ANDROID BASED "HS CODE FINDER WITH TARIFF CALCULATOR" APPLICATION FOR SRI LANKA CUSTOMS

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DECLARATION

The work described in this dissertation was carried out by me in collaboration with Sri Lanka Custom and the Department of Computer Sciences, University of Sri Jayewardenepura, Sri Lanka under the guidance of Prof. R. G. N. Meegama and has not been submitted elsewhere.

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LIST OF ABBREVIATIONS

VAT – Value Added Tax

PAL – Port and Airport Development Levy

ED – Exercise Duty

NBT – National Building Tax

ADT - Android Development Tool

AVD - Android Virtual Device

IDE - Integrated Development Environment.

OHA - Open Handset Alliance

SDK - Software Development Kit

API - Application Programming Interface

APK – Android Application Package

XML - Extensible Markup Language

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Abstract

Sri Lanka Customs is playing a major role in international trade. Imports and exports are the major functionalities that it has to be engaged in daily operations. When importing or exporting goods, a nomenclature for products which is known as the HS (Harmonized System) coding system, is employed as an internationally standardized system of names and numbers.

"HS code finder and Tariff Calculator" application for Sri Lanka Customs is a mobile application which facilitates in finding HS (Harmonized System) code of a product and the inbuilt tariff calculator will enable calculating the tariff for the CIF value that is being provided. HS Code Finder facilitates in finding the related HS codes for a given description and vice versa. Tariff can be calculated for the related HS Code by taking an effective rate of all levies. It includes Customs Duty, Surcharge, Exercise Duty, VAT, CESS, PAL and all other levies. The existing system used inside Sri Lanka Customs is an Excel calculator which is being released annually. This implemented mobile application would be one of the leading solutions since a mobile presence is necessary for any application in this exploding technology sector. Over and above all, this is the first ever mobile application in Sri Lanka to find HS Code and to calculate tariff. Countries like China and India already own HS code finder apps that enables easy engage in international trade. This application will be very useful to Custom Officers as well as for general public in their daily negotiations. This will directly unveil opportunities to engage in importing and exporting, since people can initiate their engagement in international trade with an estimated value of tariff that is being calculated for the importing or exporting goods. CIF value should be entered in order to output total tax value with the effective rate of all levies.

Since Android is the most used mobile operating system in the world and since it has more users, this mobile app was created with Android Studio. Android, MySQL and PHP languages were used throughout. The major advantage of this implemented mobile application can be named as that the tariff can be calculated prior the trade in palm of the user. Once the application is launched it will drive the customs transactions into a new era.

Chapter 1 - Introduction

1.1 Overview

Sri Lanka Customs is one of the oldest Customs administrations in the world which celebrated its 207 years in 2016. However, there is evidence of the existence of Customs tax collection in Sri Lanka over 2000 years ago at the Godawaya Harbor in Hambanthota. The Customs Department is playing a major role in controlling and monitoring imports and exports of restricted and prohibited goods of environmental, health, social and security concerned.

Main Functions of Sri Lanka Customs includes:

- Collection of revenue

- Prevention of revenue leakages and other frauds

- Facilitation of legitimate trade

- Collection of import and export data to provide statistics.

- Cooperation and coordination with other Government Departments and stakeholders in respect of imports and exports.

From the above functions of Sri Lanka Customs, imports and exports play a major role. Import duty and taxes are due when importing goods into Sri Lanka whether by a private, individual or a commercial entity. When importing or exporting goods, there is a nomenclature for products which is known as the HS (Harmonized System) coding system.

HS (Harmonized System) is an internationally standardized system of names and numbers to classify traded products. It is also known as the Harmonized Commodity Description and Coding System. HS code varies from 4 digits to 8 digits. It would go up to 10 digits for some local products.(Figure 1 and Figure 2)

Figure 1 - Structure of a HS Code

Figure 2 - HS Code Guide by Department of Import and Export

Import duty and taxes are calculated by a valuation method. It is called CIF (Cost, Insurance and Freight), which means that the import duty and taxes payable are calculated on the complete shipping value, which includes the cost of the imported goods, the cost of freight, and the cost of insurance.

In addition to duty, imports are also subject to Sales Tax, Import Cess, Ports and Airport Levy (PAL), and Excise…etc in some cases.(Figure 3) Total tax is calculated by the mathematical formulas. (Figure 4)

Following duties and fiscal levies are collected at the time of importation by the Sri Lanka Customs.
1. Customs Duty (Preferential and General)
2. Value Added Tax (VAT)
3. Port and Airport Development Levy (PAL)
4. Social Responsibility Levy (SRL)
5. Surcharge
6. Cess under Export Development Board Act
7. Excise (Special Provisions) Duty (ED)
8. Regional Infrastructure Development Levy (RIDL)
9. Special Commodity Levy
10. Nation Building Tax

Figure 3 - Types of duties and levies(Source - Sri lanka Customs)

Abbreviations used

v	CIF Value in Rupees		p	Ports and Airports Development Levy
c	Cess under Export Development Board Act		n	Nation Building Tax
d	Customs Duty *		re	Rate of Excise (Special Provisions) Duty
e	Excise (Special Provisions) Duty		rt	Rate of Value Added Tax
t	Value Added Tax		rn	Rate of Nation Building Tax

