WoTCoMS: A Novel Cross-Layered Web-of-Things Based Framework for Course Management System

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Abstract— **A course management system (CMS) is a tool that facilitates faculties and students of any educational institution to develop and to support online education management system. By creating a virtual classroom, CMS provides an online platform where students and faculties can share and can access course resources. Moreover, functionalities that come with managing a large class room can be organized and controlled by using such system. Due to its flexibility, interactive features and delivery medium satisfaction, CMS is getting more popularity over the years. Thus, incorporating CMS with Web of Things (WoT), the cutting edge web technology, is getting more importance in the research community. This paper proposes a novel cross-layered WoT based CMS framework, named "WoTCoMS". Design and operational features of the proposed WoTCoMS have been highlighted in this paper. While designing the proposed framework, different layers of WoT are considered, however, the proposed system is designed as a cross-layered approach. The proposed CMS also considers that strengths and limitations of the existing CMSs. To the best of our knowledge, this is the first course management system with the integration of the features of WoT.**

Keywords—Course Management System (CMS); Web of Things (WoT); Web-based learning; WoTCoMS; E-learning

I. INTRODUCTION

Now-a-days web of things (WoT) has become one of the most widely used areas for research. The terms web of things is used to define that any object of the world is allowed to use/ access the World Wide Web (www). Web of things is a layer based model where the layers are impactful in real world. In general there exist five layers in WoT, Where Layer 0 contains the networked things like teleconferencing, RFID code etc. Layer 1 which support to access coding part like PHP, Android, Windows etc. Layer 2 actually contains the finding parts like Rest crawler, Semantic web, Search engine and so on. Sharing part of a system such as social network, authentication, encryption etc. is contained by layer 3. Layer 4 contains the composing parts namely web application, system integration etc. The WoT is very important for online course management system.

The utilization of online instruction frameworks has increased exponentially in the last couple of years. Online course management system (CMS) is a tool or engine that allows instructors, universities, and corporations to develop and to support online learning or education. Specially, shared and specialized tools of CMS are generally utilized as a part of instructive settings. Therefore, Virtual Learning Environments (VLE) are introduced more by universities, community colleges, schools, businesses, and even individual educators. In some cases, such e-learning frameworks are called as Learning Management System (LMS), Managed Learning Environment (MLE), Learning Support System (LSS), Course Management System (CMS), Learning Platform [1] or Learning Content Management System (LCMS) and so on [7].

E-learning is much more effective to maintain all the tasks properly of a classroom based education system. There are many factors in a bigger classroom such as large number of enrolled students, role type of various faculty members, different types of assistantships, grades, assignments, class lectures, assignment collection, scores etc. Learning management system accumulates an extraordinary arrangement of log information about understudies' exercises [5]. Many institutions choose to use e-learning because of many reasons such as - (1) providing consistent and worldwide training, [2] lessen conveyance process duration, (3) building learners' comfort, (4) reducing cost and so forth.

Thus, considering the benefits of WoT, a framework for course management system named "WoTCoMS" is proposed in this paper. Though, there are several different course management systems, however all of these CMSs fail to extract the maximum benefit of WoT technology in their design. For instance, in many CMSs, there is no feature to see all course results at a glance. Moreover, existing CMSs are also incapable to notify run time updates to the users in different social media platforms or/and incapable to notify the users using the existing telecommunication systems. Therefore, this paper proposes a novel WoT-based framework for course management system. This proposed system includes the standards for identification, discovery and interoperation of the services across platforms from several vendors. It also involves the need for rich descriptions and shared data models, as well as concern about the security, privacy, scalability, accessibility and many things. Different layers of web of things are considered while designing the proposed WoTCoMS system. Moreover, while designing the proposed framework, these layers are merged to make the system more efficient. Thus, WoTCoMS is considered as a cross-layered WoT-based course management system. The layered diagram of this proposed system is shown in Figure 3. The Design aspects and features of the proposed WoTCoMS are discussed thoroughly in the later section of this paper.

The paper is organized as follows. In section II, a brief study on the existing CMS tools has been presented. This section also discusses about different CMS tools with their

pros and cons. Section II also highlights current global trends of CMS usages. The existing state of CMS usages in Bangladeshi University is highlighted in section III. The proposed model is presented in Section IV. Conclusion and future works have been discussed in section V.

