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Evaluation Of CPSU-Track System Quality and Process: An Electronic Contact Tracing System

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ABSTRACT

This study was conducted to evaluate the implementation of CPSU-Track in terms of its system quality and process as an e-contact tracing system of Central Philippines State University-Hinigaran Campus. It sought to determine the level of CPSU-Track system's quality in terms of functionality, usability, efficiency, reliability, maintainability and portability, and processing in terms of record and time keeping, contact tracing, and processing time as assessed by staff, head of office and students. This study made use of a descriptive type of research design using the total enumeration process for staff and head of office respondents, while purposive quota sampling was used to identify student-respondents of Central Philippines State University-Hinigaran Campus. The results revealed that the staff and head of office's assessment of the system's quality exceeded the expectations of the end-users and obtained excellent interpretation in terms of the factors and criteria set on the standardized questionnaire of ISO/ IEC 9126, Meanwhile, the staff, head of office and students found the system's process excellent in terms of record and time keeping, contact tracing, and processing time. Results and findings also concluded that the system much likely had the standards and characteristics to be an effective digital tool for contact tracing especially in managing the spread of the COVID-19 disease.

Keywords: *CPSUTrack, System Quality, System Process, QR Code, Digital Contact Tracing*

INTRODUCTION

During the rise of the Coronavirus Disease (COVID-19) in the country, digital technology applications that concern on the contact tracing were developed and introduced to the community to help stop and manage the spread of this novel virus.

As stated by the World Health Organization (WHO), one of the crucial tactics for stopping SARS-CoV-2 transmission chains and lowering COVID-19-related mortality is through contact tracing. When appropriately incorporated into an existing public health system, digital solutions can contribute to improve contact tracing activities. To effectively control the spread of the

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Coronavirus disease, contact tracing is essential (Park et al., 2020). With the utilization of technology, digital contact tracing has been shown to have the ability to significantly reduce the COVID-19 outbreak (Hinch et al., 2020). The constraints of conventional contact tracing are most likely to be addressed by an app-based contact tracing while taking into account the privacy and utility trade-offs that are always present (Kleinmen & Merkel, 2020). The nature of concentrates on digital contact tracing following COVID-19 was for the most part restricted and limited by their observational and frequently clear nature (Braithwaithe et al., 2020). Digital applications have already proven their effectiveness; however, concerns related to their usability (Golinelli et al., 2020), degree of adoption (Kleinmen & Merkel, 2020), and their acceptability must also be considered (Anglemyer et al., 2020).

According to Lee and Kim (2021), practices using mobile apps can potentially increase the capacity of conducting contact tracing, where mobile technologies can be incorporated into the existing model. Emerging community technology of QR codes are now often used as an approach in contact tracing for faster retrieval of information and quick deployment of the application. It is a technology considered to be the most practical, economical option to automation (Uzun & Bilgin 2016) that provides a new level of interactivity for the public when embedded with a smartphone (Lorenzi et al., 2014). Some research findings also suggest that QR codes may be effective when they are required to be used by all patrons of a specific location or service and tied to a specific exchange (ESNetwork, 2020). Having a QR-code-based contact tracing framework can aid the identification and isolation of cases at an earlier stage and generates seamless, delay-free cooperation of individuals, institutions, public authorities, and other responders in both short and long terms (Nakamoto et al., 2020). Thus, in order for the technology to be innovative and impactful, users need to adopt and adhere to it for the success of having a digital solution (Rodriguez, 2021).

Existing technologies are vital keys that are needed to foresee on how to conceptualize the operation and function of the application. Relation of the study is associated to several locally implemented digital contact tracing application here in the Philippines. Traze is an example of a currently developed system introduced by the Philippines Port Authority (PPA) to trace movements of individuals inside their facilities through a QR code tag. The same goes for the eSalvar, a QR code-based contact tracing system used in Naga City that mandates anyone who enters enclosed establishments to use and register with the application (Laguardia 2020).

Building on this literature, this study sought to evaluate the implementation of CPSU-Track as an electronic contact tracing integrated with a smartphone and QR code technology for the Central Philippines State University- Hinigaran Campus. The CPSU-Track would serve as a digital solution that provides an effective and efficient way of recording, retrieving and tracing transactions made by the personnel, students, and other clientele inside the university. Specifically, the researchers focused on the evaluation of the system's software quality using the international standard of ISO/ IEC 9126 model system evaluation. The system's process is also assessed considering the operation of CPSU-Track as an approach of contact tracing to the stakeholders involved. Findings of this study would provide an overview of the substantial impact of a digital contact tracing solution in an organization.

