Road Surveyor System Prototype

By

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Dissertation submitted in partial fulfillment of

the requirement for the

Bachelor of Technology(Hons)

(Information Communication Technology)

JANUARY 2008

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the

Information Communication Technology Programme

Univesiti Teknologi PETRONAS

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Bachelor of Technology(Hons)

INFORMATION & COMMUNICATION TECHNOLOGY

Approved by,

(GOH KIM NEE)

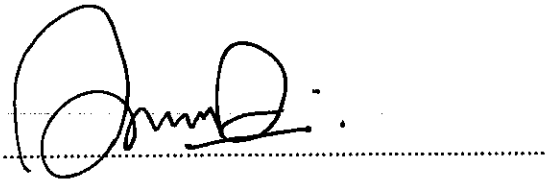
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2008

CERTIFCATION OF ORIGINALITY

This is to clarify that Im responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



MOHD BAZLI BIN OTHMAN

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank the All Mighty Allah for his blessings and every door of opportunity He has opened for me throughout the period of completing this project. I thank my family especially both of my parents for their support and encouragement.

This report should have been finished without the help and guidance from my Final Year Project supervisor, Ms Goh Kim Nee. Her positive comments and critics have vital in getting the best out of me for this project.

I also like to thank other UTP IT/IS lecturers for their views and suggestions during the presentation and evaluations. If it is not because of them, the project would have only been a mediocre or a failure. Not to forget to all my friends and peers throughout my four and half year at this university. The likes of Tan Shern Shiou, Wan Afiq, Khairil Hafriza, Aizuddin, Nazwan, Najihah and other people around have made my student life a worthwhile. The times spent with them will always be cherished.

Lastly, I convey my thank again to all individuals who had given their support and thoughts throughout the completion of this project. May Allah bless u all, InsyaAllah.

ABSTRACT

This report concerns with the progress to develop a prototype of "Road Surveyor System Prototype", which the prototype system that will detect and count on every car pass by the road. It consists of five elements that cover the introduction, Literature review, Methodology or project work, discussion, conclusion, and references.

The new part added from the preliminary is the introduction part that is mainly discussing about the background study of area, characteristics, resources, and the description of it. For the second part, the focus is more on the study of the project and the theory.

Part three is where the project works, methodology, research, project timeline and it also describes more on the relevance and the feasibility of the project within the scope, user interface design and time frame given. Finally, the project conclusion is stated in the report together with the references used while doing my research work on this project.

Table of Contents

1.0 Introduction

Real-time processing of moving pictures of traffic flow is considered to be useful for obtaining various types of special traffic parameters. It is also expected to reduce time and work required in traffic investigation.

1.1 Objective

- To detect number of cars
- To calculate total number of cars using a road
- To gather the information and present it in a proper way

1.2 Description

The "Road Surveyor System Prototype" consists of a system that trains a camera to detect an object (cars). The camera will capture the image of the cars in many frames and the system will recognize the vehicle and start counting. The system will deliver the total number of cars using the road in certain time.

2.0 Problem Statement

Inconsistent survey by human

Road Surveyor is very useful to lessen the human effort. Traditionally, no machine was assigned to survey the number of vehicles using a road. Human will do the survey and count on every car use the road. Human concentration can easily disturb by external factor and will affect the surveying process

For example, in PETRONAS, an officer will be assigned to survey on the numbers of car using the road in some periods.

Solution

The road surveyor system prototype will take over the human's works and efforts. The system can be the solution to easy their work. The result from the system also can be made as a reference on the traffic situation of the area.

3.0 Background of Study

Road survey is a study of gathering information and data from the road, the data is usually, number of vehicles using the road, type of vehicles, time of most vehicles using the road and traffic information. The process of gathering this information is usually will take lot of time and it will become inconsistence when human assigned to the job because of the lack of focus.

The system will be developed to replace the human to do survey on road. The advantage of having the system is the consistency of the counting number. The system will give the consistent number or units of vehicles and can stay longer to do survey.

The system is more on to analyze the traffic on the road and the information is very useful for some organizations or businesses. The system also can save cost in long term of use.

