

***CITIZEN IDENTIFICATION SYSTEM: THE CASE FOR
ETHIOPIA***

By Tewodrose Negussie

Department of Computer Science,

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Advisor: Dr. Solomon Atnafu

“A Project submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Masters in Computer Science”

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Abstract

In the face of advancement in technology like smart card and biometrics, Citizen Identification System is getting the attention of many countries of the world. Most of the developed countries are in the process of implementing robust ID card system.

However, Ethiopia uses the manual ID cards issued at kebele level for citizen identification. On the other hand, many government and private organizations are automating their day-to-day operations. Among them lie organizations that keep citizen information for one or other purpose. Exchange and Integration of citizen information among these organizations is very important. However, there is no much effort done in this respect. It is therefore important to anticipate and prepare a mean for integration before more automation is done and the data repository in many organizations grew. In this project, we studied a system that keeps citizens' identification information and generates unique national ID number, which can assist in the integration of citizen information.

We assessed the experience of other countries in using citizen identification systems and the efforts in Ethiopia in that direction. We also analyzed the requirements for citizen identification system and proposed a working architecture for Ethiopian condition. The implementation issues like the privacy of individuals and the functionality creep of ID system is also assessed. Moreover, the security requirement of the proposed system is specified and a scheme for generating unique national ID number is proposed from based on the experience of other countries.

Finally, we developed EthioCIS prototype for the Citizen Identification System of Ethiopia using software development tools i.e Jbuilder 5.0, Oracle 9i DBMS, Dreamwaver 2004 Mx, and also OpenSSL for addressing the security issue.

Chapter One

1. Introduction

1.1. Background

The ability to uniquely identify citizens in any country is very important to facilitate various activities of the government such as Public Administration Services, Social Security Services, Medical Services, Tax Collection Services, Vital Registration Services, and much more. It can also enable government agencies to provide these services with better integrity and control. Currently, developing such capabilities is possible because of the information technology revolution that allows sharing of large amount of information among computer networks [1].

However, some Human Rights Activists reject the idea of having Identification systems mainly due to its potential for “functionality creep”, which means serving purposes other than its original intent. For instance, the Rwanda genocide of 1995 G.C. was facilitated by the use of Identification (ID) cards. In addition, they argue that such systems give more power to the government over its citizens and can also cause more identity frauds and other privacy issues [1]. Implementing such systems requires study on its impact in this regard and particularly the information to be kept in the database and the ID cards should be carefully approached.

In general, Persons Identification Systems can be broadly categorized in three forms, that is, Stand Alone ID Documents, Registration Systems, and Integrated Systems. The Stand Alone ID documents are issued in primitive conditions, or in environments that are subject to sudden economic or political change. Their principal purpose is to establish the fact that a person is authorized to live in a region [17]. The second type is the popular ID systems that have a supporting register, which contains parallel information to that of on the ID card. A regional or municipal authority often maintains this register.

This is the type of ID system that is currently being used in Ethiopia [10]. The third type, Integrated ID systems, has been designed to form the basis of general government administration. In such systems, the card number is, in effect, a national registration number used as a common identifier for many government agencies [17]. This ID system, for instance, is implemented in USA by the name Social Security Number. Depending on the purpose for which the ID system was built, some countries include not only their citizens but also foreign nationals who have become permanent residents.

Ethiopia as a country can greatly benefit from an integrated Citizen Identification System if it can implement it for the purpose of identifying its citizens at a country level.

1.2. Problem Statement

It is known that Ethiopia is one of the countries with little Information and Communication Technology (ICT) utilization. The government wills to encourage the use of ICT in the country and most of the government offices invest in Information Technology (IT) products, but most of them still work in a manner similar to manual methods or semi-automation and independently. Most of these offices offer various services to citizens and keep their own individual identification technique.

When an office has to use information from another office, it is difficult to get the information and validate the identity of the individual. The government offices that suffer from lack of a means to uniquely identify individuals at the national level are, for instance, Municipalities, Local administrations, Police, Courts, Schools, Hospitals, Immigration Office, etc. Most of these offices invest in one or more ways for using ICT but they get little from such investment. One reason for this is that they work not in an integrated way and also with little automation.

On the other hand, the country is making a lot of efforts to benefit from ICT. Among these efforts lies the Woreda-Net project intended to connect more than 500 Woredas (districts) in the country and the fiber cable expansion across the country. These efforts can be used as communication infrastructure to greatly improve the services of government offices. In order to enable the sharing and integration of individual records at various offices, a means of individual record identification across the offices is required. For achieving this, the country needs to use Citizen Identification System, which would be primarily accessible to government offices.

A Citizen Identification System is a mechanism used by governments to assist public agencies in identifying and verifying the identities of citizens who seek various services from these agencies. Usually, the citizen is assigned an identification number at birth or when he or she reaches legal age [1]. Currently, in Ethiopia manual ID system issued at Kebele level is used for the purpose of citizen identification. However, for the purpose of tax collection, the Federal Inland Revenue Authority (FIRA) has recently started to use an integrated database system that helps to identify Tax Payers by issuing Taxpayer Identification Number (TIN). This system is currently being used to uniquely identify only taxpayer organizations and businesses at national level. Moreover, the Authority is also working to expand the use of TIN to individual taxpayers but not the rest of the citizen [9].

Although some efforts are made to introduce e-governance in the country, no significant effort is made on the Citizen Identification System, which can greatly assist e-governance by enabling the sharing of individual citizen information to facilitate the service rendering process of government offices. Some efforts, like hiring consultants that will carry out a study on integrated ID system, are under way by Addis Ababa Municipality [10].

This Project is multidisciplinary in nature since various aspects of having such a system in a country has to be studied. For instance, assessing the impact of

the system on individual privacy and the legal issues in using the system has nothing to do with Computer Science. However, the major part of the project has to be studied in Computer Science since realizing such system is impossible without it. For instance, the system architecture, identifying the possible applications, means of integration, means of sharing, etc are issues that require study by a Computer Science professional. Thus, the Project will employ both Computer Science and non-Computer Science knowledge to meet its objective stated in section three.

Generally, in this Project we intend to identify the various applications that can benefit from Citizen Identification System, assess its consequences particularly on individual privacy. We also study how the system can be implemented with the current communication infrastructure and existing IT systems. Finally we design a feasible "Citizen Identification System" that can be used in Ethiopia, assess its security requirements and develop a prototype to show how various applications can make use of the system.

1.3. Objective

1.3.1. General Objective

The general objective of this project is to study the need for Citizen Identification System in Ethiopia, assess the issues that can arise in implementing such system and develop its prototype.

1.3.2. Specific Objectives

The specific objectives of the project are:

- Study the possibility of implementing the Citizen Identification System in the country.
- Assess the consequence of having such a system particularly on individual privacy.

- Propose architecture for the Citizen Identification System and assess its security requirements.
- Study how the system can be implemented based on the current ICT infrastructure of the country.
- Develop a prototype to show how the system can be used for various e-government applications.

1.4. Motivation

The motivation for this project is the lack of a unique national identification number for Ethiopians, which could be used in government databases primarily, and private institutions consequently. At present, integrating citizens' records in various government offices or private institution is a very difficult job for lack of a unique key, which can link the records in various data repositories. Each organization uses its own primary or other keys as it stores individual records for identification purpose in its own scope. The integration with the records of other organizations is really difficult. Normally, the search uses the full name of citizens that makes it difficult, as names by their very nature are not unique and also the spellings used in registering the name of an individual citizen might be deliberately or erroneously different in each organization.

The other motivation is that currently the country uses a manual ID card system. This makes it difficult to maintain integrated information about citizens' identification. Thus, ID fraud is most likely to happen depending on the honesty and professional ethics of many individual authorities at Kebele administration as well as the responsibility of citizens. The current system has little control on its own since the records in each kebele are not integrated but kept separately.

Therefore, to alleviate these problems and mainly to introduce a unique Identification number scheme for data integration, the country needs to have an integrated Citizen Identification System.

In this project, our motivation is to contribute to the effort of introducing Citizen Identification System to the country, as no much work has been done in the area.

Chapter Two

2. Literature Review

Governments issuing Citizen Identification card can use it for different purposes such as efficient public transactions and border control. The concept of a citizen identification system was first instituted in countries with populations coming from diverse ethnic groups. Earlier, Group Classification was one reason for using ID systems. Other purposes for which Citizen Identification systems are used include control of illegal migration, control of tax evasion and welfare fraud, citizen Identification purposes, e-governance, fighting terrorism, etc [1].

However, in history, oppressive regimes used the group classification information on the ID card to discriminate against certain ethnicities or group of society and committed atrocity. For instance, ID systems are said to have been used extensively during the Nazi regime and recently in Rwanda to carry out various crimes against humanity [1]. Thus, information to be stored in ID systems has to be carefully identified.

According to Hammond [2], the increasing use of the Social Security Number (SSN) for identification purposes in USA is seen as a support in the argument that a universal, unique identifier is beneficial. An individual citizen having only one number that he/she would use for any identification purpose would result in considerable savings for federal agencies, vendors, health care agencies, and any other organization that creates a database [2].

The suggestion that a single number could be used to access patient data in any hospital database or to join the data from any database regardless of its purpose or owner seems frightening. Yet, in this age of connectivity and computerization, it is a trivial problem to link any number of systems, particularly if 100 percent accuracy is not sought [2]. Therefore, Hammond [2]

recommends that the Citizen Identification should be used in any legal operations subject to the individual's approval.

In the following sections, we summarize the experience of other countries and particularly African countries in the use of national Identification system. Finally, the efforts that are exerted in Ethiopia in this regard are also reviewed.

2.1. Citizen Identification System in Other Countries

As literatures indicate, most countries in the world use ID cards but most of the ID cards serve for identification purposes and don't use nationally unique numbers. Some of the countries without compulsory ID cards system are Finland, Canada, Denmark, Japan, Sweden, etc [4]. In these countries ID cards are substituted with other documents like driving license, passport, etc.

