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An integrated academic programmes information system: a case of the inter university council for east Africa

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AN INTEGRATED ACADEMIC PROGRAMMES INFORMATION SYSTEM: A CASE OF THE INTER UNIVERSITY COUNCIL FOR EAST AFRICA

Alban Manishimwe

A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Embedded and Mobile System of the Nelson Mandela African Institution of Science and Technology

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ABSTRACT

The re-establishment of the East African Community (EAC) necessitated the need to establish various institutions required for proper implementation of the harmonization pillars (Customs Union, Common Market Protocol, Monitory Union and Political federation) within various sectors. For example, the Inter-University Council for East Africa (IUCEA), a surviving institution of the EAC was tasked to lead the harmonization of education and training system in East Africa (IUCEA, 2009). The IUCEA has set up various frameworks and programs to achieve this mandate, however IUCEA has not yet established a one stop live data system on Universities and Programs which would provide for evidence-based policy process. This study therefore leads to an establishment of an Academic Programs Information Management System (APIMS) which breaks the ground for an established regional system on Universities and Programs offered with in the East African Community. The application was developed using Django Web Framework and validated with 15 IUCEA staff. The established system will promote Students and Staff Mobility and also protect students against degree mills.

DECLARATION

I, Alban Manishimwe, declare to the satisfaction of senate that this is my original work, and that it has not been submitted for consideration of a similar degree award in any other University.

Alban Manishimwe
Candidate Name

Signature

20/10/2021

Date

The above declaration is confirmed

Dr. Edith Talina Luhanga
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25-10-2021

Date

Dr. Kisangiri Michael
Supervisor (2)

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22/10/2021

Date

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CERTIFICATION

The undersigned certifies that he/she has read and hereby recommend for acceptance by the Nelson Mandela African Institution of Science and Technology a Project report titled "An Integrated Programs Information System for the Inter-University Council for East Africa" in fulfillment of the requirements for the degree of Master of Science in Embedded and Mobile Systems of the Nelson Mandela Institution of Science and Technology.

Dr. Edith Talina Luhanga   25-10-2021
Supervisor (1)   Signature   **Date**

Dr. Kisangiri Michael   22/10/2021
Supervisor (2)   Signature   **Date**

ACKNOWLEDGEMENTS

DEDICATION

I dedicate this work to God in whom all wisdom comes from. Blessed be your name Hallelujah.

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LIST OF ABBREVIATIONS AND SYMBOLS

APIMS	Academic Programmes Information Management System
EQAR	European Quality Assurance Register
ERD	Entity relationship Diagram
ETER	European Tertiary Education Register
HCMIS	Human Capital Management Information System
HEC	Higher Education Council
HEIS	Higher Education Information System
HEIs	Higher Education Institutions
IAU	International Association of Universities
ICT	Information and Communications Technology
IDE	Integrated Development Environment
IS	Information System
IUCEA	Inter-University Council for East Africa
KNQA	Kenya National Qualifications Authority
MySQL	My Structured Query Language
NCPD	National Council for Population and Development
RIMS	Research Information Management System
TCU	Tanzania Commission for Universities
UIMS	University Information Management System
UNCHE	Uganda National Council for Higher Education
UNESCO	United Nations Educational, Scientific and Cultural Organization

CHAPTER ONE

INTRODUCTION

1.1   Background of the Problem

Regulating higher education institutions is such a complex venture, since universities differ in terms of structural systems, funding, and governance. Some Universities are self-regulated, others regulated by legislation. These complexities often hinder international mobility and quality of higher education. At times one qualification in one country may not be recognized in another.

And since the current trends of higher education require deliberate policies that favor internationalization and globalization of higher education, regulatory bodies must therefore be intentionally and create ways that will enable international student mobility, and collaboration with foreign universities, among other forms of internationalization despite the already mentioned complexities.

Presently, internationalization of higher Education exists in many forms but the major one is in form of students and staff mobility development (Ogachi, 2009).

International mobility in higher education is important due to its contribution in diversifying the student body, improving global rankings, and income generation.

Studies show that international students' mobility is greatly influenced by the cost of higher education programmes, financial and living costs present in the host country in comparison to future potential income that could be generated by taking up this international mobility, social political ties and trade flows between a student's home and host country promote students to seek education abroad (Beine *et al.,* 2014).

Other studies also reveal that push and pull factors such as few resources in universities, overcrowding in lecture halls and accommodation, arbitrary assignment of majors or enrollment in second choice majors, prevalence of strikes and other financial woes, and home political climate, funding opportunities, freedom of academic choices and greater opportunities to satisfy intellectual curiosity play a greater role in international students' mobility (Azmat *et al.,* 2013).

The main sources of information for international students' mobility being exchange links between universities, and scholarship provisions. The European Union has one of the best international mobility rates due to domination of English language as a medium of teaching and research, and significant diplomatic relations in terms of trade and social political ties. The East African region however suffers from the information gap that exists among universities themselves and limited funding which hinders international mobility.

To promote internationalization and globalization, therefore there is need to diffuse technology from the start when a student applies to a university, until when the student graduates. There are already systems that promote student's mobility whilst maintaining quality such as the world education database portal, the uniRank, the European Tertiary Education Register (ETER), European Quality Assurance Register (EQAR). The Inter-University Council for East Africa (IUCEA), thus needs to lead by example and spearhead the implementation of Information System (IS) strategies across the EAC Partner States.

These existing tools show information on universities, and little on programmes offered by these universities. For the case of East Africa, there is no systematic data on student and staff mobility (McCowan *et al.*, 2018) yet implementation of mobility largely depends on accessibility to information on universities and programmes. Without systematic and consistent information, students and staff are unable to make informed decisions about the programmes they may be willing to undertake in other universities other than their home-based universities whilst taking care of the quality and recognition of the programmes.

For the case of East African Community, there are national initiatives aimed to promote quality and student mobility, for example Kenya has put in place a system/software that allows online verification of programmes offered by universities in Kenya (Kenya National Qualifications Authority [KNQA], 2021). The problem however is that there is no regional system where students and other parties interested parties would find a localized data on programmes offered with in all universities in the six (06) partner states of the East African Community.

This research thus presents an Information Management System that shows information on accredited programmes and chartered universities for the six (06) partner universities of the East African Community. This software will guard against degree mills, spur mobility, and contribute to common market protocol of the East African Community.

1.2 Statement of the Problem

Whereas there exist national information systems on academic programmes and universities in some Universities in the EAC, there is no centralized system that aggregates harmonized information at the regional (IUCEA, 2020) for enhancing of regional mobility programmes and protecting students from degree mills. Thus, there is a need to establish a centralized regional Information System on programmes and universities recognized in the East African Community.

1.3 Rationale of the Study

To promote international student's mobility and enabling easy access of regional information on chartered programs and universities in East Africa.

The developed Academic Programs Information Management System (APIMS) will provide the basis for guiding and informing institutions, decision and policy makers, and stakeholder on the accredited programs and universities at the regional level. In a nutshell, study led to the following contributions:

(i) A mobile responsive web portal with visualized data on universities, and academic programs offered at different institutions in the region.

(ii) The study introduces an open access academic programs information management system to be used by students, parents, guardians, researches and higher education experts.

1.4 Research Objectives

1.4.1 General Objective

To deliver a fully functional an academic programs information system or software that promotes international students' mobility.

1.4.2 Specific Objectives

(i) To assess the requirements for the information system that provides information on universities and programs in East Africa.

(ii) To develop a relational database for storing and communicating information with the

developed system.

(iii) To develop a web platform that will present the information on universities and programs in the East African region.

(iv) To validate the database and web platform with quality assurance experts in the region.

1.5   Research Questions

(i) What are the variables that are to be stored in the database?

(ii) What are the functional and non-functional requirements for the academic programs information system in East Africa?

(iii) What are the main human interactions that the system users are most interested in achieving?

1.6   Significance of the Study

Students, researchers, and experts of higher education will all benefit from this study as the developed system will enable them fact check the credibility of programs, and recognized Universities within East Africa. For students and staff, it will enable them to make informed decisions on which courses to undertake within their country and abroad. The researchers and higher education experts will benefit since the system will offer a one stop live data on only regional recognized programs and universities.

1.7   Delineation of the Study

The selected participants were free to participate. No one was coerced to participate. The study was also carried out at the Inter-University Council for East Africa.

CHAPTER TWO

LITERATURE REVIEW

2.1   Background of University Education in Africa

University education is vital for economic development of any country, and without adequate higher education and research institutions providing a critical mass of skilled and educated people, no country can ensure genuine endogenous and sustainable development and developing countries and least developed countries cannot reduce the gap separating them from the industrial developed one (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1998). Therefore, every economy needs strong education coupled with strong research and development.

Creation of Universities in Africa often dates back to the colonial period. The most recent ones have been set up under the patronage of former colonial powers (France, Belgium, Portugal and the United Kingdom) (Sall & Ndjaye, 2014). For instance the University of London has been manifested in such higher education institutions such as Fourah Bay College in Sierra Leone, (which was a college of the University of Darham), University of Ibadan, University of Ghana and Salisbury (the modern Harare University), and college of Rhodesia (now College of Zimbabwe). French Universities also have 'African campuses' such as University of Dakar, Yaounde, Abidjan and Brazzaville (Mohamedbhai, 2008).

With technology advancement now the current trend of university education is characterized by internationalization and globalization of higher education which leads to increased students and staff flows across borders, domination of English as a medium if instruction and research, setting up offshore campuses and leveraging of advanced technologies to provide education (Education, 2002; Ogachi, 2009a). The marketplace for university education is highly complex and calls for innovativeness and proper strategic direction.

With this complexity, East African Partner states have come together and identified the need for harmonizing education and training systems in East Africa as a way of promoting free movement of labor with in the region. To achieve this IUCEA was identified as the institution to come up with mechanisms and frameworks for ensuring the harmonization agenda. Information at the regional level is required for IUCEA to promote harmonization of education and training institutions.

2.1.1 Status of University education in the East African Community Burundi

Burundi's population is about 11 million people (Worldometer, 2021). It has a gross enrolment rate of approximately 4 percent (World Bank, 2021). The oldest University in Burundi is the University of Burundi (and presently Burundi has two (2) public Universities and nine (9) private universities (Wikipedia, 2021).

(i) Kenya

Kenya's population is about 52 million people (National Council for Population and Development [NCPD], 2020). It has tertiary gross enrolment rate of approximately 11 percent (World Bank, 2021). The oldest University in Kenya is the University of Nairobi which was earlier on a constituent campus of the University of East Africa (Oketch, 2008). Presently, Kenya has a total of 74 institutions as shown in Table 1 as extracted from Commission for Universities-Kenya.

