

QR CODE ROLL CALL SYSTEM QR CODE ROLL CALL SYSTEM

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Abstract -- Computer systems play a very important role in education by generating powerful and alternative tools that streamline the internal processes in which students are involved in academic and social processes, also help the areas involved to monitor the performance of each of the processes, the roll call system is a tool that allows the generation of reports and information related to the attendance of students in each of the academic events of the institution in order to keep a history of attendance to be consulted and derive the decision-making as needed.

The attendance registration system is for internal and external academic events using QR code as a means of registration for those attending the events of the Tecnológico Nacional de México Campus Ciudad Serdán, attendees at each of the various events that take place, must register through a website, which are published all the events to be held by the Institute, At the time of registration the platform generates a badge for each applicant, this badge will allow access to the various events, then the attendance is recorded through a mobile application which reads the QR code found on the badge and records the participation in the database of the roll call system, then the system is able to generate attendance lists and certificates of participation in PDF format.

The implementation of the QR roll call system represents a significant evolution in attendance management in educational and business environments. This system not only modernizes the attendance recording process, but also offers multiple benefits that improve operational efficiency and the accuracy of the data collected.

Keywords -- System, QR, PDF, List, Database.

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that streamline the internal processes in which students are involved in academic and social processes, and also help the areas involved to monitor the performance of each of the processes. The roll call system is a tool that allows the generation of reports and information related to student attendance in each of the academic events of the institution in order to keep a history of attendance so that it can be consulted and lead to decision-making as needed.

The attendance registration system is for internal and external academic events using QR code as a means of registration for attendees at events at the National Institute of Technology of Mexico Campus Ciudad Serdán. Attendees at each of the different events held must register through a website, where all the events that will be held by the Institute are published. At the time of registration, the platform generates a badge for each applicant. This badge will allow access to the different events. Attendance is then recorded through a mobile application that reads the QR code found on the badge and records participation in the roll call system database. The system is then able to generate attendance lists and participation certificates in PDF format.

With the implementation of the QR roll call system, a significant evolution is represented in attendance management in educational and business environments. This system not only modernizes the attendance registration process, but also offers multiple benefits that improve operational efficiency and the accuracy of the data collected.

Key words -- System, QR, PDF, List, Database.

INTRODUCTION

One of the main problems when registering the attendance of students in the different academic events organized by the Institution was the waste of time, the excessive use of paper, and in some cases some participants of the event who for some reason did not arrive on time, were no longer registered as attending.

Another situation that arose with the information on event participants was that the data had to be filtered and reports generated manually, as well as counting how many students attended by career, by semester, or if it was necessary to know the number of men and women who attended the events, it had to be counted individually on the registration sheets, which generated a waste of time and investment of time.

At the end of this process, the list was shared with the areas involved for the generation of awards to participants, so that later the area hosting the event could give them their recognition of participation. In the best of cases, participants were registered on Excel sheets, but most of the they were registered manually on registration sheets, which caused errors when transferring the data from the paper sheets to an electronic medium, which was shared with the area in charge of the event's recognition.

The fact that the registration of attendees at events held by the National Technological Institute of Mexico's Ciudad Serdán campus was usually done manually meant that the information was prone to errors, such as forgetfulness, incorrect records, or missing data. Without an automated system, there was the possibility that attendance records could intentionally manipulated. The manual process of taking and recording attendance was slow and time-consuming for both students/workers and registrars.

The design, development and implementation of software is part of our daily lives, we find it present in virtually all areas and allows us to perform activities, repetitive, complex tasks or with large amounts of information in a simple and above all fast way. In education, software is present supporting processes such as e-learning, school control systems, virtual libraries, etc. The systematization of administrative processes in a Higher Education Institution generates an adequate management of the process in question, through the development and implementation of software, and with it the reduction of time, since it allows repetitive tasks to be controlled through an information system, which can reduce resources, and in moments you can have the necessary information that is required. We consider the systems as support resources within the educational area, allowing to manage all the information related to the activities that students can perform.