STATEMENT OF THE PROBLEM

This study sought to evaluate the implementation of CPSU-Track in terms of system quality and process as an E-contact tracing system of Central Philippines State University-Hinigaran Campus.

Specifically, this study sought to answer the following:

1. What is the level of CPSU-Track System Quality as assessed by the
    a. Staff, and

b. Heads of Office?

2. What is the level of CPSU-Track System Process as assessed by the
   a. Staff,
   b. Heads of Office, and
   c. Students?

METHODOLOGY

This research employed a descriptive research design in order to assess the system quality and process on the implementation of CPSU-Track at Central Philippines State University-Hinigaran Campus.

This study was conducted at Central Philippines State University-Hinigaran Campus, Brgy. Gargato, Hinigaran, Negros Occidental. The respondents were seven staff and eight heads of office for system quality, while system process had seven respondents from the staff, eight from the head offices and thirty from students. To determine the respondents for staff and head office, the total enumeration process was used by the researchers, while purposive quota sampling was used to determine the number of student respondents.

This section also described the application of Rapid Application Development (RAD) as the model used in the software development cycle of the project. The ability to modify the design, add functionality, and iterate as frequently as possible without having to start over is one of the main benefits of rapid application development. This helps the researchers to quickly understand the end-user's needs and speed up the development process that would clinch that all end-users requirements are aligned and ensure also the prototype's quality.

The system's development process follows through and executes several stages such as planning the requirements, analyzing, designing, and system testing as can be seen in Figure 1. These stages allowed the researchers to provide iteration and make changes to the functions and features of the application if necessary. Lastly, after all the software development processes were observed and done, the application went through a testing phase in which the researchers conducted an evaluation to the end-users and IT experts to gather feedback and an overview on the project. This is to ensure the integrity and reliability of the system before and after the implementation.

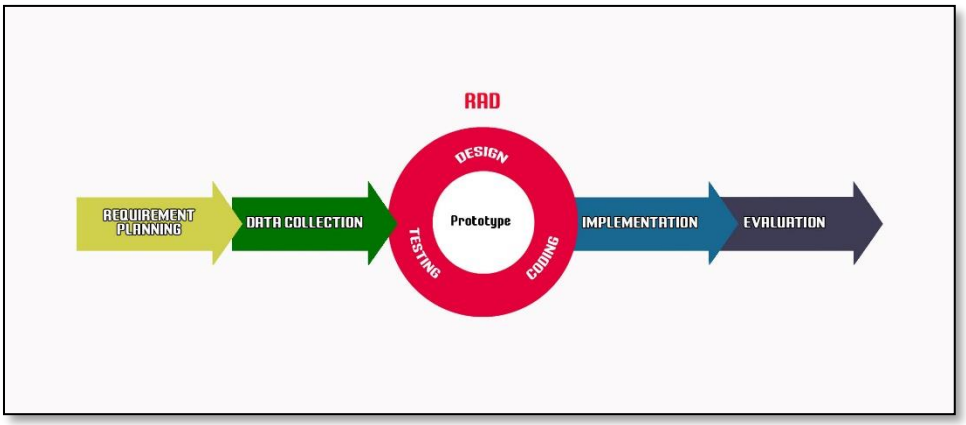

Figure 1. Research Methodology

A. Requirement Planning

The system development process began with planning. Defining and gathering the requirements needed for the development were a must to segment specific needs on the construction of the prototype. Time management and planning out resources such as what relevant software and programming languages are to be used were carried out at this stage.

B. Data Collection

There were two (2) sets of questionnaires conducted upon the completion of the study. The first set was the instrument for system quality, of which the researchers adapted the software evaluation using the ISO/ IEC 9126 standardized questionnaire. It followed the criteria to assess the prototype system in terms of functionality, usability, efficiency, reliability, maintainability and portability. The second set of questionnaires was for system process in terms of record and time keeping, contact tracing and processing time.

Likert's scale was utilized to measure the point scales and descriptive equivalent of the participants' responses with regard to their evaluation of the system quality and process.

