Development of a Web-based University Collaborative Tool for Effective Distributed Learning

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ABSTRACT
Due to advancement in technology, digital collaboration has become an extension of our traditional means of distributed learning and workflow. Currently in most tertiary institutions in Nigeria, students and lecturers use existing collaboration tools such as yahoo, google groups, whatapps for collaboration and knowledge sharing. However, they come with their limitations. For example, On Yahoo groups, students with yahoo mail account can only join yahoo groups and vice versa for google groups. This makes it difficult for students with other email address to participate and obtain relevant course materials on each of the platforms. Therefore, we propose the development of a unified platform for the purpose of collaboration for the University community. The system (TeamCollab) was designed using extreme programming model and developed using PHPs Laravel framework, CSS3, HTML5, Bootstrap and MySQL for the database query. The developed system was evaluated by potential users and found to meet predefined user requirements.

Keywords: *Knowledge management, Collaborative Learning, Distributed Learning*

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I. INTRODUCTION

Web based learning is growing in popularity and offers many benefits over traditional learning environments. The web-based learning approach provides a powerful environment for distributing information and delivering knowledge to an increasingly wide and diverse audience [1]. Students who study a course on the Internet tend to be more heterogeneously distributed than those found in a traditional classroom situation [1], [2]. Student-student interaction in collaborative learning communities may contribute to the achievement of educational goals by

influencing educational motivation and aspirations through peer relationships [3], [4].

Focusing on tertiary institutions in Nigeria, the available collaboration system assumes the use of Electronic mails, email groups and physical meetings. Students have to wait till they meet face to face in other to collaborate. One alternative adopted by students is to create groups on social media. This is done by specifying the preferred platform among the students, for example Facebook and then inviting different members that make up the team to join the group. Another alternative to this are instant messaging platforms such as Whatsapp and BBM. On Whatsapp app, the leader of the group or anybody assigned creates a group and then adds other members of the team based on the contacts which he has. The group is expanded by acquiring and adding more phone numbers or by setting more members as administrators who then go ahead to add their own contacts. On BBM it is a similar process, the leader simply has to create a channel or a group while the other members look for this channel request to join. After adding all respective members, they begin to communicate, share resources and other information over the chosen platform till they complete their project. To the best of our knowledge, there is no existing sophisticated electronic collaboration system within any tertiary institution in Nigeria that can be used for a group chat. As an alternative, different messaging platforms are being used as a means of collaboration. However, they come with some limitations (such as unnecessary distractions) which can make the entire process ineffective. For example users may get distracted while working on a project because the chosen platform is the same one that houses their friends and family. Furthermore, the use of instant message platforms for collaboration makes it difficult to keep track of vita information's and has a structured storage for files. For example when certain information is to be retrieved, it cannot easily be tracked and recovered majorly because of poor organization. More so, the user receives every notification regardless of the relevance of the message to him which can be distraction. When working with big teams, a structure cannot be created to house smaller units which are still within a team; these units have to be created independently as groups on their own. As for the email groups, users who are not using a particular email host cannot join a group created on the email host.

In this paper, we developed a Web collaborative system (TeamCollab) that can be used in Nigeria tertiary institution for collaborative learning. The system was developed using extreme programming model and developed using PHPs Laravel framework, CSS3, HTML5, Bootstrap and MySQL for the database query. The remaining parts of this paper are organised as follows: Section 2 presents a short over of collaborative tools for collaborative learning. Section 3 discusses the methodology and frame work used for the system development. In Section 4, the system design, use-case and unified modelling of the system is discussed, and in Section 5, the application development, interface and the evaluation results are presented. Finally, Section 6 concludes the paper and outlines future works.

II. LITERATURE REVIEW

This section presents background on collaborative learning and the framework adopted for the development of our proposed system.

