Group 11

Demographic Uganda

Software Design Document

Team

Name	Reg.Number
Nabikolo Shiba	15/U/8925/PS
Mwesigye Robert	15/U/771
Opoloti Stephen	14/U/14203/EVE
Muyambi Julius	15/U/8610/PS

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1. INTRODUCTION

The Software Design Document provides a documentation which is used to aid in software development by providing the details for how the software should be built, and the insight into the structure, architecture and design of each component. Within the Software Design Document are narrative and graphical documentation of the software design for the project.

1.1 Purpose

The purpose of the Software Design Document is to provide a description of the architecture and design of the UgaDemos system fully enough to allow the development proceed with an understanding of what is to be built, and how it is expected to be built. The document expands the functionality described by the features in the UgaDemos system's Software Requirements Specifications(SRS), and describe the additional classes, attributes and methods to be implemented.

1.2 scope

UgaDemos system is a web based system that provides a flexible and thorough analysis of Uganda's population for the past twenty years (1996 to 2016) to the intended users, basing on the following characteristics; Births, Deaths, Total population, Number of migrants per 1000 population, rate of natural increase, Births per 1000 population, Deaths per 1000 population, Growth rate, Net number of migrants, Natural increase and population change. The system is limited to English language and because of the nature of the dataset provided to us by the instructors, it does not estimate the life expectancy, child dependency ratio, aged dependency ratio, population composition and structure.

1.2.1 Benefits:

- ✓ Provides Statisticians with concise information about the population in the country.
- ✓ Provides mechanisms for book keeping and storing relevant information about the citizens in different areas in the country.
- ✓ Provides a platform for government to plan for the people in the country according to the population available.

1.2.2 Goals:

- ✓ Analyzes data about the statistics in the country.
- ✓ Provides a platform that visualizes population data graphics such as scatter plots matrix, box and whisker plots, bar plot, and pie charts depending on selected parameters.

- ✓ Predicts the population of future.

1.2.3 Objectives.

- ✓ Provides information about the current population in Uganda.
- ✓ Provides a brief description about the location, geography, and current administration of Uganda.
- ✓ Analyzes Uganda's population data for the past 20 years.
- ✓ Visualizes the population information using graphics such as Box and Whisker plots, bar plots, pie charts, and scatter plot matrices.
- ✓ Draws conclusions based on the observations of the analysis of the population basing on parameters such as deaths, births, birth rate, and others.
- ✓ Predicts future population over a specific period of time in the future.

1.3 Overview

The software design document is divided into various sections which includes, the introduction, system overview, system architecture, data design, component design, human interface design, requirements matrix, appendices with their corresponding subsections.

2 SYSTEM OVERVIEW.

The UgaDemos web based system provides a quick and flexible access to information concerning Uganda's population for the past twenty years (1996 to 2017).

2.1 General description of the functionalities:

The user searches for a specific population data of Uganda for a particular year by entering any year between 1996 and 2016. If the entered year is not in range, an error message is displayed.

The user also uploads a CSV file which is displayed in form of a table, and then puts text inputs to select what is plotted.

The system calculates population change which is analyzed by measuring the change between population sizes and be able to give supportive information as to why there is such

a change (either an increase or decrease). This is calculated by taking one population size of a given year minus the population size of the previous year.

The system provides information about the current population in Uganda.

The user downloads population data and graphics then uses them for their own needs.

The system also visualizes the population information using graphics such as Box and Whisker plots, Bar plots, line graphs, pie charts, and scatter plot matrices.

The system uses current and previous data to predict the future population over a specific period of time in the future.

3. SYSTEM ARCHITECTURE

3.1 Architectural Design

The UgaDemos system is broken up into two major components: a client-side application and a server-side application.

The client-side application is also separated into two parts: the functional component, and the graphical component. The functional component forms the core of the UgaDemos system. It receives user input and downloads graphics, visualize data, and predict future population. It performs all the calculations for population change, growth, and density as required by the user. The graphical component, as the name implies, is simply the graphical user interface. It provides all of the buttons, text boxes, and other onscreen elements which allows the user to access all of the features provided by the application.

The server application receives serialized data from client and parses it into useful information.

