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Research Paper

A Serious Game Model Proposal for Detecting Explosives

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ABSTRACT

The purpose of this work is, before the mission, training of personnel searching for explosives with metallic mine detectors for their operations in the battlefield and gaining experience by searching for explosives in a virtual environment. In this context, a search model was created by determining the factors affecting the search for explosives in the methodology. In this study, first of all, a scene where explosive materials will be detected was prepared. In this scene, three-dimensional models of the explosives and detector to be used were made from the first point of view of the character. In addition, a signal model proposal for how to detect explosives placed on the field by the detector operator using the Unity game engine is presented. In this model proposal, detectors, explosives, land and user-related issues have been evaluated and added to the model. With the prepared model, the reaction of the search coil to the signal source was observed, and it was ensured that the speed and method of the operator affected the signal. In addition, soil structure change in different types of land has been added to the model. A generic flow chart showing the behaviors to be applied by the detector operator during the intervention to the signal was prepared and this scheme was requested to be used for control purposes in the application. As a result of the study, a realistic and cost-effective training aid that can be used in the training of detector operators has been prepared.

INTRODUCTION

Improvised explosive devices and mines are one of the important problems faced by defense elements in recent years. The detection and destruction process of this type of explosives is very risky. In this process, it is very important and costly to train the personnel correctly and at the same time to provide realistic environment and scenarios. Thanks to the developed virtual environments and applications, new generation training areas and systems are now being created. In this way, it is possible to implement dangerous and costly trainings under more suitable conditions.

In this study, a virtual training area was created using the Unity game engine. In this training area, a sample metallic detector to be used by an operator has been modeled and it is aimed to develop a model for detecting explosive materials in the field with this detector. Many factors affecting the search process have been evaluated, including the properties of the explosive substance and the conditions depending on the operator, detector and the field. Thanks to the correct modeling of these factors, the signal that the detector operator will hear will be more realistic and precise. In addition, depending on this signal, the movements to be performed by the operator must be applied correctly and in order.

In this context, in the second part of the study, the literature review on the subject will be explained; In the third part, the methods used in the serious game preparation process will be mentioned, in the fourth part, certain stages of the application will be explained, in the last part, the result of the work will be explained and evaluated.

LITERATURE REVIEW

When the subject of this study is examined, it is seen that it concerns more than one discipline. These are the departments that concern the defense industry and software and information systems issues that require serious games to be created. In this context, it is considered that it would be beneficial to conduct a literature review covering the specified areas.

In this context, when the military literature is examined, in a study conducted in 2008, systems such as acoustic and seismic detection using magnetic anomaly method, electromagnetic induction systems and infrared imaging were used to identify mines and these systems were evaluated (Kalender, 2008). Similarly, in a study conducted in 2017, a mine exploration training simulator was prepared and the improvements that the simulator could provide for practical training were emphasized (Arısoy, Küçüksille, & Arısoy, 2017).

On the other hand, the term gamification is a very popular topic. Today, how this concept of gamification, which is frequently encountered in digital games, is defined and whether this concept is useful in improving learning and motivating individuals are being investigated (Deterding, Dixon, Khaled, & Nacke, 2011). In this context, space and time, which are included in the concepts of gamification and serious play, should be chosen correctly and evaluated in sociological theoretical terms (Kara, 2018).

When evaluated in this context, serious games differ from video games. Especially in serious games, it is very important that the environments tasks and situations are as close to the reality as possible and provide a realistic experience to the user. Generally, serious games can be reduced to many subheadings that are frequently encountered in real life such as social policies, communication, human performance engineering, health and education (Zyda, 2005). In addition, issues such as analyzing the events processed in the games, defining the cases and classifying their possible features, and the platform or game engine the application will be created using are important (Uskov & Sekar, 2013). The feeling in the game should be strengthened by improving the control, sensor and reality factors in games (Alexander, Brunyé, Sidman, & Weil, 2005).

Serious games are prepared to guide or experience people in difficult or dangerous situations. In a study conducted in 2011, a computer-based design was prepared that expresses how people should make decisions in difficult situations (Spek, Wouters, & Oostendorp, 2011). Another example of such applications is an application implemented using the Unity game engine in 2012. Within this application, a study has been carried out to enable passengers to decide how they can exit from the subway in case of a sudden and dangerous situation that may occur in the subway (Sharma, Member, Jerripothula, Mackey, & Soumare, 2012) (Figure 1).


Figure 1. Example of Serious Game - Subway Exit

Similarly, another area where serious games are used is the defense industry. Serious games can be prepared in order to use military equipment, to improve training or to follow changes in knowledge or behavior and to raise awareness (Lim & Jung, 2013). Another example that can be given in this field is an application that enables soldiers to communicate correctly with people in the regions where they will be assigned in the future, and helps train their soldiers in areas such as leadership, questioning and cultural transition (Kenny, Hartholt, Gratch, & Swartout, 2007).

