

# ARCHITECTURAL REQUIREMENTS

PROJECT: TRAFFIC CAMERA IMAGE ANALYSIS

CLIENT: DPSS, CSIR

TEAM: QUADCORE PRODUCTIONS

*Author(s):*

Mpho BALOYI

Hlengekile JITA

Mayimela MOSES

Mbhele THEMBA

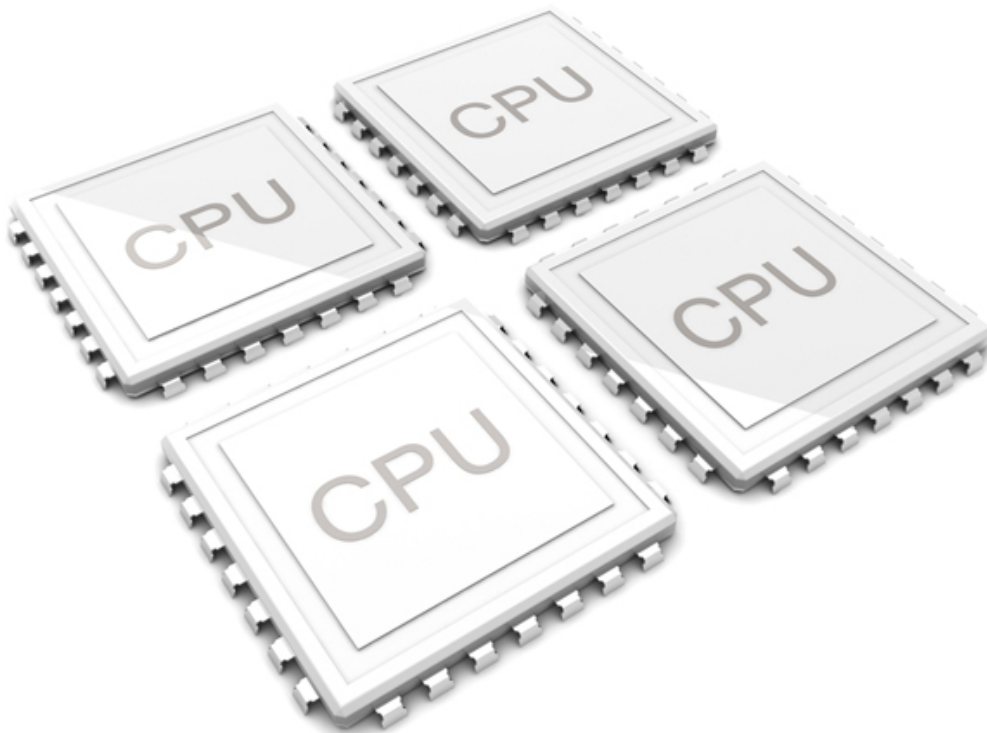
*Student number(s):*

14133670

14077893

14019702

14007950



University of Pretoria, Department of Computer Science  
27 May 2016

# Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
<b>2</b>	<b>Vision</b>	<b>2</b>
<b>3</b>	<b>Background</b>	<b>2</b>
<b>4</b>	<b>Architectural Requirements</b>	<b>3</b>
4.1	Architectural Scope . . . . .	3
4.2	Quality Requirements . . . . .	3
4.2.1	Usability . . . . .	3
4.2.2	Scalability . . . . .	3
4.2.3	Maintainability . . . . .	4
4.2.4	Reliability . . . . .	4
4.3	Integration and Access Channel Requirements . . . . .	4
4.4	Architectural Constraints . . . . .	5
4.4.1	Technologies . . . . .	5
<b>5</b>	<b>Initial Software Architecture Design</b>	<b>6</b>

# 1 Introduction

This document describes the architectural requirements of the Traffic Camera Image Analysis System. The target system will run on a web server and be accessed by users on an Android Application which will provide the users with the necessary functionality to access real-time traffic information that assists them with things such as avoiding traffic and choosing the best alternative routes.

In this specification we will cover the architectural scope of the system, the quality requirements, integration and access channel requirements and architectural constraints. In addition we will describe the software architecture we will use by describing the architectural patterns and tactics we will use as well as which frameworks and technologies will be used to achieve them.

## 2 Vision

For this project we aim to achieve a system that makes use of images obtained from highway cameras to provide users with up-to-date real-time traffic information. The system should simplify the user's travels by providing traffic information and notifying them before they depart of traffic conditions, calculating arrival times based on traffic conditions and help them select the most suitable route for their trips using the traffic information and additional metrics. Our vision for the target system is that it should be reliable and perform relatively quickly, both for user satisfaction and in order to be the an up-to-date traffic information system.

## 3 Background

As a commuter, traffic is something that is a part of everyday life, and it is not one of the more pleasurable aspects of life. Already there is software in place that assists us in dealing with this problem, such as Google Maps. This software uses the crowd-sourcing of GPS data in order to provide their up-to-date traffic information.