Table 1: Growth Trend in the Number of Universities Licensed in Kenya

University Category	2016	2017	2018
Public Chartered Universities	23	30	31
Public Universities Constituent Colleges	8	4	6
Private Chartered Universities	17	18	18
Private Universities Constituent Colleges	5	5	5
Private Universities with LIA	12	12	14
Registered Private University	1	0	0
Total	**66**	**68**	**74**

(ii) Rwanda

Rwanda's population stands at about 12 million people, with tertiary enrolment of about 6.2 % (World Bank, 2021). The University of Rwanda is the oldest University in Rwanda. Rwanda has 26 private universities and two public universities i.e., the University of Rwanda and the Institute of Legal practice and development (Higher Education Council [HEC], 2021)

(iii)   South Sudan

South Sudan's population stands at about 11 million people (World Bank, 2021), with no data publicly available for tertiary enrolment. Presently South Sudan has 5 public universities and 13 private universities, but only four of them are recognized (Kuyok, 2017).

(iv)   Tanzania

Tanzania's population is approximately 58 million people with tertiary enrolment rate of approximately 3% (World Bank, 2021). The oldest university in Tanzania is the University of Dar es Salaam which was a college of the University of East Africa. Currently, there are thirty-four (34) Fully-Fledged Universities, fifteen (15) University Colleges, and eleven (11) University Campuses, Centers and Institutes (Tanzania Commission for Universities [TCU], 2021).

(v)   Uganda

Uganda's population is approximately 44 million people (World Bank, 2019) with tertiary enrolment of about 4% (World Bank, 2014). Makerere University in Uganda is the oldest university in Uganda and East Africa at large. Currently, Uganda has about thirty-nine (39) private Universities, and 11 public Universities (Ochwa-Echel, 2016).

2.1.2   Status of internet development in East Africa

The internet use in the East African Community (EAC) region is without challenges such as high cost of broadband (Ayoo, 2009). This is brought the fact that East Africa is cut off from the Internet's global economic and information opportunities; while most of the world is connected to multiple submarine backbone fiber cables that offer the cheapest option for getting online, East Africa is one of the only regions without a connection to fiber and is thus forced to pay exorbitant prices for satellite connectivity (Goldstein, 2008).

There have been efforts to bridge this gap such as SEACOM which is a Mauritius- based firm invested $650 million to cover 15 000 km connecting Djibouti, Kenya, Tanzania, Mozambique, Magadascar, South Africa; East Africa Submarine Cable System and it covers 9900 km at initial capacity of 20 gigabits per second, and East African Marine System Projected to cover 4887 km from the United Arab Emirates to Mombasa in Kenya (Ayoo, 2009). Also, Internet usage (% of population) among East African Community countries has increased steadily for the past 10

years as shown in the Table 2.

Table 2: Internet Usage for the past 10 Years in EAC

Country	Internet Usage in 2009 (%)	Internet Usage in 2019 (%)
Burundi	0.9	2.661
Kenya	6.1	22.565
Rwanda	7.7	21.768
South Sudan	3.83(2013 data)	7.977
Tanzania	2.4	25
Uganda	9.78	23.707

(World Bank, 2009; 2019)

2.2 ICT for University Education

Clarkson (2002) categories Information and Communications Technology (ICT) impact in terms of what is learned, how students learn, and when and where students learn. In terms of what is learned the World Bank recognizes that there is a widespread belief that ICTs can and will empower teachers, and learners, transforming teaching and learning processes from being highly teacher-dominated to student centered, and this transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills and other higher-order thinking skills (World Bank, 2008).

2.2.1 Benefits of using ICT in University Education

Technology has drastically changed higher education, there is now an existence of virtual classrooms, and possibility for eLearning systems in terms of Massive Open Online Courses. In terms of education management, ICTs allows people to showcase their educational and professional achievements to provide transparency of regulated qualifications, awards, and experience to members of the public and employers (Qualification Register [QR], 2021). The ICT also promotes students' mobility; someone is able to write an email to a prospectus university abroad and receive instant communication. Massive Online courses, and degree programs are ably now delivered online without need to be at the university physically.

2.2.2 Challenges of using ICT in University Education

Barriers to using ICT in University education is classified as extrinsic or intrinsic barriers. Ertmer (1999) Extrinsic barriers relate to access, time, support, resources and training while

Intrinsic barriers relate to attitudes, beliefs, practices and resistance. Al-Alwani (2005) also defined extrinsic barriers as barriers which are related to organizations rather than individuals and intrinsic barriers as those related to teachers, administrators, and individuals.

Some other researchers grouped the barriers into two categories of teacher-lever barriers and school-level barriers. Salehi *et al.* (2012) classified the barriers based on whether they refer to individual (teacher-level barriers), such as lack of confidence, shortage of time, and resistance to change, or to the institution (school-level barriers), such as lack of effective training on solving technical problems and lack of access to resources.

2.3   Existing Systems

2.3.1   World Higher Education Database Portal

World Higher Education Database (WHED) portal **is** a web-based portal and has been the reference tool since 1950 for national higher education authorities, government agencies and national academic bodies. The portal in collaboration with UNESCO provides authoritative information on higher education systems, credentials in 196 countries and territories and over 19 900 officially accredited or recognized Higher Education Institutions (HEIs) (International Association of Universities, [IAU], 2021). Although the developed software for this study provides high data quality, it employs a more general definition of a "university" without an easy or consistent mechanism for filtering where institutions that do not grant the equivalent of a bachelor's are included but not easily identifiable.

2.3.2   UniRank

UniRank is the leading international higher education directory and search engine featuring reviews and rankings of over 13 800 officially recognized institutions (UniRank, 2021). Much as UniRank includes data from all these institutions, it has limitations such as not including distance universities, and universities offering theological, and or military course among other things.

2.3.3   European Tertiary Education Register

The European Tertiary Education Registesr (ETER) is a database of higher education institutions in Europe. The ETER provides detailed data on 2465 higher education institutions hosting more than 17 million students at Bachelor, Master's and PhD level. Covering 32

European countries, the data includes university size, number and gender of students and staff, subject areas and degree levels, as well as information about research, international students and staff, and funding (European Tertiary Education Register [ETER], 2021).

2.3.4 The European Quality Assurance Register for Higher Education (EQAR)

This is the official register for European Higher Education Area, and it lists institutions that comply with the agreed common frameworks that guide higher education in the European Union (The European Quality Assurance Register for Higher Education [EQAR], 2021).

2.4 International Students Mobility and Factors Influencing It

Globalization, through mobility of students has grown significantly for over the past 40 years. The number of students who study abroad has been steadily rising since the 1970's. It has grown fourfold between 1975 and 2008 (Beine *et al.,* 2014). The decision to study abroad can be seen as having 3 stages:

(i) **Stage one**: The student decides to study abroad than locally due to variety of push factors; The pull factors are few resources in universities e.g., few Library books and internet facilities, overcrowding in lecture halls and accommodation, arbitrary.

(ii) Assignment of majors or enrollment in second choice majors, prevalence of strikes and other financial woes, and home political climate.

(iii) **Stage two**: The student decides on a destination country due to a variety of pull factors; funding opportunities, freedom of academic choices, greater opportunities to satisfy intellectual curiosity.

(iv) **Stage three**: The Student selects an institution.

The challenge is however, for African countries, mobility is majority dominated by exchange between African Universities and overseas universities. There is little student and staff exchange among Universities within Africa as a result of wider information gap that exist among these institutions. Historically few students have received appropriate preparation, reporting that they had inadequate knowledge of the country and the industries to which they were headed (Wake *et al.,* 2017). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), Global Education Monitoring (GEM) Report, Massive

Open Online Courses (MOOCs) expand access to education to students overseas. Massive Open Online Courses are seen as a way for facilitating international student mobility.

The challenge is MOOCs have a higher dropout rate due to; inefficient interactive nature of the MOOCs, challenges with technology employability, nature of the course design, and low perceived value (Hone & El Said, 2016). Massive Open Online Courses therefore are not an efficient methodology for ensuring proper international mobility, and do not provide prior information on the quality of the course that's to be offered thus not being able to protect students against degree mills.

CHAPTER THREE

MATERIALS AND METHODS

3.1   Location for the Study

UCEA which is an institution of the East African Community responsible for harmonization of education and training systems in East Africa was the main location for the study. The map below shows the location where the study was carried from.
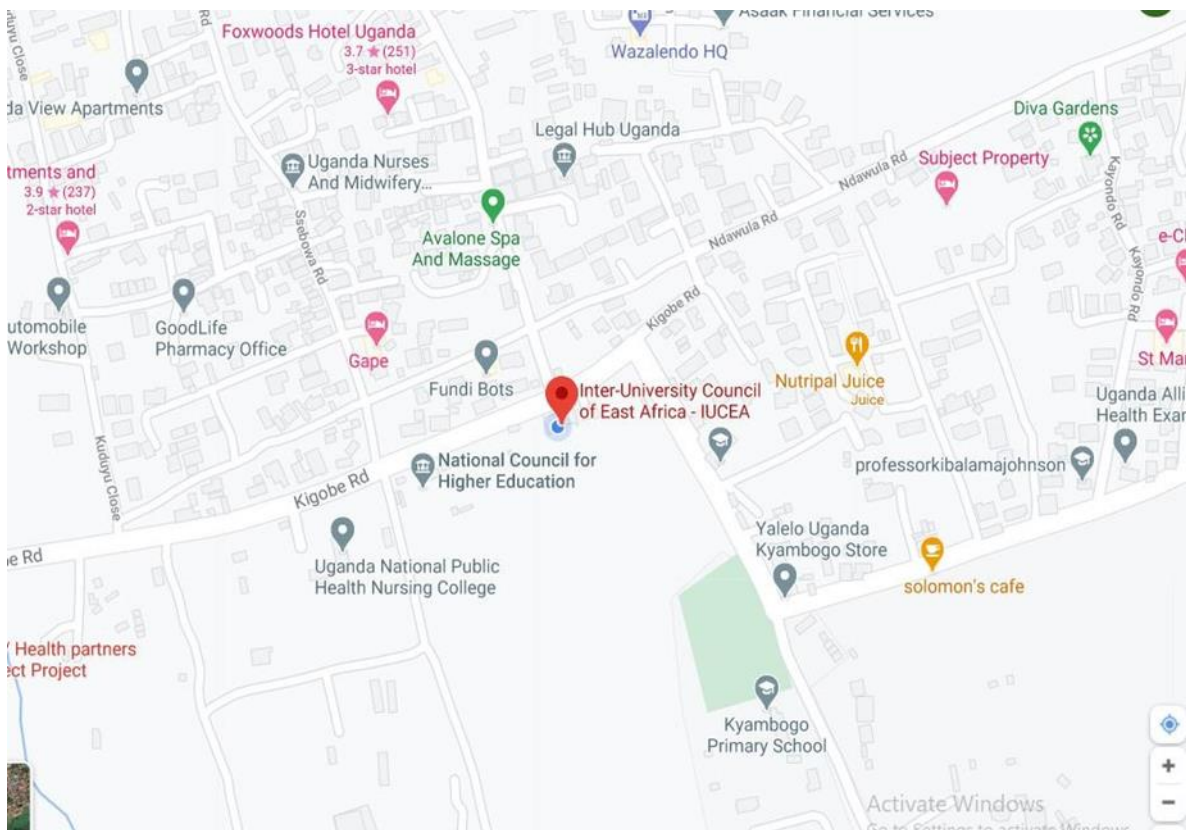
Figure 1: Location for the Study

