Video Surveillance for Road Traffic Monitoring

by

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information & Communication Technology Programme
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Approved by,

on behalf

____

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TRONOH, PERAK

SEPTEMBER 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the reference and acknowledgments, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(MUHAMMAD ZAINURIN AKMAL BIN AHMAD ZAINI)

ABSTRACT

This project addresses the improvement of the current process of road traffic monitoring system being implemented in Malaysia. The current monitoring system implies video feeds from a particular road to a place where there will be personnel monitoring the traffic condition. The personnel will then manually update the traffic condition to various radio and television networks throughout the country to be broadcasted. FM radio is a famous channel for traffic updates since every vehicle is equipped with one. This project will provide a real-time update of the current traffic condition.

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ABBREVIATION AND NOMENCLATURES

A-GPS	Assisted Global Positioning System
AJAX	Asynchronous JavaScript and XML
AVI	Audio Video Interlaced File Format
CCTV	Closed-circuit Television
FCD	Floating Cellular Data
GPS	Global Positioning System
GSM	Global Systems for Mobile Communication
ITIS	Integrated Transportation Information System
ITS	Intelligent Transportation System
PHP	Pre-processor Hypertext Programming
RFID	Radio Frequency Identification
XML	Extensible Mark-up Language

CHAPTER 1
INTRODUCTION

1.1 Project Background

Video surveillance is the act of monitoring behaviour or activities in a particular environment. It is used mostly for the security purpose such as home monitoring and also closed-area monitoring in vulnerable place such as bank. In fact, road traffic monitoring also benefits from video surveillance.

In road traffic monitoring, video surveillance is considered as a part of Intelligent Transportation System (ITS). It is an utilisation of information and communication technology to the vehicle and transport infrastructure for a better management while improving the transportation times and fuel cost [**1**]. In a developing city, the deployment of ITS is highly demanded due to the ever increasing population which reflects to the transportation on the road. The congestion has cost 20 billion British pound per year in UK alone [**2**].

There are a few types of technologies applications being used today. Some of them are wireless communications, floating car data, sensing technology and video vehicle detection.

Wireless communications utilise UHF and VHF frequencies in its applications. These radio frequencies include short-range communication using IEEE 802.11 protocols and long range communication implements IEEE 802.16 protocol and also Global Systems for Mobile Communications (GSM) networks.

Floating car/cellular data (FCD) utilise GSM networks by measuring the amount of mobile phones in a particular location. By using triangular, pattern matching or cell sector statistics, the number of mobile phone is calculated to provide the traffic condition of the current location. It was then enhanced with the aid of Global Positioning System (GPS) to provide more accurate result.

Radio Frequency Identification (RFID) is used in the sensing technology. Each vehicle will be provided with a transponder to respond to the readers placed along the road. Every transponder passing by a particular reader will be counted to provide the amount of vehicle in the traffic.

In the video detection, a stream of video provides the data which will be analysed for the changing of characteristic as vehicle pass through to determine the flow of the traffic on the road [**1**].

Each of these technologies has its own pros and cons. However, in the real-life implementation, all the pros and cons need to be measured especially the cost and effectiveness of the technology.

1.2 Problem Statement

The current practice of road traffic monitoring does not provide a real time updates to the end users. The delayed information has caused more motorists going into the traffic congestion.

The current practice in traffic updates is direct information from those stuck in the traffic jam to the DJs of popular radio stations. In the recent years, social networking applications have become a medium for traffic updates such as Twitter, Facebook, and Foursquare. These information and status updates of road traffic condition could benefit the road users who are planning for their journey or to those already on the road.

Through the status updates, it is obvious that they are in tense when they found themselves trapped in the congestion. This project aims to provide beneficial solution to the motorist on the road for them to plan their journey thus in some ways it could help reducing the stress level before starting their jobs at the workplace.

1.3 Objective

The objectives of this project are:

- To grab a real-time video feed of the current traffic condition
- To determine the current condition of the traffic
- To broadcast a real-time traffic condition on maps

1.4 Scope of Study

- CCTV camera will be used as the source of input for the surveillance setup
- The application GUI will be developed using C# programming language with the aid of AForge.NET framework
- A website to broadcast the traffic condition

CHAPTER 2
LITERATURE REVIEW

2.1 The current practice – traditional announcement through FM radio network

Nowadays, radio is accepted as the main source for motorist to be informed regarding the traffic condition. Since every car is equipped with a radio, it is proven to be the most convenient source of information. While they are on the road, the traffic condition will be announced by the DJs while the motorist could enjoy some favourite tracks broadcasted by the station. However, it may not be a perfect time for the announcement when they are already stuck in the traffic jam due to late information from the radio. This is the main flaw for the traffic condition to be broadcasted by the radio. It happens when the DJs need to refer from another source before broadcasting the information to the motorist. The usual practice in Malaysia consist direct information from the motorist who already stuck in the traffic jam, to the radio DJs. There could be a delay while the information being reported to the radio thus trapping more motorists into the congestion. Without a real-time update of the traffic condition, this practice is found to be less effective.

2.2 Intelligent Transportation System

Intelligent Transportation System (ITS) is an application of diverse technologies to the transportation system. It focuses on making the system safer, more efficient, more reliable, and more environmental friendly, without having to physically alter the existing infrastructure [3]. The technologies implied in the Intelligent Transportation System are Wireless Communications, Computational technologies and Sensing technologies. Wireless communications consist of radio waves based technologies such as Floating Cellular Data (FCD) and Global Positioning System (GPS). Video surveillance is included in the Computational technologies while Radio Frequency Identification (RFID) is one example of sensing technologies [1].

