



A Web Based System for Easy and Secured Managing Process of University Accreditation Information

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ABSTRACT

Higher institutions run various programs. These programs must be authorized, in other words accredited by a National Institution for accreditation to ensure quality and standards. This research paper aims to provide a convenient way of accreditation for the various programs in universities or institutions of higher learning. The College of Engineering at the Kwame Nkrumah University of Science and Technology (KNUST) was used as a case study. Using the client-server model, a web-based, very flexible, and well secured accreditation management software was designed to address most of the challenges faced with manual accreditation process of the College of Engineering. The system provides a central database where all accreditation related information of the various programs is stored for easy access and modification by authorized personnel. A secured link and robust access control via authentication were implemented and a user management system was integrated. The system was tested and resulted encouraging outcomes, with some further works are recommended in the future to improve the features of the system.

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1. INTRODUCTION

Accreditation is the approval of the university programs of study to meet the agreed standards established by a nationally recognized accreditation association. In the case of Ghana, it is the National Ac-

creditation Board (NAB) ("NATIONAL ACREDITATION BOARD," n.d.). Accreditation is important as it is a process conducted by an outside authority to ensure that a school and degree program meets certain standards of quality and rigor. The accreditation process requires a series of

stages or steps that span over some time and the ability to keep track of the stages of accreditation of a particular program at a point in time can be very challenging.

In Ghana, at the Kwame Nkrumah University of Science and Technology ("Home: Kwame Nkrumah University of Science and Technology," n.d.), College of Engineering, the accreditation of the programs of study is done by the National Accreditation Board of Ghana. Programs are mostly accredited every 5 years. It is sometimes difficult to track the programs in the college that are yet to be accredited. The KNUST College of Engineering over the years has been conducting accreditation manually. This is very stressful considering the amount of workload on faculty members who prepare all the documents before accreditation is done. Typically, the program accreditation is handled manually at the college when the next accreditation date of a program is due. The provost of the college will then have to contact the various Heads of Department in charge to begin the preparation of the said accreditation documents.

The NAB visits the college and takes various inspections of the documents submitted and the rest of the processes

follow accordingly. Although several different school software management applications have been developed to facilitate management of schools, for accreditation, however, which is a vital part of the school management process, is unfortunately not included in most school software management applications.

This project seeks to design accreditation software called AccSOFT for the College of Engineering and by extension the university, that aims to address all the issues and provide an easy way to track the accreditation status of all programs in the university or institution of higher education and automatically generate materials required for the accreditation process to the NAB. The AccSOFT software system will automatically inform all officers in charge of the accreditation-related issues at the College of Engineering to start preparing their documents before the auditor arrives for accreditation. Thus, the system will automatically send alerts and emails to officers in charge by generating a PDF file and or any required document format containing the various accreditation status of respective programs which would be forwarded to the officers and authorities.

Table 1. Some management software applications

Application	Description
ACADEMIC INFO MANAGEMENT (AIM) ("Academic Information Management System," n.d.)	KNUST management software suite for students to monitor their academic performance ie. check their results, register for courses, access lecturers, and other necessary academic activities.
VIRTUAL CLASSROOM (VCLASS) ("Home: Kwame Nkrumah University of Science and Technology," n.d.)	KNUST online system for all colleges to access their course materials, submit assignments, take tests and examinations, and other classroom-related activities.
KNUST APPS PORTAL ("KNUST PORTAL," n.d.)	The KNUST apps portal helps prospective students access online application forms and book accommodation.

2. RELATED WORKS

A few software management applications have been developed by KNUST to help facilitate management of school-related activities on campus, yet none of these applications made it possible to ease and automate the accreditation process. Some of these software applications or projects are shown in **Table 1**. All of these software applications designed by the university for the use of students in their respective colleges and they can cater to some extent for the academic information and other necessary educational needs. However, the system does not have a facility for evaluating the evidence, documents, and reports for accreditation.

Another work considered for this project is the Accreditation Software for Higher Education Programs (ASEP) (Hassan, Al-Badarneh, & Qawasmi, 2016). In ASEP, an academic institution can use automated system developed to analyse and formulate qualitative data such as exams, quizzes, and assignments.

