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Research Article

Design and Development of an Automated Monitoring System for Class Schedules and Student Attendance in Higher Education

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ABSTRACT

Information and communication technology has also greatly enhanced administration in academics especially in keeping track of the time of classes and attendance of students. Nonetheless, several higher education institutions continue to use manual and traditional approaches, which are time-consuming and inefficient for managing and monitoring attendance records. This paper set out to design and develop an automated system of monitoring schedules and attendance of students based on Radio Frequency Identification (RFID) technology. The system was created on the basis of the Rapid Application Development (RAD) model, which focuses on the iterative design, rapid prototyping and constant user feedback. The mixed-methods design was used which relied on descriptive-survey design to evaluate and analyze the current system as well as analyze the developed solution. The major features of the system include classroom status monitoring, classroom management based on the Create, Read, Update, and Delete (CRUD) operations, RFID-based attendance tracking, and real-time reporting. It also consists of role-based access control in order to provide system security and data integrity. The developed system was tested with ISO/IEC 25010 Software Quality Model in the context of functional appropriateness, dependability, protection, ease of use, and efficiency of performance. The results of the summary of the answers gave the overall mean of 4.88 which is considered to be excellent. Security received the most rating (4.94), then performance efficiency (4.93) and usability (4.92) meaning that the system is secure, efficient and easy to use. The results affirm that the created system is extremely efficient and can be successfully implemented, which offers an efficient, reliable, and secure system to enhance the process of academic monitoring in higher education institutions.

Keywords: *Automated monitoring system, Class Schedule Management, ISO/IEC 25010, Radio frequency Identification, Rapid Application Development*

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Introduction

Teaching, learning and administration processes in the higher education sector have been drastically changed by the introduction of Information and Communication Technology (ICT) in education. Schools and colleges are becoming more interested in digital technologies to promote the efficiency of their operations, to facilitate their communication, and to allow making decisions about their work based on specific data. The state of the United Nations Educational, Scientific and Cultural Organization (UNESCO) says ICT facilitates extended reach to education, increases the quality of learning, and also enriches institutional management by making academic management systems more efficient. With the continued growth and diversification in the size and complexity of academic institutions, the application of technology has increasingly become fundamental in overseeing the operations of the academic institutions through scheduling, tracking of attendance, and the apportionment of the resources.

Monitoring schedule of classes and student attendance is one of the important administrative functions in higher learning institutions. Attendance management is crucial in the assessment of involvement with students, accountability of the teaching, and performance enhancement. It has been found that frequent attendance of classes is closely linked with better academic performance and student activity (Crede et al., 2010). However, many institutions continue to use traditional attendance-monitoring systems, including roll calls, sign-in sheets, and paper-based records. These methods are time-consuming and inefficient.

In overcoming these shortcomings, scholars and organizations have examined a number of automated attendance tracking technologies which are biometric systems, barcode scanners, Quick Response (QR) codes and Radio Frequency Identification (RFID). RFID has attracted a lot of attention among these technologies because it has proven to be able to offer contactless identification, involve real time data capture as well as managing data effectively (Want, 2006). The RFID technology involves the emission of radio waves that identify and track tagged objects or people, thus fitting in the management of attendance in learning institutions where huge groups of students and faculty members interact within constrained periods.

Various research works have proven that attendance systems that are based on RFID are effective in enhancing monitoring accuracy and in increasing administrative efficiency. As an example, Agrawal and Bansal (2013) have created an RFID-based student attendance system which automatically records the attendance data and minimizes the manual intervention. On the same note, Chen and Yue (2017) adopted RFID technology to develop an intelligent campus supervising system with the ability to track the movements and attendance of students in the campus setting. These systems underline how RFID technology can be used in streamlining institutional procedures in improving the overall management of the academic undertakings.

Even with all these technological development, most institutions of higher learning continue to face the trouble of effectively tracking the schedules of classes and the attendance of students. Manual and semi-automated systems are not always able to offer real-time monitoring, centralized data management and reliable reporting mechanisms to the administrators. Also, there is not a unified system that suits to jointly control the class schedules, classroom surveillance and student attendance, which deprives administrators of the chance to effectively govern the operations in the academic fields. Against these challenges, there is the need to come up with an integrated and automated surveillance system that is able to efficiently administer the schedules of classes and student attendance in learning institutions. This kind of system is able to enhance efficiency in administration, an increase in transparency in attendance checking as well as aid in the decision-making procedure of the institutional administrators.

Thus, the proposed study is intended to design and develop a system of automated control over classrooms and attendance of students at a higher educational establishment. The suggested system employs the latest electronic technologies to help with efficient monitoring, enhance the accuracy of attendance data and

use the new technology in providing efficient academic administration. The invention of this system is set to offer the institutions of higher learning with a dependable platform through which they manage the academic schedules and the participation of students in a more effective and safer way.

Objective of the Study

The main aim of the research consists of designing and developing an automated monitoring of the schedule of classes, and attendance of students via RFID technology to aid in the effective monitoring of academic issues in institutions of higher education, especially in the College of Information Technology and Engineering of Bulacan State University - Bustos Campus.

Specifically, this study aims to:

1. Examine the current system applied in the tracking of schedules of classes and student attendance in the institution.
2. Design and build an automated monitoring system that consist of the following features:
   a. classrooms status monitoring.
   b. managing the classroom based on the CRUD operation of creating, reading, updating, and deleting.
   c. RFID-based identification on attendance record; and
   d. administrator classroom monitoring.
3. Provide a system design and architecture of the automated system of class monitors.
4. Assess the formulated system according to the software quality features of ISO/IEC 25010 Software Quality Model, in relation to the qualities:
   a. Functional suitability.
   b. reliability.
   c. security.
   d. usability; and
   e. efficiency.

Conceptual framework

This paper is based on the Input-Process-Output (IPO) model that contains an appraisal aspect by which it is a systematic transformation of inputs into outputs with a particular development process, and the output is then evaluated in terms of the effectiveness of this system. The IPO model gives a systematic means through which processing of resources and requirements are needed to create a functional system although evaluation stage ensures that the output created is of the requisite quality. The framework is also extensively applied to the system development study research as an example of illustrating the interdependence between inputs, processes, outputs, and evaluation of an information system design and implementation (Ravitch and Riggan, 2017).