Generally, it is a very good solution for the road surveyor activities and traffic analysis.

4.0 Literature Review

Human concentration

Human concentration performance will drop when doing a repetitive work such as surveying cars on road.

Professor Christopher Conway. (2006). journal Psychological Science. National Institutes of Health researcher, Indiana University. *United Press International.* "Performance of human concentration will drop when the two sets of sequences were from the same perceptual class of stimuli, such as two sets of speech stimuli". Human concentration performance will drop when doing a repetitive work such as surveying cars on road.

In common sense, human will need rest at least 5-10 minutes in 2 hours working to retain the focus. Machine is a device that transmits or modifies particles. It does not affect by psychological. Machine can works in specific time non-stop depending on the hardware capability and software reliability.

Image processing

Image processing technique will be used for the car detection process. Neural network studies are one of the important things in image processing. Abdi, H., Valentin, D., Edelman, B.E. (1999). *Neural Networks.* Thousand Oaks: Sage. In Computer science, artificial neural networks are made up of interconnecting artificial neurons (usually simplified neurons) which may share some properties of biological neural networks. Artificial neural networks may either be used to gain an understanding of biological neural networks, or for solving traditional artificial intelligence tasks without necessarily attempting to model a real biological system.

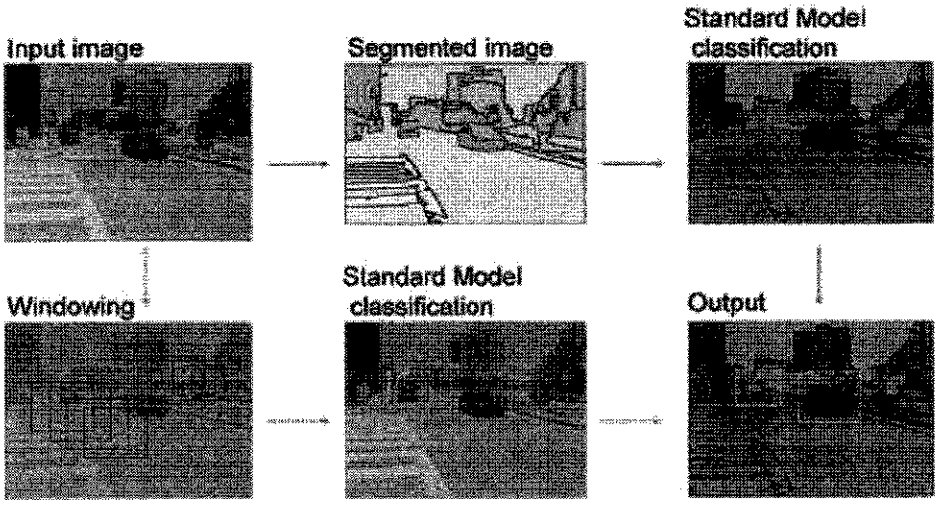
OpenCV LIbrary

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real time computer vision.

Example applications of the OpenCV library are Human-Computer Interaction (HCI); Object Identification, Segmentation and Recognition; Face Recognition; Gesture Recognition; Motion Tracking, Ego Motion, Motion Understanding; Structure From Motion (SFM); and Mobile Robotics.

Haar cascade training was also given time during this project. It is anticipated that what I have accomplished here may be of use to the image processing. Several neural networks were trained to be used in a computer vision application. The training of these cascades is accomplished by iteratively looking at a sizable image data set. The haar training will go through a number of stages, at each stage it will look at the positve images, with objects already marked, and compare them against the negative images, those without any objects of which we are considering. Over time the algorithm will eventually learn, becoming more and more

accurate, until it reaches some specified false alarm rate. That is, a false alarm rate of considerable insignificance.



Diagrams illustrate the architecture of the data flow diagram, specifically highlighting the two pathways for the detection of the texture-based and shape-based objects.

Shape base

Shape-based objects are those objects, for which there exists a strong part-to-part correspondence between examples, including pedestrians, cars, and bicycles. In order to detect shape-based objects, a standard windowing technique is used.

