Learn Muay Thai Basic Movement In Virtual Reality And Sattolo Shuffle Algorithm

Martin Wongso[1*], Wirawan Istiono[2]

[1,2] Information and Technology, Faculty of Informatics, Universitas Multimedia Nusantara, Tangerang 15810, Indonesia
[*]Corresponding Author:
Email: wirawan.istiono@umn.ac.id

Abstract.
Muay Thai is a martial art from Thailand that uses punches and various clinching movements. Muay Thai is one martial art whose popularity is growing and is in great demand, including in Indonesia. However, very few people still know the basics of this Muay Thai martial art. Therefore, a media that can introduce Muay Thai martial arts is needed. In this study, to introduce the basic movements of Muay Thai martial arts, Virtual Reality technology is used, which aims to make it easier for users to understand and practice basic Muay Thai movements correctly. In this study, the method used to design virtual reality games is the Sattolo Shuffle algorithm which functions to generate unique and different randomized Muay Thai movement animation results. To measure the level of user acceptance of learning Muay Thai using VR technology, the GUESS method is used. From the result of GUESS method, it was found the user acceptance rate is 83.84%, which means the user is "satisfied" with the application that has been made to learn basic Muay Thai. Based on this level of acceptance, it can be concluded, that the virtual reality game introducing Muay Thai using the sattolo shuffle algorithm can be used as an alternative tool to learn basic Muay Thai.

Keywords: *Muay Thai, Virtual Reality, Sattolo Shuffle and Digital Martial art.*

I. INTRODUCTION

Muay Thai is a martial art originating from Thailand that uses punches and various clinching techniques, this martial art uses eight body contacts or what is commonly referred to as the "Art of Eight Limbs" which uses a combination of the use of fists, elbows, knees and feet. Muay Thai is a martial art that is growing in popularity and one of the most widely used martial arts by Mixed Martial Arts (MMA) fighters. In Indonesia, the development of Muay Thai continues to grow and becomes one of the most popular martial arts [1], [2]. This can be seen from the number of gyms or training places in provinces to cities and districts that teach Muay Thai martial arts [3] and interest in competitions at national and international levels [4]. However, only few people know the basics of Muay Thai. This is due to the fear of getting injured while practicing this martial art, because martial arts related to striking, throwing or immobilizing are more prone to injury than other athletic activities [5].Along with the development of technology, games that were originally used as a means of playing, have now developed into educational tools that are used to educate someone in a more fun way. Based on research [6], it was found that the use of games that provide simulations can affect three characteristics by an individual, such as cognitive, habitual, and affective elements [7]. Cognitively, games are able to produce knowledge that connects knowledge in the activities carried out.

Traditionally, games are able to increase cooperation and relational abilities as well as skills in adapting and resolving conflicts [8]. Affectively, games can increase interest, motivation, and satisfaction in playing games. The research states that games are used for academic and practical purposes in education that are educative effectively by increasing one's motivation to learn [9].The development of games is becoming increasingly rapid along with technological advances. One of the technologies used is virtual reality, which allows users to feel the real sensation of being in a virtual world. The use of virtual reality can add to the experience received when playing a game [10], [11]. Based on research, virtual reality provides a deeper experience in interacting between games and users, which refers to its use in terms of training and education [12]. In attracting individuals to do learning, virtual reality is able to divert the intensity from exercise and other negative thoughts that are carried out because of the resulting immersion effect [13]. In addition, the use of virtual reality to learn martial arts can be done without causing the risk of injury in the martial arts learning process [14], [15].

In the development of a game, randomization is used to provide variety and diversity in order to make the game less boring. One of the algorithms used to perform randomization is the sattolo shuffle algorithm. The sattolo shuffle algorithm is an algorithm used to perform randomization, this algorithm is a modified result of the fisher-yates shuffle algorithm. In addition, the resulting randomization is a unique randomization result and does not differ from one another [16]. Based on the statements above regarding Muay Thai, games, virtual reality, and sattolo shuffle algorithm, it will design and build a basic introduction game to Muay Thai martial arts using virtual reality technology. The application of virtual reality in the design of the basic introduction to the Muay Thai martial art game is expected so that someone knows the basic movements of the Muay Thai martial art.