In addition, a study was carried out in 2015 to determine the measures that can be taken in case of a serious incident that may occur in a civil or military area. In this study, analyzes were made on the method and how the cities should be evacuated in biological, chemical or nuclear (NBC) attacks that may occur in cities (Choi, Seok, Choi, Kim, & Kim, 2015) (Figure 2).

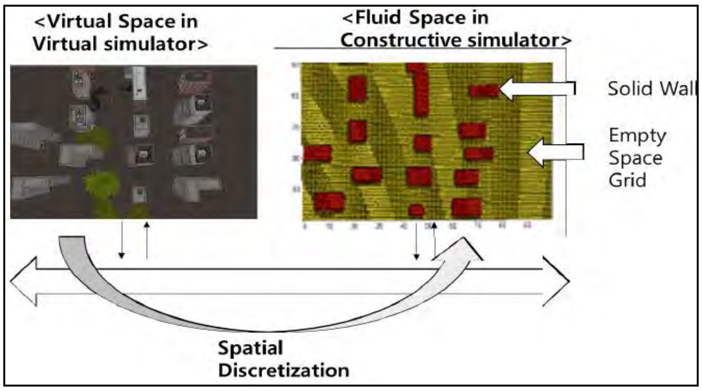

Figure 2. Example of Serious Game - NBC Attack

In 2017, a serious game application was prepared on the evacuation of the injured (Figure 3), which includes various scenarios and allows the training group to be divided into different training groups (Planchona, Vacherb, Combletc, Rabateld, & Darsesb, 2017).

Figure 3. Example of Serious Game - Casualty Evacuation

The software in which such games and applications are prepared are game engines. There are dozens of game engines in the literature today. How to apply the commands, physics rules and graphics processes given in the application is decided by the game engine through the user. Unity game engine was used in this study, but there are studies in the literature that mention the features of other game engines and comparing these game engines.

Which game engine to choose for a created project is a very important issue. In particular, the fact that game engines have different performance, license, price and capacity has created the need to compare these engines. In this context, a study was conducted in 2014 (Pattrasitidecha, 2014). In another study conducted in 2018, game engines were evaluated on visual benefit, integrity, accessibility, multi-platform support and functional utility (Petridis, et al., 2012).

These engines are used not only for application development but also for creating new technologies. As an example, in an open source study carried out in 2014, an application was made to create an object in the area where the user looks (Jangrawa, Johri, Gribetza, & Sajdaa, 2014).

The realistic modeling of the virtual world experienced by the user is an important factor affecting the experience. In this context, there are many three-dimensional modeling programs in the literature. These programs provide the opportunity to transfer the necessary textures on the model in order to prepare the objects in three dimensions and increase the reality.

There are many examples in the literature about three-dimensional modeling. For example, a study conducted in 2016 involving modeling the buildings and the general campus in the Ahmet Necdet Sezer University campus and subsequently transferring the textures on these models in accordance with the reality and placing them in the Google Earth program can be cited as an example. (Tiryakioğlu, Uysal, Erdoğan, Yalçın, & Polat, 2016).

Three dimensional modeling methods contain many different methods in itself. Today, more than 30 different modeling methods can be mentioned (Figure 4). One of them is a modeling with mathematical expressions. The methods that enable the transformation of this model into a product with 3D printers, the creation of complex geometric shapes and the production of low-weight and cost-effective products in a short time are included in the literatüre (Gür, 2017).

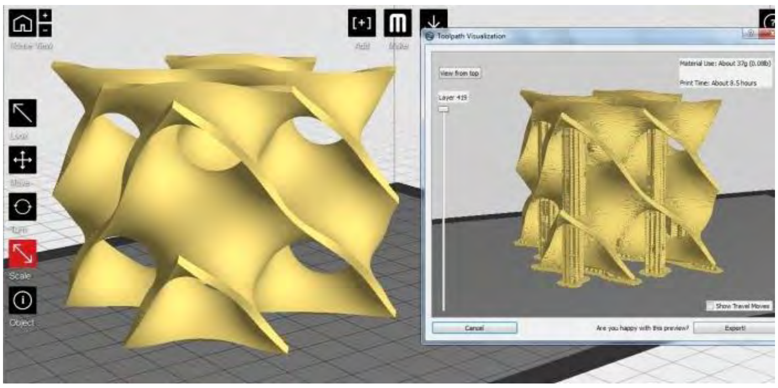

Figure 4. Mathematical 3D Modeling Example

In another application made in 2018 (Figure 5), Unity game engine was used and a virtual drone was prepared and modeling of forest or bushland was provided (Meng, Hu, Lin, Lin, & Teo, 2015).