2.3 Video Surveillance

Video surveillance in a road traffic monitoring is 'non-intrusive' traffic detection where there is no component required to be attached to the vehicle [1]. Video surveillance utilise stationary cameras to provide a real-time viewing of the current state of road condition and also congestion which is could not be seen with the other type of intelligent transportation system [4]. Video surveillance in road traffic monitoring incurs low installation cost while less disruption of the traffic for its maintenance. In fact, it provides a wide area for monitoring including speed measurement and vehicle type counts and classification [5].

2.4 Usage of Video Surveillance

Video surveillance is used in various aspects in our daily life. From the home security to the wildlife research, video surveillance plays an important role as the key component. Since the threat of terrorist attack on Bishopsgate, United Kingdom, in 1993, video surveillance was introduced to monitor the entrances to the City of London. The CCTV system covers London's transport infrastructure which consist of London Underground, Mainline Railway system, roads and airports. The surveillance system later extended to the sport stadiums, cultural and tourist attractions, police stations and jails [6]. In United States of America, video surveillance is used to monitor wildlife underpasses along the highway of Green Valley in Arizona [7].

2.5 Malaysia's Intelligent Transportation Information System

In Malaysia, video surveillance is available for selected roads in Kuala Lumpur. It is provided by the City Hall of Kuala Lumpur under Integrated Transport Information System (ITIS). ITIS is using CCTV camera, Automatic Incident Detection System, and Automatic Vehicle Location System to provide the data. The data is gathered by the Transport Management Centre (TMC) to be analysed which then will be published through Variable Message Sign (VMS), Call Centre, and a web site. VMS is an interactive signboard placed along the road to provide the information to the motorist while a Call Centre received enquiry regarding the traffic condition by the end user. ITIS web site provides snapshot from the CCTV camera and also live video streaming [**8**]. However, the video streaming feature requires JAVA Virtual Machine to be running and also ActiveX control to be enabled. It may looks simple to IT savvy people but not to the regular people. In fact, live video streaming requires a fast and stable internet connection to be effective which is questionable in term of the cost.

2.6 Malaysia Highway Authority

Another important body with regard to the road traffic monitoring in Malaysia is the Malaysia Highway Authority through its National Traffic Management Centre (NTC). NTC is responsible in providing information regarding the traffic for the highways under its supervision. All the information will be broadcasted through its official website (http://llmtraffik.gov.my/). The information are available from a few services offered in the website which include GIS (Geographic Information System) map, traffic update through its live CCTV cameras, and also automatic traffic info. The GIS map provides real-time traffic condition of the highways on an interactive map [**9**]. However, the map is not mobile friendly to the end users. The live traffic updates from the CCTV cameras only provide static images on the web browser and the end users have to manually refresh the browser to receive updated image sequences. The automatic traffic info is an update service of the traffic condition which will be forwarded to the end user's emails. It could be troublesome for them to keep checking the mail inbox for the traffic update. In the worst case, the email may be undelivered if the inbox is full of messages. There is a mobile website dedicated to the mobile users at http://m.lltraffik.gov.my but the traffic update is still static and requires the users to refresh the page manually for the next images. In fact, it could be inconvenience for the users to keep staring on the tiny mobile screens to determine the traffic condition.

2.7 Floating Cellular

Floating Car Data (FCD), also known as Floating Cellular data, is another satellite based monitoring technique which employs the GSM networks for the data acquisition. The GSM networks consist of GSM, CDMA, and UMTS [**9**]. These are the networks which our cell phones are connected to depending on the signal receiver configuration. Since every car would have at least one cell phone, it is sufficient enough for each car to act as a traffic probe when it keeps communicating with the networks while the car is moving. By using the same triangulation concept as GPS, the data can be converted into traffic flow information. With more probe in a particular location, we could estimate the route is having congestion [**1**]. However, FCD on GSM networks is less accurate compared GPS in term of positioning. The cell phones may catch signal from the antenna towers in the adjacent cellular cells which bring to a false location for the traffic flow information. It was then improved by utilizing the GPS satellites for more accurate monitoring by installing the GPS receiver to the public transports such as taxis and buses as practised in Germany [**10**].

2.8 Global Positioning System

Global Positioning System (GPS) is the best technology adapted from the military field back in 1960s. It was developed by the US government organisation for the three-dimensional position determination. GPS became fully operational in 1994 with 24 satellites orbiting the Earth. It was first intended for the military purpose but is now available for public use since 2007 [**11**]. GPS works based on the trilateration concept where a particular point is determined by measuring the distance of two known points which represented by the satellites. The interception from the third reference points narrow down the location to one or two points from the previous two spheres [**12**]. It is no doubt GPS is one of the most accurate method for location tracking which translates to its capability for road monitoring purpose. It is widely used in most countries for the navigation purpose including Malaysia. However, the implementation of GPS is really costly. Not everybody could afford a GPS navigation device. In fact, low-cost GPS devices do not offer traffic updates and up-to-date maps due to the lack of support from the manufacturers thus the low cost of it [**13**]. GPS accuracy may also be affected by propagation delay when the signals are slowed down by water vapour or any other form of particles in the atmosphere. In a city with high-rise buildings, the signals may be bounced off before reaching the receiver's antenna causing multipath fading which also reduce the accuracy of GPS [**12**].