The proposed system measures course learning outcomes and student outcomes and automatically generates a course syllabus and course survey. Student outcomes are one key component to getting a program accredited, so this system focuses on getting this data from questions in exams, assignments, quizzes, and additional questionnaires. One of the main tasks of ASEP is to perform all different mapping automatically, such as mapping the department objectives and Program Learning Objectives (PLO) to Students Outcomes (SO). ASEP enables the institution to have updated records of students' performance which aids any institution to accredit the university's performance. However, the software is not able to automate the tracking of the accreditation process. **Table 2** contains accreditation processes of some countries.

3. METHODS

Accreditation is a process of external quality review created and used by higher education to scrutinize colleges, universities, and programs for quality assurance and quality improvement. The accreditation process involves several stages and procedures regarding the universities and the countries. This paper focuses on accreditation programs that are taught at the higher level: universities. The process involves two main parties: the accreditor and the university. The university, upon its decision to introduce a new program, provides a well-documented set of information to the accreditor, and based on that, the accreditor will decide whether to accredit the program or not. There are other stages in the accreditation process, but those are beyond the scope of this paper. Each accreditor has its parameters for determining program quality, but some important parameters to most accreditors are:

- Employability of students after taking the program
- Students' performance and achievements
- Staffing
- Resources

A university must provide all the necessary information for accreditation to the accreditor. Accreditation shows the performance of a higher-level institution, and accreditation from a reputable accreditor is highly respected. Upon submitting the required information, the universities track the process of program accreditation, which is mostly done manually. This paper focuses on the provision of an accreditation management software (AcSOFT) that can track the accreditation process and keep the university updated about progress.

Table 2. Accreditation processes for some countries

Country	Process
Ghana ("NATIONAL ACREDITATION BOARD," n.d.)	Accreditation of programs in Ghana is done by one principal accreditor: National Accreditation Board (NAB). The accreditation process requires a series of steps that spans over some time. After a program has been accredited, the accreditation immunity lasts for five years, after which the program must be re-accredited. There is no convenient way to submit materials needed for the accreditation, and there is no accessible system to track the accreditation progress of the program.
Vietnam (Nguyen, Evers, & Marshall, 2017)	In Vietnam there are several aspects in higher education accreditation, including the development of the accreditation framework, establishment of accrediting agencies, completion of almost all universities' self-assessment reports, and implementation of external assessment exercise at some institutions. However, there remain several challenges: the independence of the accrediting agencies, human resources, accreditation standards and criteria, institutions' awareness about accreditation, and the pace of accreditation implementation. The Vietnam accreditation can be improved when it establishes more credible accrediting agencies and has the necessary infrastructure such as an automatic application to manage the accreditation process.
USA (Education, 2021)	In the United States, accreditation is carried out by private, nonprofit organizations. The USA accreditation structure is decentralized and complex. There are four types of accrediting organizations in the USA. Accreditation organizations derive legitimacy from the colleges, universities, and programs that created accreditation, not the government. Accreditation of institutions and programs takes place on a cycle that may range from every few years to 10 years. The steps involve a combination of several tasks: preparation of evidence of accomplishment by the institution or the program, scrutiny of this evidence, and a site visit to the faculty and administrative peers and action by the accreditation organization to determine accreditation status. One of the recognized accrediting agencies is Accrediting Commission of Career Schools and Colleges. This agency can accredit postsecondary, non-degree-granting institutions and degree-granting institutions in the United States. The agency provides a digital platform that enables the tracking of the accreditation process.
Egypt (Schomaker, 2015)	<p>The accreditation process in Egypt has five (5) steps as follows:</p> <ol style="list-style-type: none"> 1. Self-evaluation of the institution 2. Review (on-site or off-site) 3. Report of the reviewers 4. Feedback option for the institution of higher education 5. Final review and decision by NAQAAE <p>A significant drawback with this accreditation system is that the process is time-consuming. Beyond quality problems, only a few universities have undergone accreditation despite the number of applications per year mainly due to poor quality of accreditors. The university applying for program accreditation can track the progress of the accreditation manually. There is no easy tracking system available.</p>

The AccSOFT system consists of two main users, the school or program administrators and the external body, which is the National Accreditation Board. The National Accreditation Board can easily send the requirements or documents needed to mark a program as accredited through

the platform. The administrators in charge are then able to have access to these documents and begin preparing their accreditation documents to meet the said conditions or requirements. Complete accreditation documents are sent via the AccSOFT management system, after which

the NAB can begin the verification of the documents to mark a program as accredited. If the program is marked as verified, the system generates an accreditation certificate for that program. The AccSOFT accreditation software allows the school administrators, the lecturers, and the person in charge of accreditation to know the accreditation status of a particular program and submit accreditation materials for programs due for reaccreditation so that the accreditation process can begin. The accreditation body can then access these materials and start the accreditation process. An administrator can go through the process to see whether a program is marked accredited or otherwise. The AccSOFT system is designed to keep track of every college, every faculty in the college, every department in the faculty, and every program offered in the department.