According to the national development plan 2019-2024 (Government of Mexico, 2024) and the comprehensive development program (PID) of the Tecnológico Nacional de México (Tecnológico Nacional de México, 2020), the Institutes have the task of carrying out activities that foster the

integral development in the student community cultural, academic, sports and social activities, which is why we work together with all the areas that make up the Institute to manage and bring events to our students from different semesters, thus generating the need to keep track of attendance of participants in each of them, classifying information by careers, semesters, men, women, guests, speakers, workshop participants, by age, date, place of origin, among others. Each of the reports are generated in PDF format for easy handling and sending by e-mail or printing.

It is of utmost importance to have this information at our fingertips for making, that is why the system is intended to cover the need to consult the information at any time from any electronic device, to determine the percentage of participation of the Tecnológico student community in each of events organized, evaluate the results and determine the degree of impact it leaves on each of our students.

In order to feed the database, each participant must register to the platform

registerat the web platform
<https://eventosacademicos.cdserdan.tecnm.mx/index.html>, then log in as long as they are registered in the system, otherwise they are registered when the applicant enters for the first , once the user is authenticated the system displays all events that are about to place so that the student community can register, when registering their participation in the event, the system will display a list of all upcoming events so that event participants can register for the event offered by the institution and generates participation badge, which will contain a QR code that will identify you as a participant of the event.

At the beginning of each event, a roll call of the students attending is carried out through a mobile application, which reads the QR code of the badge and records the student's control number, date and time of attendance at the event, all this information is stored in a database, in order to generate any query that may be required for academic or administrative use.

Before the implementation of the system, to conclude the process, it was required at least a week after the event, generating a delay in the work, because the Institute has 6 careers and at least each career runs two activities per month in which the attendance pass is required, so with the implementation of this system we achieved our goal which is the application of a system that allows recording the attendance of participants in the different activities.

academic events organized by the Institute to reduce the time and material resources used in the process of attending events.

According to the times we live in due to the great advances in technology, in the educational area we advance in matters of educational processes and activities that accompany the comprehensive learning, that is why in the Tecnológico Nacional de México Campus Ciudad Serdán we work in collaboration with the different areas that integrate it for the constant search for improvements in the services offered to the student community. The importance of systematization is that from certain experiences and / or practices, learning processes and the generation of new knowledge are produced, and also in this way seek the active participation of actors from social organizations, educational institutions and others, which are related to the practice to be systematized activities. Basically, systematization aims at describing and explaining what happened during an experience (event) and why it happened. The results of an experience are fundamental, and describing them is an important part of any systematization, but what is most important in the process is to be able to explain why these results were obtained, and to extract lessons that will allow us to improve our practice. However, despite the importance of systematization, the practice of reflection on our practices and experiences is not a habit, it is not something frequent and only after failure do we value the importance of reflection (Acosta, 2015).

According to Torres (1997:37), "although the production of knowledge (reconstructing, interpreting, theorizing) is central to systematization, its task is not exhausted there; the socialization of the knowledge generated (communication), its character as a pedagogical experience for those who participate in it (training) and its interest in strengthening the practice being studied (transformation and participation) also appear as dimensions or domains of systematization".

The following resources were used: Web site

It is a set of web pages that are connected to each other and are hosted on a web server that intended to provide the interactive part with the system administrator to feed it with the required information (Coppola, 2023).

Database

It is a tool that collects data, organizes it and links it so that it can be quickly searched or retrieved with the aid of an electronic device with

access to the Internet. Today, databases are also used to develop analyses (European Knowledge Center for Information Technology, 2023).

MySQL

It is an open source relational database management system (RDBMS) with a client-server model. RDBMS is a software or service used to create and manage based on a relational model (TechTarget, 2021).

The way it works is that one or more devices (clients) connect to a server through a specific network. Each client can make a request from the graphical user interface (GUI) on their screens, and the server will produce the desired output, provided that both parties understand the instruction.

Mobile Application

This term can be defined as a computer application designed to be executed on mobile devices, with the passage of time applications have become a means that facilitates user interaction with their mobile (Xperto Solutions, 2017), currently the great diversity of applications opens endless possibilities in different areas; from entertainment, transportation to work functions such as mail or other options, in short applications that are for mobiles are similar what programs are for computers.