2.1 COLLABORATIVE LEARNING

Collaborative learning according to [5] refers to an instruction method in which students at various performance levels work together in small groups toward a common goal. The students are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful [6]. In general, this kind of learning environment provides a means to manage the learning resources and also present a structured framework for the activity across a large number of students. The system makes extensive use of the web and the internet for information access, communication and collaboration necessary to complete the various tasks [7]. The impact and implications of technology on new ways of learning and new models of teaching are far-reaching. Educators are just now beginning to realize the power of wikis, blogs, and podcasts, as well as emerging social software applications [8]. These emerging technologies provide opportunities for instructor-student as well as student-student real-time and/or time-delayed collaboration. Collaborative learning refers to tasks that require joint intellectual efforts among students or between students and teachers. Collaborative learning is a personal philosophy, not just a classroom technique. There is a sharing of authority and acceptance of responsibility among group members for the group's actions [9].

Web-based technology is a potential tool in collaborative learning and also an incredible opportunity to study nowadays. The first-generation web-based tools include email, chat rooms, and discussion boards, among others [10]. Nevertheless, the second-generation web-based tools promised to take interactivity to the next level, such as the use of blogs (weblogs), wikis, and podcasts. The second generation web-based tools can be developed

alone or in conjunction with open source technologies such as Imeem, InstaColl, and Writeboard to increase real-time collaboration between learners, especially in courses that are fully asynchronous [8]. Web-based collaborative learning allows students to approach more complex problems, and to share designs, critiques, and arguments with partners [11]. Web-based learning has also been known to offer flexibility and greater motivation of students to excel, thereby enhancing the conventional (class room) mode of learning. Furthermore, the design and development of web-based learning systems have become widespread since the beginning of 1990, and is becoming an important part of human learning and living in the 21st century [8]. Web-based collaborative learning tools have an impact on new models of teaching and new ways of learning; therefore it is the responsibility of instructional designers, administrators, and technology experts to investigate which tool offers the best solution for the task of providing interaction in both synchronous and asynchronous learning environments [8]. The added control and interaction provided to learners using technology tools may help tap into a student's expertise, and promote collaboration through peer-to-peer mentoring, teamwork, and other strategies.

According to Roberts & McInnerney [12], if a collaborative learning tool is developed appropriately, it provides an ideal environment in which interaction among students plays a central role in the learning process. To design effective web-based collaborative learning, it is first necessary to understand the key elements, advantages, and disadvantages of this approach, as well as the limitations of using web-based collaborative learning [13]. There are fundamental features and requirements in collaborative learning; Sun and Lin [14] stated that the features of web-based collaborative learning are active learning, simulation-based learning, interactive and inter-creative learning, and accumulative learning.

2.2 Model for Web-based Application

The study adopted Laravel framework [15] that uses Model- View-Controller (MVC) model to develop the Web-based Collaborative tool. MVC model was adopted because it organizes an interactive application into three separate modules: one for the application model with its data representation and business logic, the second for views that provide data presentation and user input, and the third for a controller to dispatch requests and control flow. Figure 1 represents Web-Tier Service Cycle. The Web tier does four basic things in a specific order: interprets client requests, dispatches those requests to business logic, selects the next view for display, and generates and delivers the next view. Figure 1 below illustrates the duties.

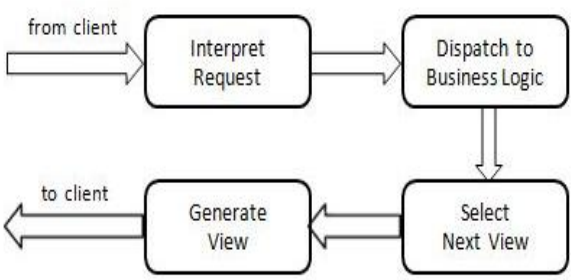

Figure 1: Web-Tier Service Cycle [16]

2.3 The Web-Tier Development

Web application framework was developed using "Model 2" architecture, where a servlet manages client communication and business logic execution, and presentation resides mainly in JSP pages. The Model 2 architecture uses servlets for processing requests and selecting views. In this research the Front Controller is typically developed as a servlet. Figure 2 below shows a simplified diagram of the model 2 pattern.