5.0 Methodology

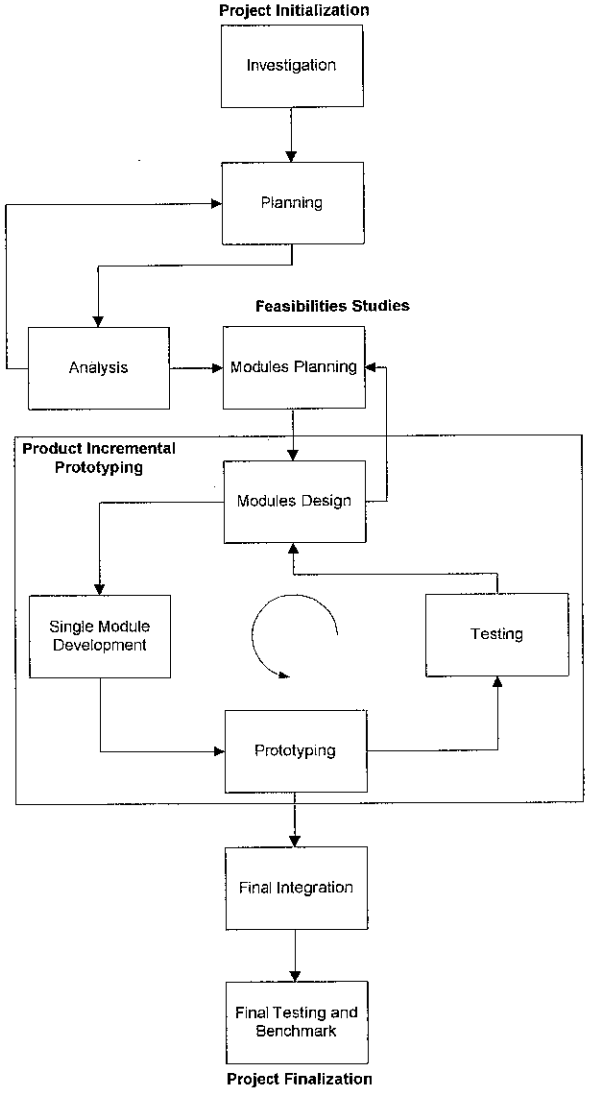


Diagram: Methodology

The methodologies that will be used in this project are the combination with prototyping, module & spiral development model. All the methods have their own benefit to develop the best final product.

Analysis

After gathering all the information and data, it will be used to answer all the question such as what the system will do, where & when the system will be used and who will use the system.

Analyses consist of 2 major part, first part is the analysis on development process and the second part is the analysis on the outcome of the system. On the development few steps were taken to recognize on how the project will be developed. From the analysis, the major software of the project were recognized and the data that required in the system were gathered.

Design

This part decides how the system will operate, in terms of the hardware, software, environment and user interface. The system will be designed according to the research in planning and analysis phase.

Prototyping & Testing

Prototype is a partly completed system and ready to use. The Prototype is used to show the concept and idea of the real system. After completing the prototype of the system, the system will be tested.

Module Planning & Design - analysis where planning for every module that will be develop for the whole project.

Module design mainly for the overall structure and blueprint for a single module that will be develop in the next stage. After development, it will be prototype with the previous module for testing to pass a certain expected result.

6.0 Discussion

This technique to do the surveying process which is detecting vehicles on road make use of image processing on a camera image and produce a predictive matching of object

6.1 Approach

Vehicles survey by human

1. Human to stay near road and waiting
2. Count on every vehicle using the road
3. Tick & take note on every single vehicle using the road on paper
4. Make analysis

Digital Vehicles surveyor system

1. Setup on the place where we the surveying activity will be done
2. Capture and process the input
3. Show the data (counted vehicles) on the screen.

6.2 Equipment / Tools

Procurement of tools and equipment for Road Surveyor System:

1. Visual Studio .NET 2005
   - To develop the software for machine vision and image processing while controlling the camera frames and deduces the coordinate using C language.