3.1. AccSOFT System Architecture

Figure 1 shows the system architecture of the AccSOFT accreditation system. University or college administrators can submit full or part of the accreditation documents and as well retrieve accreditation requirements from the secured cloud-based database. NABs can also send accreditation documents or requirements and specifications and receive accredita-

tion documents from same centralized database. Finally, the AccSOFT system checks for successful process completion and issue program tag and accreditation certificate. There is an alert system which monitors all dates of programs due for re-accreditation and triggers alarm as well as auto-generate emails to notify authorities and person responsible to initiate the accreditation process.

3.2. AccSOFT System Block Diagram

As shown in **Figure 2**, the AccSOFT system contains two main components; the frontend (ReactJS) (Gackenhimer, 2015), (Eisenman, 2017), (Mohan, 2020) system and the backend (ExpressJS, NodeJS) (Brown, 2016), (Cantelon, Harter, Holowaychuk, & Rajlich, 2013), (Mardan, 2014) and the ExpressJS framework (Mardanov & Chakkaev, 2013), (Mardan, 2014), (Hahn, 2016). It connects to the MongoDB database via a mongoose Object Data Mapper (ODM). ODM is a special technology that allows applications to connect to a database server such as MongoDB (Banker, Bakkum, Verch, Garrett, & Hawkins, 2016), (Chodorow & Dirolf, 2010), (Copeland, 2013). The Backend system contains the CRUD system which allows writing and reading data to and from the database.

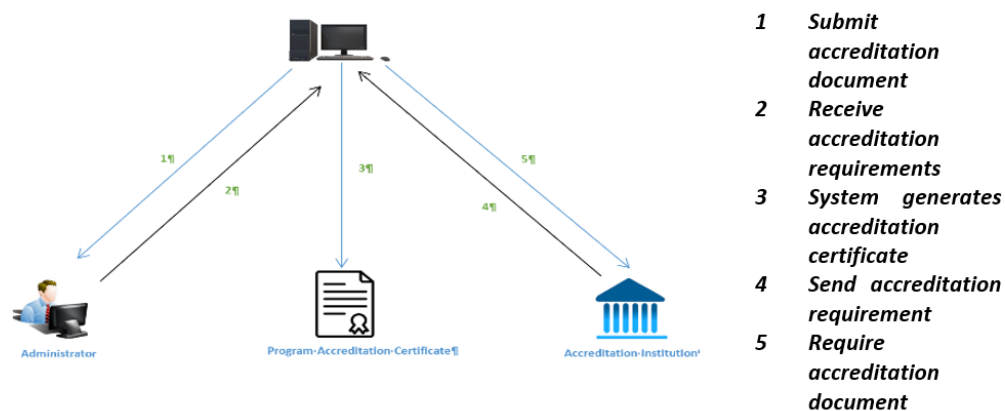


Figure 1. AccSOFT Sytem Architecture

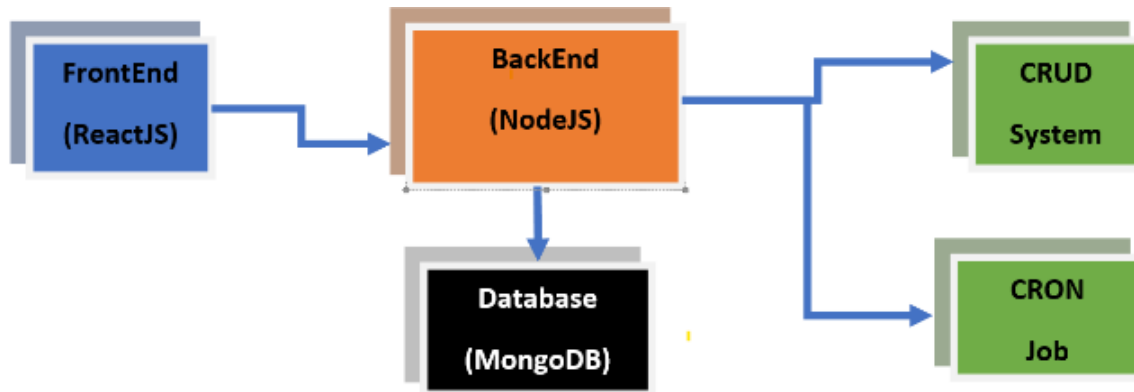


Figure 2. AccSOFT System Block Diagram

The backend is also connected to three main services which are the authentication service, the email service, and the security service.