II. LITERATURE STUDY

Muai Thai, commonly called Thai Boxing, is a martial art or combat sport that uses almost all parts of the body to produce eight body contacts (fists, elbows, knees, and feet) or what can be called the art of eight limbs. Muay Thai is used for self-defense. In addition to improving physical health, Muay Thai also has an effect on mental health, Muay Thai can train patience and courage for people who learn Muay Thai martial arts [17]. In practicing basic Muay Thai techniques, there are several types of strokes that can be learned, such as [18]:

1. Jab: a punch that is done by punching thinly toward the face or other parts of the opponent's body.
2. Cross / Straight: a punch that can be used to knock down opponents. Like the jab, this punch technique also hits the front with more power.
3. Hook: a punch technique that hits the enemy from the side. This punching technique is done by making attacks such as hooks or hooks.
4. Uppercut: a blow from below that targets the chin of the opponent.

Based on research [19], the sattolo shuffle algorithm is a modification of the fisher-yates shuffle algorithm by Sandra Sattolo in 1986, this algorithm performs random permutations of a finite set. The results of the modifications made to produce permutations originating from one cycle are more optimal. Just like the fisher-yates shuffle algorithm, the sattolo shuffle algorithm also produces unbiased permutations, that is, it does not have the same permutations as the previous results. In addition, the concept is simple and randomization is carried out on the same data so that it can save on the use of resrouces [20]. The following are the steps of the basic method of the sattolo shuffle algorithm.

1. Enter the data set to be shuffled into an array.
2. Save the array's length from the data set then set it into variable i.
3. Choose a random number r between 0 and (i – 1) which will be used to determine the array index.
4. Exchange the elements in the r index array with the elements in the (i – 1) index array.

Subtract the number i by one and check whether the number i is greater than one or not, if the number i is greater than one then repeat the third step until the number i is less than one.

III. METHODS

The In the process of making applications, the stages carried out in application development are using the waterfall method. The stages of the waterfall method consist of:

1. Requirements Analysis at this section, the necessary system development is carried out for the game to be built. The game that was built is a Muay Thai martial arts learning game with two main modes, namely the direct learning method through theory and the combat method against the enemies that have been provided.
2. System Design, this section is the system design stage that will be built based on the requirements analysis that has been done. System design is done by designing flowcharts, display / UI, and design assets used in building games.
3. Implementation, at this section, the game development process is carried out based on the previous system design stage. Game development is carried out using the C# programming language with the

Unity application based on the flowchart design, display / UI, and asset design carried out in the previous stage.

4. Integration & Testing, this section is the section of merging the results of the implementation carried out in the previous stage, then testing is carried out to find out the game that was built is in accordance with the design and the functions contained in it are running well or not.
5. Operation & Maintenance, at this section, maintenance of the game that has been successfully built is carried out, including fixing errors that were not found in the previous stage.

The application testing stage is the stage of testing the functionality contained in the game. The test uses black box testing, which is a test that focuses on the functions contained in the game. This test will be tested in detail from the main menu, selection mode, learn mode, and battle mode contained in the game.Learn Mode is a mode that is used to learn the basic stroke movements in Muay Thai. When Learn Mode is run, it will display a description of the input that can be use by the user. After selecting the character, the player can see the animation basic movement of the stroke that demonstrated by the choosen character, and also user can see the description of the movement, such as, the name of the movement and an explanation of the movement. The learn mode flowchart can be seen in Fig 1.