2. OpenCV
   - Open source image processing library which include background and foreground segmentation, mathematical function for blob analysis and much more.

3. Webcam
   - Webcams is a cheap alternative beside camcorder to capture the image of the

6.3 Check-list

Status of equipments / tools readied:

1. Visual Studio .NET 2005
2. OpenCV
3. Webcams

6.4 Project Organization:

Major Software Components

The OpenCV major four libraries:

'CV'- Computer Vision Algorithms.

This contains all vision algorithms.

'CXCORE'- Linear Algebra.

This provides raw matrix support such as matrix manipulation etc.

'HIGHGUI'- Media/Window handling.

Allows reading/writing of AVI's, window displays, etc.

'CXAUX'- Experimental/Beta algorithms.

6.4.1 Code:

In order to begin training, firstly image data were gathered, which should be in the thousands of images were used for both positive and negative image data using HAAR method. Objects were manually marked within the positive images. Object Marker, has been used to make this chore more bareble, it is still a very tedious and time consuming task. Especially true for the image that is populated with many objects of which were considered. After marking the objects, The training of the cascade using the haartraining application were began.

6.4.2 Metrics

As far as the neural network or cascade goes, a performance measurement can be obtained by running the performance app. This will give a measurement of a certain degree of accuracy for a particular cascade.

6.4.3 Testing

Again, the performance app helps us with the testing of a particular cascade. This will tell us the accuracy of the cascade against some test images. These test images are not to be used for training as well, otherwise we may incur a slight bias in our testing/performance results.

6.5 Project Initialization

Investigation on problem statement has been done where the problems of "Road surveyor" in the market are identified. To build a good human computer interface and replace human effort to do survey must be tackle. A new and novel idea generated using image processing techniques and cameras to overcome the existing problem giving us a Road Surveyor system without needed for human to do survey with high learnability and usability. Besides, this idea of replacing the current effort by human to do survey, the system is aimed to be useful to check the daily traffic on the road.

After the problem statement and research has determined in the investigation phase, planning is the stage where we layout the future course and come out with a schedule which include step by step progress and milestone in order to achieve the result. A methodology is introduced to accommodate this special modular development.

6.6 Feasibilities Studies

Feasibilities studies stage includes analysis and modules planning. From the analysis phase, the outcome of the analysis is the layout of the schedule and the modules to be worked on for the project. There are two milestone need to be completed before end of this year which is System interface & functionality and object detection. Conceptual diagrams have been illustrated to visualize the idea in figure format.

Modules planning will be updated and revisit every time each modules has finished so that the project has some flexibility in terms of deliverables.

All the neural network theory will applied in the project to detect vehicles. In the detection process, automatic measuring system and real-time image processing algorithm is used for measuring traffic-flow data. Traffic-flow-data inclusively means the number of passing vehicles. The sample points are set across the lanes at some height from the footprint of the camera. Sample points of moving picture taken by a webcam and processed by a personal computer. The arrangement or will be above the road to lower detection error rate and capable for multi-lane road.