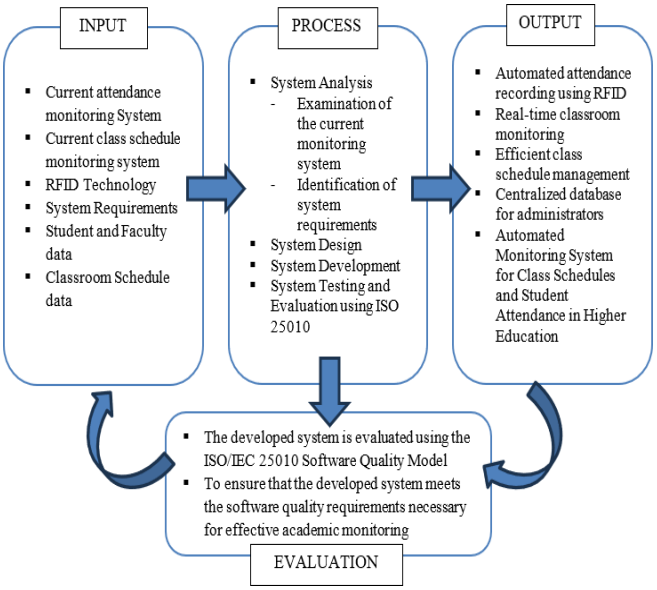

Figure 1. IPO Framework

In this study, the required resources include the required data, system requirements, and technological elements needed when establishing the automated monitoring system of class resolutions and student attendance. These involve the current processes of the administrators and the faculty members in monitoring the classes schedules and the attendance of students that are usually carried out through the manual and traditional means. Other inputs are student and faculty identification data, classroom timetables and technical devices like Radio Frequency Identification (RFID) devices and database management systems. The RFID technology provides opportunities to automatically identify and trace individuals, using the radio waves and optimally record the attendance data, non-contractually (Want, 2006).

Process. It is done through the design and development of the automated monitoring system based on Rapid Application Development (RAD) methodology. RAD is a software development method the focus of which lies on quick prototyping, iterative development, and constant feedback with the users to rapidly develop a system but keep it at a pace that makes it satisfy the needs of the users (Pressman and Maxim, 2020). In most cases, the RAD model comprises of four significant stages: requirements planning, user design, construction and implementation. During these stages, the system components keep being refined based on feedback until the required system is developed to meet the functional and operational requirements of the system users.

The output of the research is the automated monitoring tool of student attendance and classes recruitment in higher learning institutions. After the development stage, there is evaluation process where the quality and performance of the system is evaluated. The system is rated under the ISO/IEC Software Quality Model 25010 Software quality model that is a comprehensive model of software quality evaluation. In particular, functional suitability, effectiveness, reliability, usability, and security are used to measure the system. This testing step is to aim at determining the functionality that the created system fulfills the user demands, is able to work effectively under the projected conditions, safeguards data integrity and confidentiality, and offers user-friendly interface to the administrators and faculty members.

Moreover, the evaluation phase is used as a validation tool of ascertaining whether the proposed system is viable in mitigating the constraints of the current manual procedures. The evaluation outcomes give clues on strong sides of the system and areas to be improved upon to promote integrated development and make sure the system is part of enhanced academic tracking and efficiency in the administrative side. It is in this context that this study shows how the combination of the RFID technology, an organized methodology of development and a systematized assessment procedure can help to increase the efficiency of administration, decrease the level of manual work, and increase the accuracy and reliability of attendance record keeping in institutions of higher learning like the Bulacan State University - Bustos Campus.

In this context, the study demonstrates how RFID technology can be utilized to automate the monitoring of class schedules and student attendance, by using effective methodology of development and systematic evaluation process can help to achieve efficiency in administration, lessen the number of man hours spent by the administration, and increase the accuracy and reliability of attendance monitoring in institutions of higher learning like the Bulacan State University -Bustos Campus.

Methodology of the Study

The research design used in this study was mixed methods as it used descriptive-survey and developmental research methodologies to examine current practices and come up with an automated monitoring system of the class schedules and student attendance. In order to explore the existing system, determine the problems within the context and determine the acceptability of the suggested solution, a descriptive-survey approach was applied. The descriptive research is suitable in investigating the current status of a phenomenon and giving a systematic and precise description of the current status (Best, 2003; Traverse, 2000). It is

also helpful in establishing relationships between variables and also forms an underlying basis of solving practical problems within institutions (Sarmiento, 2008). In this work, the information collected through the respondents was used to determine the inefficiencies of manual implementation of monitoring and to inform design and development of the proposed system.

The quantitative part included the collection and analysis of the survey responses using the descriptive statistics (weighted means) to assess the developed system in terms of the ISO/IEC 25010 software quality characteristics. Qualitative data analysis involved interviews with selected administrator-clients using a semi-structured interview approach. Thematic analysis of the interview data was used to explain, verify and complement the quantitative evaluation results. The quantitative and qualitative results were merged during results interpretation to give a more holistic appraisal of the developed system.

Along with that, a developmental research approach was used to design and implement the proposed system based on Rapid Application Development (RAD) model. RAD is a user-related software development model, an iterative one, relying on the basic principles of rapid prototyping, constant user feedback, and speeded up system development (Pressman and Maxim, 2020). The steps involved in the development were four, which included requirements planning, user design, construction and implementation. In the process of conducting requirements planning, the current system designed to track the schedules of classes and attendances of students was studied to determine the limitations of the system and to collect the needs of the users. During the user design stage, system prototypes, interface designs, and database structures were created whereby active user participation towards defining system functions like classroom management through Create, Read, Update and Delete (CRUD) operations, classroom status monitoring, and RFID based attendance monitoring was made. The construction phase was aimed at developing the systems, which involved coding, RFID technology integration in the system to record the attendance automatically, and the formation of a central database. Iteration testing was done to verify the system accuracy and functionality. Lastly, during the implementation stage the system developed was implemented into the real setting and evaluated to check whether the system actually achieved the intended goals and requirements of the users.

To test the developed system, ISO/IEC 25010 Software Quality Model was used which is a relatively complete framework for software quality assessment. This was based on the main features, such as functional suitability, efficiency, reliability, usability, and security. These parameters were to be employed to gauge general performance, effectiveness, and acceptability of the automated monitoring system towards assistant support of academic administration. The outcomes of the appraisal were the foundation for confirming the functionality of the system to enhance the monitoring system of class schedules and student attendance in higher learning institutions.