The authentication service is the service that prevents unauthorized users from seeing some parts of the application. It helps in identifying the various users on the platform through a login system. The email service is the service that the backend system leverages to send emails to administrators and lecturers in charge when a program is near its next accreditation or has expired accreditation. The email service is also used in sending out general system notifications such as password reset mail, etc.

The security service is used to ensure the entire system is robust and is prevented from common attacks such as Cross-Site Scripting attack (XSS) (Grossman, Hansen, Petkov, Rager, & Fogie, 2007), (Tripathi & Thingla, 2019), (Gupta & Chaudhary, 2020) and Server Side Includes (SSI) (Fagan, 2002), (MLIS, 2004), (Alten, n.d.) Injection attacks by setting various HTTP headers. It also prevents the application from certain domains using Cross-Origin-Resource Sharing (CORS) headers (Hossain, 2014), ("Setting up CORS," n.d.).

Also, there is a particular application called cron job, a background task scheduler that runs at the beginning of every

month. The cron job goes through each program in the entire database to see if it is getting close to its next accreditation date. In the case that a program is due for reaccreditation, the system automatically sends message or alert to the administrators in charge of that program and the responsible person for the accreditation application initialization, informing them that the said program is due for reaccreditation. The administrator can now begin the preparation of the accreditation materials for onwards submission to the next accreditation phase. When all stages are completed, the accreditation body can mark the program as duly accredited. The AccSOFT management software allows authorized officers to view the accreditation certificates of programs that are accredited. These accreditation certificates can be printed out. Furthermore, the AccSOFT system shows the step involved in the accreditation process, clearly outlining how to go about it. There is a functionality in the ACCSOFT system that allows authorized officers to download the various templates required for the accreditation and there are provisions for authorized officers to download and fill accreditation forms online. Users with administrative rights can also tag or mark a program as accredited. The AccSOFT application allows a super-administrator to create new programs and add or remove existing programs.

3.3. AccSOFT Software System Accreditation Process

Flow charts in **Figures 3a, 3b, 3c** and **3d** depict stages or steps involved in the AccSOFT software system accreditation process. There are mainly four (4) main stages involved in this case:

1. Application and application review Stage
2. Assessment Stage
3. Decision Stage
4. Surveillance and Renewal Stage

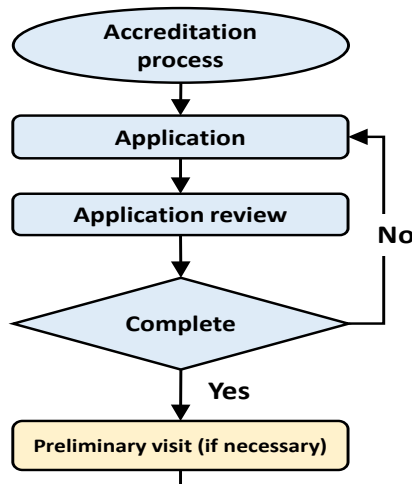


Figure 3a. Accreditation stage 1

Step 1: Application and Application Review

An application must be submitted to the Director General. The applicant receives GhaNAS documentation and must then provide all elements required to determine the adequacy of the application. A documentary review is carried out to determine the suitability of the file.

Step 2: Assessment Stage

An assessment is conducted by a team of qualified GhaNAS assessors and experts competent in the quality and technical aspects related to the requested accreditation scope.