3.2   Software Engineering Methodology

Iterative and incremental software development methodology was used to develop the software. This methodology was chosen since the requirements for the software were already determined during the baseline study of the IUCEA. This methodology also constructs a partial implementation of a total system then, slowly increase functionality Incremental prototyping was chosen among other reasons because requirements are already known, and for this study it was deemed appropriate for this project because IUCEA had already carried out a baseline

study that sought to understand the needs of the software before actual development. The Fig. 2 below shows the processed underwent during incremental and iterative prototyping.
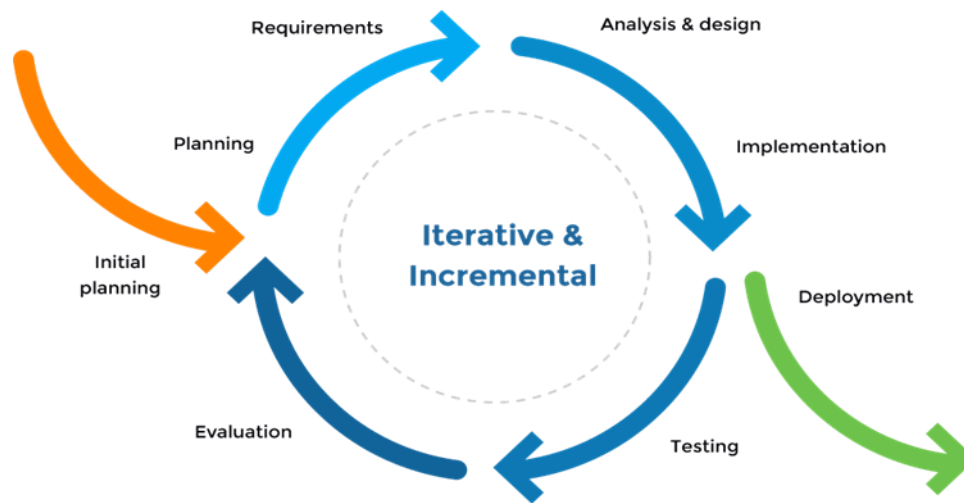
Figure 2: Incremental and Iterative Model

3.2.1 Sampling Methodology

The participants of the study were chosen purposively since an assumption that the staff at IUCEA already have knowledge on students and staff mobility in East Africa. A total of 15 participants took part. A survey distributed via Google Forms was used to collect responses. An email with the link to the survey was sent to all staff in IUCEA.

Furthermore, two (02) focus group discussions were held with the Tanzania Commission for Universities (TCU), and the Uganda National Council for Higher Education (NCHE). A total of 05 participants took part in the first focus group and 06 in the second focus group. The participants were purposively sampled basing on their participation in the monthly Common Higher Education Area Committee Meeting.

Focus group was chosen because it enables the researcher collect richer information about the participants' experiences and beliefs.

3.2.2 Survey and Focus Group Structure

This study was conducted in February 2021 for three weeks, and the researchers did review of baseline study reports, two (02) focus group discussions, desk-research and questionnaire were developed and distributed to the staff of IUCEA, Quality assurance Officers, ICT officers.

3.2.3 Questionnaire Tool

The developed questionnaire was divided into 3 sections:

(i) The first section was for all staff of the IUCEA, and it consisted of nine (09) questions. The objective was to identify the impact that the developed system would have, and the focus areas.

(ii) The second section was for ICT staff of the IUCEA, and it consisted of eight (08) questions. The objective was to understand technological needs of the developed software.

(iii) The third section was for quality assurance of IUCEA, and it consisted of nine (09) questions. The objective was to understand data flow and information flow from IUCEA and the national councils/commissions within the region.

3.2.4 Interview

The structured interview consisted of five (05) unstructured questions aimed at understanding the brief history and status of quality assurance systems in the East African region, challenges they face, and the procedures for execution of their mandate. This information was needed for showing the credibility of the system.

3.2.5 Observation

The objective of this activity was to determine the procedures used by quality assurance staff in accrediting programs. The observation carried out on was on: how the quality assurance staff used internet for comparative purposes with other harmonized systems like the bologna process. The results of the findings of were used to design the data flow for the development of the system.

3.2.6 Document Review

We reviewed the report from the baseline study on status of Higher Education Information Management System (HEMIS) in East Africa, and a booklet on the East African Qualification Framework. The purpose of this exercise was to qualitatively analyze the national systems and their architectural designs to ensure compatibility with the developed system.

3.2.7 Data Analysis

The information submitted was analyzed within google forms and the data was visualized using pie charts, and frequency tables. This approach was chosen for ease of use by the staff of IUCEA as it's the most common used approach within the organization. For free response data, was thematically coded and validated by the quality assurance officer of the IUCEA together with the researcher.

3.2.8 Integrated Development Environment (IDE)

An IDE is basically used to edit source code. There exists several IDEs such as Notepad +++, Pycharm, VSCode and Atom among others. For this study we used Pycharm because of easy integration with python, support for data visualization and automatic version control system

3.2.9 System Architecture

From the Baseline study of the IUCEA, it was established that data from universities would be channeled to IUCEA. Figure 3 shows the comprehensive architecture that shows the planned comprehensive system, Higher Education Information System (HEIS) and it comprises of the Academic Programmes Information System (APIMS) which was done for this particular study.
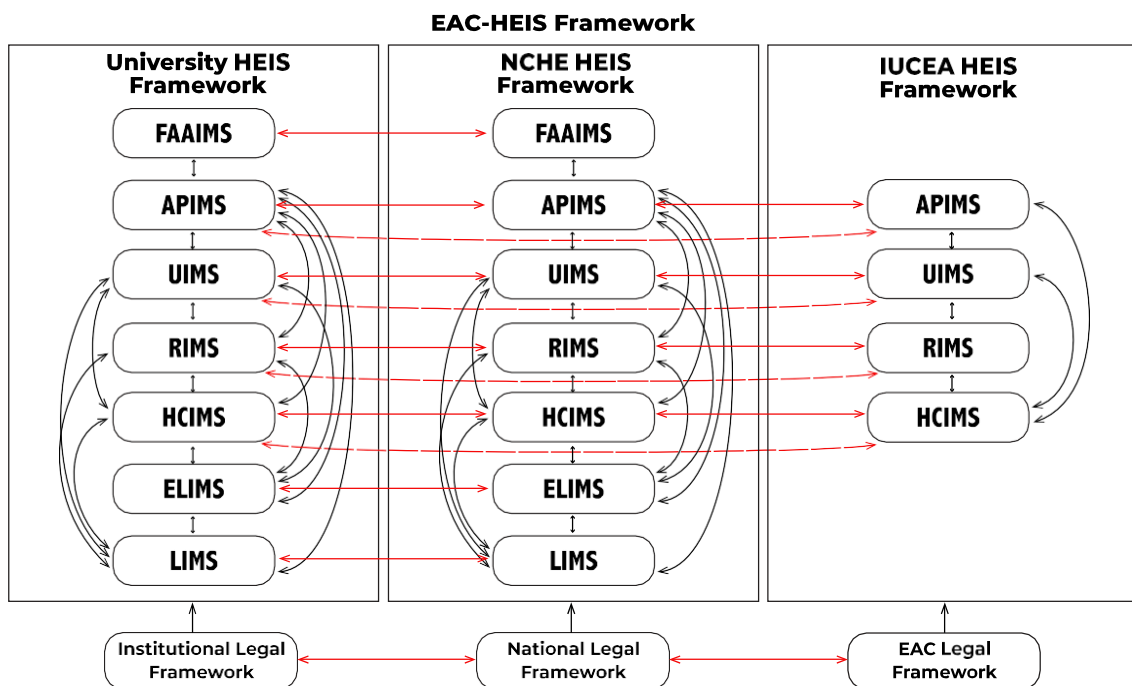
Figure 3: Higher Education Information System Architecture

3.2.10 Technologies Used

The system was developed and implemented using various technologies; ChartJs, Django and Bootstrap.

3.2.11 Client-Side Technologies

(i)   Bootstrap

Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS and JavaScript based design templates for typography, forms, buttons, navigation, and other interface components. The current stable release is 4.6.0. For our case bootstrap template was used from https://themes.getbootstrap.com/ and incorporated in the Django template methodology.

(ii)   JavaScript

Javascript is a mostly used and popular language for the web, it is either implement on the front-end or back-end. For our case, ChartJs which is a framework for charts, and maps design was used to give us visualizations of universities and programmes. ChartJs was used together with Django rest framework to dictate which data must be plotted and visualized.

(iii)   Scripting Language

Python is an interpreted high-level language used for general purpose development, it can be used for data science, network programming, web development among other. Presently its mostly used to develop data driven software, and we chose to use it since in future IUCEA plans to leverage on the developed system to be able to incorporate Artificial Intelligence in the developed information system.

(iv)   Django

The Django framework is the most popular web framework based on python. It offers quick and rapid developed and ease to learn. For this study Django was used because provides a built-in administrator that helps the administrator to manage users and do model manipulations. The researchers were well versed with Django development, so this enabled easy development and development.

The 2020 developer survey of stack overflow show that Python is among the top populous languages for web development, and Django is based on Python as shown in the Fig. 4 below (Source Stack Overflow).
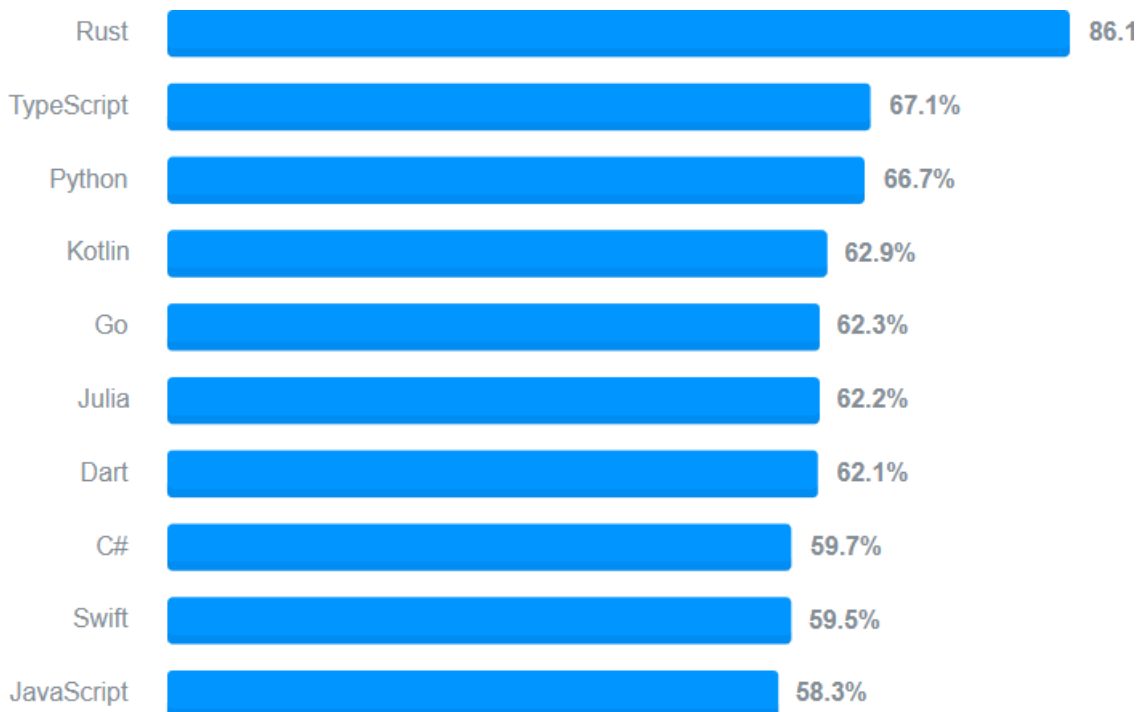
Figure 4: Comparison of Django and Other Scripting Language

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1   Requirements Engineering

The researchers analyzed the requirements specified with in the report of the Higher Education Information System (HEIS) in East Africa and grouped them into functional, non-functional and other requirements.

