

Wireless LAN based Mobile Attendance System (WL-MAS)



Rajeev Singh, Jitendra Kumar

Abstract: In any education system, attendance of students is the first and foremost thing. Apart from academic compulsion, it reflects trust and belongingness of the students in system. In current scenario with large number of students and modern teaching equipments, the methodology of attendance keeping and maintenance needs to be changed. Hence, we have developed a prototype system using PHP/MySQL in which attendance is marked via mobiles that use wireless LAN connectivity through Access Points. The attendances so marked are stored on to a server. From the stored data, the reports of the students (regarding status: regular, short or condone) are generated. The developed system is tested in class room environment at G.B. Pant University of Ag. & Technology during teaching and is found to be effective. This system can be easily customized as per attendance system of any other Institute/University.

Keywords: WLAN, mobile application, attendance system, CAPTCHA, HI-CAPTCHA.

I. INTRODUCTION

With phenomenal growth of students and Institutes, an autonomous attendance system is the need of the hour. Students require it for transparency reasons and teachers require it for reducing their over-load. Such system is also often required by the administrators for smooth functioning of an Institute. Use of mobiles for such system is the best choice as smart phones are being used by almost all the students studying in any Institute. The prices of mobile devices are decreasing and the available bandwidth is increasing day by day. Use of mobile devices is also time effective as all the students of a class room can mark their attendance in one go within few seconds. Use of any specialized and dedicated device (like finger print scanning device OR signature verification device) for such student attendance system has its own limitations: (i) device installation and maintenance requires cost, (ii) problem in the device may lead to halt in the process of attendance of entire classroom (iii) In case Instructor/Administrator wishes to take re-attendance at any point of time, students will have to again form queue and mark

their attendance and, (iv) it is easy to fool such devices as these are placed at one location usually outside the classroom. The classroom presence of students (indicated through attendance) reflects trust and belongingness of the students in system. More student attendance in classroom means more effective teaching and learning. Most of the traditional classroom teaching still relies on Teacher's Register based attendance system which is not only time consuming but also less effective due to manual calculations and slow information dissemination. Chances of error are also high in such manual system. Thus, the methodology of attendance keeping and maintenance needs to be changed. The researchers have come up with several novel ideas and concepts in this direction using technologies like fingerprints, card, Near Field Communication (NFC), Bluetooth and mobile technology. These technological solutions have associated weaknesses such as limited possible connections, slow speed, high costs, dependency on GPS and possibility of proxy attendance [1-5]. Mobile based student attendance systems are proposed by Reddy et al. (2012) and by Rastogi & Gupta (2013), but in their models instructor marks the students attendance either by clicking the details or by swiping name/id of the student and hence, is not fully automated process [6][7].

In this paper, we propose a Wireless LAN based Mobile Attendance System (WL-MAS) that utilizes the Human-Intervened CAPTCHA (HI-CAPTCHA) [8]. WL-MAS system is developed with four major objectives:

- i) To automate and strengthen the attendance process of an Institute.
- ii) To have least interference in attendance system from instructor or student.
- iii) To provide the administration the where about of the students and teachers.
- iv) To fasten the decision process of the administration.

The main contributions of this paper are: (i) development, testing and demonstration of a complete prototype of WL-MAS on mobile phones with implementation in PHP/MySQL and APACHE web server and, (ii) enhancement of the HI-CAPTCHA system via introducing the notion of re-attendance. Through this notion, an Instructor in a classroom (if desired) may at any later stage again take the attendance of the students. In the proposed system student attendance is marked via mobiles that use wireless LAN connectivity through Access Points. The attendances so marked are stored on to a server. From the stored data, the reports of the students showing daily status i.e., whether the student attendance is regular, short or condone.

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The other useful reports from the administration point of view are also generated by this system.

The rest of the paper is divided into V sections: Section II provides the review of existing CAPTCHA systems, section III provides methodology used to develop the proposed WL-MAS system, section IV discusses the results, section V provides discussions and finally section VI sums up the paper by providing conclusion and future work.

II. EXISTING CAPTCHA SYSTEMS

A. Traditional Efforts

CAPTCHA is basically Completely Automatic Public Turing test. This test is utilized to differentiate humans and bots (computer programs) apart. It is a Challenge-Response Test used to enhance security in applications [9][10]. CAPTCHA test is generated by computers and this test is easy to pass by humans whereas difficult for the bots. It is reverse automated test and hence machine is the judge that declares the result. This test is frequently used by various Internet websites like Gmail, Yahoo, PayPal etc. and by other online E-commerce applications [11-15]. Google's reCAPTCHA is an enhanced CAPTCHA, wherein the human efforts involved in solving the CAPTCHA are used by the system to try to solve AI problems and help in machine learning. One such example is book digitization, where the text that is not identified by machine is presented before the users who identify the text correctly and hence indirectly helps in digitization process [16][17].

B. HI-CAPTCHA

Another novel CAPTCHA concept termed as Human Intervened CAPTCHA i.e., HI-CAPTCHA is proposed by us at [8] for the mobile based applications. WLAN environment is considered in this work for testing the classroom application. The HI-CAPTCHA represents a modified CAPTCHA and its main purpose is to utilize the human efforts for solving the CAPTCHA presented on mobile screen of the users. It is based upon the notion of perceiving and identifying things and user actions within the room for authenticating users in that room. Thus, only the users present inside the room working through their mobile are able to correctly answer the CAPTCHA questions. The users that answered the CAPTCHA questions correctly are termed as genuine (authenticated) while others are termed as invalid users (unauthenticated).

