REAL-TIME OBJECT TRACKING AND SURVEILLANCE USING A PARALLEL COMPUTING ARCHITECTURE

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Degree of Master of Science

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science.

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DECLARATION

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Abstract

Closed-circuit television (CCTV) cameras are used widely in surveillance applications where operators need to constantly monitor the videos on the video wall. The objective of this research is to improve the efficiency of the personal who monitor the videos in vehicle surveillance applications. Two types of vehicle surveillance are considered: the detection of vehicles coming to a stop, and tracking moving vehicles through multiple cameras.

The event of a vehicle coming to a stop occurs in situations such as vehicles stop at the toll plaza at express ways or car parks. The purpose of detecting a vehicle coming to a stop is to minimize frauds which may occur during the toll collection process. The approach to minimize such frauds is by using the vehicle count as a reference. The use of Graphics Processing Unit (GPU)s to process the videos reduces the average execution time from 0.098s to 0.075s.

The detection and tracking moving vehicle through multiple cameras are considered as the second type of vehicle surveillance. These multiple cameras are fixed in different locations and the same vehicle may appear on different cameras in different times. It is a tedious process to manually track these vehicles through non-overlapping cameras. In the approach of tracking moving vehicles through multiple cameras the processing power of GPUs are used. GPUs parallelize the detection algorithm to achieve the real time performance for two video streams which are processed concurrently. The algorithm which matches the vehicles through multiple cameras gives an accuracy of over 80%.

In the events of detecting a vehicle coming to a stop and detecting and tracking moving vehicles through multiple cameras, the processing power of GPUs are used to reduce the processing time of a frame to achieve the real time performance.

This thesis is dedicated to all the soldiers who sacrificed their lives to end the civil war in Sri Lanka.

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Abbreviations

API Application Programming Interface.

CCTV Closed-circuit television.

CPU Central Processing Unit.

CUDA Compute Unified Device Architecture.

DCT Discrete Cosine Transform.

FLANN Fast Library for Approximate Nearest Neighbors.

GMPHD Gaussian Mixture Probability Hypothesis Density.

GPGPU General-Purpose Graphics Processing Unit.

GPU Graphics Processing Unit.

IP Internet Protocol.

ITS Intelligent Transportation Systems.

MHI Motion History Image.

NPP NVIDIA Performance Primitives.

PCA Principal Component Analysis.

ROI Region of Interest.

SIFT Scale-Invariant Feature Transform.

SIMD Single Instruction Multiple Data.

SURF Speeded-Up Robust Features.