Respondents of the Study

The clients of the study were the faculty members of the College of Information Technology and Engineering, Bulacan State University - Bustos. The sample was 30 faculty members, which included the department chair, three program chairs, 10 I.T. faculty members, seven engineering faculty members and nine general education faculty members. At this point, it should be noted that the questionnaires were distributed to 30 people and a 100% retrieval was achieved.

Table 1. Distribution of System Evaluators

Position	Specialization	F
Departement Chair	Information Technology	1
Program Chair	Information Technology	1
	Engineering	2
Faculty Members	Information Technology	10
	Engineering General	7

Position	Specialization	F
	Education	9
Total		30

Table 1 displays how the clients are arranged with respect to their position and specialization. A purposive sampling was used to select the respondents and entails focusing on individual units or cases with respect to an intended purpose.

Research Instrument

This research used the ISO - IEC 25010 questionnaire (see Appendix A) as a measuring tool to assess the developed monitoring system as a means of class monitoring and attendance of the students. To evaluate the acceptability of the new system of monitoring the class schedule and student attendance in regard to efficiency, reliability, security, operability, and functional suitability, the clients were assessed on a 5-point Likert-type scale (from Strongly Disagree, to Disagree, to Neither Agree nor Disagree, to Strongly Agree). The researcher also employed a semi-structured interview guide to obtain information about the experiences, concerns and recommendations of the administrator-clients concerning the monitoring of class schedules and student attendance. The interview guide was used with open-ended questions to give participants an opportunity to describe the problems with the current manual system and to give feedback regarding the proposed system. The interview responses were then used as a qualitative data source for triangulation and a complement to the results of the evaluation of the ISO/IEC 25010 survey. The guide for the interview was piloted prior to administration to make certain that the questions were appropriate, comprehensible and focused with the goals of the research.

Data gathering procedure

The administration of Bulacan State University - Bustos was requested to give permission to carry out the survey. A survey was carried out in the form of questionnaires and pilot implementation was done to collect client data. The questionnaires were personally given out after a close discussion orientation of the research focus. Adequate time was allowed to have an effective and efficient completion of the questionnaires. The researcher assured the clients of the confidentiality of their information to make them give genuine responses. This procedure made 100 per cent retrieval of the data among the clients. Moreover, unstructured interviews were also conducted to validate the reactions of the clients as it is important to understand the reactions of the survey. Any of their views, contributions, and suggestions are deemed as valuable contribution to the study and be treated as confidential so as to extract an objective and unbiased evaluation of the investigation.

Data processing and statistical treatment

To elicit the data that were required to address the aim of this research, the data collected were analyzed and interpreted with the help of a proper statistical method. The data was summarized in a tabular form, analyzed and handled statistically employing simple descriptive statistics such as mean and Likert scale to items that were included in the survey questionnaire. There was a 5-point Likert-type scale to assess the monitoring system developed on the schedule of classes and students attendance. The scale used in the study with the following verbal interpretation was as follows:

Table 2. Likert Scale

Scale	Range	Descriptive Rating
5	4.21 – 5.00	Excellent
4	3.41 – 4.20	Very Good
3	2.61 – 3.40	Good
2	1.81 – 2.60	Fair
1	1.00 – 1.80	Poor

Likert Scale was used to rate the respondent on a Likert Scale and the weighted mean or average was used to record the rating. They react to the Software Quality Evaluation Criteria; a) Functional Suitability, (b) Reliability, (c) Security, (d) Usability, and (e) Efficiency.

Result and Discussion

Part I. The System of Monitoring Class Schedules and Student Attendance at the College of Information Technology and Engineering, Bulacan State University – Bustos

The administrators of the College of Information Technology and Engineering, Bulacan State University - Bustos have a manual system of tracking the schedules and attendance of the classes. The college administrators used a form and engaged the teachers and the class mayors in checking schedules of classes. This is manually conducted at the end of each class. It entails the collection of information and data. Nonetheless, the students and faculty members can voluntarily sign the monitoring form. Despite the fact that they did not hold their classes. The monitoring form handed to the program chairs, then, department head. The forms are gathered together after the verification and stored in a place where all people can easily retrieve them. Thus, a risk to the information and data collected may exist.

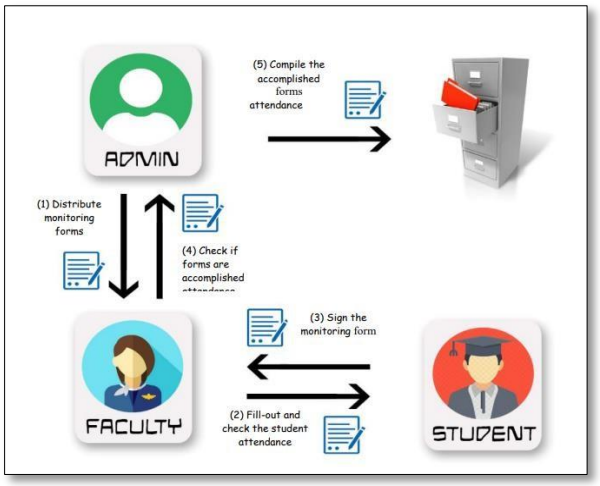

Figure 2. Manual System of Monitoring Class Schedules and Student Attendance

More so, the manual process does not generate reports. This approach might pose a difficulty in cases where the administrators would wish to countercheck with the data, particularly with the daily time record of the faculty members in addition, the primary difficulty of the administrators in this manual approach to monitoring the schedules of classes and student attendance. The flow of manual system of monitoring class schedules and attendance is presented in Figure 2.

Part II. Features in a Monitoring of Class Schedule and Student Attendance

The Monitoring System of Class Schedule and Student Attendance, which includes classroom status, classroom management using CRUD, RFID, and class monitoring, was a feature. Figure 3 shows the dashboard of the design of an Automated Monitoring System of Class Schedules and Student Attendance in Higher Education. The interface is used as the primary control panel of the administrators where they can have a centralized view of the information in the classroom and the monitoring capabilities. The dashboard also shows a feature to search where one may easily find a particular room and this boosts the usability and efficiency of the system. There are separate room panels below the search bar, with each having important details like the room number, instructor assigned and the kind of room (e.g. laboratory or lecture room). The layout allows administrators to find assignments in the classroom within a short time and get real-time updates about the schedule of classes.