The example questions considered in HI-CAPTCHA system are: Is admin moving or standing? What is the colour of the shirt admin wearing? Which direction admin is standing? It is important to realize that the answer to these questions vary depending upon the circumstances prevailing at a particular time inside the classroom. For example, in question one – the admin may choose to move or standup; in question two - on one day admin wears red other day he wears blue shirt; in question three – the admin may choose any one among four directions i.e., east, west, north and south. Thus, it is clearly visible that answer depends upon the circumstances prevailing at a particular time inside the classroom. Hence, answer of the HI-CAPTCHA is visible only to students inside the classroom.

The HI-CAPTCHA system is useful in various mobile based applications like e-polling, attendance based system, online exam etc. HI-CAPTCHA system also helps in differentiating between a bot and human. A small prototype model where the admin and clients have their own mobile application interfaces to interact with the system was developed in [8]. In the developed model, the users connect via WLAN Access Point (AP) to Spring Tool Suite (STS) web server and database. A notion of timer is introduced in the HI-CAPTCHA that is basically set by the classroom instructor. This reduces the time interval in which a student is supposed to answer the HI-CAPTCHA question.

III. METHODOLOGY

In our University (G.B. Pant University of Ag. & Technology, Pantnagar, Uttarakhand, India), we have a very robust attendance system in which a student has to score above 85 percent (termed as regular student). A student scoring less than 75 percent attendance is failed in the subject while a student with attendance above 75 percent but below 85 percent is allowed to condone his attendance. The existing system rests heavily upon the way attendance are marked, kept and maintained. With increase in intake strength of students it has become very difficult for an instructor to manage the attendance properly. Hence, attendance automation through Wireless LAN based Mobile Attendance System helps a lot in such situation. We followed the strategy to first develop a prototype of the system and then deploy it in a real classroom environment.

The prototype system has been developed using PHP/MySQL and APACHE web server. It has two modules: student and instructor/staff module. Both the modules were installed as mobile applications on different mobile phones. The mobile models used during the prototype development and testing phase for running student and instructor/staff modules were: Oppo F7 & F1S, Redmi note 6 Pro, Vivo V9 and, Honor 7X. Students in the classroom used their own mobiles of different make.

After development, the entire system was deployed in the College of Technology, G.B. Pant University of Ag. & Technology, Pantnagar, Uttarakhand, India in 13 classrooms. 16 Access Points (APs) were installed in the classrooms. The larger class room required more than one AP. These APs have 3 different configuration: DLINK ACCESS POINT (Model: DAP 2230), TP LINK INDOOR ACCESS POINT (Model: EAP220) and CISCO ACCESS POINT (Model: WAP121). The student and instructor/staff modules were installed on mobile phones of students and Instructors respectively. The students were asked to mark their attendance in various courses of the Department of Computer Engineering. The process of re-attendance was also tested through this prototype WL-MAS system. One of the primary assumptions of HI-CAPTCHA that of restricted visibility to the student outside the classroom was by default maintained in this system i.e., the classrooms of the College are themselves so designed that this assumption is met.



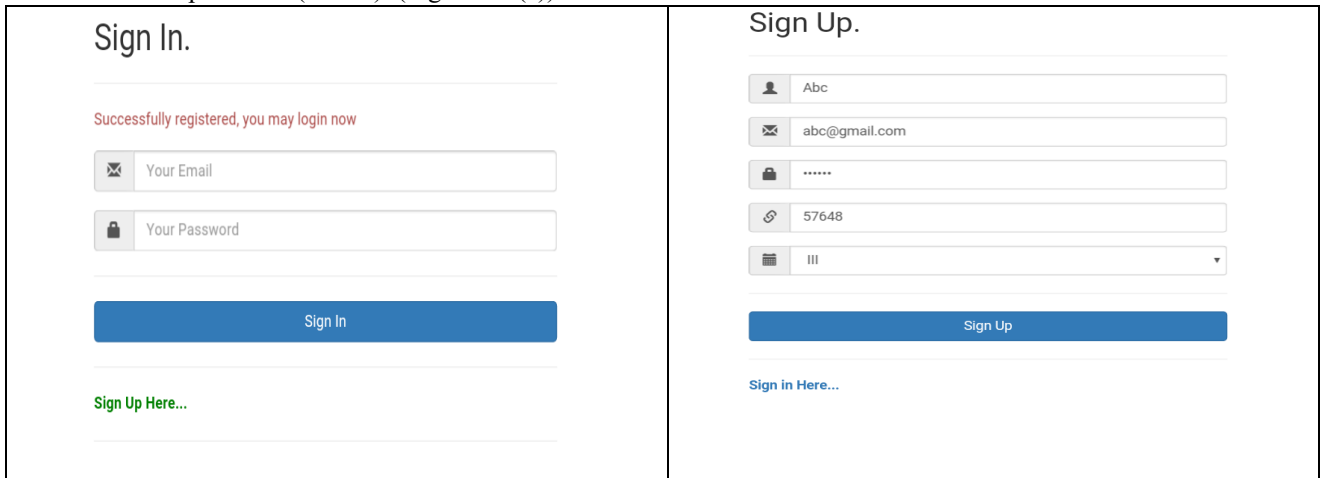
IV. RESULTS

The outcome of our work is a developed prototype that automates the attendance process. Some of the captured screenshots of the developed prototype of the proposed system are shown in Figures 1-3 to explain the functioning of the system. Figure 1 represents the student module, Figure 2 represent the re-attendance process whereas Figure 3 represents Instructor/Staff Module.

students who do not mark their attendance through this screen are marked as absent (as 'A').