Table 1. Likert's Scale for the System Quality and Process

Range	Description (System Quality)	Description (System Process)	Interpretation
4.21-5.00	Strongly Agree	Very Easy	Excellent
3.41-4.20	Agree	Easy	Very Good
2.61-3.40	Moderately Agree	Neutral	Good
1.81-2.60	Disagree	Difficult	Poor
1.00-1.80	Strongly Disagree	Very Difficult	Very Poor
4.21-5.00	Strongly Agree	Very Easy	Excellent
3.41-4.20	Agree	Easy	Very Good

The research instruments were validated by the three (3) jurors who were experts and knowledgeable of the study using the criteria of Goods and Scates, and it garnered an overall mean of 4.8 which is interpreted as excellent and valid to be used for the study.

Furthermore, the instruments were subjected to reliability with the use of Cronbach A. The Cronbach's obtained a value of 0.899 for system process and 0.936 for system quality which indicated a high reliability result. Hence, the questionnaires were all reliable and can be utilized for the study. Direct interview with the respondents was also observed in order to gather an overview of their current process.

Finally, in terms of the application, it would only obtain the necessary data of the respondents such as their names, address, and purpose of transaction, time-in and time-out to ensure that it would follow the data collection guidelines and protocol implemented by the local COVID-19 Inter-Agency Task Force.

C. Prototyping

Upon securing a ready-to-conduct manuscript, the researchers asked from the different authorities for approval to conduct the research and for the actual development of the prototype system. The system developers constructed and worked out the application that would fit the expectations based on the feedback and overview of the respondents, as well as its objectives of being a digital contact tracing platform. The developers observed a server-client model where the server side is a pure web application while an android application was utilized for the client. The client-side caters the scanning of QR Code through an android application where it relays all the data and transaction to the web application of the server. Each front office of the university was installed with the application to track the offices visited by the students and have its throughput on their turn-around time.

Figure 2. CPSUTrack Mobile Scanner

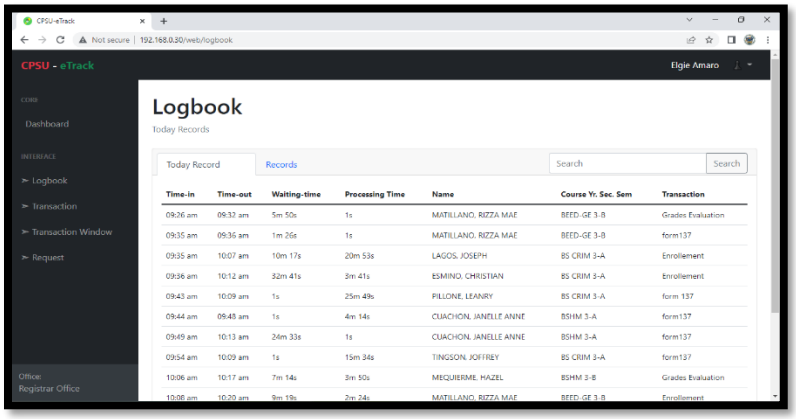

Figure 3. CPSUTrack Dashboard

The user identification was integrated using their ID number and was embedded in a personal QR code asset tags which were incorporated in their official university ID. All QR assets are generated by a series of library implemented to the system to ensure the security and integrity of the tags. Assets are also encrypted for additional layer of protection to the user's data and identity.

Figure 4. CPSUTrack QR Code Generator

The main operational aspects of the developed digital application is to aid in exposure identification of a suspected carrier of the virus. Offices visited by each individual are recorded electronically by scanning their personal QR tags to a mobile scanner provided to omit the traditional paper-based way of contact tracing. Figures 5 and 6 show the tracing feature of the e-contact tracing.