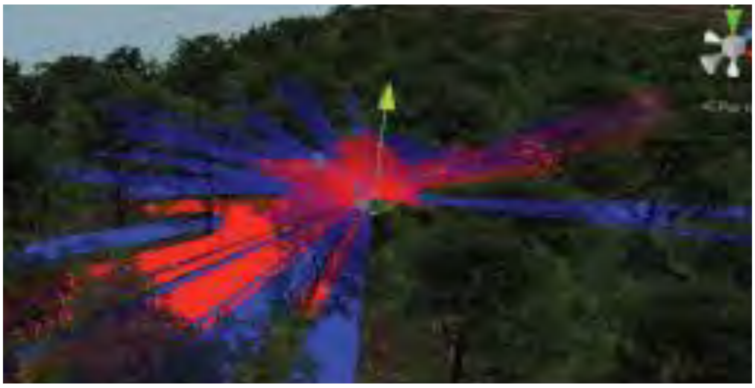

Figure 5. Modeling Complex Areas such as Forest

There are applications that make 3D modeling by using photos instead of modeling programs. In a study conducted in 2009, photographs of the battlefield were taken and a decision support system was created to help the commander by modeling enemy conditions and terrain through these photographs. (Koyuncu & Bostancı, 2009) (Figure 6).

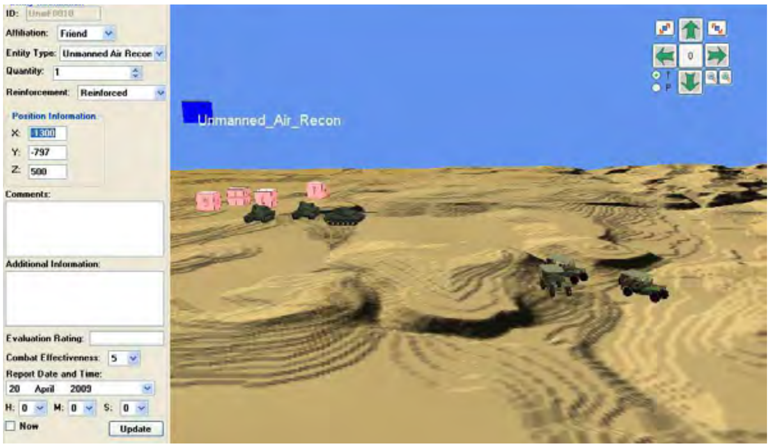

Figure 6. Battlefield Modeling with Photography

The significance of the Study

The main features that distinguish this study from other studies; modeling the real life problem, transferring the experiences gained in the battlefield to the model and using this model in training.

MATERIAL AND METHOD

In order for an application to be prepared for the fight against improvised explosive devices (IED) to be useful and realistic, it is necessary to determine the correct variables, to prepare a realistic serious game and to create an intervention model that can be used in combating IED. For this reason, it is considered that it would be beneficial to provide information about the process of fighting against IED and the concepts of serious play and the preparation process of the serious game.

Fight Against Improvised Explosive Devices

Improvised Explosive Devices, as the name suggests, do not have any standardization and are explosives prepared with materials seized by terrorist elements. Due to the fact that these explosives do not have a certain shape or scheme, it is very difficult to detect and neutralize them and is a very important problem for security elements.

These explosives generally consist of elements such as initiator device, explosive material, container and energy source. Mine detectors are one of the basic equipment used to detect such explosives. Generally, these mine detectors are sensitive to metal and try to find the metal content in the explosive substance. In this study, a mine detector will be modeled in three dimensions and this will create a model of the mine detector signals from the surrounding metals.

Serious Gaming Concept

Combating IED is a very dangerous and serious issue. It is very important that the personnel who will intervene with these explosives, or who will search for or contact these explosives in the field, receive a very good and detailed training.

Although detailed trainings are given to the units specified by various institutions, the need for these trainings to be realistic, to be based on different scenarios and to use real explosives during the training are risky and costly elements. For this reason, it is necessary to update the specified training with the developing technology and to motivate the personnel in this context. From this perspective, the concept of serious play can be significantly useful. One of the main features that distinguish serious games from digital games is that the field of interest has a real-life equivalent and the training of this field is difficult, costly or dangerous.

A few examples of serious games are still prepared using national resources in this context, the Republic of Turkey are as follows (Ciddi Oyun Kataloğu, 2018);

- Hostage Negotiation
- Fighting IEDs in Land Operation
- System Engineering Education
- Protection Education
- Strategic Communication and Information Operations War Game
- Press Conference Simulation
- Cost Analysis Training
- Integrated Logistics Support Training
- Close Protection Training
- Policy Development Decision Networks Training
- Logistics Training
- City of the Future Concept Development Workshop
- Occupational Health and Safety Training
- Foreign Language Practice in Officer Training
- Human Resources Training
- Airline Management Training
- Combat Logistics Education War Game: Cyber Security Serious Game

In this application, it is aimed to prepare a mine detector operator training support material, which aims to enable a personnel using a mine detector to find explosives in the field. The important thing here is that all metallic objects and substances in the field send the signals to the detector correctly and the operator perceives these signals correctly and applies the necessary course of action.