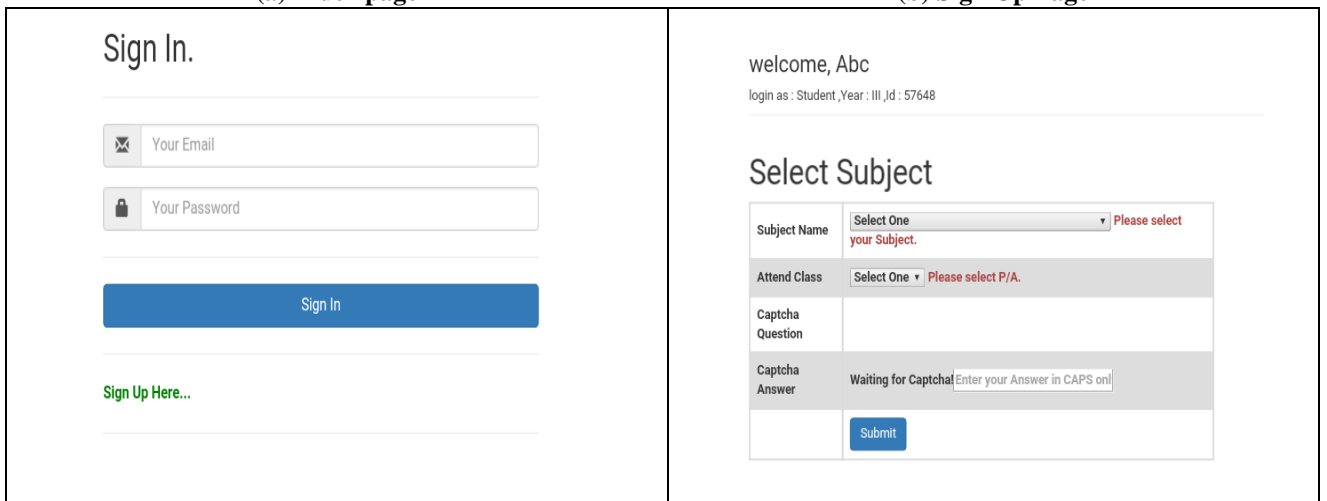
A. Student Module

The student is first asked to register the system through Sign Up Screen. Once register, the student can Sign In and open the Student Home Page where he can submit the answer to the HI-CAPTCHA question (Figure 1 (a)-(d)). In the example, the student name, student ID and year of study (III year) are shown. The student selects his subject and marks his attendance for his presence (as 'P') (Figure 1 (e)). The



(a) Index page

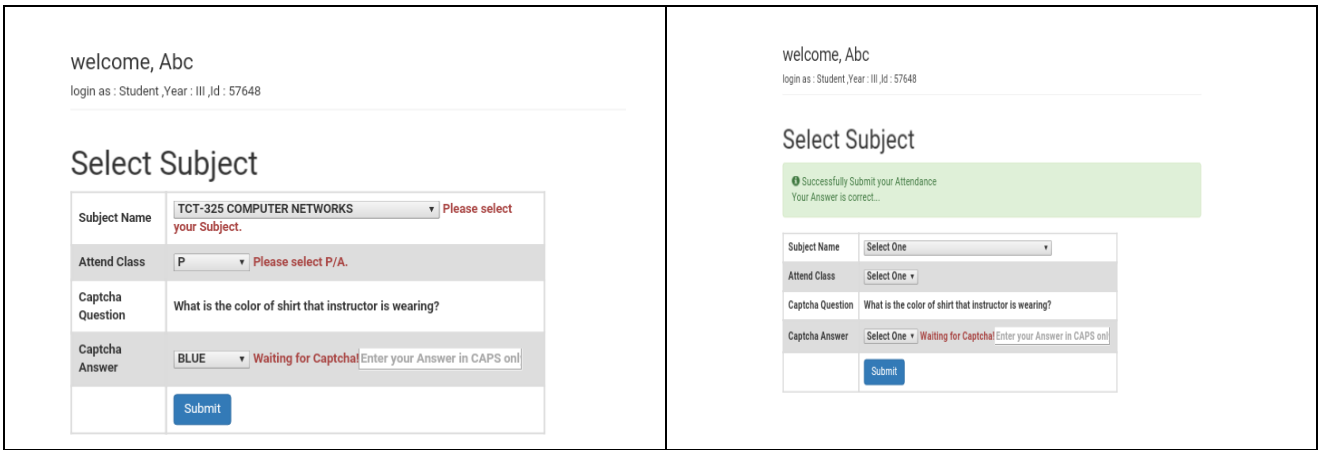
(b) Sign Up Page



(c) Sign In Page

(d) Student Home Page (waiting for CAPTCHA question)

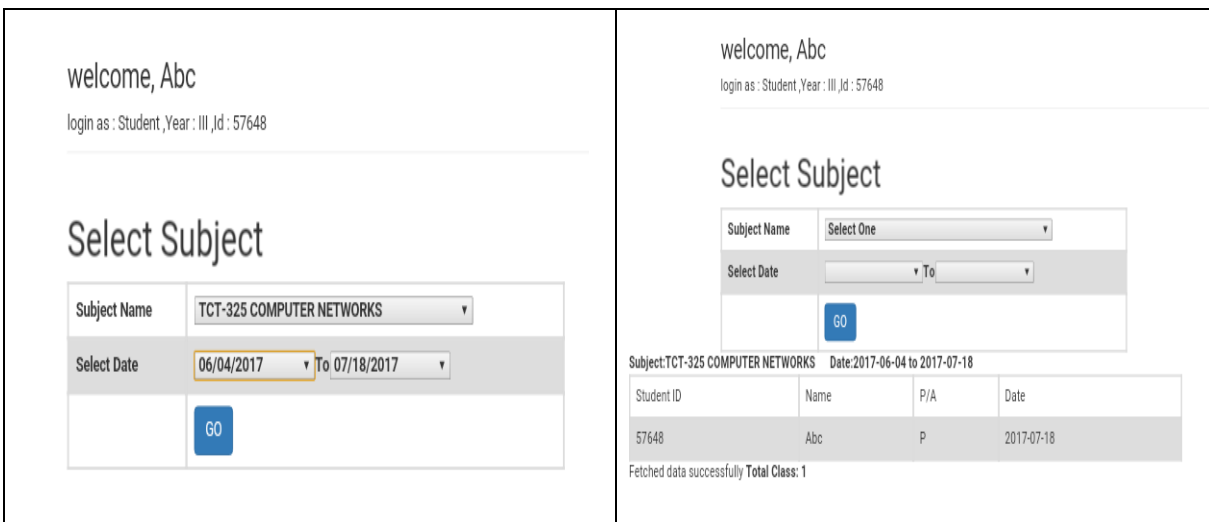
Wireless LAN based Mobile Attendance System (WL-MAS)