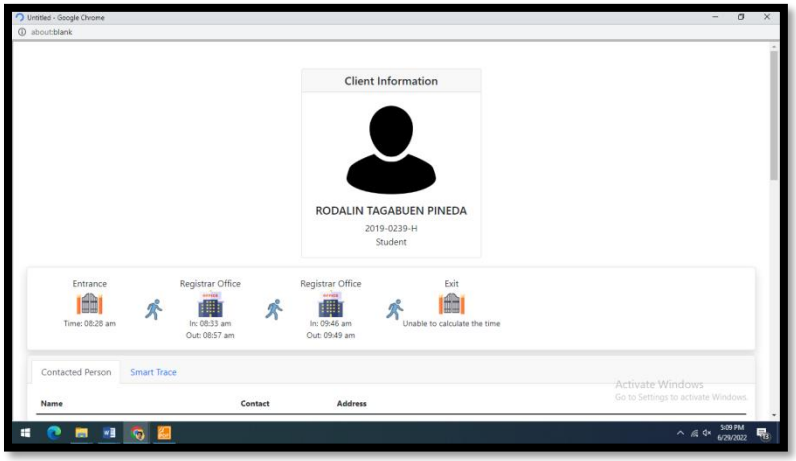

Figure 5. Features of Smart Trace

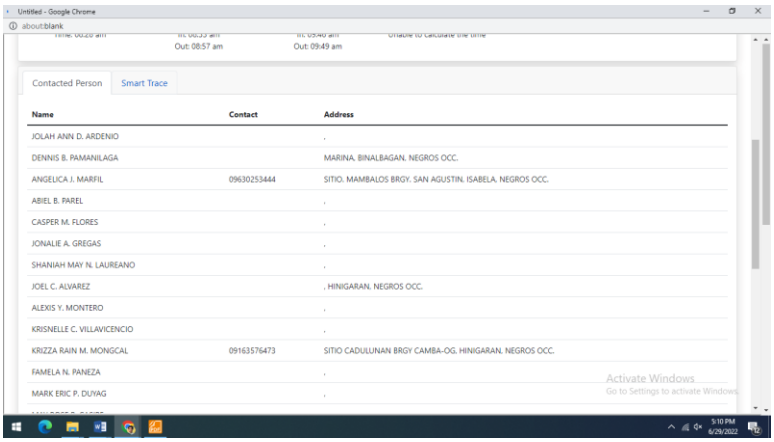

Figure 6. Features of Smart Trace

D. Design and Coding

As for the server model of the project, the back-end layer was constructed using PHP, Javascript and MYSQL, while Bootstrap and CSS for the front-end. Kodular was utilized for the client model in terms of the android application.

E. Testing

In order to measure the performance, reliability and over-all functionality of the project, the application had undergone the testing phase. The testing of the prototype system was done by each office involved in the study. Suggestions and feedbacks of the respondents were considered to provide iterations to the system.

F. Implementation and Evaluation

As the system was finalized and concluded by both researchers and end-users, the Management Information System Office (MIS Office) in Coordination with the Research and Administration office had initiated the implementation of CPSU-Track, where the system was installed in selected offices. As the longevity and duration of the application produced no errors and bugs, an evaluation was carried out to the staff, heads of office and students of the university through an instrument to evaluate the system quality and process of the CPSU-Track. This was done in order to assess and evaluate the system's integrity in terms of its quality and process as a digital solution for contact tracing.

After collecting all the required data, the scores were classified, tabulated, analyzed and interpreted, and the mean and standard deviation were measured using the Statistical Package for Social Sciences (SPSS). The results were dealt with strict confidentiality.

RESULTS, CONCLUSION AND RECOMMENDATIONS

Results and Discussion

After a thorough analysis of the data gathered, the following findings were drawn from the result of the study:

Level of CPSU-Track System Quality

The quality of the prototype system was evaluated using the ISO/ IEC 9126 software quality model in which it was categorized into six characteristics and were sub-divided into its sub-characteristics. Each factor involved different criteria such as (1) functionality in terms of suitability, accurateness, interoperability, and security; (2) usability in terms of understandability, learnability, operability, attractiveness and compliance; (3) efficiency in terms of time behavior and compliance; (4) reliability in terms of maturity, fault tolerance, recoverability and compliance; (5) maintainability in terms of analyzability, changeability, stability and testability, and (6) portability in terms of adaptability, installability, coexistence, replaceability and compliance.

All respondents had undergone the testing and implementation phase of the prototype system with a duration of 2 months. As the implementation phase continued after the given duration and were found to have no occurrence of bugs and errors, the respondents involved in the operation of the system were given a self-made questionnaire where they evaluated the integrity of the digital application implemented. The survey audited the results from the factors and criteria set on the instrument and obtained a grand mean of 4.86 from the staff, and 4.81 from the heads of office. The findings were interpreted with excellent remarks and revealed that CPSU-Track exceeded end-users' expectations with regard to the system's quality. The result of the survey is summarized in Table 2.