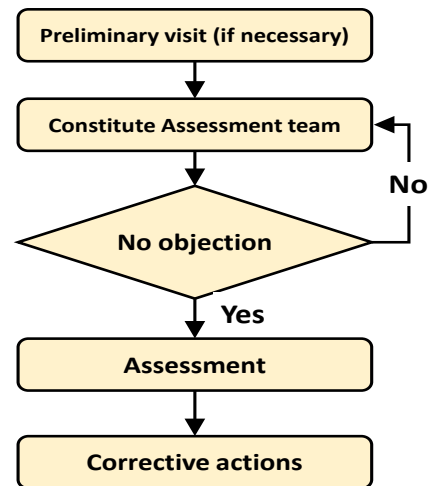


Figure 3b. Accreditation stage 2

Step 3: Decision Making Stage

The Director General decides on granting of accreditation based on evaluation of all accreditation information.

Accreditation is granted for a period of 5 years that can be renewed. GhaNAS conducts an average of three (3) surveillance assessments (1st Surveillance in 12 months followed by once in 2 years) to ensure that CAB continues to be compliant with accreditation requirements. An assessment of renewal is made towards the end of the 5-year cycle.

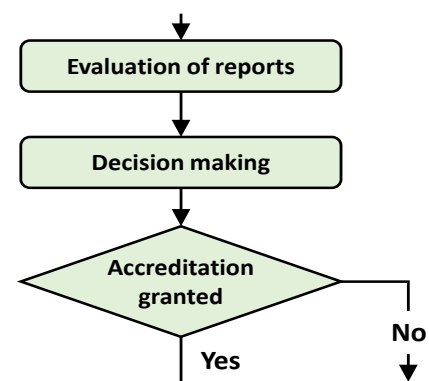


Figure 3c. Accreditation stage 3

Step 4: Surveillance and Renewal Stage

There are basically two (2) actors involved in the AccSOFT system software: Guest and Administrator. **Figure 4** and **Figure 5** depict the Use Case Diagrams for 'Guest' and 'Administrator' respectively.

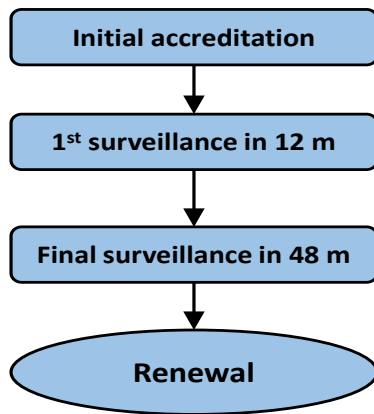


Figure 3d. Accreditation stage 4

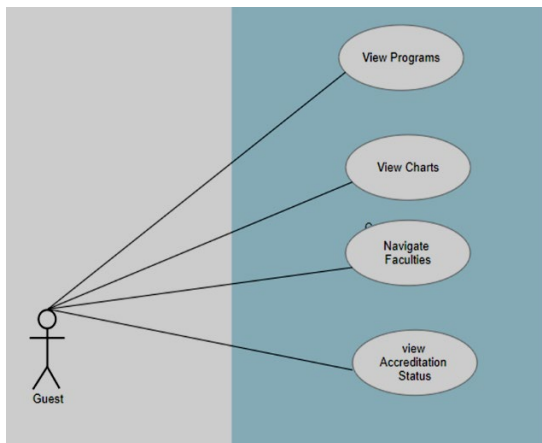


Figure 4. Guest Use Case Diagram

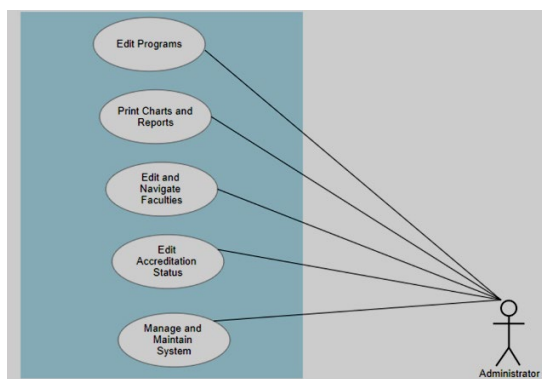


Figure 5. Administrator Use Case Diagram

4. RESULTS AND DISCUSSION

The AccSOFT software management application was tested vigorously. All the individual modules and functionalities were tested in various ways. Once the software is launched, the user is directed to the main page or frontpage. The frontpage contains a welcome message, and a navigation bar of various features

such as the About, Contact, Help, Login, etc. as shown in Figure 6.