The interface has been designed as a card-based design that makes the information easier to read and to have access to. The system simplifies the complications that manual monitoring process can follow by displaying room data in a well-structured format. Ease of use is also facilitated by a simple and intuitive interface thus complying with principles of usability regarding the ISO/IEC 25010 Software Quality Model.

Generally, the dashboard shows how the system gives a centralized, easy to use and effective platform of tracking classroom schedules and attendance, thus facilitating better administrative decision making and operational efficiency.

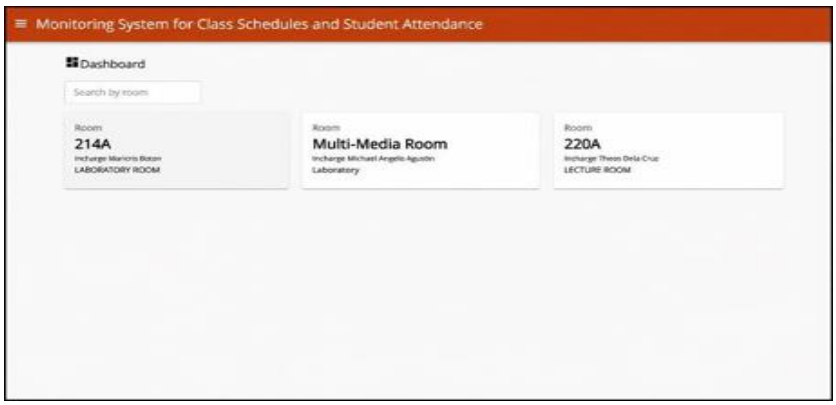

Figure 3. Dashboard Interface of the Automated Monitoring System for Class Schedules and Student Attendance

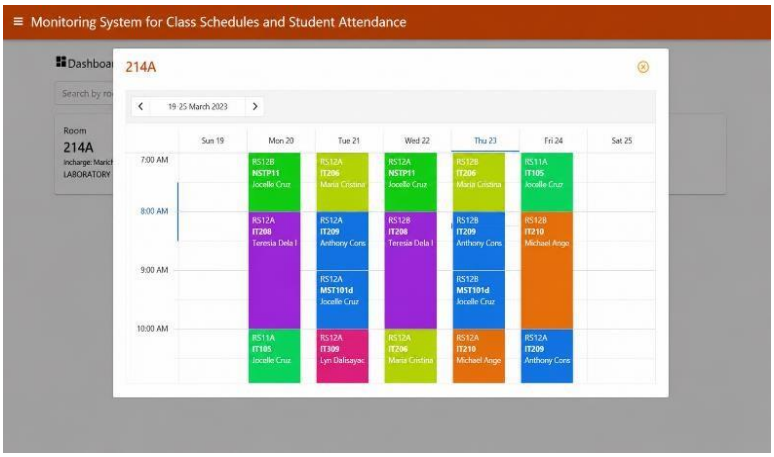

Figure 4. Class Schedule Visualization Interface of the Monitoring System

Create, Read, Update, and Delete (CRUD) Classroom Management. Figure 4 describes the class schedule visualization interface of the developed monitoring system. The interface displays the classes scheduled in a specific room (e.g., Room 214A) in a weekly calendar format, enabling administrators to easily view and monitor classroom utilization over a given period.

The schedule is arranged according to time slots, days of the week, with color-coded blocks being used to represent each of the classes. All vital information like the course code, instructor name, and schedule is included in each block, and this allows one to identify the assignments of classes easily. Differentiation of colors provides more clarity to the eye and assists users to make the distinction between various subjects and teachers effectively. The visualization can enhance the process of monitoring since it can give a real-time and organized view of the schedules in the classroom, unlike the manual or fixed methods of scheduling, which causes confusion. It is also useful in making a

better decision because it enables the administrators to identify a scheduling conflict, time slot that is not fully used, or overlapping classes.

In the context of quality of a system, this capability improves the suitability to functionality and usability, as ISO/IEC 25010 Software Quality Model defines, which is providing the relevant information which is presented in an efficient and clear manner. The user-friendly design and interactive nature also make the layout more effective with user experience and efficiency in managing classes.

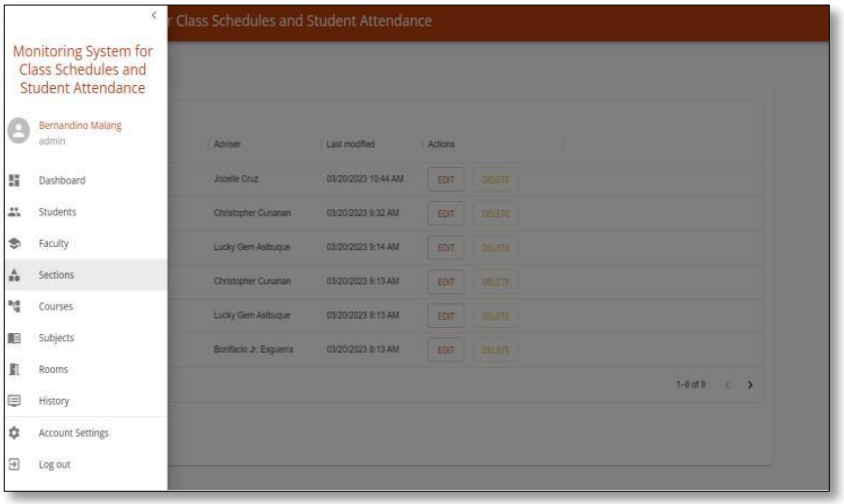

Figure 5. Sections Management Interface

The sections management interface of the developed monitoring system was depicted in figure 5 and in this system administration is able to manage section specific information in an effective manner via a centralized dash board. The interface presents a table of sections with respective advisers, time of the last modification and action buttons like the edit and delete buttons. The navigation sidebar also gives the user the ability to easily access other modules in the system (e.g. students, faculty, courses and rooms) and they help in integrating the entire system. The interface is an effective implementation of Create, Read, Update and Delete (CRUD), allowing to manage data effectively and reduce the number of records kept by hand. In addition to this, the structured structure and easy to use layout to contribute to its usability and functional adequacy i.e., computing to ISO/IEC 25010 Software Quality Model in the sense that administrators can easily manipulate and revise section information of the system.