II. BACKGROUND STUDY

Currently different types of Learning Management Systems (LMS) [1] or Course Management Systems (CMS) are used such as Moodle [2], Blackboard [6], Edmodo [3], Schoology, etc. Moodle is much more popular than the other CMS. Nearly 74% of associations currently use Learning management systems (LMS) and Virtual classroom or web-casting or video broadcasting or course management system (CMS) [2].

Table1. The growth rate of CMS usage country

Rank	Country	Growth rate (Percent)
1	India	55
2	China	52
3	Malaysia	48
4	Romania	38
5	Poland	28
6	Czech Republic	27
7	Brazil	26
8	Colombia	25
9	Indonesia	20
10	Ukraine	20

Online learning management places the most important role for many academic training or courses, where many CMS are used for the academic purposes, which contain many features. Most of the CMS have user friendly interface, personalized dashboard, convenient file management system, simple and intuitive text editor, notifications or get alerting features, tracking progress, customizable site design and layout, secure authentications, multilingual capability, roles & permission, direct learning path, encourage collaboration, group management, marking workflow, assignment module, workshop, badges, grade booking, embedded external resources and so on. All of these features are the benefits of these CMS. There are also many drawbacks in existing CMS. It is worth to mention here, the admin side of the CMS is not much user friendly. Thus, it is not so easy to maintain all the features properly. The existing CMS have no easy way to manage groups of students whereas it would be easier if there exist a way to manage groups site wide rather than course wise. LMS has no grading system that can show all grades as a report to the user. User can only see the grade of each of the courses at a time. Current researches on e-learning or course management systems focus e-learning management system [7], design of e-learning [10], evolution of e-learning [11], impact of online learning management system [17-18], online management to improve classroom [17], characteristic of usage e-learning [11], [20], cloud computing based e-learning [13-

14], web based learning management system [15-16],[18], [21-22] and so on.

E-learning can be characterized as the utilization of PC system innovation, essentially over an intranet or through the Internet, to convey data and direction to people. To highlight the importance and its trends of CMS development rate of self-managed e-Learning by developing nation is given with a Table 1 [4]. As a test case, Bangladesh is taken into consideration, where current state of CMS is highlighted in the next section.

III. EXISTING STATE OF CMS USAGES IN BANGLADESHI UNIVERSITY

Course management system is used by some of the private and public universities in Bangladesh. Developing countries all over the world uses the course management system very in a wide scale. Comparing with other countries, Bangladesh has some lacking to use the online course management system. Some private and public universities use the CMS but the number of the users is not that high and many of the universities use CMS partially. In Fig. 1, all universities of Bangladesh are denoted with a pie chart. Our survey shows that almost 70% of the universities don't use CMS which is denoted with red in Fig. 1. Few departments of some universities use CMS partially, which is denoted as partially in the figure. Approximately 9% of the universities are using CMS. Only 21% universities use the CMS properly and regularly as shown in Fig. 1 with blue zone.
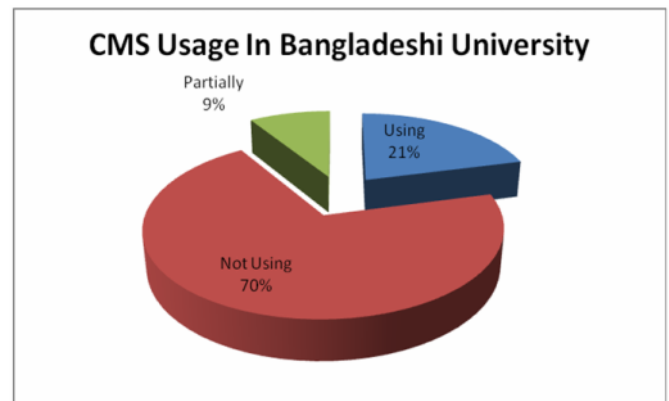