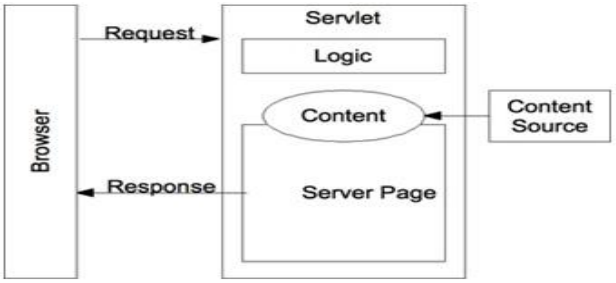

Figure 2: Model 2 Pattern [16]

The Web-tier MVC controller maps incoming requests to operations on the application model, and selects views based on model and session state. Web-tier controllers have a lot of duties, so they require careful design to manage complexity. A Web-Tier Controller Object Interactive Diagram as shown in Figure 3 illustrates the relationship and duties between the three tier computing involved in the web application.

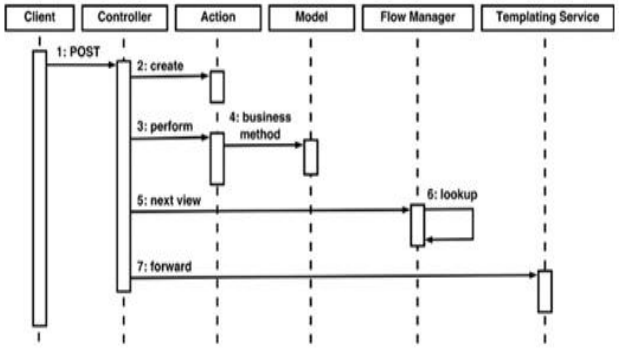

Figure 3: Web-Tier Controllers Object Interactive Diagram [16]

III.METHODOLOGY

This section presents detailed description of how data used in this research work was captured. This includes the data source, model and database design. Data used for this study were gotten from both primary and secondary sources. The data required for this research was voluminous, so it was grouped according to the modules of the software for simplicity. The primary sources of data were the information derived from first hand source to gather the functional requirements of the proposed system and these sources include direct interview, observation, presentations and tutorials from students. A total number of 70 students were randomly selected from the Faculty of Information and Communication Sciences, University of Ilorin, out of which 10 were team leaders. The functional requirements for the proposed system were gathered from the team leaders and some of these requirements include: sharing resources or information, allow real-time posting of questions and inquiries, which students can respond to in real time, send notifications and alerts, amongst others. The secondary sources were information that was derived from existing information. Thus, already used data in existing collaborative tools (such as Slack, Asana and Zulip) were collected and analyzed for the purpose of this study.

3.1 DESIGN

This section outline the design of the most common object, their basic identity and actions performed in the system by Using Unified Modeling Language comprehensive notations.

3.2 Class Diagram

In software engineering, a class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. The class diagram for the proposed project is shown in Figure 4.