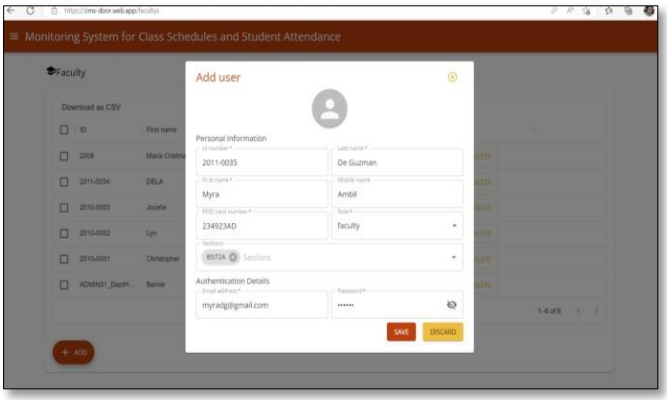

Figure 6. User Registration Interface

Figure 6 below shows the user registration interface of the developed monitoring system enabling the administrators to type in new users especially faculty members into the system. The form can store the necessary personal and authentication information, such as name, RFID card number, assigned section, email, and a password that can make tasks unique and that each user can be duly identified and connected with the system. Introduction of RFID information facilitates the smooth incorporation with the automated feature of attendance monitoring. There are also well defined input fields and action buttons, which are placed in the interface including save and discard that encourage user-friendliness and reduce mistakes that may occur when entering data. This functionality assists in effective user administration and increased integrity, on one hand, security and usability of the data in the system, according to the ISO/IEC 25010 Software Quality Model, because it guarantees proper and secure processing of user data within the system.

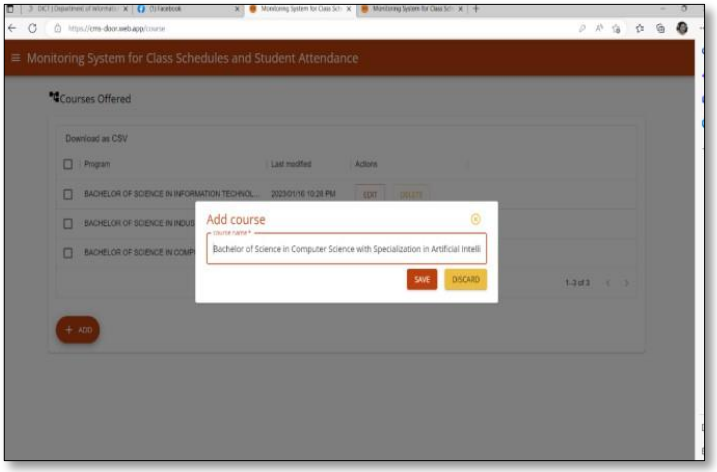

Figure 7. Course Management Interface

The course management interface of the developed monitoring system can be displayed in Figure 7 the module of adding new academic programs or courses. The interface enables the administrators to add course information via a simple dialog box with action buttons like save and discard to confirm or cancel adding course. There is the ability to efficiently manage academic offerings by updating and making timely changes on course data in the system. Integration of this module with the larger database is done to ensure that the input of courses is always in line with the schedules of classes and attendance monitoring capabilities of the database. Besides, the simple and clear design also makes it easier to use and implement in a functional manner, as stated in the ISO/IEC 25010 Software Quality Model, where administrators get to manage the information related to courses in an easy and efficient manner.

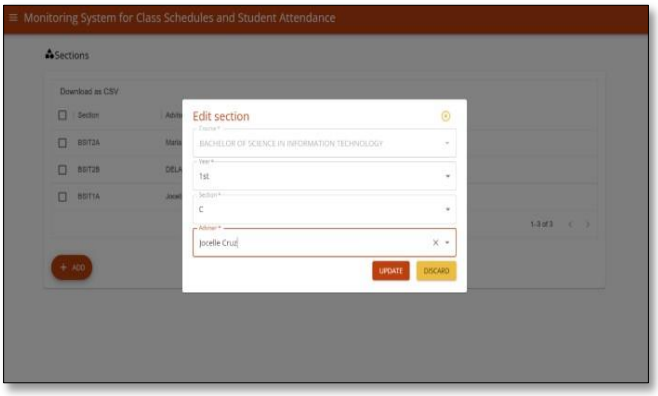

Figure 8. Section Editing Interface

Figure 8 demonstrates the part of the editing interface of the monitoring system developed, which allows the administrators to manage the section details quite effectively. The shape enables input of the major details like the program, the year level, section name, and the adviser assigned, so that the records of the sections is accurate and complete. Action buttons like update and discard are used to control either the saving or the rejection of changes to reduce the possibility of unwanted modifications. This interface shows the usage of the update feature in the CRUD operations that allows proper data management in the system. Further, the guided and structured layout adds to usability, reliability, and functional suitability as per the ISO/IEC 25010 Software Quality Model, given that the administrators easily and precisely work on section information.

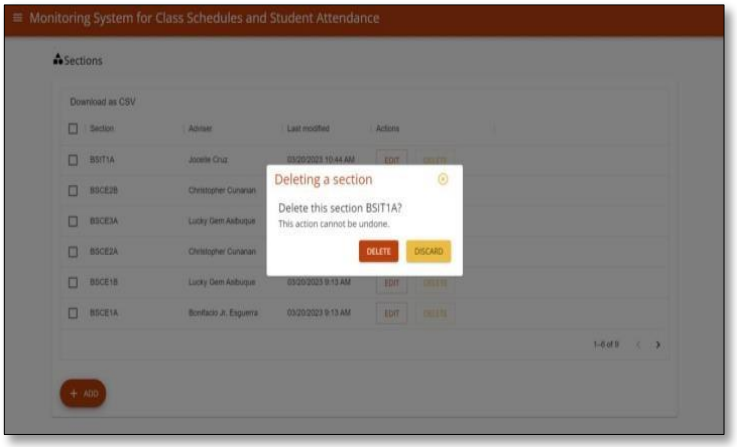

Figure 9. Deletion Confirmation Interface

The section deletion confirmation interface in Figure 9 is the interface created in the developed monitoring system used to control the secure deletion of section records. The dialog box invites the administrator to ensure that he/she is deleting something, and it is very obvious that this is permanent. It has action buttons like delete and discard with which the user can either continue with the operation or abort it. This is useful to avoid unwanted destruction of data by making them confirm the removal of records before it becomes irreversible. This safeguard is implemented to augment security, reliability, and information integrity in line with ISO/IEC 25010 Software Quality Model, as it takes essential precautions in ensuring crucial data and information in a system is safeguarded and is handled in responsibility.