2.9 Assisted GPS

Assisted GPS (A-GPS) is an improved GPS system which is used extensively in the GPS-capable cell phones. Most of today's smartphones are natively equipped with an A-GPS chip such as Apple's iPhones and Android based devices [**11**]. A-GPS enhances GPS signal reception by hooking up to cellular of Wi-Fi infrastructure which has a reference receiver with better signal reception to the GPS satellites for example on an antenna on a high-rise building [**12**]. It is successfully implemented in Singapore through the collaboration between Singapore's Land Transport Authority and Google Maps. The traffic data is contributed by the motorist by activating the A-GPS in their smartphones and running Google Maps for Mobile. The anonymous data from thousands of motorist is gathered to create a traffic layout on Singapore's Google Maps [**14**]. The traffic layout is updated every minute by Quantum Inventions, a local company who is in charge of providing the island wide coverage of data to Google Maps [**15**]. Even though it is successfully implemented, A-GPS also brings another concern on privacy. Since it is operating on a mobile device which is always carried along by the owner, the location of the owner can be easily abused by a third party. It may cause harm to the owner such as robbery, kidnapping, or even worst a murder.

2.10 Radio Frequency Identification

Radio Frequency Identification (RFID) system consists of a transponder and a reader. In traffic monitoring, the transponder will be installed on the vehicles while the readers are placed along the road. It is a part of automatic vehicle identification (AVI) technology implemented in the United Stated to as a toll-collecting system [**16**].The AVI system was developed by Amtech System Division of TransCore. Each vehicle is provided with a passive transponder tag which is slightly larger than a credit card to be attached to a car's windshield. The battery powered transponder tag will responds to the signal transmitted by the readers along the road thus providing the time when it pass through. The times will be collected and sent to the server for further calculations. The calculations will yield the average times taken by a number of vehicles thus providing the flow of the traffic condition [**17**]. The traffic condition will then be updated on the dynamic message signboards along the road [**16**]. The implementation of RFID in traffic monitoring seems efficient but incurs a high cost. The installation of the transponder tags requires a large number of vehicles while the distance between each reader reflects to the effectiveness of the system. It requires a short distance to make it more effective thus demanding more readers to be installed on each side of the road. Moreover, there is also privacy issue raised by the public since each transponder comes with its own unique ID.

2.11 Conclusion

Based on the research done regarding the Intelligent Transportation System, video surveillance is found to be the most feasible and cost effective solution to be implemented in Malaysia. This research put an added value for the video surveillance in order to provide a real-time update to the end users. With the motion detection algorithm, the video from the surveillance will be processed to provide a more meaningful result. The end users do not need to waste their time buffering the large video files as provided by the current Intelligent Transportation Information System offered by the City Hall of Kuala Lumpur. This research intends to offers the result of the processed video in colour-coded map to determine the traffic flow which much faster to load compared to the video file.

CHAPTER 3
METHODOLOGY

This project will adopt incremental software development process and will be segmented into several increments. New features would be introduced after going through each increment.

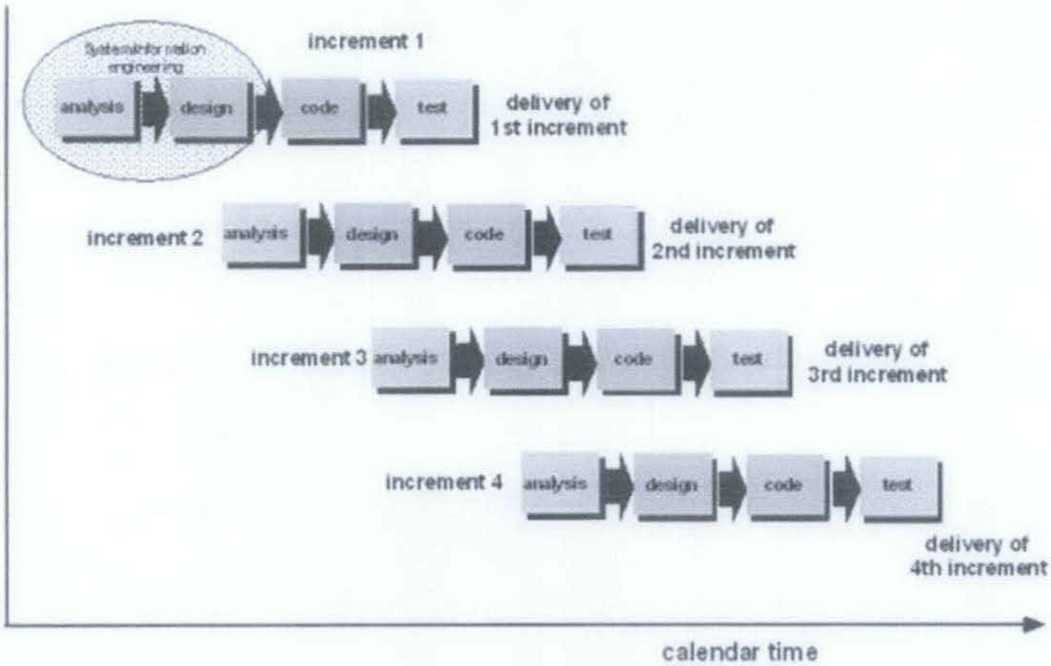

Figure 1: Incremental model

Incremental model provides a more flexible environment where changing the scope and requirements would incur less cost. It also allows the system to be tested and debugged in smaller iteration where any arising problems could be easier solved.

3.1 Phase 1: Critical Review of Related Subjects

Analysis of current practice in Malaysia, info broadcasted through FM radio networks.

Advantages	Disadvantages
The info can be broadly broadcasted to all the listeners at one time	The radio frequency reception may be affected by bad weather
Frequent updates from the radios	The updates only cover major roads
The motorist could feed the information to the DJs	The info only updated once the motorist is stuck in the congestion

Table 1: Advantages and Disadvantages of Current Practice

3.2 Phase 2: Video Surveillance Setup

CCTV camera with Internet Protocol (IP) capability will be used to capture the video for the surveillance setup. A few selected cameras have been short listed according to the requirement. The criteria for the camera are:

- Imaging device
- Output format
- Lens compatibility

The following shows the information of cameras that are possible to be used for this project.

