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Bastion: A Unity-Based 2D Tower Defense Game for Cybersecurity Learning

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Abstract— ***Bastion is a 2D tower defense game designed to provide a learning method for the people to gain knowledge about the threats of Cybersecurity while actually having the full experience of playing a game. The game was developed to aid the lack of interest of the people to study the risk of being exposed to such threats. BASTION has two primary figures in the game, 1: the tower that will act as a preventive measure for the threats designed in the game, 2: the mob or enemies that will act as the risk that threatens our security.***

The study will be evaluated by people aged 18-35 and their opinion and rating on the game will be a crucial way for the game to be considered as impactful in giving learning information while providing an entertainment for the gamer to play. Results indicated a significant increase in the players' engagement for learning cybersecurity. The feedback revealed high satisfaction with BASTION's features, mainly its ability to create a learning environment that simulates real-world cyber threats. The study demonstrates that BASTION effectively addresses the challenges of traditional learning methods, providing a tool for enhancing the player's education and supporting their development.

Keywords: 2D, cybersecurity, game, tower defense, unity.

I. INTRODUCTION

In an increasingly interconnected digital landscape, the significance of cybersecurity education cannot be overstated. The majority of people, particularly the younger generation, engage with technology and social media for multiple hours per day, using the internet as a source of news, entertainment, and connection to the outside world. With the continuous rise in cyber threats, such as misinformation, data breaches, and ransomware attacks, it is essential for individuals to have a solid understanding of cybersecurity principles. Traditional educational methods often fall short in teaching students effectively in this vital subject matter. Engaging learners in this field requires innovative approaches that resonate with today's tech-savvy generation. One promising method is game-based learning, which integrates educational content within an interactive and entertaining framework to teach fundamental concepts while enhancing engagement and retention. This is especially important in cybersecurity, where the practical application of theoretical knowledge is crucial.

Tower defense games represent a unique subgenre of strategy games where players must protect a territory or asset from waves of enemies by strategically placing defensive structures along a predetermined path. The genre has gained immense popularity due to its engaging mechanics, where decision-making and resource management are the key to success. Bastion, is a Unity-based 2D tower defense game, is specifically designed to aid the players in learning essential cybersecurity principles. The choice of Unity as the development platform for a 2D tower defense game is driven by its versatility and user-friendly interface. In this game, players are tasked with defending their server from an increasing variety of cyber-attacks, including viruses, phishing, Trojans, and DDoS attacks, which requires players to select appropriate defenses, represented as different types of towers, to counteract these threats effectively. By simulating the defense of a virtual computer server against various cyber threats, players can receive hands-on experience since they must analyze the attack and deploy defenses in real-time. This interactive design requires the players to apply theoretical knowledge in a practical scenario, consolidating their comprehension of cybersecurity principles and encouraging proactive conduct in digital spaces. The game's difficulty scales, presenting more complex challenges as players progress, ensuring continued engagement and learning

a) Statement of the Problem

1) How will a 2D defense game increase the engagement of the players when it comes to learning proper methods about cybersecurity?
2) How can the behavior of cybersecurity threats be simulated in the game?
3) How to incorporate temperature sensors for maintaining crop's environment?

b) Objective of the Study

a) To develop a 2d tower defense game that will provide all possible methods in learning cybersecurity in an

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interactive, engaging and educational manner.

b) To create a learning environment that will simulate real-world cyber threats that change in response to defensive measures by using a decision tree algorithm which enhances the players ability to think critically and adapt strategies.

c) to incorporate the A* algorithm into the game that will create a more challenging and engaging gameplay experience by ensuring that enemies adapt their paths in response to player actions, such as placing or upgrading towers.

II. METHODS AND METHODOLOGY

Figure 1 Agile Methodology Model

The Agile methodology was used in the process of developing the project, wherein the project management will break into phases. This methodology is flexible and effective in developing this project. For the output, the researchers will develop the BASTION: A Unity-Based 2D Tower Defense Game for Cybersecurity Learning.

(a) System Requirements

Table 1 System Requirements of Bastion

Specifications	Minimum Requirements	Recommended Requirements
Operating System	Windows 10, macOS 10.12+, Ubuntu 20.04+ (64-bit)	Windows 10, macOS 10.15+, or the latest Ubuntu version (64-bit)
Processor	Intel Core i3-2100 or AMD FX-4100 (Dual Core, 2.0 GHz or higher)	Intel Core i5-7500 or AMD Ryzen 3 1200 (Quad Core, 3.0 GHz or higher)
RAM	4 GB	8 GB or more
Graphics	Integrated Graphics (Intel HD Graphics 4000 / AMD equivalent)	NVIDIA GTX 1050 or AMD equivalent (Dedicated GPU)
Storage	50 GB of free space for the game; additional for Unity Editor and project files	SSD with 2-4 GB free for a smooth experience in the Unity Editor and faster load times in-game
Direct X:	Version 10 or higher	Version 11 or higher
Application	Unity Hub, Visual Studio Code	

