

# Development and Implementation of a Contactless School Attendance Monitoring System with Thermal Scanning during the COVID-19 Pandemic

Jodell R. Bulaclac<sup>1</sup>

<sup>1</sup>College of Information and Communication Technology,  
Nueva Ecija University of Science and Technology Papaya Off-Campus,  
Gen. Tinio, Nueva Ecija, Philippines - 3104

**Abstract:-** Due to the COVID-19 pandemic, schools have been forced to close and shift to blended learning while implementing strict "new normal" protocols. As a result of these restrictions, the principal of a secondary public high school in Laur, Nueva Ecija has requested the NEUST Papaya Off-Campus to provide technology transfer assistance through system development and training to create a system that could track the time in and out of any persons in school through a contactless technology. The proposed system is based on infrared temperature sensors, generated Personalized QR Code, and a web-based application to store and manage data. It can also be used in other schools and institutions to help prevent the spread of COVID-19.

**Keywords:-** Attendance Monitoring System, Contactless Technology, New Normal Protocols, Preventing the Spread of COVID-19, System Development, Technology Transfer, Web-Based Application.

## I. INTRODUCTION

The COVID-19 pandemic has had a significant impact on the global education system, necessitating the closure of schools in many countries to prevent the spread of the virus. In response to this challenge, the Department of Education (DepEd) in the Philippines has issued guidelines and protocols for the implementation of distance learning and blended learning to ensure the continuity of education during the pandemic [1].

These protocols emphasize the importance of various measures, including physical distancing, wearing face masks, frequent hand hygiene, and temperature screening, to reduce the risk of COVID-19 transmission within educational institutions [2]. Adhering strictly to these protocols is crucial in mitigating the spread of the virus and safeguarding the health and well-being of students, teachers, and staff.

However, as schools gradually reopen, the risk of COVID-19 transmission remains a concern. To address this, the utilization of contactless technology has emerged as a viable solution for monitoring the time-in/time-out of individuals and screening for high temperatures. Contactless systems enable the recording of attendance without the need

for physical contact, minimizing the risk of virus transmission.

To ensure the safety and well-being of the school community, the principal of Hilario E. Hermosa Memorial High School in Laur, Nueva Ecija, Philippines requested assistance from NEUST Papaya off-campus (Gen. Tinio, Nueva Ecija, Philippines) to develop and implement a "Contactless School Attendance Monitoring System with Thermal Scanning". This system would track the time-in/time-out of any person in the school using contactless technology, such as personalized QR codes, while also having the ability to identify individuals with high temperatures.

Contactless technology, particularly personalized QR codes, has been widely adopted as a method for attendance tracking during the pandemic. Each individual is assigned a unique QR code that can be easily scanned using smartphones or dedicated devices [3]. This approach eliminates the need for physical contact and minimizes the risk of virus transmission during the attendance monitoring process.

In addition to personalized QR codes, the system developed for Hilario E. Hermosa Memorial High School incorporates thermal scanning using infrared temperature sensors. These sensors have been proven to be accurate and efficient for non-contact temperature measurements [4]. By integrating infrared temperature sensors into the system, individuals with high temperatures can be identified, which may indicate potential COVID-19 symptoms. Prompt identification of such individuals allows for further evaluation and necessary actions based on health protocols.

The use of contactless technology for school attendance monitoring with thermal scanning offers several advantages. Firstly, it reduces physical contact and minimizes the risk of virus transmission among students, teachers, and staff. Secondly, it provides a convenient and efficient method for recording time-in/time-out information, streamlining attendance monitoring processes. Finally, the system's ability to identify individuals with high temperatures contributes to the early detection and prevention of potential COVID-19 cases within the school community.

## II. METHODOLOGY

The development and implementation of the contactless school attendance monitoring system with thermal scanning during the COVID-19 pandemic involved an agile development approach. Collaboration among the research team, NEUST Papaya off-campus, and the principal of Hilario E. Hermosa Memorial High School was crucial in identifying system requirements and specifications, ensuring that the system met the specific needs of the educational institution.