However, a growing number of countries including the United Kingdom and the United States of America are currently preparing legislations and bills to introduce robust National Identification System with a central database that can be connected to other databases of the government. The system will contain personal identification information, past and current residential addresses, unique Identification number, and biometrics data like fingerprints, Iris scans, and digital facial scan. The database of the British national Identification system is to be called National Identity Register (NIR) [3]. Terrorism and identity fraud are said to be the main reasons for initiating such a system.

In Britain, the Identity Cards Act (effective from 30 March 2006) makes ID card compulsory for anyone that requires a new or renewed passport starting from 2008. Currently, in Britain, driving licenses and passports are the most widely used ID documents [4].

The United States of America also passed a bill entitled the Real ID Act on 11 may, 2005. The bill was passed as a growing number of governments are

showing more interest in employing technology in ID cards to make them smarter and more secure. The Real ID Act bill authorized the Department of Homeland Security to design some aspects of state ID cards including biometric information such as retinal scan, fingerprints, DNA data and RFID tracking technology [4].

Currently in USA, the social security number (SSN) is serving as unique citizen identification number in most governmental and private institutions databases including Internal Revenue Service, Veteran Administrations, Hospitals, Banks, Insurances, etc. [5] SSN is a nine digit number resembling "123-00-1234" which is issued to an individual by the Social Security Administration of the government of the United States [8]. Formerly, some people did not have SSN until they reach 15 or 16 years of age, as it was used for tax purposes and those people under 15 hardly had income generating employment. At present, many parents apply for social security numbers for their children as soon as the children are born. However, SSN was never intended to be a National ID number, although it is usually used for identification [8].

Greece has a wide ID system with personal ID cards. ID cards are issued only by Local Police Offices on behalf of the Ministry of Public Order and they include information on both sides such as holder's sign, photo, personal details (Name, Surname, Father's name, Father's surname, Mother's name, Mother's surname, Date and Place of Birth, Height, Place of suffrage (voting station) including the Family Number and Place and Police Office of the issue. They also have 2 more optional fields, which are Blood Type and Blood Rhesus [4].

Since 2005, the procedure to get an ID card was simplified and it is compulsory for all citizens over 12 years old to have an ID card. Before 2005, the age of compulsory issuance was at 14 and the whole procedure could last over a year. In Greece, an ID card is the most important document of a

citizen. It is used in all public and private transactions. For instance, It is required to create a bank account, to make a contract, to have state insurance, to register in a school or university, to be fined by a policeman, etc. Also, it is required to be shown at every police officer's request. A refuse could be a reason to be jailed for some hours or to be arrested. Moreover, students who enroll in National or Private Examinations must have an ID card to verify they are the right person to be examined [4].

In Hong Kong, there are two classes of Identity Cards. They are known as the Hong Kong Permanent Identity Card (HKPID) and the Hong Kong Identity Card (HKID). The HKPID states "the holder has the right of abode in the Hong Kong Special Administrative Region" while the HKID does not state that right. In addition, these are further divided into "children" identity card for people below age 11, "youth" identity cards for people from the age 11 up until 18, and "adult" identity cards issued from age 18 onwards. "Children" identity cards are not compulsory to obtain, and are normally issued when children obtain a Hong Kong Special Administration Region (HKSAR) passport. "Children" identity card holders are required to change to "youth" identity card when they reach age 11. Thus, there were six types of ID cards in total [6].

However, with the introduction of the smart ID, beginning August 2003, all of Hong Kong began to replace their cards in order of birth year, starting with 1960 and before. The process is expected to be completed in 2007 [6].

The new cards contain an embedded microchip, which stores the bearer's information electronically. The introduction of Smart Identity Cards was, amongst other things, motivated partially by the influence of counterfeit HKID documents being produced in China, and partially in order to speed up processing at Hong Kong's Immigration Checkpoints into Shenzhen, China. At this point around 10,000 residents cross daily for work or school [6].

In Malaysia, they have a compulsory ID card system known as MyKad. All Malaysian citizens and permanent residents that are 12 years old or above are currently eligible for a MyKad. From 2001, it gradually replaced an older Malaysian Identity Card system that had been in use since 1949 under British colonial rule, with the intention of becoming ubiquitous by 2007 [7].

All newborn babies are issued with a MyKid. This is "upgraded" to a MyKad on the 12th birthday. The MyKad must be replaced when a person reaches 18 years old, as it is a requirement that the photograph be 'current'. The MyKad must be carried by all persons when leaving their home. The MyKad is a piece of plastic with an embedded microchip and has the dimensions of a standard credit card. The card contains 64 KB EEPROM. A register of all cardholders is kept by the National Registration Department of Malaysia, which operates the MyKad system [7].

MyKad was originally intended to have four functions. These are identity card (including fingerprints), driving license, passport (serves in Malaysia and several neighboring countries, although a conventional passport is still required internationally. This should reduce congestion at Malaysian borders as holders will pass through unmanned gates using biometric-fingerprint identification), and storage for health information. However, four further applications were added before or during its initial release. These include e-cash, ATM integration, road transport, digital signing [7].

2.1.1. Generating Systematic Citizen ID numbers

At present, several countries are implementing a citizen Identification system. However, the type of card, its purpose and the information it contains vary from country to country [1]. The unique citizen identification number scheme used is also different. The experience of other countries in generating national ID number systematically is reviewed below.

In Belgium every citizen has a unique National Number, which is created by using the citizen's date of birth (encoded in six digits), followed by a serial number (three digits) and a checksum (two digits). The serial number is used so that men get the odd numbers, while women get the even numbers; thus, there can be only 500 men or women on each day [8]. In Israel, an Identity Card, known as a Teudat Zehut, bearing an Identity Number, is issued to all residents over 16 years old who have legal permanent residence status, including non-citizens [4].

In the People's Republic of China, an ID card is mandatory for all citizens who are over 16 years old. The ID number has 18 digits and is in the format RRRRRYYYYMMDDSSSC, which is the sole and exclusive identification code for the holder. RRRRRR is a standard code for the political division where the holder is born (country or a district of a city), YYYYMMDD is the birth date of the holder, and SSS is a sequential code for distinguishing people with identical birthdates and birthplaces. The sequential code is odd for males and even for females. The final character, C, is a checksum value over the first 17 digits [8]. The ID card is used for residential registration, army enrollment registration, registration of marriage/divorce, going abroad, taking part in various national exams, and other social or civil matters [8].

In Malaysia, a 12-digit number having format of YYMMDD-SS-###G is used since 1991. It is known as the Identification Card number (IC). The first group of numbers (YYMMDD) is the date of birth. The second group of numbers (SS) represents the place of birth of the holder - the states (01-13), the federal territories (14-16) or the country of origin (60-85). The last group of numbers (###G) is a serial number in an unidentified pattern which is randomly generated. The last digit (G) is an odd number for a male, while an even number is given for a female [8].

In the Republic of South Africa, the ID number is a 13-digit number of which the first 6 digits are the date of birth in the form YYMMDD. The next digit is a

gender indicator (0-4 denoting female, 5-9 denoting male) followed by a 3 digit sequence code. The last 3 digits start with 0 if the person is a citizen of SA, otherwise with 1. The second last number is usually either 8 or 9 and the last digit is a control digit. During the apartheid era, these last three digits also denoted race [8].

2.1.2. Traditional ID numbers

There are countries that don't have a nation wide ID system but use some way of identifying individual citizen using passport, driving license or in some cases even ID cards issued by state authorities (local regional administrators). In such cases the Identifier number used is not nationally unique since the local administrators produce it for use in their database or register.

The identifying number is not planned for use in other database systems but for use as reference locally and it is not possible to guarantee the uniqueness of the number nation wide. Such systems do not follow systematic identifier number generating methods but use alphanumeric characters like those used in letter references.

In most countries organizations give ID cards to their employees. That ID card normally keeps ID number among other information like personal and employment data. However, the uniqueness of the ID number is maintained only in the company's database or register. This, therefore, cannot be used outside of the company as identifier number.

Therefore, without having a carefully planed national ID system and systematically generated nationally unique identifier number, it is not possible to integrate the different individual citizen data stored in different databases.

2.2. Citizen Identification System in Africa

Most African countries do not have National Identification System. However, some countries like the Republic of South Africa have adopted the national ID system.

In the Republic of South Africa, every citizen can be issued an Identity Document from the age of 16 years. This passport-size document contains only 8 pages - the first page containing the national identification number (also in barcode format), name of bearer, district or country of birth, as well as a photograph of the bearer. The other pages are used for recording of voting participation, a page for driver's license information (although it is no longer used since the introduction of credit card type licenses), as well as pages for fire arms licenses.

The Identity Document is not used for travel purposes (a separate passport is issued), and mainly serves as proof of identification. Some authorities may accept the driver's license as proof of identity, but the Identity Document is the only universally accepted form of identification in the country [8]. However, the country is also in the process of deploying a new computerized ID system [11]. The system is known as HANIS and it is being deployed within government and commercial sectors, providing both online and offline authentication and verification of an individual's identification. During the initial rollout, manual transactions are being diverted to HANIS to populate the database. With the new system applications can be processed within 48 hours and prevents duplicate registrations, which had previously been a problem. The implementation team declares that when fully operational, HANIS will become one of the largest civilian fingerprint databases in the world [11].

Ghana has prepared a bill in 2002 G.C to establish a National Identification Authority which will basically collect personal data on citizens of Ghana and

non-Ghanaians permanently resident in the country; ensure the accuracy, integrity and security of the data; issue national identity cards to citizens and non citizens permanently resident in the country; and make data in its custody available to persons or institutions authorized by law to access the data [12]. In 2003, the government issued a bid for the development of a National Identification system for Ghanaian Citizens and foreign Residents. No information could be found on the current status of the project. However, from the bid document [13] we learn that the system is to be used with other government database like population database and it will produce electronic ID card.

According to Global Platform web site [14], in an effort to curb illegal immigration, the Moroccan National Security Service will implement a National ID program beginning in early 2007. The Moroccan cards will include both personal and biometric data and meet established security requirements for travel documents and control of border migration flows. The implementing company will deliver to the Moroccan government solutions that will include equipment and software for ID document production, and will connect with the Automated Fingerprint Identification System (AFIS) which acquires cardholders' digital fingerprints and compares them with a fingerprint database.