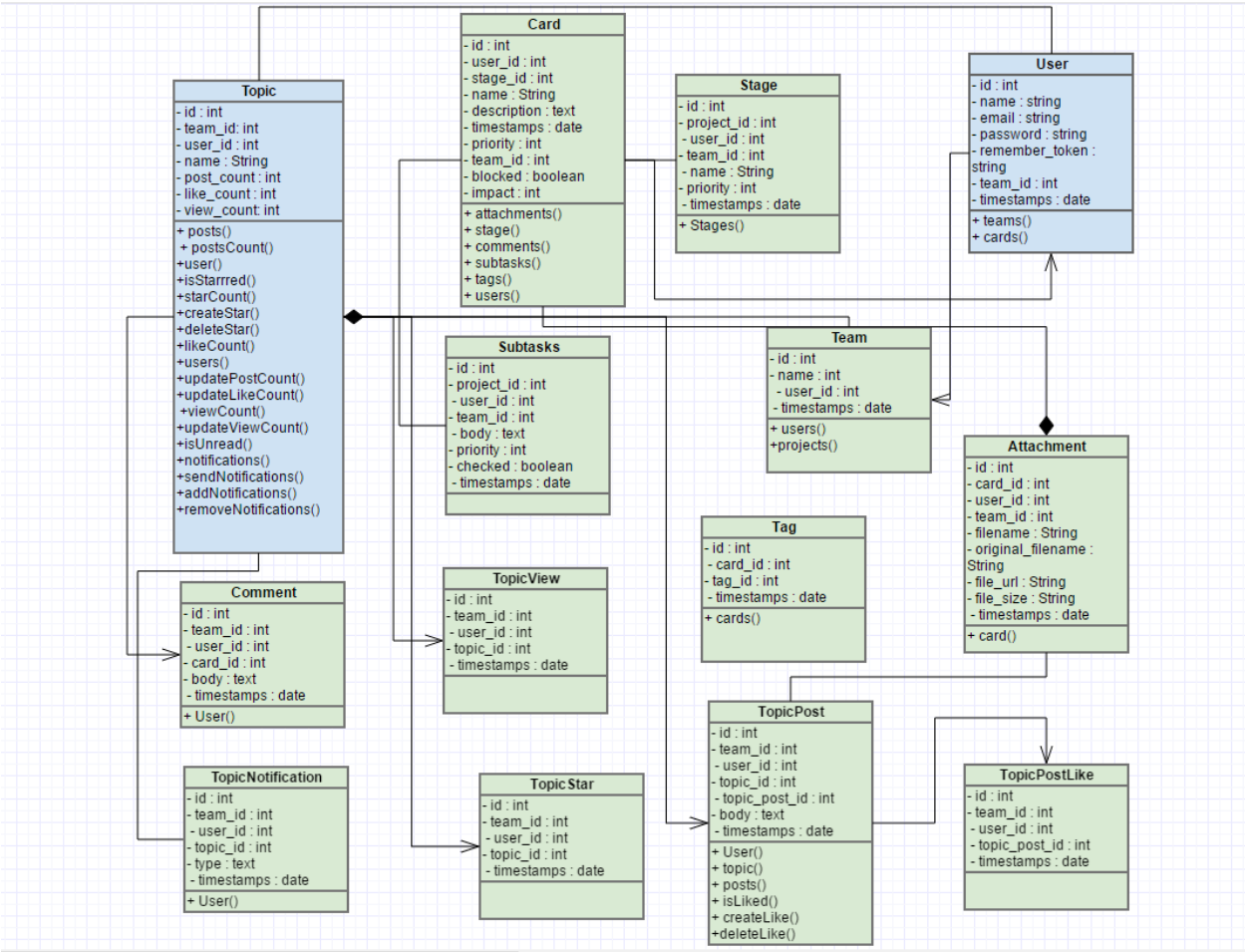

Figure 4: The Class Diagram of the System

3.3 Use Case Diagram

A Use Case Diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. In this case as shown in Figure 5, the users are the students, and lecturers/administrators in the University.