Serious Game Preparation Process

The preparation of a digital game or serious game can be divided into four basic stages. In this context, although much more detailed and different distinctions or divisions are made, four stages can be considered as roughly modeling, coding, using the game engine and making preparations for the relevant platform. First of all, by using 3D modeling programs, the virtual environment and all the objects in the environment and the character or equipment that the user will use must be modeled. In this context, three dimensional modeling programs called Maya or Blender are generally used (Figure 7).

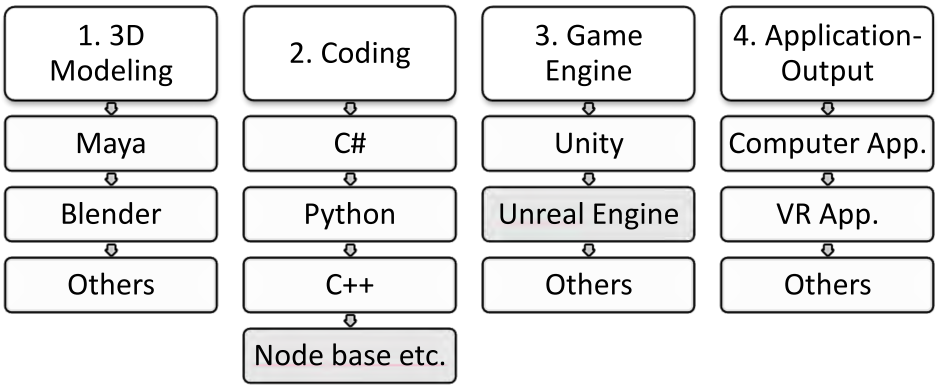

Figure 7. Serious Game Process Simple Representation

Generally, the software language to be used depending on the game engines is determined. For example, if Unity game engine will be used, C #, if Unreal game engine will be used, C ++ software languages should be used. By means of these software languages, the objects on the stage can communicate with each other, the commands from the user can be executed and the whole operation of the game can be controlled and followed.

The game engine associates the created models and the relationships between these models. The game engine also supports the designer in many subjects such as physics rules, how to see the scene and how to get user commands. Arrangements are made on which platform the prepared application will be used. For example, there are many changes that need to be made between a computer application and a mobile phone or augmented reality application. These should be constantly checked and monitored during the design, production and printing stages.

Method

The factors affecting the metallic mine search detectors used by the detector operator are usually the metal content found in the field. In addition, how the operator uses the detector, the position and size of the explosive material and some etc. issues arising from the field affect the incoming signal. In this context, it is considered that the following issues can be included in the signal model.

• Detector Issues: **Search Coil Angle, Model, Sensitivity,**
• Explosive-Related Issues: **Volume, Density, Coating, Position, Rotation, Amount, Distance to Surface,**
• Land Related Issues: **Other metals in the soil, Soil Type, Other Environmental Elements,**
• Operator Related Issues: **Search Area, Horizontal and Vertical Speed.**

THEORY/ CALCULATION

During the preparation of the application, preparation of three-dimensional models, some arrangements made in the game engine and an approach for detecting explosives will be mentioned. In addition, animation, control procedures, environmental conditions, camera settings and other similar issues used in this application will not be discussed in this study.

Three Dimensional Modeling

Different modeling methods were used during modeling. When necessary, the model was prepared manually, in other cases, ready-made models were used. The prepared three-dimensional models should be transferred into the game engine properly. In this study, the operator model, military equipment, surface and explosive materials to be used in person were modeled by hand, and the free downloadable content on the Unity official page and similar content producer pages were used in the preparation of other environmental elements.

Some applications have been made in the modeling of equipment, land, operator, explosives and other elements used in this study. During the modeling of the terrain, the terrain modeling editor of the Unity game engine was used. During the detector operator modeling, a ready-made primary person controller was used. The modeling of explosives and mine detector was done by a three-dimensional modeling program called Blender, and these models were subsequently textured in the program called Substance Painter (Figure 8).

3D Modelling	
Modeling of the Equipment Used	Modeling the mine detector — Blender / Substance painter / Unity
	Mine skewer and marking — Unity assets store / Sketchfab etc.
Modeling of the detector operator	Human model with Fusion
	Riging without Mixamo
	Animating with Mixamo
Modeling the Terrain	Obtaining real height map with Terrainparty
	Editing the map with Photoshop
	Making the height map into a model
	Preparing surface material with Quicksel Mixer
	Editing the land with Terrain Editor
Modeling of explosives	3D modeling with Blender
	Preparing object maps
	Preparation of textures with Substance Painter
Modeling other elements	Free content used

Figure 8. 3-D Modeling

In addition, different programs can be used to transfer texture to the created models. Although it is not used in this application, it is possible to model some objects with Photogrammetry method, which can be used frequently. The steps to be followed during this method were shown in detail in a study conducted in 2017 (Günen, Çoruh, & Beşdok, 2017).