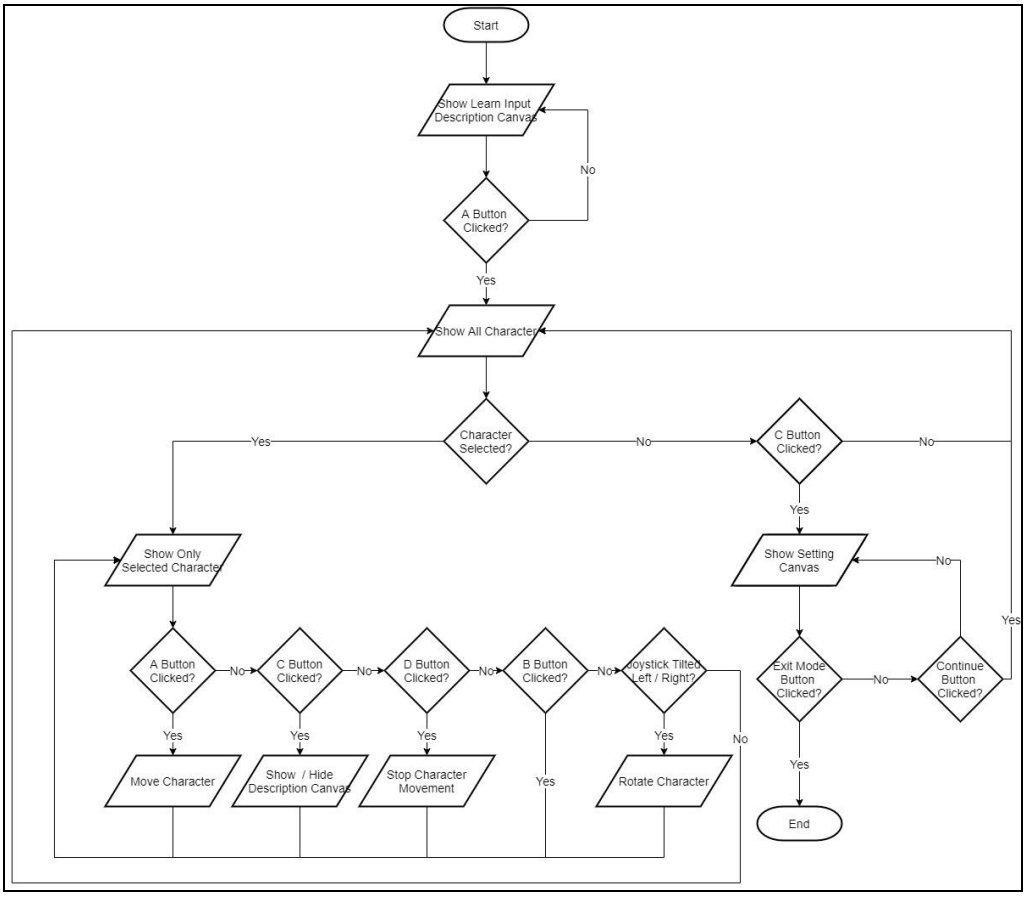


Fig 1. Flowchart Learn Mode

Battle Mode is a mode that is used to learn the basic movements of the punch by fighting the enemies that have been provided. In this mode, players will be asked to perform basic stroke movements based on the movements requested by the system. When this mode is running, the players will be asked to choose the level difficulty that they want to play. After that, the description of the input will be displayed to the player. After the description is closed, the system will randomize the moves that must be completed by the player in the Shuffle Attack Combo. After the randomization is complete, the battle mode will be started. When the game starts, the movement that the player must do will be shown first, after that the player will be asked to perform the requested move. When the player makes a movement, a Check Movement will be carried out. There are five types of movements in this game, such as, jab, hook right, hook left, cross or straight and uppercut. Players will be asked to make these five moves according to the description previously explained, if the player makes a wrong move then the player will be penalized for time reduction and the

enemy will attack the player, and to get additional time the player is required to complete a set of moves first. The addition of time will decreases according to the level of difficulty played, the formula to calculation this task can be seen in formula 1

$$Time = Time + (40 - (difficulty + 1) * 5) \quad (1)$$

Based on the calculation that shown in formula 1, the additional time that will be given is 40 minus the difficulty level plus one then multiplied by five. This designed for, when the more hard the difficulty level, the less additional time is given. When the player completes or fails to complete the game, the game results will carry out the Check Result process. In the game results menu, players are given 2 choices, namely Restart and Exit Mode. The battle mode flowchart can be seen in Fig 2.