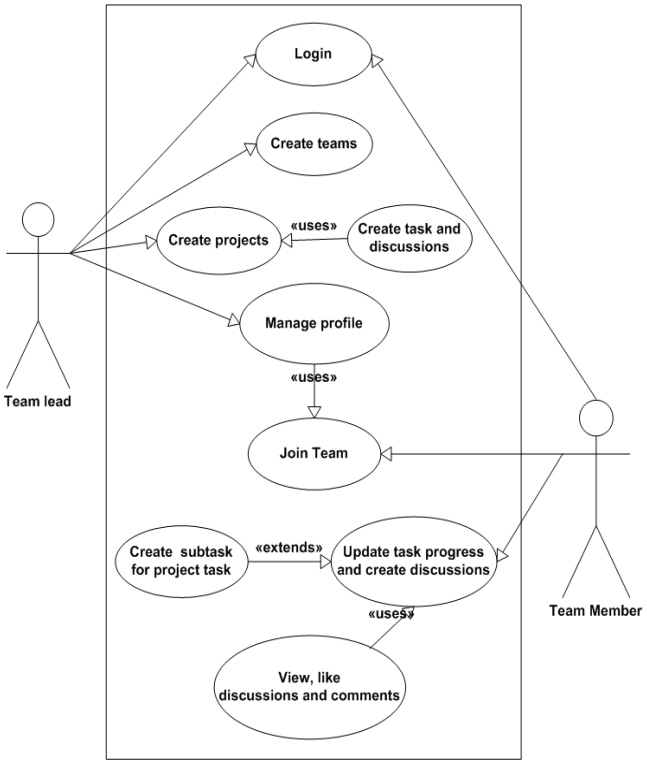

Figure 5: Use Case Diagram of the System

3.4 User Activities

In order to represent user's activities in the proposed system, a flow chart diagram is adopted. A flowchart is a convenient technique to represent the flow in a program. It is a pictorial representation of an algorithm that uses symbols to show the operations and decisions to be followed by a computer in solving a problem [17]. The flow of the system, from its input, processing and output is illustrated in Figure 6. In the system, a team leader has a pseudo administrative privilege with ability to create project and add a team member to a discussion while other team members will have access to less assigned content.

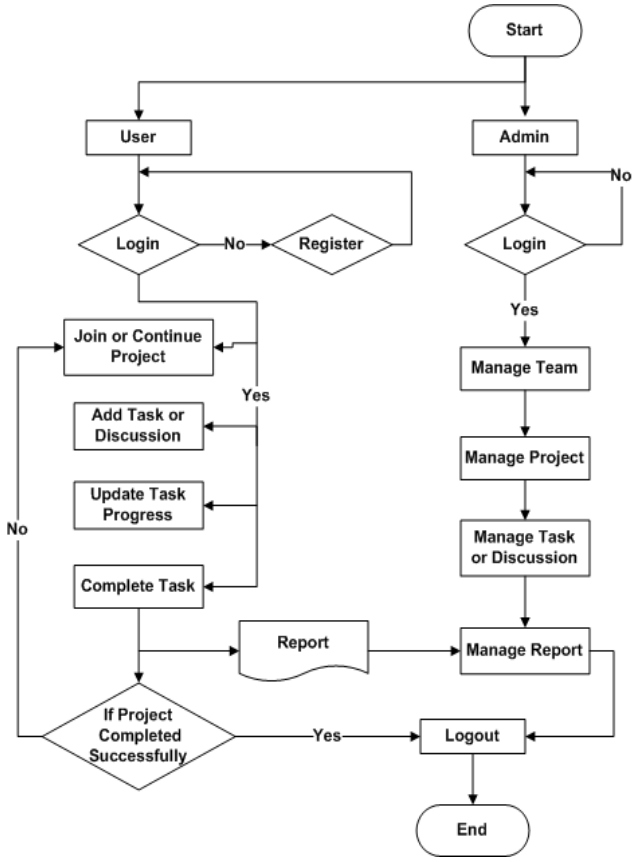

Figure 6: Flowchart of the Proposed System

IV. SYSTEM DEVELOPMENT AND EVALUATION

The development of this new system entails using a PHP Framework and then hosting it on a web server. In order to create the database for our proposed system, MySQL database management system was adopted. Figure 7 below shows the entities, attributes with their assigned data types and entity relationship descriptions for our database system.