Fig. 1 Current state of CMS usage in Bangladeshi universities

In Bangladesh the universities use different platforms of CMS. Fig. **2** shows the usage ratio of the different platforms users of the course management system. Most of the CMS users use moodle [1-2], [22] in Bangladesh. Black box and Schoology are also used. Other types of platform are also used such as edmodo [3], google classroom etc. However usage of these platforms is quite rare among all of the existing course management systems. As shown in Fig. 2, it is observed Moodle is the most popular in Bangladesh. After analyzing the strengths & limitations of existing CMS, WoTCoMS is proposed and presented in this paper. The proposed system

also considers standards for identification and interoperation of the services over the different platforms.
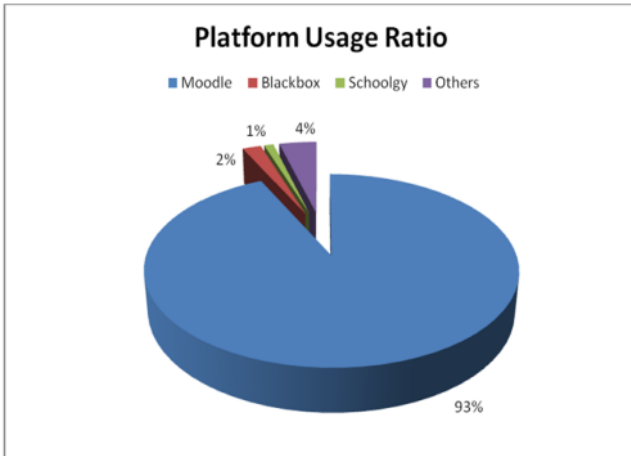

Fig. 2 Usage ratio of different CMS Platforms in Bangladesh

WoTCoMS also involves the need for flourishing descriptions and shared data models, as well as concern about the authentication, privacy, scalability, accessibility. The proposed WoTCoMS is described in the following section.

IV. PROPOSED FRAMEWORK

This section is discussed about the model that is proposed in this paper. The overview of the proposed framework is detailed with a flowchart view in Fig. 4. The key features of the proposed CMS tool is briefly discussed here.

A. Portability

Most of the web-based CMS have the flexibility to run on any platform like Linux, Windows, Mac OSX and so on. The proposed system is design with the help of existing system and also adds some other features to ensure portability.

1) Platform
Considering platform dependency, the proposed system is designed as platform independent. Thus, it can run on any OS such as windows, Linux, Mac OSX etc.

2) Environment
This system works in different environments like iOS application, android apps, windows app, desktop app and web application.

B. Design Features

While designing the proposed system, firstly we are interested to understand how the system will be used and how the proposed system will be able to fulfill the requirements of the users. Thus, some policies and rules are integrated in this system that can override on case-by-case basis and also can be able to notify the users (particular user) of the updated information via mobile phone and social media.

1) Teleconferencing
This option can be used by both teacher and students. By using this feature, the users are able to make a teleconference or video call. This features is quite unique as it has one to one confernicing and many to many confernicing abilities. Our present research shows very few systems has this option.
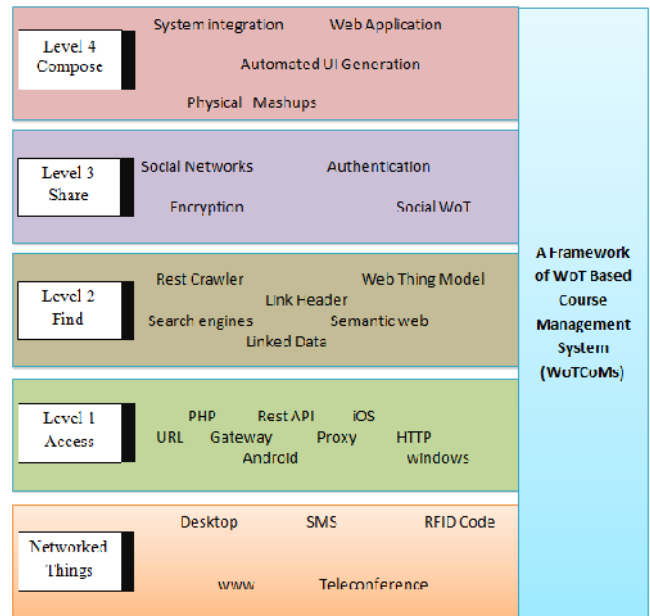

Fig. 3 Cross-layered Design of the proposed Model

2) Plagarism Check
This option gives the opportunity to the faculties to check plagiarism of the individual or group assignments. It is a very important feature for any course management system.

