SILVESTERMOB – A GAME FOR LEARNING GEOGRAPHY WITH MOBILE PHONES

Erisvaldo G. Saraiva Júnior[1], Liliane S. Machado[2], Paulo R. de Oliveira Rosa[3], Ronei M. Moraes[4]

Abstract — The exploration of mobility allow teachers to expand educational resources and transcend the classroom environment. Besides, the use of games for learning can provide additional motivation for students. SilvesterMob is an educational game for mobile phones that intends to help students to consolidate Geography concepts. The game is being developed for children around twelve years old. It consists on a RPG with several challenges that explore concepts as cardinal and intermediate points, limit, density, among others. In order to help an ET to return home, the player must use the concepts to find pieces of his spaceship. The paper presents the game design and the results already obtained.

Index Terms — SilvesterMob, Educational games, Mobile games, Geography learning.

INTRODUCTION

Educational games are learning activities in which the learner becomes an active participant in the discovery process [1]. They are important since they affect cognitive functions, motivation and curiosity of the student. However, to ensure that educational games can achieve their goals, they need to present attractive plots [2]. Thus, the main goal of the teaching process is the significant learning, which means that the learning material should make sense for the student. This happens when a new information is based on relevant concepts of student's cognitive structure [3].

Mayo [4] shows that there are several advantages of using an educational game. A game can motivate the students for learning the concepts, facilitate their comprehension, help students to make decisions, help teachers to diagnose common mistakes and difficulties of students.

Educational Games are meticulously prepared to entertain students at the same time they explore specific contents, concepts and skills embedded in the game [5]. The script is one of the most important documents to the success of an electronic game, as the design, history and weft are at this stage [6]. Commonly, the games adopt an instructional approach in which the player performs an activity integrated to a subject [7]. They are also adapted

and developed to explore the resources of the chosen platform for their implementation.

Since the end of the twenty century, mobile devices presented a fast progress related to processing power, storage and connectivity. Then, more modern software began to be embedded in such devices which allowed to the software industry to develop more powerful applications [8]. Nowadays, the mobile games have become more complex and already support multiplayer, three-dimensional graphics and high quality sounds. New researches indicate mobile technologies can be an effective tool to bring students to the digital age [9].

The SilvesterMob is inserted in the context of educational games and explore the mobility of the cell phones. It provides to the student the learning of Geography in a fun way. The idea is that the student can reinforce the concepts learned in classroom, at the time and place he wants to. The target audience of the game are students of the first school years (around twelve years old). However, the game can be played by people of all ages.

SILVESTERMOB

There are several works related to educational or mobile games. The present work intends to join both aspects (educational and mobile) in a single game, obtaining the benefits of the mobility applied to educational purposes.

Techniques that can be applied to enhance game portability for mobile were presented by [10]. In his work it is described how to avoid the occurrence of errors in games developed for mobile phones when the device is changed. In fact, the development of games for such devices is not a novelty. However, an educational approach can demand a completely different conception of the game. With the recent increase of graphics capability of mobile phones, the development of educational games related to 3D concepts can also focus such devices [11].

The SilvesterMob is an educational RPG where the player must help an ET to return home, finding the pieces of his spaceship. For achieving this target, the player will have to answer several questions about geographical concepts. These answers are never provided directly to the player, but the NPCs (Non-player characters) can help

[1] Erisvaldo G. Saraiva Júnior, Universidade Federal da Paraíba, João Pessoa, Brazil, erisvaldojunior@gmail.com
[2] Liliane S. Machado, Universidade Federal da Paraíba, João Pessoa, Brazil, liliane@di.ufpb.br
[3] Paulo R. de Oliveira Rosa, Universidade Federal da Paraíba, João Pessoa, Brazil, labema@geociencias.ufpb.br
[4] Ronei M. Moraes, Universidade Federal da Paraíba, João Pessoa, Brazil, ronei@de.ufpb.br

him giving tips. Thus, the student learns naturally, with no need to memorize the concepts but understanding what actually they mean, in practice.