Most countries in Africa keep ethnic and religious information on traditional ID cards which makes it more sensitive and exposed for functionality creep [15]. For example in Egypt, they keep religious information on ID cards and discrimination is done citizen based on their religion. Therefore, proper attention should be given to what type of information is to be incorporated.

2.3. Efforts towards Citizen Identification System in Ethiopia

Although some efforts are made to introduce e-governance in the country, no significant effort is made on the Citizen Identification System, which can greatly assist e-governance by availing a means to integrate citizens' information from different organization to facilitate the service rendering process of the government offices.

We could not find any research or project made in this area for the Ethiopian context. However, we learnt that the Ethiopian Information Communication Technology Development Agency (EICTDA) has a project in its plan to study the need for Citizen Identification system in Ethiopia. Moreover, Addis Ababa Municipality's Acts and Documents Registration Office is also doing some efforts to hire consultants that will carry out a study on introducing integrated ID system [10].

From the automations done in government offices, the tax collection system of the Federal Inland Revenue Authority (FIRA) is remarkable in this regard. The system uses taxpayer identification numbers (TINs), which uniquely identify taxpayer organizations and businesses nation wide. The system is a distributed system that is remarkable and is being shared by the Customs Authority and some banks to identify Organizations and businesses registered as taxpayers [9].

Chapter Three

3. Requirement Analysis of Citizen Identification System for Ethiopia

In this chapter, we first present our proposal for Citizen Identification System for Ethiopia. Then, we discuss the overview of the general requirement for the proposed system. The detail requirements, which are organized into functional requirements and non-functional requirements, are presented in the last two sections of this chapter.

3.1. Proposal for Citizen Identification System for Ethiopia

It is known that e-government applications improve government to citizen service delivery. However, integration of individual citizen records or data in various e-government applications remains to be a challenge without some means to identify individual citizens uniquely among the different e-government applications. Thus, Integrated Citizen Identification System is a central component for many e-government applications.

Currently, many government and private organizations are moving towards using ICT to carry out their day-to-day activities. Most of them, in one way or another, deal with citizen related information. Thus, the integration of citizens' information among them is a very important issue. For example, a certain doctor may need a patient's medical history from other hospitals or health care centers. To get the information from the other institution, a reliable unique identification method is required. We cannot rely on the patient's name or on his/her other attributes since they are not nationally unique. Integrating citizens' information among different organization is a common problem for other sectors as well.

Therefore, initiating the use of an integrated Citizen Identification System in Ethiopia is a timely measure. For this, we propose the system to be based on

the architecture of web application. In this project, we have presented the architecture for the citizen identification system in Ethiopia and have developed its prototype. The architecture is a three-tiered architecture consisting of the client browser (connection to the system from any authorized location), the web server (business logic of the system), and the database (citizen identification information repository). It is a working architecture for Ethiopian condition since it requires less development cost and runs on the existing Internet communication infrastructure. The technical detail of the architecture is presented in Chapter four.

3.2. Overview on the General Requirement of the Proposed System

The Citizen Identification System is a system that has a purpose to assist in providing the service of identifying Ethiopian citizens at the national level having their own unique Citizen Identification number. This number can be used by different government organizations for the purpose of integrating Individual Citizen Records in these organizations.

The system should allow the registration of individual citizens at their nearest location across the nation as they request Identity Cards. Only authorized personnel in the authorized government body can perform registration into the system. The system should be available at various locations across the country, at least one database for each regional state to achieve better performance and it should also work in co-ordination among these databases.

The system is required to assign each citizen a systematic unique number that will not be used by any other citizen. The system needs to have a facility for authorized personnel to review the individual citizen's personal information in order to check and approve the issuance of the Identity Card. The Identity Card should contain the unique Citizen Identification number in addition to other information of the citizen. The system has to provide the facility for

printing the citizen information on the Identity Card that will be issued to the citizen. Moreover, the system should provide an alternative method for verifying issued identity cards online from the repository by any government offices that want to verify if the ID card bearer is the legal owner of that identity.

The system has to allow and require the renewal of the Identity Card every few years for the purpose of updating the individual's current address and minimizing ID misuse. This can be achieved by marking Citizens with un-renewed ID cards as illegal until their ID card is renewed. IDs that are not renewed can be identified by expiry date indicated on the card or by their online status from the repository, which can be seen during online verification. Next, we present the functional and non-functional requirements of the system.

3.3. Functional requirements of Citizen Identification System

To identify the functional requirements of the Citizen Identification System, we considered to elicit the three aspects of the system, that is, the input to the system, the output from the system and the different functions that the system performs. The following functional requirements are drawn from the general requirements of the proposed system described in the previous section.

3.3.1. Input to Citizen Identification System

The citizen identification system accepts personal information about individual citizens as input data. The information includes the citizen's full name, citizen's mother name, gender, birth date, birthplace, photo, current residence address, profession, place of work, and citizenship information. In addition, citizen's contact person name in case of emergency and the address of the contact person are input to the system. Then later, it generates the unique

citizen identification number, which will be used to identify the individual's information. This number is also stored in the database.

The system also accepts administration information like authorized user information, approving user information, and system administrator information.

3.3.2. Output of Citizen Identification System

The output of the citizen identification system can be information about individual citizen identity and any combination of the information stored in the database such as statistical summary. One such output is a report containing the individual bio data to be printed on Identity Card. The other is verification report to be seen online by authorized government offices.

3.3.3. Functions of Citizen Identification System

The citizen identification system has different functions as shown below.

1. Registration of Citizen Identification

The system requires an interface to register individual citizen information into the system. The information to be entered into the system is basically the personal information of individual citizens who requested to have identity card. The information includes the citizen's full name, citizen's mother name, gender, birth date, birthplace, photo, current residence address, profession, work place, citizenship information, citizen's contact person name (in case of emergency), and the address of the contact person. The registration into the system is to be performed by authorized personnel of the system's administering organization.

2. Generating Citizen Identification Number

Once an individual citizen's Identification information is entered into the system, the system will generate the unique Citizen Identification Number for

that particular citizen. This number will be used to uniquely identify the individual citizen in the system. This number is unique for all citizens and can be used by any government organization for the purpose of uniquely identifying individual citizen records in their database. This is very important, as it will be used as a means for integrating individual citizen information across different government organizations. The issue of individual privacy is discussed in the first section of chapter 5.

Different countries use different methods for uniquely generating Citizen Identification Number as discussed in chapter two-literature review. However, the proposed scheme in this project can be seen in the second section of chapter four.

3. Approving Individual Citizen Identification

Before the individual citizen Identification card is issued and used, it has to be approved by authorized personnel of the Identification registration and issuance center of the authorized government body. These personnel are responsible for the issuance they have approved and they will sign the ID card before being issued to the citizen.

4. Issuing Citizen Identification Card

Once the individual citizen is registered into the system, has fulfilled the formality and obtained approval he/she can get the Identification card, which is to be printed from the Citizen Identification System. As the Identification Card is issued, additional information, the name of authorized issuer, date of issue, and expiry date, will be printed on the ID card. The authorized person will also sign on it. However, the system will log or keep the registration personnel and the authorized issuer or the one that approved the issuance for future reference.

5. Online verification of the Citizen's Identification information

The Citizen Identification System has to make sure that every citizen identification number generated and assigned to citizens is unique across the nation. Moreover, it has to provide a secured web interface for other government bodies that need to verify if the citizen's Identification information is correct when the citizen presents his/her Identification card.

6. Renewing Citizen Identification card

Each individual Citizen should renew his/her Identification card every three to five years, which can be basically decided by the citizen identification system administering government body. The renewal is required to keep track of the current address of each citizen and most importantly to further restrict the use of lost Identification cards beyond the service duration.

During renewal of the Identification Card, the citizen's personal information that can change and has changed should be updated on the system. Such information is the citizen's current residence, work address, profession, contact person name and the address of the contact person. Moreover, the authorized issuing personnel can also change. The changes made have to be approved by authorized personnel (as shown above) before the Identification Card is renewed and issued to the citizen. Finally as it is issued, the issuing process has to be followed.

7. Changing the status of ID that is not renewed

If the Identification Card is not renewed after its expiry date, then the citizen will not be legal to use it until renewed. Moreover, the status of his/her Identification card should be displayed as expired when interested government bodies try to verify it online. The system should also remove the "expired" mark after the individual ID is renewed.

8. System administration utility

The system should also have a module for registering authorized users, approving officials and administrators. In this module, users are added to and removed from the system as necessary.

3.4. Non- Functional requirements of Citizen Identification System

The non-functional requirement of a system describes the quality constraints of the system like Response time, Throughput, Resource usage, Reliability, Availability and others.

For Citizen Identification System, the following quality requirements are remarkable.

- It is desirable to have acceptable response time.
- Availability during government offices' working hours at the locations that the system will be used across the nation.
- It has to be a multi user system i.e. a lot of ID issuance centers across the nation plus the various government offices that possibly try to verify the citizen Identification online from time to time can use it.
- The system has to be secured and reliable enough to minimize the different Identification Fraud that may be attempted.

Chapter Four

4. System Design of Citizen Identification System

In this chapter, we discuss the design of the Citizen Identification System. Particularly, we discuss the design goal of the Citizen Identification System, the proposed software architecture for the system, the database design and the user interface design.

4.1. Design Goals of the System

The design goal of a given system is derived from its quality or non-functional requirements. The same way, we can drive the design goals for the Citizen Identification System from its non-functional requirements described in chapter three. Thus, the following are the design goals for the system, which require the system to be designed in such a way that

- It will be available at least during working hours throughout Ethiopia.
- It will have a response time up to 5 seconds initially.
- It will support a number of users at a time.
- It will be secured and reliable enough to be protected from unauthorized use or ID fraud.