Customs Duty

$$d = (CIF\ value) * (Customs\ Duty\ Rate)$$

or

$$d = (Quantity) * (Unit\ Rate\ of\ Customs\ Duty)$$

Cess Levy

$$c = (v + 10\%\ v) * (Cess\ Rate)$$

or

$$c = (Quantity) * (Unit\ Rate\ of\ Cess)$$

Excise (Special Provisions) Duty

$$e = (v + 15\%v + d + c + p) * r_e$$

or

$$e = (Quantity) * (unit\ rate\ of\ Excise\ Duty)$$

Value Added Tax

$$t = (v + 10\%\ v + d + c + p + e) * r_t$$

Nation Building Tax

$$n = (v + 10\%v + d + c + p + e)\ r_n$$

Port and Airport Development Levy

$$p = (CIF\ value) * (PAL\ Rate)$$

Special Commodity Levy

$$SCL = (Quantity) * (unit\ rate\ of\ SCL)$$

Note: If the Customs Duty is waived by the Ministry of Finance or a concessionary Duty rate or a preferential rate is granted, then 'd' stands for the actual amount of Duty paid. In the event the Customs Duty payment is suspended (for e.g. under the Bonding Regime), then d' stands for "actual amount of Duty that was payable".

Sri Lanka Customs National Imports Tariff Guide - 2017

Figure 4 - Mathematical Formulas used to calculate tariff

1.2 Problem Definition

Sri Lanka Customs still uses a book and the pdf version of the book with all HS Codes. When they need to find the HS Code they need to refer the book.(Figure 5)

Figure 5 - PDF version of HS Code guide

Also there is an excel sheet released annually including a tariff calculator and HS Code Guide. It is burned to a CD and given to the staff.(Figure 6)

Figure 6 - Tariff Calculator in Excel format

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There are so many problems in the current system since there are changes happening after a budget, and also new HS codes are introduces. So the excel calculator cannot be changed when a change happens. Then that would be not accurately updated and a problem arises. Apart from that finding something on a book is a tiresome process. Finding an HS code from nearly millions of items would be rather tedious. Another problem here is the equation changes that happen annually. Those should be changed annually when they announce for a new equation for tax calculation.

1.3 Aims and goals

Objectives of this proposed android based tariff calculator with HS code finder is to let the importers, exporters and the general public to give access easily for calculating the tariff as well as to give an HS code guide.

The proposed android based tariff calculator enables estimation of the combined cost of trade taxes for almost all of the approximately 6,500 HS coded items in the Sri Lanka Tariff Schedule.

This android based tariff calculator has a HS code finder, that will search the products when the HS code is given and vice versa(Only the importers and exporters know the HS code nomenclature relevant to their importing goods, but this application will enable the general public to let them know about the import tariff before engaging in imports)

1.4 Research Purpose

To find the HS code there is a guide given for the officers who are working inside Sri Lanka Customs. Importers, exporters and the general public uses http://www.imexport.gov.lk/ as the HS code Finder. (Figure 7)

Figure 7 - HS Code Guide by Department of Import and Export

Sri Lanka Customs releases an Excel Version of the Import Tariff Calculator. The total tax value can be calculated when the CIF value is entered. (Figure 8)
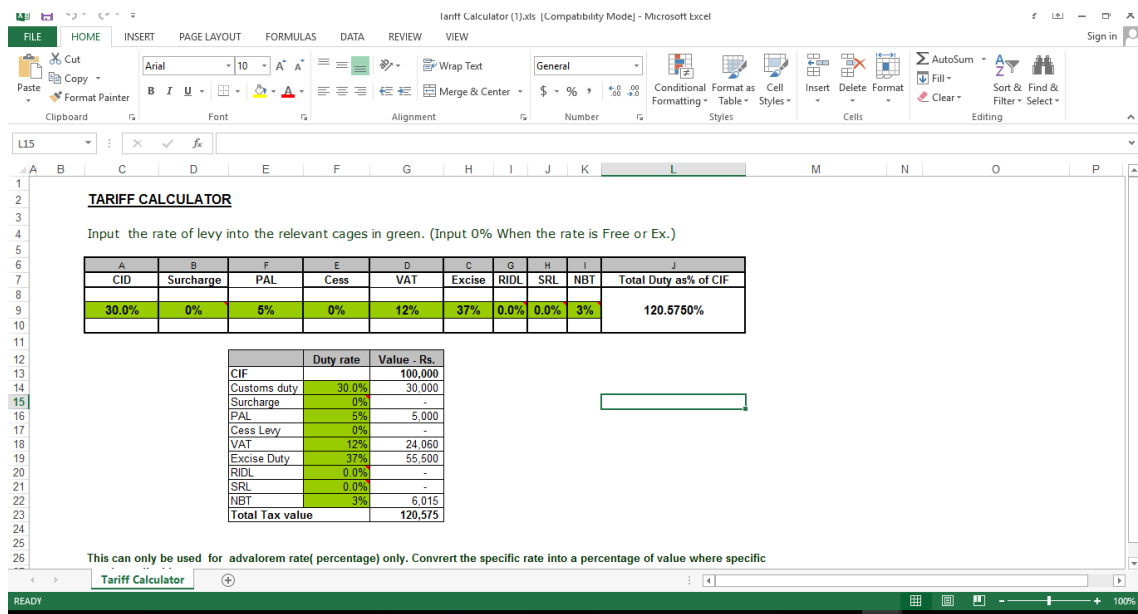
Figure 8 - Annually released excel calculator

The problems with the existing system are

- The excel version needs manual updating when the tax percentage changes.

- When new goods are introduced new HS codes are not added to the HS code guide.

- Not user friendly.

- General public are not allowed to use the excel version.

- When the equations of calculating the tariff changes, the excel version needs to be changed.

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1.5 Proposed Solution

Proposed system is an android based user friendly application that will enable the importers, exporters and general public to calculate the tariff easily when the CIF value is entered (For some products the quantity should also be entered)

Propose system will have the following functionalities.