Stakeholder collaboration is vital in research, as it significantly contributes to the success and impact of various projects [5]. Collaborating with stakeholders, including researchers, policymakers, practitioners, community members, and industry partners, offers researchers diverse perspectives, resources, and expertise, resulting in more comprehensive and relevant research outcomes [6].

This method ensures that research aligns with the needs and priorities of the target community or industry, leading to enhanced research relevance and applicability [5][6]. By involving stakeholders in the research process, researchers can co-create knowledge and address real-world problems and challenges directly, increasing the potential for successful implementation and impact.

It also provides opportunities for knowledge exchange and capacity building between researchers and stakeholders [7]. In collaborative research projects, stakeholders contribute their contextual knowledge and experiences, while researchers provide their scientific expertise, enriching the research process and empowering stakeholders by fostering a sense of ownership and promoting capacity building within the community or industry [5].

Involving stakeholders in the research process enhances the rigor and quality of the study [5]. Stakeholders can provide valuable input in research design, methodology, data interpretation, and dissemination strategies. Their participation in data collection and analysis contributes to data validity, ensuring that research findings are relevant and meaningful to the target audience [7].

Furthermore, stakeholder collaboration facilitates collaborative decision-making processes and policy impact [5][6]. By involving policymakers and practitioners, research findings directly inform evidence-based decision-making and policy development. Collaborative approaches increase the likelihood of research uptake and translation into practice, leading to tangible improvements in policies and interventions [7].

For the actual development of the system, the team applied the agile development approach. Agile development is characterized by iterative and incremental development cycles, was employed to facilitate flexibility, adaptability, and continuous improvement throughout the development process [8]. The research team followed the Agile principles and practices, which emphasize close collaboration between cross-

functional teams, frequent communication, and iterative development to deliver a high-quality solution [10].



Fig. 1. Project Design and Development<sup>a</sup>

<sup>a</sup>source: Okeke (2021), retrieved from <https://targettrend.com/agile-methodology-meaning-advantages-disadvantages-more>

The use of Agile methodology in the development of the contactless school attendance monitoring system with thermal scanning during the COVID-19 pandemic allowed for several advantages. One key benefit is the ability to rapidly prototype and iterate on the system design. This is essential in a dynamic and evolving situation, such as the COVID-19 pandemic, where requirements may change or new insights may emerge. By breaking down the development process into manageable iterations, the team could quickly respond to changing requirements and incorporate user feedback [9].

Early user involvement was also a crucial aspect of the Agile development approach. By involving stakeholders from the Hilario E. Hermosa Memorial High School, including teachers, staff, and administrators, the research team ensured that their needs and perspectives were taken into account during the development process. This collaboration helped to refine the system requirements and align the solution with the specific needs of the school community [8].

Continuous testing and refinement were integral to the Agile development approach. The iterative nature of Agile allowed for regular testing and evaluation of the system's functionality, accuracy, and reliability. By conducting continuous testing, the research team could identify and address any issues or bugs in the system promptly. This iterative testing and refinement process helped to ensure that the final solution met the desired quality standards [10].

In summary, the Agile development approach proved to be well-suited for the development and implementation of the contactless school attendance monitoring system with thermal scanning during the COVID-19 pandemic. It facilitated flexibility, adaptability, and continuous improvement, enabling the research team to respond to changing requirements, incorporate user feedback, and address emerging challenges effectively [9] [8].

## III. RESULTS AND DISCUSSION

From the meetings and constant communication with the principal of Hilario E. Hermosa Memorial High School, the team analyzed the Contactless School Attendance Monitoring System with Thermal Scanning for Hilario E. Hermosa Memorial High School must fulfill several key requirements. Firstly, it should enable contactless attendance tracking using personalized QR codes or similar technologies to eliminate

physical contact. Additionally, the system should incorporate infrared temperature sensors for thermal scanning, allowing the identification of individuals with high temperatures as a potential indicator of COVID-19 symptoms.