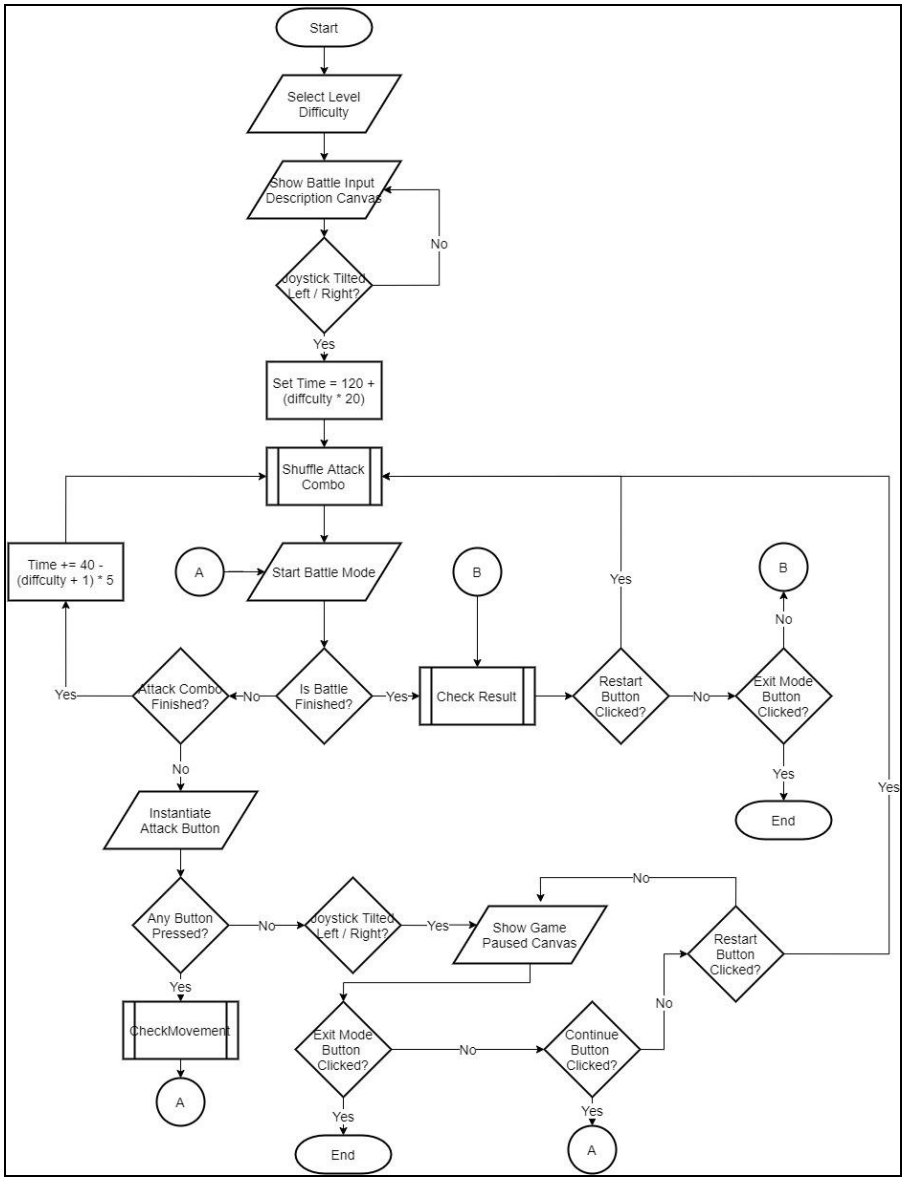


Fig 2. Flowchart Battle Mod

Check Movement is the process of checking movement based on player input. If the player input is correct, then the player character will attack the enemy. However, if the input is wrong, then after the player character attacks, the enemy character will attack the player character, and the player will be given a penalty time reduction. The calculation of the time reduction will be increases based on the level of difficulty, and the calculations can be seen in formula 2