- When the HS code is entered, the application should provide the user with relevant products.

- When the product is entered, the application should provide the user with relevant HS codes.

- Tariff Calculator Functionalities - When the CIF value of a relevant product is entered, the application should provide the total duty value. (In some cases, the total duty payable is calculated per quantity, for that the total quantity in kilograms should be entered)

Chapter 2 - Technologies Adopted

2.1 Android

Android is a software platform and operating system for mobile based on the Linux kernel which currently developed by Google. It provides a rich application framework that allows building innovative apps for mobile devices in a java language environment and for developers, Android innovation leads to build powerful, differentiated applications that use the latest mobile technologies. Android is designed primarily for touchscreen mobile devices such as smartphones and tablet computers, And also Android designed specialized user interfaces for televisions (Android TV), cars (Android Auto) and wrist watches (Android ware).Android operating system uses virtual keyboard and touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching, and reverse pinching to manipulate on-screen objects .

Android apps are built as a combination of distinct components that can be invoked individually. An individual activity provides a single screen for a user interface, and a service independently performs work in the background. From one component, can start another component or even a component in a different app using an intent. Android provides an adaptive app framework which allows providing unique resources for different device configurations.

2.2.1 Android updates

Google is constantly working on new versions of the Android software. Google is launching all the android versions with a numerical code and name that's so far been themed after sweets and desserts, in the alphabetical order. The Android versions are

- Android Beta 1.x

- Android Cupcake 1.5

- Android Donut 1.6

- Android Éclair 2.1

- Android Froyo 2.2

- Android Gingerbread 2.3

- Android Honeycomb 3.2

- Android Ice Cream Sandwich 4.0

- Android Jelly Bean 4.1

- Android Jelly Bean 4.2

- Android Jelly Bean 4.3

- Android Kit Kat 4.4

- Android Lollipop 5.0

- Android Marshmallow 6.0

- Android Nougat 7.0

2.2.2 Android Manifest file

Every Android application should have Android manifest .xml file in its root directory. This Android manifest file consists of characteristics of the application.i.e.it describes the components of the application such as activities, services, content providers etc. When the application has more than one activity it should be included in the manifest file. And also it is important to define the permissions, which is needed to interact with the application components and external libraries that helps to access protected parts of the API and interact with other applications in Android manifest file.

Structure of the Manifest file

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.hiruni.hscodefinderandtariffcalculator">
    <uses-permission android:name="android.permission.INTERNET" />

    <application
        android:allowBackup="true"
        android:icon="@mipmap/qqq"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
        <activity android:name=".HSCodePage" />
        <activity android:name=".TafiffCalculatorPage" />
        <activity android:name=".FindHSbyDes" />
        <activity android:name=".FindHSbyCode" />
        <activity android:name=".ResultActivity"></activity>
        <activity android:name=".ResultActivityForCalculator"></activity>
    </application>