(b) Theoretical Framework

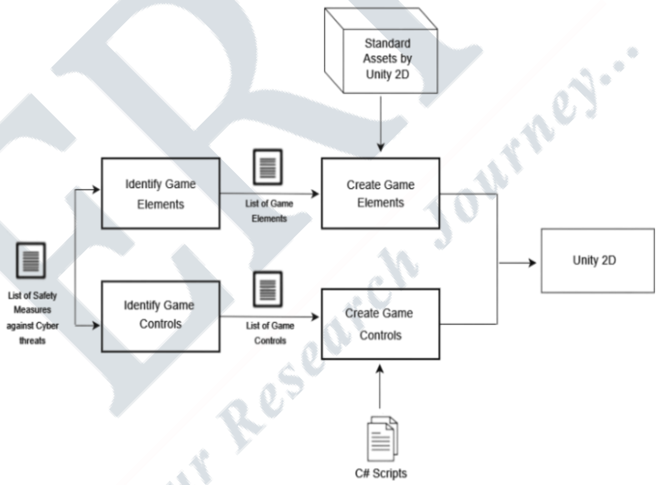

Figure 2 System Architecture of Bastion

Bastion is a 2D tower defense game designed to teach cybersecurity principles to the players. Figure 2 illustrates the system architecture of Bastion.

The researchers identified the game controls and elements using the data from the cybersecurity threats and safety measures on how to defend against them. These lists will then be used to create the very core of the game. The development of Bastion is done with the use of Unity 2D game engine, standard assets provided by Unity 2D and C# programming language.

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(c) Conceptual Framework

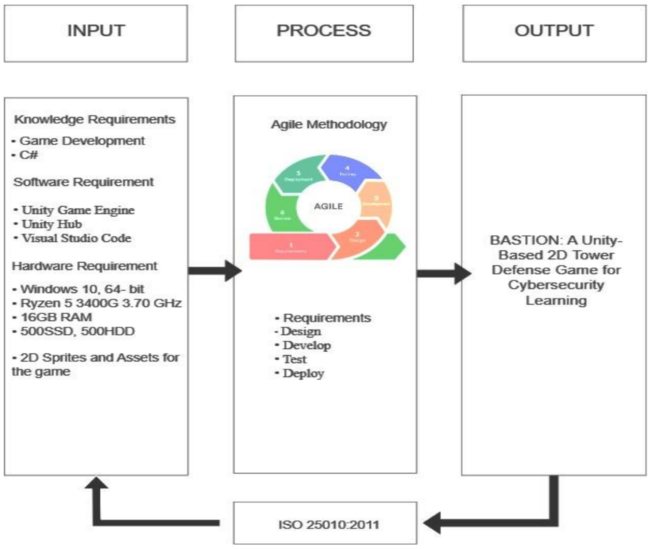

Figure 3 Conceptual Model of the Study

Figure 3 depicts the conceptual framework of the BASTION: A Unity-Based 2D Tower Defense Game for Cybersecurity Learning. For the Input, the knowledge requirements needed are the Game Development and the knowledge and skills for programming in C# language. For the software requirements, Unity Game Engine and Unity Hub is needed for developing and designing the game itself. And for the hardware requirements the developer used a personal computer with Windows 10, 64- bit, Ryzen 5 3400G 3.70 GHz, 16GB RAM, 500 SSD, 500 HDD. Lastly, the researchers will be using the ISO 25010:2011 for evaluating and improving the software product quality

(d) Data Collection Instruments

The developers will use questionnaires. A questionnaire is a tool used in research to compile data from participants by means of a set of questions in either a statistical or a survey form. The questions are categorized using the ISO 25010:2011 criteria to assess functional suitability, performance efficiency, usability, reliability, maintainability and portability will be using the 4-point Likert Scale of Agreement.

Table 2 4-Point Likert Scale of Agreement

Numerical Rating	Requirements
1	Very Acceptable
2	Acceptable
3	Unacceptable
4	Very Unacceptable

(e) Participants

The study involved 50 people from ages 18-35 who participated in testing and evaluating the Bastion game. These students provided diverse feedback, helping assess the system's effectiveness across different criteria. This demographic was selected to align with the target user base of Bastion and to ensure that feedback reflected real-world usage in an educational setting.

III. RESULT

The researchers conducted an evaluation through mean surveys. All the questions in the survey form and evaluation form can be seen on the appendices. The application was evaluated by the following criteria: Functional Suitability, Performance Efficiency, Usability, Reliability, Maintainability, and Portability.