In this study, in the modeling made with the Blender program, a mine detector was prepared and the basic parts of this detector were modeled as a separate object. Then, texture maps of these pieces were prepared. The images of these models in Blender and Substance Painter are as shown in Figure 9.

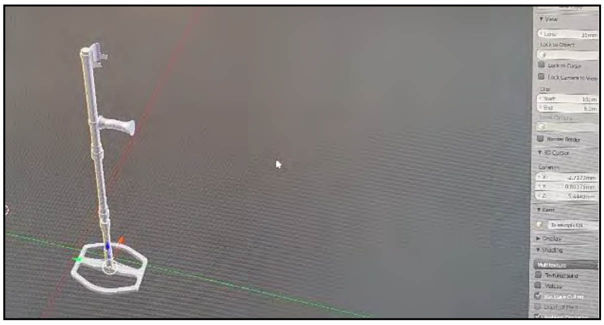

Figure 9. Modeling a Mine Detector with Blender

In addition, different textures were transferred to the models with the help of these programs and how the model would look on the stage was evaluated. In this way, it is aimed to create an object that will provide a more realistic image in the desired field and light conditions. The view of an anti-tank mine during material assignment is given in Figure 10.

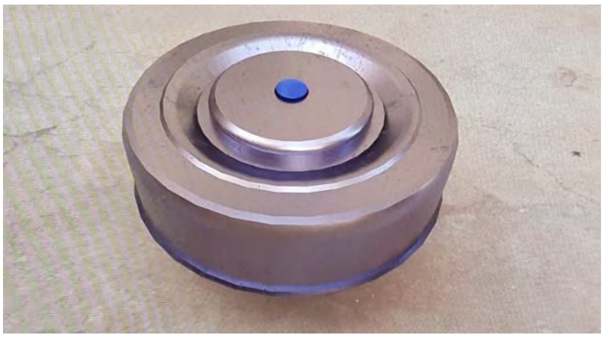

Figure 10. Assigning Material to the Mine Model with Substance Painter

Serious Game Application

There are many stages in the preparation of serious game application in Unity game engine. Before and during this application, models were prepared and transferred to Unity, after the terrain design was made, section designs were made according to the need. Humanoid and simple object animations were prepared with Unity and utilities. The animations have been transformed into infinite state machines through the Animator panel in Unity. The interface that the player will see on the screen has been prepared with the help of the UI panel. In addition, a code fragment has been prepared to ensure that explosives are distributed randomly to the terrain. Details of these parts of the application will not be explained. The application emphasizes on the modeling of the explosive material signal. Finally, the performance and optimization of the application was checked and the output was prepared with the stage manager.

Preparing the User Interface

There are three panels on the main screen of the application that transmit different information to the user. The first is the radar on the upper right of the screen, through this panel the user can see his / her location in the field. The second panel is the signal indicator of the detector in the lower right corner. In this display, the user can visually notice the signals coming to the detector. In the display named "distance" and "value" in the lower left corner, related calculations are shown. In these calculations, the distance between the tip of the detector search coil and the explosive substance center point is measured and converted into a numerical value (Figure 11).

Figure 11. User Interface

Method Used to Detect Explosives with a Detector

It is very important that this application, which is planned to be used by detector operators, sends a correct and realistic signal to the operator. In this context, the signal and the factors affecting the signal must be modeled correctly. In this application, the elements in the field, the explosive substance, the detector operator and the attributes originating from the detector itself were added to the model and the elements affecting the signal model are shown in Figure 12.