Real-time data recording is crucial for prompt monitoring and risk identification, while a secure and centralized database ensures data integrity, accessibility, and privacy. The system should feature a user-friendly interface, making it intuitive and easy for students, teachers, and staff members to navigate. Integration with existing systems facilitates seamless data flow and avoids duplicative efforts.

Scalability and flexibility are important considerations to accommodate varying numbers of individuals and adapt to changing requirements or protocols. Reporting and analytics capabilities should be implemented to generate attendance reports and identify attendance trends, enabling data-driven decision-making and improving operational efficiency.

Security measures must be robust to protect attendance data from unauthorized access or breaches, ensuring compliance with privacy regulations and safeguarding personal information. The system should be accompanied by comprehensive training materials and ongoing technical support to facilitate adoption and address user inquiries or issues.

Finally, cost-effectiveness is a key factor in developing and implementing the system within a reasonable budget, without compromising functionality, performance, or security.

By fulfilling these requirements, the development team can ensure that the Contactless School Attendance Monitoring System with Thermal Scanning meets the specific needs of Hilario E. Hermosa Memorial High School, adheres to COVID-19 protocols, and contributes effectively to preventing virus transmission within the school community.

Figure 2 below presents the face-to-face meeting held by the research team during the initial gathering of the needed data.



Fig. 2. Meeting with the Beneficiary

#### A. System Design and Development

Considering all the requirements, the team strictly implemented the Agile approach in order to come up with a rapid but efficient prototype. The team members were assigned based on their specialty to maximize their capability

and skill to develop all the components required to develop the system. Some were assigned to the web-based system that will handle all the data and records including the generation and reading of personalized QR Codes. Some were focused on the hardware components such as microcontrollers, sensors, and the like to develop the contactless thermal scanner. While the author as the team leader had the obligation to combine both web-based systems and contactless thermal scanning and ensure that all requirements have been met.

Figure 3 below shows the dedication and excitement of the research team during the system development phase.



Fig. 3. The System Development

Despite the division of labor, coordination among team members was prioritized to produce the desired output and proceed to pilot testing. One of the outputs created and considered was a Network Plan as shown in Figure 4 below, to strategically determine the installation locations for the developed thermal scanners, the system, and the main server.

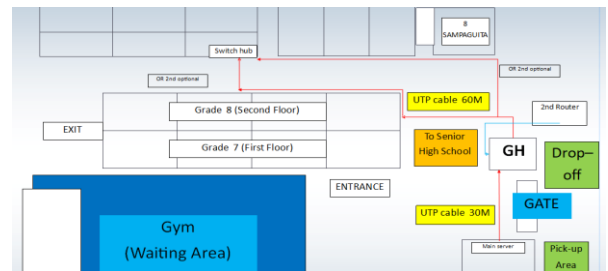


Fig. 4. Network Plan

Additionally, the development of a thermal scanner and a web-based application with a QR scanner has taken place. The thermal scanners were created by combining various sensors and modules with Arduino microcontrollers. Numerous experiments were conducted using breadboards and the Arduino library to ensure the scanner's optimal functionality. To familiarize users with the design and functions of commonly found thermal scanners, the team decided to utilize broken thermal scanner cases from the school. The cases were modified to accommodate all the necessary sensors and components, enabling the thermal scanner to communicate with the web-based application with a QR scanner and subsequently with the server.

Figure 5 below depicts the prototyping process to develop the thermal scanner for the system.





Fig. 5. Thermal Scanner Prototype

A crucial feature of the system is the ability to read personalized QR codes to identify individuals entering the school before recording temperature data and managing that information. To ensure the system's versatility and portability, it was tested on various devices such as PCs, laptops, cellphones, and tablets as shown in Figure 6.

