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E-Workflow for Official Documents

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Abstract: Documents are important part of any business or organization. Traditional methods of document processing rely on staff members manually handling data and taking documents from one office to the other either for approval or evaluation. This comes with many drawbacks like delay in processing, heaps of files on someone's desk, misplacing of documents, missed steps or sequence of reporting, mutilation of files due to mal-handling and the worst - incomplete workflow. An Electronic Document Workflow Management System (e-DWMS), e-workflow, is a system for capturing, generating, tracking, editing, approving, storing, retrieving, retaining and destroying documents related to business processes using automation or digital means. This article used flowchart in modelling various processes and stages for document workflow in a typical institution where course registration and approval are important aspects of student's activities. PostgreSQL database was used to keep track of documents in the workflow. An e-signature solution was integrated, allowing the appropriate departments to electronically verify and accurately sign documents. The result showed various stages of the workflow from the case study used. This illustrate the output from the admin, staff and students' daily operations which were effective, accurate and seamless as discussed in the article.

Keywords: *Electronic Document Workflow Management System (EDWMS); COVID-19 pandemic; e-workflow; traditional method*

1. Introduction

Documents are an important part of any business or organization. They are part of what is kept as records for the survival of the business. Some examples of such documents are project records, deliverables, invoices, receipts, agreements, certificates, charters, bonds, contracts, registration course form in higher institutions and memo. Traditional methods of document processing make use of members of staff to keep or physically move it from one desk to another for assessment or approval. This manual document workflow is a common practice in our society but has its associated drawbacks. Some of the challenges with manual work flow include delay in processing, heaps of files on someone's desk, misplacing of documents, missed steps or missed line of reporting, mutilation of files due to mal-handling and the worst - incomplete workflow. Organizations that use paper-based processes also face security risks due to paper documents that have been lost, damaged, misfiled, or fallen into wrong hands [1]. While some organisations are still manual some others engage in semi-manual workflow system. A salient example is the processing of student course registration form within the University system.

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Having registered online, students are requested to print the form and physically take to their teachers to sign for the courses registered, then to the head of department, dean of Faculty and other officials for signing and due processes. This process could constitute a lot of bottlenecks in the system such as misplacement of the course form by a student, mal-handling and even the stress of having to sign on every document with respect to the total number of students. Categorical challenges of several organizations running manual workflow include shelves and tables overflowing with files and other official documents, clerks and secretaries going in and out to take documents to their bosses for signatures and clarification on errors. While manual document management systems can be easy for some time and maybe an option at the start of a business, as the business grows, manual processes can become a very time-consuming and burdensome practice. This can have a significant impact on the organization's workflow and cash management activities. Ref [2] stated that manual filing systems demand a lot of physical space and yet generate inefficiencies when searching for archived papers. More importantly, this poses a lot of security risks [3]. In today's highly competitive and rapidly changing environment, businesses must constantly modify their business processes, i.e. the flow of documents and tasks in a business. A workflow, also known as a workflow model, is a specific description of a business process that is represented in such a way that it can be executed directly by a workflow management system [4].

Moreover, a system that accelerates and completes activities associated with document processing is required. A

Document Workflow Management System (DWMS) is one such system. An Electronic Document Workflow Management System (EDWMS) is a system for capturing, generating, tracking, editing, approving, storing, retrieving, retaining and destroying documents related to business processes [5]. Digital document workflow assists organizations in reducing the large amounts of paperwork that often slow down day-to-day operations like purchase orders, invoices, holiday requests, proof of delivery, dispatch, payroll, vehicle documentation, and so on. Although in some cases, these systems may also manage digitally scanned versions of original paper documents, EDWMS refers explicitly to a software system that handles digital documents rather than physical documents. It provides flexible and efficient management of business operations while reducing administrative time. The use of digital documents and electronic workflow systems possess the potential of saving a great deal of costs and time. Therefore, it also saves time and money on printing by allowing document sharing to be done electronically. Digital documents are easier to search, share and secure than paper documents, and the space consumption are relatively preferred [2]. From a finding, about 48% of businesses choose to store their confidential and important data in the cloud, due to the fact that the cloud-based documentation enables flexibility and security [6]. Digital document processes favour organizations in terms of improved efficiency, improved accountability and visibility, reduced number of errors, and increased flexibility [7]. Digitalization relates to all business processes, such as electronic order tracking, mobile warehousing, online invoicing, intelligent store management, or remote document approval. The shift of businesses into online processing as a result of the COVID-19 outbreak has influenced the growth of technology and industry. Researchers, scientists, teachers, students, and employees from all walks of life were compelled to switch to working remotely by using digital technologies during COVID-19. Findings from empirical research showed that more than a half of joint stock companies (57.1%) have fully automated business processes, for instance carrying out automated payroll and invoicing [8].