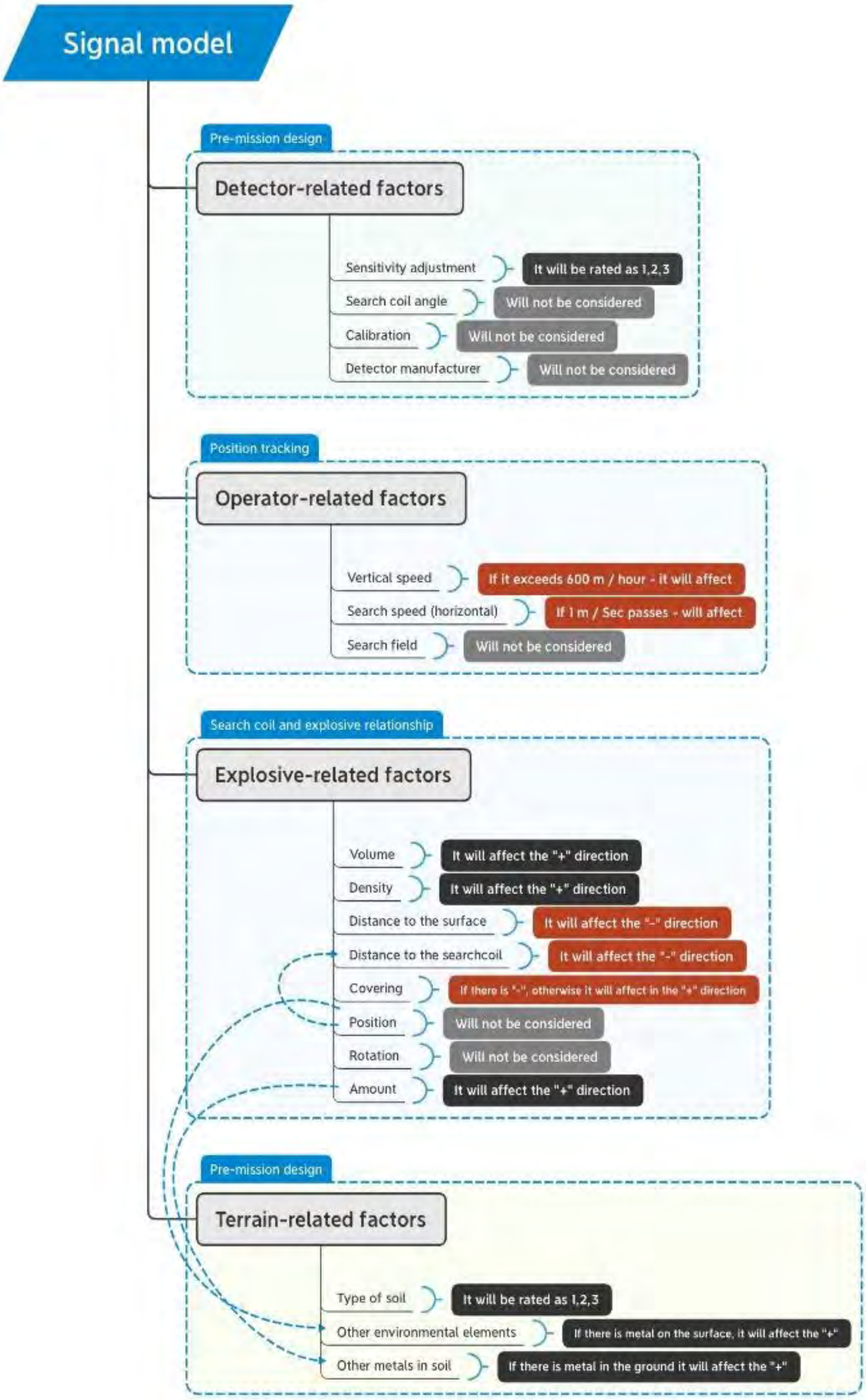

Figure 12. Signal Model Elements

1. Detector-related Factors: While modeling the factors related to the detector, variables such as device model, sensitivity setting, search coil angle, calibration and brand can be included in the evaluation. However, in this study, factors other than the sensitivity setting was considered constant (Figure 13).


```
void sensitivityAmount(int sensitivity)
{
    if (sensitivity == 1)
    { sensitivityCollider.radius = 0.5f; }
    else if (sensitivity == 2)
    { sensitivityCollider.radius = 0.75f; }
    else if (sensitivity == 3)
    { sensitivityCollider.radius = 1.0f; }
    //else if (true)
    //{ sensitivityCollider.radius = 1.0f; }
}
void Distance()
{  distance = Vector3.Distance(metal.transform.position,
    search_coil.transform.position);
    if (distance < 0.3f)
    {
        distancetext.color = Color.red;
        sinyal.Play();
            }
    else
    distancetext.color = Color.white;
    sinyal.volume = 1 / (1 + (distance * distance));
    distancetext.text = ("distance = " +
        ((1 / (1 + (distance * distance)))).ToString());
    slider.value = (1 / (distance * distance));
```

Figure 13. C # Code of Sensitivity Setting

In this way, the sensitivity level of the detector is increased with the values 1, 2 or 3 to be entered by the user. In order to achieve this, in the "Start" phase of the application, the collider of the search coil was accessed from the lower parts of the detector and the radius of this part was changed (Figure 14).