4.1.1   Functional Requirements

In software engineering, a Functional requirement is that it essentially specifies something the system should do. The Functional requirements for the developed system are shown in Table 3.

Table 3: Table Showing Functional Requirements

Requirement	Description
Users, Adding, and Editing information on Universities and Programmes	An Admin Portal that allows an administrator to perform management of Users and Information in the database
Views for Universities and Programmes	The software shall display information on Universities and Programmes in East Africa
Generate Report	The software should be able to generate report for users.
Search Option	The software shall have an option for users to search information according to their need
Visualization	The software shall allow visualization inform of bar chart and pie chart.

4.1.2   Non-Functional Requirements

Non-functional requirements (NFR) specify the quality attribute of a software system. They judge the software system based in the responsiveness, usability, security, portability, and other non-functional standards that are critical to the success of the software. The Non-Functional requirements for the developed system are shown in the Table 4.

Table 4: Table Showing Non-Functional Requirements

Requirement	Description
Availability	The software shall be available and not available only when the developers are carrying out maintenance.
Ease of use	The system shall be easy to use with employment of the already known user behavior.
Language	The software shall be in English, with future option of adding Kiswahili and English which are the languages of the East African community.

4.1.3   Other Requirements

The developed system requires a laptop, or personal computer connected to internet for it to be accessible via web browser such as chrome, and or Mozilla.

4.2   Use Case Diagram

A use case is a list of actions defining interactions between a role. Figure 5 shows the use case for administrator and stakeholders for the developed system.
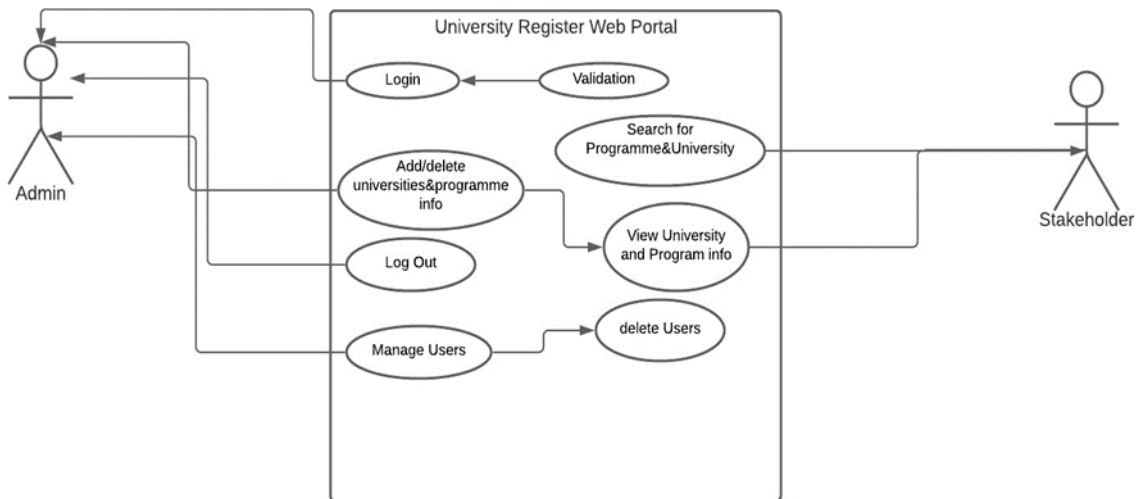

Figure 5: Use case for Administrator and Stakeholder

The Actors of the developed software are stakeholders (East African Bureau of Statistics, National Council for Higher Education, Students, researchers, parents, guardians, policy makers and the software administrator. The Use cases: Login, perform CRUD (Create, Read, Update and Delete) operations, log out and Manage users.

4.3   System Features

(i)   Dashboard

The platform was developed mainly for higher education Quality assurance officers, Students, East African Bureau of Statistics, National Councils/Commissions of Higher Education representatives, students, parents and guardians and higher education researchers.

The main features captured by the system are:

(a)   Universities

- IUCEA Membership status e.g Full member, non-member etc

- University Type of establishment (e.g., public, private, etc.)

- University Level of Progression (e.g., chartered, not Chartered, etc.)

- University Website (e.g., https://www.nm-aist.ac.tz)

(b)   Programmes

- Programme name (e.g., Masters of Embedded and Mobile System)

- Programme Level (e.g., Bachelors, Masters, PhD, etc.)

- Programme offering (e.g., Full-Time, Part-time, online, blended etc.).

- Thematic area (e.g., Business, Engineering, etc.)

More so, the users are able to search for information of their need, and also generate regional or country specific reports on the status of programmes and universities in the region.

The administrator's job is to basically upload information on universities and programmes and manage users.

4.4   Conceptual Framework

A conceptual framework is a written or visual representation of an expected relationship between variables. Variables are simply the characteristics or properties for the study. The conceptual framework for the developed system is shown in Fig. 6.
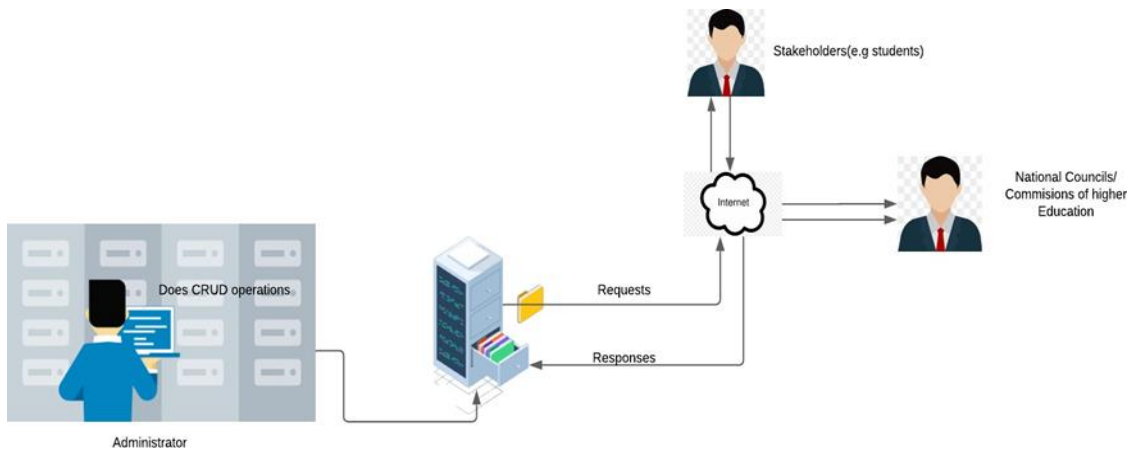
Figure 6: Conceptual Framework for the Developed System

4.5   Data Flow

Data flow for the system helps to define and clarify the boundaries of the software system. Figure 7 shows the data flow for the developed system.
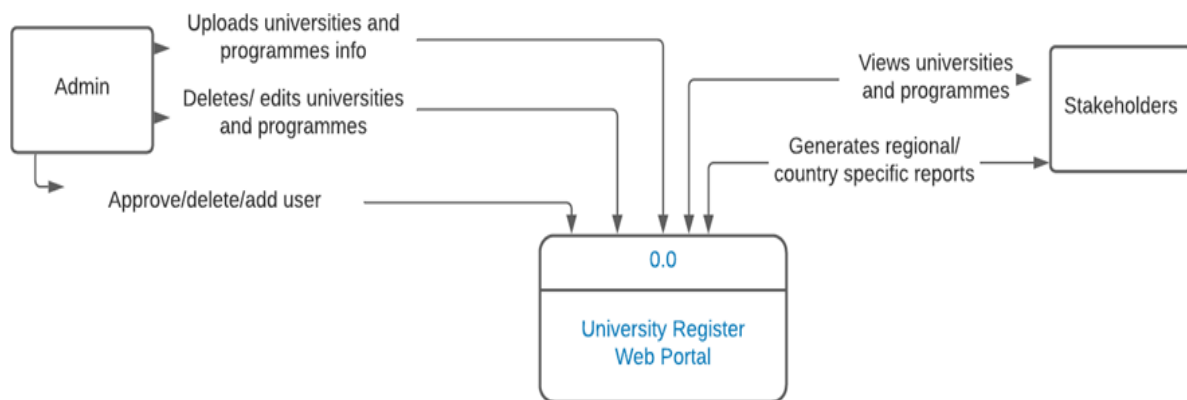
Figure 7: Data Flow

4.6   Data Base Model

Database modelling basically is about defining models for the system. This involves turning the information into rows and columns and specifying relationships in terms of primary and foreign keys.