This article proposes to apply electronic document workflow management system in school and office environment to ease day-to-day activities like student registration and other official document-based activities.

2. Problem Statement

Traditional or manual methods of processing official documents depend solely on employees or members of staff manually handling data and taking documents from one office to the other either for approval, assessment or submission. This is associated with serious bottlenecks or delay in processing, piling up of files on someone's desk, misplacing of documents, missed steps or missed line of reporting, mutilation of files due to mal-handling and incomplete workflow. Other challenges include security risks and as a result paper documents get lost, damaged, misfiled, or fallen into wrong hands. An Electronic Document Workflow Management System (e-DWMS) could be implemented to handle these challenges digitally. Digital document workflow assists organizations in reducing the large amounts of paperwork that often slow down day-to-day operations like purchase orders, invoices, holiday requests, proof of delivery, dispatch, payroll and vehicle documentation.

3. Objective of the Article

The aim of this study is to develop an e-workflow system which proffers solutions to inherent problems in manual document workflow in organizations, while the specific objectives are to:

i. demonstrate how electronic document workflow system increases productivity differently from the manual system using student course registration as a salient case study
ii. design and develop an Electronic Document Workflow System with the ability to track all the necessary processes of course registration and processing of course form.

4. Literature Review

Generally, every process has its workflow for the job to move from start to completion. Having a workflow in place increases productivity and reduces loss of focus. With workflow automation, companies can be more efficient, productive, and successful [9]. Automating workflow allows employees to focus on the most important aspects of their work [7]. Invariably, paperless system could provide organizations benefits such as increased efficiency, outputs, and information security [10].

4.1 Workflow Management System (WMS)

Workflow can be simple and at each stage of the workflow, one person or group is responsible for a specific task and then it is moved to the next. Workflows can also have more complex dependencies; for example, if a document is to be translated into multiple languages, a translation manager could select the languages and each selection will be activated as a work order form for a different translator. The next task in the process is only activated when all translators have completed their respective tasks. Workflow management system also automates redundant tasks and ensures that uncompleted tasks are tracked. A workflow is a set of business activities ordered according to a set of procedural rules to deliver a service [11]. A workflow model, commonly called workflow specification, is the definition of a workflow. An instance of a workflow is called a case. In each case, work items are passed and manipulated. A case can be illustrated as for instance the process that handles semester registration of a student while an example of a work item is the course form of the student. The definition, creation, and management of workflow instances is done by a workflow management system, on the basis of workflow models. Generally, two important dimensions of workflows are the

control-flow dimension and the resource dimension. The control-flow dimension concerns the ordering of activities (tasks) in time (what should be done). The resource dimension concerns the organizational structure (who should do it). Activities are done by actors. An activity is an amount of work that is uninterruptible and is performed in a non-zero span of time by an actor.

4.1.1 Components of a WMS

The components of a WMS include the following:

i) Orientation system: This is the basic function of a Workflow management system. It controls the flow of information or documents, transfers information from one work item to the next. This function does not respond to exceptional circumstances.
ii) Distribution system: This functions as an extension. It recognizes exceptional circumstances and relays the information to designated jobs. With a dynamic assignment, you can assign new tasks to understaffed positions to achieve continuation or workload balancing within your workflow.
iii) Coordination system: This function coordinates simultaneous activities to avoid resource or priority conflicts.
iv) Agent system: This function does the preliminary work automatically. This frees the executing entity from operations that do not require decisions.
v) Assistance system: This function extends the previous functions with an instance of adapting the process and with suggestions for later actions.