Client Server Architecture

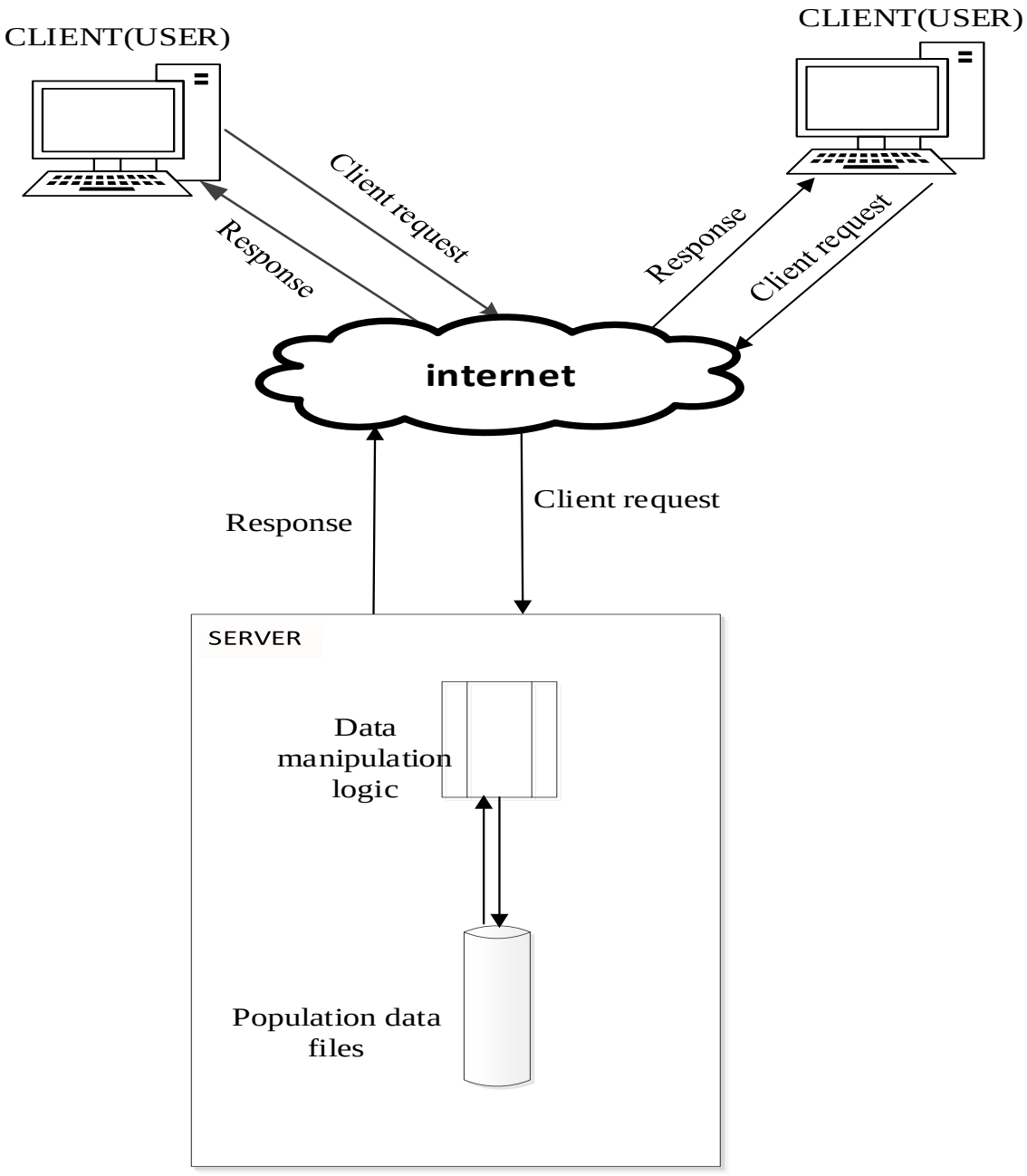

Figure 1.0. Client-server architecture for UgaDemos System

3.2 Decomposition Description

The UgaDemos System is designed using structured analysis approach which involves the use of top level data flow diagrams mainly the Context Level Diagram showing the System as a whole, and the level 0 Diagram showing the internal processing of the major subsystems.

3.2.1 Context diagram for the UgaDemos system

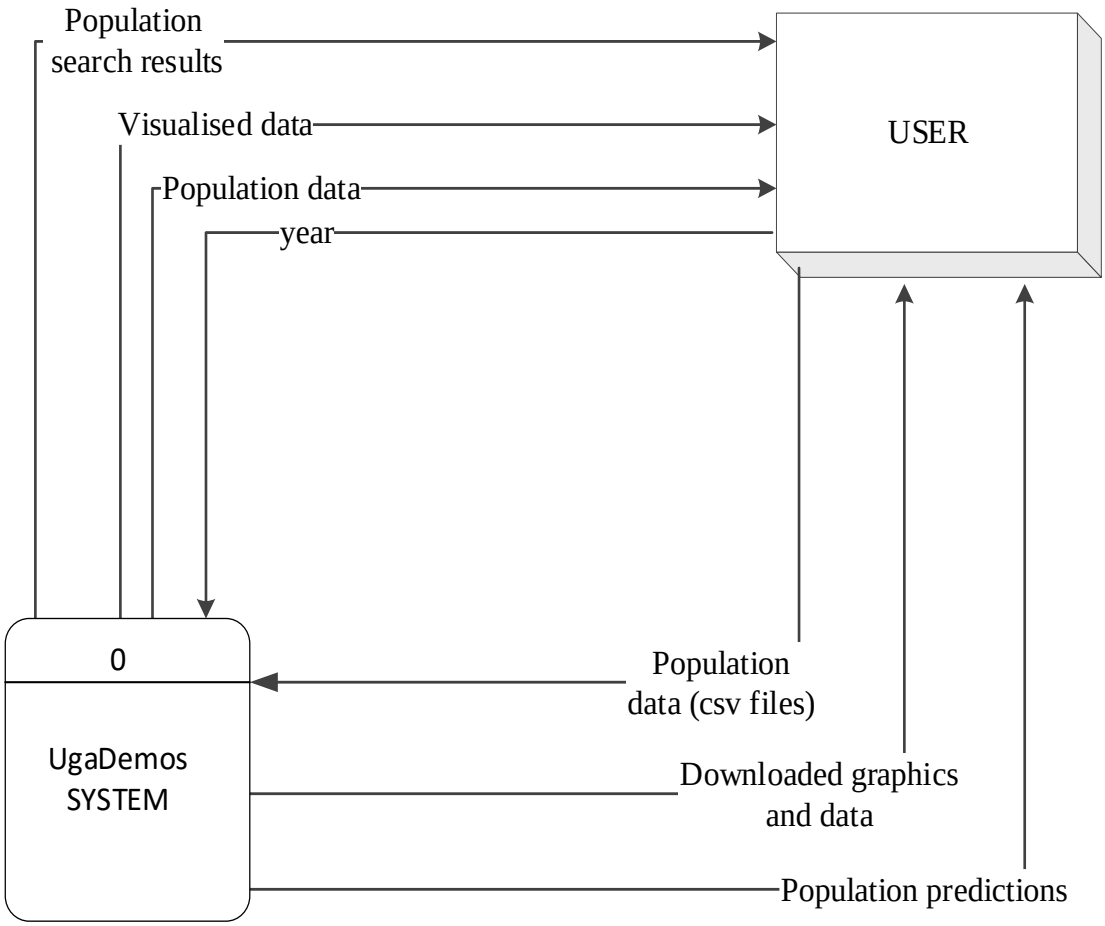

Figure 2.0. Context Diagram for UgaDemos System

The UgaDemos system is decomposed into ten subsystems i.e. import data, search, upload population data, clean/ organize population data, compute dynamics (change, density, and growth), display population data, store data, visualize data using graphics, download data, and predict future population trends. These subsystems work together to produce the complete set of functionalities of the UgaDemos system. The user as the major external entity in the UgaDemos system is able to visit the web site so as to use the system.