</manifest>
</manifest>
```

2.2 Android Studio

Android Studio is the IDE for Android that was announced in May 2013 at the Google I/O developers' event, and is intended as an alternative to Eclipse. At the time of this writing, Android Studio is currently in Early Access Preview, with the most recent version being 0.0.5. At this time, Android Studio is not ready for full end-to-end Android application development, but should be ready in the coming months. Android Studio is based on the Java IDE called IntelliJ. All In-telliJ products share the same shell IDE, which you'll see as soon as you open up Android Studio. Most of the tooling in Android

Studio is very similar to Eclipse, such as shortcuts, designers, and code editors. You'll still export signed APKs, view logcat, and edit code virtually the same way in Android

Studio.

2.5 Android Emulator

An Android emulator is a virtual Android device running on the computer. The Android emulator mimics all of the hardware and software features of a typical mobile device, except that it cannot place actual phone calls. The emulator allows an application developer to test an Android application on different API levels without using a physical device [Using the emulator]. An Android Virtual Device(AVD) is a device configuration that is run within the Android emulator. It works with the emulator to provide a virtual device-specific environment in which to install and run Android apps. The AVD Manager provides a graphical user interface in which a developer can model different configurations of Android devices, which are required by the Android emulator.

2.3 WAMP Server

The acronym WAMP refers to a set of free (open source) applications, combined with Microsoft Windows, which are commonly used in Web server environments. The WAMP stack provides developers with the four key elements of a Web server: an operating system, database, Web server and Web scripting software. The combined usage of these programs is called a server stack. In this stack, Microsoft Windows is the operating system (OS), Apache is the Web server, MySQL handles the database components, while PHP, Python, or PERL represents the dynamic scripting languages. For the project MYSQL Database was handled by WAMP Server.

2.6 MySQL Database

MySQL is a world renowned open source Relational DBMS supporting standard SQL. At the server end, it can be configured to provide single user or multi user access to a number of databases and tables. Some of the best features are: cross-platform support, updatable views, cursors, information schema, query caching etc. It can easily be integrated into PHP scripts. It is developed, distributed & supported by Oracle foundation.

2.7 PHP Scripting