4.1.2 Related Concept in WMS

i. Processes: This has to do with a set of procedures that have to be undertaken to achieve or accomplish a defined task. This could also involve a group of techniques together with action steps to be taken.
ii. Planning and programming: A plan is an outline of the set of logically essential and partly ordered objectives which can be required to acquire a given goal below positive preliminary conditions. A plan, while augmented with an agenda and aid allocation calculation, completely defines a specific example of systematic processing to pursue a goal. Plans need to be coordinated.
iii. Flow control: This is the order in which individual statements, or work are executed. Sometimes, some dynamism is implemented in the flow.
iv. Visibility in transit: In-transit visibility is about keeping track in real time, so one can update clients with status reports and actions that are being taken in order to address issues that may arise.

4.2 Improved Project Management Through Improved Document Management

The article aimed to facilitate project-oriented business process management by the tools provided with electronic document management. The major part addressed are process management, document management and case studies. The focus is if it were possible to facilitate business process management with partially automated document management conventions. By evaluating three different types of business projects the article outlines an improved document management approach. The three global cases, which comprise business process re-engineering (BPR), new product development (NPD) and one-of-a-kind manufacturing, enable to track a common set of document-based operations which hold the vital information for the success of respective cases. This information reveals what is the true active organization of the enterprise, what are the document usage profiles of the people and how knowledge-related creative processes are really performed by the organization. Managing documents and information in a structured manner has been difficult to implement and fundamentally the success in generating value adding through better document management lies in changing way of operations [12][13].

5. Materials and Methods

This article used flowchart in modelling various processes and stages for document workflow in a typical institution where course registration and approval are important aspects of student. PostgreSQL database was used to keep track of all documents in the workflow. An e-signature solution was integrated, allowing the appropriate departments to electronically sign the documents and verifying that signatories enter information accurately.

The analysis, design and modelling were done using use case diagrams, flowcharts and Data flow diagrams. The proposed system design is expected to be web-enabled application. Implementation tools include Reach JS, JavaScript XML, React Router (providing routing logic to client-side application (app) for easy navigation without reloading the entire page), Node.JS, Express.JS, and PostgreSQL. In an organization like the University system which is under consideration, there are a number of internal processes like approval of students' course forms or other official documents which could be electronically accomplished. This approval process is a type of workflow, indicating a sequence of work to be done from the start to completion.

5.1 Description of the Proposed System

The proposed system would provide a platform for educational institutions and their various departments to make use of electronic workflow while processing course form or other school documents. The system ensures that a document or form is initiated, filled, submitted, routed, reviewed, approved and tracked to ensure an easy flow from the point of generation to the point of completion. There are two main users/roles in course form instance, the student and the staff. The system can have multiple admins having level of permissions to take certain actions. The system has a submission and activity portal where students can track the status of documents to know if it has been approved, pending or rejected. The proposed e-workflow for official document comprises three modules namely: admin, student and staff as further described below:

1. **Admin Module:** the module is the super user of the system having administrative rights. The admin is privileged

to manage Students, Staff, Documents, and check for approval status, view messages and complaints and edit admin profile.

2. Student Module: the admin grants the students limited rights. Students are responsible for submitting course forms for approval. Students could have real-time audio/video collaborations. They could also edit profile, track status or activity of documents and receive notification on pending document.

3. Staff Module: the staff register by receiving onetime code to enforce security. Staff hold right to approve or reject documents.

5.2 Functional Requirements of the E-Workflow System

The functional requirements here connote statements of services the system should provide. Therefore, the identified functionalities in the course of analysis conducted that satisfy the article objectives are categorized as follow:

(a) **Functional Requirements for Admin (System Administrator):** the administrator should be to login to the system, register staff members using a onetime code, be able to review registered staff, register and add students, view existing students, assign different roles to individual users, append students and staff profiles, deactivate existing profiles, generate meeting link for registered users, send emails to registered users and logout of the system.