Model	Imaging device	Output format	Lens /Mount	Price
Vivotek IP8332 	1/4" CMOS sensor in 1280x800 resolution	Real-time H.264, MPEG-4, MJPEG	f=3.6mm F1.8 lens, fixed mount	RM 1420.00
Vivotek IP8161 	2 megapixel CMOS sensor	Real-time H.264, MPEG-4, MJPEG	f=3.0~8.0mm auto-iris lens, CS mount	RM 3220.00
Vivotek 7361 	2 megapixel CMOS sensor	Real-time H.264, MPEG-4, MJPEG	f=3.0~9.0mm vari-focal, auto-iris, CS mount	RM 3880.00

Table 2: The short listed camera models

Item	Model	Price
Weather-proof housing* 	ODH200 IP66	RM120.00
Network switch 	ETEN PS254-AT 5 Ports PoE Network Switch	RM400.00

**for Vivotek IP8161*

Table 3: Additional equipment for video surveillance

Preparation for video surveillance setup includes identifying and planning on the location for the camera. Installation of the camera requires some observation on where the congestion took place. The observation also includes the angle of camera viewing for the optimization of the data gathered throughout the surveillance process.

However, there are also live video feeds from the CCTV cameras available for public viewing. This service is provided by the Malaysia Highway Authority through its portal at http://llmtraffik.gov.my/

3.3 Phase 3: Design and Development of the application

In this phase, an extended research will be done to get the AForge.NET framework working with the video surveillance.

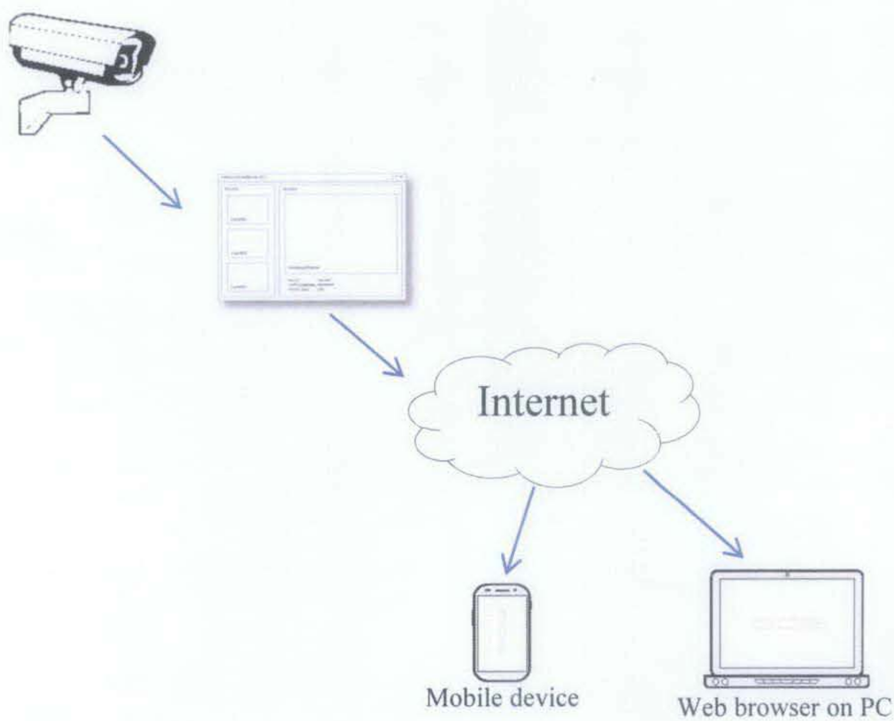

Figure 2: System architecture of the project

Figure 2 shows how the entire system works. It starts by capturing the video by the input source (in this case is a CCTV camera) and sending it to the Application Server to be processed. The images from the CCTV camera will be treated in the form sequences which look like a video. The motion detection algorithm will detect the movement in the video while the processing algorithm will determine the traffic condition. The result from this process will be broadcasted to the website directly to the end users. The end users could retrieve the result either from a web browser on a personal computer or even a web browser from a mobile device.

3.3.1 Surveillance setup

There are three types of input source which could be processed by the algorithm: a JPEG stream from a CCTV camera, an .AVI video file, and a local capture device connected to the machine. These input sources provide the surveillance required for this project to run.

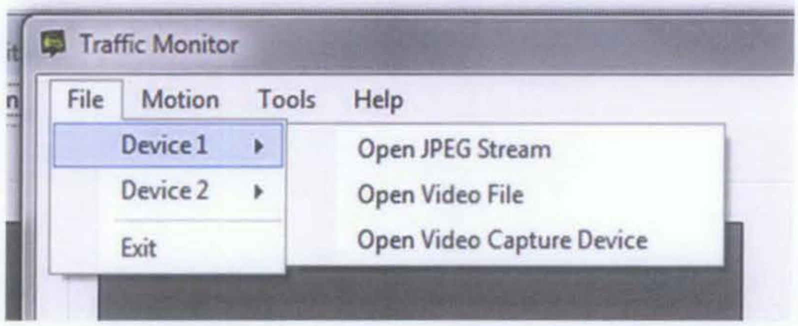

Figure 3: Input source selection

A JPEG stream is a sequence of images retrieved from a CCTV camera. The images come in statically but the framework will keep updating the images to create a sequence which looks like a video. An .AVI video file is a normal video file which could be used as an early test before the application being deployed in the real-life environment.

```
URLForm form = new URLForm( );

form.URLs = new string[]
{"http://llmtrafik.gov.my/traffic.aspx?ImagePath=HYEC4fuAN
i4FALhGgLSGmDWAlRFhYuAE7/is8T3p+ROwE7P5XavMS0d7oafOXpVJOOw
+dgx9lHx1tNrsPfDodUtHM0Z8e31YO6wv7TJtQUygN347fFYisA=="};

// create video source
JPEGStream jpegSource = new JPEGStream(form.URL);
OpenVideoSource(jpegSource);
```

