INTRODUCTION:

Traffic congestion is a common problem that has arisen due to the increased number of vehicles on the road.Under present scenario, traffic control is achieved by the use of a system of hand signs by traffic police personnel, traffic signals, and markings. A comparable and matching education program is needed, through driver-licensing authorities, to assure that those who operate motor vehicles understand the rules of the road and the actions that they are required or advised to take when a particular control device is present. Each traffic control device is governed by standards of design and usage; for example, stop signs always have a red background and are octagonal in shape. Design standards allow the motorist to quickly and consistently perceive the sign in the visual field along the road. Standard use of colors and shape aids in this identification and in deciding on the appropriate course of action. Under current circumstances, traffic lights are set on in the different directions with fixed time delay, following a particular cycle while switching from one signal to other creating unwanted and wasteful congestion on one lane while the other lanes remain vacant.

In order to deal with this problem, researchers have proposed many solutions. One of the currently used models is the timer model. Traffic can be controlled to a great extent by using timers at each phase of the traffic. Another model used is with the help of electronic sensors which detects the presence of vehicles, and produce appropriate signals. The cause of traffic is dependent on many factors like peak time, special days, season, bad weather, or unexpected events like accidents, special events or constructional activities.

Once we get stuck in traffic, we may have to wait for hours to get out of it. We can solve this problem to a great extent by implementing this density based traffic control system using image processing which continuously manages the traffic lights based on traffic. Our project includes interfacing of camera module, image processing system and LED’s to Arduino microcontroller. The project can be divided into three phases.

Phase 1 includes interfacing the camera module with Arduino microcontroller and storing the image in computer. In phase 2, the image processing is performed on the stored images and density of vehicles in a lane is calculated. Phase 3 includes allocation of timers to each signal based on the density of vehicles in that lane.

We have used CMOS OV7670 Camera Module to capture grayscale images and they are sent to the Computer through Arduino UNO microcontroller. Image processing is performed on the images using MATLAB R2015b. Then, the output signals are shown using LED’s

DESCRIPTION:

1. IMAGE ACQUISITION:

Generally an image is a two-dimensional function f(x,y)(here x and y are plane coordinates).The amplitude of image at any point say f is called intensity of the image. It is also called the gray level of image at that point. We need to convert these x and y values to finite discrete values to form a digital image. Each digital image composed of a finite elements and each finite element is called a pixel.

1. IMAGE RESIZING/SCALING:

Image scaling occurs in all digital photos at some stage whether this be in Bayer demosaicing or in photo enlargement. It happens anytime you resize your image from one pixel grid to another. Image resizing is necessary when you need to increase or decrease the total number of pixels. Even if the same image resize is performed, the result can vary significantly depending on the algorithm.

Images are resized because of number of reasons but one of them is very important in our project. Every camera has its resolution, so when a system is designed for some camera specifications it will not run correctly for any other camera depending on specification similarities. so it is necessary to make the resolution constant for the application and hence perform image resizing.

1. RGB to GRAYSCALE CONVERSION:

Humans perceive colour through wavelength-sensitive sensory cells called cones. There are three different varieties of cones, each has a different sensitivity to electromagnetic radiation (light) of different wavelength. One cone is mainly sensitive to green light, one to red light, and one to blue light. By emitting a restricted combination of these three colours (red, green and blue), and hence stimulate the three types of cones at will, we are able to generate almost any detectable colour. This is the reason behind why colour images are often stored as three separate image matrices; one storing the amount of red (R) in each pixel, one the amount of green (G) and one the amount of blue (B). We call such colour images as stored in an RGB format. In grayscale images, however, we do not differentiate how much we emit of different colours, we emit the same amount in every channel. We will be able to differentiate the total amount of emitted light for each pixel; little light gives dark pixels and much light is perceived as bright pixels. When converting an RGB image to grayscale, we have to consider the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One of the approaches is to take the average of the contribution from each channel: (R+B+C)/3. However, since the perceived brightness is often dominated by the green component, a different, more "human-oriented", method is to consider a weighted average,

e.g.: 0.3R + 0.59G + 0.11B.

1. IMAGE ENHANCEMENT:

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further analysis. For example, we can eliminate noise, which will make it more easier to identify the key characteristics. In poor contrast images, the adjacent characters merge during binarization. We have to reduce the spread of the characters before applying a threshold to the word image. Hence, we introduce “POWER- LAW TRANSFORMATION” which increases the contrast of the characters and helps in better segmentation. The basic form of power-law transformation is s = cr^ γ, where r and s are the input and output intensities, respectively; c and γ are positive constants. A variety of devices used for image capture, printing, and display respond according to a powerlaw. By convention, the exponent in the power-law equation is referred to as gamma. Hence, the process used to correct these power-law response phenomena is called gamma correction. Gamma correction is important, if displaying an image accurately on a computer screen is of concern. In our experimentation, γ is varied in the range of 1 to 5.

1. EDGE DETECTION:

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more technically, has discontinuities or noise. The points at which image brightness alters sharply are typically organized into a set of curved line segments termed edges.

We use Canny Edge Detection method.