Table 2. Level of CPSU-Track System Quality as Assessed by Staff and Head of Office

Staff	Mean	SD	Interpretation	Head of Office	Mean	SD	Interpretation
Functionality	4.83	0.373	Excellent	Functionality	4.93	0.149	Excellent
Usability	5.00	0.000	Excellent	Usability	4.85	0.177	Excellent
Efficiency	4.83	0.373	Excellent	Efficiency	4.73	0.399	Excellent
Reliability	4.77	0.373	Excellent	Reliability	4.75	0.366	Excellent
Maintainability	4.83	0.293	Excellent	Maintainability	4.78	0.362	Excellent
Portability	4.89	0.302	Excellent	Portability	4.85	0.233	Excellent
Grand Mean	4.86	0.281	Excellent	Grand Mean	4.81	0.218	Excellent

This study encompasses that the CPSU-Track has the preferred characteristics of being a digital tool in reducing the COVID-19 outbreak through contact tracing. Findings and observation throughout the research period also indicated that the integration of smartphones and QR code technology has the potential to fill-in the gap of the traditional contact tracing. The QR framework of the developed application was also found to be efficient, portable and cost-effective in the way of identifying the authentication of a person when conducting a tracing. However, the usability and adoption degree of the digital solution would mostly be dependent on the interest and support of each individual involved.

Level of CPSU-Track System Quality System Process

Table 3 shows the data obtained from the respondents where they measure the CPSU-Track system process in terms of its features in (a) record and time keeping; (b) contact tracing and (c) processing turn-around time. With the use of the questionnaire instrument, the CPSU Track gathered a grand mean of 4.77 from the staff; 4.92 from the head of offices; and 4.59 from the students were it was interpreted as Excellent. It implies that the system process of CPSU-Track was very effective in terms of delivering its deliverables. These results showed that the respondents from the staff and head offices of the Central Philippines State University- Hinigaran Campus can do an up-to-date track and trace of individuals who went in and out per office and campus with an excellent processing time.

Table 3. Level of CPSU-Track System Process as Assessed by Staff, Head of Office and Students

Indicators	Staff			Head of Office			Students		
	M	SD	*Int.	M	SD	*Int.	M	SD	*Int.
Record & Time Keeping	4.81	0.307	Excellent	4.93	0.153	Excellent	4.62	0.447	Excellent
Contact Tracing	4.67	0.450	Excellent	4.88	0.282	Excellent	4.51	0.469	Excellent
Processing Time	4.83	0.408	Excellent	4.97	0.088	Excellent	4.56	0.511	Excellent
Grand Mean	4.77	0.365	Excellent	4.92	0.152	Excellent	4.59	0.456	Excellent

*interpretation

After conducting the evaluation, most of the respondents stated their feedback with a positive response. Respondents also said that they observed faster and more convenient way of how the university conducted their contact tracing as soon as they entered and left the premises. Heads of office also averred that upon the implementation of the application, no tasks were added on their current process. The electronic contract tracing also earned the praise of the Board of Regents of the university where they recommended it to be used to the other extension campuses. It was also observed that the association of QR code to the official ID of the university aided in

the cooperation of both students and faculty of the university, in which it provided an effective impact to the digital application.

Conclusion

Conducting contact tracing was a significant cycle to put an end to the spread of the pandemic flare-up. Nonetheless, processes and methods were difficult as the current techniques utilized more on a traditional paper-based strategy which led to some various constraints that rendered contact tracing endeavors ineffectual. The approach of the QR code technology and smartphone would undoubtedly upgrade its definition with advancements in digital health, digital technologies, and a more accurate scientific understanding of the disease. Integration of exposure notifications to an individual in-contact was a big significance to add to its features to innovate the existing technology. A comparison of the system and its process to other existing digital application must also be considered in identifying what would be the best practices and technologies that can be used in aiming for an effective digital solution. It is also suggested that a privacy-preserving architecture and data management in compliance with the data privacy act must be enhanced in the development of a digital application as the system only guaranteed that transactions logged were not stored permanently on the server database. The interest, support and adoption rate of users to the technology implemented played significant factors as basis for the effectiveness and success of the digital solution. Lessons learned and expectations from this current deployment would play paramount roles in future pandemics, further aid the establishment of an effective routine surveillance approach, and provide meaningful insights for other countries and regions.

Recommendations

Based on the aforementioned conclusions, the researchers would like to recommend the following for the improvement of the system:

Administration. It is recommended to the school administration to utilize the system in the whole University, not just in Hinigaran Campus but also in the Main and other extension campuses to have a digital tool for conducting contact tracing of the University and to contribute to its aim for SMART campus.

Head of Office. It is recommended for the heads of office to coordinate with the researchers as to how the system should be improved and innovated to ensure the continuous and long-term period implementation of the system.

Staff. Staff of the schools are recommended to learn and practice the implementation of the system to assist more clientele, to cater to their needs, and in preparation for face-to-face campus transactions.

Students. Students are recommended to follow protocols and guidelines, as well as follow the rules set in using the CPSU Track as system.

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