An .AVI file is a normal video file which could be a useful input source especially during the development phase. It allows us to adjust the algorithms' variables in a controlled environment.

```
// create video source
VideoCaptureDeviceForm form = new VideoCaptureDeviceForm( );

 if ( form.ShowDialog( this ) == DialogResult.OK )
        {
      // create video source
      VideoCaptureDevice videoSource
      = new VideoCaptureDevice( form.VideoDevice );
            // open it
            OpenVideoSource( videoSource );
        }
```

A local capture device input utilise any camera connected directly to the machine which runs the algorithm. It feeds live video from the camera to the algorithms. It could be useful during the development process too.

```
  videoDevices = new FilterInfoCollection(
                     FilterCategory.VideoInputDevice );
```

This code fraction extracts the list of attached capture device.

```
// create video source
VideoCaptureDeviceForm form = new VideoCaptureDeviceForm( );

 if ( form.ShowDialog( this ) == DialogResult.OK )
        {
      // create video source
      VideoCaptureDevice videoSource
      = new VideoCaptureDevice( form.VideoDevice );

            // open it
            OpenVideoSource( videoSource );
        }
```

This code fraction attaches the selected device to the algorithms and utilising it as an input source.

3.3.2 Application GUI

Graphical user interface (GUI) will be developed using C# programming language with the aid of AForge.NET framework for the motion sensing algorithm. The GUI will able to show the view of the camera while providing the sensing mechanism to measure the flow of the traffic. The flow will be converted into line of colours to be shown on the map on the mobile application. A web based server will cater the synchronisation between the GUI and the mobile application through the internet.

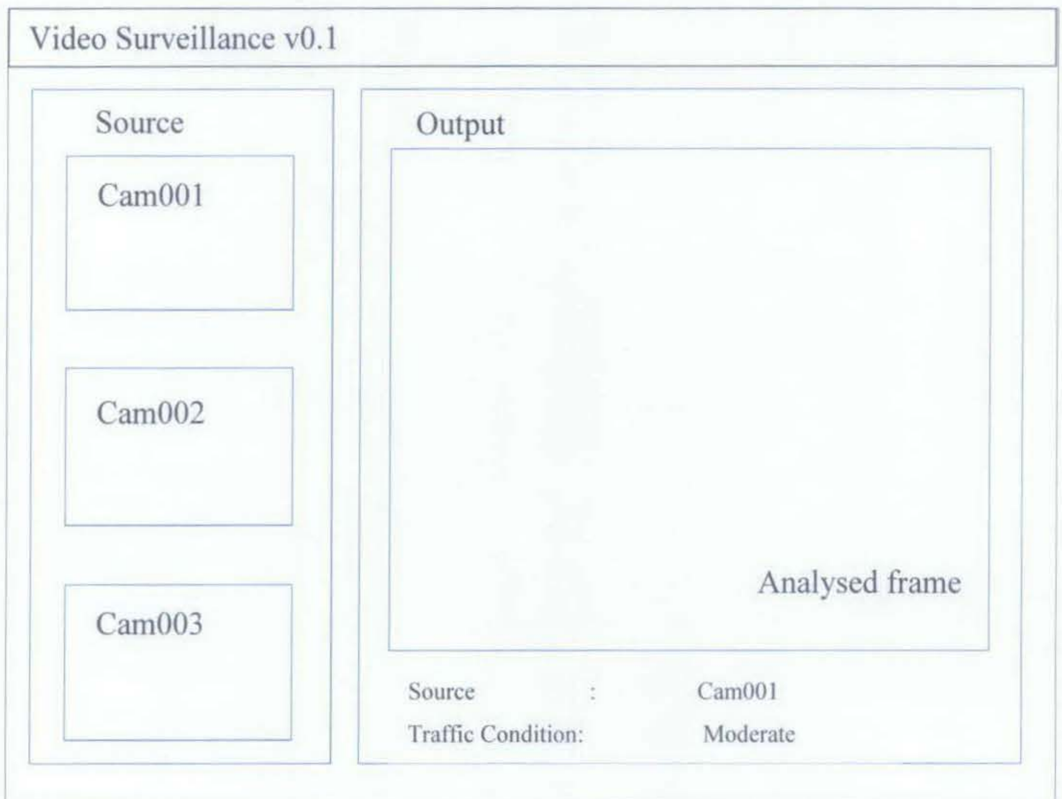

Figure 3: Basic proposed GUI

A sample of the GUI is shown in Figure 3. The *Source* portion displays the view of input sources being utilised by the application. The *Output* segment shows the analysed frame together with the condition of the traffic. It also features the motion level property which can be modified to determine the level of the traffic flow. The GUI may be changed to incorporate future enhancement when the evaluation and testing are done.

3.3.3 Motion Detection Algorithms

There are three motion detection algorithm offered by AForge.NET framework. They are: Two frame difference algorithm, Simple background modelling algorithm, and Custom frame motion detector algorithm. Each of these algorithms varies in term of processing speed and the degree of details of the detected motion.

