change the control from manual to time clock based system. We use Arduino nano to program a command for 4 way directional control. The traffic lights are modified to switch on only at that exact moment until and unless an infrared signal comes into its vicinity. The sensor here is placed at a certain distance to optimise the flow of the density of traffic to maintain a proper traffic light control system ta particular junction. Once there is no sign identified by any of the four sensors the traffic lights keep on dealing with an auspicious premise. The approximate mean response time was found to be around 0.41 seconds. However further experiment conduction would help us use it in real life situations.

Keywords: Traffic signals, Arduino Nano, IR Sensors.

I. INTRODUCTION

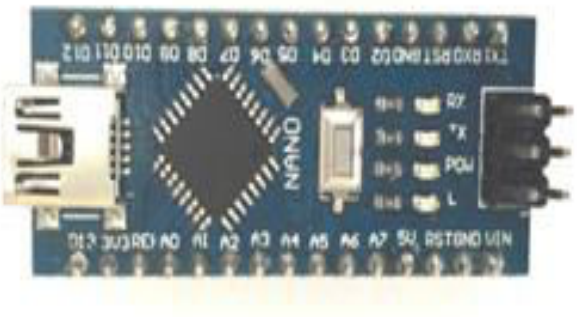
This project aims to improve the efficiency of traffic light system usingArduino based model. The traffic determination is done by IR sensors on each path. Using the details provided by the IR sensor we can guide the traffic signal to work efficiently with the traffic flow. The traffic density on each road determines the change of the timing of the signal. The road with the least traffic is assigned with the red signal and the one with the most traffic is assigned the green signal. In this project we imply the use if IR sensor to wok accordingly with Arduino to provide a better and efficient traffic light control system. We propose this paper with the idea of improving the traffic light system resulting in reducing the jamming level henceforth eradicating the problems like loss of fuel, energy dissipation, pollution and time loss. For the betterment of the nation the necessity to improve the traffic light system is very much necessary. The programming for the easy change in traffic light will result in the better movement of vehicles resulting in safe and easy floe of traffic density. This will also help to reduce major accidents like car crashes caused due to confusion of traffic lights due to the drivers and also problems caused due to trespassing of lanes .This system can be helpful to provide better traffic control in urban cities.

II. LITERATURE SURVEY

Density, speed, and flow are the three critical parameters for road traffic analysis. High-performance road traffic management and control require real-time estimation of space mean speed and density as input for large spatial and temporal coverage of the roadway network. In Adaptive Traffic Control System which receive information from vehicle such as position and speed and then it utilize to optimize the traffic signal. The system specifies the use of onboard sensors in vehicle and standard wireless communication protocol Specified for vehicular applications. They implement various traffic Signal control Algorithms. Intelligent traffic system for VANET suggest that creation for smart city framework for VANET consisting of Intelligent Traffic Lights which transmit warning messages and traffic statistic. In That System Various Routing Protocol Has Been Discussed and compared.

III. COMPONENTS USED

- **Arduino Nano**

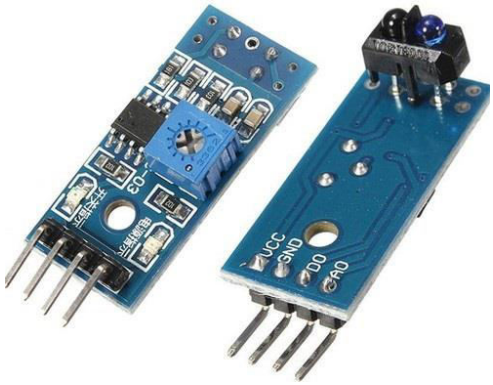


The Arduino board is designed in such a way that it is very easy for beginners to get started with microcontrollers. This board especially is breadboard friendly is very easy to handle the connections. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0.

The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards.