$$Time = Time - (10 + (difficulty * 5)) \quad (2)$$

Based on the calculations that shown in formula 2, the reduction will increase based on the level of difficulty. An overview of the check movement flowchart can be seen in Figure 3.

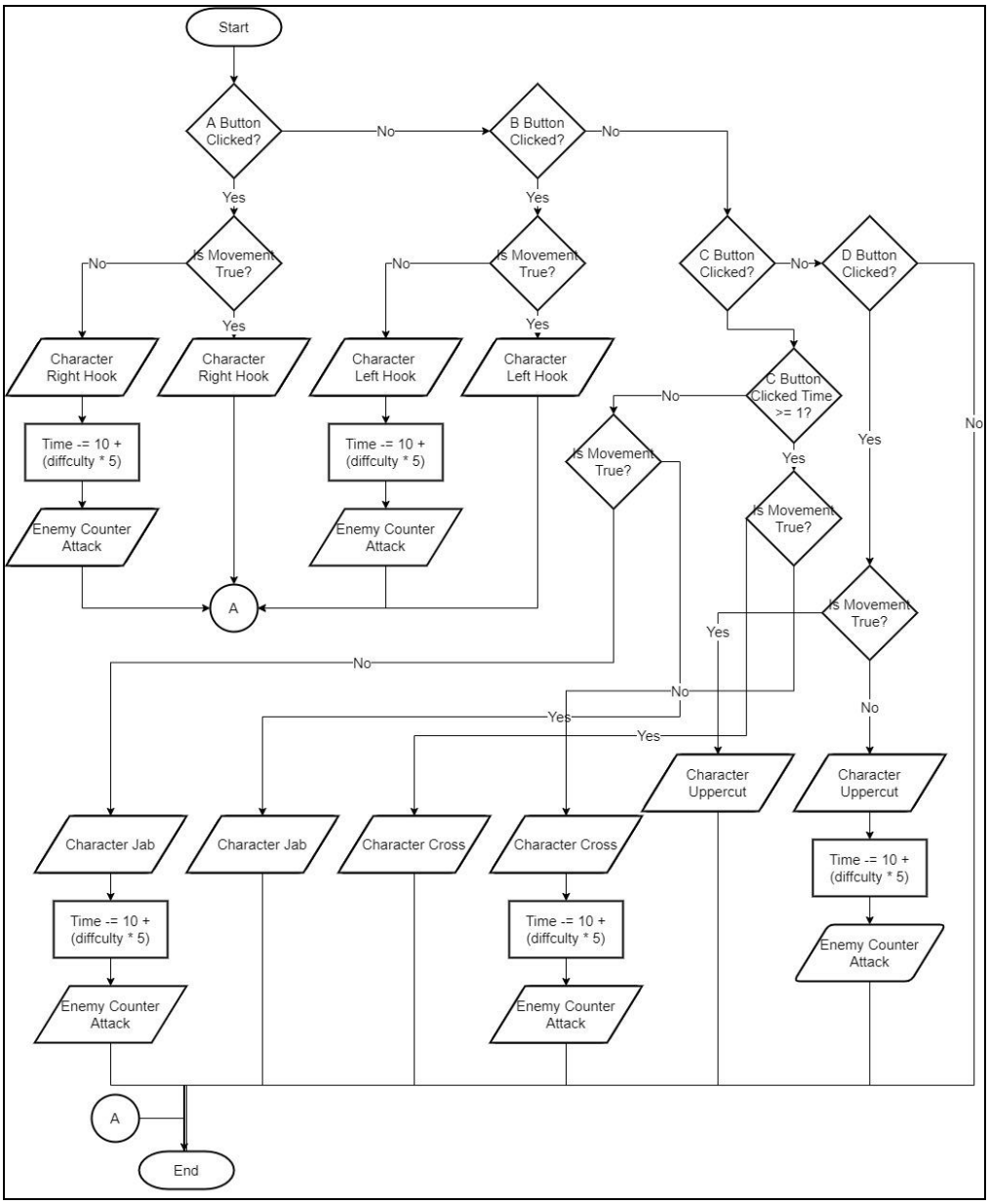
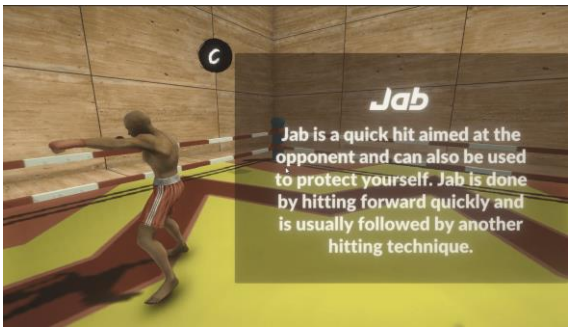