(e) Student Home Page (Mark Attendance)

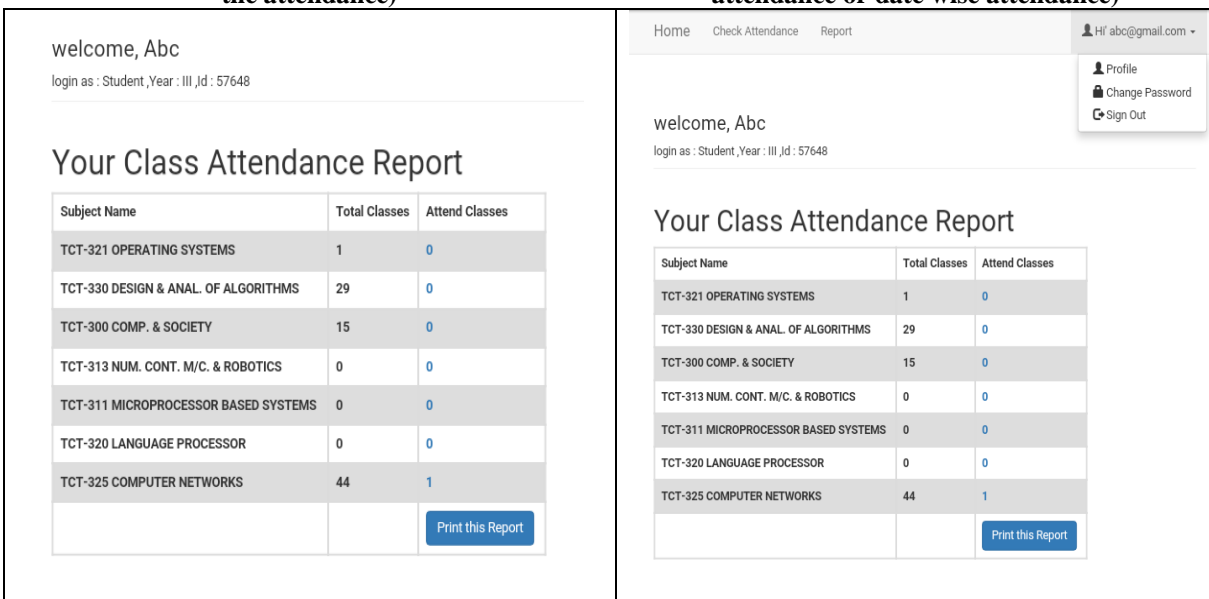
(f) Student Home Page (Successfully submit the attendance)

Figure 1: Student Module



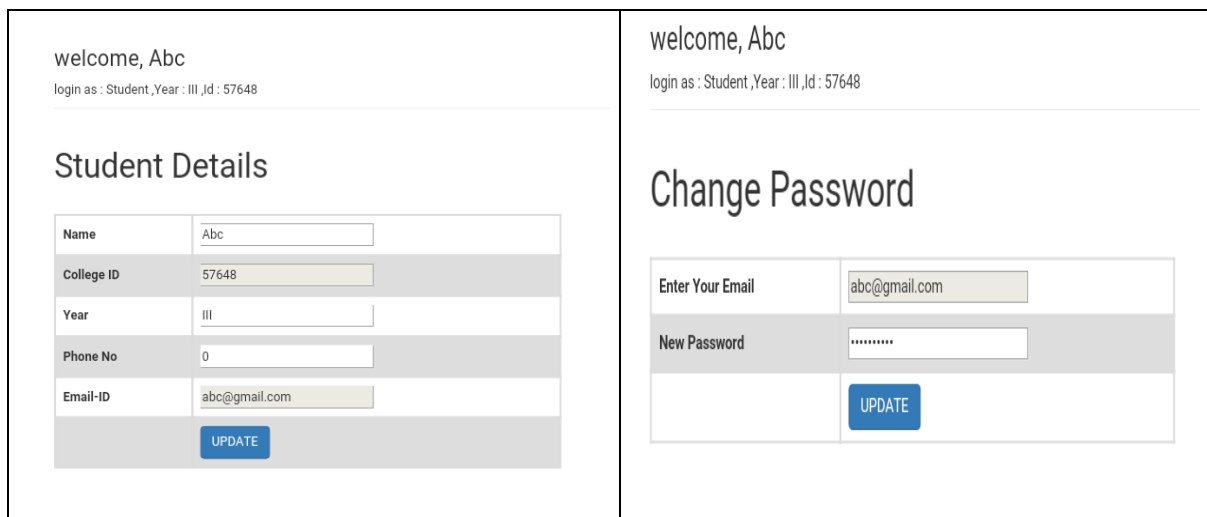
(g) Attendance Page (Select subject & date to view the attendance)

