

Density based Traffic Control System with Emergency vehicle detection

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Abstract - The project is aimed at designing a density based dynamic traffic signal system where the timing of signal will change automatically by determining the traffic density at any junction. Traffic congestion is a severe problem in most cities across the world and therefore it is time to shift from manual mode or fixed timer mode to an automated system with decision making capabilities. Present day traffic signaling system is fixed time based which may render inefficient if one lane is operational than the others. To optimize this problem, a framework for an intelligent traffic control system needs to be designed. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time. Also emergency vehicles such as ambulance, fire extinguishing engines etc should be prioritized. Therefore proposed here is a mechanism in which the time period of green light and red light is assigned on the basis of the density of the traffic present at that time and if emergency vehicle is present in any lane, that particular lane is cleared first. This is achieved by using Image Processing techniques. The images of the roads are captured by the camera, that are processed in MATLAB and the information about the emergency vehicle and the density of each road is sent to the microcontroller. Once the density is calculated, the glowing time of green light is assigned with the help of the microcontroller (Arduino UNO). The microcontroller will control the signal lights.

Key Words: Traffic congestion, emergency vehicles, intelligent traffic control system, automated system, MATLAB, microcontroller.

1. INTRODUCTION

In modern life we have to face with many problems one of which is traffic congestion. Traffic congestion is becoming more serious day after day. It is said that the high volume of vehicles, the inadequate infrastructure and the irrational distribution of the development are main reasons for increasing traffic jam. The major cause leading to traffic congestion is the high number of vehicles, caused by the population and the development of economy.

This problem can be solved by developing an intelligent traffic control system which can provide efficient control of traffic so that the precious time of the people is not wasted in the traffic.

1.1 Block Diagram

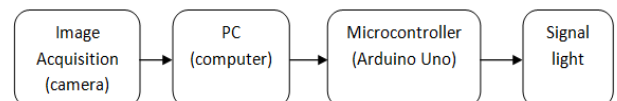


Fig -1: Block diagram of the proposed system

The basic block diagram of the density based traffic control system is as shown in figure 1.3. It consists of four basic blocks, the camera, a personal computer, a microcontroller unit and signal lights (LED's). The web camera and the microcontroller (Arduino Uno) are interfaced with the PC. The camera captures the images of the road and passes these images to the computer. These images are processed in the computer and the condition for emergency vehicles along with the density is checked and the output is passed to the Arduino Uno. The Arduino microcontroller uses this information and glows the LED's accordingly, so as to manage the traffic system efficiently.

The components required are as follows:

1. MATLAB Software
2. Light emitting diode
3. Arduino UNO
4. Camera
5. Computer

1.2 MATLAB SOFTWARE

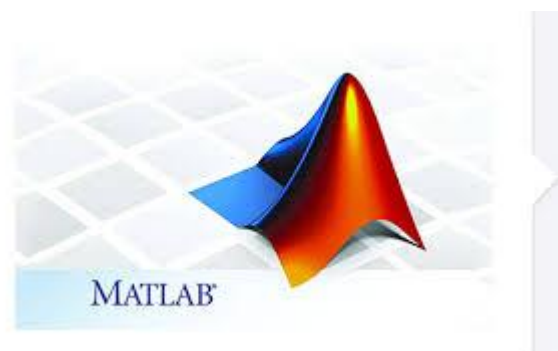


Fig -2: MATLAB software symbol

MATLAB software is an open source which contains various features and support packages. MATLAB is intended primarily for numerical computing. An additional package, simulink adds graphical multi domain stimulation and model based design for dynamic and embedded system. And also it has various support packages for interfacing the MATLAB with other hardware devices such as camera, Arduino Uno, IR sensors and many more. To communicate with hardware components various support packages are available. This application requires camera and Arduino UNO support package, which can easily be installed in higher versions of MATLAB (2017, 2018).

1.2 LIGHT EMITTING DIODE

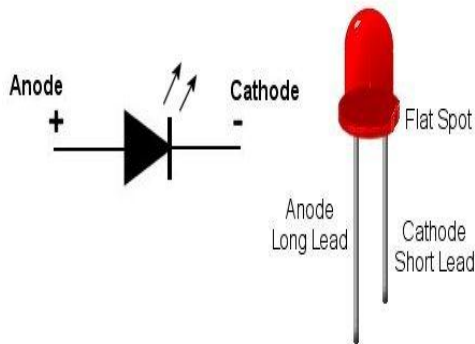


Fig -3: Symbol of LED

A light-emitting diode (LED) is a two-lead semiconductor light source, as shown in below figure (fig 3.1). It is a p-n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LED's are typically small (less than 1 mm²) and integrated optical components may be used to shape the radiation pattern.

1.3 ARDUINO UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button as shown in fig 4. 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.