Use of RFID. This feature gathers information which are important in vowing the history of log in users. It comes in handy to establish certain locations and times of logs. The RFID installed in the system is seen on figure 10.

Figure 10. RFID – RC522 for student attendance tracking

The RFID-RC522 module shown in Figure 10 is part of the developed monitoring system of the automated student attendance tracking system. This is a hardware component which primarily reads the RFID tag, which is placed in the ID cards with the help of radio frequency signals so that it is able to capture the data without having physical contact thus it captures the data by means of radio frequencies. Upon scanning with the RFID card, the module sends the identification data that the user is unique to the system as it is processed in real time and the attendance recorded. The integration of the RFID-RC522 module enhances system automation by reducing manual intervention and improving the accuracy and reliability of attendance records. This component contributes to the efficiency, reliability, and security of the system in accordance with the ISO/IEC 25010 Software Quality Model because it can help to identify users in the monitoring system fast, consistently and securely.

Classroom Monitoring. This system can assist the department and program chairs in observing the faculty members according to their cycles. It is able to take automatic attendance of the students. Due to these characteristics, one can make processes easier and more convenient. Monitoring in the classroom is represented in figure 11.

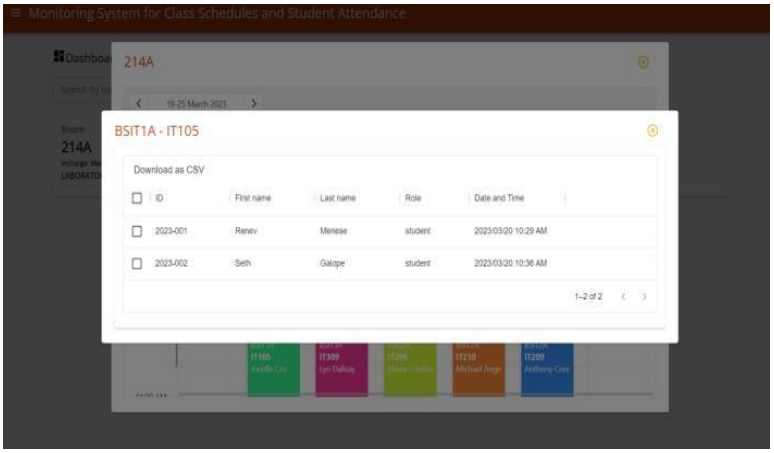

Figure 11. Classroom Monitoring

The user need not wait, but should look at Figure 10 and, in its right section, find the button, which is entitled Download as CSV. Report generation is done in CSV file. Should the user desire to organize the reports, he or she may simply use a vertical ellipsis to sort the reports either in an ascending order or descending order and Figure 12 illustrates a sample Attendance Report.

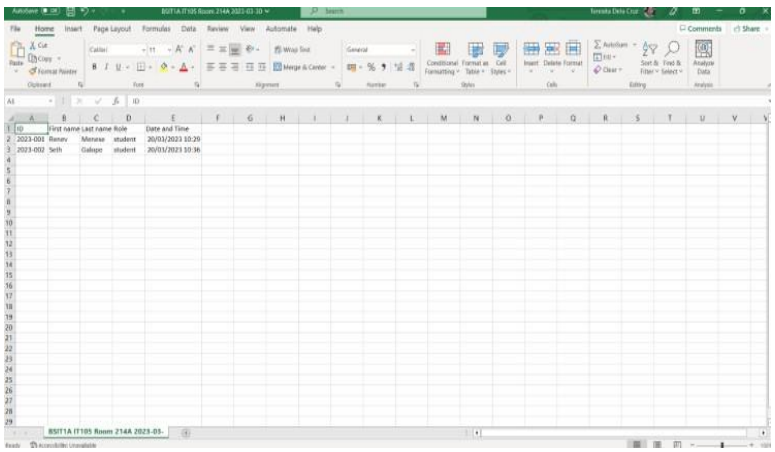

Figure 12. Attendance report

Figure 12 show the attendance report created by the monitoring system developed in a spreadsheet format that gives a systematic and ordered attendance record of the students. The report is supported with basic information like the student identification number, name, role, date, and time of attendance enabling the administrators to easily monitor and certify the attendance records. The ability to export the data to a spreadsheet format (e.g., Microsoft Excel) allows storing and analyzing data efficiently and write reports to assist with administrative activities (e.g. performance monitoring, documentation, etc.).

Part III. Design Model Utilized in Developing Class Monitoring

The design tool that the researcher used in developing the application was Rapid Application Development (RAD). The quality of the implementation and time to market is directly linked with the success or failure of enterprise digital transformation initiatives. RAD is no longer based on the Waterfall technique but on the Agile style of building new product/feature and functions in a way that the business can keep up to date in the rapidly changing digital world. The consequent establishment of quick application development processes preconditions the successful implementation of the digital transformation (Low, 2021).

The researcher intends to use RAD in the course of analyzing and design. When a basic framework is at hand, then a basic version is developed. The first version is given feedback and features are introduced during later production cycles. Since this is time-consuming, conventional application development processes and tools are not able to meet the requirement of the modern enterprise applications where customers seek solutions that have the shortest turnaround time.

Besides, companies are now seeking more stable, less involved, minimal efforts, no-coding and highly adaptable application building methodologies. The solution of these needs is RAD. Thus, the utilization and adoption of RAD is quickly becoming a requirement. To create superior products at shorter times, RAD collects requirements in focus groups and workshops, early prototypes, proof of design testing, and makes prototypes by means of reusable software components (Idesis, 2020). RAD has specifically been adapted to providing differentiation and innovation systems. These projects require higher degree of business participation and also regular update cycles to remain in tune with the market. Speed and agility are emphasized in RAD. This high speed is led by the ability of RAD and emphasis towards reducing the efforts in the planning phase, maximizing and attaching the prototype phase, and subsequent assistance in reducing the project release time.