3.2.2. Level 0 DFD for UgaDemos system.

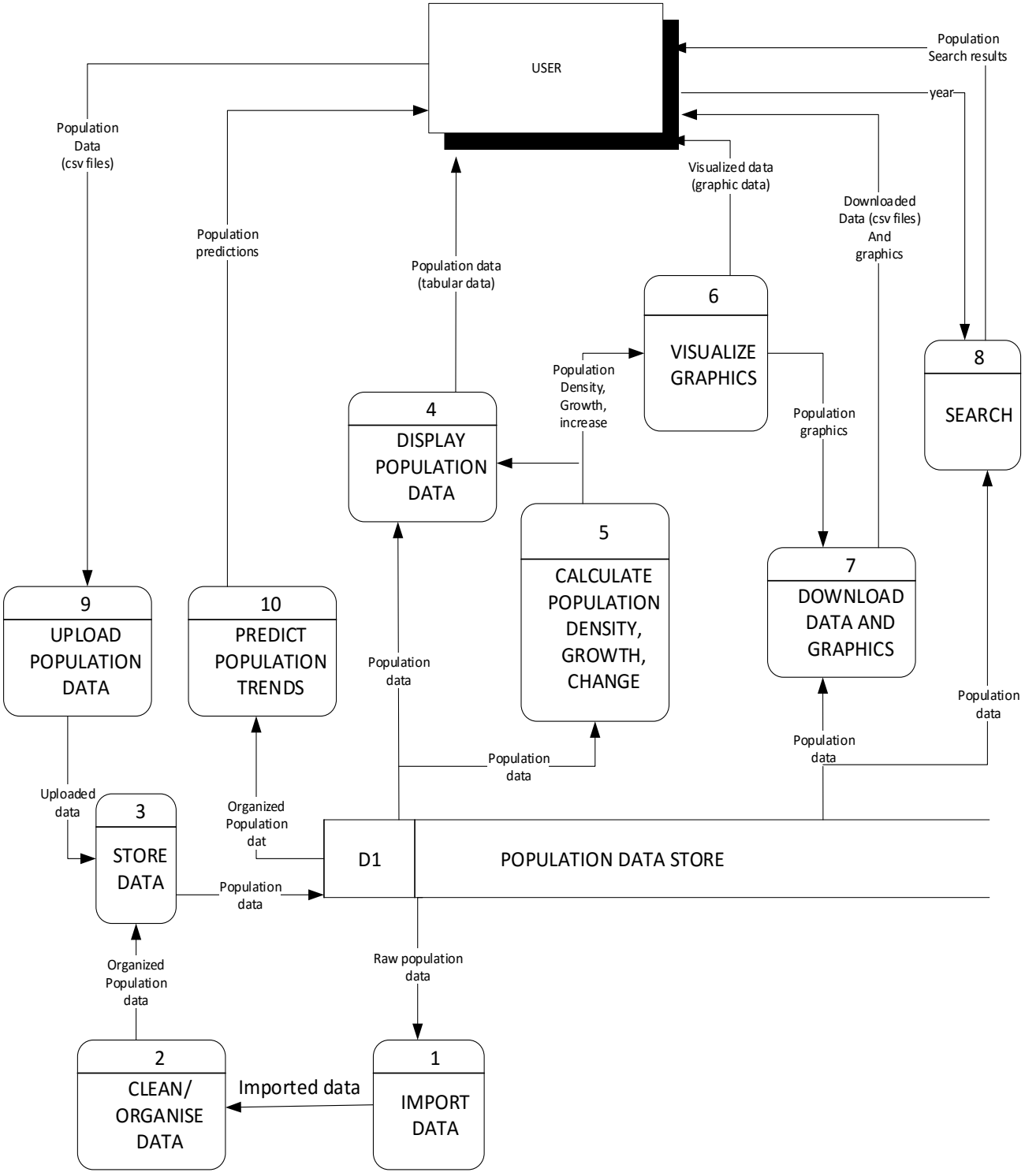

Figure 3.0. level 0 diagram for UgaDemos System

3.3 Design Rationale

The client server architecture is a central management of the server, whereby only one server is used to host the resources that all the clients request and use, and that's the major reason for selecting it. One centrally managed server is the key to ease of management, and it is cost effective.

Another reason for using the client server architecture is that the configuration is simple to set up and takes less time to troubleshoot. For instance, if there were a site with multiple servers providing redundant services, and it was having issues, it could take an extreme amount of work to effectively troubleshoot why services are being hindered. In a single server role, all troubleshooting takes place at one physical server, so it takes much less time.

4. DATA DESIGN

The data in the UgaDemos system is written and read from files in form of csv files

4.1 Data Description

Population data for UgaDemos system is imported as csv file, stored into data frames and then categorized. The categorized data is stored into small sized data frames. All processes interacting with the data access their data from the data frames.

The imported dataset (population.csv) is composed of twelve fields (columns) explained as below shows;

- ✓ Year; this is unsigned numeric integer ranging from 1996 to 2016 with an interval of one year.
- ✓ Births; this is also unsigned numeric integer consisting the total number of live children produced in each year.
- ✓ Deaths; this is unsigned numeric integer consisting of the total number of recorded people who died in each year.

- ✓ Net number of migrants; signed numeric integer consisting of the total number of difference between the immigrants and emigrants for each year.
- ✓ Births per 1000 population; also called birth rate, this is unsigned floating-point number expressed as a percentage.
- ✓ Deaths per 1000 population; this is a floating-point number expressed as percentage, it contains the death rate for each year.
- ✓ Net number of migrants per 1000 population; this is a signed floating-point number expressed in percentage, also called migration rate.
- ✓ Rate of natural increase; unsigned floating-point number consisting of the difference between birth rate and death rate divided by 10 for each year.
- ✓ Growth rate; unsigned floating-point number.
- ✓ Population; unsigned numeric integer consisting of the total number of people in each year.
- ✓ Population change; unsigned numeric integer.
- ✓ Natural increase; unsigned numeric integer consisting of the difference between births and deaths for each year, then these vectors will be stored into one data frame.

Each of the above fields is stored as an independent vector as a simplest unit of storage in UgaDemos system.

Uploaded data by the User is stored into data frame and is only available for only his browsing session, when users exit the session their data is not available and they have to reupload the data again.

Downloaded data is saved in csv format and the graphics are save as png files.