Android Studio

It is an official integrated development environment (IDE) for Android application development, based on JetBrains IntelliJ IDEA software. To support application development on the Android operating system, Android Studio uses a Gradle-based build system, emulators, code and Github integration (Android Studio, 2024).

The programming language used is Java. And for those not yet familiar with it, it is a general-purpose programming language designed to allow developers to write code that runs once and anywhere it is compiled.

Java code can run on any Java-enabled platform. The structure of the Java programming language is such that developers can write code anywhere and run it anywhere, without worrying about the underlying computer architecture.

Software development methodologies are a set of organizational techniques and methods that are applied to design computer software solutions. The objective of the different methodologies is to try to organize the teams of work for that these

develop the functions of a program in the best possible way (Santander Universities, 2020).

These resources are used in the field of programming, among others, with the aim of working as a team in an organized manner. Methodologies have evolved over time from a mere organizational procedure to a very important basis for developing software in a productive and efficient way.

One of the agile methodologies is Scrum which is also considered as an incremental methodology that divides requirements and tasks in a similar way to Kanban. It iterates over short, fixed blocks of time (between two and four weeks) to achieve a complete result in each iteration. The stages are: planning sprint, sprint execution, daily meeting and sprint review. Each iteration through these stages is also called a sprint.

DEVELOPMENT

For the development of the roll call system QR, the SCRUM methodology was used for its easy implementation and distribution of activities among the participants, so that each one of them could contribute to the problem with part of the solution considering their strengths in the different stages of development, from the requirements gathering, analysis, design, coding, testing and deployment of the system through the publication of the system in the Institute's server, for the realization of the system was done in four stages.

Stage 1: In this stage, a requirements survey was conducted with each of the areas that need to organize academic events in order to identify what type of information they require and what use will be made of it.

Stage 2: At the end of the previous stage, we proceeded to the analysis and proposal of the design of the system through software that will allow us to create the proposed screens as shown in Figure 1.

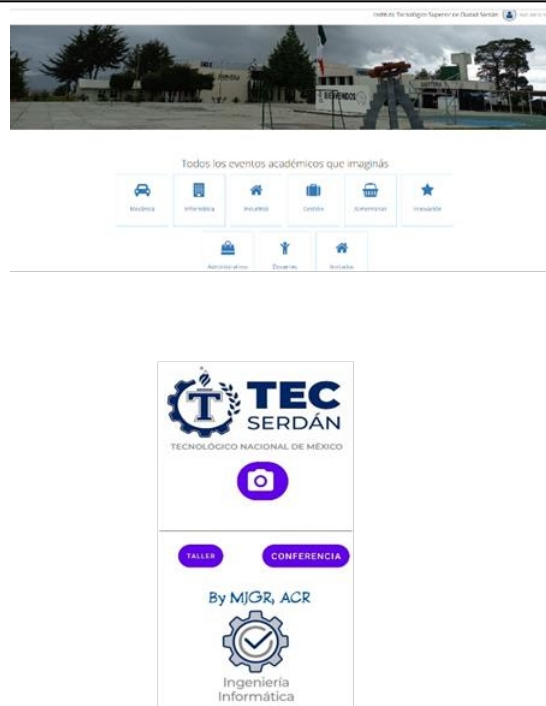


Figure 1. Website and mobile application home page
Source: Own.

Stage 3: In this stage the codification of the design made in the previous stage was carried out, in this project php was used to establish the communication of the design with the database that is elaborated in Mysql, thus achieving the communication between the backend and the frontend, so that the user can interact with the system, as it is visualized in the Figure 2.