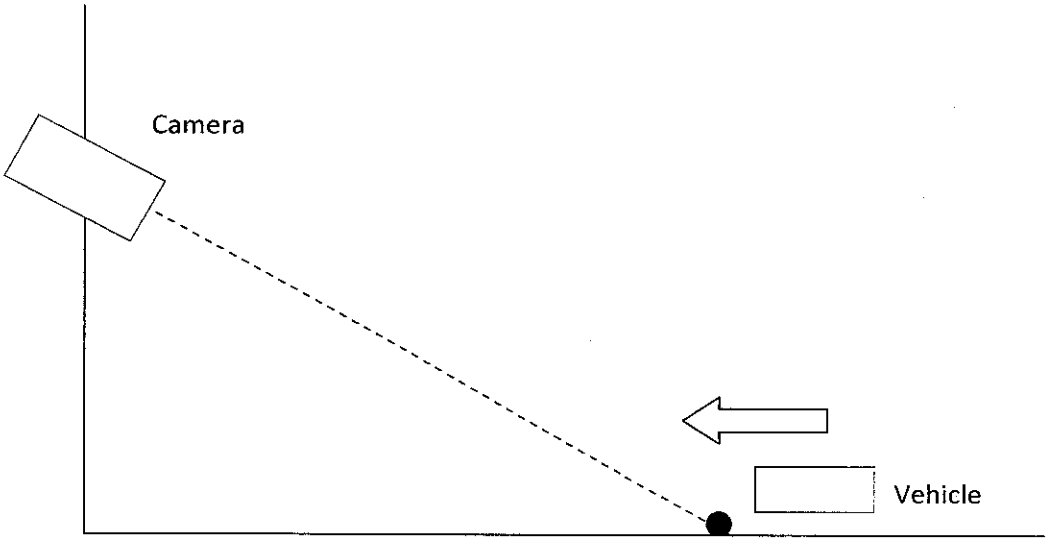


Figure: 1

6.7 **Designing & Testing**

The program was coded in C language using the OpenCV library. The main part of the project is to create the cascade of the program. Cascade is the classifier in xml file type. Cascade will help to system to recognize the object. To create the cascade, few training sample were created, first positive and negative picture were taken like mentioned in the previous chapter. Positive picture is a picture where few samples of the object that we need to detect and negative is the others false image. This training is called HAAR training. Haartrainning application was used to generate the symmetric coordinate of the picture. After done with the training, xml file were coded. The XML file is known as the cascade or the classifier for the OpenCV library will use as reference in the program.

**The work log on how was the cascade training were done is on the appendix*

After done with the cascade coding. The main program were designed and coded by using facedetection template and add with the counter function. After completing the first prototype, testing schedule were arrange and bug were fixed to done with the real prototype.

7.0 Conclusion

For the conclusion, the methodology which is used in this project can support the objectives in the project. In the first part, the interface must be done first, the study about usability and learnability is the best way to make the system interface better.

Two important method to be used in this project to recognize the vehicle is shape based and pixel view differentiate which can differentiate between the moving vehicles and the background. This project will be preceding more on the image processing part with the techniques.

The next steps in this project is the development phase, the development of the system require a lot of efforts, resources and expertises from different area such as computer language programming, computer vision and image processing . But the project can improve the accuracy of road surveyor system. Upon finishing of the project, the system prototype wills at least cars.

References

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2. IEEE transactions on pattern analysis and machine intelligence, vol. 29, no. 3, march 2007