It serves as a server side scripting language. The interpreter used at server end is a dedicate PHP processor module and interprets the chunk of code within the delimiters. Acronym for Hypertext Preprocessor, PHP helps in designing dynamic web content. PHP code is processed in command-line mode performing desired operating system operations and producing program output on its standard output channel.

The three main reasons to work with PHP are: first, it fits in greatly with HTML, being interchangeable with it, and only adds new content. Secondly, its user interface provides a richer experience as compared to HTML only. Third and foremost, it's easy to learn and we can easily get started by using only a few functions.

2.1 Agile software development

Agile software development is a group of software development methods which is reduce overheads in the software process by minimizing documentation and to be able to respond within a short time period to changing requirements without excessive rework. This is a conceptual framework for software engineering which promotes development iterations throughout the life-cycle of the project and focuses on frequently delivering small increments of working software.

In this project Feature Driven Development (FDD) and Test Driven Development (TDD) methods were used as agile methods for software development process.

2.1.1 Feature Driven Development

Feature-driven development (FDD) is an iterative and incremental software development process which uses a short iteration model. The main purpose of Feature-driven development is to deliver tangible, working software repeatedly in a timely manner.

2.1.1.1 Feature Driven Development process

1. Develop Overall Model

2. Build Feature

3. Plan By Feature

4. Design by Feature

5. Build by Feature

2.1.2 Test Driven Development

Test-driven development (TDD) is a testing technique as well as a design technique, which combines test-first development where you write a test before you write just enough production code to fulfill that test and refactoring.

TDD always starts with failing test and then writes the simplest code needed to pass the test. In this process the code was tested using valid inputs, invalid inputs, errors, exceptions and boundary conditions etc.

2.1.2.1 Test Driven Development process

- First step was think about what we want to do

- Then find method to test it

- Write a small test .This will be enough code to fail the test.

- Run the code and watch the test fail, then write a code which need to pass the test

- Run the test again and see whether if there is working properly or not.

- Repeat the test above until you cannot find any more tests that drive writing new code.

Chapter 3 - Methodology

3.1 Setting up the Development Environment