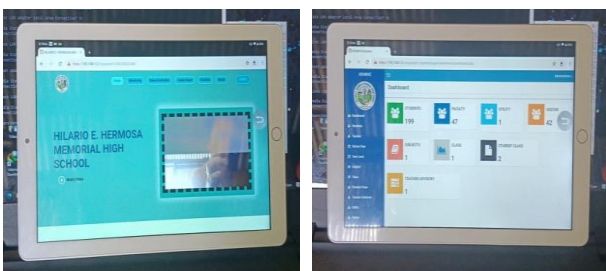


Fig. 6. The Web-based application with QR Scanner

The pilot test results provided compelling evidence of the effectiveness and reliability of the Contactless School Attendance Monitoring System with Thermal Scanning. The integration of infrared temperature sensors proved to be instrumental in identifying individuals with elevated body temperatures, enabling prompt assessment and appropriate actions based on health protocols. This capability is particularly crucial during the COVID-19 pandemic, as it helps to prevent the potential spread of the virus within the school environment.

The use of generated personalized QR codes further contributed to the system's efficiency and convenience. These QR codes allowed for easy and contactless recording of time-in/time-out information for students, teachers, and staff. By simply scanning their unique QR codes, individuals could swiftly and accurately log their attendance, eliminating the need for physical contact and reducing administrative burden. This streamlined approach enhanced the overall attendance monitoring process, allowing for better time management and ensuring accurate attendance records.

The web-based application played a vital role in the storage, management, and analysis of the system's data. It provided real-time access to attendance records, temperature measurements, and generated reports, enabling timely decision-making and intervention when necessary. School administrators and authorized personnel could effortlessly monitor attendance trends, track temperature patterns, and generate reports for further analysis or compliance purposes. The availability of such data in real-time empowered them to respond promptly to any emerging issues and implement necessary measures to maintain a safe learning environment.

Overall, the pilot test results underscored the efficacy of the Contactless School Attendance Monitoring System with Thermal Scanning in achieving its intended goals. Through the integration of infrared temperature sensors, personalized QR codes, and a web-based application, the system demonstrated its ability to efficiently monitor attendance, identify individuals with potential health risks, and enhance safety protocols within the school setting.

#### B. System Transfer and Implementation

Once the system was completed, meeting all the necessary requirements, a pilot testing was conducted at Hilario E. Hermosa Memorial High School. Following the successful testing, the system was permanently installed on the school premises and the technology was transferred to the school as the beneficiary. A system demonstration and training sessions were then organized for all users, including students, teachers, and staff members, ensuring they were acquainted with the new system. These training sessions as shown in Figure 7, spanned several days to ensure that participants gained familiarity and proficiency with the developed system.



Fig. 7. Training and Demonstration

The system developed was evaluated by all participants, who unanimously rated it as "Excellent" in terms of overall satisfaction. Even though it fell within the same client satisfaction category, they still provided a "Very Satisfactory" rating for the system. Additionally, they issued a certificate of utilization, further validating the effectiveness and quality of the developed system.

## IV. CONCLUSION

The development and implementation of a Contactless School Attendance Monitoring System with Thermal Scanning represent a significant contribution to ensuring the safety and well-being of students, teachers, and staff during the COVID-19 pandemic. By leveraging contactless technology, such as infrared temperature sensors and generated personalized QR codes, schools can effectively monitor attendance and identify individuals with potential symptoms. The successful pilot test conducted at Hilario E. Hermosa Memorial High School showcases the feasibility and efficacy of the proposed system. This research offers valuable insights and serves as a blueprint for other educational institutions seeking to prevent the spread of COVID-19 and ensure a safe learning environment.

By minimizing physical contact and optimizing administrative processes, the Contactless School Attendance Monitoring System with Thermal Scanning significantly contributed to the overall safety within the school premises. The reduced physical contact not only mitigated the risk of virus transmission but also created a more hygienic and efficient attendance monitoring process. This system proved to be an invaluable tool in upholding the "new normal" protocols and ensuring the well-being of students, teachers, and staff.

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