(b) Functional Requirements for Student: the students should be able to login with valid credentials, track activity or status of students, receive notification when a document has been approved, receive notification for meeting invite/collaboration and logout at will.

(c) **Functional Requirements for Staff Member:** the staff members should be able to register using a onetime code, login to the system, review documents, approve/reject documents, edit profiles and logout of the system.

5.3 Non-Functional Requirements of the E-Workflow System

These define system properties and constraints on functions offered by the system. Based on the nature of the proposed system, the following are expected non-Functional requirements: the system must be reliable, the system must be efficient, with easy access and fast response, the system must be secure, it must be transparent/consistent and it must be interactive.

5.4 System Modelling for Course Form Approval e-Workflow

Figure 1 depicts the illustration of e-document approval processes. The typical example here is student's course form, from the point of initiation to approval. The student initiates course registration by generating courseform, selects courses and submits the course form. The courseform comes to the Course/Advisor's page (same role can be performed by the Head of Department (HOD)), the Advisor reviews the form ensuring the form was correctly filled with respect to the expected courses according to the bulletin, he/she approves or disapproves the courseform. The rejected courseform goes back to the student for correction/update or modification and he/she resubmits for a repeat review until the form is correctly filled. The approved course form goes to the School Officer for further review and approval. The student is notified of complete/correct registration of course after approval which completes the workflow.

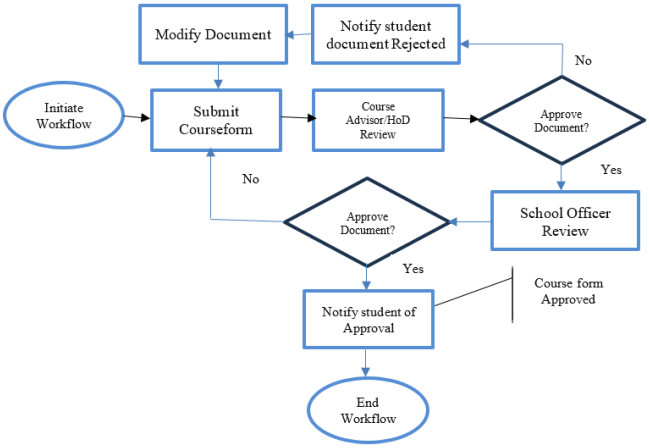

Figure 1. Course form approval workflow diagram.

5.5 The System Analysis and Design

This entails the process of defining the system components, modules, interfaces and data flow which is to satisfy the specified requirements. This system design consists of activities that fit between software requirements analysis and software construction.

5.5.1 The Course Form e-Workflow Use Cases

This represents the set of actions (use cases) the system can perform. Here, crucial actors are mapped to their functions. The following figures present the use cases for the major roles involved in the e-course form workflow. ***Preconditions*** include that there is an active network connection to the Database and that sensitive information is accessed by only Administrators.

(a) System administrator Use Case: The actor which implies the role here is the System Administrator or simply the Administrator who is responsible for a number of use cases, that is actions that can be performed and rights. The following Figure 2 is the System Admin use case:

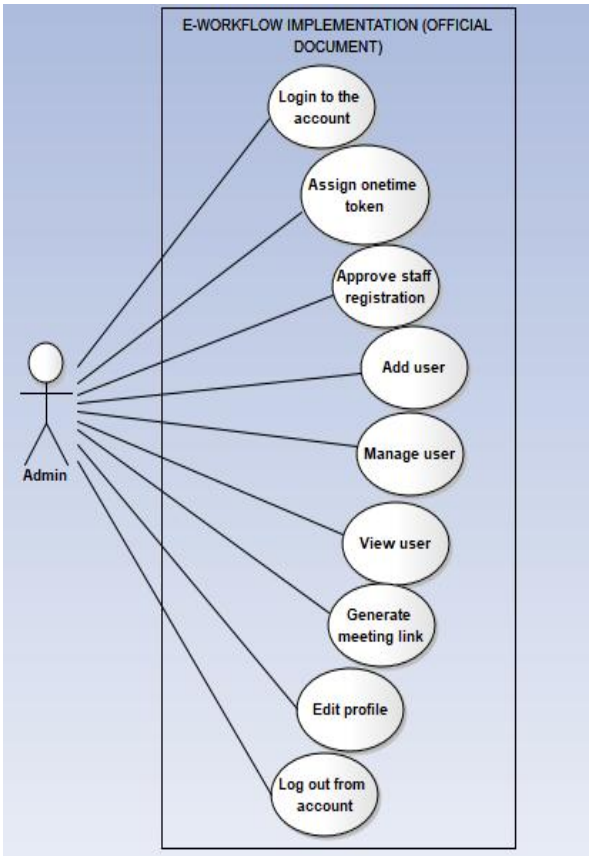

Figure 2: System Administrator Use Case Diagram

(b) Student Use Case: The role here is the student and Figure 3 illustrates what actions the student can perform including rights. The student actor interacts with the system based on what extent or what he/she can do on the system.

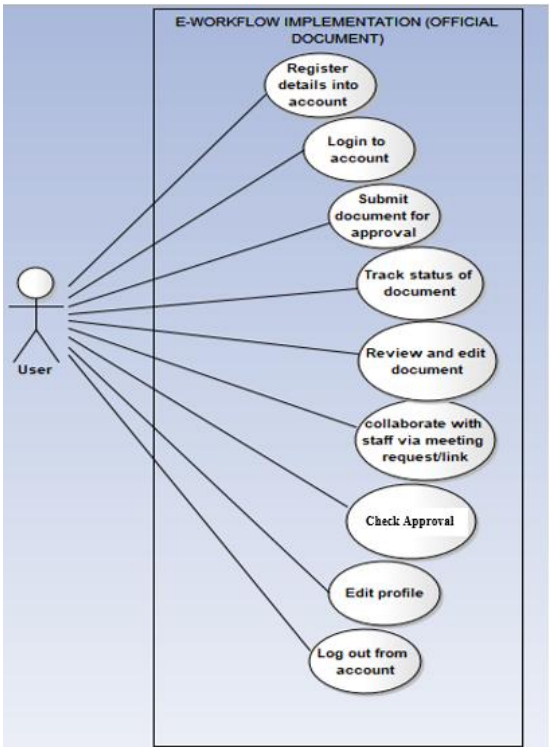

Figure 3: Student User Use Case Diagram

(c) Staff Use Case: The role as showed in Figure 4 is the Staff and the diagram illustrates what actions the Staff can perform including rights. The Staff actor interacts with the system based on rights and privileges he/she has.

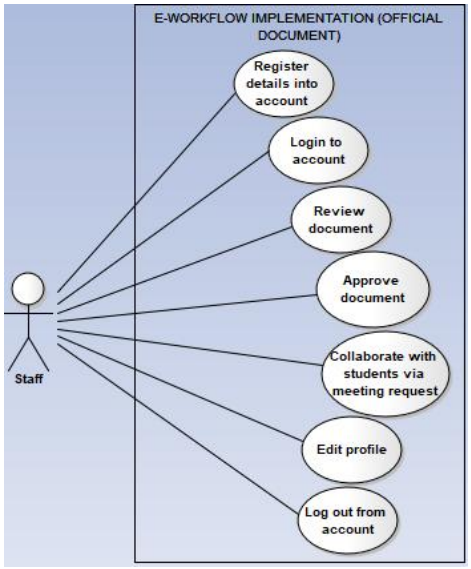

Figure 4: Use case Diagram of Staff roles

5.5.2 Data Flow Model/Conceptual Design

Figure 5 and 6 present a high-level view of the proposed system showing information flow within the system. This provides a broad overview of system abstraction which does not reveal concrete details of the system's processes, data flows, and data stores:

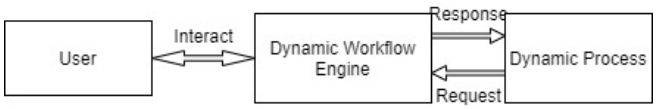

Figure 5: Context flow diagram

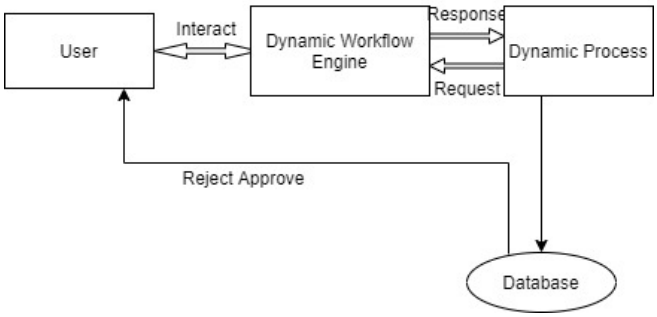

Figure 6: Logical flow diagram

5.6 Database Design

The database for the web-based electronic workflow for official document is designed to have five tables namely: Users, Groups, Documents, Docfeedback and Codes.

(a) Users Table

The Table 1 stores information that uniquely describe a user on the platform. It is a table of registered users. The roles field stores Admin values, student's values and staff values. The key table attributes or properties are summarized in the following Table 1:

Table 1: ***"public.users"***

Column	Type	Nullable
Id	text	not null
userId	text	not null
username	text	not null
Mail	text	not null
phoneNumber	text	not null
Type	text	not null
Hash	text	not null
userRole	text	not null
userToken	text	not null
refreshToken	text	not null
Joined	text	not null
documentPermissions	integer	

Indexes:

"users_pkey" PRIMARY KEY, btree (id)

"users_mail_key" UNIQUE CONSTRAINT, btree (mail)

"users_userId_key" UNIQUE CONSTRAINT, btree ("userId")

(b) Groups Table

The Table 2 stores all the groups created by students for final year project documents.

Table 2: *"public.groups"*

Column	Type	Nullable
Id	text	not null
Name	text	
courseType	text	
courseName	text	not null
userId	text	not null
memberId	text	not null
created_at	text	not null

(c) Documents Table

The Table 3 stores documents assigned to staff by students and also the document type:

Table 3: *"public.documents"*

Column	Type	Nullable
Id	text	not null
Title	text	not null
documentType	text	not null
courseType	text	not null
courseName	text	not null
userId	text	
groupId	text	
staffId	text	not null
Status	text	not null
File	text	not null
created_at	text	not null

(d) **Docfeedback Table**

The Table 4 stores document feedbacks of students' request received from staff.

Table 4: "*Feedbacks Received"*

Column	Type	Nullable	Primary key
Id	text	not null	yes
Note	text	not null	no
documentId	text	not null	no
staffId	text	not null	no
created_at	text	not null	no

(e) Codes Table

The Table 5 store the onetime code sent from the Admin during registration:

Table 5: *"public.codes"*

Column	Type	Nullable
userId	text	not null
Token	text	not null
issued_at	text	not null

Table Relations

The following Table 6 depicts a summary of relations of existing tables-i.e. interactions between the objects:

Table 6: "*Representation of table relations"*

Schema	Name	Type	Owner
Public	Codes	Text	Postgres
Public	docFeedback	Text	Postgres
Public	Documents	Text	Postgres
Public	Groups	Text	Postgres
Public	Users	Text	Postgres

6 Implementation and Results

The implementation of the e-workflow in the University System model (case study) is basically into three main modules, which are the Admin module, Student module, Staff module. The following are the screenshot of implementations and output for the system:

6.1. Admin Module

This module gives the Admin access to the system. An Admin entry opens the Administrator to the rights he/she has and the roles that can be performed in the application software. Figure 7-17 show the output screen shorts from signup page to staff page (who is a super user and as such must input valid credentials to access the system).