- **IR Sensors**



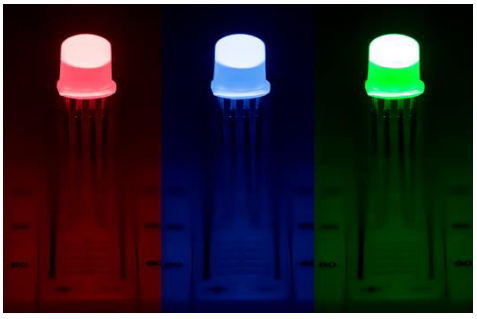
- **IR Transmitter**

IR transmitter looks like an LED. This IR transmitter always emits IR rays from it. The operating voltage of this IR transmitter is 2 to 3V. These IR (infra red) rays are invisible to the human eye. But we can view these IR rays through camer. Infrared is an invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometres (frequency 430 THz) to 1000000 nm (300 GHz) (although people can see infrared up to at least 1050 nm in experiments). Most of the thermal radiation emitted by objects near room temperature is infrared. Infrared radiation is used in industrial, scientific, and medical applications. Night-vision devices using active near infrared illumination allow people or animals to be observed without the observer being detected. Infrared astronomy uses sensor-equipped telescopes to penetrate dusty regions of space such as molecular clouds, detect objects such as planets, and to view highly red-shifted objects from the early days of the universe. Infrared thermal imaging cameras are used to detect heat loss in insulated systems, to observe changing blood flow in the skin, and to detect overheating of electrical apparatuses.

- **IR Receiver (Photodiode)**

A photodiode is a semiconductor device that converts light into current. The current is generated when photons are absorbed in the photodiode. A small amount of current is also produced when no light is present. Photodiodes may contain optical filters, built-in lenses, and may have large or small surface areas. Photodiodes usually have a slower response time as their surface area increases. The common, traditional solar cell used to generate electric solar power is a large area photodiode. Photodiodes are similar to regular semiconductor diodes except that they may be either exposed (to detect vacuum UV or X-rays) or packaged with a window or optical fiber connection to allow light to reach the sensitive part of the device. Many diodes designed for use specifically as a photodiode use a PIN junction rather than a p–n junction, to increase the speed of response. A photodiode is designed to operate in reverse bias.

- **LEDS**



A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The colour of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device. Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light. Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics.

The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet (UV), and infrared wavelengths, with high light output. Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced high-output white light LEDs suitable for room and outdoor area lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

Problem Definition

Nowadays congestion in traffic is a serious issue. The traffic congestion can also be caused by large Red-light delays, etc. The delay of respective light is hard coded in the traffic light and it is not dependent on traffic. Therefore, for simulating and optimizing traffic control to better accommodate this increasing demand is arises. In this paper the optimization of traffic light controller in a City using Arduino nano is done. The system tries to reduce possibilities of traffic jams, caused by traffic lights, to an extent.

The system contains IR transmitter and IR receiver which are mounted on the either sides of roads respectively. The IR system gets activated whenever any vehicle passes on road between IR transmitter and IR receiver. Adruino Nano controls the IR system and counts number of vehicles passing on road. Microcontroller also store vehicles count in its memory. Based on different vehicles count, it take the decision and updates the traffic light delays as a result. The traffic light is situated at a certain distance from the IR system. Thus, based on vehicle count, it defines different ranges for traffic light delays and updates those accordingly.

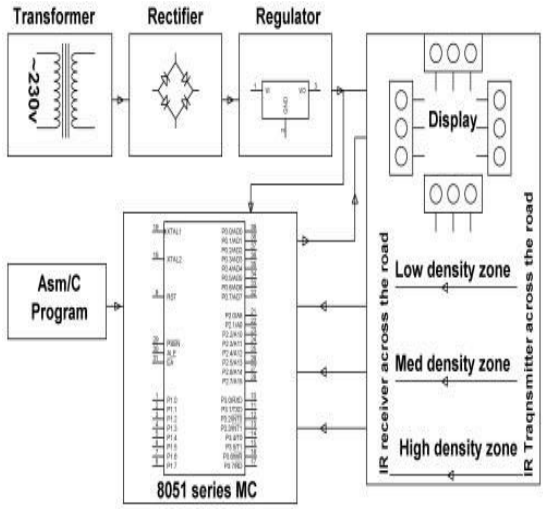
IV. METHODOLOGY

As we all know that traffic congestion is a major problem from a long time and traffic administration is also trying overcome this serious from a long time. So as a result, one solution has been deducted which is controlling the traffic on time delay.

The basic idea of this paper has been taken from the foresaid concept. According to that idea the traffic signal switches after a certain interval of time. The time interval is controlled by any microcontroller. This was a very basic step towards the optimization of traffic on road but this was not up to the mark. So, to control the traffic in a smarter and efficient way this project has been made by modifying the previous idea.