5. COMPONENT DESIGN

In this section, we take a closer look at what each component does in a more systematic way.

Below we give a brief description of the algorithms of processes of the UgaDemos system shown in the level 0 diagram for UgaDemos system, figure 3.0.

5.1 Algorithms

1: Import data

i. Save population csv files on the server having population data
ii. Read population data in step i.
iii. Temporarily store the data into a data frame

2: Clean/Organize data

i. Split the temporarily data frame from process 1 into its constituent single vectors less than columns of the data frame
ii. Categorize the vectors into related population characteristics
iii. Store each category into a small sized data frame while duplicating the year vector in each of those data frames in step ii

3: Store data

i. Add the data frame in process 2 to a single data frame

4: Display population data

i. Fetch data frame the categorized data frame
ii. Add the fetched data in step i to a table output
iii. Render the table of data in step ii to the interface in the page

5: Calculate population change, density, growth

a) Population density
   i. Fetch total population vector from categorized data frame
   ii. Divide population vector in I by the total area of Uganda to get population density vector
   iii. Store the calculated population density in ii as a vector
   iv. Add the vector in iii to a data frame, including total population and the year
   v. Display the data frame in step iv to the user

vi. Plot line graphs and bar graphs for the in step iv

b) Population growth

i. Fetch natural increase and net number of migrants' vectors from the categorized data frames

ii. Add the natural increase vector to net number of migrants' vector to get the population growth vector

iii. Add vector in ii, the year vector and total population vector to a data frame

iv. Display the data frame in step iii to the user

v. Plot the line and bar graphs for the data in step iii

c) Population change.

i. Fetch total population vector from categorized data frame

ii. Subtract total population of the year in front from the total population of the immediate previous year

iii. Store the population change results in step ii into a data frame including the year vector

iv. Display the data in data frame in step iii to the user

v. Plot line and bar graphs for the data in step iii

6: Visualize graphics

Fetch population data from categorized data frame

Make plots (bar plots, line plots, pie charts) for the fetched data in step i

Display the plots in step ii to the user

Take observation from the graphics (plots)

Provide conclusions for the observations n step iv

7: Download data and graphics

a) Data

i. Fetch data from the categorized data frame

ii. Write the fetched data in step I as a csv file

iii. Save the written csv file onto the user's computer

b) Graphics

i. Write the graphics produced by process 6 as png images

ii. Save the results of step I on the user's computer

8: Search

i. User enters a year
ii. Check if the year is between 1996 and 2017
iii. If step ii is true, search through he organized data frame and locate the searches for the results
iv. Return the row of the data matching the searched year to the user
v. Else if step ii is false, print an error message to the user notifying them that the search result is not found

9: Unload population data

i. User browses his/her computer and selects a file to upload
ii. Check if file is csv
iii. Check if the file is less than 10mbs
iv. When both ii and iii are correct, accept the file
v. Check if the file has less than or equal to 8 columns
vi. When v is true, temporarily same the data and draw a table for the uploaded data and display it to the user
vii. Capture the fields of the uploaded data in step vi
viii. Allow user to interact with the uploaded data using processes 5,6,7
ix. Alternatively, when v is false don't draw the table but temporarily save the data and capture the fields of that data
x. Do step viii
xi. When step ii and iii are false reject the uploaded file, and notify the user by sending an error message

10: Predict population trends

i. Fetch categorized data
ii. Fetch current population data
iii. Compute current population data with fetched categorized data
iv. Make regression of the data in I and ii
v. Make conclusions about how future data will be.

6. HUMAN INTERFACE DESIGN

6.1 Overview of User Interface

The human interface design of UgaDemos is implemented using a Graphical User interface, where its user navigates the system by clicking on certain buttons, menu bars in order to complete certain tasks with the system for example downloading content requires the user to click on the download button, users have to type in text in text input boxes to label their plots, to search for specific data and other action described below;

Navigation; the user clicks on the menu icons and menu tabs to navigate the UgaDemos system.

Downloading contents; user clicks on the download button next to the content that he or she would wish to download.

Uploading files; the user has to click on the upload file icon in order to select which file to upload onto the UgaDemos system.

Viewing content; in case content does not fit on the whole page, the user is required to scroll up or down in order to view all the content.

Plotting graphics; user clicks plot buttons in order to make plots from his or her uploaded data after selecting the fields to plot using the select inputs.

Labeling plots; user types in the text box in order to give labels to the plots he/she makes using the UgaDemos system.

Note:

On top of the description above, the users of UgaDemos system are assumed to be well vast with the general principles of a GUI.

6.2 Screen Images

Below are some of the screens which users of UgaDemos system will interface with.

6.2.1. Home interface.

This is the page displayed first as soon as the user visits UgaDemos system.

It is on the home page where the user is able to get general information about Uganda and About UgaDemos.