4.2. System Architecture Design

In order to meet its design goals and be widely available throughout the country, the system is designed based on the architecture of web applications. It is known that Web applications can be made to be available throughout Ethiopia. Moreover, Web applications can also be available during working hours and can even be 24 hours per day available if there is no problem on the communication infrastructure. They also support a number of users at a time depending on the capacity of the hardware, web server, and speed of the communication link. The other design goal is security. Currently, web applications can have secure exchange of Information with proper

attention on security. The detail of the security requirement of the Citizen Identification System is discussed in section two of chapter five.

Therefore, as we have discussed in the previous chapter, the software design of the Citizen Identification System of Ethiopia is based on web architecture. The design is three-tiered architecture. That is the front-end, middle and back-end tiers. The front-end tier is the client side running on web browsers. The middle tier contains the web server and/or application server. The back-end tier is the database server, which has the feature of distributed database. Figure 1 below shows the web architecture we use for the Citizen Identification System.

The three components are described in detail as follows.

1. Front-end tier / Web browser /

As with any other web application, this tier is normally implemented by web browsers, which are available on every computer. The necessary web protocols like http and https are already available on most computers. From this tier, authorized users can access the system using the web protocols. However, since Citizen Identification System is sensitive, we give enough attention to the security issues that can arise in the proposed architecture i.e. web based applications. One important issue is that the Citizen Identification System is available only to authorized users and to the level that they are authorized.

This can be achieved by using secure communication and authentication. For this, we propose the use of Certificates and Secure Socket Layer connection that encrypts information exchange between the front-end tier (web browsers) and the middle tier (web server). The detail of the security requirement issues can be seen in section two of the fifth chapter.

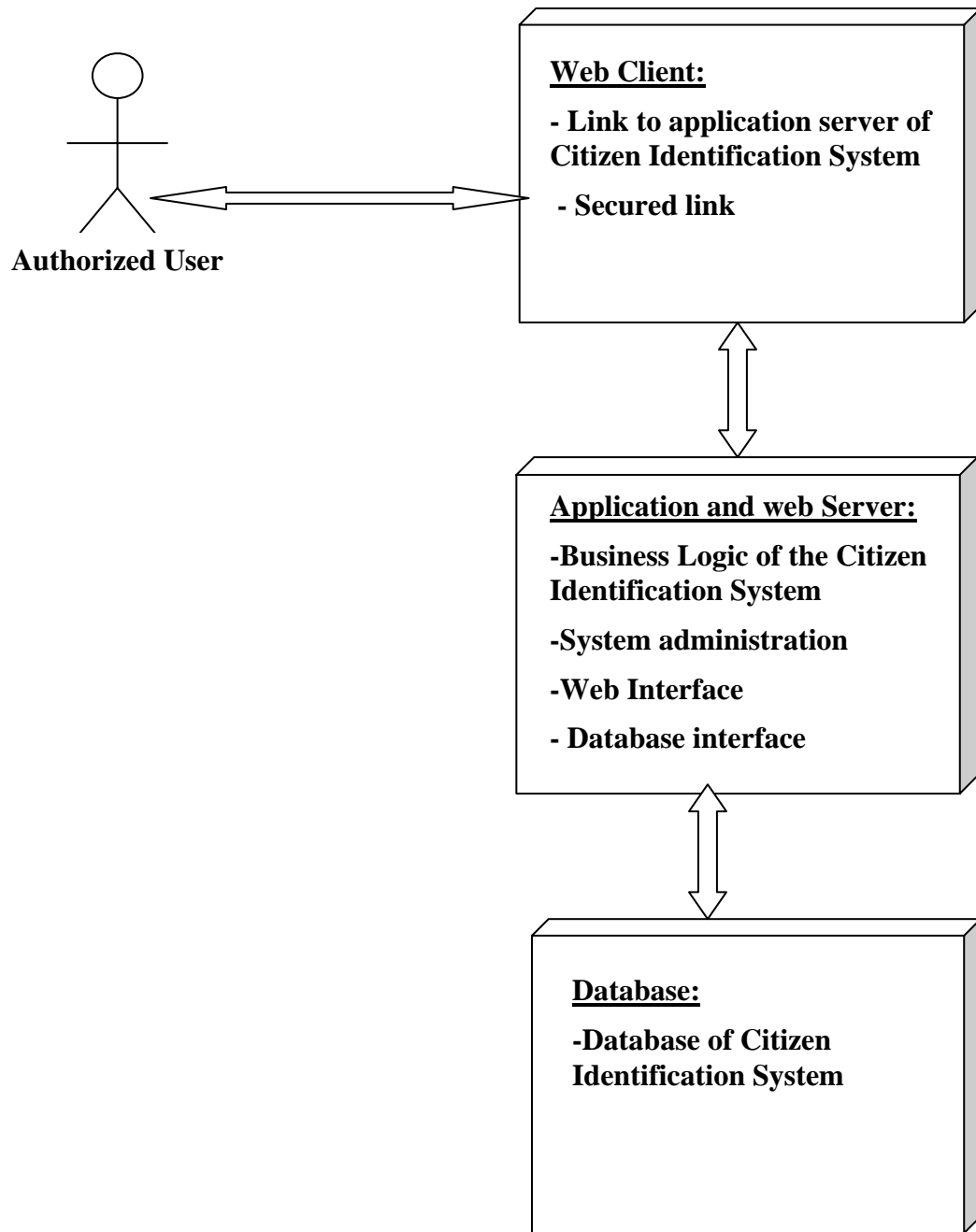


Figure 1: Architecture of Citizen Identification System

2. Middle tier / Web Server or Web Application Server /

It is in this tier that the business logic of the Citizen Identification System is placed. Basically, we address the functional requirements of the system in this part. We have a number of modules for handling the different requirements of the Citizen Identification System. The following are the modules to be included.

a. Citizen Registration

We have a module for registering Citizen Identification information. This module is responsible for assuring that no citizen is registered in the system more than once. To achieve this, keeping biometrics data like fingerprint, iris scan, etc is very important. However, since it is not in our scope to deal with biometrics, we based our unique key for the citizen identification information on the combination of a set of attributes. The attributes are full name, birthplace code, birth date, and mother's name.

b. Generate nationally unique ID number

After a citizen is registered in the system, his/her identification information will be associated with a nationally unique Citizen's ID number, which the System generates automatically.

The number is to be generated systematically by the combination of a code for the citizen's birthplace, birth date, and a sequential number. The ID number is 14 digits long. The first two digits represent the code for birthplace, the next eight digits represent birth date and the last four digits are assigned sequentially for citizens born in the same place (as identified by the code) and on the same date as per their registration order in the system. Then these codes and numbers are concatenated to give the unique citizen identification number. This combination is used to balance the two views on Identification number format. The two views on ID number format are telling the person

from his/her ID number should not be simple (to protect from ID stealing) and the number should be systematically generated from the person's attributes.

c. Approving the Issuance of the ID card

In order to minimize the risk of ID fraud, a registering user should not approve the issuance of the ID card. Thus, the system has a module that enables an approving authority to approve the issuance of ID cards for registered citizens. In this module, all the records of the registered citizens in the same birthplace code appear to the approving user and he can approve one by one after checking it as per the procedure given to him.

d. Issuing or printing the ID card

This module controls the issuance of printed ID cards to registered citizens. ID cards are to be printed once unless the ID card is renewed or lost in which case the printing will be allowed after proper authorization.

e. Validate Citizen ID number

This module enables any authorized government offices to query the Citizen Identification System for validating any Citizen ID number online.

f. Renew Identification

ID cards will expire in three to five years depending on the rule by the administering authority. Thus, with this module, expired ID cards will be renewed.

g. System Administration

With this module, system administrators, registering users, and approving users' information and authentication information will be handled. The password of the users is stored in the database after hashing it so that it will not be visible to any user even the database administrator. Therefore, only the user knows his /her password and if he/she lost it, it will be reset.

3. Back-end tier / Database Server /

The back-end tier is the database server where the citizen Identification Information, birthplace information, system users' information will be stored. The database is a distributed database where a number of databases at different location collaborate to store and provide citizen Identification information. The database server synchronizes the information stored among the different replicas. At this layer, the expiring of the issued ID card to citizens is also carried out. The expiry date can be three to five years depending on the policy of the administrating body. The detail of the database design and database distribution is presented in section 4.3 below.

4.3. Database design

The database of the citizen identification system is designed based on the relational database model. We have four tables that store information about citizens, birthplace codes, UniqueID generating fields and administering Users. The tables are named tblCitizen, tblRegion, tblUniqueID, and tblUser.

In tblCitizen table, we keep information on the Identification of citizens. The tblRegion table keeps information about the different codes used for identifying birthplaces. We keep the birthplace codes and related information separately because if any information about the birthplace codes changes we can modify it in this table only. This enhances the maintainability of the system. In the tblUniqueID table, we keep information that we use in generating nationally unique ID number for each citizen. In the fourth table, tblUser, we keep information about authorized users of the system that administers it. These include registering users, approving users, and system administrators.

The database we chose supports replication and during actual implementation, for performance reason, we might need one database for two or more birthplace as system or database grows. Then, the databases

replicate the data among each other. The detail design of the database tables and relationship is shown in figure 2.