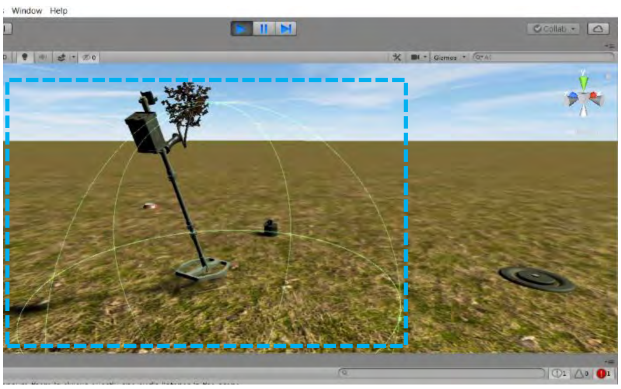

Figure 14. Expansion of the Search Area with Sensitivity Adjustment

2. Explosive-Related Factors: While calculating the effect of explosives placed on the field or on the stage on the signal; Factors such as explosive material volume, distance to the surface, density, distance of the search coil to the surface, current position and rotation, whether the explosive substance has been covered and the amount were evaluated. However, since some of the factors stated above directly or directly affect the other data in the model, position and rotation data are not included in the calculation. In this calculation, the dimensions of the object were used when calculating the volume, the type of metal it was taken into account when calculating the density, and the distance between these two points was continuously followed while calculating the distance between the search coil and the explosive substance. The amount of explosive material and whether there is a coating or not are positively added to the model (Figure 15).

```
void Start()
{
    var volumee = GetComponent<Transform>();
    float volumex = volumee.transform.localScale.x;
    float volumey = volumee.transform.localScale.y;
    float volumez = volumee.transform.localScale.z;
    volume = volumex * volumey * volumez;

    string[] metalnames = new string[5];
    metalnames[0] = "iron";
    metalnames[1] = "steel";
    metalnames[2] = "copper";
    metalnames[3] = "aluminum";
    metalnames[4] = "tin";

    int density_amount = Random.Range(0, metalnames.Length);
    yogunluk = metalnames[density_amount];
```

Figure 15. Determination of Volume and Density C # Code

For this purpose, the "Transform" property of the object was obtained in the volume calculation and the X, Y and Z values were taken. The object is evaluated as a simple geometric object and its volume has been calculated. A random model was created to determine the type of metal in the explosive substance and a density factor was calculated. In addition, the difference of position information was followed in the "Update" section of the code for continuous tracking of the explosive material's surface and the distance of the detector to the search coil.

3. Land-Related Factors: In the calculation of the variables related to the land, the effects of metallic elements in the soil, the soil type and the environmental elements above the soil on the search and signal were calculated. Metallic values calculated for these three elements affect the sensitivity of the search (Figure 16).

```
void Start()
{
    string[] soil_types = new string[3];
    soil_types[0] = "Çernezyom_Erzurum_Kars_1,44";
    soil_types[1] = "Terra-Rossa_BatıAnadolu_Akdeniz_1,87"
    soil_types[2] = "Step_İçAnadolu_1,19";

    int rndToprak = Random.Range(0, soil_types.Length);
    soil_type = soil_types[rndToprak];

}
```
Figure 16. Soil Types Code

Examples of the types of soil easily seen in determining soil types are given Turkey. In this context, "Terra-Rossa" from the Western Anatolia Region, "Çernezyom" from the Erzurum Kars Region and "Step" type soils from the Central Anatolia Region were designated as a "Collider" and a game object was added to the application (Figure 17).

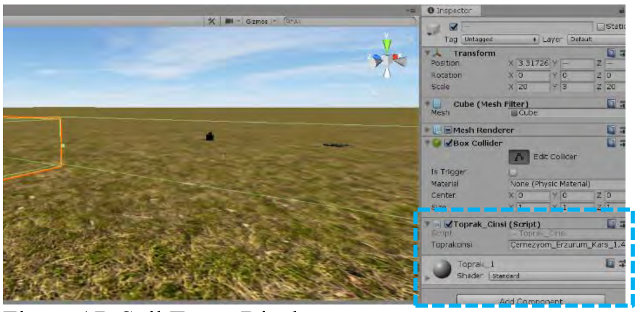

Figure 17. Soil Types Display

4. Operator-Related Factors: The horizontal and vertical speed of the search coil is monitored among the variables related to the operator. For this purpose, the velocity of the vertical and the horizontal search speed should not exceed certain limits. Also, the empty spaces between the search area caused by progress and search speed were not taken into account during the model.

In determining the vertical speed of the detector operator and the detector horizontally, the "Transform" feature of the user was reached and position information was used. A system error alert is returned if the specified speed limits are exceeded (Figure 18).

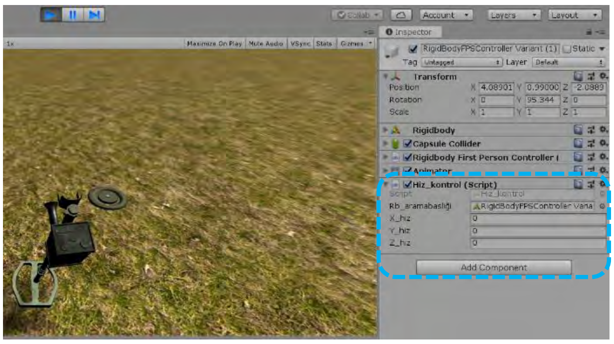

Figure 18. Detecting the Operator's Speed

Model Used in Signal Intervention

Different approaches can be taken in different defense units in response to the signal coming from the detector. In this study, a useful and generic model was created and associated with reality and presented in Appendix A. First of all, the signal should be transmitted by the mine detector to the detector operator making the search. According to the flow chart, if there is a signal, the center point of the signal must be determined. The area around this point should be carefully checked against other explosives and signs. With suspicion of the signal, the detector operator must put the director on the ground and sit on his knees, digging into the explosive starting from a sufficient distance with his hand or auxiliary equipment.