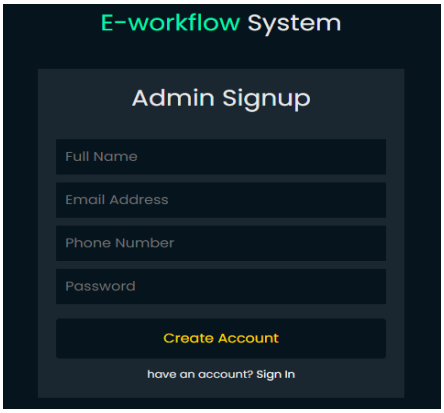

Figure 7: The signup page for the system administrator

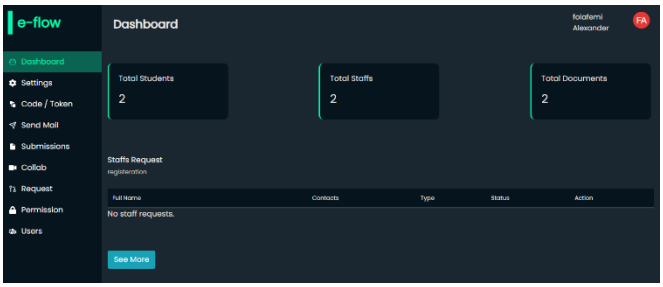

Figure 8: The Dashboard shows the total number of students and staffs that are registered into the system. It also shows the total documents approved or pending in the system.

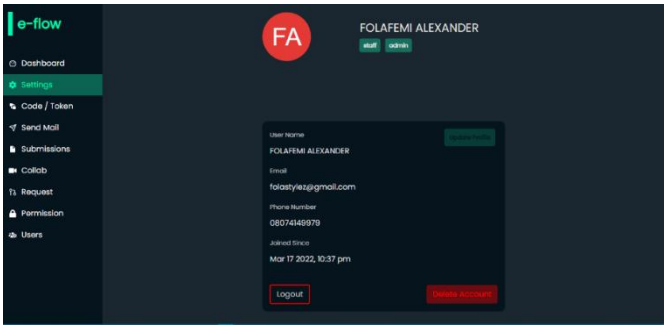

Figure 9: Shows that the admin can edit and update her profile, delete account and also logout of the system

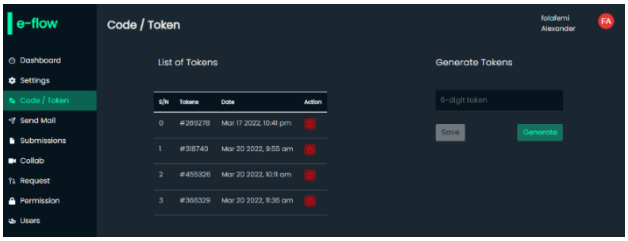

Figure 10: Shows the Admin generating code for staff members during registration. The admin creates and saves the 6-digit token, which appears on the list of tokens generated for each staff member.

Figure 11: Displays the submission page. This page displays the staff's approved, rejected, and pending documents.

6.2 Student Module

Student can play the role of initiating course form for semester registration or submit project for review and approvals. The following are selected activities that could be performed by student within the e-workflow system.

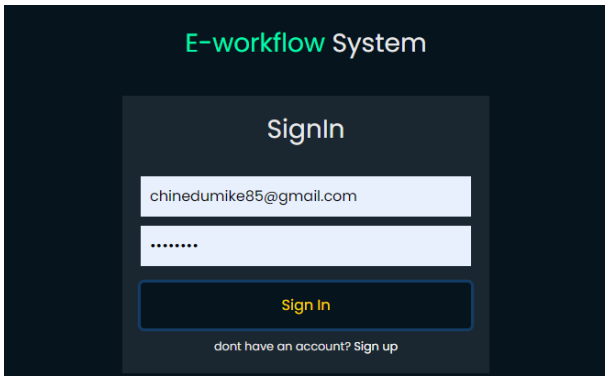

Figure 12: The Sign in / Sign up page for students

Figure 13: Student page with the ability to view approval status and track events.