No.	Algorithm type	Features	Sample
1	Two frame difference	• The algorithm finds the amount of difference in two consequent frames • It is the simplest and quickest algorithm • Not optimized for highlighting moving objects	
2	Simple background modelling	• The algorithm finds the difference between the current video frame and a frame representing the background • Using a simple technique of modelling the scene's background and updating it from time to time to adapt to the scene's changes • It give the ability for a more précis highlighting of the motion regions	

3	Custom frame difference motion detector	• Utilizing both *Two frames difference* and *Simple background modelling* algorithms • The algorithm detects the difference between the current video predefined background by differencing the current frame with the predefined background frame • The predefined background will never be updated in case there are any changes in the scene

The algorithms determine the level of the motion captured according to the motion level property. The motion level property is a value predefined in the code by the developer.

The proposed values for the motion level property are:

- 0 ~ 30% – indicates free flow traffic
- 31 ~ 75% – indicates moderate flow traffic
- 76 ~ 100% – indicates busy flow traffic

The values may be changed once the algorithm is tested to suite the environment later.

Here is a sample programming code on how the detection works.

```
1   // create motion detector
2   MotionDetector detector = new MotionDetector(
3       new SimpleBackgroundModelingDetector( ),
4       new MotionAreaHighlighting( ) );
5
6   // continuously feed video frames to motion detector
7   while ( ... )
8   {
9       // process new video frame and check motion level
10      if ( detector.ProcessFrame( videoFrame ) > 0.02 )
11      {
12          // ring alarm or do something else
13      }
14  }
```

In the code segment shown above, the motion level property is defined in `line 10`. Once the motion detected is exceeding 20% (0.02 as defined is the code) an action will take place as in the comment `ring alarm or do something else` `[18]`.

3.3.4 Motion Processing Algorithms

There are four types of motion processing algorithms. These algorithms help the motion detection algorithms to process the detections to be presented in the form of highlights. Each of these algorithms provides different style of highlights of the motion regions.

No.	Algorithm type	Features	Sample
1	Motion Area Highlighting	• Highlights the motion area found by the motion detection algorithm with specific colour	

2	Motion Border Highlighting	• Highlights only the borders of the motion areas found by the motion detection algorithm • Requires motion detection algorithm which may accurately locate moving objects	
3	Grid Motion Area Processing	• Highlights motion area according to grid • The entire motion frame can divided by a grid of a number of cells • The processing algorithm shows which part of the video frame having more motions according to the cells	
4	Blob Counting Objects Processing	• Allows counting separate objects in the motion frame • Highlights detected objects with a rectangle of specified colour	

	• Requires motion detection algorithm which may accurately locate moving objects

3.3.5 Web Server

A web based client will be developed to retrieve the data from the analysed frame. It will be hosted on a web server running on Apache with PHP scripting capability. The PHP scripting will be used to process the data from the detection and processing algorithm to be presented to the end users. The detection and processing algorithm will output the traffic condition based on the object counts to an XML file. The XML file will be updated according to the condition changes. A PHP script will process the XML file and read the latest node written to XML file as an analysed data.

3.3.6 Client Website

With the aid of the web server, a website will show the traffic condition with the analysed data retrieved from the web server. The analysed data will be converted into graphical lines to represent the traffic flow condition. The web server will also cater the request from the mobile users through a mobile website.

3.4 Phase 4: Evaluation, Testing, and Further Enhancements

The integration of video surveillance and the graphical user interface will be made and tested in the real world environment. During the development phase, an .AVI video file and a local capture device will be used as the input sources to test the functionality of the algorithms. In the real-life testing, a JPEG stream from CCTV camera will be fed from the Malaysia Highway Authority through its traffic updates portal maintained by the National Traffic Management Centre. The Apache web server will be installed locally on the machine which is running the application for a close monitoring. Any changes could be done directly to the website scripting for an immediate result.

3.5 Conclusion

The project focuses on providing a real-time updates of the traffic condition for the benefits of the end users in a more effective way. The video captured by the input source will be analysed using an application built on C# programming language. With the aid of AForge.NET framework, motion detection algorithm will be included in the application. Motion processing algorithm will determine the traffic condition. The result from the analysed video will be published to the web server and it is accessible from any personal computer with internet connection. A mobile website also will be hosted on the server to cater mobile devices for the benefit of the end users.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Real-time Traffic Updates

There is nothing worse than getting caught in a traffic jam in a busy city life. It will get more tensed especially after a long tiring working hours. Therefore a traffic updates could help us plan our journey effectively while avoiding this congestion. There are some ways of getting traffic updates. The most widely used is radio announce since every car should have an FM radio receiver. But the current practice is evolving with the aid of smartphones and mobile data connection.

Smartphone is slowly replacing the traditional phone usage. More and more people are switching to smartphones for various reasons including business applications, social networking, and instant messaging. Another utilisation of smartphone is of course for getting the traffic updates.

Twitter is one example of how traffic updates being done through social networking with the aid of smartphones and mobile data connection. A Twitter name `@KLTU` provides traffic updates for people in Klang valley with the helps in information reported from other Twitter users. The user `@KLTU` will relay any traffic information on Twitter with the hash tag `#KLTU` to its followers. Thus the `@KLTU` followers will receive the information instantly on their smartphones. This is the closest effort for the real-time traffic updates so far. However, it still requires information of the traffic from the other users.

4.2 AForge.NET Framework

AForge.NET framework is being the core of this application. Based on the sample source codes provided with the framework, an intensive research has been done to customize the framework for the current needs.