Fig 3. Flowchart Check Movement.

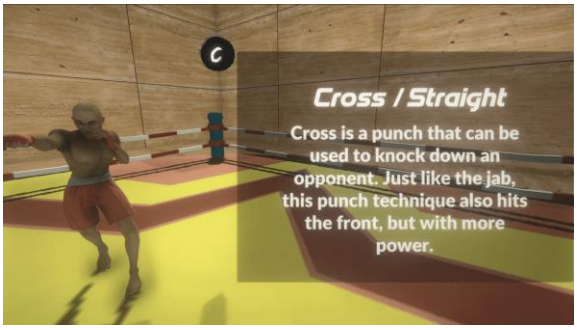
IV. RESULT AND DISCUSSION

In this research, the application is made in the form of a learning game. This game introduces the basic movements of Muay Thai martial arts by introducing the basic movements with 2 modes, the first mode is to introduce the basic movements of Muay Thai martial arts by displaying the name and description of the movement, then the second mode is the introduction of basic Muay Thai movements by doing direct combat. With enemies that have been provided with 3 levels of difficulty that can be selected by the player. In combat mode, players are asked to perform Muay Thai martial arts movements based on the movements requested by the system to the players by pressing certain buttons, the movements requested by the system will be randomized using the sattolo shuffle algorithm.

The game development is carried out using the C# programming language with the Unity application based on system design in waterfall model.In the game design carried out in this study, the movements used are the basic strokes movements of Muay Thai martial arts. The basic movement consists of 4 movements: jab, straight or cross, hook, and uppercut. The implementation of these movements is done by making the characters provided perform each of the four basic movements of Muay Thai self-defense contained in Learn Mode, which can be seen in Fig 4a and Fig 4b.



(a)



(b)

Fig 4. Sample Movement animation in Learn Mode

For the users can try basic Muay Thai basic movements that already learn in Learn Mode, a battle mode menu is also created. Where in the Battle Mode the implementation is carried out on the character played by the player and the opposing character. What distinguishes between Learn Mode and Battle Mode is the way players see the Muay Thai martial arts movements, while in Learn Mode players will see the movements as a whole made by other characters, while in Battle Mode players will see these movements as if the players were make this movement because only the hands of the character that the player is playing are visible when making the movement. For opposing characters in Battle Mode, these characters can perform all the same moves as in Learn Mode. Fig 5 shows the implementation of the basic strokes movement of Muay Thai in Battle Mode.