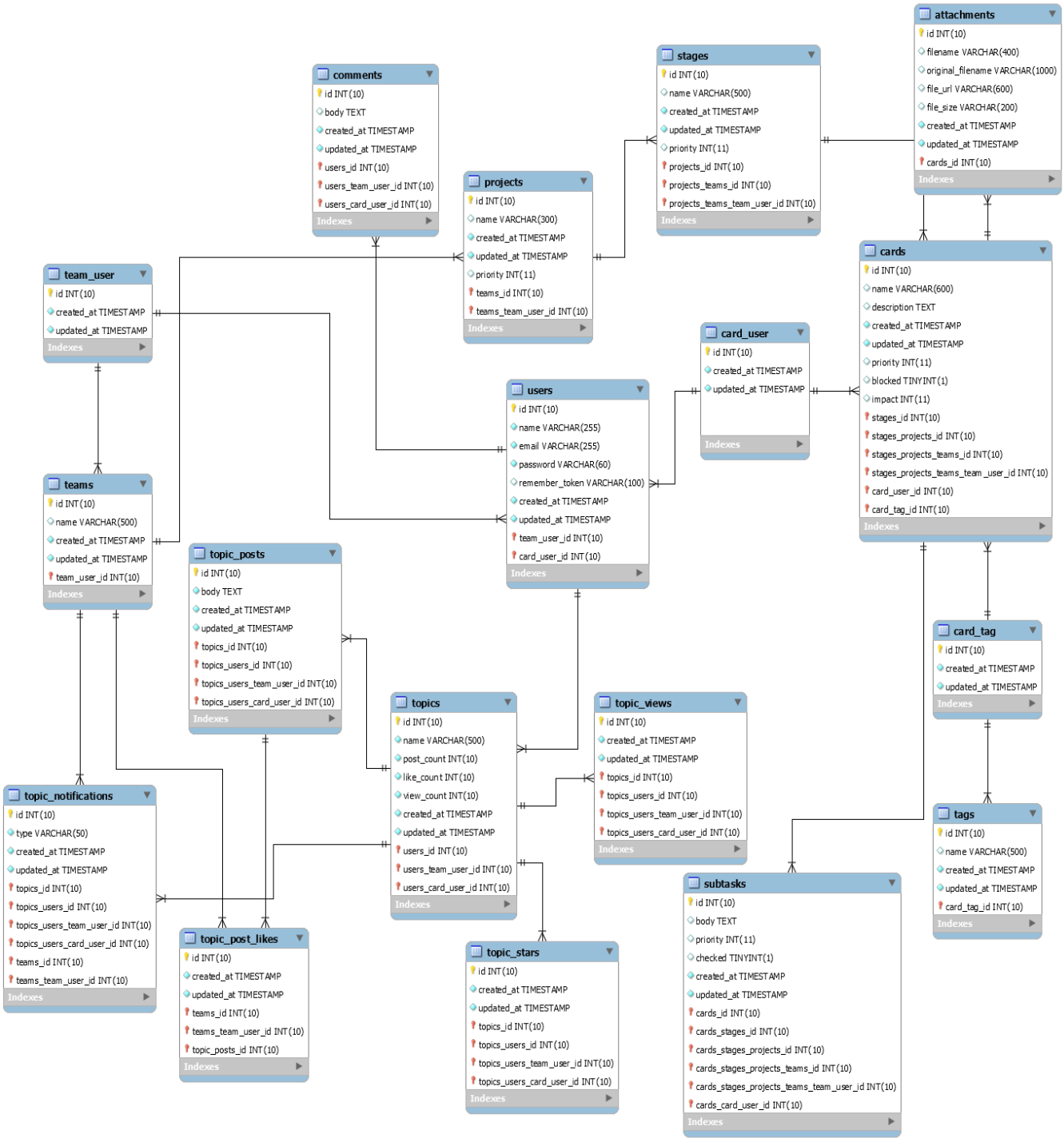

Figure 7: TeamCollab Entity Relationship Diagram

4.1 Application Development

The application was developed using PHP, HTML 5 and deployed on Heroku, a cloud hosting platform. The developed system is available at http://unilorincollab.herokuapp.com/. Figure 8 shows the home-page for the developed system. It has features such as; create account link for new user and signing in link for returning users. After signing in, you are directed to the dashboard page where projects, tasks and discussions can be created as shown in figure 9.