Therefore, IT departments able to become more productive and yield better project results. RAD approach transforms the IT teams to complete projects within months, days, or weeks. By developing a production-ready application at a faster pace, the business ables to take advantage of its early availability even though additional functionality is newly added to the application at later phases (Venkata, 2020). The scholar was using RAD, through which one can create a software within a brief duration and can see the outcomes promptly to the interested parties.

This software development process integrates both requirements definition phase or activities with iterative 53 prototyping to enable usable systems to be created within a small period of time. This design model enables the researcher to roll out fast and save time on the total development process due to the reusability elements and the parallel development. Other features of RAD included requirements alterations, gauging advancement, rapid preliminary test, promotion of feedback, and incorporation of integration concerns. Figure 13 Rapid Application Development Based on the Original Author James Martin (1991) illustrates the key stages through which the researcher followed to use the RAD.

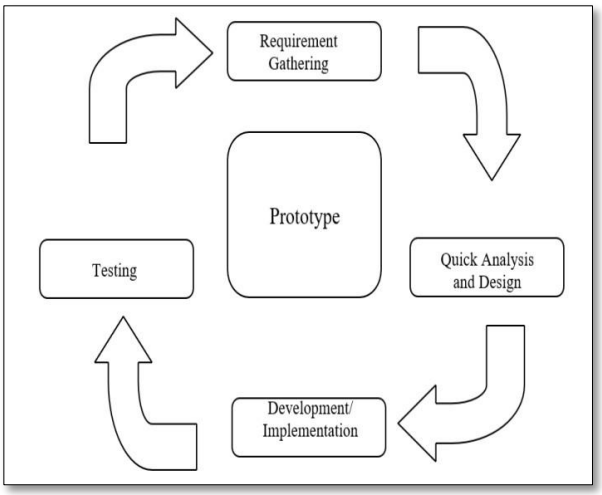

Figure 13. Rapid Application Development (James Martin, 1991).

Requirement Gathering. The requirement gathering was the initial stage that the researcher encountered. The input is discussed in this phase therefore leading to rapid analysis and design status hence translating to programming and development which are technical. The researcher engaged in interviewing in order to establish the existing issue of the College of information technology and Engineering in terms of monitoring class schedules and student attendance. According to the outcomes of the interview, the researcher established and concluded the requirements of the project requirements with the client. The researcher emphasized the role of communication due to the fact that it plays a vital role in the process of measuring objectives, expectations, schedule, budget of the project.

Analysis. The researcher then went on with the analysis after the requirement-gathering phase. The first stage of the system life cycle is the planning, and the concept of the system flow, analysis of the system requirements, data collection, and the project start-up. At this level, the researcher examined all possible questions of the study and required processes of development.

Design. The limitations and capabilities of the software development tools that were necessary in the development were also examined. The researcher looked at the plans and the system design to be prepared to any eventualities that can occur during the course of development. The required information such as the schedule of classes, student information and faculty information was obtained, scanned and utilized to document and conduct research of the study.

The layouts that were based on the design developed by the researcher were used as the user interface to the system after research and planning. These design features assisted the researcher to comprehensively describe the usage to design and provide the tracking system to class schedules and attendance of students. It is at this point that the researcher began developing the front end of the system and at this point, the back end was regarded as the most crucial part of the development.

The researcher also made sure that the design developed is not hidden but must have fundamental functions. This aspect was the final detail of the application and the code was incorporated in the user interface. The part of analysis and design was the bread and butter of the RAD design methodology. In these phases, the researcher was a collaborator with the client in that their needs and expectations were addressed. The process enabled the researcher to adjust the model system until it was attained using a satisfactory design.

The programming part is part of the **development stage** including the front-end application development and the back-end application development. The researcher had been engaged closely with the clients in developing and refining the working prototypes till final product was completed. The prototype and beta systems are a result of the design that was converted by the researcher into the working

nursing model. Since most of the issues and potential modifications were taken into account during the analysis and design phase, the researcher built the final working model by performing the preparation of rapid construction, program, and application development, coding of program and units, and integration. Moreover, when the finished product was released, it involved data conversion, testing and changeover to the system and training was done.

Testing. This was the stage where system performance testing and Evaluation was used. The discrepancies between the system and its model were discovered through the implementation of the system using the example input data. The researcher made sure that program, codes, tests, and development worked as a unity to make sure that nothing went wrong and that developed system fulfilled goals and objectives set by the client. During the testing, the clients provided their input during the testing. 56 The idea about their alterations, changes, and new ideas were included, as they can be used to solve problems arising. At the end of each round of the process, there is an effective monitoring system of the classes schedules and attendance of students. The researcher also made sure that everything was revised and proceeded with looking at the system bugs along with the client.

Part IV. System Evaluation using ISO/IEC 25010 Software Quality Standards

This section entails the analysis of the Development of a Monitoring System on Class Schedule and Student attendance based on the ISO/IEC 25010 Software Quality Standards in the aspects of (1) Functional Suitability, (2) performance efficiency, (3) Reliability, (4) Security, (5) Usability.

Table 3. Mean and Descriptive Interpretation of the "Design and Development of an Automated Monitoring System for Class Schedule and Student Attendance in Higher Education" Summary of responses

No	Criteria	Mean	Descriptive Interpretation
1	Functional Suitabilitu	4.83	Excellent
2	Reliability	4.82	Excellent
3	Security	4.94	Excellent
4	Usability	4.92	Excellent
5	Performance	4.93	Excellent
	Mean	**4.88**	**Excellent**

The response summary analysis shows that the designed monitoring system attained a total average of 4.88, which corresponds to excellent score that depicts a very high standard of system acceptability and performance according to the ISO/IEC 25010 Software Quality Model. Security was the parameter that received the greatest mean of 4.94, which means that the system is effective in guaranteeing the protection of data and other safe management of user information. This is then followed by performance efficiency (4.93) and usability (4.92) which indicate that the system is efficient and its interface to the system is user friendly. Also, the functional suitability (4.83) and reliability (4.82) were rated highly as well, which shows that the system fulfills its functions and works in the expected circumstances all the time. These findings also suggest that the system can be capable of tracking the schedules of classes and the attendance of students with minimal and reliable variations in performance. In general, the summary of responses proves that developed system is quite effective, reliable and could be used in higher education institutions to enhance the process of academic monitoring.

