**CHAPTER 1**

**INTRODUCTION**

* 1. **Introduction of Adaptive Traffic Signal Control**

Adaptive Traffic Signal Control (ATSC) is the process by which the timing of a traffic signal is continuously adjusted based on the changing arrival patterns of vehicles at an intersection. During the process, a traffic signal provides green time to each intersections approach based on anticipated arrivals for adjacent intersections. As arrival patterns change from cycle to cycle, the length of green time provided to each approach also changes.

The Federal Highway Administration (FHWA) released the Every Day Counts initiative to assist agencies and municipalities address congestion issues by identifying and deploying innovative technology that maximizes the usefulness of the existing infrastructure.

ATSC can be used as a method to reduce delays to the motoring public and extend the life of the current roadway systems by delaying the need to add capacity through additional travel lanes. Fewer delays also result in improved fuel efficiency and lower vehicle emissions, which have a positive impact on the environment.

First, traffic sensors collect data. Next, traffic data is evaluated and signal timing improvements are developed. Finally, adaptive signal control technologies implement signal timing updates. The process is continuously repeated internally by the system hardware or software. Then, the signals using ATSC share information with each other and make necessary adjustments to the signal timing parameters to keep traffic flowing smoothly.

According to the Texas Transportation Institute, the cost of traffic congestion is $87.2 billion in wasted fuel and lost productivity. That translates to $750 per traveller. Outdated traffic signal timing currently accounts for more than 10 percent of all traffic delays. When traffic signals are responsive to traffic demands, overall travel times are decreased. Average speeds improve when adaptive signal control technologies are used. Adaptive signal control typically improves travel time and delay by 10 percent and as much as 50 percent at locations with outdated signal timing plans. Within the United States, adaptive signal control technologies have been in use for roughly 20 years, though they have been deployed on less than 1 percent of existing traffic signal.

* 1. **Statement of the Problem**

Traffic congestion has been one of the fundamental problems faced by modern cities since the wide usage of automobiles. Just a normal few minutes trip to the convenience store may take up to half an hour due to traffic jam or slowdown. According to the police, congestions are actually the causes of some issues like road rage, road bullies and major accidents.

The small road capacity is also one of the contributing factors. As the number of private cars increases greatly over the years, traffic congestion occurs when the needed road capacity is not fulfilled. Simple improvements of the road infrastructure can easily solve this problem. Since congestion occurs frequently in the cities, local government municipal can consider passing laws on restricting the number of car owned in a family. This method is in fact, workable and effective.

* 1. **Introduction to Image Processing**

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics or features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

1. Importing the image via image acquisition tools
2. Analysing and manipulating the image
3. Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

* 1. **Aim and Objectives**

The main aim of thesis is to develop adaptive traffic signal control system which system will reduce traffic congestion issue.

The objectives are:

1. To study Webster’s Methods
2. To study image processing with python
3. To study OpenCV framework and image processing technique
4. To reduce traffic congestion, time, cost and energy
5. To study object detection and classification with deep neural network
6. To study User Datagram Protocol in Ethernet communication
   1. **Scope of Thesis**

Basically, the thesis can be classified in two parts. These are software and hardware parts that will be used in order to implement this thesis. The scope of this thesis will be focused on the adaptive traffic signal control with image processing and Arduino. The scope will include as follows:

1. To implement adaptive traffic signal control system
2. To implement objects detections and classification with YOLOV3 framework
3. To implement Arduino, Shift register and seven-segment using differential signalling
4. To reduce traffic congestion, time, cost and energy
5. To construct adaptive traffic signal control system with Arduino, Computer and Cameras
6. To implement image processing technique at modern traffic control system
   1. **Outlines of Thesis**

Chapter 1 is the introduction of adaptive traffic signal control system. This chapter explains about image processing theory, aim and overall system of the thesis.

Chapter 2 will describe traditional traffic light system, adaptive traffic control system, Webster’s Methods, image processing technique and for all required framework, and Multi-threading.

Chapter 3 will describe the theory of components and methods used in adaptive traffic signal controls system.

Chapter 4 deals with the design and implementation of the thesis.

Chapter 5 is the discussion, conclusion and future recommendations about this thesis.