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SMART TRAFFIC CONTROLLER

SMART TRAFFIC CONTROLLER USING ARDUINO AND IMAGE PROCESSING

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Abstract: Traffic congestion is a serious problem in every city. Most of the time in traffic is spent waiting for the red signal to turn green. The changing of traffic light is hard coded and it does not depend on the traffic volume. The system we have created tries to minimize the possibility of traffic jams at a reasonable degree. In our system we have used the Arduino, Cameras and LED lights. Image processing is used to count the number of cars present on each road. Depending upon to the count of cars the signal timing will be varied and thus the amount of waiting time will be reduced. Hence, this system will minimize the traffic problem at a considerable level.

Index Terms **– Traffic, Arduino, LED's, Cameras.**

I. INTRODUCTION

Many problems are faced by us in this modern life and one of them is traffic congestion. Traffic congestion is a severe problem in many major cities across the world and it has become a nightmare for the commuters in these cities. With affordability and increase in purchasing power, it has become very easy for a common person to own a vehicle. Though this has led to a comfortable lifestyle, it also leads to problems such as road congestion and traffic pile up around our cities. Traffic congestion is a condition of road networks that occurs as increases in the use of vehicles, and is characterized by slower speeds, longer trip times, and increased vehicular queuing as shown in figure.

Figure: Vehicular Queuing

II. THEORY

1) Proposed System Review

Here we are going to use Arduino UNO as the controller. We are going to connect the Camera to the Arduino and the perform the image processing. Each road will be checked for the presence of vehicles. If the count of vehicle is zero, i.e., not even a single car is present on the road then that road's green signal will be skipped. If any road has severe traffic, then the green signal timing of that road will be increased. In this way we are going to use the vehicle count to decide the traffic signal timing. A maximum time limit will be set, so that no single road will get over priority. We are going to use 12 LED's, 1 Arduino and 1 Camera.

2) Components Used

a) **Arduino UNO**

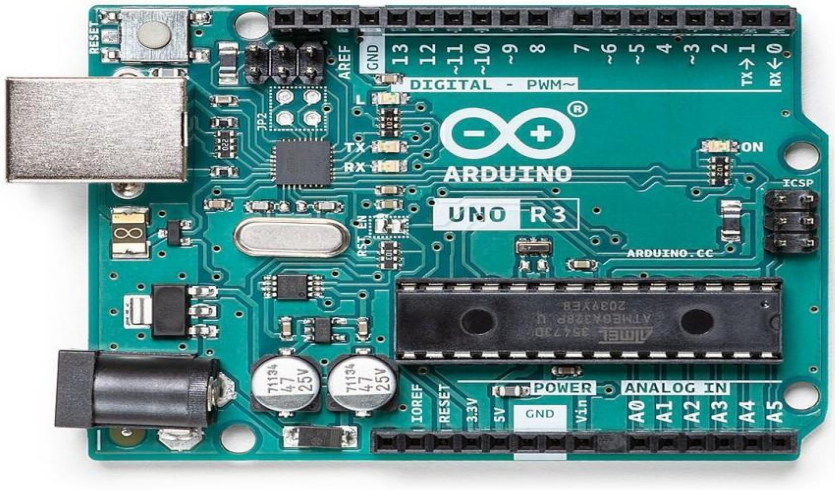


Figure: - Arduino Uno

Arduino is an open-source hardware based on the microcontroller Atmel ATmega328P. ATmega328P is an 8bit microcontroller based on the Reduced Instruction Set Computer (RISC) with an operational speed of 20 million instructions per second (MIPS) when operated at a 20MHz. It is also equipped with various other features which can be conveniently categorized into the various systems, namely: memory system, port system, timer system, analog-to-digital converter (ADC), interrupt system and serial communication. Below is the technical specification of Arduino.