The findings also indicate that the system is capable of tracking the schedule of classes and attendance of students without any significant changes in performance that are likely to occur. In sum, the general overview of responses proves that the developed system is very effective, reliable, and it is appropriate to be implemented in order to enhance the academic monitoring processes in higher education institutions.

Conclusion

The results and findings of the study were used to come up with the following conclusions. The program that was developed on class schedules and student attendance monitoring at the College of Information Technology and Engineering, Bulacan State University - Bustos Campus, has the potential to be used successfully to substitute the manual-based system that is currently being used at the department. The study has managed to exhibit major system functions such as classroom status monitoring, classroom management through Create, Read, Update and Delete (CRUD) functions, RFID integration, and classroom monitoring, as a whole by use of Data Flow Diagrams (DFD) and system flow diagrams. The real classroom status of the dashboard supports the efficient classroom utilization, and CRUD capabilities allow structuring of the data and creation of reports.

The RFID technology can be integrated to enable the system to store the information about the user and automatically record his or her attendance. The system can also help the administrators keep track of the faculty members according to their timetables and also record attendance of the students in the real time. Also, one of the system was created on the Rapid Application Development (RAD) model and approved by the respondents with the help of the ISO/IEC 25010 Software Quality Model with a total average score of 4.88 which can be discussed as excellent. This outcome implies that the system is highly efficient and responsive as well as usable by utilizing a web browser.

Maintaining the user roles is another way in which the system works successfully, with the distinction of the type of user logged in and requiring the authorization of actions. Only authorized users are allowed to have administrative privileges like the management of user accounts, which makes sure that the system is in control. The information management is also upgraded as the system keeps records that are correct, consistent, and up to date. With regard to reliability, the system is very consistent in terms of supplying correct reports and ensuring the administrators can easily identify a problem and remedy in the monitoring process. Security-wise, the system applies the role-based access control, maintains the use of transaction logs (user actions, time and type of activity), and uses RFID to identify in a secure way. Regarding functionality appropriateness, the system makes the process of monitoring easier and faster, facilitates competent classroom management, upholds detailed records acquisition, and facilitates the creation and renewal of user and administrative accounts. The constructed system is in general confirmed as efficient, reliable, secure, and relevant to be implemented to the improvement of the academic monitoring processes.

Recommendation

To refer further improvement of the developed monitoring system and increase the area of further research, the following recommendations may be offered:

1. Image and Image capture technology integration. Advancement of the research can include the use of technologies that can record images or videos in the classroom. This can be used to enhance monitoring where more data is recorded on what happens in a classroom and this enhances the checking of attendance.
2. Installation of Alarm and Notifications. It is suggested to include automated warnings and notification services to remind members of the faculty and students about when they have classes. This can assist in reducing cases of lateness, scheduling conflicts, under and overtime attendance.
3. Implementation of Biometric Technologies. Based on the monitoring of attendance, the recommendation is to use biometric systems, e.g. fingerprint recognition, to enhance the accuracy and reliability of monitoring. Biometrics have the potential of improving identity authentication, minimizing fraudulent activity as well as increasing the effectiveness of data retrieval and record management. New Technology Implementation and Growth.
4. Considering that all evaluation indicators of the monitoring system on class schedule and student attendance were rated positive by the respondents, the system can be

deemed to be viable to implement. It is thus advisable that the institution embrace and scale up the system in order to enhance efficiency in the academic monitoring and administrative procedures.

References

Agrawal, A., & Bansal, A. (2013). RFID-based student attendance management system. International Journal of Advanced Research in Computer Science and Software Engineering, 3(2), 784–789.

Best, J. W. (2003). Research in education (9th ed.). Pearson Education. https://www.pearson.com/en-us/subject-catalog/p/research-in-education/P200000003465

Bhalla, N., & Bhalla, A. (2010). Generations of RFID technology. International Journal of Computer Applications, 1(7), 27–30. https://doi.org/10.5120/1451-1976

Chen, Y., & Yue, Z. (2017). Design of campus intelligent safety supervision system based on RFID technology. International Journal of Security and Its Applications, 11(4), 123–132. https://doi.org/10.14257/ijsia.2017.11.4.12

Credé, M., Roch, S. G., & Kieszczynka, U. M. (2010). Class attendance in college: A meta-analytic review of the relationship between class attendance and grades. Review of Educational Research, 80(2), 272–295. https://doi.org/10.3102/0034654310362998

Domdouzis, K., Kumar, B., & Anumba, C. (2007). Radio-frequency identification (RFID) applications: A brief introduction. Advanced Engineering Informatics, 21(4), 350–355. https://doi.org/10.1016/j.aei.2006.09.001

Hightower, J., & Borriello, G. (2001). Location systems for ubiquitous computing. Computer, 34(8), 57–66. https://doi.org/10.1109/2.940014

International Organization for Standardization. (2011). ISO/IEC 25010: Systems and software engineering—Systems and software quality requirements and evaluation (SQuaRE)— System and software quality models. https://www.iso.org/standard/35733.html

Kumar, P., & Pateriya, R. K. (2010). Design and development of RFID based attendance system. International Journal of Engineering Science and Technology, 2(5), 108–113.

O'Leary, D. E. (2005). RFID technology and its implications. Information Systems Management, 22(2), 1–10. https://doi.org/10.1201/1078/45317.22.2.20050301/87168.1

Pressman, R. S., & Maxim, B. R. (2020). Sofware engineering: A practitioner's approach (9th ed.). McGraw-Hill Education. https://www.mheducation.com

Ravitch, S. M., & Riggan, M. (2017). Reason & rigor: How conceptual frameworks guide research (2nd ed.). SAGE Publications.

Salah, K., & Al-Mamari, A. (2016). RFID-based attendance system. International Journal of Advanced Computer Science and Applications, 7(5), 143–149. https://doi.org/10.14569/IJACSA.2016.070520

Sarmiento, U. P. (2008). Methods of research. Rex Book Store.

Traverse, M. W. (2000). Introduction to educational research. Macmillan.

United Nations Educational, Scientific and Cultural Organization. (2019). ICT in education: A critical literature review and its implications. UNESCO. https://unesdoc.unesco.org

Want, R. (2006). An introduction to RFID technology. IEEE Pervasive Computing, 5(1), 25–33. https://doi.org/10.1109/MPRV.2006. 2