The Canny edge detection algorithm consist of the following basic steps:

1. Smooth the input image with Gaussian filter.
2. Compute the gradient magnitude and angle images.
3. Apply nonmaxima suppression to the gradient magnitude image.
4. Use double thresholding and connectivity analysis to detect and link edges.

1. IMAGE MATCHING:

Recognition techniques based on matching represent each class by a prototype pattern vector. An unknown pattern is assigned to the class to which is closest in terms of predefined metric. The simplest approach is the minimum distance classifier, which, as its name implies, computes the (Euclidean) distance between the unknown and each of the prototype vectors. It chooses the smallest distance to make decision. There is another approach based on correlation, which can be formulated directly in terms of images and is quite intuitive.

We have used a totally different approach for image matching. Comparing a reference image with the real time image pixel by pixel. Though there are some disadvantages related to pixel based matching but it is one of the best techniques for the algorithm which is used in the project for decision making. Real image is stored in matric in memory and the real time image is also converted in the desired matric. For images to be same their pixel values in matrix must be same. This is the simplest fact used in pixel matching. If there is any mismatch in pixel value it adds on to the counter used to calculate number of pixel mismatches. Finally percentage of matching is expressed as

%match= No.of pixels matched sucessfully / total no.of pixels

HARDWARE AND SOFTWARE USED:

1. ARDUINO UNO:

The Arduino UNO is an open-source microcontroller board based on the [Microchip](https://en.wikipedia.org/wiki/Microchip_Technology) [ATmega328P](https://en.wikipedia.org/wiki/ATmega328P) microcontroller and developed by [Arduino.cc](https://en.wikipedia.org/wiki/Arduino).[[2]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-2)[[3]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-What_is_Arduino?-3) The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[[1]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-Makerspace-1) The board has 14 Digital pins, 6 Analog pins, and programmable with the [Arduino IDE](https://en.wikipedia.org/wiki/Arduino#Software) (Integrated Development Environment) via a type B USB cable.[[4]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-priceton-4) It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.[[3]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-What_is_Arduino?-3) It communicates using the original STK500 protocol.[[1]](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-Makerspace-1) The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

[[](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-website-7)

1. CAMERA MODULE CMOS OV7670:

The OV7670/OV7171 CAMERACHIPTM is a low voltage CMOS image sensor that provides the full functionality of a single-chip VGA camera and image processor in a small footprint package. The OV7670/OV7171 provides full-frame, sub-sampled or windowed 8-bit images in a wide range of formats, controlled through the Serial Camera Control Bus (SCCB) interface. This product has an image array capable of operating at up to 30 frames per second (fps) in VGA with complete user control over image quality, formatting and output data transfer. All required image processing functions, including exposure control, gamma, white balance, color saturation, hue control and more, are also programmable through the SCCB interface. In addition, OmniVision CAMERACHIPs use proprietary sensor technology to improve image quality by reducing or eliminating common lighting/electrical sources of image contamination, such as fixed pattern noise (FPN), smearing, blooming, etc., to produce a clean, fully stable color image.

1. SERVO SG90:

Servo motors operates from 4.8V to 6.5V, the higher the voltage higher the torque we can achieve, but most commonly they are operated at +5V.  Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle.The torque at which the motor operates is the 2.5kg/cm.

1. MATLAB R2016A:

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming environment. Furthermore, MATLAB is a modern programming language environment: it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. It has powerful built-in routines that enable a very wide variety of computations. It also has easy to use graphics commands that make the visualization of results immediately available.It is used for image processing and interfacing the result with Arduino board.

LITERATURE SURVEY:

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IoT Based Traffic Signalling System

IoT Based Traffic Signalling System IoT based traffic signaling system is based on traffic density on road where the count of vehicles is done at each side of road by placement of sensor. In this system, three traffic lights i.e Green amber and red are placed on junction of road sides. Two pairs of sensor are placed across the roads which mark the distance for density zones. In here ultrasonic sensor are placed and ultrasonic receiver opposite to each other. In here Sensors are placed at 50 meters distance from one another. The logic here is that as the vehicles crosses the first pair of sensors, a digital signal is produced and accordingly sensor assumes that there is traffic congestion on the road. So based on the data gathered, Arduino microcontroller sends the timing signal output by comparing with adjacent road’s traffic. As the vehicle crosses the second pair of sensors, Sensor assumes that it contains high traffic density respectively. For high density traffic, there will be more time allotment and for low density traffic normal time is given. The data on traffic density and traffic signaling control are sent wirelessly to Raspberry Pi3 where analysis made as Heavy traffic and Normal Traffic with date and time. This information is finally updated on Cloud webpage which can be used for further planning and analysis by Traffic department. The system design of IoT based Traffic signalling system is where Ultrasonic sensor is placed on sides of road every 50 meters. The sensor here would capture the data for counting the density of that particular side and corresponding signal will be provided by Arduino Microcontroller based on heavy and normal traffic. The density traffic information with appropriate signaling along with date and time of each road sent to Pi3 where analysis done as heavy and normal traffic. This traffic analysis sent to Cloud webpage for further analysis in future.