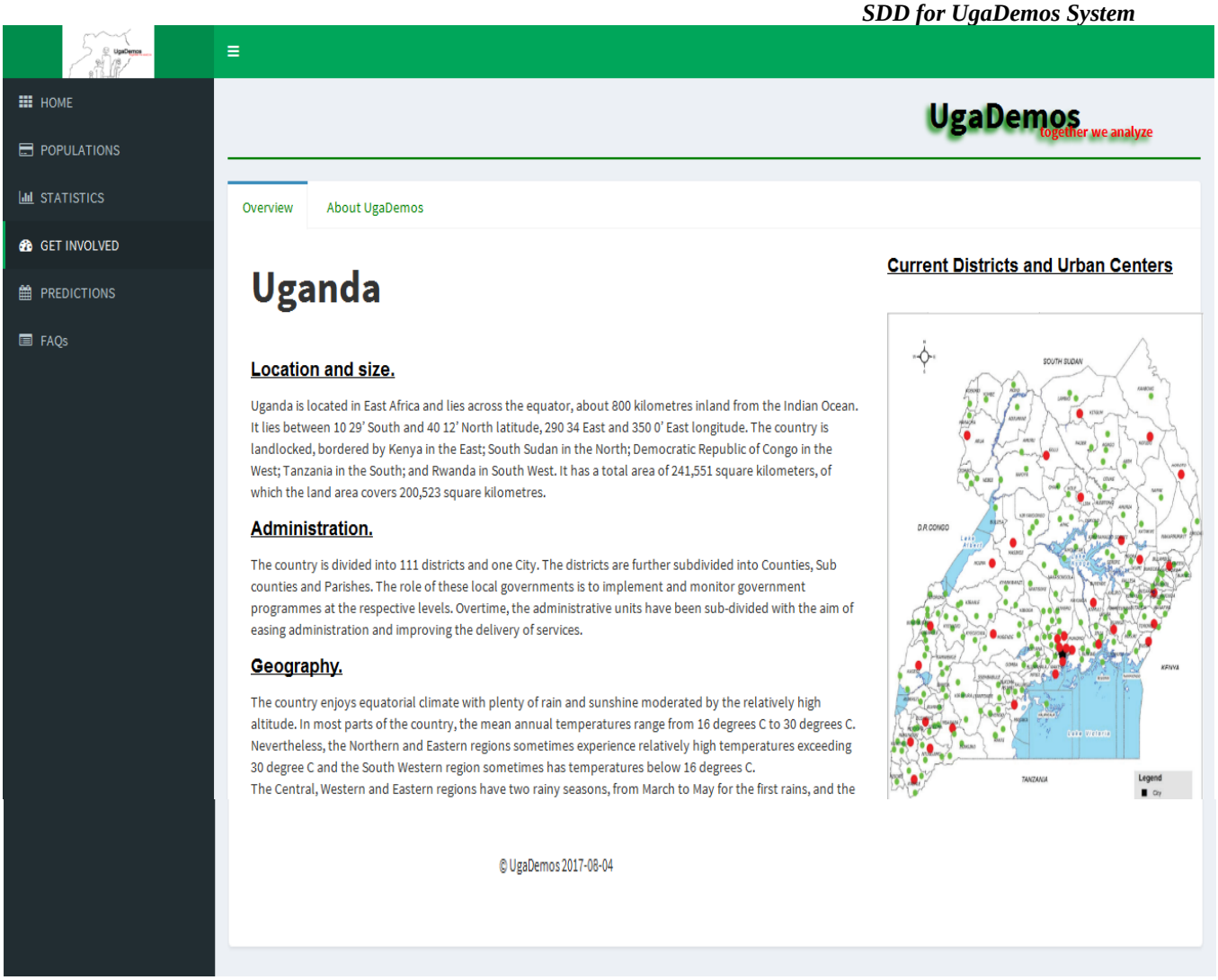

Figure 4.1. Home page for UgaDemos system

6.2.2 About UgaDemos interface.

On this page, the users is able to get information concerning the UgaDemos system.

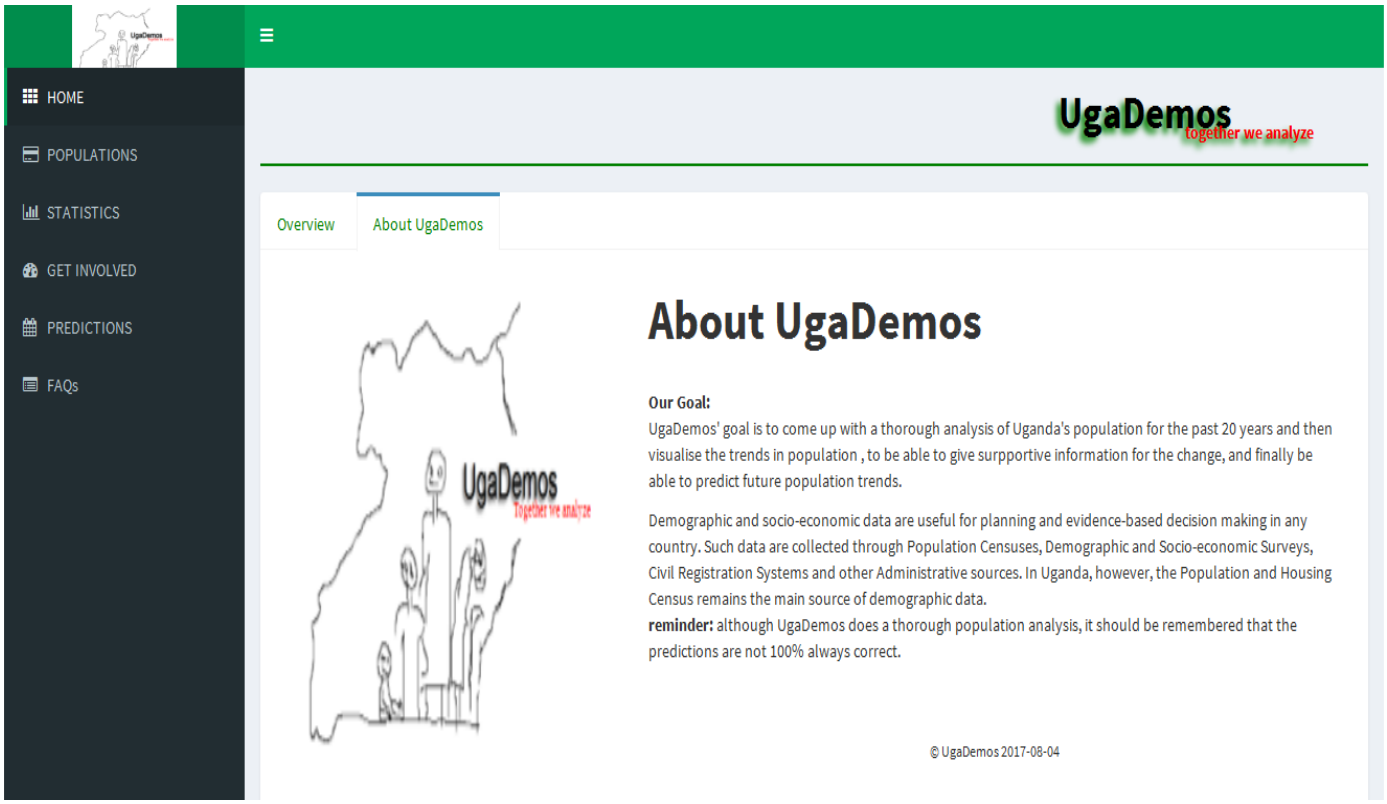

Figure 4.2. About UgaDemos page.