(h) Attendance Page (View selective subject attendance or date wise attendance)



(i) View overall student attendance report

(j) Manage Account



(k) Profile

(l) Change Password

Figure 1: Student Module

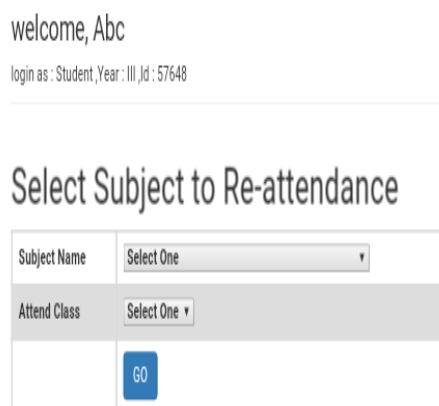
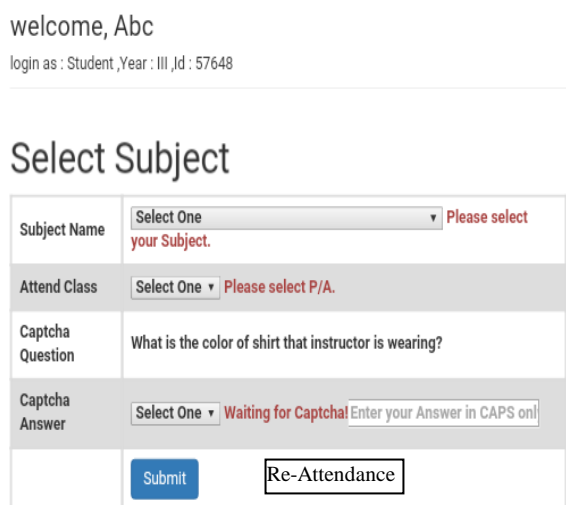
A student is permitted to mark attendance only in the subject (course) whose class is scheduled at the time of attendance marking and student is registered in this subject. This is ensured using the current time of attendance, student ID of the registered student and time table of the subject. After the student marks his attendance on the screen, the HI-CAPTCHA question set by the Instructor of the scheduled course appears on this screen. This HI-CAPTCHA question is visible for the duration fixed by the Instructor.

Attendance of the student who is not able to submit answer to the system within the specified duration is also marked as absent. Such students can request the teacher for re-attendance. In the example considered, the HI-CAPTCHA is “What is the color of the shirt that Instructor is wearing”. The student answers it as “Blue”. As the answer given by the student is correct, his attendance of the scheduled course is marked (saved). The attendance details like subject, scheduled class time and attendance marking time are saved in the My SQL database (Figure 1 (f)). The student can at any time visit the attendance page of the student module, select

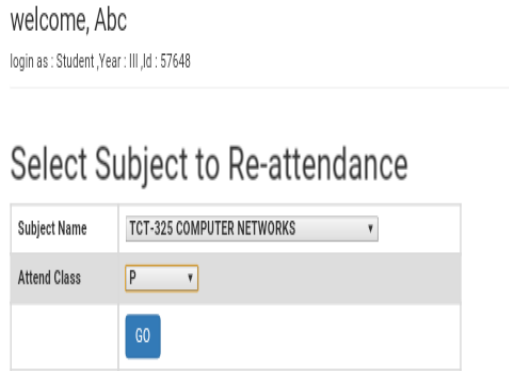
subject & date to view his attendance record. He may also see the complete attendance status in all the subjects (Figure 1 (g)-(i)). He can update his profile and can also change his password in the student module (Figure 1 (j)-(l)).

B. Re-Attendance Process

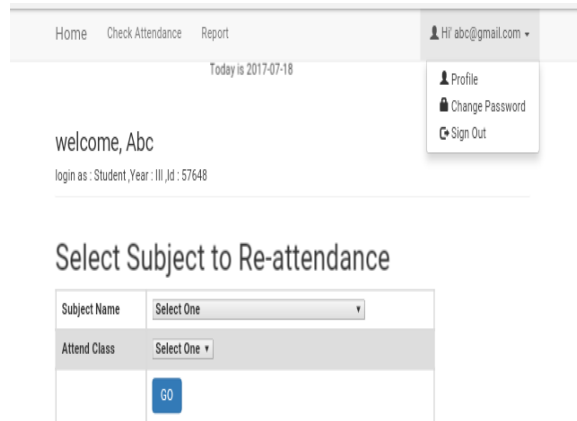
Re-attendance process is required when student is marked absent by the system as either he has entered wrong HI-CAPTCHA or due to expiry of timer set by the Instructor. Teacher on request of student or on his own may initiate the re-attendance procedure. In such cases student is prompted/notified for re-attendance on his attendance page. The student is supposed to enter subject name and his attendance as ‘P’ (Figure 2 (a)-(d)). The re-attendance submitted by the student is validated by the concern course instructor i.e., attendance will be entered in the database only after the approval of the concern course instructor. As this is a special case and is verified individually by the Instructor, no HI-CAPTCHA answering is required.