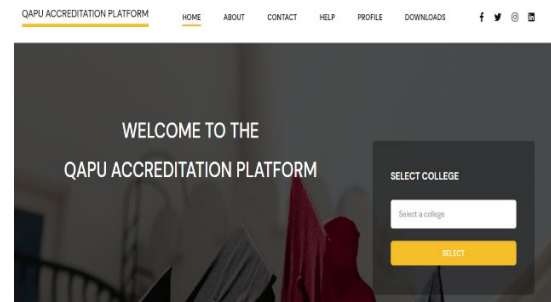


Figure 6. AccSOFT Frontpage

Here, all of the existing colleges in the university are listed for selection. Once a college is selected, user is redirected to the login page, where one has the option to login as an administrator with the root credentials or as a guest with no or limited credentials as shown in Figure 7.

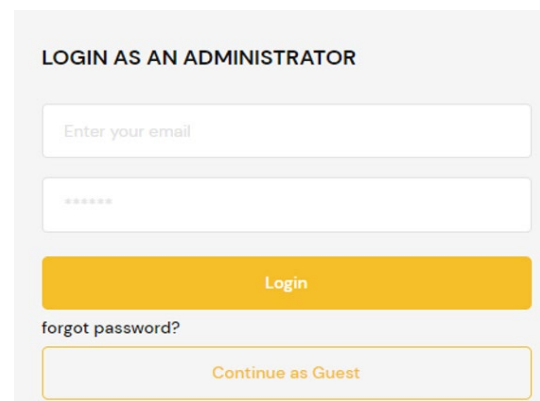


Figure 7. User login screen

Figures 8, 9 and 10 contain screen shots and functional description of some menu items.

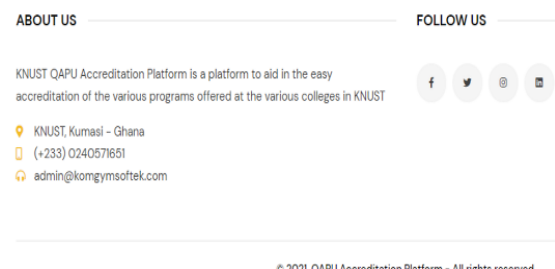


Figure 8. About Menu Item

The About item provides general information about the AccSOFT telephone accreditation application. Location,

number and email address are also provided.

Figure 9. Contact Menu Item

On the Contact item, user gets information about how to contact the institution. Links to the various social media platforms are available, as well as a message text form where users can directly send the institution messages by providing their names, email addresses, website – if needed – and finally the body of the message.



Figure 10. Download Menu Item

The download tab opens two templates that can be downloaded, they include the KNUST accreditation template and the NCTE support request template. These have been made readily accessible and easy to download as files with a .docx extension.

As stated earlier, there are two (2) ways a user can login: Guest and Administrator.

4.1. GUEST LOGIN

To login as a guest, the user clicks 'continue as guest' button on the login page as shown in Figure 7. The guest user can navigate from a faculty to a department, down to specific programs to check on their accreditation information.

At the first level a user is introduced to the faculty as shown in Figure 11. Here, user can view accreditation chart and generate accreditation status report if required. There is also an option to export record of accreditation status as excel sheet.

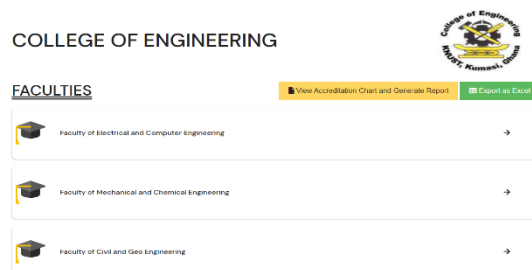


Figure 11. Guest faculty level screen

Upon selecting a particular faculty, user then proceeds to selecting the desired department as shown in Figure 12.

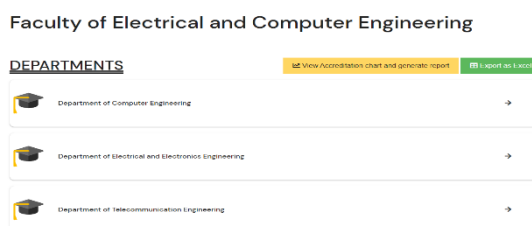


Figure 12. Guest department level screen

User can now choose a particular program they wish to be informed about as displayed in Figure 13.

