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ParaESSU Game using Performant Internet-of-Things (IoT)

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Abstract*: *Eastern Samar State University Salcedo Campus envisions to be an academic paradise in this side of the country. Like any organization it encounters environmental problems like improper garbage disposal. It aimed to design and develop and test a ParaESSU game. A waterfall model of software development was utilized on the creation of the game. Planning, conceptualization and data gathering were the activities in designing, interface design and coding followed to insure the system's functionality. The game was evaluated using the ISO 9126-1 Quality Model and System Usability Scale (SUS) to show that the game was technically and operationally effective. Every after testing the game was updated to conform to the suggestions made by the evaluators. Results showed that the game can now be utilized and ready for deployment. SUS showed high scale which means that first time user can play the game without any demonstration and guidance. Further studies must be directed to add details not specified in the game and to further enhance its structure.

Keywords*: *Game Development, Global Positioning System (GPS), Internet-of-Things (IoT)

I. INTRODUCTION

Life nowadays is impossible without technology. Modern inventions make life easier. Most people, especially professionals and students are using every single piece of modern technology. GPS is an abbreviation of the term Global Positioning System, it is a radio system that conveys latitude, longitude, and average velocity from any location on the Earth to transmission devices (Broda & Baxter, 2003; Lucking & Christmann, 2002). In the context of gaming, it offers the players' movement tracking and what volume of information it can provide players' location awareness.

GPS-based games are among of those prevalent games that is being played by the most people at the present time. In fact, its prevalence surpassed many mobile application and mobile games to be the most used worldwide app. Biseria & Rao (2016) cited Pokemon Go as an example which broke all the records in merely 14 days of getting launched and was downloaded by more than 30 million people and is expected to surpass other apps to become the most used app.

As an academic paradise in this side of the country, Eastern Samar State University Salcedo Campus is the proper place for deploying a Global Positioning System (GPS) -based game that promote awareness on environmental problems. Therefore, the researchers' aims to utilize this game for a cause -- to make students aware in environmental change in ESSU Salcedo. By playing this game, the way students, face environmental problems will change.

II. OBJECTIVES OF THE STUDY

This study aims to design, develop, and test a ParaESSU Game using Performant Internet of Thing (IoT).

Specifically, this study will evaluate the acceptability and system usability of the developed game.

III. CONCEPTUAL FRAMEWORK OF THE STUDY

Figure 1 shows the conceptual framework of the study. It utilizes the waterfall model of software development which was synthesize in the input process and output.

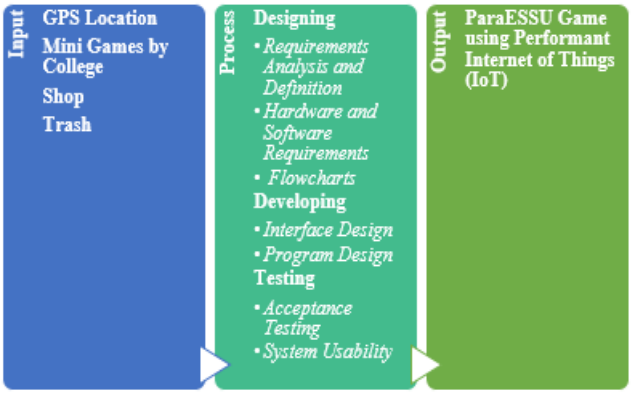

Fig. 1.The Paradigm of the Study showing the Input-Output-Process Model

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The input of the study involves GPS location, player information, mini games per sector and shop.The process of the study includes the designing of ParaESSU Game using Performant IoT. It includes requirements analysis and definition, data gathering, hardware and software requirement and flowcharting.

Developing consists of creating table on database, finding right background and other enhancements, making the interface and the program. Then testing the system followed that includes the Benchmark Test, Pilot Test which composed of Alpha Test and Beta Test and System Usability Test. The output of the study is a ParaESSU Game using Performant Internet of Things (IoT).

IV. PROCEDURE

A. Designing, Developing and Testing the Game

The ParaESSU game was designed after gathering all the necessary information needed. It made up the game interface, database and system flow charts. It was designed using Unity for the general creation of the game; Blender for the modeling of the characters; Sketch-Up for the modeling of the buildings and Quantom Graphical Information System (QGIS) for plotting the map for ESSU Salcedo.

The development of the game commenced on the month of April 2019 and was finished on the month of June 2019.

After the system development, testing the system took place for further evaluation and assessment of the developed game. Testing the game was done in two stages. The benchmark test and the pilot test. ISO 9126-1 Quality Model was utilized to measure the games functionality, reliability, usability, efficiency, maintainability and portability.

V. RESULTS AND DISCUSSION

A. Acceptance Testing

After the development phase, the developed system had undergone series of testing to evaluate its quality. This allowed the respondents to determine if the requirements as specified during the development stage were accomplished. After each testing, the respondents stated whether requirements are not attained and which must be deleted, revised, or updated because of changing needs.