(a) Re-attendance notify in home page of student module



(b) Select subject for re-attendance



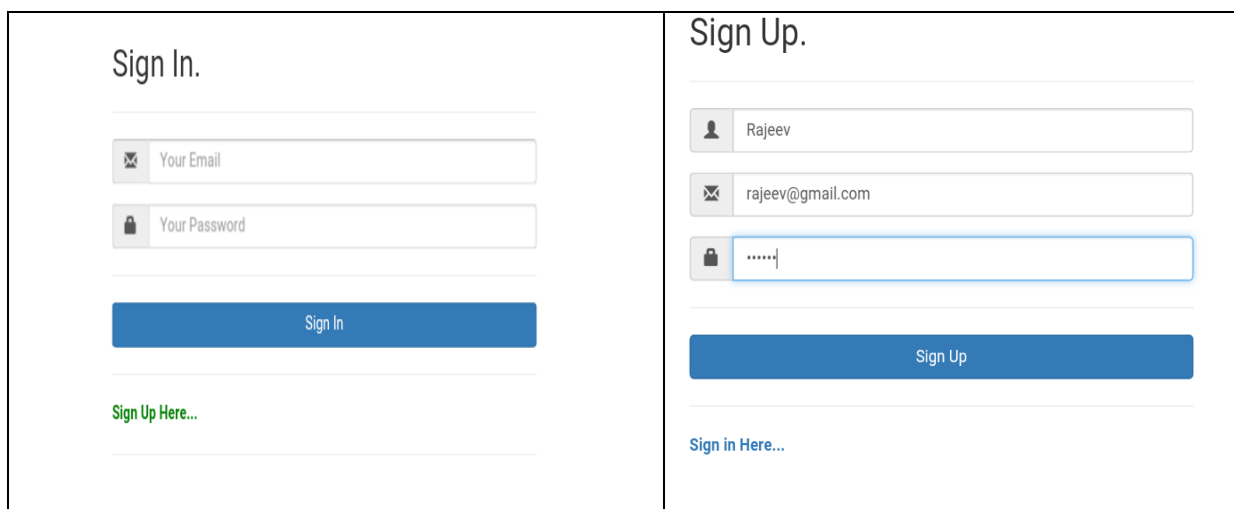
(c) Submit re-attendance

(d) Sign Out after re-attendance

Figure 2: Student Re-attendance Process

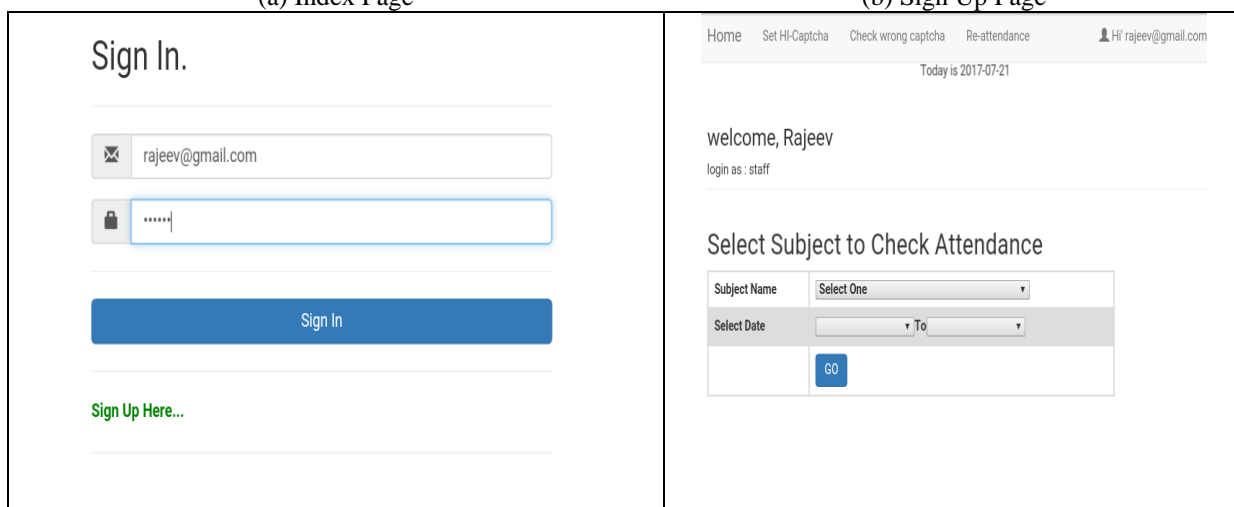
C. Instructor/staff module

Like student, the Instructor is also asked to register into the system through Sign Up Screen of the Instructor module. Once registered the Instructor can Sign in and open the Instructor Home Page (Figure 3 (a)-(d)). On the home page, an Instructor can select any one among the four tasks: (1) view attendance reports, (2) set HI-CAPTCHA, (3) check wrong attendance and (4) initiate re-attendance. Option (1) (Figure 3 (e)) is used to see the student’s attendance status in a subject. This is the most common task required by the Instructor. Here, Instructor select subject to check attendance. He can also select the range of dates i.e., start and end date for viewing the student attendance report. Option (2) (Figure 3 (f)-(g)) is used whenever Instructor wants to change the HI-CAPTCHA question and associated answer. For example