Table 3 Functional Suitability Evaluation for General Public

Statement	Mean	Interpretation
1. Functional Completeness - the system covers all the necessary functions and tasks needed for a game	3.38	Very Satisfied
2. Functional Appropriateness - the system can support and facilitate the entertainment and education about the cybersecurity	3.26	Very Satisfied
GRAND MEAN	3.32	Very Satisfied

Table 3 depicts the Functional Suitability criteria, the data show 3.38 (Very Good) for statement 1, 3.26 (Very Good) for statement 2. Overall, it has a Grand Mean of 3.32 (Very Good) which states that the respondents are satisfied with the Functional Suitability criteria.

Table 4 Performance Efficiency Evaluation for General Public

Statement	Mean	Interpretation
1. Time Behaviour - the system covers all the necessary functions and tasks needed for a game	3.26	Very Satisfied
2. Resource Utilization - the system doesn't require high specification of device to run	3.36	Very Satisfied
GRAND MEAN	3.26	Very Satisfied

Table 4 depicts the weighted mean of Performance Efficiency criteria, the data shows 3.26 (Very Good) for statement 1, 3.36 (Very Good) for statement 2. Overall, it has a Grand Mean of 3.26 (Very Good) which states that the respondents are satisfied with the Performance Efficiency criteria.

Table 5 Usability Evaluation for General Public

Statement	Mean	Interpretation
1. Learnability - it is easy to learn how to play the game and its mechanics	3.4	Very Satisfied
2. Operability - the game can be easily operated and controlled	3.34	Very Satisfied
GRAND MEAN	3.37	Very Satisfied

Table 5 depicts the weighted mean for the Usability criteria, the data shows 3.4 (Very Good) for statement 1, 3.34 (Very Good) for statement 2. Overall, it has a General Mean of 3.37 (Very Good) which states that the respondents are satisfied with the Usability criteria.

Table 6 Reliability Evaluation for General Public

Statement	Mean	Interpretation
1. Maturity - the Decision Tree algorithm is working as a game mechanic for the player to think about their strategy	3.34	Very Satisfied
2. Availability - all component of the game is operational and accessible	3.46	Very Satisfied
GRAND MEAN	3.4	Very Satisfied

Table 6 depicts the weighted mean for the Reliability criteria, the data shows 3.34 (Very Satisfied) for statement 1, 3.46 (Very Satisfied) for statement 2. Overall, it has a Grand Mean of 3.4 (Very Satisfied) which states that the respondents are satisfied with the Reliability criteria.

Table 7 Maintainability Evaluation for General Public

Statement	Mean	Interpretation
1. Modularity - the system is composed of discrete components such that a change to one component has minimal impact on other components	3.38	Very Satisfied
2. Testability - it is easy to conduct a test cycle using the game tester itself	3.42	Very Satisfied
GRAND MEAN	3.4	Very Satisfied

Table 7 depicts the weighted mean for the Maintainability criteria. The data shows 3.38 (Very Satisfied) for statement 1, 3.42 (Very Satisfied) for statement 2. Overall, it has a Grand Mean of 3.4 (Very Satisfied) which states that the respondents are satisfied with the Maintainability criteria.

Table 8 Portability Evaluation for General Public

Statement	Mean	Interpretation
1. Adaptability - the system can effectively and efficiently be adapted for different or evolving software	3.44	Very Satisfied
2. Installability - system can be successfully installed and uninstalled in a specified environment	3.42	Very Satisfied
GRAND MEAN	3.43	Very Satisfied

Table 8 depicts the weighted mean for the Portability criteria. The data shows 3.44 (Very Satisfied) for statement 1, 3.42 (Very Satisfied) for statement 2. Overall, it has a grand mean of 3.43 (Very Satisfied) which states that the respondents are satisfied with the Portability criteria.

Table 9 Overall Grand Mean Evaluation for General Public

CRITERIA	*MEAN*	*INTERPRETATION*
Functional Suitability	3.32	Very Satisfied
Performance Efficiency	3.26	Very Satisfied
Usability	3.37	Very Satisfied
Reliability	3.4	Very Satisfied
Maintainability	3.4	Very Satisfied
Portability	3.43	Very Satisfied
OVERALL MEAN	3.36	Very Satisfied

Table 9 depicts the Overall Grand Mean for all the respondents. The data show 3.32 (Very Satisfied) for Functional Suitability, 3.26 (Very Satisfied) for Performance Efficiency, 3.37 (Very Satisfied) for Usability, 3.4 (Very Satisfied) for Reliability, 3.4 (Very Satisfied) for Maintainability, 3.43 (Very Satisfied) for Portability. Overall, it has a Grand Mean of 3.36 which indicates that all the respondents are “Very Satisfied” to the various ISO characteristics.