There are several steps when methodology is considered. As the first step the necessary software's were downloaded. For the development process Java Development Kit was downloaded from Oracles Java site. (Figure 9 and Figure 10)

Figure 9 - The Java Download button on the Java Downloads page

- Java Developer Day hands-on workshops (free) and other events
- Java Magazine

JDK MD5 Checksum

Looking for JDK 8 on ARM?
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Linux x64	153.42 MB	jdk-8u25-linux-x64.tar.gz
Mac OS X x64	209.13 MB	jdk-8u25-macosx-x64.dmg
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Solaris x64	94.24 MB	jdk-8u25-solaris-x64.tar.gz
Windows x86	157.26 MB	jdk-8u25-windows-i586.exe
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Product / File Description	File Size	Download
Linux x86	58.63 MB	jdk-8u25-linux-i586-demos.rpm
Linux x86	58.52 MB	jdk-8u25-linux-i586-demos.tar.gz

Figure 10 – Accept the license agreement and click on relevant jdk to download

Follow the installation wizard.(Figure 11)

Then the environment variables PATH and JAVA_HOME was set.(Figure 12, Figure 13
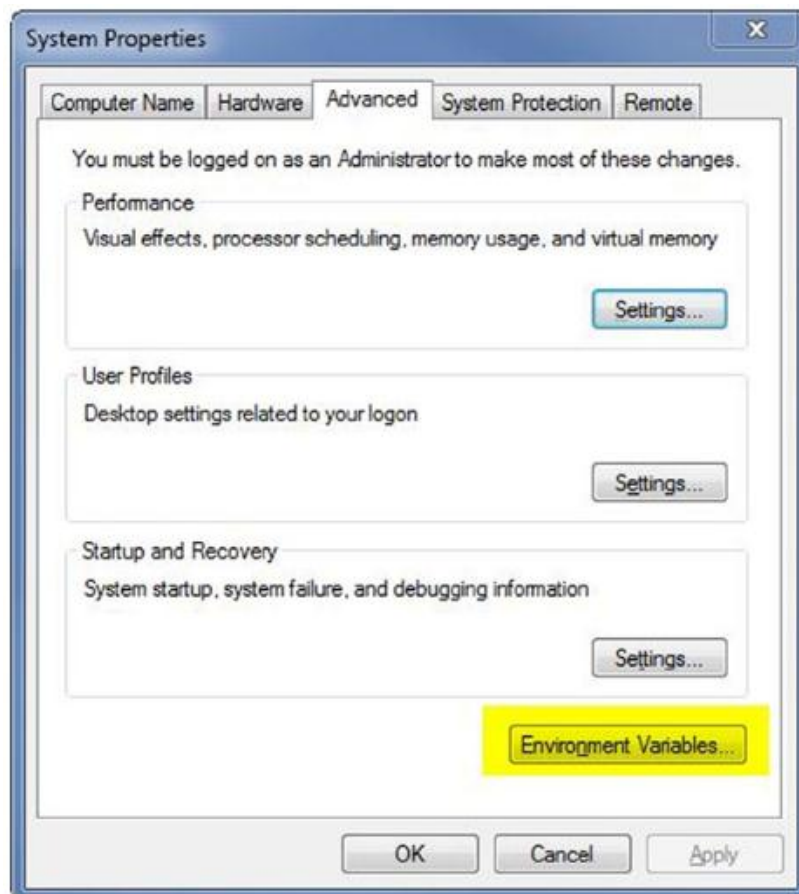
and Figure 14)

Figure 12 - Change the environment variables

Figure 13 - Edit the Java Home variable

Figure 14 - Edit the PATH variable

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The latest version of Android SDK was also downloaded along with Android Studio (Figure 15 and Figure 16).Android studio is a free and open source software and there are so many advantages in initiating the mobile application in android platform.

Figure 15 - Download Android Studio

Figure 16 - Choose components

Select locations for android studio and SDK. (Figure 17)

Figure 17 - Select locations for android studio and SDK

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The setup wizard is completed by downloading the necessary components.(Figure 18)
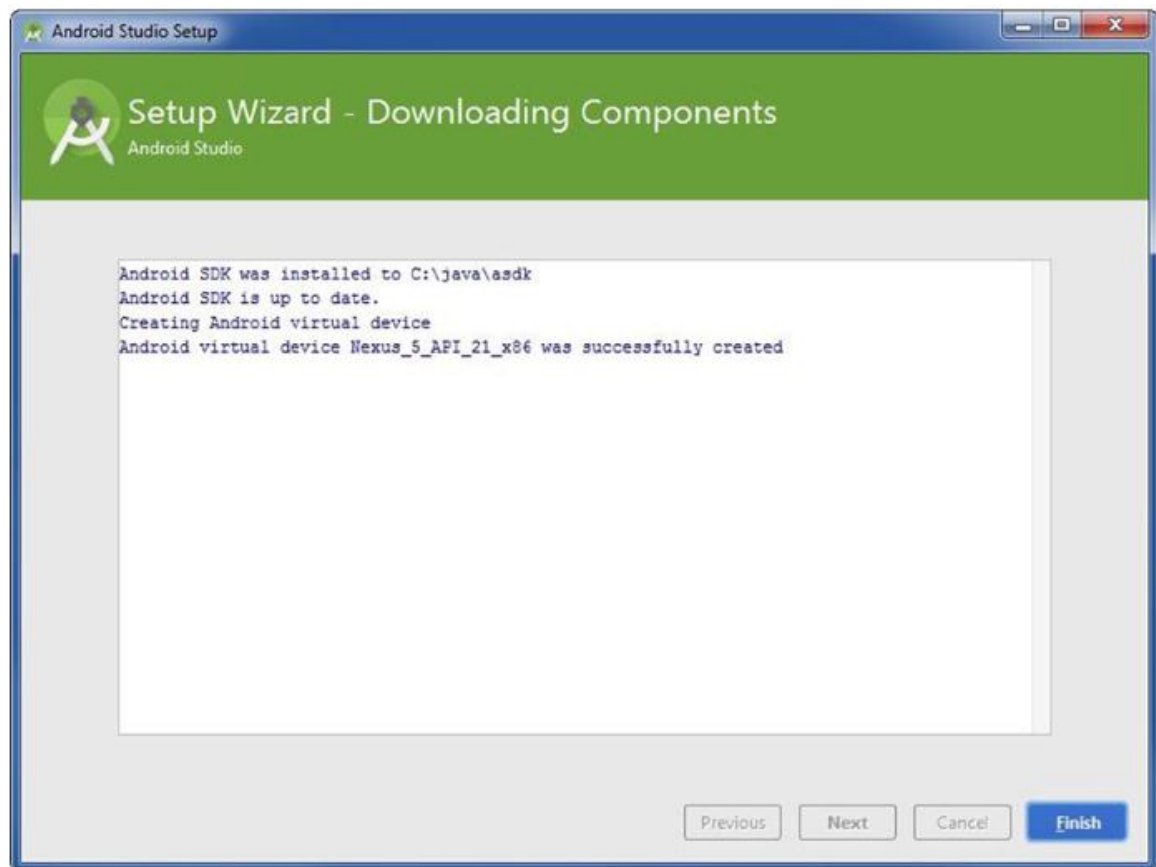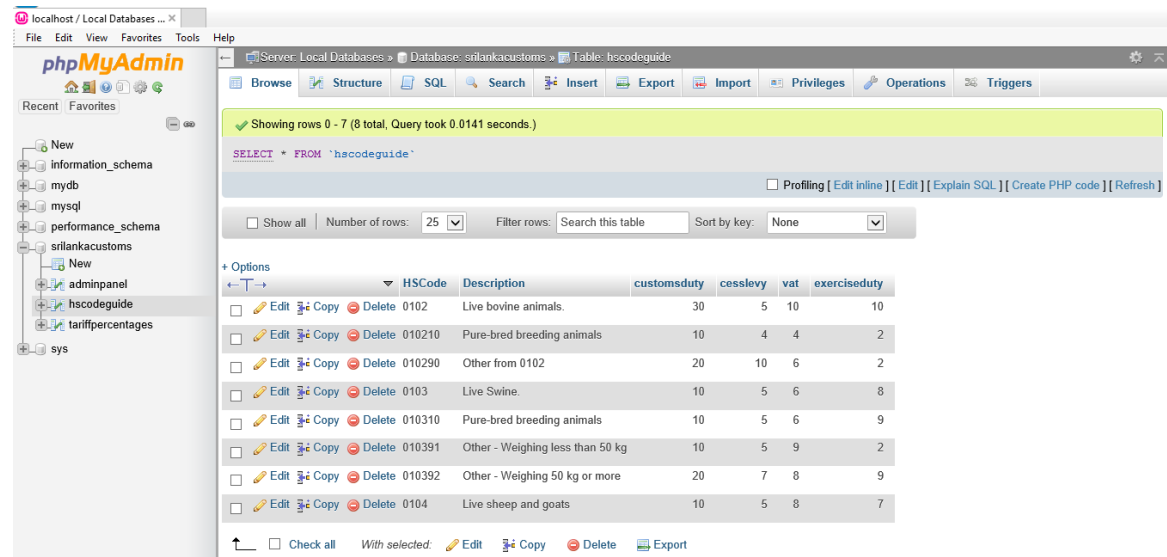

Figure 18 -Setup Wizard - Downloading Components

The requirement was to create a HS code finder application to replace the traditional system. For that, we connected a database and created the HS code finder. Along with that, the other implementation was to replace the traditional tariff calculator that is used inside Sri Lanka Customs.

This android application includes two main processors such as Finding the HS Code and Calculating Tariff.

3.1 Analyzing the requirements

The requirement was to create a HS code finder application to replace the traditional system. For that, we connected the database and created the HS code finder. Along with that, the other implementation was to replace the traditional tariff calculator that is used inside Sri Lanka Customs.