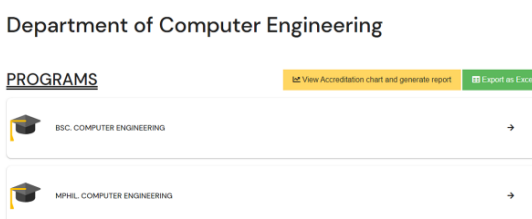


Figure 13. Guest program level screen

Once a program is chosen, a pop-up comes up on the screen with all the details pertaining to the accreditation of that program as shown in Figure 14. At the top of the pop-up is the status of the program: whether accredited or not accredited. Here, there is also the possibility to view the accreditation certificate issued if program is accredited.

BSC. COMPUTER ENGINEERING		Status: Accredited
Title	Value	
NAME	BSC. COMPUTER ENGINEERING	
TYPE	Undergraduate	
ACCREDITED	True	
NEXT ACCREDITATION DATE	2nd August, 2025	
ACCREDITATION PROCESS STARTED	False	
ACCREDITATION STATUS	ACCREDITED	
ACTION TAKE		
ACTION CONTEXT		

[View Accreditation Chart](#)

PHD. BIOMEDICAL ENGINEERING		Status: Not Accredited
Title	Value	
NAME	PHD. BIOMEDICAL ENGINEERING	
TYPE	Postgraduate	
ACCREDITED	False	
NEXT ACCREDITATION DATE	-----	
ACCREDITATION PROCESS STARTED	True	
ACCREDITATION STATUS	NOT ACCREDITED	
ACTION TAKE	WITH GITEC	
ACTION CONTEXT	RECEIVED RECEIPT FOR PAYMENT OF ASSESSMENT FEES	

Figure 14. Guest accreditation status

Other information provided about the program are Name, Type (undergraduate or postgraduate), Accredited (True/False), Next accreditation date, Accreditation process started (True/False), Accreditation Status, Action to Take and finally Action context. On every page in the guest login view from faculty to programs view, users are given options to view a summary of the accreditation chart and generate a report or export the file as an excel sheet. At the faculty level, when a user clicks on the 'View Accreditation chart and generate report' button, the user is shown a pop-up of the summary of all accredited and not accredited programs in the college of engineering as shown in **Figure 15a** and **Figure 15b**.

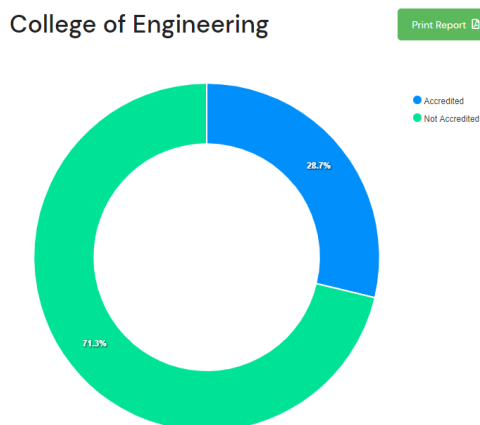


Figure 15a. Guest summary of accreditation status

Program Name	Program Type	Accredited	Next Accreditation Date
BSC. COMPUTER ENGINEERING	Undergraduate	True	31st August, 2025
MPhil. COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
MSC COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
PHD. COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
BSC. BIOMEDICAL ENGINEERING	Undergraduate	False	-----
MPhil. BIOMEDICAL ENGINEERING	Postgraduate	False	-----
PHD. BIOMEDICAL ENGINEERING	Postgraduate	False	-----
Bsc. Gender and Women studies	Undergraduate	False	-----
BSC GEOLOGICAL ENGINEERING	Undergraduate	True	31st January, 2022
MPhil. GEOGRAPHIC INFORMATION SYSTEMS	Postgraduate	True	11th May, 2023
MSC GEOGRAPHIC INFORMATION SYSTEMS	Postgraduate	True	11th May, 2023
PHD GEOMATIC ENGINEERING	Postgraduate	True	10th May, 2023

Figure 15b. Guest summary of accreditation status

A pie chart of the accreditation status of the various programs are shown, and below it is a summary of the various programs with the following details: Name of the program, Type, Accreditation status and Next accreditation date. The type of summary obtained varies from the faculty level page down to the programs level page. At the department level, a summary of all programs in the faculty chosen is seen **Figure 16a** and **Figure 16b**.