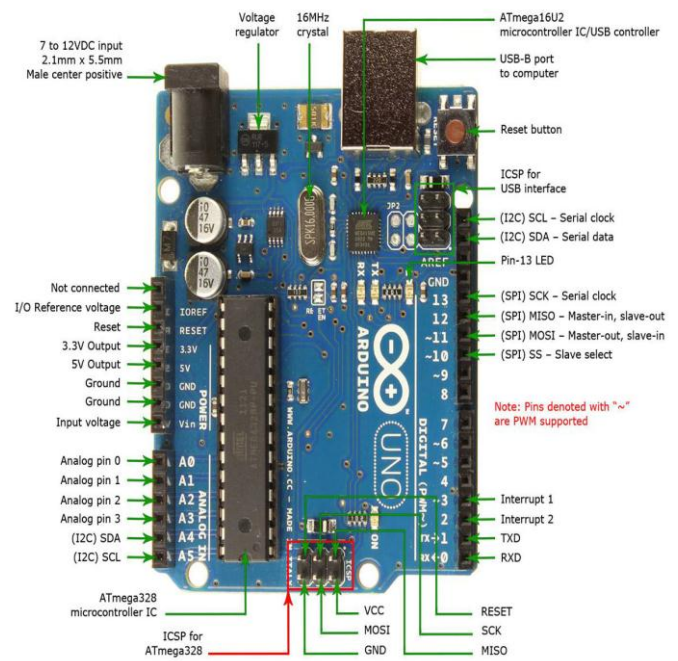


Fig -4: Arduino UNO

The support package for Arduino Uno microcontroller is installed in the MATLAB software from the internet. It involves two parts:

1. Arduino hardware support package.
2. Arduino input and output support package.

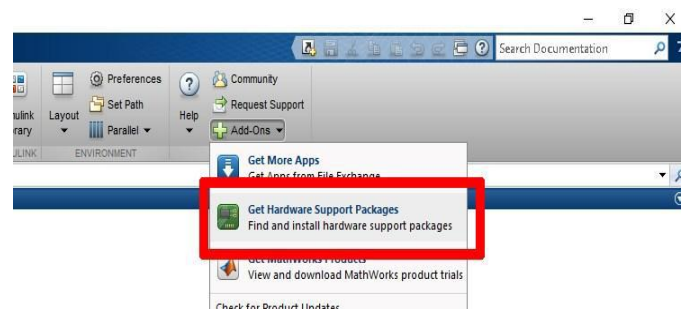


Fig -5: MATLAB Support package for arduino

These support packages establishes communication between the MATLAB and the Arduino Uno microcontroller. It makes writing or reading of pins from or to Arduino in the MATLAB possible. It is required for the controlling of traffic lights based on the density of traffic and in emergency condition, which is the timing variation based on the density of the traffic and priority for the lane where emergency vehicle is present.

1.4 CAMERA



Fig -6: Camera

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without physical contact. The word camera comes from camera obscura, which means "dark chamber" and is the Latin name of the original device for projecting an image of external reality onto a flat surface. The modern photographic camera evolved from the camera obscura. The functioning of the camera is very similar to the functioning of the human eye.

The support package for camera is installed in the MATLAB software from the internet. This package name is OS generic video interface package (USB Camera), which enables the MATLAB to directly use the camera connected to its USB port. Hence it is possible to use the video or image captured using the camera directly in the MATLAB. This makes the proposed system the real time system.

2. CIRCUIT DIAGRAM

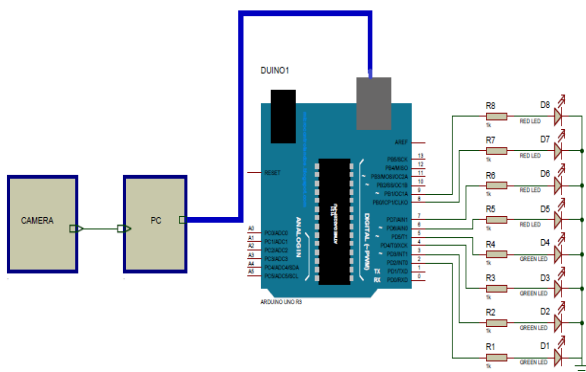


Fig -7: Circuit diagram of the proposed system

The circuit diagram of density based traffic control system is as shown in figure 3.4. It consists of four blocks. The web camera (USB Camera), a PC, a microcontroller

(Arduino UNO) and LED setup to show the efficient control of traffic. The camera captures the images of the road and passes these images to the computer. These images are processed in the computer and the condition for emergency vehicles along with the density is checked and the output is passed to the Arduino Uno. The Arduino microcontroller uses this information and glows the LED's accordingly, so as to manage the traffic system efficiently. Here few toy vehicles and LEDs are used (a prototype of the real world traffic light control system). MATLAB sends the information to the Arduino through the support package installed. The MATLAB support package for Arduino enables reading data from and writing to the Arduino. The density of the vehicles and the emergency vehicle condition is checked in MATLAB. If there is an emergency vehicle in any lane, that particular lane is cleared first. If there is no emergency vehicle, the green time is allotted to each road. Based on the density of the vehicles in the road. The time allocation information is communicated from MATLAB to Arduino and the Arduino board glows the LEDs in the fashion specified by MATLAB.