This android application includes two main processors such as Finding the HS Code and Calculating Tariff. First, the manual procedure of finding HS Code and Calculating tariff was learnt. The requirements were gathered. The requirements should be documented, actionable, measurable, testable, and traceable. So I sketched the main functionalities of the android application and started creating the first part of the application. It was the HS Code finder part. According to the mentioned details by Sri Lanka Customs the HS code finder should be implemented to search the relevant HS Codes and descriptions. If a part of the description was typed all the relevant codes should be displayed and also if a part of HS Code was entered the descriptions should be displayed.

Then I traced the requirements of the Tariff Calculator. As they mentioned the Tariff should be calculated for a specific HS code. The necessary equations and percentages should be used when calculations are done. They gave me the necessary equations and percentages for all HS Codes.

3.3 Preparing the Database

A MySQL database was created including the necessary tables.(Figure 19) The table is created with the information of HS Codes as well as percentage values.

Figure 19 - MySQL database

3.4 PHP Scripting
I used PHP scripting codes for querying the necessary things from the database.

For the HS code finder I have used hscode.php (Figure 20) and for the tariff calculator tariffcal.php (Figure 21) file.

Figure 20 - hscode.php

Figure 21 - tariffcal.php

3.5 Develop the Android Application

The android application was developed with 7 new activities. For the result activities a web view client was used. (Figure 22)
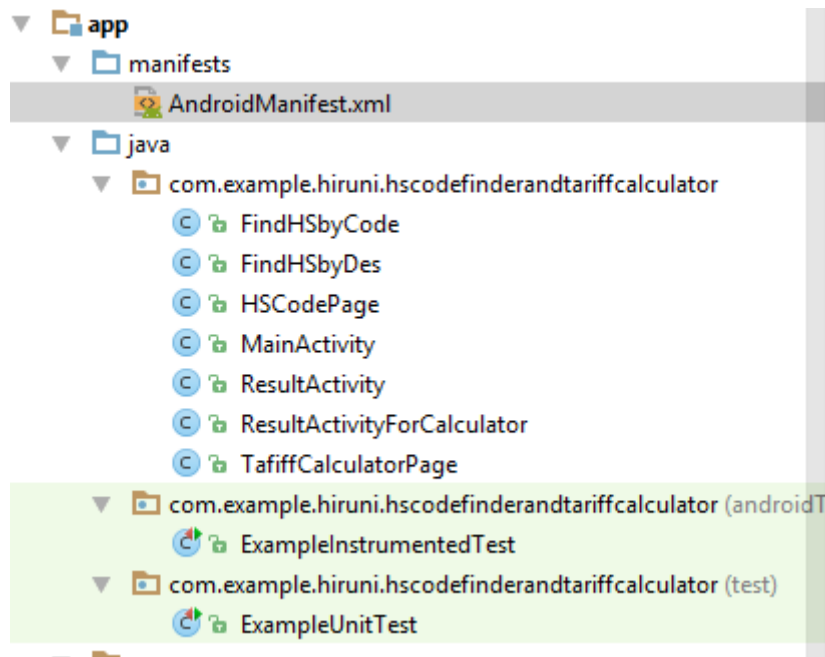
Figure 22 - Android Studio activities

Chapter 4 – Results and Discussion

4.1 Results

The mobile application was implemented with the following functionalities.

The layouts were designed for HS Code finder and Tariff Calculator pages.

This is the layout of the first page when a user navigates to the application.(Figure 23)
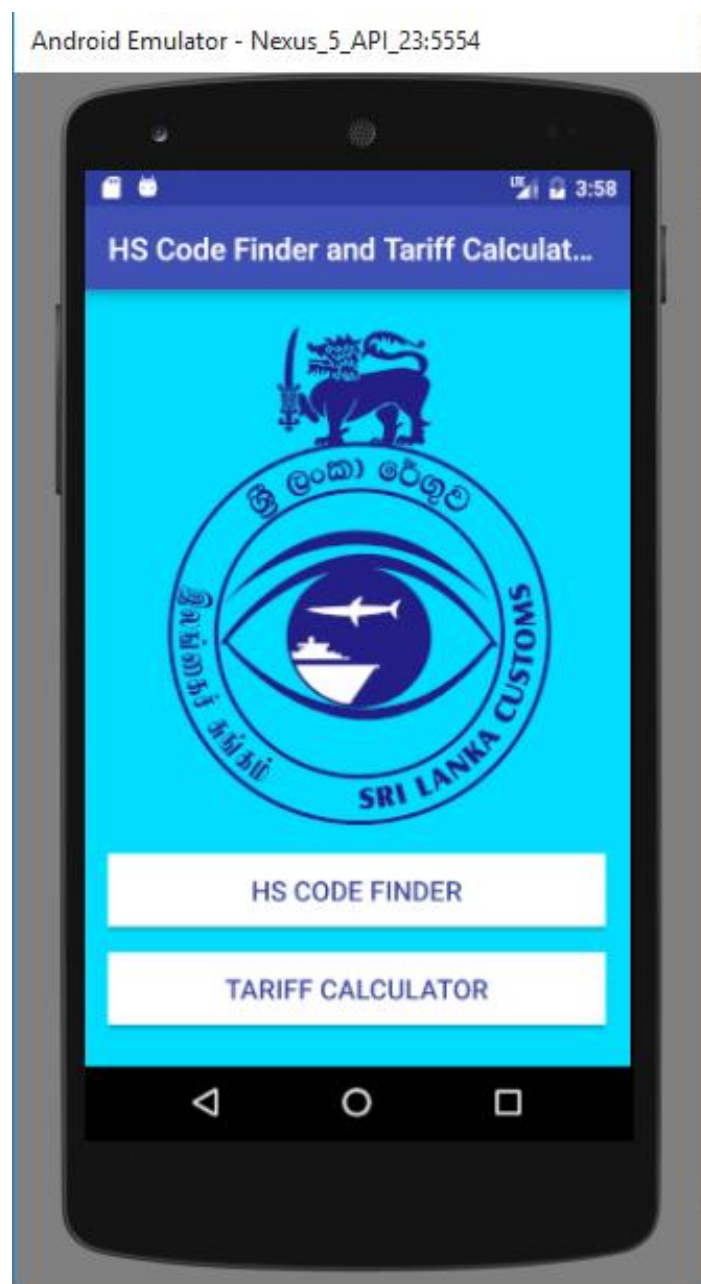
Figure 23 - HS Code and Tariff Calculator mobile application

To find the HS Code there are two options. A person can enter any part of the description and find the relavant HS Code or they can search by the HS Code for a description.(Figure 24)
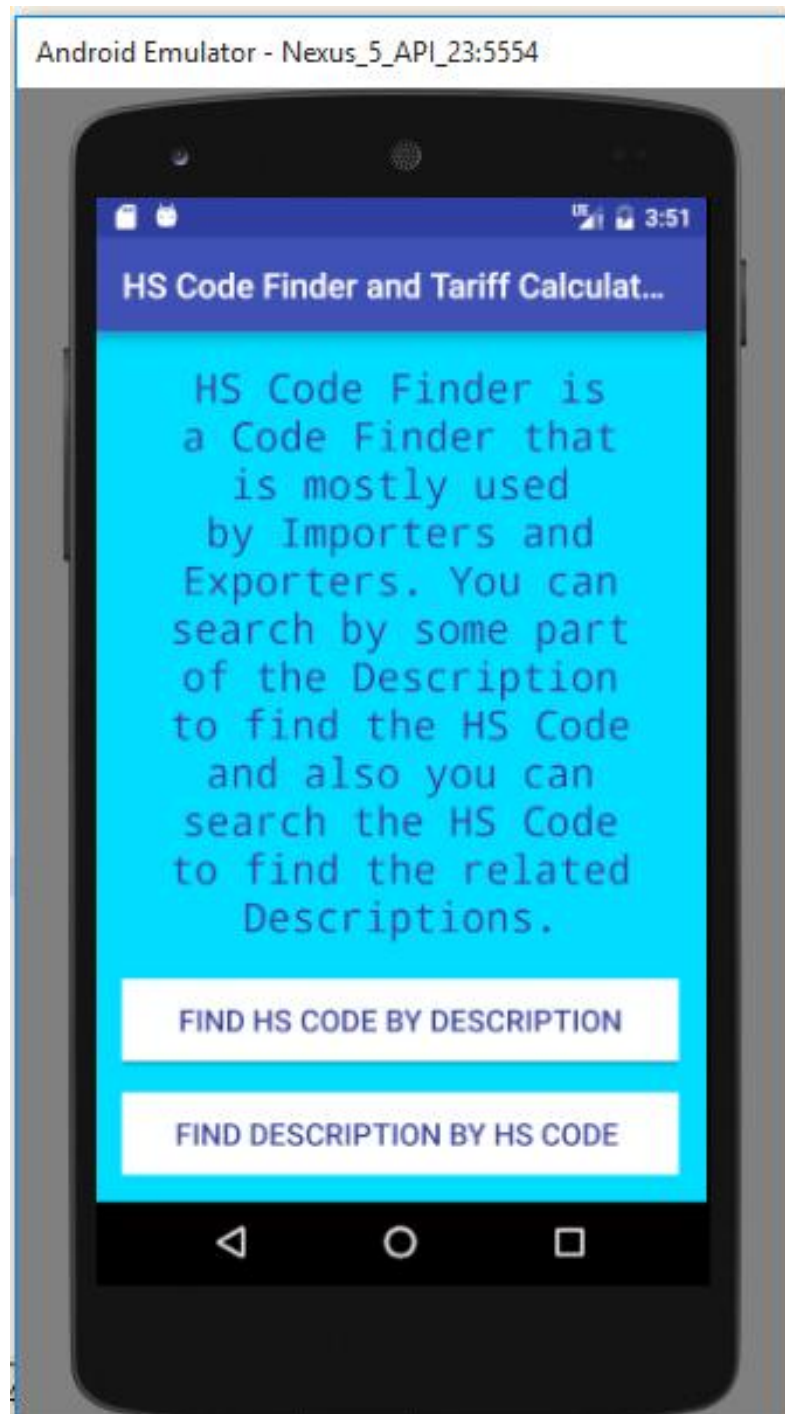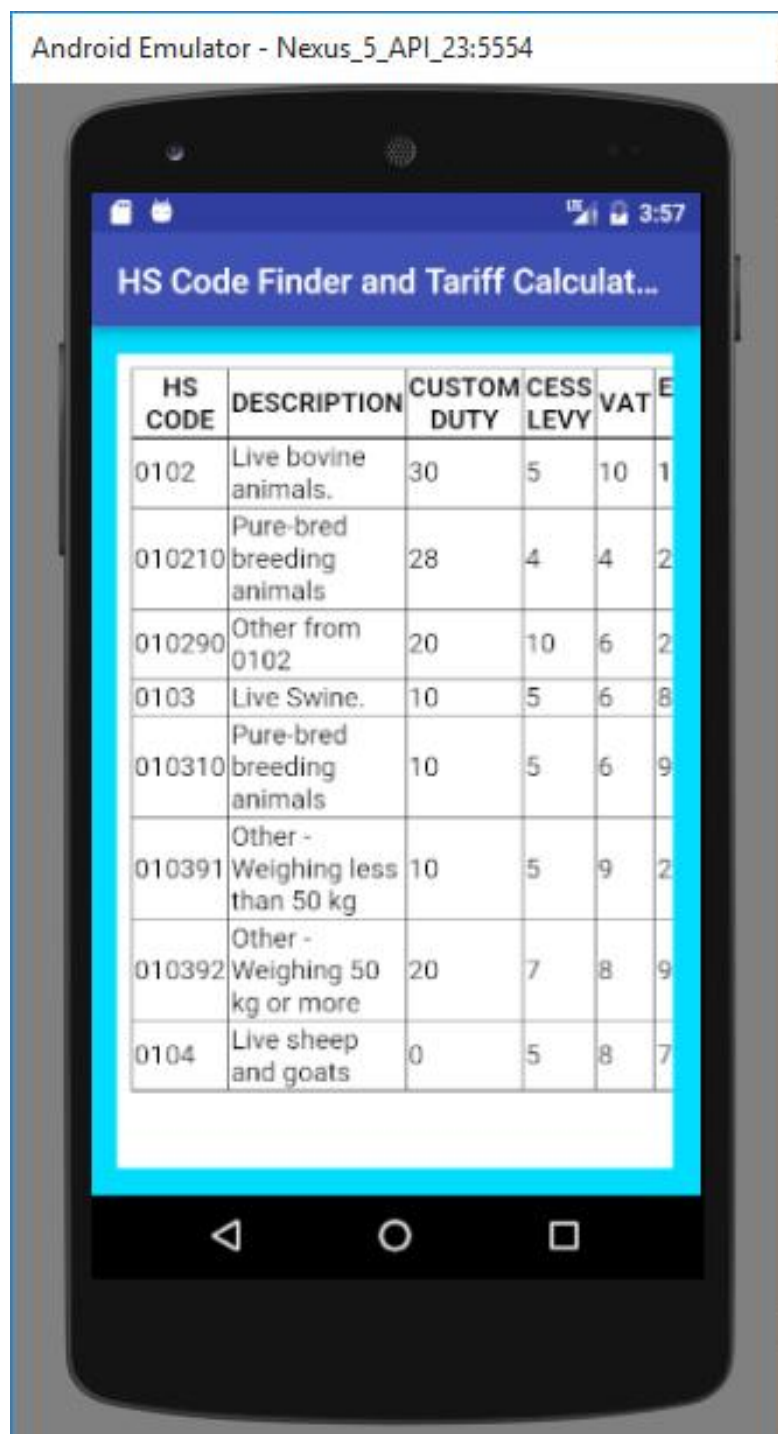
Figure 24 - HS Code Finder

The results of the search result will be shown like this. (Figure 25)

Figure 25 - Results activity of HS Code Finder

The tariff calculator application has two user inputs. One is the HS Code and the other is the CIF value. When both are entered we can calculate the tariff. (Figure 26)

Figure 26- Tariff Calculator

When the "calculate tariff now" button was clicked the total tariff value is shown along with individual tax values for each type of levy. (Figure 27)