eventosacademicos: asistencia	eventosacademicos: asistencia	eventosacademicos: asistencia
clave_id : int(10)	nc : varchar(100)	idCarrera : varchar(100)
nc : varchar(100)	idEvento : varchar(500)	nc : varchar(45)
nomCarrera : varchar(100)	idEvento : varchar(500)	nombre : varchar(45)
eventosacademicos: registroinstituto	eventosacademicos: registroinstituto	eventosacademicos: registroinstituto
clave_invitado : int(10)	idCarrera : varchar(100)	paterno : varchar(45)
nombre_inv : varchar(100)	idEvento : varchar(45)	materno : varchar(45)
paterno_inv : varchar(100)	nomEvento : varchar(45)	correo : varchar(45)
materno_inv : varchar(100)	finicio : varchar(250)	carrera : varchar(100)
celular_inv : varchar(100)	hinicio : varchar(150)	semestre : varchar(20)
pass_inv : varchar(100)	lugar : varchar(100)	sexo : varchar(20)
eventosacademicos: asistenciaevento	eventosacademicos: asistenciaevento	eventosacademicos: asistenciaevento
idAsistencia : int(5)	semestre : varchar(12)	pass : varchar(200)
nc : varchar(100)	eventosacademicos: conferencia	
idEvento : varchar(45)	idConferencia : int(10)	
eventosacademicos: asistenciaevento	nomConfe : varchar(150)	
clave_id : int(10)	nomEvento : varchar(100)	
nc : varchar(100)	fecha : varchar(500)	
idEvento : varchar(500)	eventosacademicos: administrador	
	nc : varchar(8)	
	nombre : varchar(100)	
	paterno : varchar(100)	
	materno : varchar(100)	
	correo : varchar(100)	
	pass : varchar(100)	

Figure 2. Database .
Source: Own.

Stage 4: In the testing stage, the system is deployed on the institute's server to release the first version in order to submit the system in a real situation through a massive academic event to evaluate the behavior and response times of the server. The system starts its operation with the

The student's registration in the platform requests personal data such as: race key, control number, name, father's surname, mother's surname, institutional e-mail and password, as shown Figure 3.

Figure 3. Registration form.

Source: Own

When the student is already registered, he/she will have access to the system by logging in with the data registered in the previous step, upon entering the platform, the following menu will be displayed Figure 4.

Figure 4. Event menu.

Source: Own.

When selecting the registered events option, the system will display a list of all the events in which the student has registered. Figure 5. Academic events, shows the moment in which the student will be able to select the event in which he/she wishes to participate and the system will allow him/her to generate the badge to register his/her attendance to the event, as shown in Figure 6.

Eventos Académicos						
Clave del Evento	Nombre del Evento	Fecha de Inicio	Hora de Inicio	Lugar	Semestre	
IIINF-2023	Software Libre 2023	2023-03-31	9:00 a 15:00 horas	ITSCS	Todos	Registrar

[REGRESAR](#)

Figure 5. Academic events

Source: Own.

When you select the event to participate, the system will allow you to generate the badge as shown in Figure 6. Badge, in which we can see the QR code that will allow you to register your attendance at the event, the system only reads the control number which is your student identifier and that also

is unique, allowing you to link it with the event, with your career and also with the semester you are currently studying, so that later the same system can generate the certificate or the student can download it.



Figure 6. Badge.

Source: Own.

The use of this system is for academic or social events in which it is required to have a control of how many attendees participate in such events, such as internal or external events, currently the average number of users is 200 participants attending the various events organized by the Institution.

DISCUSSION AND ANALYSIS OF RESULTS

In this work we investigated how to systematize the registration and roll call process in a quick way in order to save time and have an accurate control of the community that participates in the academic events, by storing this information the corresponding areas have all the information within reach that allows them to classify and manipulate it according to the needs of the Institute.

It is worth mentioning that this attendance pass system works for any institutional event or if any other agency requires the support of the loan of facilities and access control of their guests, the system and the mobile application allows them to manipulate the event.

The results obtained during the implementation of the system can be seen in the efficiency of the registration process and in the preparation of acknowledgments, since it allows the systematization of repetitive tasks and processes, saving time and reducing human error. By controlling these tasks, more resources and time can be devoted to other areas or activities of the Institute that require attention.

During this process the system allows to improve scalability because it can help the Institution to scale and grow effectively, schedule more events in which they can invite a greater number of participants because it will allow us to have an overview of the possible number of attendees before the event takes place, to be prepared with the resources required within the event, when the processes are well defined and systematized, they can be easily replicated in different areas and at different scales. This can help the institution to grow faster and more effectively.

The Instituto Tecnológico Superior de Ciudad Serdán, by implementing the roll call system using the QR code, demonstrated the modernization of its processes with the use of technology, streamlining the process of student attendance at the various events organized by the Institute.