4.7   Entity Relationship Model

An entity relationship model also known as Entity Relationship Diagram (ERD) shows the relationships of entity stored in the database. Entities have attributes and an entity is an object, component of data. Figure 8 shows the relationships between the entities for the developed system.
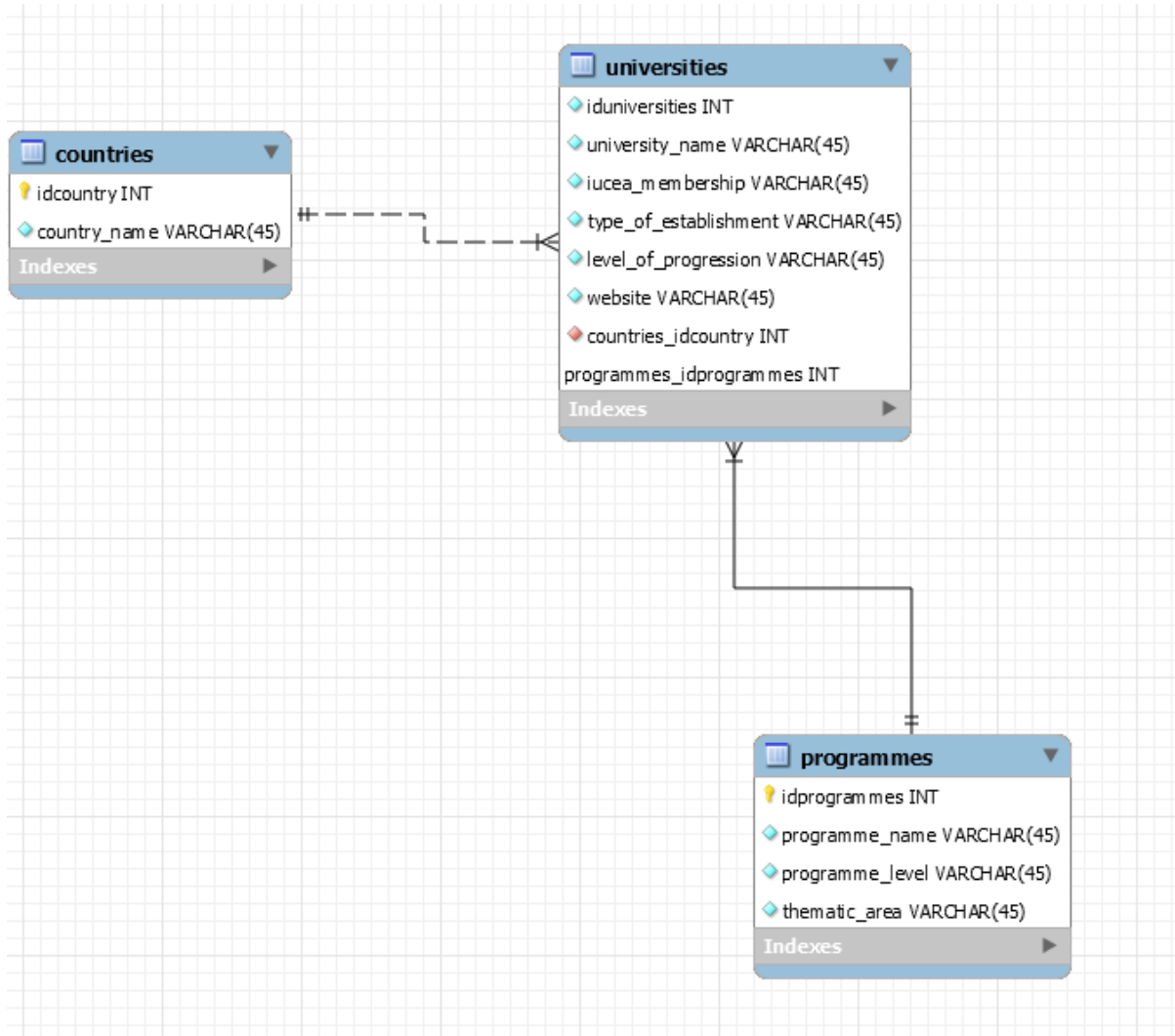
Figure 8: Entity Relationship Model

In this case entities are Countries, universities, and programmes. The models for the system are:

(i) Countries (idcountry, country_name)

(ii) Universities (iduniversities,university_name,iucea_membership, type_of_ establishment, level_of_progression, website,)

(iii) Programmes (idprogrammes, programme_name, programme_level, thematic_area)

For the system to work, a server must be turned on for local environment the apache server has to run simultaneously with the MySQL server on ports 80443 and 3306 respectively as shown in Fig. 9. On the Intranet of IUCEA the system runs on http://iucn.universityregister.org
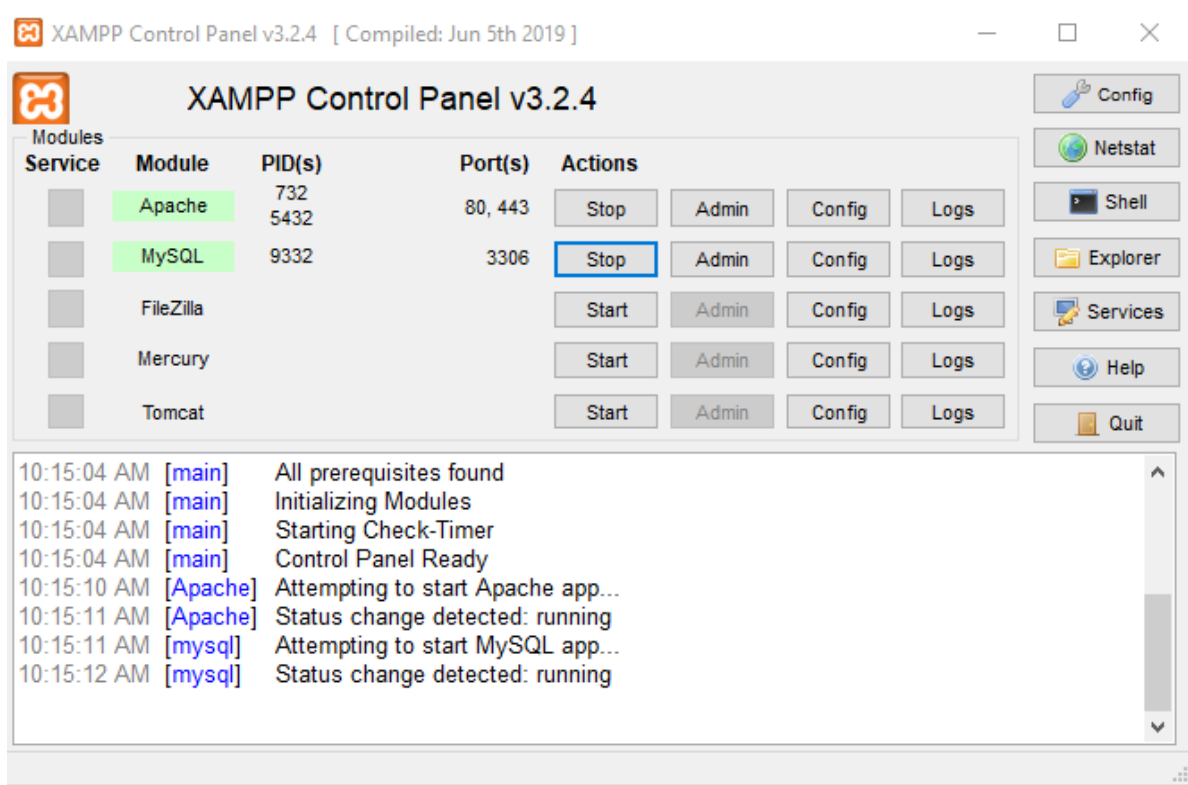
Figure 9: XAMP showing Apache and MySQL running

4.8 Django Object Relational Mapper (ORM)

The Django Object relational mapper (ORM) was used for database queries since it allows easy mapping of data stored in the database and source code.

4.9 Data Base Implementation

The MySQL database was chosen due to its compatibility nature and its ability of running in different server environment and is open source.

4.10 Assumptions Made

An assumption that users there was no fault connection between the database and Django and that the users have access to the internet and access to the computer was taken.

4.11 Modules of the Academic Programs Information System

4.11.1 Home Page

The Home page consists of the main dashboard, where summarized data of the whole region in form of graphs is displayed. It displays number of universities in the region, accredited post,

and undergraduate programmes in East Africa as shown in Fig. 10. The page also allows the user to search about a university or programmes in the region.
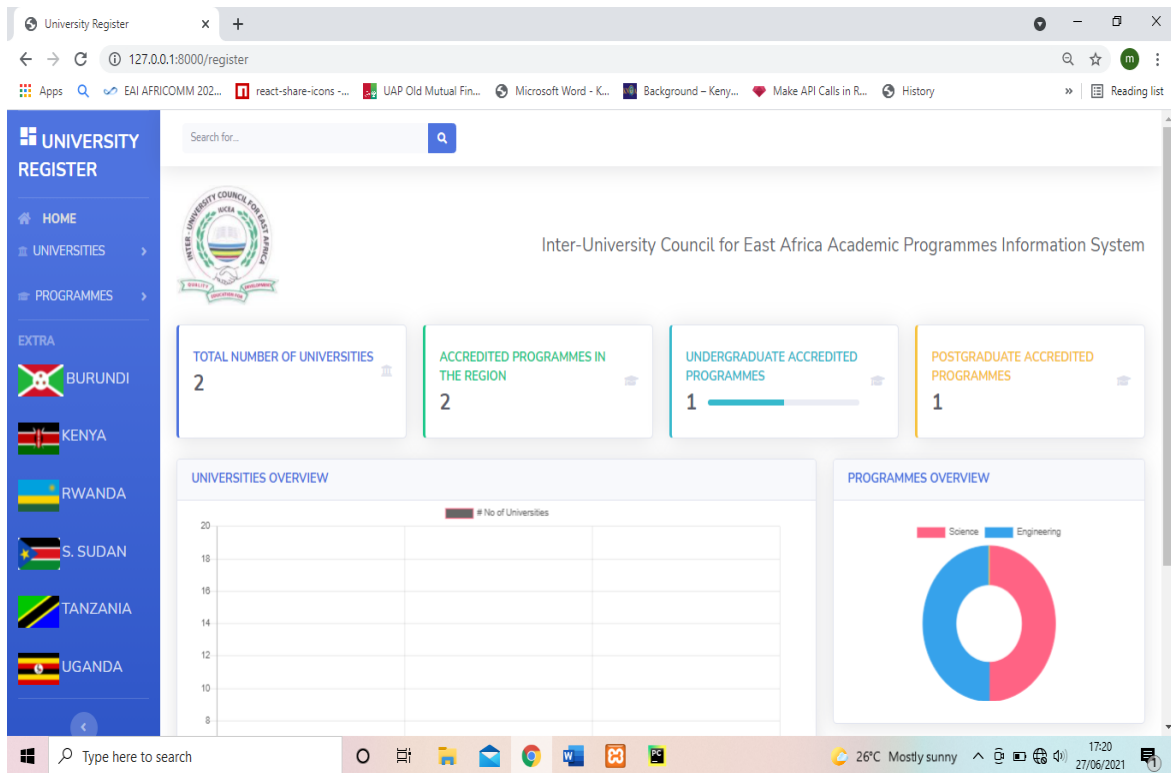
Figure 10: Home Interface for the APIMS