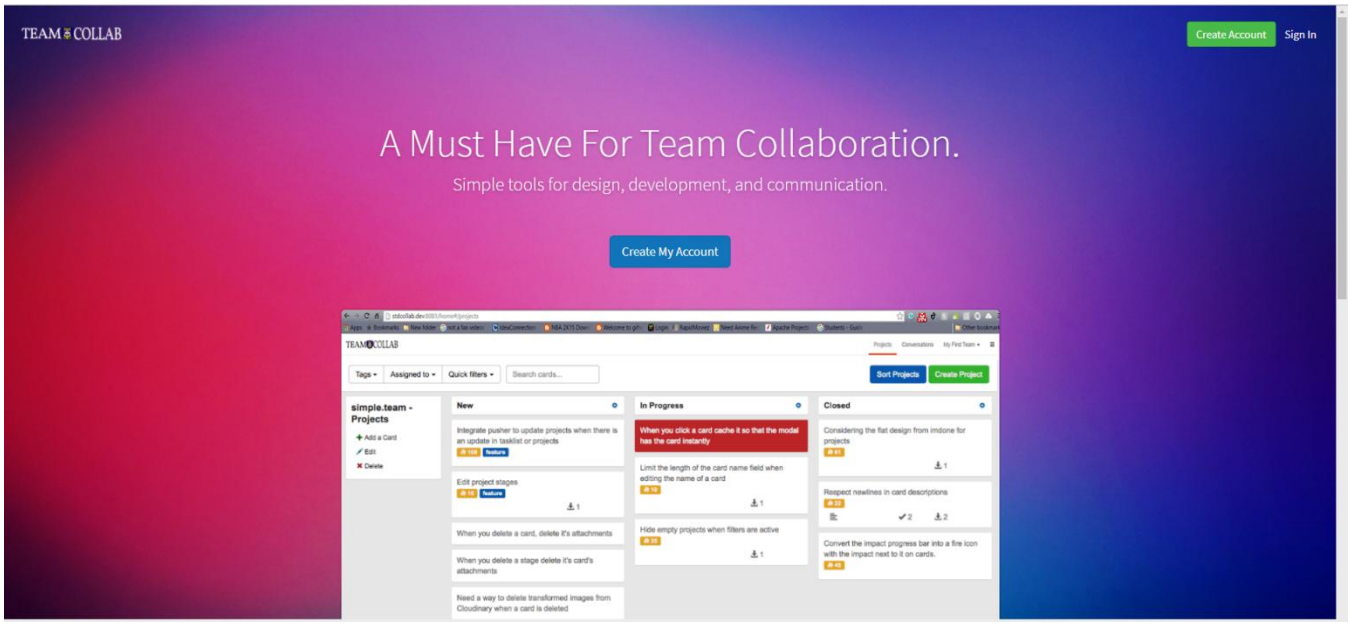

Figure 8: Home Page

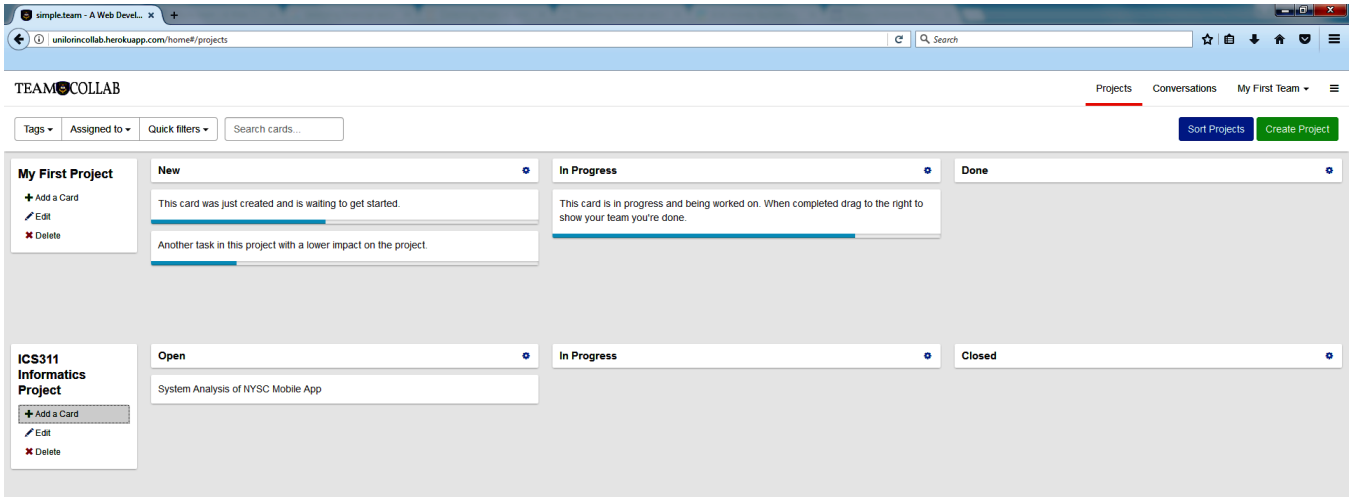

Figure 9: Discussions Dashboard

The dashboard as shown in Figure 8 provides a platform where projects are created and managed. This creates a structured and organized communication platform where different discussions can be created for different projects. The dashboard has other features such as assign task, filter discussions and tag users.

4.2 Evaluation

After the system development, it was evaluated using face to face survey after running the web application by selected team leads and team member using random sampling approach. For the needs of evaluation, students of Faculty of Information and Communication Sciences, University of Ilorin were used. During the evaluation, 70 students were selected out of which 10 were team leaders, the functionalities of the system were then assessed by these students to ascertain how well their requirements were met. The questions asked relates to the navigability, responsiveness to queries, ease of use, consistency of the application and the interface presentation. In all, 63 respondents questionnaire were returned and evaluated as valid, representing 90% of the targeted sample. The results of the system evaluation are summarized in figure 10.

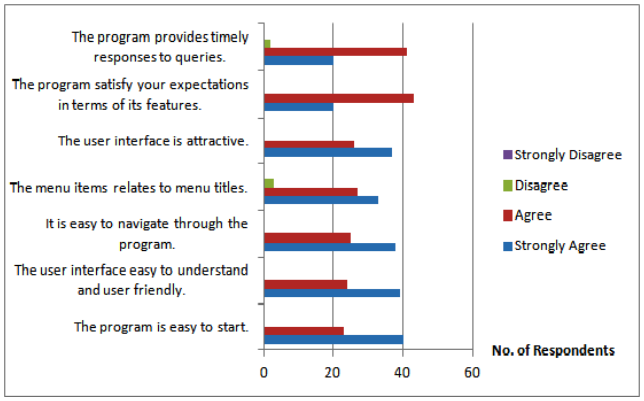

Figure 10: Showing result from the evaluation of the system by respondents

From figure 10, all the users responded positively to the features evaluated. The developed system provides a platform for which students can collaborate for academic purposes i.e it serves as a platform where users can have topic driven discussion to create focus rather than just general discussion. The overall result demonstrated that

more than one third of respondents who part took in the evaluation indicates that the system is easy to use and has positive effects of its principal objective. The ability of respondents to effectively use the tool was considered, and as a result students who had substantial experience with some of the existing tools were selected. Although open ended questions were not used for the evaluation, however respondents provided suggestions about other features that can be incorporated in the developed system as highlighted in the concluding section.

V. CONCLUSION

In this paper, we designed a collaborative web application to foster collaborative learning for members of the university community. The system was designed using extreme programming model and developed using PHPs Laravel framework, CSS3, HTML5, Bootstrap and MySQL for the database query. The developed system was evaluated by potential users and found to meet predefined user requirements. As further work, the system can be improved by adding more features which will further improve its use and meet user needs. Some of the features that were recommended are: Video Chat meetings, Expanding Stages for bigger projects, integrating other forms of collaboration tools, adding support for update tracking on Source control platforms.

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