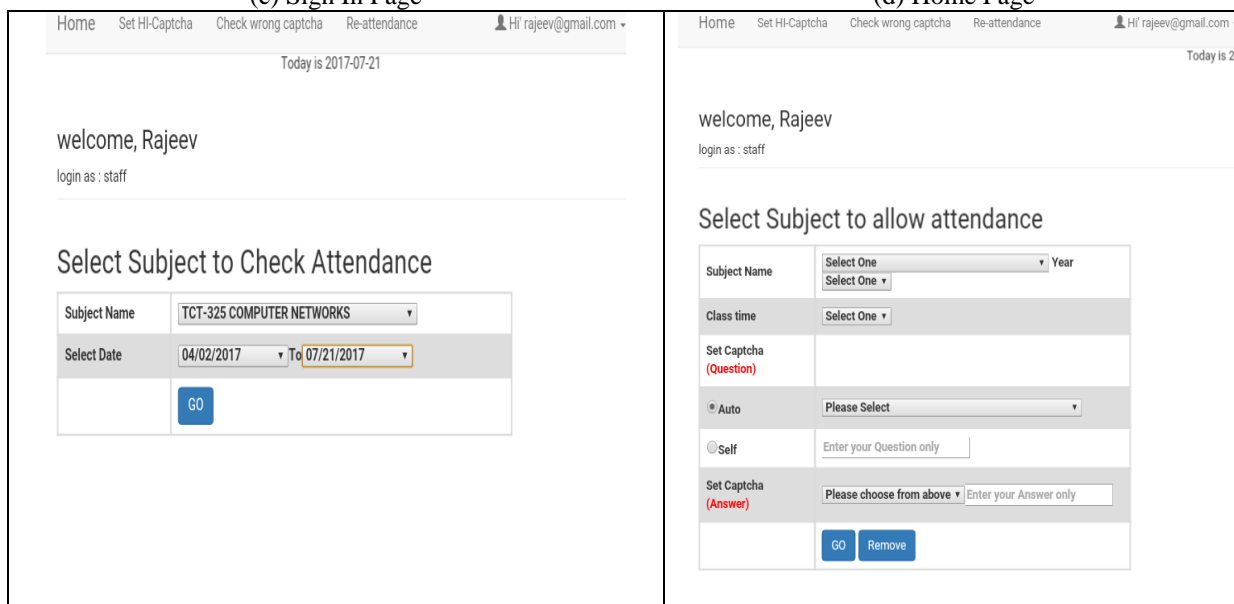
(a) Index Page

(b) Sign Up Page



(c) Sign In Page

(d) Home Page



(e) Check Attendance - Select subject & Date to view the attendance reports

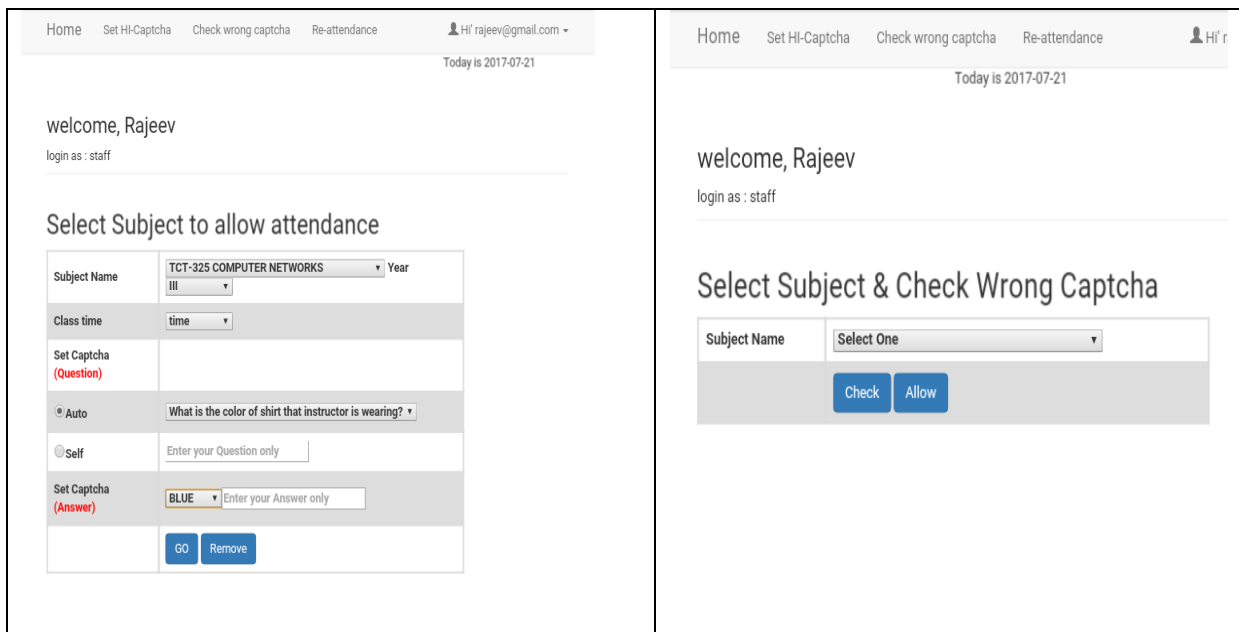
(f) Set HI-CAPTCHA

Figure 3: Instructor Module

if the Instructor want to have only two options for the direction of movement in the class, he can set only two options among four (East, West, North, South). In this case, answer set by the instructor is continuously varying.