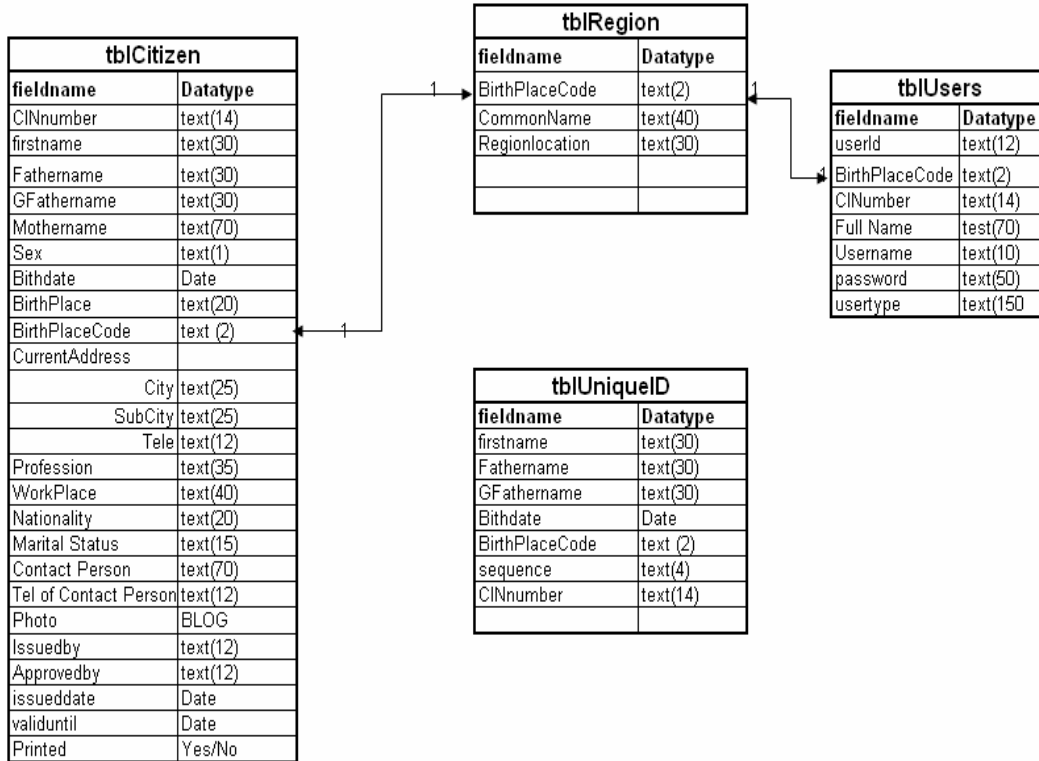


Figure 2: Database design for Citizen Identification System

4.4. User Interface Design

The user interface provides different home page for different users of the Citizen Identification System. Most of the user interface is designed for citizen registering Users, approving users and system administrators.

Registering users have interfaces to the citizen identification system for registering citizens, renewing citizen's ID card, changing their account information by which they authenticate themselves to the system. They also have interface by which they print ID cards to be issued to the citizen after the concerned authority approves the issuance.

Approving users have also interfaces to the system by which they approve the issuance of ID cards to registered users.

Another user interface is also designed for government offices so that they can validate the citizen's ID number as the citizen presents his/her ID card for identifying himself/herself to that government office. This is very important because it gives the government offices the ability to validate citizen Identification information directly from the Citizens Identification System online.

Generally, the system has a home page that shows up in a web browser that can establish secure link to the citizen identification system. It is not all web browsers that can access the system for security reasons. From the home page the ID number validating interface is accessible. The rest of the interfaces require logging into the system using authorized user account and password. Normally, it is registering users, approving users, and system administrators that can log into the system. For government offices that require validating it is enough if they can access the home page in a secured link.

The language used in the user interface is English. However, in the future multilingual design can be incorporated so that different users can interact with the system in the language they prefer.

Chapter Five

5. Issues in the Implementation of Citizen Identification System

In this chapter, we discuss the issues that should be considered when the Citizen Identification System is implemented. We raise four issues in this regard that we believe are important. They are individual citizen privacy issues, the security of the system, the data communication infrastructure of the country, and the need for government administrating authority of the system.

5.1. Individual Citizen Privacy Issues

Currently there are two groups of people that stand for or against the need for integrated citizen identification system in many countries particularly in the developed nations like the United Kingdom and U.S.A. Most people including government officials are in favor of it for its obvious advantage. However, other people like human rights advocates oppose the idea claiming that it violates privacy and it may suffer from functionality creep, which means that it may be used for purposes other than its original intent. For instance, some government officials who have access to the system may use the individual citizen identification information for intimidation. In England, there is a group of people organized, like No2ID, to file petition against the new national Identification system [3].

The claim from the human rights groups is aggravated by the existence of case history in the use of ID cards in some countries for human rights violation and even to the level of genocide like the case in Rwanda [1]. Rwandan genocide is said to have been assisted by ID cards as the gangs of Hutu used it to identify the Tutsi individuals to kill. At that time, the Rwanda government kept ethnic information on the ID card.

Even to date, most African countries keep either ethnic or religious information on ID cards, which is very sensitive and can be used during conflicts among citizens. For instance, in Egypt non-Muslim citizens are harassed for their religion by Muslim citizens or Muslim government officials, and ID card is used in identifying non-Muslims [15, 16]. Even most of the developed countries that don't have nation-wide ID cards avoided it because some time in their history, it was misused by their previous government officials like for example in France [4].

Although we don't have information in the misuse of ID cards in Ethiopia, currently, ethnic and religious information are registered on the manual ID cards, which could be dangerous considering the experience of other countries. Therefore, if Ethiopia adopts integrated citizen Identification System, these issues have to be seriously addressed. Some government officials or other groups may use such information to intimidate people for their religion or ethnic Identification. On the other hand, there is also the right of individual citizens to be identified by their ethnic or religious Identification. However, it is equally important not to be intimidated if some people or even some government officials turn to atrocity.

Therefore, our recommendation is that group classification information like religion and ethnicity should be excluded from citizens' ID card especially if the integrated Citizen Identification System is to be adopted. This information can be kept in other databases like the population database of Central Statistics Authority for statistics purposes. However, we believe further study by social scientist should be done before decision is made so as to balance the right to be identified by ethnic and religious Identification and its potential for functionality creep. Furthermore, this project mainly deals with the technical aspect of the Citizen Identification System.

5.2. Security requirements of the system

Any information transmitted mainly over public networks or the Internet is subject to interception. Most of such networks use the unsecured TCP/IP protocol suite; transmitting sensitive information over these networks requires the use of cryptographic techniques for secure delivery of the information, i.e., without affecting the confidentiality and integrity of the information communicated.

The Citizen Identification System for Ethiopia is designed based on the architecture of web applications and uses the public network for communication throughout the country. Thus, it is required that it has the security feature of web application plus its own inherent security requirements. The security requirements of the system are identified as follows.

- Although it is a web-based application, it is not to be accessed by the general public at least in the initial phase since it is mostly intended for use by government offices. Therefore, we need to implement security techniques so that it will be available only to authorized users of government offices and the system's administering government authority.
- The system offers issued citizen ID card verification support to interested government offices. Therefore, there is a need for making the system available to such offices without letting them deal with other features of the system.
- The users of the system in the administering government office have to be audited for the actions they do in the system. For instance, which citizen Identification information is registered and approved by which registering user and approving user. Therefore, it is necessary to make sure that no other person can access the system anonymously or with other users account information (username and password).
- The system should also protect against ID frauds to the extent possible.

5.3. Communication Infrastructure requirement

It is known that the country has nation-wide data communication infrastructure using the public switching telephone network (PSTN) and also currently the fiber cable network is being implemented in the country. This service offered by Ethiopian Telecommunication Corporation (ETC) can support the Citizen Identification System's need for nation-wide communication.

ETC provides broadband connection of different bandwidth. The broadband service uses DSL technologies that is launched in late 2004 G.C. ETC can provide ADSL services for its customers with a downstream rate of 8Mbps and upstream rate of 1 Mbps. However, according to ETC experts, so far its network is tested for a maximum 4Mbps downstream and upstream SDSL service, which is subscribed by AAU. Its service area spans to most of the major cities of the country like Dessie, BahirDar, Jimma, etc [18].

The corporation gives mainly the ADSL service for data and Internet, but it doesn't incorporate the telephone service. The price of the service depends on the downstream data rate, with the type of service the customers need and with the quality of service. For example, they may use copper wire with different gauge, or they may use wireless in place of copper wire. Currently, ETC has more than 700 customers most of which are users of 64 kbps downstream rate [18].

In the future as the database of the citizen identification system grows, there will be a need to have large bandwidth for replication. Moreover, the coverage should be expanded to more area in the country, as the citizen identification service should be available nearer to all citizens.

5.4. Administration requirement for the system

The Citizen Identification System cannot be thought of without appropriate administrating body. Since the system gives service for the entire nation, the administrating authority should also operate at the federal level having its own regional offices. The administering body should not be necessarily founded as new but rather existing federal government offices with close working relationship to the subject can be assigned to carry out the task.

There is also a need for legislation and enforcing policies like the citizens should have the ID card from the system in order to get certain services like higher education, employment, trade license, passport, etc. Moreover, legislation concerning ID fraud should also be in place.

Currently the minimum age for an Ethiopian to get ID card from the local administration, Kebele, is 16 years [10]. This can be kept for the new system as well because most children do not get the chance to be registered in most service giving government offices before that age. However, for hospitals and school purposes other numbers like birth date registration numbers can be used.

The birth date certificate is very important information for the citizen identification system and the automation of the system should get due attention in realizing the citizen identification system. People should be encouraged to have their children registered in due time possibly as they are born.

Awareness campaign is also necessary on the importance of both the birth registration and citizen identification system. Therefore, the administration and legislation issues also require the attention of concerned authorities in order to successfully implement the Citizen Identification System in Ethiopia.

Chapter Six

6. The Prototype EthioCIS

In this chapter, the prototype for the Citizen Identification System of Ethiopia is discussed. The prototype is named EthioCIS (Ethiopian Citizen Identification System). It is developed based on the proposed design of the Citizen Identification System as in chapter four. In the first section, we discuss the different software tools used for the prototype development; then in subsequent sections, we describe how the three components of the design are addressed in the prototype. That is, the user interface on the client browser, the business logic of the system on the application/web server and the database that runs on the database server. Moreover, we discuss how the security requirements of the system, specified in chapter five, are addressed in the prototype.

6.1. Software development tools used

As there are different components in the design of the Citizen Identification System, we used different software development tools for each of the components.

The first component is the user interfaces that are basically web pages. We used HTML code generating tool called Macromedia Dreamwaver MX 2004. Macromedia Corporation owns the tool and it is a friendly tool by which we can develop dynamic web page interfaces having forms, text boxes and others that help in entering data into the database. Moreover, they also help to create user interface links to navigate from one interface to another.