The new idea is doing its job good as it has been seen that traffic jams are reduced and also the crucial time of the citizens are saved.

Block Diagram

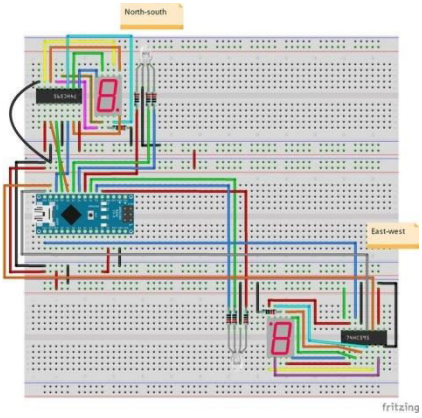


Procedure

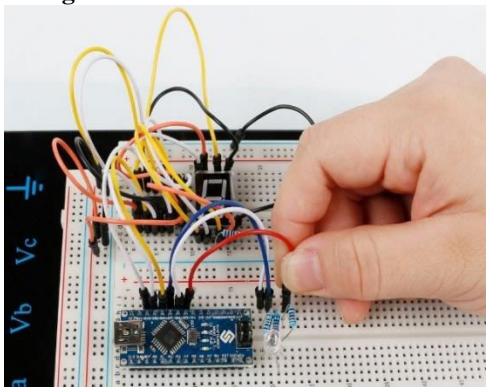
Step 1: Prepare the materials

Sun Founder Nano board
2 x RGB LED
8 x 220Ω resistor
2 x 7-segment display
2 x 74HC595
Breadboard
USB cable
Several jumper wires

Step 2: Arrange the circuit, seven segment display and Nano



Step 3: Wiring for RGB LED and Nano

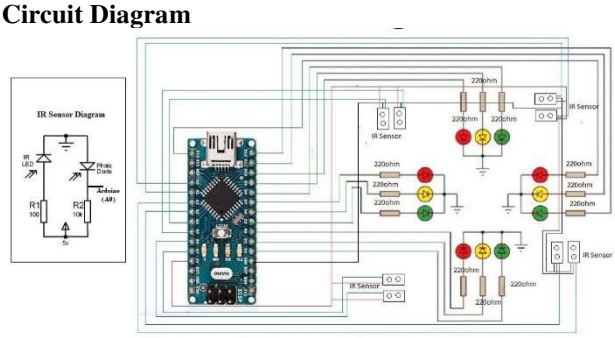


SunFounder Nano	RGB
2	Red1
3	Blue1
4	Green1
5	Red2
6	Blue2
7	Green2

Step 4: Upload the Code

```
const int red1Pin=
5; //red1 led attach to
const int yellow1Pin
=6 ; //yellow1 led attach to
const int green1Pin=
7; //green1 led attach to
const int red2Pin=
2; //red2 led attach to
const int yellow2Pin
=3 ; //yellow2 led attach to
const int green2Pin=
4; //green2 led attach to
const int STcp1 =
9;//Pin connected to ST_CP1 of 74HC595
const int SHcp1 =
8;//Pin connected to SH_CP1 of 74HC595
const int DS1 = 10;
//Pin connected to DS1 of 74HC595
//display
0,1,2,3,4,5,6,7,8,9
const int STcp2 =
12;//Pin connected to ST_CP2 of 74HC595
const int SHcp2 =
11;//Pin connected to SH_CP2 of 74HC595
const int DS2 = 13;
//Pin connected to DS2 of 74HC595
//display
0,1,2,3,4,5,6,7,8,9
int datArray[16] = {
0, 252, 96, 218,
242, 102, 182, 190, 224, 254, 246};
void setup()
{
pinMode(red1Pin,
OUTPUT); //set the redPin as an output
pinMode(yellow1Pin, OUTPUT); //set the yellowPin as an output
pinMode(green1Pin, OUTPUT); //set the greenPin as an output
pinMode(red2Pin, OUTPUT); //set the redPin as an output
pinMode(yellow2Pin, OUTPUT); //set the yellowPin as an output
pinMode(green2Pin, OUTPUT); //set the greenPin as an output
pinMode(green2Pin, OUTPUT); //set the greenPin as an output
//set pins to output
pinMode(STcp1,OUTPUT);
pinMode(SHcp1,OUTPUT);
pinMode(DS1,OUTPUT);
pinMode(STcp2,OUTPUT);
pinMode(SHcp2,OUTPUT);
pinMode(DS2,OUTPUT);
Serial.begin(9600); // start serial port at 9600 bps:
}
void loop()
{
State1();
State2();
}
void State1()
{
digitalWrite(red1Pin,HIGH); //turn on a red led
for(int num = 10; num>=0; num--) //display 9-0 and turn on a green led
{
digitalWrite(green2Pin,HIGH);
digitalWrite(STcp1,LOW); //ground STCP1
and hold low for transmitting
shiftOut(DS1,SHcp1,MSBFIRST,datArray[num]);
digitalWrite(STcp1,HIGH); //pull the ST_CP
to save the data
delay(1000); //wait for a second
}
digitalWrite(green2Pin,LOW);// turn off the green led
for(int num = 1 ;num>=0; num--)
{
digitalWrite(yellow2Pin,HIGH);
delay(1000); //wait for a second
}
digitalWrite(yellow2Pin,LOW);
digitalWrite(red1Pin,LOW); //the red led finally turn off
}
void
State2()
digitalWrite(red2Pin,HIGH);
for(int num = 10; num>=0; num--)
{
digitalWrite(green1Pin,HIGH);
digitalWrite(STcp2,LOW); //ground STcp2 and
hold low for as long as you are transmitting
shiftOut(DS2,SHcp2,MSBFIRST,datArray[num]);
digitalWrite(STcp2,HIGH); //pull the STcp2 to
save the data
delay(1000); //wait for a second
}
digitalWrite(green1Pin,LOW);
for(int num = 1 ;num>=0; num--)
{
digitalWrite(yellow1Pin,HIGH);
delay(1000); //wait for a second
}
digitalWrite(yellow1Pin,LOW);
digitalWrite(red2Pin,LOW);
}
```