This system replaces the traditional method of manual roll call and aims to improve the accuracy of attendance recording, reduce the time spent on this task and provide real-time data on student attendance.

To evaluate the effectiveness of this system, several activities were conducted and data were collected during an academic semester. Metrics evaluated included:

- Accuracy of Attendance Record
- Time Reduction in the Roll Call Process
- Student and Administrative Staff Acceptance and Satisfaction
- Impact on Administrative Management
- Results

The system demonstrated significantly higher accuracy in recording attendance compared to the manual method. Human errors were significantly reduced, eliminating cases of unrecorded absences or counting errors. The availability of real-time data allowed teachers and school administration to monitor attendance more efficiently and accurately. A reduction in the time required for roll call by approximately 70% was observed. What previously could take 15 to 20 minutes per event is now completed in less than 5 minutes, with this reduction in roll call time allowing more effective time to be devoted to running events.

Surveys of students and administrative personnel indicated a high level of acceptance of the new system. Eighty-five percent of the students and 90% of the administrative staff expressed general satisfaction with the QR code system, and above all that the users expressed ease of use of the system and the application.

The students appreciated the speed and simplicity of code scanning, while the administrative staff appreciated the reduction in time for the generation of acknowledgements and the manipulation of information.

With the implementation of the QR code-based roll call system at the Instituto Tecnológico Superior de Ciudad Serdán, it has proven to be highly effective in improving the accuracy and efficiency of the attendance registration process. In addition, it has been well received by the educational community and has contributed to more efficient administrative management. The positive results suggest that this system can be a model for other educational institutions seeking to modernize and streamline their administrative processes.

There are several research projects related to this work. One of them is the project entitled "Quick Response (QR) Code Technology in an attendance control system", developed at the Instituto Tecnológico Superior de Zacapoaxtla. The main function of this system is to record the attendance of students, who place their QR code in front of a camera for the system to register it. However, the registration is done through a desktop computer with Windows 10 operating system. This limits the mobility of the system, since it depends on a single fixed computer.

On the other hand, the roll call system of the Tecnológico Superior de Ciudad Serdán does not require a desktop computer, but only a mobile device to access the system and register attendance, which facilitates mobility and flexibility.

A similar system is the DIPA System, developed by the National Polytechnic Institute of Mexico. In this system, users enter a website from a mobile device, where a QR code is generated and changes daily. This code is read by an assistance module that uses a QR code scanner. Unlike this approach, the Tecnológico de Ciudad Serdán's roll call system is done entirely through a mobile application, without the need for a physical module with a QR reader.

In the cloud we can find several mobile applications similar to the event roll call system of the Tecnológico Nacional de México, Ciudad Serdán campus. One example is Snafflz, an application designed to manage the guest list at events, allowing efficient access control. It is available for both iOS and Android devices, and offers key functions such as scanning QR codes to register entries, importing guest lists through Excel files and generating reports in real time.

However, unlike Snafflz and other similar applications, the TECNM campus Ciudad Serdán roll call system has the additional capability of generating event acknowledgements, a functionality that is not present in many of these other solutions.

CONCLUSIONS

The systematization of the roll call process through the QR code system provided the following benefits:

Time Savings: By automating the roll call process with QR codes, teachers and school administrators saved time, as they no longer have to manually call the roll of students. In addition, the information can be processed faster and more accurately.

Error reduction: Automating the process also reduces the likelihood of human error by eliminating typing errors or reading errors in the attendance list.

Ease of use: QR codes are easy to use and scan with most mobile devices, making the roll call process more efficient and easier for students and school staff.

Accessibility: The systematization of the roll call process with QR codes also allows the possibility of tracking student attendance in real time and from any location, which allows greater accessibility and flexibility for the staff involved.

Improved security: The use of QR codes can also improve school security, as it can accurately and quickly identify who is present in the institution in the event of an emergency.

A possible line of future research is the integration of geolocation to identify the exact location of users within the facilities. This would allow not only to record their attendance, but also to monitor their position in real time within a building or campus, improving security and optimizing the organization of events. In addition, it could offer a more personalized experience, allowing organizers to send specific notifications or adjust activities according to the participant's location.