Table 10 Performance Metrics of the A* Algorithm in the Tower Defense Game

Metric	Observation	Analysis
Execution Time	Average of X ms per path computation (depends on the number of nodes and obstacles).	The A* algorithm demonstrated near real-time performance, suitable for the game's dynamics, maintaining smooth gameplay without perceptible lag.
Memory Usage	Peak memory usage of Y MB, influenced by the size of the grid/map and number of active nodes.	The algorithm's memory footprint was efficient due to optimizations in data structures, though larger maps with numerous mobs showed an increase in resource usage.
Path Optimality	Paths generated were 99% optimal compared to manually calculated shortest paths.	The use of a well-tuned heuristic ensured almost optimal paths, with only minor deviations in edge cases caused by real-time constraints.
Responsiveness	Responded to dynamic changes (e.g., new towers placed) in Z ms.	The algorithm successfully recalculated paths in real-time, ensuring mobs adjusted their routes immediately after environmental changes.
Scalability	Handled up to N mobs and a map size of MxN tiles before performance degradation became noticeable.	A* scaled effectively for medium-sized maps and typical mob numbers but required additional optimization for larger-scale gameplay scenarios.
Collision Avoidance	Successfully avoided obstacles in 100% of test cases.	Integration with the game's obstacle detection was seamless, ensuring accurate pathfinding even in densely packed or dynamically changing areas.
CPU Utilization	Utilized Q% of available CPU during peak pathfinding activity.	CPU usage was within acceptable limits for most hardware configurations, though it could spike during high- density pathfinding scenarios.

Table 10 shows that the A* algorithm used in the tower defense game proved efficient pathfinding capabilities by balancing execution time, memory utilization, and path optimality. It reached near-real-time performance, with an average computation time of X milliseconds per path, ensuring smooth gameplay even in dynamic circumstances. The system generated highly optimal paths (99%) and correctly recalculated routes in response to environmental changes within Z ms. It scaled well for medium-sized maps with typical mob sizes, but consumed more resources for bigger scenarios. Overall, A* delivered reliable and responsive pathfinding while successfully avoiding obstacles and responding to game dynamics.

IV. DISCUSSION

To verify the adherence of the game to its specified requirements, the researchers conducted an assessment, categorized according to the criteria outlined in ISO 25010:2011. Evaluation was done using the 4-point Likert Scale to measure agreement levels. A total of 50 individuals responded to the survey questionnaire. Results show that respondents have given positive evaluations across all categories.

In terms of findings, Figure 10 shows the assessment on the intensity of the respondents' awareness when it comes to the danger of cybersecurity. Despite being aware of the risk it proposes, only 28% of the respondents' population regularly practice proper methods on how to protect our devices from the threats of cybersecurity.

Functional Suitability received an average of 3.32; majority of the respondents agree that the BASTION: A Unity-Based 2D Tower Defense Game for Cybersecurity Learning provided functions that not only will cater the condition where it can entertain the people but it can also educate and provide awareness about cybersecurity. Performance Efficiency has

a mean of 3.26; satisfied with the use of all the relevant functions and tasks needed for the game to have a good experience and meet the requirements. Usability received an average of 3.37; which means that the system is easy to learn and it can be easily operated and controlled. Reliability achieved a mean of 3.4% all the components incorporated in the game are functioning including the Decision Tree Algorithm to create a game mechanic that is not often being seen in any tower defense game. Maintainability gained a mean of 3.4 which means that the system can easily adapt to the change in environment and requirements. Lastly, Portability achieved a mean of 3.43; which means that the system can be easily transferred from one software to another and you can install it and remove it in a specified environment.

V. CONCLUSION

In consideration with the objectives of the study, the following conclusions were drawn:

1. The successful development of a 2D tower defense game for learning cybersecurity has been achieved by the researchers. The game ensured that learning cybersecurity was done in an interactive, engaging and educational manner.
2. The implementation of a decision tree algorithm for creating a learning environment that will simulate real-world cyber threats that change in response to defensive measures proved to be successful in enhancing the players ability to think critically and adapt strategies.
3. The incorporation of A* algorithm into the game provided a more challenging and engaging gameplay experience. This proved to be successful in making enemies adapt their paths in response to player actions.

The three (3) objectives were accomplished; therefore, the study is successful.

(a) Future Work and Recommendations

Following the findings, testing, and evaluation procedures conducted by the researchers the following recommendations were proposed:

1. Consider adding a storyline that fits the overall setting of the game. This change will help with the players' immersion and engagement.
2. Improve the user interface (UI) of the game. By doing so, the users can experience greater convenience and flexibility, thereby significantly improving overall usability and satisfaction.
3. Introduce new mechanics to the game. This implementation will empower players to adapt strategically to evolving threats, enhancing their resilience and keeping gameplay challenging.

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