- 32 KB Flash memory
- 1 KB EEPROM
- 2 KB RAM
- Clock Speed 16 MHz
- 5 V Operating Voltage
- 14 Digital I/O Pins
- 6 Analog Input Pins

b) **LED's**

Figure: - LED

LED is an active electronic device, comparable to a general-purpose diode, except for its ability to emit light with different wavelengths. When a suitable potential difference is applied across its terminals, the electrons recombine with the holes within the device thereby releasing the energy in the form of photons. This phenomenon is known as electroluminescence. Following are the specific semiconductor combination employed for obtaining a LED emitting radiation of characteristic wavelength:

1. Gallium Arsenide (GaAs) – Infrared light
2. Gallium-Arsenide-Phosphorous (GaAsP) – yellow/red light
3. Gallium-Phosphorous (GaP) – green light

c) **Camera**

Figure: - OV7670 camera

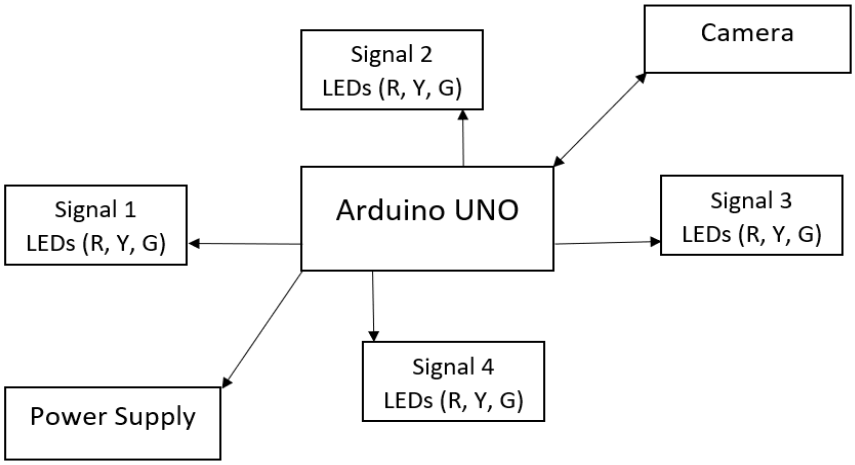
The OV7670 camera is used to capture the real time images of traffic. Its technical specifications are as follows:

- Operating Power: 60mW/15fpsVGAYUV.
- Sleeping Mode: <20 uA.
- Lens Size: 1/6″.
- Max. Frame Rate: 30fps VGA.
- Sensitivity: 1.3V / (Lux-sec).
- dynamic range: 52 dB
- Electronic Exposure: 1 to 510 rows.