Another possible line of research is the use of artificial intelligence to analyze attendance patterns and behavior. This would make it possible to identify trends and optimize the management of future events, as well as to detect irregularities in the attendance register, such as unauthorized entries or frequent absences.

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We would like to thank all those who have contributed significantly to the successful implementation of the new system for the attendance pass for institutional events at the Instituto Tecnológico Nacional de México campus Ciudad Serdán. This project represents an important step forward in the efficient and accurate management of attendance at our academic activities and events.

First of all, we would like to thank the **Academic Area** for their unconditional support and active collaboration during all phases of the project. Their commitment to continuous improvement and the adoption of new technologies has been fundamental to the success of this initiative.

The implementation of this system not only optimizes attendance taking, but also allows for a more detailed and accurate analysis of student participation and resource management.

We would also like to thank the **Division Chief** for his leadership and strategic vision. Their ability to identify the need to modernize our processes and their willingness to support this project have been decisive. Thanks to their guidance, we have been able to overcome the initial challenges and achieve a successful implementation that will benefit the entire educational community.

This system would not have been possible without the collaboration and joint effort of all the departments involved. We thank the technical, administrative and academic teams who worked tirelessly to ensure that the system was implemented efficiently and smoothly. Their dedication and professionalism are an example of the spirit of cooperation that characterizes our institution.

Finally, we would like to thank all students and teachers for their patience and adaptability during the transition process. Your understanding and support have been essential for the successful integration of this new system.

With the implementation of this system, we are confident that we will significantly improve attendance management at our institutional events, which will contribute to a more organized and effective academic experience for all.

BIBLIOGRAPHY .

[1] Acosta, L. A. (2015). Practical guide for the systematization of cooperation projects and programs.

technique. The Caribbean: FAO Regional Office for Latin America.

[2] Android Studio (September 4, 2024). Introduction to Android Studio. Retrieved from <https://developer.android.com/studio/intro?hl=es-419>.

[3] Coppola, M. (August 4, 2023). What is a website, what is it for and what are its elements. Retrieved from <https://blog.hubspot.es/webiste/que-es-site-web#:~:text=A%20site%20web%20is%20a%20means%20of%20a%20browser%20web>.

[4] Coronel, D. (2013, May). Procedure to perform information backup following good practices in a CONTACT CENTER company. Retrieved from:

<https://repository.ucatolica.edu.co/bitstream/10983/860/2/PROCEDURE%20FOR%20MAKING%20THE%20BACKUP%20OF%20INFORMATION%20C3%93N%20SIGUI.pdf>

[5] European Knowledge Center for Information Technology (December 7, 2023). Database.retrieved from <https://www.ticportal.es/glosario-tic/base-database-database>

[6] Government of Mexico (October 10, 2024). National development plan 2019-2024. Retrieved from <https://framework-gb.cdn.gob.mx/landing/documentos/PND.pdf>

[7] Luke Welling (2003). Web development with PHP and MySQL. Washington D.C.: Anaya Multimedia.

[8] Mobile Marketing Association, "App White Paper," p. 96, 2011.

[9] Pavón, J (2012). Creating a Web Site With Php and mysql. Washington D.C.: RA MA EDITORIAL.

[10] Puetate, G. (2021). Hybrid Applications. Ecuador: Centro de publicaciones PUCE.

[11] Santander Universities (December 21, 2020). Software development methodologies: what are they? Retrieved from

<https://www.santanderopenacademy.com/es/blog/metodologias-desarrollo-software.html>

[12] TechTarget (April 2021). MySQL. Retrieved from <https://www.computerweekly.com/es/definicion/MySQL>

[13] Tecnológico Nacional de México (October 2, 2020). Institutional development program 2019-2024 . Retrieved from

https://www.tecnm.mx/menu/conocenos/PDI-TecNM-2019-2024_2oct2020.pdf

[14] Torres, A. (1997). "La sistematización como investigación interpretativa crítica: entre la teoría y la práctica", in Santibáñez, E. & Álvarez, C. Santiago de Chile: Ediciones CIDE.

[15] Xperto Solutions (March 2, 2017) What is a Mobile App? App? Retrieved from

<https://www.xpertolutions.com/x/noticia/item/que-es-una-aplicacion-movil>

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