3) Search Engine
In this section faculty, admin and students can search any keywords for this system. By using this section user can optimize their search engine.

4) Crawler
By using this section sudents and faculties are able to crawl among several libraries such as world research library, university's online library, some other digital library and so on.

5) Dsicussion Forum
This option gives the opportunity to make discussion forum for the students. Users can give their philosophy or view and share with the entire user by using this feature.

6) User friendly interface
It is very important to have a system with user friendly graphical view that can help the users to use the system easily to learn and also can provide the environment to work perfectly in a secure way. The proposed system is designed with a very user friendly graphical interface.
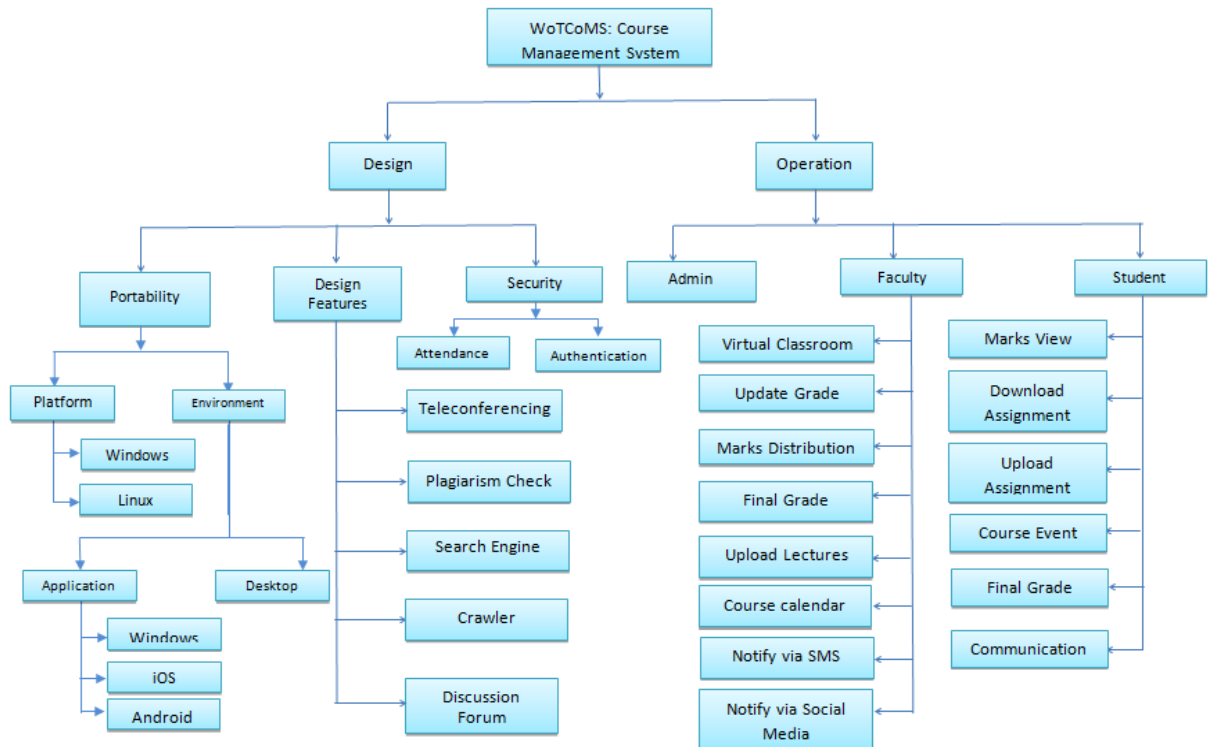
Fig. 4 Overview of the proposed CMS

C. Security

1) Authentication

"WoTCoMS" users are authenticated by their identification number. Fine-grained access control model also support this system. It is design with several level of access for the course staff, students and the admin officer. Any entity, which is not authorized, cannot access the course material.

2) Attendance

This system can track the student RFID. In WoTCoMs the attendance of the student can be taken by tracking the RFID of the student.