3. Dorin Comaniciu Visvanathan Ramesh Peter Meer

4. http://opencvlibrary.sourceforge.net/FaceDetection

5. Rubbert, Rudger (1999). *U.S. Patent No.6359680*. Berlin, DE: U.S. Patent and Trademark Office.

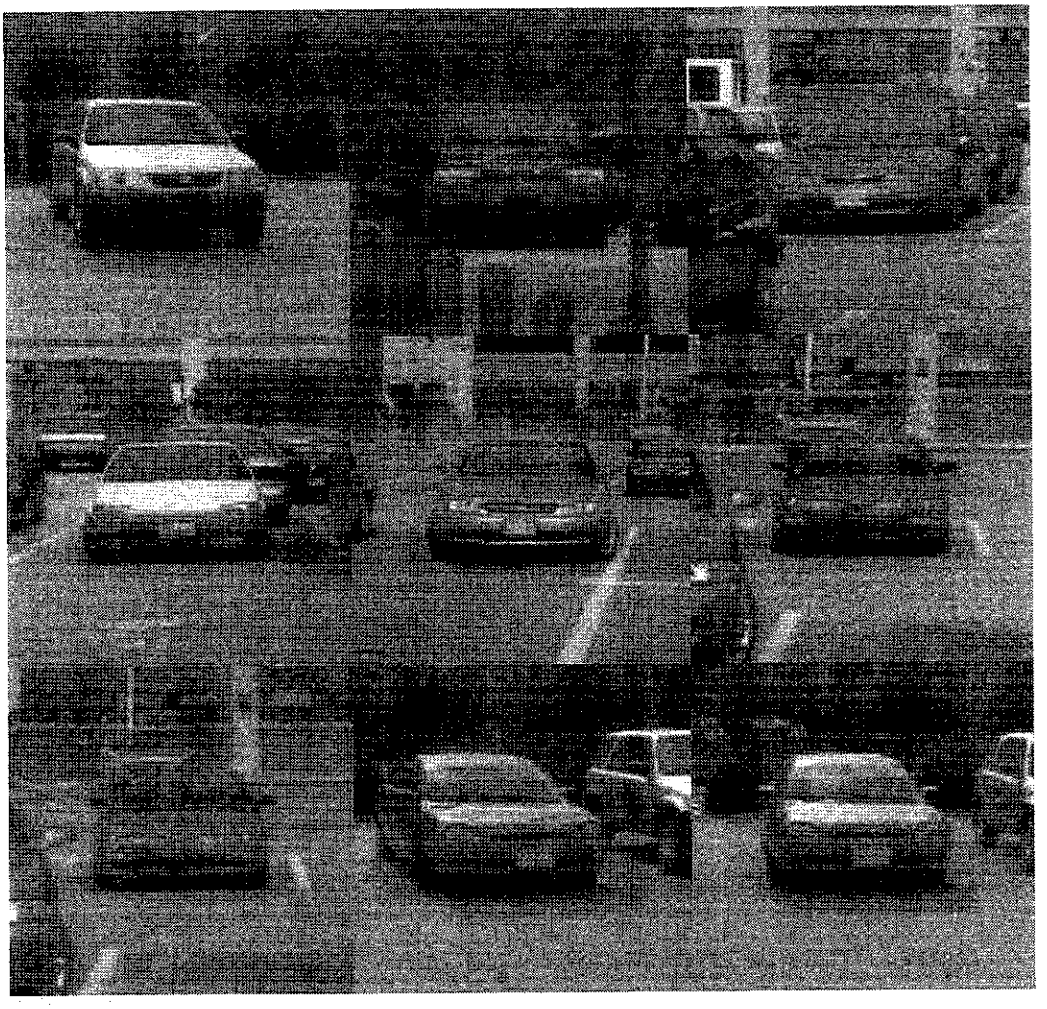
6. http://opencvlibrary.sourceforge.net/Classifier

APPENDIX 1 : Sample positive picture

APPENDIX 2 : Manual on how to train a classifier or cascade

Here is some sample of the dataset were used in the training procedure.

The real activities were used about one thousand of sample picture were taken randomly on the road and on the internet.



Here is the step on the training of the cascade were done.

Configuration

The window size for both training and testing is 32x32.

The working dictionary is:

D:/fyp2/Working

Step 1 - Preparation

Please see the page "Setup a database with LabelMe."

Positive Samples

We use sample car database as our positive samples because it is cropped and aligned. The database contains 516 car images in frontal and rear views. We use center 64x64 pixels of each image for training. We manually create a text file "positives.txt" which contains image filenames and positions of cars. The file looks like:

car_0001.png 1 32 32 64 64

car_0002.png 1 32 32 64 64

...

car_0516.png 1 32 32 64 64

The training program "haartraining" need a file that contains all positive samples and each image is a vector. We can feed the "positives.txt" into "createsamples" to create the file"positives.vec".

createsamples -info D:/fyp22/Working/positive.txt -vec D:/FYP2Working/positives.vec -num 516 -w 32 -h 32

But creating positive samples by this way will only produce 516 samples (the same with the number of the input images). Indeed "createsamples" has another function that distorts images slightly (rotation, illumination) to produce more samples.

D:\fyp2\VisionImage\CarTrain>performance -data ..\cbcltrain -info test\tests.

txt -w 32 -h 32 -sf 1.05 -maxSizeDiff 1.3

D:\fyp2\VisionImage>haartraining -data CBCLTrain\ -vec CBCLTrain\positives.ve

c -bg CarTrain\negatives.txt -npos 516 -nneg 1032 -w 32 -h 32 -mem 512 -minhitra

te 0.99 -maxfalsealarm 0.4 -nstages 15