Circuit Diagram



System Evaluation

Advantages:
• Avoids wastage of time due to the traffic
• Fully automatic
• Low power consumption
• It provides the easy access in the traffic light
• Low cost to design the circuit, maintenance of the circuit is good
•By using this Arduino Uno, we can create many more controls to the appliances
• Easy convenience to handle.

Limitations:
• IR sensors sometimes may absorb normal light also. As a result, traffic system works in improper way.
• IR sensors work only for fewer distances.
• We have to arrange IR sensors in accurate manner otherwise they may not detect the traffic density.

Applications:
• The project is mainly used in the traffic signals in metropolitan cities to provide uniform distribution of traffic.

V. RESULTS AND DISCUSSION

The construction of the project was done firstly on the breadboard before being transferred to the Veroboard. The LEDs which are red (5 mm), yellow (5 mm) and green (5 mm) are connected in series with resistors of 220 Ω each connected to the negative legs of the LEDs The connections of the LEDs and the resistors are created to represent traffic lights for each lane i.e. there will be four of these for each of the lanes. The Arduino is placed at the middle as the controlling system that will send the information for this operation to be effective. The legs of each of the components are then wired to the digital input and output pins of the Arduino board. The LEDs at the lanes will be connected to the pins on the board between pins 3 and 53. The legs of the IR sensors are 3 in number. The VCC leg is connected to the 5 V pin on the arduino board, the GND leg is connected to the GND pin on the board and the legs of the resistors simultaneously. The OUT leg is connected to one of the digital input and output pins corresponding to the traffic light it is to control. The power is connected using an Arduino power cord and a 9 V battery. Although the alternative power supply used is the USB cable to be able to send the codes and power to the board simultaneously. The Arduino is then programmed to enable the traffic flow on a timely basis. Also, when the sensor at lane 2 is being signalled, this will turn the traffic lights to green i.e. a GO on that lane and making the other lanes to stop for lane 2 to have the right of way. The sensor at lane 3 also detecting an obstacle turns the traffic light on that lane to green for go and stops all other lanes. When two sensors are detected at the same time as shown in Figure 9 the sensor that detected the signal first will be given the right of way and it will switch to the next sensor once the first one stops detecting the signal.

VI. CONCLUSION

The density-based traffic control system has been designed, constructed and tested to ensure validation of its function and operations. In this research, we have succeeded in minimizing the traffic congestions created by the fixed time-based traffic light system. The system is effective and the cost of production is very low. Future work is recommended in order to produce the device on a large scale and deploy to all roads in order to reduce traffic congestion in places like Lagos where traffic congestion has become a big issue.

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