4.11.2 Universities Page

The Universities page displays information on universities, it shows country where a particular university is hosted, university name, IUCEA membership status, type of establishment, level of progression and website link as shown in Fig. 11.
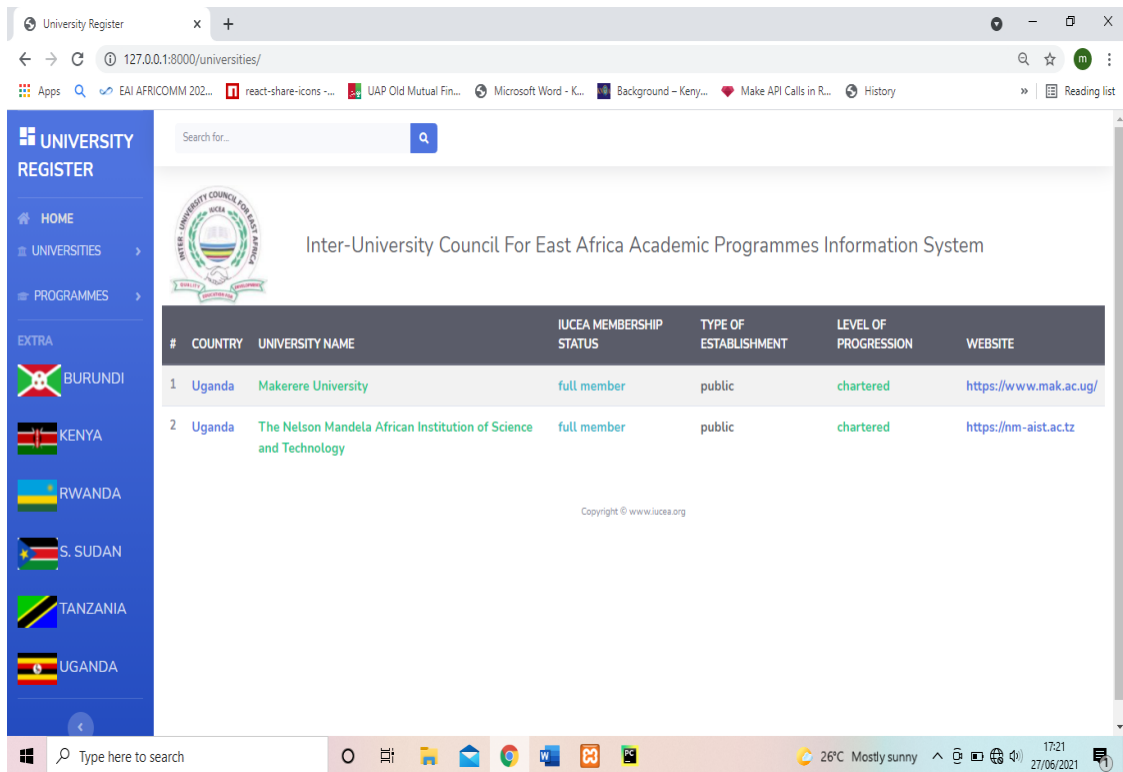
Figure 11: Universities Page

4.11.3 Programs Page

The Programs page displays information about particular universities in the region. The information displayed include University/Institution that hosts that particular program, the name of the program, Program Level, Program offering, and thematic area for the program as shown in Fig. 12.
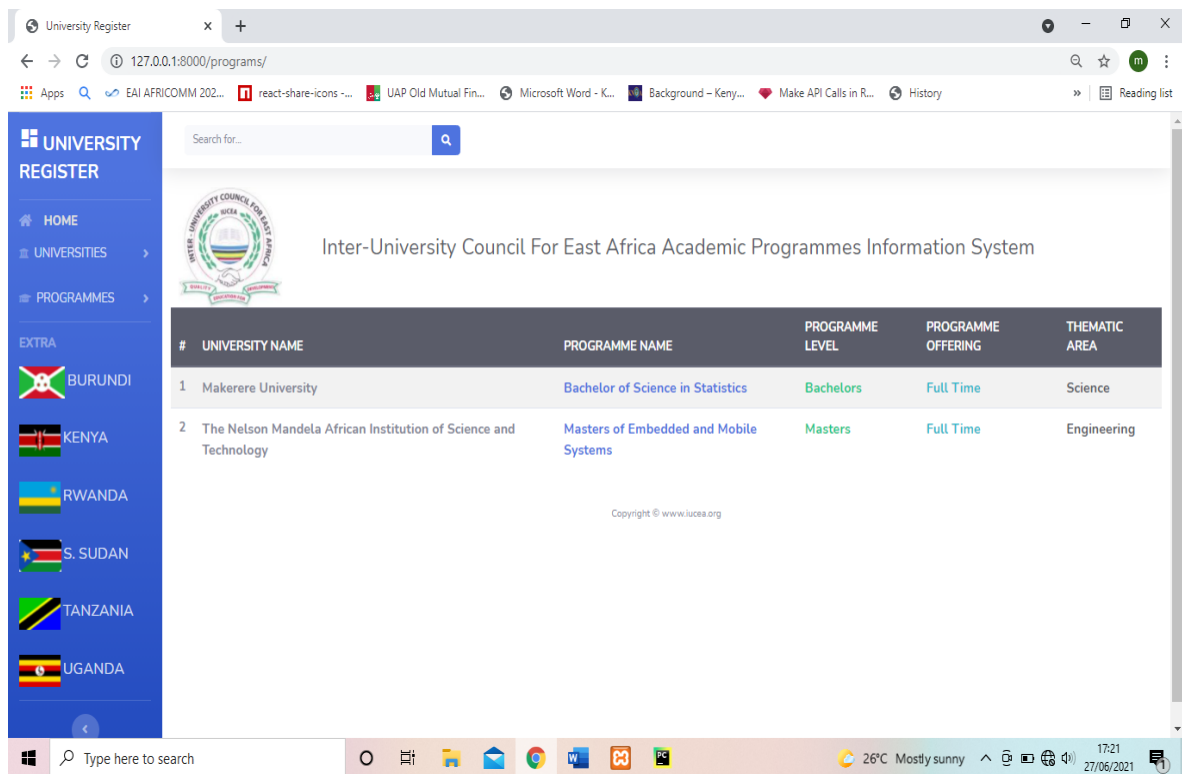
Figure 12: Programs Page

4.11.4 Individual Pages for Countries

This page disintegrates the universities and programs for each country in the region and for each country displays information on program name, program offering and name of the university where the program is hosted: The following sample page is for the Republic of Burundi as shown in Fig. 13.
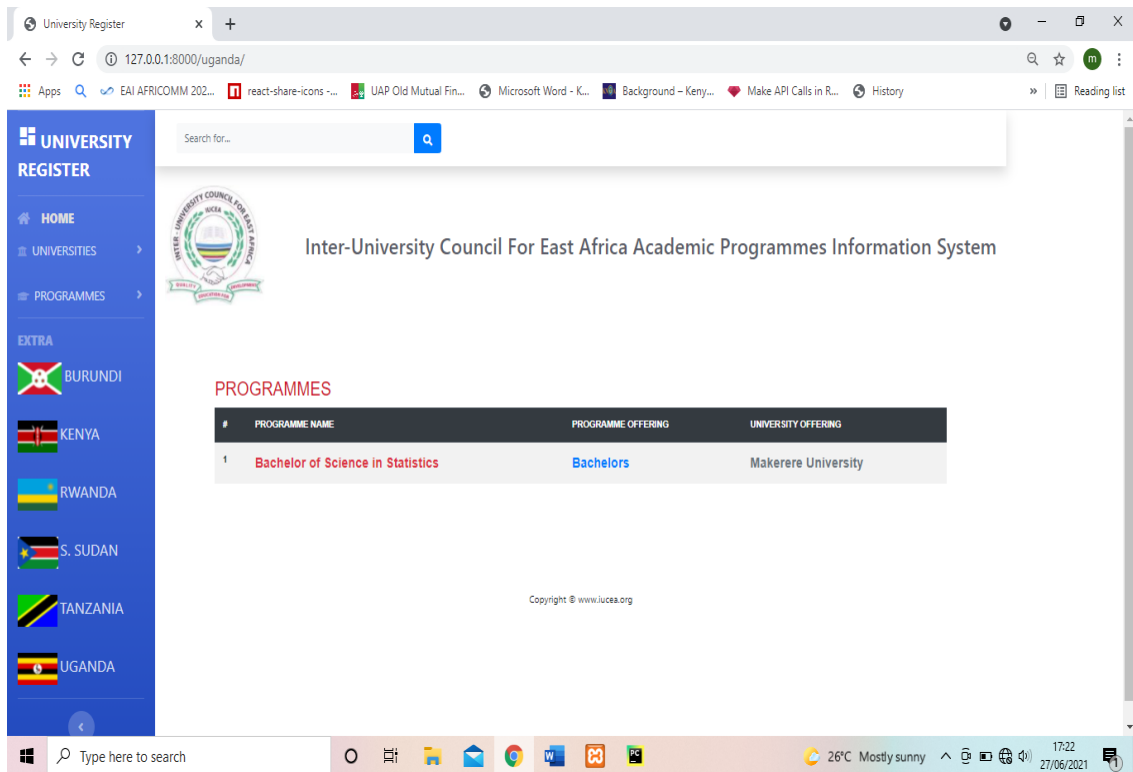
Figure 13: Individual Pages for Countries

4.11.5 Admin Dashboard

The admin dashboard is a feature that comes within the Django framework and it allows the administrator to manage the user and database models from the graphical user interface as shown in Fig. 14.
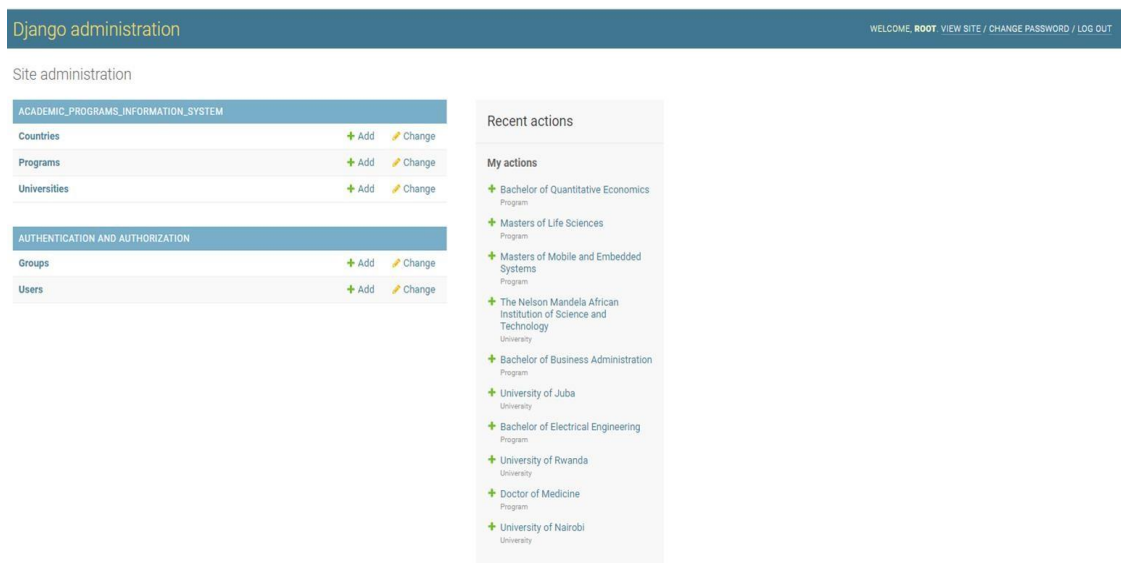
Figure 14: Admin and User Management Graphical user Interface

4.12 Validation and Verification of the System

4.12.1 Participants for the Study

The higher education experts of the IUCEA were clustered into 3 (three) clusters i.e. All Staff, ICT staff, and Quality assurance staff, the purpose of this clustering was to collect domain specific data. For this study we got fifteen (15) responses who are the staff of IUCEA and are fully involved in harmonization of education and training systems in East Africa. At the time of data collection, the Quality Assurance Unit had one (01) staff who was a female, the ICT unit had two (02) staff, and the questionnaire for all staff was filled by 12 respondents where by 41.7% were male, and 58.3 % were female.