6.2.3 Populations interface.

On this page, the users is able to view Uganda's population data for the past 20 years and also be able to download it by clicking on the download buttons below each table.

Figure 5.0. Populations page for UgaDemos system

6.2.4 Statistics interface.

On this page, the user is able to visualize population data and population plots for the various population characteristics of Uganda, see observation from plots and conclusions from the plots as well.

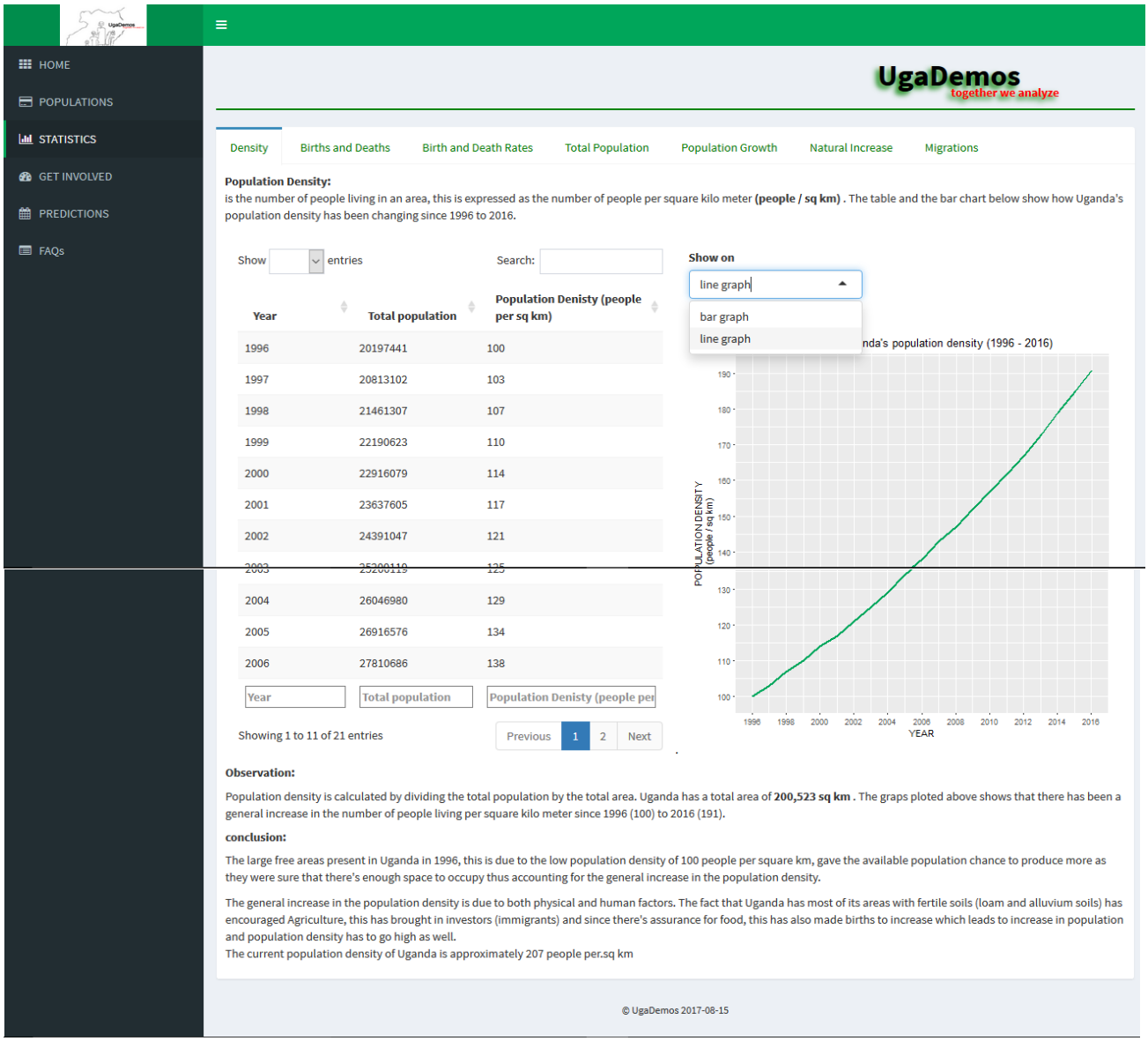

Figure 6.0. Statistics page for UgaDemos System

6.2.5. Predictions interface.

On this interface, the user will get an insight of how the UgaDemos system makes predictions about major population characteristics of Uganda's population for at least four years ahead of 2016.