The *Simple Background Modelling* algorithm is chosen for this application since it may provide a more precise detection on moving objects compared to the *Two Frames Difference* algorithm. The *Custom Frame Motion Detection* algorithm should have the same feature as the *Simple Background Modelling* algorithm to precisely detect moving objects but it lacks the capability to update the background frame if there are any changes occur on the scene.

Blob Counting Objects Processing algorithm is preferred for processing the detected motion area since it has the capability to count the moving objects in the frame. The counting capability could provide a good variable in determining the traffic condition.

```
// motion detector
MotionDetector detector = new MotionDetector(
         new SimpleBackgroundModelingDetector(true, true),
         new BlobCountingObjectsProcessing());
MotionDetector detector2 = new MotionDetector(
         new SimpleBackgroundModelingDetector(true, true),
         new BlobCountingObjectsProcessing());
```

4.3 The Application

Figure 4: Screenshot of the main application

For a real-life utilisation, the application will retrieve the images from the actual CCTV cameras which belong to the Malaysia Highway Authority. The access to these CCTV cameras is made publicly where anybody could access it through its portal at http://llmtraffik.gov.my

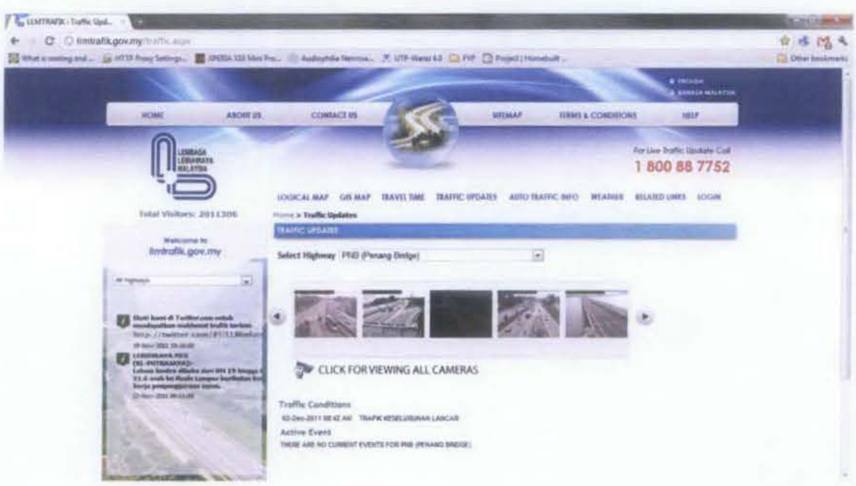

Figure 5: The LLMTRAFFIK portal website

This application is for administration usage of the traffic update. It is not accessible to the end users.

Through the *Open JPEG Stream* in the application, the images from the CCTV camera will be fed to the `videoFrame` in the application.

Figure 6: The Open JPEG Stream popup window

By using the `JPEGStream` class from the AForge.NET framework, the application will keep updating the static images to create a sequence.

```
    URLForm form = new URLForm( );

    form.URLs = new string[]
              {"http://llmtrafik.gov.my/traffic.aspx?ImagePath=HYEC4fuAN
              i4FALhGgLSGmDWAlRFhYuAE7/is8T3p+ROwE7P5XavMS0d7oafOXpVJOOw
              +dgx9lHx1tNrsPfDodUtHM0Z8e3lYO6wv7TJtQUygN347fFYisA=="};
    // create video source
  if (form.ShowDialog(this) == DialogResult.OK)
  {
      // create video source
      JPEGStream jpegSource = new JPEGStream(form.URL);
            // open it
            OpenVideoSource(jpegSource);
        }
```

Figure 7: The `videoFrame` in the application

The red rectangular lines in Figure 7 show the Blob Counting Objects Processing algorithm working in the application. With the `BlobCountingObjectsProcessing` class in the framework, the number of moving objects in the videoFrame can be counted.

The application also has the capability to define the selected motion region in the `videoFrame` for more precise objects counting. This function will tell the algorithms which part or the `videoFrame` the detection will occur.

Figure 8: Define motion regions menu

The *Motion Regions* function will pop up a window which will let the administrator to select which part of the frame where the detection is required.

Figure 9: Motion Regions popup window

The green rectangular line in the Figure 9 indicates where the detection will take place.

There is a capability to show the motion history of the frame.

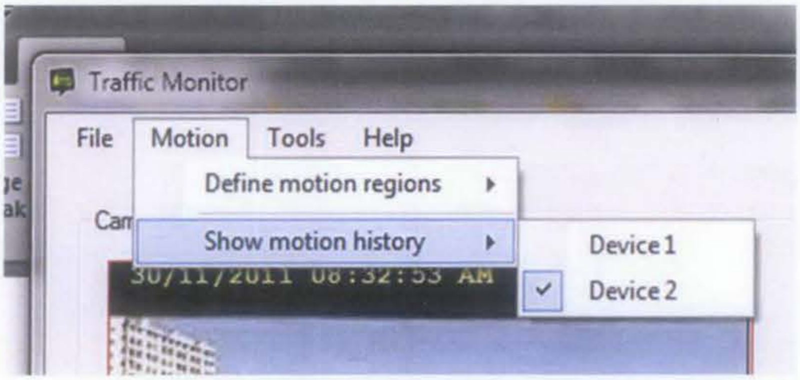

Figure 10: The Show motion history menu

Once selected, a graph will be drawn on the bottom of a particular `videoFrame`. The colours of the graph: red, yellow, and green, are tied to the condition the traffic.