The first test that was conducted was the benchmark test. This was conducted during the second week of June 2019. The system was evaluated by the researcher together with CICT core faculty using ISO 9126-1 Quality Model. Next, was the alpha test where the GE faculty members rated the system using of the same score card. It was conducted during the third week of June 2019. The last test conducted in the last week of June 2019 was the beta test where the student as actual users evaluated the system by the use of the same score card. To determine the sample size of the students' respondents, the Slovin's formula was used.

$$Ss = \frac{N}{1 + Ne^2}$$

Where: *Ss = sample size*
N = population size
e = decided marginal error

At a decided 5 percent marginal error and with a total of 2,170 students the sample size was 338 and distributed as follows.

Table I. Name of the Table that justify the values

Respondents	Population	Sample Size
College of Information and Communication Technology	677	105
College of Education	961	150
College of Agriculture and Allied Sciences	532	83
TOTAL	**2,170**	**338**

The system was rated based on the six main characteristics of ISO 9126-1 quality model which are functionality, reliability, usability, efficiency, maintainability and portability. The functionality includes suitability, accurateness, interoperability, compliance and security as sub characteristics. Maturity, fault tolerance and recoverability as sub characteristics of reliability. Understandability of system functions, learnability and operability are included in usability. Its time and resource behavior as sub characteristics of efficiency. The maintainability includes analyzability, changeability, stability and testability. Portability characteristics includes adaptability, installability, conformance and replaceability. The categories of a 5-point rating scale, code and its description are as follows:

Scale	Code	Description
4.20 – 5.00	1	Excellent
3.40 – 4.19	2	Very Good
2.60 – 3.39	3	Good
1.80 – 2.59	4	Poor
1.00 – 1.79	5	Very Poor

The data gathered was analyzed using frequency counts and weighted scoring system. Weighted means was derived from the frequency counts, while the total mean score was derived from the average of the equivalent statistical interpretation.

The following are the results done by specific evaluators.

Benchmark Test Results on the Quality Attributes of the ParaESSU Game using Performant Internet of Things (IoT) evaluated by the researcher and CICT Faculty.

Summary Result for Benchmark Test. Table 2 displays the summary of benchmark test on the quality attributes of the ParaESSU game. It shows that in the criteria on "Efficiency," it obtained a highest mean of 3.50 and interpreted as Very Good. "Usability," 3.43, Very Good. "Maintainability," 2.98, good. "Portability," 2.88 good. "Functionality," 3.35 good. Then, the "Reliability", obtained a lowest mean score of 2.43 and interpreted as poor. The grand mean score of quality attribute of the system was 4.00 and interpreted as very good. Based on the result of the benchmark testing, the researches agreed to submit the system for further testing before its implementation.

During the benchmark test the evaluators found out that the developed system stills need minor revisions especially on the hazard areas of the game. The evaluators suggested that the design should follow the basic guidelines on user interface design.

Eventually the researchers adopted the recommendation given by their adviser and prepared the developed system for further testing.

Table 2. Benchmark Test Summary Results on the Quality Attributes of ParaESSU Game using Performant Internet of Things (IoT)

Criteria	Mean	Interpretation
Functionality	3.35	Good
Reliability	2.45	Poor
Usability	3.43	Very Good
Efficiency	3.50	Very Good
Maintainability	2.98	Good
Portability	2.88	Good
Grand Mean	**4.00**	**Good**

Alpha Test Results on the Quality Attributes of the ParaESSU Game using Performant Internet of Things (IoT) evaluated by the GE faculty members.

Summary Result for Alpha Test. Table 3 displays the summary of alpha test on the quality attributes of the ParaESSU game. It shows that in the criteria on "Functionality," it obtained a mean of 4.35 and interpreted as excellent. "Reliability," 4.50, excellent. "Usability," obtained the highest score of 4.75 and interpreted as excellent. "Efficiency," 4.30, excellent. "Maintainability," 4.05 excellent. Then, the "Portability", obtained a score of 4.45 and interpreted as excellent. The grand mean score of quality attribute of the system was 4.40 and interpreted as excellent.

After the test, researcher noted that the game should be submitted for further testing specifically on the output messages. They suggested that an English critique is necessary to enhance the wordings used in the game.

Table 3. Alpha Test Summary Results on the Quality Attributes of ParaESSU Game using Performant Internet of Things (IoT)

Criteria	Mean	Interpretation
Functionality	4.35	Excellent
Reliability	4.50	Excellent
Usability	4.75	Excellent
Efficiency	4.30	Excellent
Maintainability	4.05	Very Good
Portability	4.45	Excellent
Grand Mean	**4.40**	**Excellent**

Beta Test Results on the Quality Attributes on the Quality Attributes of the ParaESSU Game using Performant Internet of Things (IoT) evaluated by the students as actual users.

Summary Result for Beta Test. Table 4 displays the summary of beta test on the quality attributes of the ParaESSU game. It shows that in the criteria on "Functionality," it obtained a mean of 4.50 and interpreted as excellent. "Reliability," 4.55, excellent. "Usability," obtained the highest score of 4.75 and interpreted as excellent. "Efficiency," 4.50, excellent. "Maintainability," 4.45 excellent. Then, the "Portability", obtained a score of 4.45 and interpreted as excellent. The grand mean score of quality attribute of the system was 4.50 and interpreted as excellent. This means that all the test done were successful and answered the objectives of the study.