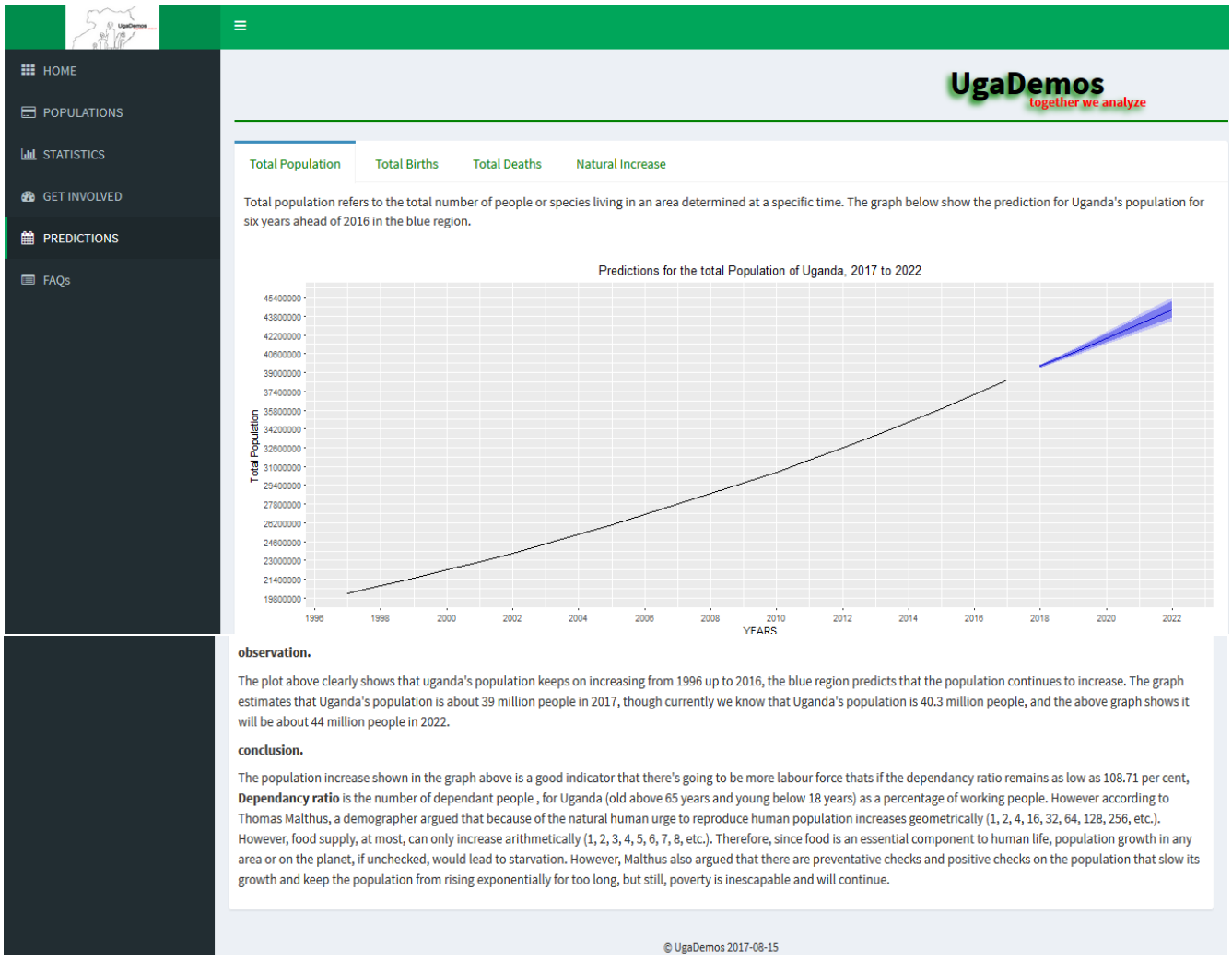

Figure 7.0. Predictions page for UgaDemos System

6.2.6. Get involved interface.

On this interface, the user is required to upload a csv file by clicking on the upload csv file button, the contents will be displayed in the Uploaded data display area.

The user can select from the uploaded data which fields he or she wishes to represent on the chart area, this is accomplished when the user clicks the select boxes on the left of the uploaded data display area.

The user gives labels to the plots made by typing the labels in the text inputs provided under the give labels to plots region on the left side of the displayed data.

The user can also download the plot made by clicking the download plot button below the chart area on the right, refer to the illustration below.

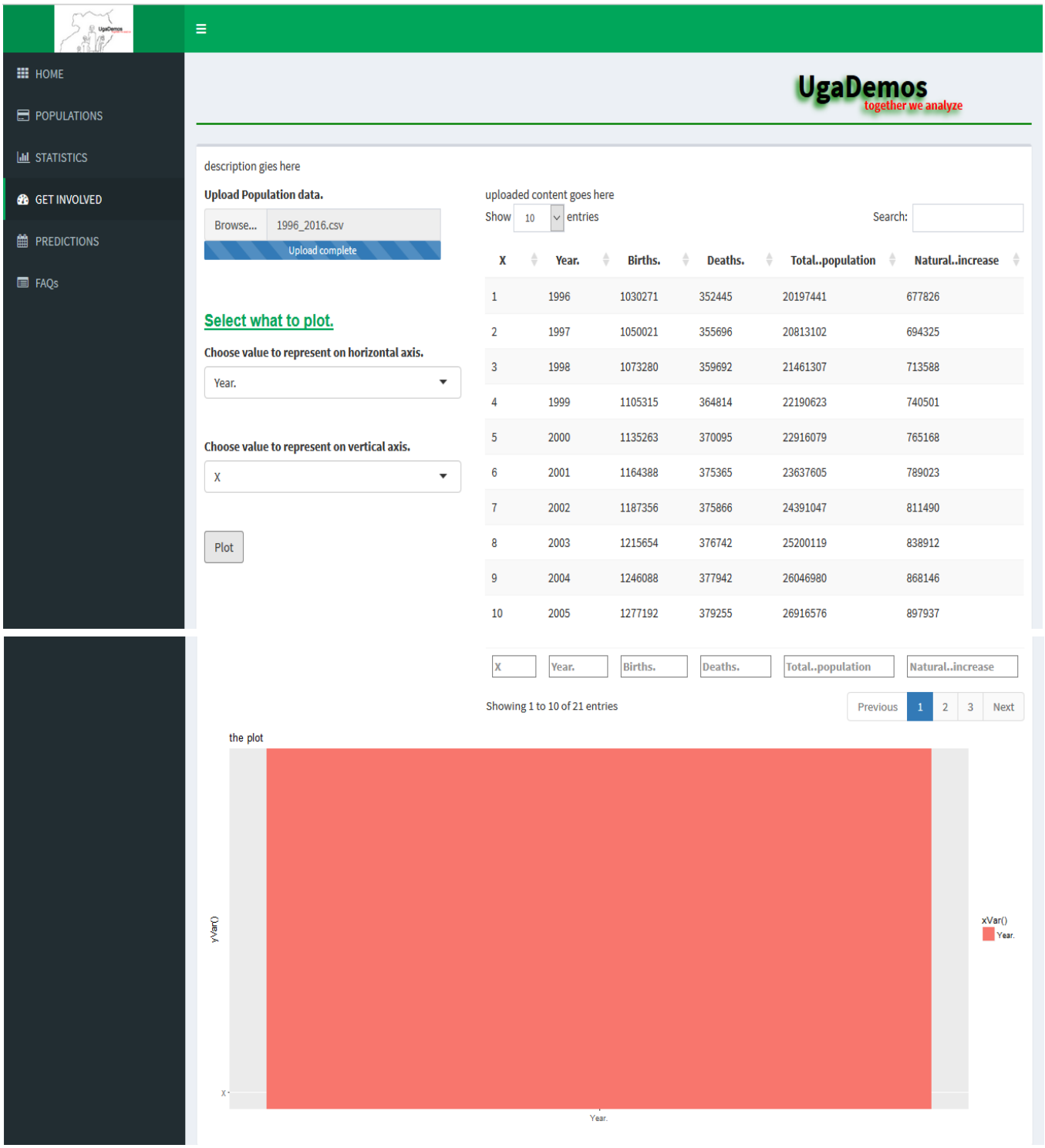

Figure 8.0. Get Involved page for UgaDemos System.

