

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This project focuses on the development of an automatic fare collection (AFC) device for Gweru – Shurugwi Transport Operators Association (GSTOA). Passengers swipe an issued Radio Frequency Identification (RFID) card or get a journey token on boarding a minibus and the Global Positioning System (GPS) coordinates at a point at which a customer boarded the minibus will be recorded. On dropping off a passenger will swipe the card again and an amount will be deducted from the customer account which will be deduced by the system from the pick-up point GPS coordinates and drop off point GPS coordinates.

1.2 Background of Study

Fares charging on many routes in Zimbabwe, is at most times determined by the conductor and at most times not according to the transport operator/bus owner's set amount or the amount expected to be charged by the Road Motor Transportation Department (RMT), the Ministry of Transport and Infrastructure's (MTI) wing that deals with regulating fare charges on different routes. The transport operator at most times does not have access to monitor if his/her staff are following the set fares. The RMT has the advantage of police checking passenger tickets against a fare table to check whether the correct fare was charged but the police do not usually check that. The situation has now even worsened since there are not many roadblocks no longer being mounted for police that could verify with passenger tickets and fare tables if passengers are being charged the correct fares. This has resulted in passengers being charged large sums of money compared to the actual amounts they should pay for a given route.

1.2.1 Organisational Structure

Lim (2017) defines an organisational structure as how coordination and supervision in an organisation takes place so as to achieve the organisation goals. Different entities, that is branches, departments and individuals have different tasks in organisations and the organisational structure

outlines the flow of information and tasks in the organisation. The organisational structure is important in providing the standard operating procedures and the entities to participate in an activity or a decision-making process.

According to the GTSOA Notarial Deed of Trust dated 24 November 2017 section 7-13 the organisation consist of the following members:

Board of Directors

This is the body that supervises and oversees the objectives, vision and functions of GSTOA. The body consists of five members namely director, ex-officio member, chairperson, secretary, treasurer and one committee member and all board members have full voting rights.

Chairperson

The chairperson of the board has the following responsibilities, on the advice and guidance of the Board:

- Report and be answerable to the board of trustees

- Preside over meetings off the board

- Signatory of all the Trust's major contracts and official documents

- Supervise all activities of the Secretariat

Finance Director

The finance director:

- Oversees the proper maintenance of the finance policy of the trust

- Enforces observance of the Finance Policy of the Trust

Present financial accounts and reports to each meeting of the Board

Furnish to the AGM a detailed report of the Trust's finances

Prepares properly detailed statement of accounts

Secretary General

The secretary general assumes the responsibilities of the chairperson in the absence of the chairperson and ensure the records of a meetings and events are well documented and kept.

Secretariat

The secretariat is responsible for the day to day operations of the organisation. He/she manages other staff employed by the organisation such as drivers, conductors, administrators that would have been appointed by the Board of Directors. Currently the only staff employed by the organisation are the rank marshals.

Committee Member

The committee member assumes the role of the secretary general or finance director in the absence of either of the two.

Secretary of the Finance Director

The secretary of the finance director does the record keeping in a bit to relieve workload from the finance director.