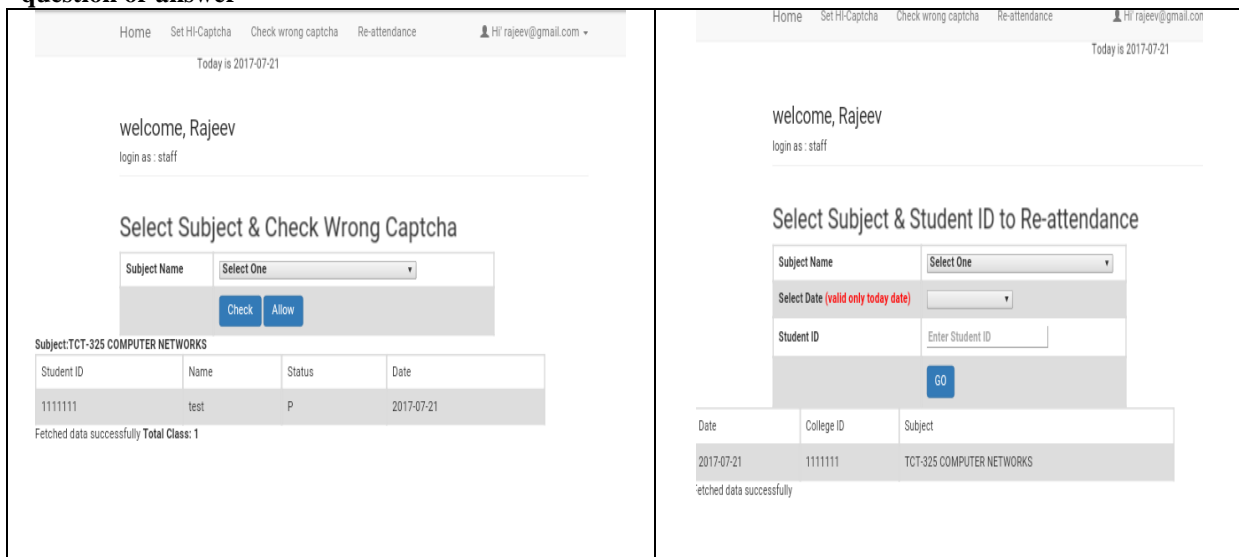
Therefore it is required from the Instructor side to change the answers frequently (even on the same day in another class) as compared to change in the questions. Thus, it is possible to change only the answer of a question at any given time. In Figure 3 (g), the Instructor enters subject/course, year and time of class. Then he can set HI-CAPTCHA for this scheduled class. The Instructor can also select the default question set previously in the system if he doesn't want to change the question and only change in answer to this question is required. The time of class is usually taken from the department time table and hence entry of time may also be ignored by the Instructor. Option 3 (Figure 3 (h)-(i)) is used when wrong attendance is being entered by the student i.e., student is present in the class but has entered

wrong HI-CAPTCHA. Upon identification, the instructor selects the class of the course and then changes the attendance of the particular student from 'A' to 'P'. Thus, Instructor has the right that he can change the attendance from 'A' to 'P' but he cannot do the reverse operation i.e., cannot change the attendance from 'P' to 'A'. Option 4 (Figure 3 (j)) is used when re-attendance is required. In this case instructor is supposed to enter the course and student detail for permitting the student to re-attendance. After Instructor has taken this step, the student is prompted for re-attendance on his attendance screen.



(g) Select subject, year, class time and CAPTCHA question or answer

(h) Check wrong CAPTCHA



(i) Select subject to check wrong CAPTCHA

(j) Select subject, date and student Id for re-attendance

Figure 3: Instructor Module

V. DISCUSSIONS

The proposed system opens new avenues of mobile based systems into the education field. Its advantages are: (1) The use of WLANs increases the data rate and possible connections, (2) The time and associated overheads of faculty taking attendance will be saved, (3) The students will get accurate and correct calculation of their attendance whenever required, (4) The administration can analyze statistics of the course, students and other records.

This WL-MAS system may also be used in the Department Laboratory classes. The WiFi connected Desktop PCs OR Laptops may be used by the students working inside the Labs i.e., this system is compatible with desktop PCs and Laptops also. The selection of publically available open source tools makes the system interoperable. We have identified that the proposed WL-MAS system can be integrated with other modules of the existing online grade submission software being operated by Registrar Office at G.B. Pant University of Ag. & Technology. It can also be integrated with various College websites of the University. The developed prototype gives ultimate power of marking attendance to the Instructor. Instructor can change the status of the student as present (P) incase the attendance of the student is either wrongly marked as 'A'. Instructor can initiate the re-attendance process if he wants student to again mark the student. It may be due to timer expiry or due to wrong CAPTCHA entered. As visible in Figure 3 (g), an Instructor may create his own customized question and set its answer. This means that Instructors can set large number of customized HI-CAPTCHA questions whose answers depends upon classroom environment and are not known to the users before entering into the class. This introduces the complexity into the system and makes the answer guessing by misbehaving student outside the classroom difficult.

VI. CONCLUSION

The attendance systems are prevalent in various Departments. In an educational Institute, an Instructor is custodian of attendance. Right from taking attendance in the class to display of attendance to students, Instructor is overburdened with the record keeping work. A system that somehow reduces his burden is required. The students feel that more transparency in the attendance system is required i.e., less grievances occur. The Institute administrator requires knowing the present status of Instructor and students at any given time. With these requirements, an improved wireless LAN based Mobile Attendance System (WL-MAS) is developed and presented in this paper. The system is developed using PHP/MySQL. It is useful to the students, Instructors and administrators in an educational institute. This system automates the attendance process. It provides transparency to the student as he can view the attendance of any subject retrieved from the system at any given time via student module. It lessens the Instructor's load (via use of instructor module) as no manual record keeping is now required; the time to disseminate the information to the student is saved. The administrators are able to locate the students and faculty. They are able to get the reports on the fly. Overall, the system is time saving and in the present day

world doesn't require any major costs. It utilizes smart phones and it is assumed that students use them frequently in their Institute. The attendances marked in the system are stored on to a server. From the stored data, the reports of the students (regarding status: regular, short or condone) are generated. The developed system is tested in class room environment at G.B. Pant University of Ag. & Technology during teaching and is found to be effective. This system can be easily customized as per attendance system of any other Institute/University. The system modules (student and instructor module) are also compatible and can be easily integrated with other existing softwares procured/developed in an Institute. In future, the proposed system can be customized and expanded in functionalities as per the growing needs of an Institute.

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Rajeev Singh is currently working as Associate Professor in the Department of Computer Engineering, G.B. Pant University, Uttarakhand (India). He received his Ph.D. Degree from N.I.T. Hamirpur (H.P.). and M.Tech. Degree from Indian Institute of Technology, Roorkee (India), both in Computer Science and Engineering. His research interest includes information systems, computer networks and network security. He has published several book chapters and research papers in journals/conferences of repute.



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