3. FLOWCHART OF THE PROPOSED SYSTEM

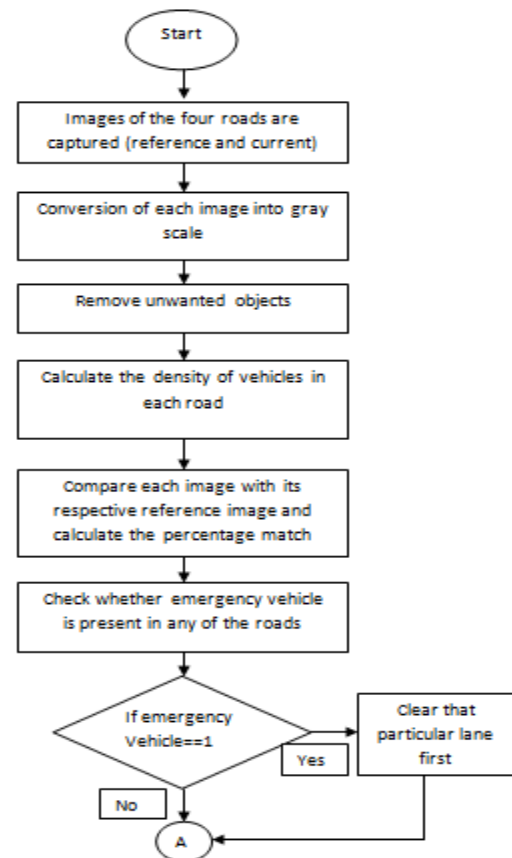


Chart -1: Flowchart of the proposed system(part A)

The flowchart of density based traffic control system is as shown above in two parts (part A and part B). The software program is written in MATLAB. The images of the empty roads are captured at first and stored as reference images. The real time images are captured and compared with the stored reference images. All the images are converted into gray scale and the unwanted objects such as footpath, trees etc are removed. The density of each road is calculated using edge detection techniques (prewitt /canny/sobel/Robert). Then the real time processed images are compared with the previously stored reference images and the percentage match is calculated. Emergency vehicle condition is checked based on the red color of the siren of emergency vehicles by making use of the color detection techniques in MATLAB. If the emergency vehicle is detected in any of the lane , then that particular lane is cleared first. If no emergency vehicle is detected, then the time for which the green light should be ON is assigned and the information is passed to the arduino with the help of the arduino support package of MATLAB. The LEDs that are connected to arduino glow according to the assigned time and the process repeats.

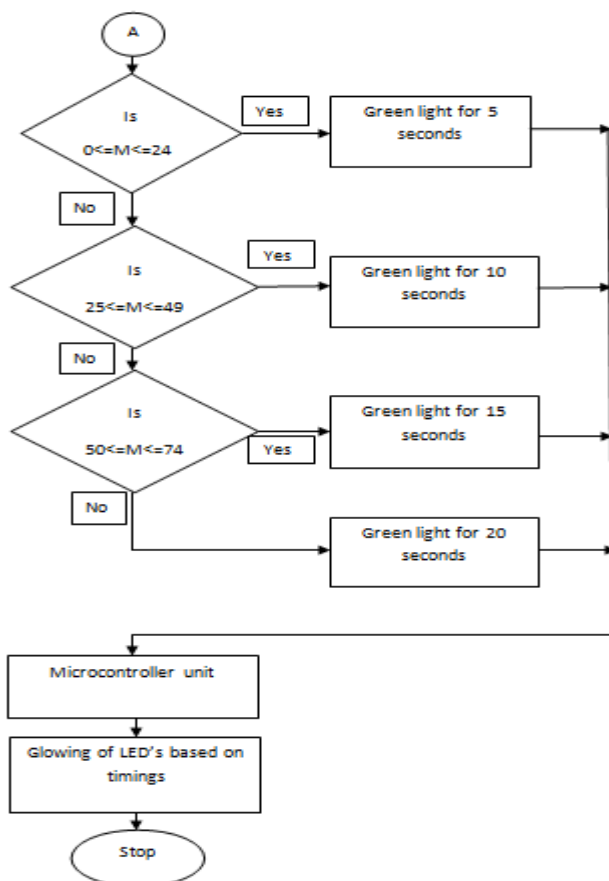


Chart -2: Flowchart of the proposed system(part B)

4. CONCLUSIONS

The MATLAB program is written as per the flowchart explained above. The obtained output is given to the Arduino and the LEDs are glown according to arduino outputs.

The proposed system uses a traffic density estimation technique using image processing, based on the area occupied by the edges of vehicles. This method can even save lives of many people who have lost their lives in ambulances due to traffic congestion. The proposed method will play an important role in estimating traffic congestion to control traffic signals but it still requires development to attain higher accuracy.

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