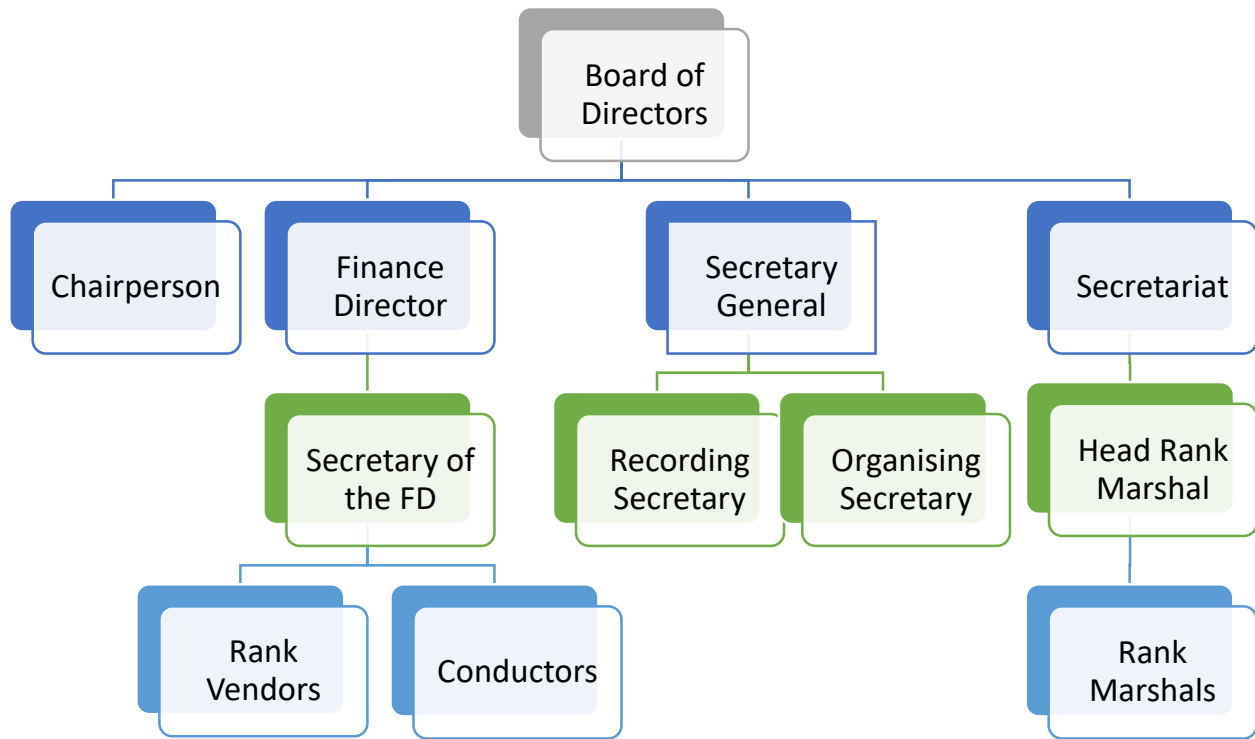


Fig 1.1 Organisational structure

1.2.2 Vision

Create a peaceful working environment for commuter operators and their employees

Provide a formal channel of communication between commuter operators, their employees and service providers from various institutions and government sector

Do all things and undertake all activities, alone and or in collaboration with other persons and organisations both locally and internationally as shall further the intersect and wellbeing of its members

1.2.3 Mission

The main objects of GTSOA are:

To bring sanity to transport activities within the scope of the trust

To provide a means of communication between members of the Trsus and the Zimbabwe Republic Police, Ministry of Transport, Road Motor Transportation, Zimbabwe Revenue Authority, City of Gweru, commuters and other stakeholders

To ensure compliance of the law by commuter operators

To promote the interest of the operators

To provide better working conditions for commuter operators

1.2.4 Values

Sanity

Dignity

Safety

Compliance

1.3 Problem Definition

GSTOA members who happen to be the minibus owners for minibuses operating on the Gweru – Shurugwi route are not benefiting much from their minibuses as conductors have a tendency of faking the fares paid by passengers on log sheets and the number of passengers who boarded the minibus for a journey. The minibus crew that is the conductor and the driver can also lie on the number of trips travelled in a day and the transport operator or his/her manager have no means to detect the lies. This has resulted in the crew benefiting more than the minibus owner.

On the other hand, passengers are being charged fares that exceed the approved fare from the RMT as stated from the fare table. Other passengers who board for example from Gweru to Guinea Fowl

pay \$1 which is unfair considering that it costs \$1 from Gweru to Shurugwi is \$1 and someone dropping off halfway the journey pays the same amount.

1.4 Aim

The aim of this project is to assemble an automatic fare collection device to be used by GSTOA minibuses that records the GPS coordinates where a passenger boards a bus and the GPS coordinates where a passenger drops off and deducts an amount that has the value of the distance travelled, that can be monitored its activities by the transport operator/manager through a web application.

1.5 Objectives

To design and assemble an automatic fare collection device that allows passengers:

- 1 On boarding a bus to swipe an RFID card and note the passenger's identity as well as the pick-up GPS coordinates for the passenger
- 2 On dropping off to swipe an RFID card and note the drop off point GPS coordinates and calculate the bus fare for the distance travelled in the bus

To develop a web application that enables the transport operator / fleet manager to:

- 1 View bus operations (fare collections, number of people, estimated number of people from the motion sensors) in real time
- 2 View current location of a bus
- 3 Monitor and analyse best pick up points and times from the system data history

1.6 Instruments and Methods

These are the means by which the student will acquire the data for the research project and the means by which the data will be used to develop the required project objectives.

1.6.1 Data collection tools

Text books

Journals and Articles

Internet

Statistical Tools

Interviews

Focus groups

Questionnaires

1.6.2 Device Assembling Instruments

The developer is going to make use of the following technology and devices in assembling the automatic fare collection device

1.6.2.1 Arduino

Arduino is an open source platform that simplifies building electronic devices (Ben, 2008). Arduino was developed at Ivrea Interaction Design Institute and is aimed at students with little background in electronics and programming. Arduino boards read inputs which can be light on a sensor, finger on a button and turn it into output. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Alternatively, the student could have hardcoded a microcontroller, but that would be a bad software engineering practice known as reinventing the wheel when there is something that has already been made.