3) Course management for the administrator and the user

The administrator is responsible for adding, deleting or updating any information in the proposed system. For updating any course info, students or faculties information, or any kind of changes the administrator must be authenticated and after that they can able to do the changes. At the end of the each semester the faculties are able to update the grade of the students and the system can automatically make a final mark sheet in a file which contains all courses grade for each of the students. At the end of the semester the students whose registration date is finished are not able to access the particular courses. However they can check their grade sheet or others information.

D. Course management system for the faculties view point

Faculty memebers must need to register to use this system. After completing their registration the memebers are able to select the courses and their consultation hour from the system. After finishing all these steps, faculty can manipulate or maintain the CMS by doing the following steps.

1) Virtual classroom management

This section is used for placing the marks distribution for a particular course by a faculty member. When the faculty member enters into this section s/he can see the registered students for this particular course. And only the registered students can access the course material. Faculty can add some students if s/he wish to add unregistered students to this course. This features gives extra flexibity for the faculties. From this section the teacher can also take attendance in online rather than the manual one. There is also another feasibility, where once the students open their RFID the students automatically detect in this system and assign as an attendee.

2) Updating grade system

Grading policy may vary from terms to terms, course to course and faculty to faculty. This section gives the opportunity to the faculty members to set the grading system in their own way for a particular subject or course.

3) Marks distribution policy

Sometimes it is needed to change the grading policy and this section gives the user to change their grading policy or can add new content or new policy.

4) Final grade calculation

In this section faculty can overview the grade of all students in a file. If any faculty wants to change any marks of the students they can change that particular part by using this option.

5) Students marks

To search any examination marks of a particular course or student of a particular exam, assignment or quiz, this section can be used.

6) Uploading lectures, materials and assignments

In CMS faculties need to upload their lectures, materials, assignments and so on for the students. This option can be used to upload their necessary things. The uploaded documents by the students like assignments, quiz paper can be downloaded by the faculties.

7) Course calender

Course calendar is one of the most important things for the online course management system. The faculty member can add the event details for the particular courses by using this section.

8) Notify students with message

By using this option faculty can be able to notify the students via text message using web to SMS technology.

9) Notify students via social media

If any faculty post the update anything to the CMS and wants to notify the students, faculty can be able to notify the students via social media like facebook, linkedIn, yahoo or gmail by using this option.

E. Course management system for the students view point

The particular students who are approved their registration by the administrations can access the proposed CMS and their particular courses. Each student requires ID number and a password to login to this system.

After login to the system, the students will find all the facilities of the online course management system. This system may create a virtual classroom for the students and the faculties. The students can enjoy the following facilities by using the proposed system.

1) Marks view

Students can see all their examination, quiz or assignments marks that are given by their course teacher. Students can also be able to find their grade on the basis of marks where the grade is automatically calculated by the system from the policy which is assigned by the course teacher.

2) Downloading Assignments & Lecture Slides

Students can download their necessary lectures, course materials or others thing by using this option.

3) Lectures viewing

Lecturers can record their lecture and upload to the system. Thus, using this option, students of a particular course can view any missed lecture or important lecture for better understanding the topic.

4) Uploading assignment

This section enables the students to upload their assignments for the courses.

5) Course events

Course calendar option gives the opportunity to the students to be informed about the upcoming course events. It may also work as notice board for the students.

6) Final Grade

At the end of the semester students can able to view their final grade.

7) Communicate with the faculties

By using this option the students can communicate with their course teacher by the chat box.

F. Updating Notification

This option is used by the faculty and also by the students to make the notification for any change or update in any things such as new upload lectures, assignments etc.

G. Mobile apps

This system can be also used by the mobile application. For any update, users can check their update through mobile application. Students can also submit their assignments using mobile app. Faculties can also upload their lectures using the mobile application to the proposed course management system.

V. CONCLUSION AND FUTURE WORKS

In this paper, a novel Cross-Layered Web-of-Things Based Framework for Course Management System is presented. The proposed model aims to provide all the features described in the earlier sections. Though there exist many CMS however features considered in the proposed CMS differs from others because of its uniqueness. It is worth to mention that features of the proposed "WoTCoMS" are very important for the CMS users and make the system very friendly and easier to use. Our next research step is to introduce WoTCoMS to different universities and based on the feedbacks enhance the proposed system. Moreover, more components of WoT are intended to be integrated with the proposed model.

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