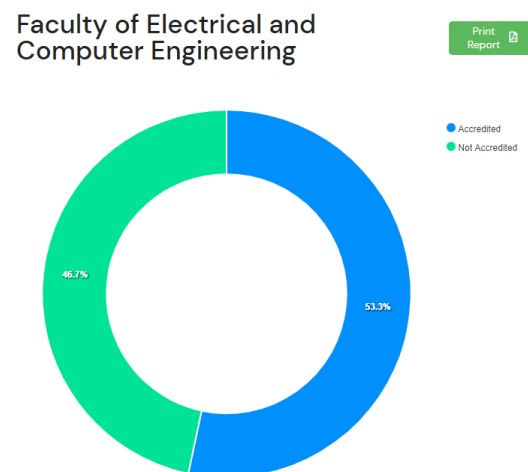


Figure 16a. Guest pie chart of accreditation status

Program Name	Program Type	Accredited	Next Accreditation Date
BSC. COMPUTER ENGINEERING	Undergraduate	True	31st August, 2025
MPHIL. COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
MSC COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
PHD. COMPUTER ENGINEERING	Postgraduate	True	31st July, 2023
BSC. BIOMEDICAL ENGINEERING	Undergraduate	False	-----
MPHIL. BIOMEDICAL ENGINEERING	Postgraduate	False	-----
PHD. BIOMEDICAL ENGINEERING	Postgraduate	False	-----
Bsc. Gender and Women studies	Undergraduate	False	-----
BSC. ELECTRICAL AND ELECTRONIC ENGINEERING (OBUASI CAMPUS)	Undergraduate	False	-----
BSC. ELECTRICAL AND ELECTRONIC ENGINEERING	Undergraduate	True	1st September, 2025
MPHIL ELECTRICAL AND POWER SYSTEMS ENGINEERING	Postgraduate	False	-----
PHD. ELECTRICAL AND ELECTRONIC ENGINEERING	Postgraduate	False	-----

Figure 16b. Guest pie chart of accreditation status

4.2. ADMIN LOGIN

A user can login as an administrator once that user has been invited by another administrator or the platform manager. In the login page as seen in Figure 7, the user will require an email address and a password. When a user is logging in for the first time, they will be provided with a randomly generated One-Time-password (OTP), upon which the said user would have to set a new password as seen in Figure 17.

Figure 17. Change password

When a user forgets the password when logging in next time, they can use the forgot password link. They will be made to enter their email address so that a link will be sent to their email where they can reset their password as seen in Figure 18a and Figure 18b.

Figure 18a. Change password 1

Figure 18b. Change password 2

Once logged in, the navigation bar for an admin user is modified to contain a new feature: Profile. The profile feature enables the user to change their username and password, add a new administrator and logout as can be seen in Figure 19.

Figure 19. Add Administrator

To add a new administrator, the user should provide a username and the email address of the new administrator. Upon submission, an invitation is sent to the new user alongside a randomly generated password. The administrator has more privileges than a guest user. An administrator can add new programs to the department as well as delete or modify existing programs as seen in Figure 20. When in the details of a particular viewing

the program, the administrator aside from accreditation certificate can upload or download accreditation requirements and materials all in pdf format. **Figure 21** contains the admin view of program details.

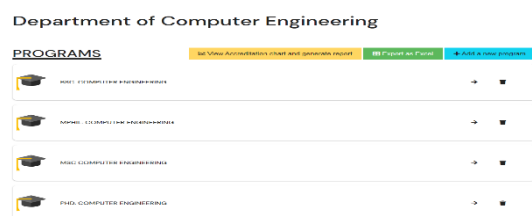


Figure 20. Administration of Departments



Figure 21. Administration of Programs

5. CONCLUSION

Previously, accreditation of programs at the KNUST was done manually, which is time-consuming and stressful because of

the number of the severe and mechanical inputs involved. Accreditation officers and other workers find it very difficult to keep dates and meet up deadlines due to the number of programs hosted by each college in the university. This accreditation system has every functionality that is needed to run the accreditation process automatically, simply, and smoothly. Ac-SOFT provided a flexible but very secured interaction with users and helps the accreditation officers to prepare accreditation documents on time and improve upon the quality of coursework delivered by the university. Other functionalities such as real-time notification alerts, super administrators delegating new admin users are all provided.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper is free of plagiarism.

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