

Chapter 63

An Advanced Fuzzy Logic Based Traffic Controller

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ABSTRACT

Traffic light plays an important role in the urban traffic management. Therefore, it is necessary to improve the traffic controller for effective traffic management and better traffic flow leading to greener environment. In this paper, an advanced and intelligent traffic light controller is proposed, utilising the fuzzy logic technology and image processing technique. A fuzzy logic control has been implemented to provide the attribute of intelligence to the system. For real-time image acquisition, the process is further linked to the fuzzy logic controller which generates a unique output for each input pattern. Here image processing and fuzzy logic tool boxes of MATLAB are used where the final output is sent to Peripheral Interface Controller (PIC) microcontroller to drive the traffic signals in the desired manner. The results obtained show an improvement of 44% in the overall outcome of traffic management as compared to the conventional traffic controller, marking great feasibility and practicality of the current model.

INTRODUCTION

One of the prerequisites of traffic control and management involve the use of traffic signals. Their main goals are improving the traffic safety at the intersection, maximising the capacity at the intersection and minimising the delays (Abd-Fatah, Yusuff, Aziz, & Zulkifli, 2011). On a larger scale, the effectiveness of traffic flow yields a number of economic and environmental benefits (Azimirad, Pariz, & Sistani, 2010). The conven-

tional traffic controller comprises of a constant cycle for the signal operation and the output is indicated in red, yellow or green colours. A lot of advancements have been made in the traffic light control systems (Bohang, Yan, Qingbing, & Shougang, 2010). Such as set-ups function according to the 'time-of-day' principle (Abd-Fatah, Yusuff, Aziz, & Zulkifli, 2011). Further research and knowledge of the applications of modern traffic controllers state that the vehicle-actuated controllers operate with an improved

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workability (Laisheng, Xiaohong, Zhengxia, Bing, & Pengzhi, 2009). A number of controllers and data acquisition methods have been used before such as neural networks (Soloman, 2010), embedded systems (Chavan, Dr. Deshpande, & Rana, 2009), SMART-SIGNAL (Liu, Ma, Hu, Wu, & Yu, 2008), inductive loops sensors (Ms. Kulkarni & Ms. Waingankar, 2007) and Agent based traffic control (Tan, Khalid, & Yosuf, 1996), Top-down and Bottom-up control (Wang, Wang, & Wei, 2011) have been the popular choices. Here, the length of the green phase is adjusted according to the traffic flow and the decision making is carried out by the controller itself. Today, vehicle-actuated controllers are gaining more popularity as they hold a supreme capability of managing traffic flow on real-time basis (Seifnaraghi, Ebrahimi, & Ince, 2009). Microcontrollers are an essential constituent of microelectronics in this modern era (Ibrahim, 2008). Their use is considered to be both efficient and economical. Furthermore, the scope of applications can be further enhanced with integration with software/computers (Zeng & Zhang, 2011).

In this project two traffic signals are set in a T-junction configuration as shown in Figure 1. Intelligence governed by the fuzzy logic controller has been linked to image processing which acts as a superior mode of data acquisition (Marques,

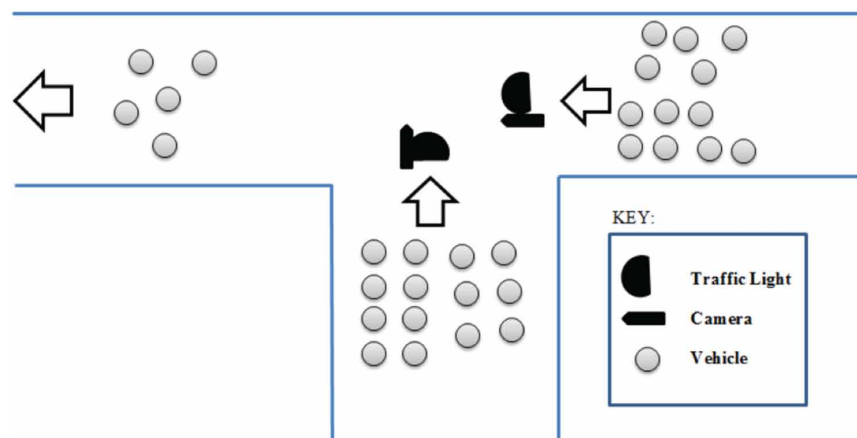
2011). The final stage comprises role of a micro-controller which recognises and drives the traffic signals accordingly.

IMAGE PROCESSING

The inputs regarding the number of vehicles at each participating signal are obtained through vision sensors. Coloured vision provides maximum amount of information regarding the subject which proves to be quite beneficial most of the times (Birdal & Erçil, 2010). The same goes in the current set up in which each vehicle is detected regardless of its colour, shape and location within the work space of the vision camera.

The logic uses background estimation for filtering each vehicle from the background along with its recognition as an independent variable. The initiation of the system is accompanied by acquisition of the base frame which is then compared with all the preceding frames. To be more precise, the base frame pixel values are compared with all the following frames. Pixel values of base frame are compared with all the following frames and difference in pixel values form the basis of vehicle recognition (see Figure 2). Areas with different pixel values are highlighted by a rectangular frame as shown in Figure 3.

Figure 1. General outlook of project



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