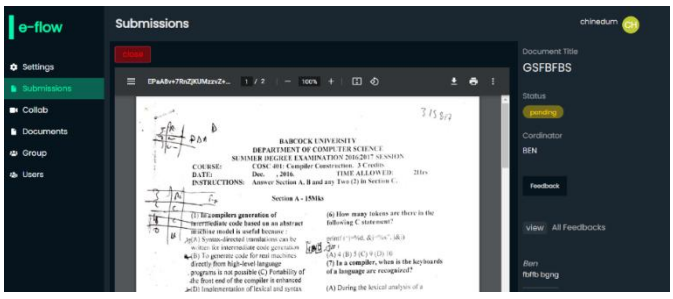

Figure 14: Student page to see document status, review document and check feedbacks

6.3 Staff Module

The functionalities in this module are strictly meant for the staff. The following are the screenshots of some of the roles / activities they can perform in the module.

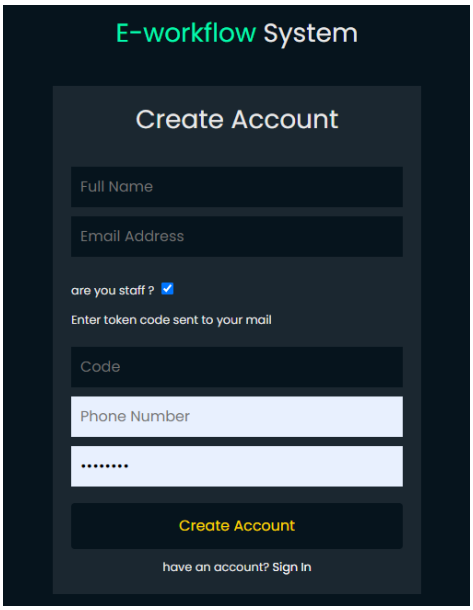

Figure 15: Staff registration page. Employee's credentials and one-time token code are required for the first-time registration.

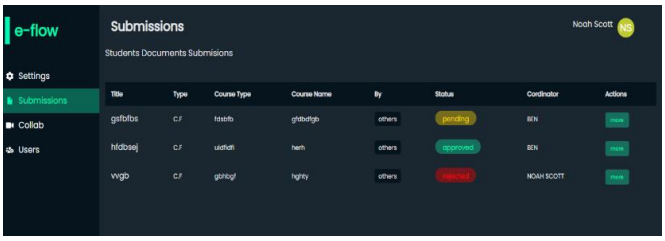

Figure 16: Shows a list of documents approved or pending approval.

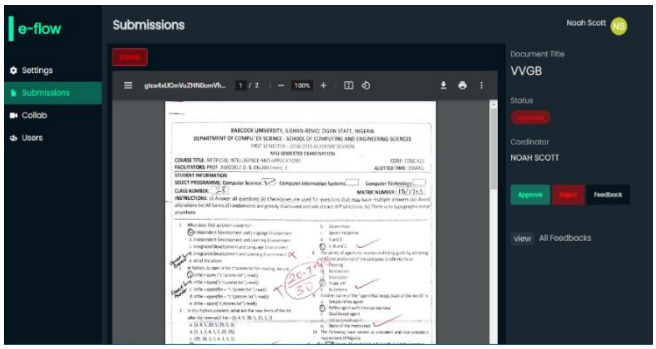

Figure 17: Staff page with ability to review document, approve or reject and also provide feedbacks on document.

7. Recommendation and Conclusion

This article is concerned with the development of an electronic document workflow management system (e-Workflow) to eliminate the possible bottlenecks in processing physical documents such as unnecessary delay, missing or mutilation of documents, storage space, access and retrieval. Using modern technologies to generate digital documents and automate document workflow processes, the developed output proves to be simple, secure, easy-to-use and efficient. The document workflow management system is a web application limited to initiation of course forms or submission of research project by the students of the University. The case study used in this research is the Babcock University, Nigeria. A student can upload documents and follow up on the status automatically from their devices till the documents have gone through all due processes. This software saves time for everyone, including the students, advisors, heads of departments and school officers. This system may require some modification for it to be applicable to other institutions or organisations. Integrating e-Workflow management systems could bring significant business success and more comfort to organizations considering it.

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