For the business logics of the system, we used a Java 2 Enterprise Edition (J2EE) Integrated Development Environment (IDE) tool called Jbuilder 2005. The tool was very useful in developing java servlets, classes, and methods developed for each class. Jbuilder 2005 is a java application development

tool from Borland Corporation and is being used in large-scale enterprise application developments. Once the application is developed, we used JBoss as application server to host the business logic of the system. JBoss uses apache tomcat web server integrated with it. As we develop the application, we can configure Jbuilder 2005 where in the JBoss application server to deploy the developed business logic of the system that interacts with both the database and the web user interface.

The third component is the database of the EthioCIS. For this component, we used Oracle 9i enterprise edition database management system.

For the security in the communication between the web client browser and the web server, we use encryption based on Secure Socket Layer. For using SSL, we need certificates, which have to be signed by Certificate Authority (CA) like Verisign. However, the certificates are to be sold and are not freely accessible. Thus, we used open source tool called OpenSSL to create our own CA and issued certificates for both the server and the client and signed the certificate by the CA we created. For password security, we use MD5 hashing algorithm to store the password in the database so that no one except the owner of the password knows it.

6.2. User Interface

The prototype has web user interfaces for different type of users and purposes. A block diagram for the user interface used in EthioCIS is presented in Figure 3 below. The interface will be accessible by appropriate users to carry out their duties. In EthioCIS, we have three basic types of users without considering system administrators. They are

- Government offices' users – for ID validation.
- The EthioCIS administering body
 - Registration clerk (registering user), and
 - ID issuance approving authority (approving user).

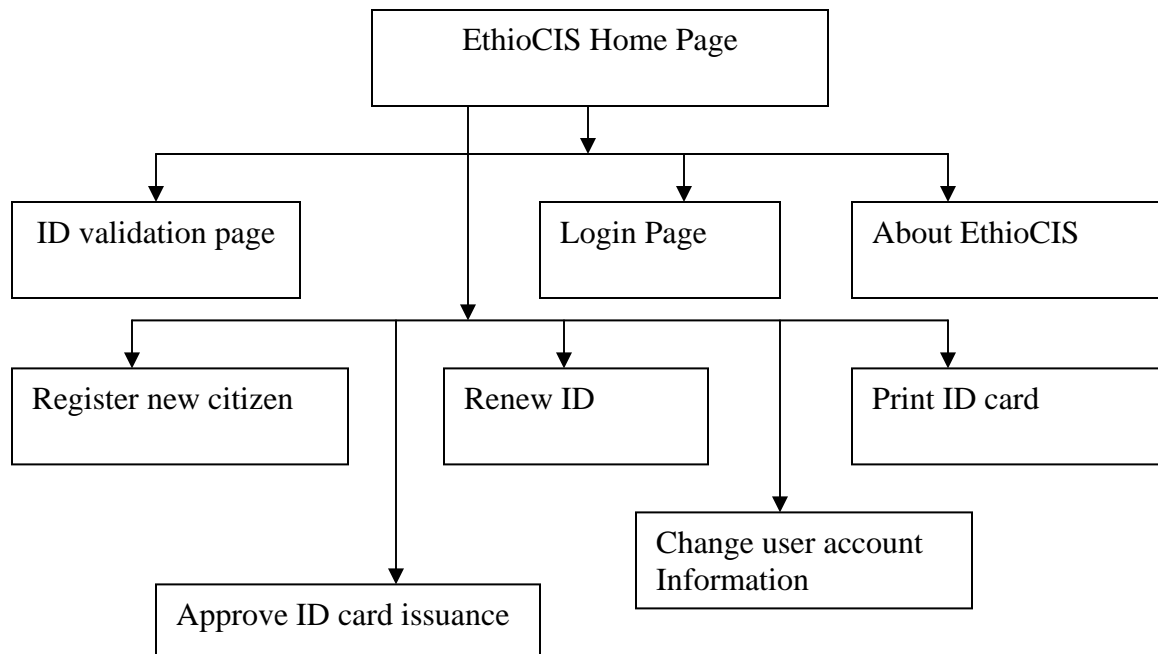


Figure 3: Block diagram for user interface design of EthioCIS

However, all the three types of users have to fulfill the security requirement before they can access EthioCIS. This is because both the web server and the client browser have to present their certificate and authenticate each other before they can communicate or exchange information. The details of the security issues addressed by the prototype are discussed in section 6.4. The only interface available for the government office users is the home page of EthioCIS and the links on the home page. They are

- **Check Citizen's ID:** this link opens another web user interface by which the user enters the Citizen's Identification Number and queries for validation.
- **About EthioCIS:** this is to see the description of EthioCIS.
- **Login:** this is intended for other users that are authorized and are given username and password to carry out the duty of registering citizens,

updating and renewing citizen Identification information, approving the issuance of the ID card.

Therefore, the screen shots of figure 4 and 5 below are the only web user interfaces that are available to government office users to validate citizen's ID since they will not have username and password.

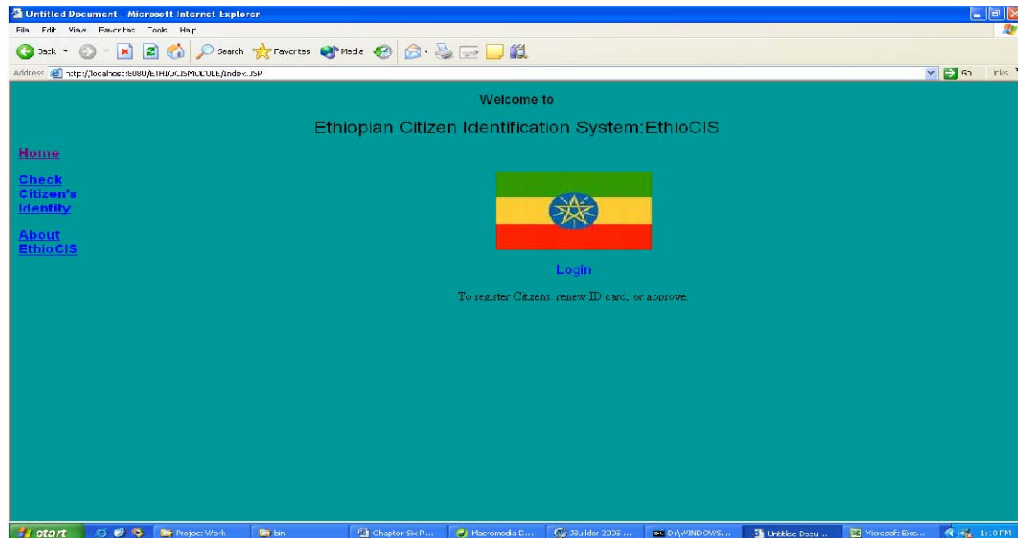


Figure 4: Home page of EthioCIS

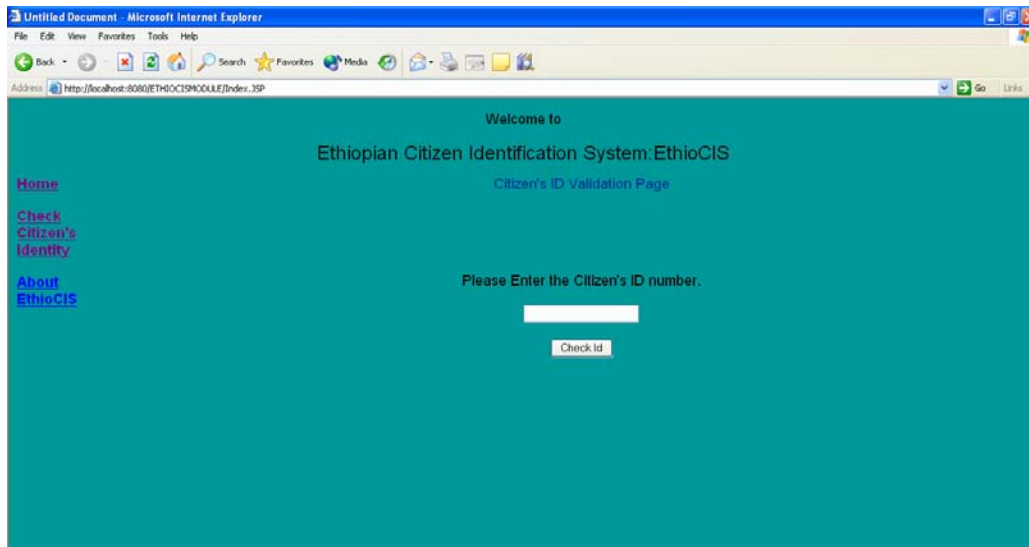


Figure 5: web user interface for validating Citizen's ID

The web user interfaces available to registration users are shown in the screen shots below. The registration users of EthioCIS's administering authority have more web user interfaces. They also access the above web user interfaces.