Figure 27 - Results Activity for Tariff Calculator

4.2 Discussion

Through this project my effort was to build an Android application for Sri Lanka Customs including a HS Code Finder and Tariff Calculator to replace the excel calculator and the HS code book. First, the manual procedure was studied and gathered the requirements necessary to implement the application. In here Agile software development method was used as the software development method. The MySQL database was used to create databases and used PHP scripting language. The Android Studio is using as the IDE. My main goal of this project was to build a user friendly android application rather than using excel calculator. In the exploding mobile technology sector, a mobile presence is necessary for any application.

The advantages of this application,

- Importers, Exporters and the general public who wish to extend in import/export business can get the tariff calculated, when the app is launched, in the palm of a hand.

- HS code finder will enable the users to find the products with the relevant HS code and vice-versa.

Chapter 5 - Conclusion and Future Works

5.1 Conclusion

This is the first time implementing an android application for Sri Lanka to find the HS Code and tariff Calculator. This android based tariff calculator with the HS code finder will open up new avenues for Sri Lankans to engage in international trade. The developed application has so many advantages for general public as well as the importers since it is a unique application including the HS code finder and tariff calculator. If a person needs an instantaneous lookup for an HS code, they can use the application once launched in Google play. It will give more than 6500 HS coded products. The tariff calculator gives the customs value on which duty is assessed, the price paid for the goods alone, or the sum of the product price, the cost of shipping and the cost of insurance. The valuation method is different from country to country, so the Sri Lankan importers cannot use any other application that is implemented by any other country. So this would be a very useful application for Sri Lanka.

5.2 Future work

- This has to be improved more with some functionalities of the tariff calculator.
- This has to be integrated with the ASYCUDA system (International) so that the changes done in that would automatically update the android application along with the date.
- I hope to add the restricted goods that cannot be imported or exported.
- This can be more improved by adding the dealers along with it so that the imports or exports would not be a tiresome process.
- Launch the application to google play with more development.

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