Gender statistic is important in this study because the researchers were interested to find out the females engaged in quality assurance and student's mobility programmes at the IUCEA. Figure 15 below shows the gender statistic of the participants for the study.
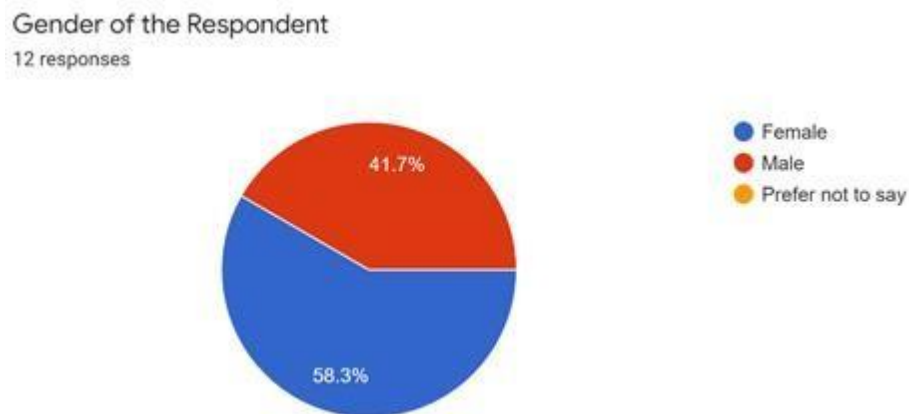
Figure 15: Gender Statistic for the Participants

Furthermore, the researchers were interested in the level of education group where by 91.7% are masters graduate, and 8.3 % are masters' graduate. This means that IUCEA's staff that is fully engaged in higher education quality assurance are those with postgraduate experience, probably they have at some point carried out individual research. Figure 16 shows the education level of the participants for the study.

Highest Level of education of the Respondent
12 responses

- Bachelors
- Masters
- Doctorate

91.7%

8.3%
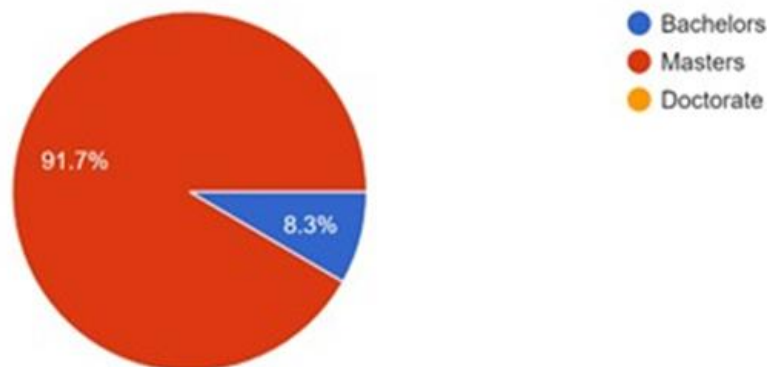
Figure 16: Education Statistic of the Participants

4.12.2 Impact of Academic Programs in Higher Education Quality Assurance

To capture the impact of the developed software platform, the researcher examined the viability and impact of the University Register on the Internal Processes and Procedures of quality assurance at IUCEA. All Respondents appreciated the impact that the System would have on their work. Figure 17 below shows the impact assessment results for the study.

Do you think the developed University Register will have an impact on your work?
12 responses

- Yes
- NO

100%

Figure 17: Impact Assessment for the System Developed

4.12.3 Perceived Impact for IUCEA work on Promoting International Mobility

To access which type of impact the System was going to have at IUCEA, the researcher outlined closed-end questions and ten (10) people who the majority were indicated that the system will have great impact on improving the cooperation and collaboration of the IUCEA. Figure 18 shows the results for the perceived impact of the system with regards to promoting international mobility in East Africa.
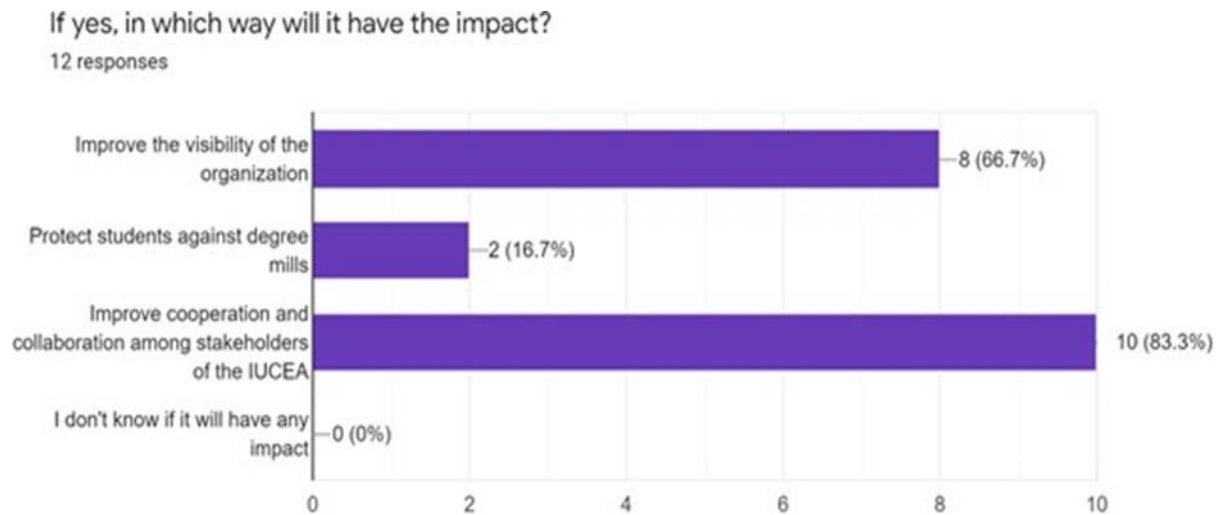
Figure 18: Perceived Impact of the System

4.12.4 Scope Area for the System

The researcher also sampled the respondents to understand the desired information and features that would impact internationalization and ten participants (10) desired the system to show information on all universities in the East Africa. Figure 19 shows results for the focus of the system.
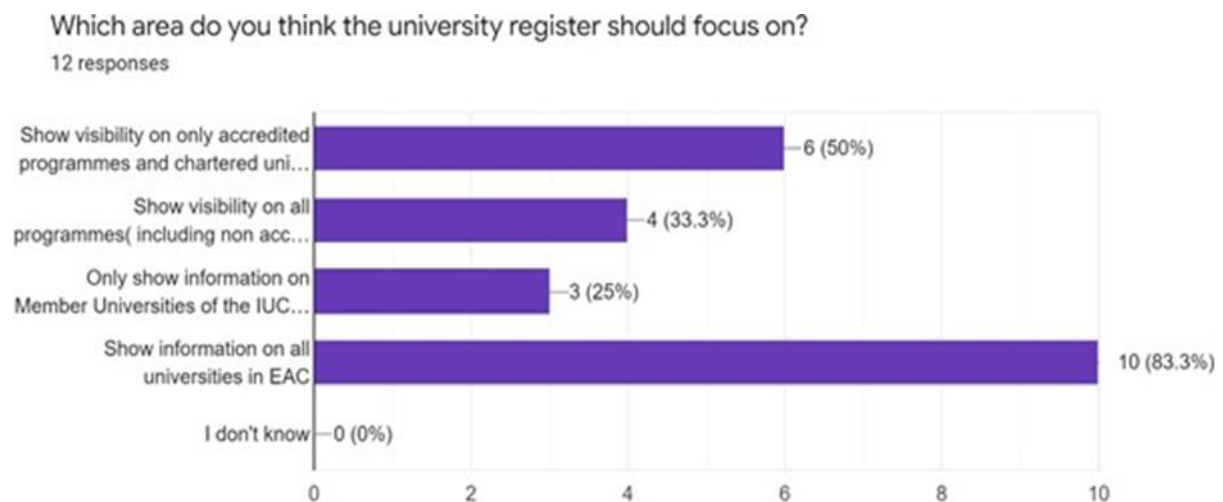
Figure 19: Focus for the APIMS

4.12.5 Data Channel for the System

The researcher attempted to find out which Channel the System will be optimized to receive data on accredited programmes and Chartered Universities. And from the quality assurance unit of IUCEA, we established that currently the University Register at IUCEA was not computerized, and that IUCEA received data from National Councils/Commissions for Higher

Education, and Universities within East Africa. Figure 20 below shows the status for computerization of Academic Programmes Information in East Africa.

Is the University Register of your Institution Computerized?
1 response

Does your University Register receive data from the National Councils/Commissions for Higher Education?
1 response

Does your University Register receive data from Universities in the EAC partner States?
1 response
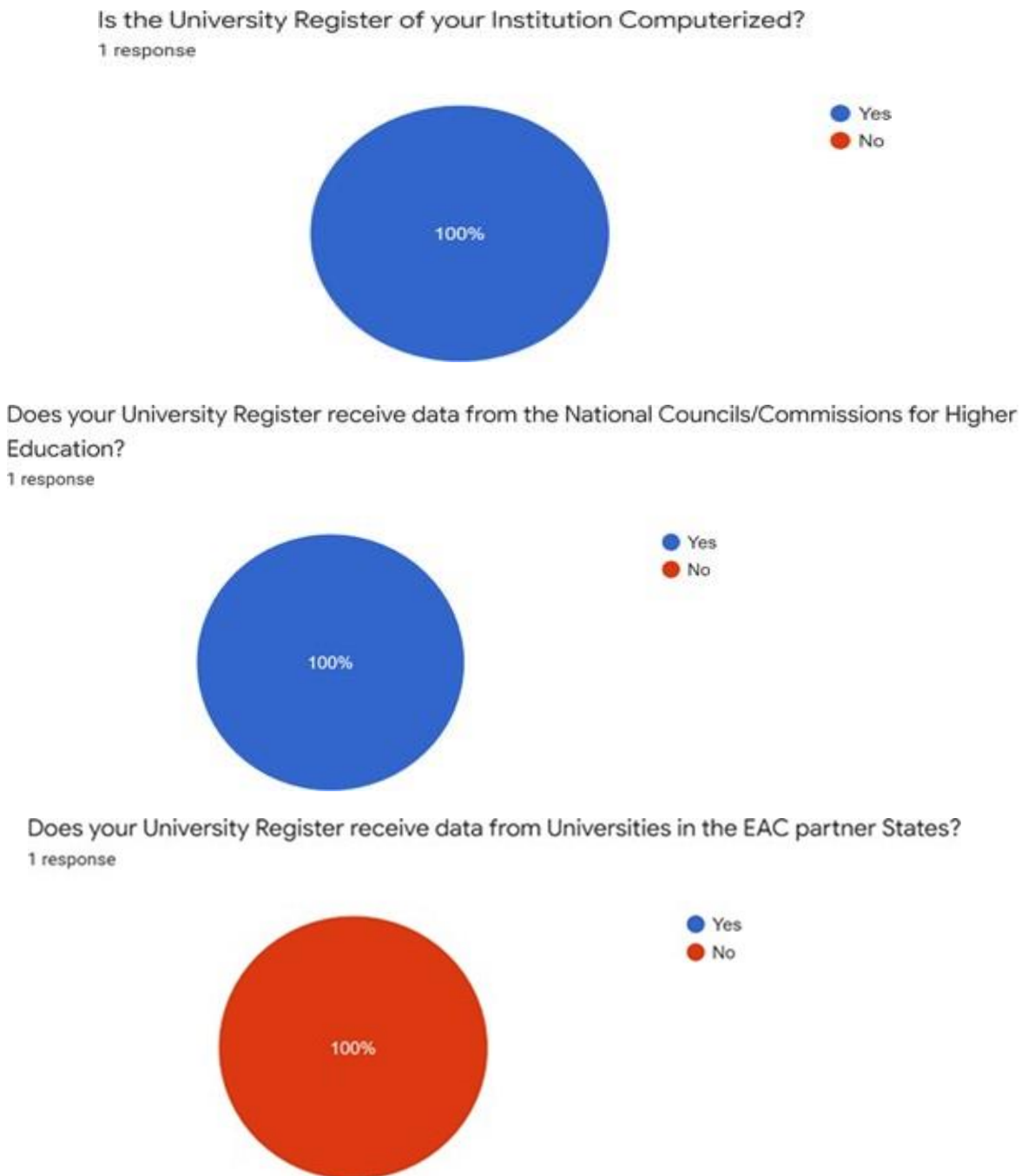
Figure 20*: **Status of Computerization of Academic Programs Information in East Africa**