During the digging process, the movements should be extremely slow and precise. It should be kept in mind that any sudden or careless movement can cause an accident. If an object that is considered to be explosive is reached as a result of digging, this object must be destroyed without moving from its location. For this reason, the destructive material is prepared and placed at the appropriate point of the explosive. Subsequently, search units are withdrawn to a safe point. However, this point should also be searched carefully. The explosive is destroyed by taking necessary safety precautions as a result of searching the back zone. If all these operations are done correctly and in order, the task is considered to be completed.

Profiler and Optimization

It is very important that the prepared application performs at an appropriate rate as well as working in a realistic and correct way. In this context, there is a panel called Profiler in Unity game engine. With the help of this panel, the staff who prepares the application can monitor the background processes at any time of the application and can monitor the load these processes bring to the system with the hardware. Especially high resolution, unnecessary loops, image processing and tasks calculated for each frame can overload the system. It is important to use this panel to monitor the amount of load of the system and to distribute the load at the optimal rate. The picture below shows the Profiler panel in Unity, it has been observed that the application works at the desired level and between 100 and 200 frames / frame per second (Figure 19).

Figure 19. Control of a Point in Profiler

RESULTS AND DISCUSSIONS OF THE APPLICATION

With the developing technology, it is very important to train defense elements against enemy elements in a beneficial and cost-effective way. It should be evaluated whether the serious game application prepared for this purpose meets the need and whether it will benefit the personnel who will use the application.

Analysis of Needs

Nowadays, there are some applications to intervene and detect explosive substances. However, these applications are generally far from fulfilling the duties and responsibilities of the elements performing their duties in the field. There is a need for applications that are particularly useful in solving the scenarios faced by the personnel in charge and that can support the personnel in determining their behavior.

In this context, executed by the elements responsible for searching and destroying mines and handmade explosives; It is aimed to meet the need for a safe and cost-effective serious game project that can be used in missions such as search in residential areas, search in the base area, search on the road and in cross-border operations and can contribute to the training of these personnel. In this context, it considers that serious game practice will meet the need in this field at a basic level.

Evaluation of Serious Gaming Application

While preparing the serious game application, two models were prepared in the application regarding the explosive intervention and detector signal. In this context, the duties of the elements faced with explosives in the field were evaluated. In order to model the detector's signal in the application, how the operators move in the field, how the explosives will be represented in the application and how the field conditions factors affect the received signal are designed. It has been tried to model which course of actions should be applied by the detector operator against the received signal.

As explained in the practice, intervention to explosives is a sensitive process that requires high attention and successive movements. With the exact execution of this process, the explosive substance can be destroyed. However, as a result of an erroneous move, an explosive material detonates and harms the operator. After this application, all errors made during the intervention process can be detected. It is also considered that it would be beneficial to make an evaluation on how this application will contribute to education.

CONCLUSIONS

In this study, the needs of the teams searching for explosives were evaluated and a signal model was prepared for the detector operator for a serious game application planned to be created within the scope of the needs. In addition, during the implementation of this model, an explosive response flow chart that can be used for control purposes has been created. In the creation of this model, the criteria originating from the operator, the detector, the field and the explosive substance were evaluated. In this way, teams that search for explosives will be able to train in a more realistic environment in virtual environments to be created during their training.

In this way, the activities of the personnel in similar dangerous tasks will be modeled, training can be contributed, and possible accidents can be prevented. In addition, it is considered that with the proliferation of similar applications, similar technologies in the sector can reach more users by cheaper.

In the continuation of this study, it is considered that it will be beneficial to prepare new applications including different scenarios. It is considered that the creation of scenarios that will meet the tasks of the searchers and the applications that can perform these searches online in the integrity of the team will be beneficial in developing the union training rather than individual training.

In future studies, it will be beneficial to try more realistic technologies that can motivate the user more by using virtual reality, augmented and mixed reality glasses and equipment other than the computer platform. In addition, it will be very beneficial to prepare sample applications (ambush activity, counter-ambush, vehicle and weapon simulators, city wars, maintenance and repair) to meet the needs of defense units.

Ethics and Consent: Ethics committee approval is not required as it does not involve clinical researches on humans as well as it does not contain Retrospective studies in accordance with the Law on Protection of Personal Data.

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APPENDIX A: Signal Intervention Model