Table 4. Beta Test Summary Results on the Quality Attributes of ParaESSU Game using Performant Internet of Things (IoT)

Criteria	Mean	Interpretation
Functionality	4.50	Excellent
Reliability	4.55	Excellent
Usability	4.75	Excellent
Efficiency	4.50	Excellent
Maintainability	4.45	Excellent
Portability	4.45	Excellent
Grand Mean	**4.50**	**Excellent**

B. Usability Testing

After the acceptance testing, the usability test followed to guarantee that the developed system conforms to the requirements can be ready for implementation. The respondents used the System Usability Scale (SUS) by (Digital Equipment Corporation, 1986) which measures how well a product allows user to accomplish her goals. SUS has proved to be a valuable evaluation tool, being robust and reliable. It correlates well with other subjective measures of usability. The SU Scale is generally used after the respondents had an opportunity to use the system being evaluated, but before any debriefing or discussion takes place.

To calculate the SUS score, first sum the score contributions from each item. Each item's score contributions will range 0 to 4. For items 1, 3, 5, 7, and 9 the score contributions are the scale position minus 1. For items 2, 4, 6, 8, and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU. A SUS score above a 68 would be considered above average and anything below 68 is below average.

The evaluators of the system usability test were students as actual users and was conducted during the last week of January 2016.

System Usability Result of ParaESSU Game using Performant Internet of Things (IoT) evaluated by the by the actual users.

Summary Result for System Usability, Table 5 displays the summary for system usability ParaESSU Game. It represents the overall score of the 10 item statements. It obtained an overall SU score of 79.58. This implies that the developed system is usable and is now ready for implementation.

VI. SUMMARY

Generally, the game aimed to design, develop and test a "ParaESSU" game. Different processes were undertaken to achieve the objectives of the study.

The first was the designing of the game. Analysis of the data was then made in order to conceptualize the flow of the game. The development phase respectively followed the design. This phase involves the creation of the game itself, modelling of assets and

Table 5. System Usability Results on the Quality Attributes of the Support Services Evaluation System at ESSU-Salcedo Campus

Statement	Mean	SUS Score
1. I think that I would like to use the game frequently	4.85	3.85
2. I found the game unnecessarily complex	1.35	3.65
3. I thought the game was easy to use	4.38	3.38
4. I think that I would need the support of a technical person to be able to use the system	1.35	3.65
5. I found the various functions in this game were all integrated	4.28	3.28
6. I thought there was too much inconsistency in this system	2.17	2.83
7. I would imagine that most people would learn to use this system very quickly	3.89	2.89
8. I found the system very cumbersome to use	2.74	2.26
9. I felt very confident using the game	4.49	3.49
10. I needed to learn a lot of things before I could get going with this system.	2.45	2.55
SUS Score		**31.83**
Over all SUS Score (SUS Score * 2.5)		**79.58**

locating the coordinates. The researchers used Unity for the general creation of the game; Blender for the modelling of the character; Sketch-Up for the modelling of the building and Quantom Graphical Information System (QGIS) as for plotting the map for the ESSU Salcedo.

The development phase was then followed by testing. Testing the system was done to in two stages – Benchmark and Pilot Test. First test was the Benchmark test, where the researchers and their advisers serves as the evaluators of the game and rated using the scorecards. The overall mean score was 4.00 and was interpreted as very good.

The second test was the pilot test, which composed of two types; the Alpha test and the Beta test. The evaluator of alpha test was the faculty members of the College of ICT as experts. They evaluated the game with the use of scorecards. The overall mean score for the alpha test was 4.40 and was interpreted as excellent

The third test performed on the game was the Beta test. The evaluator for this test was the selected students of ESSU Salcedo Campus, which was computed using the Solvin's formula. They evaluated the game with the use of scorecards. The overall mean score for the Beta test was 4.50 and interpreted as excellent.

Lastly, Usability test was performed on the game to test if the game is usable. The evaluators of this test were composed of the actual users who will use the game. They evaluated the system using the system usability scale. It consists of 10 criterions and resulted to an overall SUS score of 79.58 which is above average.

VII. CONCLUSIONS

Based on the findings and evaluations of the study, the researchers had come up with the following conclusions:

1. The ParaESSU game had been successfully design, developed and tested.
2. The ParaESSU game was motivating and engaging to students and was widely supported by the faculty.
3. The ParaESSU game was effective and usable since it met the requirements that had been specified.
4. The ParaESSU game served as a tool for promoting awareness on environmental problems.

RECOMMENDATIONS

Based on the findings of the study, the researchers had drawn the following recommendations:

1. The ParaESSU game must be promoted to be played by the students in ESSU, Salcedo Campus.
2. There must be another study in the ParaESSU game to further update the application of the developed game.

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