4.12.6 Linking with other Academic Programs Information Management System in the Region

It was established in the baseline study report that there exists in the Universities, and National Councils/ Commissions of Higher Education other academic programs information

management system, and IUCEA would link with them in order to get real time data. The research thus attempted to establish the effective way for linking with these other systems, and results indicated that use of an Application Program Interface (API) will be the most efficient. Figure 21 below shows the results for the most efficient way of collecting Academic Programs Information from stakeholders of the developed System.

How best can data be channeled from Institutions to the IUCEA?
2 responses
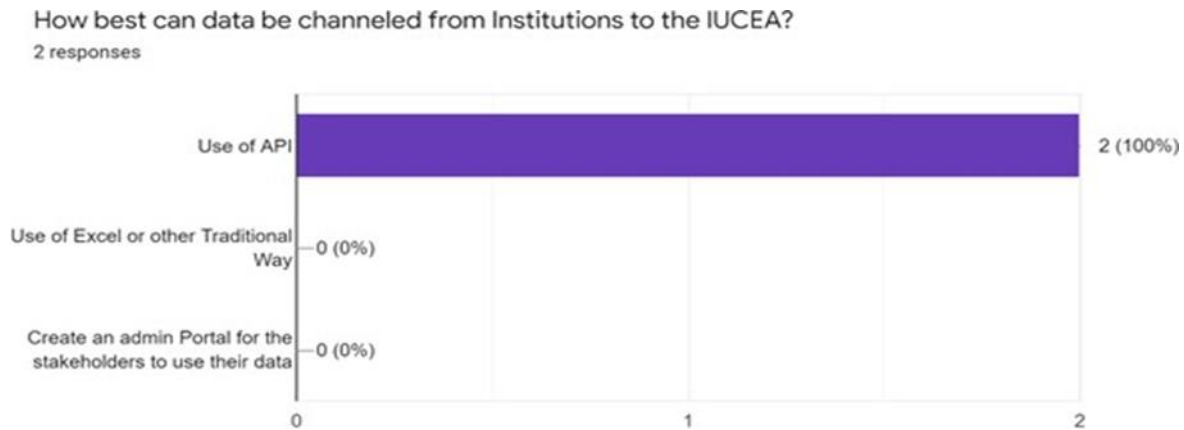
Figure 21: The most efficient way for Collecting Academic Programs Information from Stakeholders

4.13 Testing

The processes of verification of software include activities like reviews, walk throughs and inspection. Verification exercise of the system was performed by performing walkthrough which was often done by the ICT team at the IUCEA to check if the developed software met the standards or not. Validation which involves different phases of testing was done to check if the requirements for the software were met.

4.13.1 Unit Testing

Unit testing involves checking individual units or small components to check if they perform as expected. In this study, the units that were tested are home page, Search, generate report, Login to the admin dashboard, creating super user account, and adding a new user.

4.13.2 Integration Testing

Integration testing is performed to check compatibility of the system as a whole.

4.13.3 System Testing

System testing validates the fully integrated product against the requirements established for

the system. The developed software was validated according to the specified requirements and the results for the validation process are summarized in Table 5 below:

Table 5: Table Showing the Results for System Testing

Requirement	Description	Test Score
Management of the System	The Administrator shall manage the users, add, and edit information on universities and programmes	Passed
Search	The software shall enable users to search information on programmes and Universities	Passed
View Universities and Programmes	The software shall display information on programmes and Universities in East Africa	Passed
Generate Report	The software shall provide for generation of reports	Passed

4.13.4 User Acceptance Testing

User acceptance testing (UAT) is done to test if the system fulfills business requirements for end users. Twelve (12) higher education experts who gave requirements specifications for the system were given 5 days to interact with the software and later asked to give responses concerning the usability and adoption of the software Five-point scale Likert scale (5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1= Strongly Disagree).

The mean score for the questions as shown below indicated that:

- The software is easy to use and will impress the stakeholders of the IUCEA.

- The software is ready for pilot test in the East African Community.

- The software will promote students' mobility

- The User Acceptance Results for the developed system are shown in Table 6.

Table 6: Table Showing the Results for User Acceptance Testing

Validation Feature	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Score
The software is easy to use	0	0	0	6	6	4.5
The software will impress IUCEA's Stakeholders	0	0	0	0	12	5
The software will promote students' mobility	0	0	0	2	10	4.8
I recommend the system for piloting in East African Community Countries	0	0	0		12	5

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1   Conclusion

The results show that system is reliable and will r foster higher education cooperation and collaboration among universities and other stakeholders in the East African Community. The study recognizes the importance of ICT in promoting international students' mobility but there was no existing regional system that shows aggregated information of accredited programs offered in the community.

5.2   Recommendations

Lastly, I recommend that other systems which would work hand in with the academic Programs information system be developed:

(i)   Research Information System: To capture integrated information on type of research, funding and collaborations that exist among all universities in the East African Community. This would improve diplomacy and international relations for improved quality and comparability purposes.

(ii)   Human Capital Information System: To capture integrated information on human capital, i.e. Academic staff such as information on professors, senior lecturers, lecturers, teaching assistants, and other Non-Academic staff. This would promote staff mobility and strategically improve staffing among Universities in the East African Community.

(iii)   University Information System: To capture information University, in terms of student's enrollment in the programs, and existence of important facilities such as libraries and laboratories, and other assets that exists in the universities. This would improve quality of universities in the East African Community.

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APPENDICES

Appendix 1: Questionnaire for Quality Assurance Officer

Find it at this link:

https://docs.google.com/forms/d/1O4LykBFohpgD4TBltcCHT8ztZQC06BBoaUsNGW-O0s 4/edit

Appendix 2: Questionnaire for ICT Staff

Find it at this link:

https://docs.google.com/forms/d/1m_1cEWeIXlW86nAfYTqkeBSZ15TPXLw2At-jSggVb
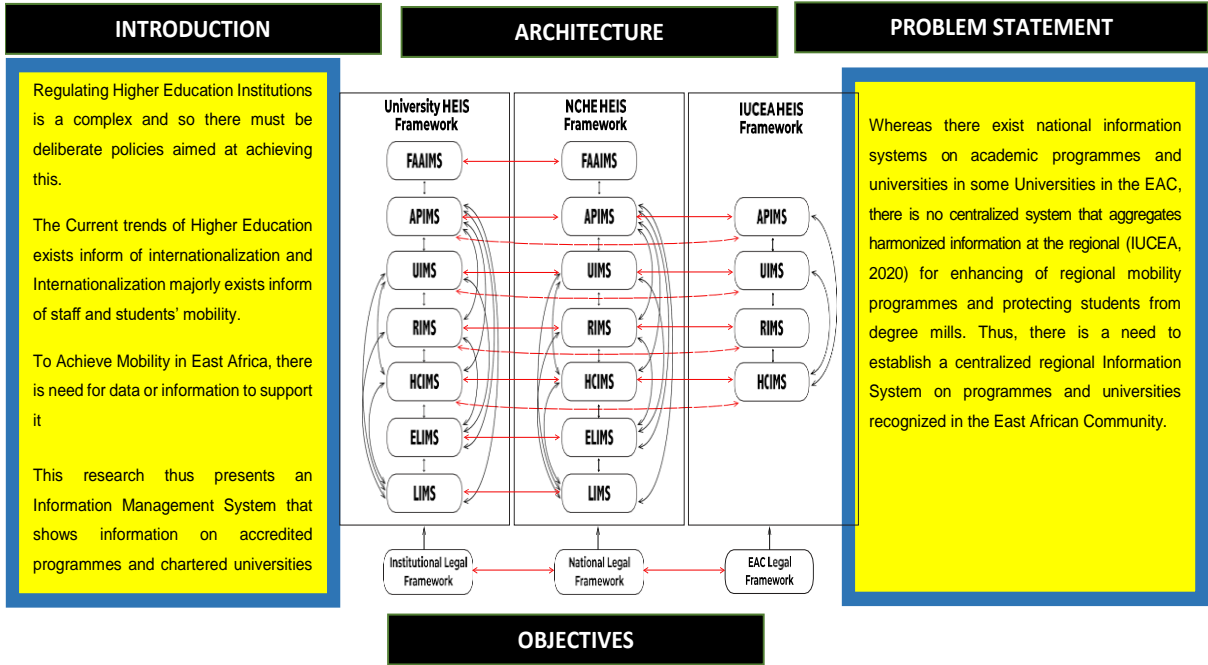CA/edit

Appendix 3: Questionnaire for All

Find it at this link:

https://docs.google.com/forms/d/1rNZ1Yn_Kh5Yq4jqsXVtZLTive-KkWhGEHk8g6P4-HN g/edit

Poster Presentation

Integrated Academic Programmes Information system: A case of Inter-University Council for East Africa

INTRODUCTION

Regulating Higher Education Institutions is a complex and so there must be deliberate policies aimed at achieving this.

The Current trends of Higher Education exists inform of internationalization and Internationalization majorly exists inform of staff and students' mobility.

To Achieve Mobility in East Africa, there is need for data or information to support it

This research thus presents an Information Management System that shows information on accredited programmes and chartered universities

ARCHITECTURE

PROBLEM STATEMENT

Whereas there exist national information systems on academic programmes and universities in some Universities in the EAC, there is no centralized system that aggregates harmonized information at the regional (IUCEA, 2020) for enhancing of regional mobility programmes and protecting students from degree mills. Thus, there is a need to establish a centralized regional Information System on programmes and universities recognized in the East African Community.

OBJECTIVES

THE MAIN OBJECTIVE: To deliver a fully functional an academic programs information system or software that promotes international students' mobility

SPECIFIC OBJECTIVES

- To assess the requirements for the information system that provides information on universities and programs in East Africa

- To develop a relational database for storing and communicating information with the developed system

- To develop a web platform that will present the information on universities and programs in the East African

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