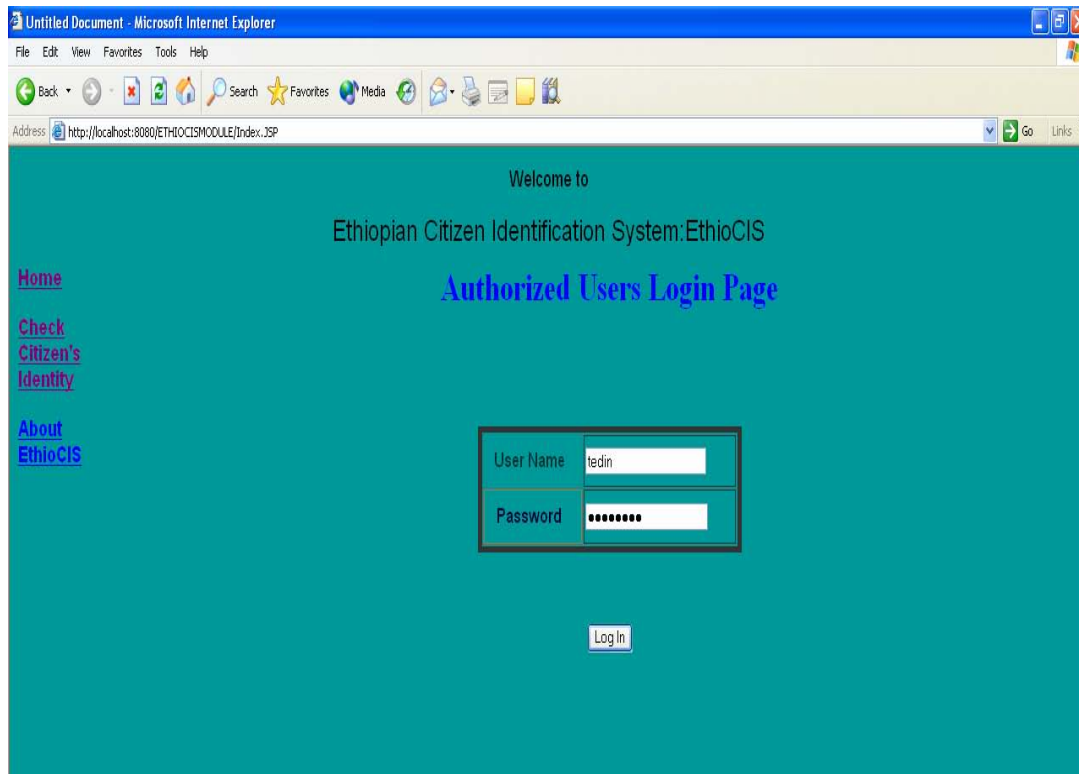


Figure 6: web user interface for Login by authorized users

The user interface prompts for username and/or password and the user has to log in by filling text in the respective text boxes. If the user is a valid user, the following page will be available to him/ her. Otherwise, the system keeps on requesting for the right username and/or password.

We present two more samples from the web user interfaces available to the registration users. The rest of the user interfaces can be seen from the prototype.



Figure 7: The web user interface that enables for selecting activities.

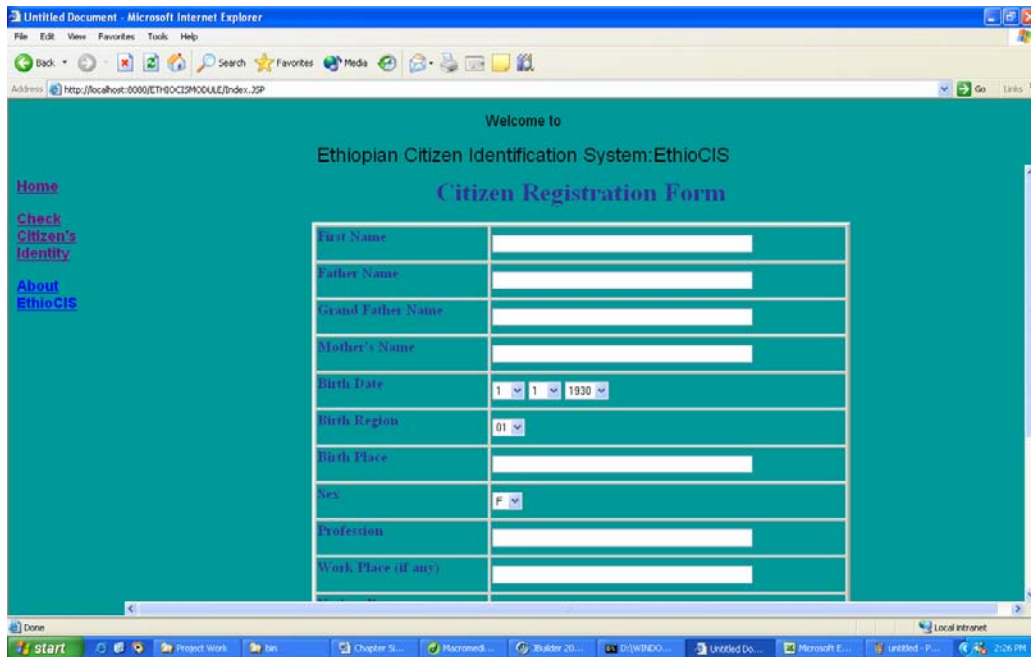


Figure 8: The Citizen Registration web user interface form

6.3. Database

The database of EthioCIS is developed using oracle 9i enterprise edition. There are four basic tables in the system as indicated in chapter four. The

design of two of the four tables in oracle 9i enterprise manager console under the schema of a user named “tedi” is seen in the screen shots below.

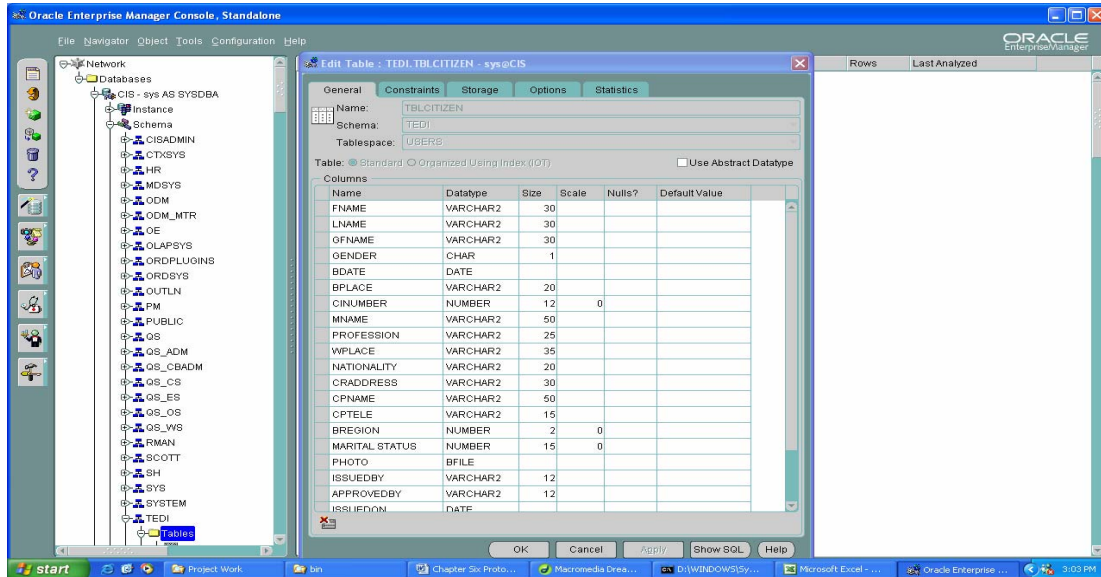


Figure 9: Table “tblCitizen” that stores citizen Identification information.

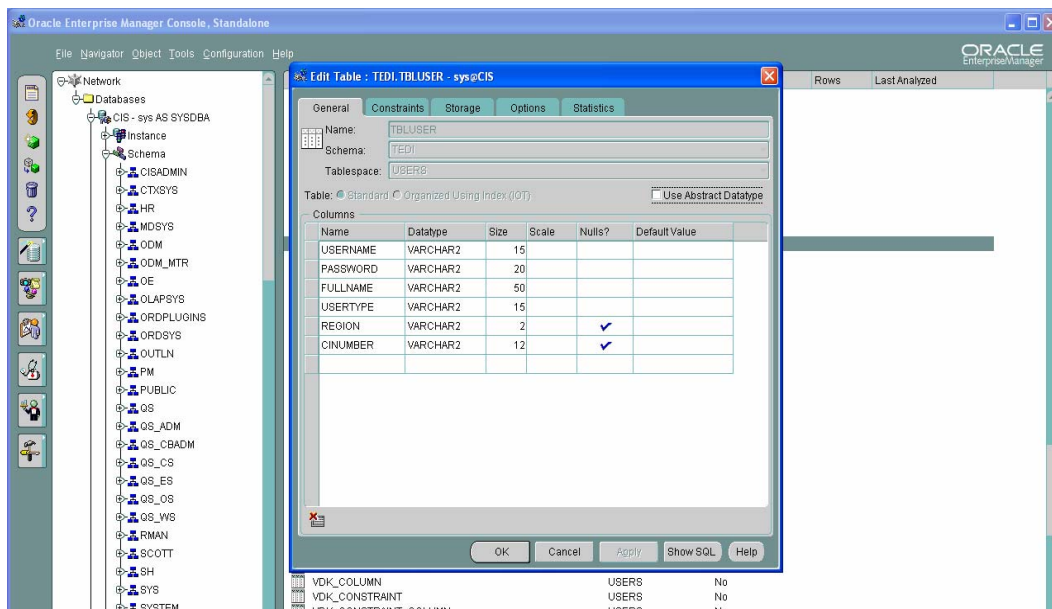


Figure 10: Table “tblUser” that stores EthioCIS’s user information.

The database is configured to replicate onto another database running on different machine. It requires authentication to be accessed from any interface including the oracle's own SQL Plus, Enterprise Manager Console, etc.

6.4. The business logic of the System

The business logic of the EthioCIS system is not complex as things stand now. We discuss some of the things we did in this part of the system development. The tool we used for this part is Jbuilder 5.0. It is developed based on the object oriented programming paradigm.

First we define the classes involved in the system. They are citizen, region, user and uniqueID. The citizen class is responsible for manipulating citizen information. It has all the attributes defined in the database design for the citizen table. The user class is responsible for manipulating the information about the user of the system whereas the region class is responsible for the birthplace code information of the country. The last class named uniqueID is created for the purpose of generating unique Identification number for each citizen. In generating the unique Citizen Identification number, we used the citizens' birth region (two digits), birth date (eight digits) and a serial number (four digits) for generating the unique citizen Identification number. The citizen identification number has fourteen digits and all are numbers.

The classes have their attributes defined and all the possible operating on them defined. Then we created Java servlets that handle the communication between the database and the web client browsers.