Figure 11: The graph drawn by the Show motion history function

4.4 The Website

Figure 12: Screenshot of the website

A website is developed using PHP server side scripting. The script will read an XML file which will be updated by the application once there is a change on the traffic condition.

```
<?php

$xml = simplexml_load_file("trafficdata/data1.xml");
$data = array();

foreach($xml->xpath('//CONDITION[last()]') as $child) {
    if ($child == $a) $data['r1color'] = "red";
    elseif ($child == $b) $data['r1color'] = "yellow";
    elseif ($child == $c) $data['r1color'] = "green";
}

?>
```

The website will keep checking the XML file every second using the AJAX (Asynchronous JavaScript and XML) scripting.

A JavaScript functions will update the map images which are grabbed from the Google's Static Maps API, according to the traffic condition gathered from the XML file.

Figure 13: The mobile website on a Motorola Atrix 4G

The same procedures take place for the mobile website. The same PHP scripting is used to get the data from the XML file and the map images will be updates using the same JavaScript function which is optimized for the mobile usage. The Google's Static Map images would appear smaller on the mobile website.

CHAPTER 5
CONCLUSION AND RECOMENDATION

This project highlights the benefits of video surveillance in road traffic monitoring. Video surveillance is found to be a cheaper technology application to be implemented compared to the other concepts in the Intelligent Transportation System (ITS). Video surveillance can be implemented without much hassle with its 'non-intrusive' property. It does not require any installation of the motorist vehicle to preserve their privacy. Moreover, video surveillance is free from any form of wave interference which could degrade its capability as opposed to the radio and satellite type of ITS. In fact, the maintenance of video surveillance does not introduce mass traffic disruption in the future.

Video surveillance also provides a real-time view of the location which reflects to the speed measurement and incident detection without any additional peripherals. It also allows the vehicle statistic to be collected for future use. It just requires the installation of camera on a particular location while the control centre could be exclusively anywhere.

Compared to the current practice in video surveillance for road traffic monitoring there are no active personnel required to monitor this system since the traffic flow is automatically determined by the algorithm in the AForge.NET framework. Since the City Hall Kuala Lumpur has come up the Integrated Transport Information System, the facilities can be used in parallel with this project which at the same reducing a lot of initial cost.

This project could possibly assist the implementation of Intelligent Transportation System in Malaysia.

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APPENDICES

6.1 Appendix I: The Proposed Gantt charts for Semester 1

No	Activities/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Research on the Current Traffic Monitoring System	■	■	■	■	■	■	■	■	■					
2	Analysis of Problem Statement								■	■	■	■			
3	Research on Similar Problem									■	■	■	■		
4	Proposing Solution													■	■

Table 4: Gantt chart for FYP1

6.2 Appendix II: The Proposed Gantt charts for Semester 2

No	Activities/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Planning for the Phases	■	■												
2	Developing the Main Application			■	■	■	■	■	■						
3	Testing the Main Application									■					
4	Developing the Support Application										■	■			
5	Integrating the Main and Support Applications											■	■		
6	Testing in the Real-life Environment													■	■

Table 5: Gantt chart for FYP2

6.3 Appendix III: Poster for presentation

UNIVERSITI TEKNOLOGI PETRONAS

Video Surveillance
for Road Traffic Monitoring

By Muhammad Zainurin Akmal Bin Ahmad Zaini 11232 (ICT)
Supervised by Ms. Siti Rohkmah Binti Mohd Shukri

Introduction

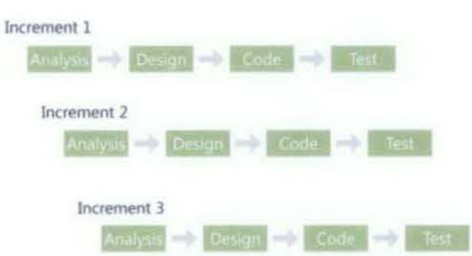
Background Study
- Video surveillance is a part of Intelligent Transportation System (ITS)
- ITS offers better transportation management while improving the transportation times and fuel cost

Problem Statements
- The current practice of road traffic monitoring does not provide a real-time update to the end users
- The delayed information has caused more motorist going into the traffic congestion

Objectives
- To provide a real-time update of the current traffic condition
- To determine the current condition of the traffic flow
- To broadcast a real-time condition to the end users

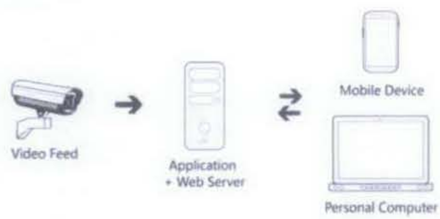
Scope of Study
- Video feeds from surveillance cameras
- Application GUI based on AForged.NET framework
- Website for broadcasting the updates
- A mobile application for Android™ device

Methodology



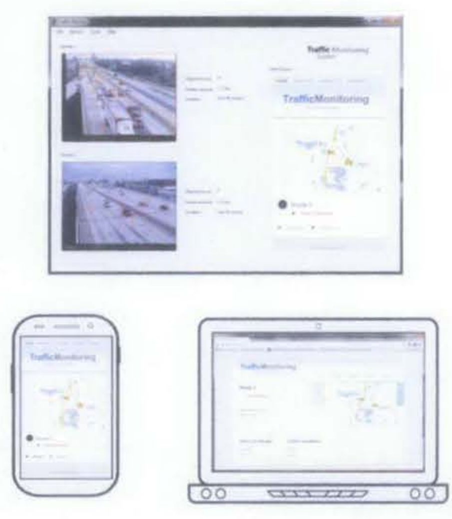
Incremental Model

System Architecture



Results & Discussion

Screenshots



Conclusion

This project should assist the Intelligent Transportation System (ITS) by:
- Processing traffic condition from a video feed
- Providing real-time updates to the end users