In our system, we want to take an image analysis approach to solve the same problem. We will make use of the publicly available SANRAL highway cameras to get images which can be found on <https://www.i-traffic.co.za/traffic/cameras.aspx>. Processing these images we will perform image analysis and determine the traffic conditions in the area of a camera. Using this information we will be able to generate information pertaining to user specified routes in order to

provide the information necessary to help them avoid traffic and choose the most suitable routes in order to do so.

## 4 Architectural Requirements

### 4.1 Quality Requirements

#### 4.1.1 Usability

Usability is the key component of the system because user satisfaction is a high priority for this system because it aims to alleviate a problem that individuals experience daily. The aim is to create that is easy to understand and thus, easy to learn how to use.

##### **How to achieve usability**

- The interface of the mobile application will be designed in an intuitive manner meaning that it will be easy to navigate and easy to understand. It will include buttons and other methods of interaction for which their functionality is self explanatory.
- The interface will only have what is required and nothing more to ensure that it is not cluttered and does not cause confusion.
- Usability tests will be conducted to ensure the successful implementation of a user friendly application.

#### 4.1.2 Scalability

Scalability refers to a system's ability to handle a heavy workload. We have identified this as an important aspect of the system because a report will have to be provided at a very fast speed because traffic changes rapidly and we need to keep up with the traffic updates. Also, multiple users will be making use of the system at the same time and they all need to be catered to at the same levels of performance.

##### **How to achieve usability**

- To improve the performance of the system, reports will only be generated when it is necessary to do so. To elaborate on this, the website from which we will be getting the images from updates its images at one minute intervals so between that period, we will not attempt to grab new images but will make use of the images that were grabbed at the previous interval. In this way, no unnecessary processing takes place.

- We will not generate a new report if it is not necessary to do so. If we generate a report for one user and another user requests a report for the exact same route when it is not time to update the images, we will use the same report that was generated for the first user. We will do this by implementing a cache server to store route reports.

#### **4.1.3 Maintainability**

The components of the system need to be implemented in a manner that makes it easy for them to be updated or replaced.

##### **How to achieve maintainability**

- Maintainability will be achieved by writing loosely coupled code.

#### **4.1.4 Reliability**

Reliability is of utmost importance because a lot of people will be using the application, especially at traffic peak hours thus the system has to get the job done and it should do it effectively so that users get the best service possible.

##### **How to achieve reliability**

- The main focus will be placed on the prevention of faults. This will be done by testing the system extensively and working towards fixing any fault that is encountered.

### **4.2 Integration and Access Channel Requirements**

When considering the access channels of our Traffic Camera Image Analysis System, there are numerous cases to consider; the human users of the system, whether the system needs to access other systems and whether any other systems may need to access the system. In this system at this initial phase of development, only human users need to access the system and our system needs to access other systems. For both of these cases one then needs to consider through which ways they will access the system, what functionality the system requires these access channels to have and how these access channels will provide said functionality.

The Traffic Camera Image Analysis System required by our client (will from herewith be referred to as the system or the target system) is a system through which users are able to receive up-to-date traffic information for

routes which they set up. The users of the system, need a channel through which they can use the system. For this an Android Application will be utilized, thus users will access the system, for which the business processes will lie in the web server, through this Android Application.

On the other hand, our system will need to be able to help users set up their routes by obtaining a departure and arrival point from the users, and using a map to get the possible routes, then combined with the traffic information that results from our image analysis and other metrics perform route optimization. Thus our system needs access to geographical maps. For this our system will integrate with Google Maps, using its Android API.

Our systems business processes will communicate with the Android Application through Google Cloud Messaging(GCM) which is used to send notification data and information from a web server to a mobile device. GCM makes use of Google APIs and SDKs and can send push notifications, deep-linking commands and application data to a mobile device.

GCM works by having the client send a registration API request to the GCM interface, thereafter GCM responds with a unique identifier known as a GCM registration ID which uniquely identifies the mobile device from which the application is running without sending any personal or device information. Thereafter to send data, a API POST request is sent to the GCM Authentication Service, which contains the registration ID, once this ID is successfully verified, the Authentication Service returns an authentication token, which is sent together with the registration ID to the GCM Service so that it can be delivered to the device.

The benefits of using GCM for communication between the server and the application is that the quality requirement, security, is already met. there is no need to store log in details and user information in a database, thus also reducing the computational load.

## **4.3 Architectural Constraints**

### **4.3.1 Technologies**

- Python: Python will be used to implement the web server of the system which will perform the necessary processing of data and after completion, the server will send the data to the mobile application via Google Cloud Messaging.
- OpenCV: OpenCV is an image processing library that the server will

make use of to process the traffic images from SANRAL.

- Android Studio: Android Studio will be used to design a mobile application on which traffic reports will be displayed.

## 5 Initial Software Architecture Design

