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Genetic Algorithm Based Adaptive Control of Traffic Light Systems in Multiprocessor Architectures

H. Kodikara Arachchi

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M.Phil. April 2000

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by

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Thesis submitted to
the Department of Electronic and Telecommunication Engineering of
University of Moratuwa

for the partial fulfillment of

Master of Philosophy

April 2000

Genetic Algorithm Based Adaptive Control of Traffic Light Systems in Multiprocessor Architectures

By

H. Kodikara Arachchi

Submitted to the Department of Electronic and Telecommunication Engineering on March 18, 2000, in partial fulfillment of the requirements for the degree of Master of Philosophy

Abstract

The traffic signal is one of the most common control devices used to manage highway traffic. Operating them as isolated units does not exploit their usefulness fully. An advanced system, in which traffic signals at junctions at a close proximity are coordinated, enables a more efficient method of traffic control. This thesis presents the development of hardware and software for the Uniroad traffic signal controller, for interfacing it to the proposed Advanced Traffic Control System (ATCS) for Sri Lanka, and a technique to calculate traffic plans based on the Genetic Algorithm for the coordinated system.

In hardware development, a communication interface and a general purpose input interface (GPII) are designed and implemented for the traffic signal controller (TSC). These are used to monitor the performance and change traffic plans manually or through computer control. The GPII is also used to interface vehicle detectors, pedestrian pushbutton etc. to the TSC.

The firmware platform of the TSC is developed to accommodate the requirements of both coordinated as well as individual systems. Synchronizing routines, temporary overrides and online time plan adjustments as well as error detecting and logging routines are introduced.

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A control and monitoring (C&M) software package is developed for the control center. Using this package, the operation of each traffic signal controller can be monitored or optimally adjusted as needed.

A traffic plan calculator (TPC) is developed to calculate traffic plans needed for a set of coordinated traffic signal controllers. A new algorithm, based on well-known evolutionary algorithm, the Genetic Algorithm, was developed for TPC. The TPC provides an optimum set of traffic signal plans for a coordinated traffic signal system. This is a one requirement of proposed Advanced traffic Control System for Sri Lanka.

Thesis supervised by:

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(Supervisor)

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April 2000

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Dr. JAKS Jayasinghe,
(Supervisor)

To you

.......who work for the benefit of this little island

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Abbreviations

ATCS	Advanced Traffic Control System
AVL	Automatic Vehicle Location
AVL	Automatic Vehicle Location
CC	Control Center
CCTV	Closed Circuit Television
CD	Code Display
ComC	Communication Controller
CRT	Cathode Ray Tube
GA	Genetic Algorithm
GPI	General Purpose Input
NP	Non-polynomial
OF	Objective Function
Paramics	PARAllel MICroscopic Simulator
PI	Performance Index
RNM	Road Network Model
Rx	Receive
SBC	Single Board Computer
SCOOT	Split Cycle Offset Optimization Technique
TMod	Traffic Model
TPA	Traffic Plan Analyzer
TPC	Traffic Plan Calculator
TPG	Traffic Plan Generator
TPG&A	Traffic Plan Generator and Analyzer
TRANSYT	TRAffic Network StudY Tool
TRRL	Transport and Road Research Laboratory
TSC	Traffic Signal Controller
TSim	Traffic Simulator

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TU	Timer Unit
Tx	Transmit
UTC	Urban Traffic Control
VRC	Vehicle/Roadside Communications

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