1.6.2.2 RFID System

RFID is the use of radio waves to read data stored on a tag attached to an object, a card in this case (EPC REF 2004). An RFID system consists of a tag and a reader. Tags are embedded with an antenna that transmits/receives a signal and a microchip that stores and process the data. Near Field

Communication (NFC) technology could have been used because its more secure and fast, but the NFC technology is expensive and therefore not everybody can own an NFC enabled device.

1.6.3 Web Application Development Instruments

The student will make use the following software, programming languages, scripting languages and frameworks to develop the web application:

1.6.3.1 MySQL8.0

MySQL is an open source and most popular relational database management system (RDBMS) structured query language (SQL). It is available under the GNU General Public License. MySQL is the best DBMS because it is open source and therefore free. It is a widely used DBMS and therefore has a strong support base through forums and frequently asked questions (FAQs) online.

1.6.3.2 PHP 7

PHP is a widely used open source scripting language and is best for web scripting. Lerdorf (2004). PHP is an acronym for PHP: Hypertext Preprocessor. It was developed by Rasmus Lerdorf and he initially named it Personal Home Page. PHP is an open source language and is free to use in development. It is supported by many web servers. The learning curve for PHP is not as steep as for other backend programming languages and therefore PHP was chosen. PHP also has a number of frameworks, which are libraries of PHP that make code and programs more secure, and allows for quick development as it is some prewritten code.

1.6.3.3 Code Igniter

Code Igniter is a lightweight PHP framework, built for developers who need a simple and elegant toolkit to create web applications. Like many PHP frameworks it takes the Model – View – Controller (MVC) development approach. Code ignitor was the chosen framework because it is more light and easy to learn. It does not have many requirements for installation compared to other PHP frameworks such as Laravel.

1.6.3.4 Apache

Apache is an open source and cross platform Hyper Text Transfer Protocol (HTTP) Server. It was released under the Apache License and is developed by an open source community of developers. Apache is the most common if not the only used PHP server.

1.6.3.5 HTMLX

HTMLX is the latest version of the famous and Hyper Text Markup Language (HTML). HTMLX comes with many features such as support for mapping interfaces, support for videos and audio. The developer also chose HTMLX to keep up with technology trends.

1.6.3.6 CSS3

CSS3 is the latest version of the Cascading Style Sheets (CSS) language. It is this language that brings styling to the web pages developed using HTML. CSS is the only web styling language and the latest version CSS3 was chosen for its support of CSS libraries and keeping up with technology trends.

1.6.3.7 Bootstrap

Bootstrap is an HTML, CSS and JavaScript (JS) library. It contains prewritten CSS and JS code and the developer has to follow some certain rules in writing HTML code which will make the styling and JS scripting job easier for the developer. Bootstrap was chosen because its easy to use and more understandable than other CSS libraries such as Material and Iconic.

1.6.3.8 JavaScript

JavaScript is an object-based scripting language commonly used to create interactive effects within web browsers. JavaScript is the best web scripting language in the market. It has many frameworks and libraries that will be used by the developer that include Ajax, JSON, jQuery, CanvasJS and Morris.js.

1.6.3.9 Google Maps

Google Maps is a web mapping interface developed Where 2 technologies. It was bought by Google in October 2004 and renamed to Google Maps. It offers street maps, satellite imagery and real time traffic analyser. The service was initially developed using C++ and later JS, eXtensible Markup Language (XML) and Ajax were added. The developer shall make use of the Google maps Application Programming Interface (API), to embed onto the project web application, which is called by Google a third party. Google Maps is an open source and free to use mapping interface.

1.7 Justification and Rationale of Study

The proposed system is of great benefit to passengers using GTSOA vehicles and the transport operators as well.

To the Passengers

Fair fares charged to the customer according to the actual fare stated by the transport operator, pickup point and drop off point.

Ability to pay fares using plastic money as the cards are preloaded with money

To the Transport Operators

Automatic collection of fares therefore no cheating by the minibus crew

The system comes with a coordinates tracking therefore a minibus can be tracked its movements

Ability to view best pick up points and best pick up times by the fleet managers and hence know how to timetable their minibuses

1.8 Conclusion

This chapter, the introduction chapter covered the problem definition that has led to undertaking the research, highlighted the aim and the objectives of the proposed system and outlined the need for the research. The next chapter will focus on the project planning activities.