6.2.7. FAQs interface.

This interface is used by the user to ask questions concerning anything about what, how, and why UgaDemos is able to perform, the user types in the question from the text input region under the Type here your question section. Answers to users' questions are displayed under the Answer region, see the illustration below.

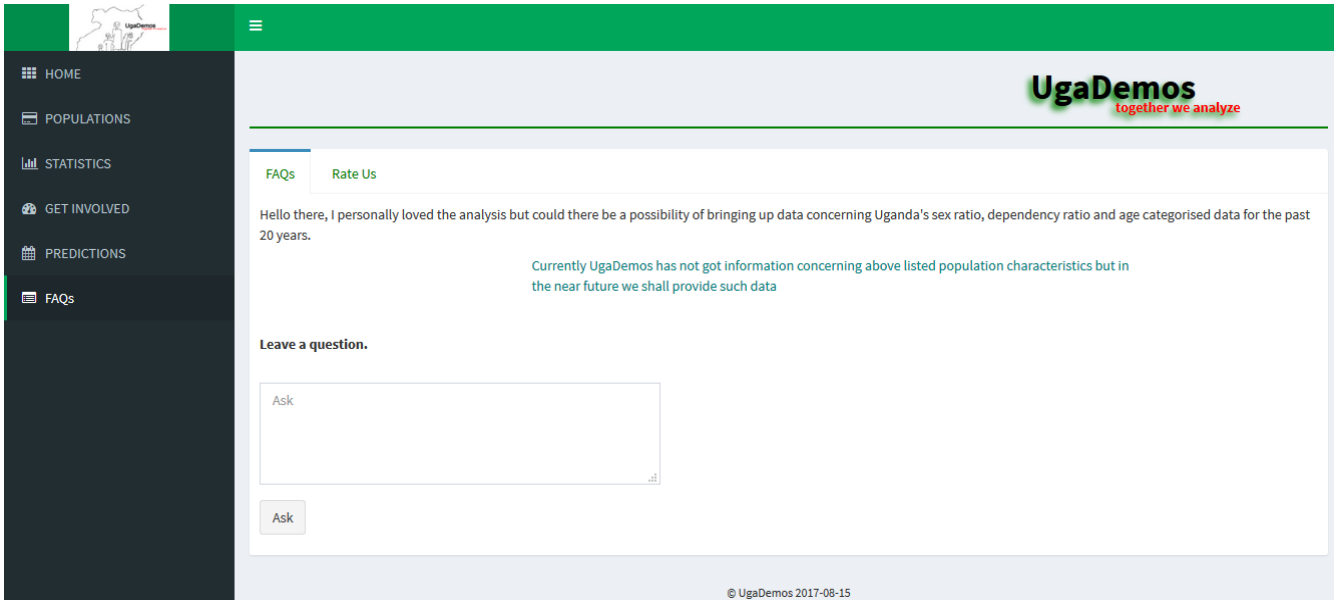

Figure 9.1. FAQs interface for UgaDemos system

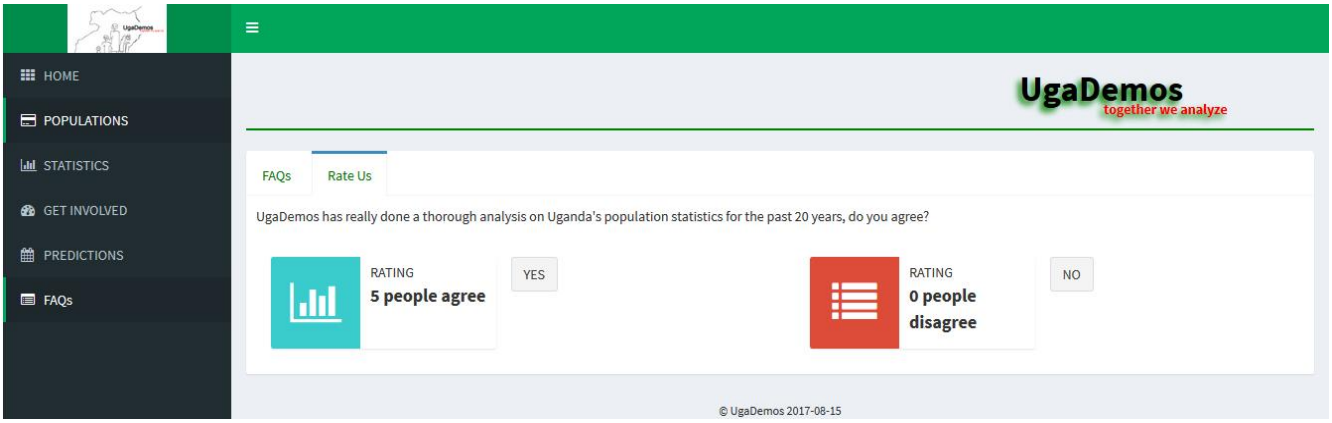

Figure 9.2. Rate Us interface for UgaDemos system

6.3 Screen Objects and Actions

UgaDemos Human interface being a GUI, is associated with the basic GUI objects including select inputs, buttons, text input boxes and menu bars.

Screen object	**Action**
Buttons	click
Menu bars	click
Text inputs	typing

6.4 Definitions and Acronyms

Demographic	Study and analysis of human population
CSV	Comma separated values
Data Flow Diagram (DFD)	Is a graphical representation of the flow of data through an information system, modeling its process aspects

7.0 CONCLUSION

In general, this document is intended to guide Group 11 team to design the UgaDemos system so that it can achieve its major objectives and functions.

8 REFERENCE MATERIAL

[1] [Gary_B._Shelly,_Harry_J._Rosenblatt]_Systems_Analysis And Design 9th Edition..