The following is a sample code written in Jbuilder 5.0 IDE for the citizen class and one of its method addcitizen.

```
package ethiocis;
import java.io.*;
import javax.naming.NamingException;
import javax.sql.DataSource;
import java.sql.Connection;
```

```

import java.sql.SQLException;
import javax.naming.InitialContext;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.util.Date;
public class CITIZEN implements Serializable{
public String Fname;
public String Lname;
public String GFname;
public String Mname;
public String Bplacecode;
public String Bplace;
public String Gender;
public Blog Photo;
public String Profession;
public String Wplace;
public String Nationality;
public String CRaddress;
public String CPname;
public String CPaddress;
public Date Bdate;
public String cin;
public CITIZEN() {
}

private Connection makeConnection() {

try {
InitialContext context = new InitialContext();

DataSource ds = (DataSource) context.lookup("java:Cis");
return ds.getConnection();
} catch (SQLException ex) {
ex.printStackTrace();
System.out.print("error in connection Delalaw db");
return null;
} catch (NamingException ex) {
ex.printStackTrace();
System.out.print("error in naming of JndI");
return null;
}
}

public boolean searchByUserName(String fName, String lName, String
gfName, String bRegion, Date bDate ){

```

```

Connection conn=makeConnection();
String sql="select * from tblCitizen where FName=? and Lname =? and
GFname=? and Bregion=? and Bdate=? ";
try {
PreparedStatement stmt = conn.prepareStatement(sql);
stmt.setString(1, fName);
stmt.setString(2, lName);
stmt.setString(3, gfName);
stmt.setString(4, bRegion);
stmt.setDate(5,new java.sql.Date ( bDate.getTime()));
ResultSet rs = stmt.executeQuery();
if (rs.next()) {
return true;
}
} catch (SQLException ex) {
ex.printStackTrace();
}
return false;
}
public Integer addCITIZEN (String FName,String Lname, String
GFname,String Mname,String Bregion,String Bplace,String Gender,String
Profession, String Wplace, String Nationality,String CRaddress, String
CPname, String CPaddress, Date Bdate) throws SQLException, CISException
{
Connection conn=makeConnection();
boolean found=searchByUserName(Fname, Lname, GFname, Bregion,
Bdate);
if(!found){
String sql="insert into TBLCITIZEN(Fname, Lname, GFname, Mname,
Bregion, Bplace, Gender, Profession, Wplace, Nationality, CRaddress,
CPname, CPaddress, Bdate); values(?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?)";
try{
PreparedStatement stmt = conn.prepareStatement(sql);
stmt.setString(1, FName);
stmt.setString(2, Lname);
stmt.setString(3, GFname);
stmt.setString(4, Mname);
stmt.setString(5, Bregion);
stmt.setString(6, Bplace);
stmt.setString(7, Gender);
stmt.setString(8, Profession);
stmt.setString(9, Wplace);
stmt.setString(10, Nationality);
stmt.setString(11, CRaddress);

```

```

stmt.setString(12, CPname);
stmt.setString(13, CAddress);
stmt.setDate(14, new java.sql.Date ( Bdate.getTime()));
stmt.execute();
stmt.close();
// ResultSet rs = conn.createStatement().executeQuery("select
@@IDENTITY");

/* if (rs.next()) {
Integer id = new Integer(rs.getInt(1));
conn.close();
return id;
}*/
} catch (SQLException ex) {
throw ex;
}
}
else
throw new CISException("The Citizen exists in the CIS ");
return null;
}

```

The rest of the code used for developing the business logic of the system can be demonstrated in the prototype.

6.5. Addressing Security Requirements

The security requirements of the Citizen Identification System are specified in section 5.2. These security requirements are addressed in EthioCIS prototype one by one as follows.

The first security requirement is that the Citizen Identification System should be accessed by authorized users of the system nation wide. The users are basically government offices with limited access for ID verification and the administering authority users for registration, approval, and ID issuance and system administration.

To address the above requirement, we used secure socket layer that is used for encrypting message communication over https protocol. For using SSL,

we need to have certificates, which are used to authenticate oneself in secured communications. The certificates are not trusted unless signed by a trusted or known Certificate Authority (CA). Therefore, for the purpose of demonstration, we created a CA that issues different signed certificates. Then, we created two certificates for the server and the client browser so that the two can authenticate each other over https using SSL. The port for http is 8080 or 80 but for https the port is 8443.

As we mentioned in section 6.1, we used OpenSSL tool for creating the certificate Authority and the certificates. After creating the CA, we self signed its certificates since getting signed by other CA involves payment. Then, the two certificates are signed by the CA we created.

Once we have the two certificates, the next procedure is to configure the web server to listen for request at the https port or port 8443 for secured communication from clients and disable it not to listen at the http port. We then indicate to the web server the location of its certificate to be used in authentication for secure communication. On the client side we import the certificate in to the client web browser. The following text shows the configuration on the server side.

```
<!-- Define a SSL HTTP/1.1 Connector on port 8443 -->  
  
  <Connector port="8443" maxHttpHeaderSize="8192"  
    maxThreads="150" minSpareThreads="25" maxSpareThreads="75"  
    enableLookups="false" disableUploadTimeout="true"  
    acceptCount="100" scheme="https" secure="true"  
      clientAuth="true" sslProtocol="TLS"  
      keystoreFile="C:\OpenSSL\Server\server.ks"  
      keystorePass="changeit"  
      truststoreFile="C:\OpenSSL\Server\server2.jks"  
      truststorePass="changeit" />
```

At this level, the client browser can communicate with the server. Therefore, for the citizen identification system to be accessed by authorized users, we have to use certificates for each government offices and authorized users so

that they can authenticate themselves to the server. The server also needs its own certificate. All the certificates have to be signed by trusted CA.

The second requirement is to limit the access of the government offices to the verification of the Identification information only. For this, we have used user level authentication techniques using username and password in addition to the certificate authentication. Therefore, since the government offices will not be given username and password, they will not access the rest of the system, which requires user level authentication. Once they can access the web site, username and password are not required for citizen ID verification.

The third requirement is to assure that all users use their own username and password and no one can access their password information from the system. To address this, when users create password the password is stored by hashing it using one-way algorithm. Therefore whenever they login their password is hashed using the same algorithm and compared against the hashed password in the database. With this method, we can guarantee their password will not be stolen even from the database since what is stored is not plain text but ciphered or hashed text.

The fourth security requirement best addressed by including biometrics features so as to control that no citizen is issued more than one ID from the system. However, biometrics feature is not in the scope of this project. Therefore, in this project we use a combination of the citizens' information like full name including grandfather name, mothers name, birth date, and birth region as unique key for controlling the issuance of more than one ID card. However, there is a chance that some people may change any of this information and ask for second Identification in which case the same person might have more than one Identification card. One solution for this is to have legislation to incriminate such act of deliberate deception, although the best solution is to use biometrics feature.

Chapter Seven

7. Conclusions and Recommendations

The last chapter of this report summarizes the work of the project and to draw some recommendations concerning the citizen identification system. These are detailed in the following two sections:

7.1. Conclusions

Throughout this project, we have seen that integrated Citizen Identification System is important for identifying the citizens of a country. Many countries including the developed nations of the world such as the UK and U.S.A are going for the system despite the opposition from some human rights activists. The system primarily assists in assigning each citizen a unique identification number. The number can then be used in every other database so that the citizens' information is stored for later retrieving of integrated information about each citizen as required.

As most countries are going for more robust type of identification system that incorporate biometrics feature and interacts with other databases of the government, Ethiopia is still using the manual ID card system with no nation-wide citizen identification number.

The concern from human rights institutions is based on facts of some countries that used ID cards in the past to commit crime against humanity. However, those ID cards kept group classification information like ethnicity and religion. Therefore, the information to be kept on the ID card and the system requires proper attention.

In this project we have assessed the experience of other countries in using citizen identification system. We then analyzed the requirements of the system and proposed a web-based architecture for the citizen identification system in Ethiopia. A scheme for generating unique citizen ID number is also

proposed based on the experience of other countries. We have also assessed the implementation issues that should be considered when introducing the system like privacy issues, security of the system, and others. Finally, we developed EhioCIS prototype and addressed the security requirements in the prototype

In the prototype, we did not show how other e-government applications can use the citizen identification numbers due to the complexity of the applications. However, by keeping the citizen identification number together with the citizen information, which is nationally unique, the integration of the citizen information from any databases is possible.

7.2. Recommendations

Currently, the country is making a lot of efforts in computerizing and automating the operation of different organizations in various sectors. Having a citizen identification system is a very important issue for the integration of citizens' information in the various organizations of the country. Thus, concerned authorities should give it more attention to introduce the system as soon as possible, before relevant automated systems are developed without considering their integration requirements with other government systems. Doing the integration later could be difficult as all the systems cannot have common key for citizen identification.

The citizen information to be stored in the database should be decided with utmost care. Special attention should be given whether to store and/or print group classification information like ethnicity and religion. That is because as has been witnessed in some countries, like Rwanda and Germany, this information has been used to aggravate conflict in case of unrest. Therefore, we recommend that further study be carried out from Policy and legislation perspective concerning group classification information and the privacy issues as well.

At the center of secured data communication lies the certificates used for authentication and message encryption. Certificates have to be signed by trusted CA. Therefore, Ethiopia might need its own CA that can issue and sign certificates for digital communication. The citizen identification system can benefit from the CA service as well.

7.3. Future Work

As can be seen in the literature reviews of chapter 2, a growing number of countries in the world are introducing Integrated ID system with biometrics support like fingerprint, Iris scan, etc. This is seen as a crucial method for protecting Identity disguise and fraud specially when coupled with other means like online verification. Therefore, it is important to assess on the feasibility and possibility of incrementing biometrics feature in Ethiopian Citizen Identification System and also testing if it serves the purpose.

Currently, the prototype uses English language both in the user interface and the data to be stored at the database. However, as the system is supposed to work at national level, it is important to assess the language need of the system and devise a way to make the system multi lingual using different Ethiopian languages to the extent possible.

Lastly, security in the use of computerized system is very important in today's world. One solution for security is encryption of data communication. Signed Certificates are at the heart of encryption methods. Therefore, Ethiopia as a country might need its own Certificate Authority (CA) instead of depending on CAs in foreign countries.

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This Project is my original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged.

Candidate: Tewodrose Negussie

Signature: _____

Advisor: Dr. Solomon Atnafu

Signature: _____