d) **Resistors**

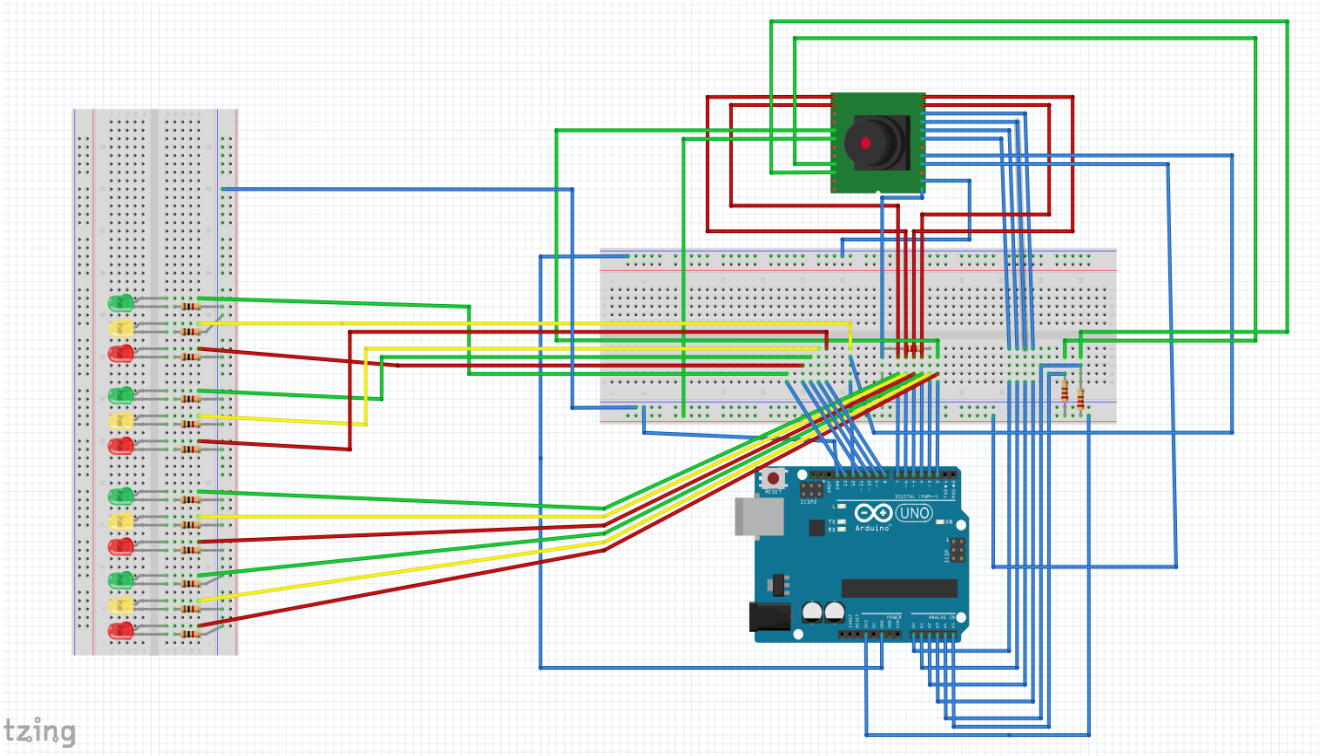
The resistor is basically used as current limiters for LEDs in order to prevent damage of the LED's due to high current.

3) Block Diagram: -



The circuit design involves a Camera being placed at the junction. This camera will be used to capture the images of vehicles. After capturing the image, the vehicle count is found in image processing. Based on how many vehicles are present on each road the green signal will be turned ON. The Arduino UNO is either powered by a power bank or using a laptop which is used to upload the code as well. The coding is done in Python. We have used the pyFirmata library to control the Arduino and do the coding. The Cameras are powered using the voltage ranges i.e., 5V and 3.3V available in the Arduino board. The code is written so as to control the Arduino and LED lights. A threshold value for the green signal timing is set. If the count of vehicles is greater than or equal to the threshold value, then we will allow the maximum green signal timing for that road.

4) Circuit Diagram



Three LEDs i.e., Green, Yellow and Red are used to indicate the GO state, Ready to go state and WAIT state. They change from LOW to HIGH indicating the passing of a vehicle. The purpose of the camera is to capture the image and store it on our PC. The OV7670 Camera is used to capture the images. After that the image is being stored in the PC. After storing the image, a separate script is run to count the number of cars present in the image. This count will be passed to the Arduino code. Then the code will function according to the count of cars. The Green signal timing of each road is varied according to the count of cars present on each road. If a road has severe traffic, then the green signal timing of that road will be increased. If a road does not have a single car on it, then that road will be skipped. In this way, the project will work according to the count of vehicles present on each road and it will help to minimize the traffic congestion problem.

5) Result

1. When the same number of vehicles are present in all the four roads of the junction, then the signal functions normally, similar to the existing system.
2. When one of the roads doesn't have any vehicle and other road has severe traffic, then the green light skips the empty road and moves forward with the one having traffic.
3. When one of the roads has traffic above the threshold limit, then the green signal timing of that road is increased.

III. Conclusion

There is a need of an efficient traffic management system in our country. So, to reduce the number of road accidents and time delay in traffic we have created an advanced system in this project. With the application of this technology for the field, the chaos of traffic will be efficiently reduced. We have successfully implemented the project using one camera. We can join three more cameras, one for each road. In this the traffic will be managed efficiently. We have implemented the prototype of this project in the laboratory. We believe that this project may bring revolutionary change in traffic management system.

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