(a)

(b)

Fig 5. Sample Movement animation in Battle Mode

The sattolo shuffle algorithm is a randomization algorithm used when running Battle Mode which serves to prepare combinations of attacks that need to be carried out by players. This algorithm is used when Battle Mode is started, repeated, or when the game has not finished but all combinations of attacks have been carried out, so randomization of attack combinations is required.To determine the level of effectiveness of learning the basic movements of Muay thai martial arts, this application was tested by 30 players which was then followed by filling out a questionnaire using the GUESS method. Where the test results with the GUESS method can be seen in Table 1.

Table 1. Guess Model Calculation Result

Subscale Item	***Statement***	**Result**	**Average**
Usability1	I find the controls of the game to be straightforward	85.27%	85.94%
Usability2	I find the game's interface to be easy to navigate	86.61%	
Narratives	I enjoy the fantasy or story provided by the game	83.04%	83.04%
Play Engrossment 1	I feel detached from the outside world while playing the game	79.91%	73.66%
Play Engrossment 2	I do not care to check events that arehappening in the real world during the game	67.41%	
Enjoyment 1	I think the game is fun	91.52%	83.93%
Enjoyment 2	I feel bored while playing the game	76.34%	
Creative Freedom 1	I feel the game allows me to be imag-inative	83.48%	83.71%
Creative Freedom 2	I feel creative while playing the game	83.93%	
Audio Aesthetics 1	I enjoy the sound effects in the game	85.71%	86.16%
Audio Aesthetics 2	I feel the game's audio (e.g., soundeffects, music) enhances my gaming experience	86.61%	
Personal Gratification 1	I am very focused on my own perfor-mance while playing the game	83.04%	87.50%
Personal Gratification 2	I want to do as well as possible dur-ing the game	91.96%	
Visual Aesthetics 1	I enjoy the game's graphics	87.05%	86.83%
Visual Aesthetics 2	I think the game is visually appealing	86.61%	
Average			83.84%

Based on the results of calculations carried out in the GUESS model, it was found that the usability level was 85.94%, this shows that players are very satisfied because the games designed are easy to play. Then the narrative factor shows a result of 83.04%, it can be interpreted that players are satisfied that the game designed is able to capture the attention of players in playing the game. Then the results on the play engagement factor get a result of 73.66%, this shows that players are satisfied with the level of player interest in playing the game being played. Furthermore, there is the enjoyment factor with a result of 83.93%, it can be interpreted that players are very satisfied because the games make players feel happy when playing the game. Then there is the creative freedom factor with a calculation result of 83.71%, this shows that players are very satisfied because the games can foster creativity, curiosity, and freedom in being creative.

Then the audio aesthetics factor got a result of 86.16%, which means that players are very satisfied because the games have an auditory aspect that enhances the playing experience. Furthermore, there is a personal gratification factor with a calculation result of 87.50%, this shows that players are very satisfied because the games can increase their sense of achievement and desire to finish and continue playing. Then the last factor, namely the visual aesthetics factor, got a result of 86.83%, which means that players are very satisfied with the game graphics contained in the game. Based on the results of all the factors contained in the designed game, the average result of all factors is 83.84%, this result indicates that players are satisfied

with the game played as a whole. Therefore, it can be concluded that the virtual reality game introducing Muay Thai can attract player's interest in learning Muay Thai.

V. CONCLUSION

Based on the results of research and testing that have been carried out, it was found that the virtual reality game for the introduction of Muay Thai using the sattolo shuffle algorithm was successfully designed and built. The user acceptance level is obtained using the Game User Experience Satisfaction Scale (GUESS) model. Through this modeling, the results of the calculation of the game acceptance rate obtained are 83.84% for the overall calculation results, so it can be concluded that users are "satisfied" with the virtual reality game introducing Muay Thai using the sattolo shuffle algorithm. The user acceptance level that shows the level of "satisfied" indicates that the user can receive a good introduction to Muay Thai martial arts in a virtual reality game and does not reject Muay Thai martial arts as an element contained in the game. Thus, it can be concluded that the virtual reality game introducing Muay Thai using the sattolo shuffle algorithm can be a means of introducing Muay Thai martial arts to users.

VI. ACKNOWLEDGMENTS

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