Geographical Concepts

In contact with teachers from the area of Geography, it was defined a set of concepts that should be addressed by the game. In this group, there are concepts with higher priority of education, called primary concepts. According to [12], they are:

- **Differentiation:** the individual must be able to visually distinguish, if possible, objects around them;
- **Density:** concentration measure of a particular object per unit area;
- **Intensity:** concentration measure of a particular phenomenon per unit time;
- **Distribution:** critical evaluation that should be developed by the individual in relation to the environment;
- **Limit:** outline well-defined region;
- **Threshold:** outline not well-defined region.

However, not only the primary concepts are addressed in this game. Other concepts, such as cardinal directions, swamp, plain and bush are also listed in the game.

DEVELOPMENT

The development process of SilvesterMob is explained in the following way: in a first moment, the development platform J2ME is detailed in the subsequent section. After that, development tools are presented, such as the NetBeans 6.1 and its excellent Game Builder, a RAD tool that allows the developer to visually construct the game design. Then, the focus is on the stages of analysis and design of the game. In this moment, modeling aspects of the game is presented, such as the classes diagram and use cases. The last item will focus the game AI (Artificial Intelligence), explaining how it was implemented to fit the capabilities of mobile devices.

The J2ME Platform

J2ME (Java 2 Micro Edition), also known as *JavaME*, is one of the platforms available for the development of applications for mobile devices. It is a kind of shorter version of J2SE, the standard version of Java, running on a reduced Java Virtual Machine (JVM), named KVM, which demand less resources than the JVM. Figure 1 shows the general architecture of Java, highlighting the J2ME architecture. J2ME is the most used platform on mobile phones. To understand its operation, it is necessary a study on its hierarchy of configurations and

profiles, which allows the differentiation and specialization of the target devices.

There are two basic settings in J2ME: CDC (Connected Device Configuration) and CLDC (Connected Limited Device Configuration) that can be observed at Figure 1. The first is dedicated to devices with higher processing capacity, which allows the presence of resources not available in the most basic configuration, the CLDC. This, therefore, is the standard configuration on mobile phones, pagers and some *PDAs* (Personal Digital Assistant), since those devices may not have high processing power. The CLDC main advantage is that devices don't need to have good hardware to run applications developed under this setting. Once defined the setting, it is time do discuss the profiles context, responsible for determining specific features for the target devices. The profile, together with the configuration, provides an ideal set of *APIs* for developing the application for the device in evidence. Thus, when developing applications for mobile phones, it is common to use CLDC configuration (version 1.0 or 1.1) and MIDP (Mobile Information Device Profile), in its version 1.0, 2.0 or the recent 2.1 version, which has support for *OpenGL* ES, allowing the creation of 3D Games. [13].

MIDP 1.0 is compatible with most of all active phones in world, but is restricted when compared to the version 2.0, specially with regard to the existence of specific components for creating games and multimedia applications. Thus, it was concluded that the best choice for developing this game would be the use of J2ME under the CLDC 1.1 configuration and MIDP 2.0 profile, which is very common on mobile phones nowadays. These features are contained in packages that did not exist in the first version of the profile, such as the *javax.microedition.lcdui.game*, which brings a lot of facilities for game development.
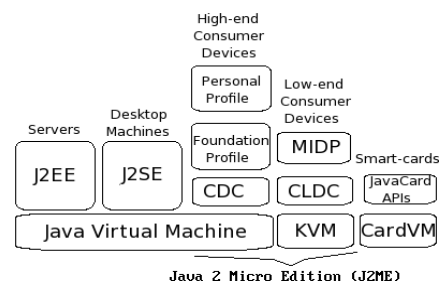

FIGURE. 1
JAVA ARCHITECTURE.

Development Tools

SilvesterMob was developed with NetBeans environment, together with its add-on NetBeans Mobility Pack and the Wireless Toolkit 2.5.2, tools of Sun Microsystems. The *Netbeans Mobility Pack* is an add-on to the *Netbeans* IDE

that intends to facilitate the development of applications for mobile devices. It offers support for both the CDC and CLDC configurations, and support the main profiles in its most varied versions. Meanwhile, the interest is in the support provided by the add-on to the CLDC 1.1 and MIDP 2.0, which is the configuration and profile used in the development of this project, respectively.

Among the many resources available in add-on, there is an ability to develop the game design through a RAD (Rapid Application Development) tool, the Game Builder, allowing to easily develop the levels and sprites without the necessity of coding. This is very useful for games, and it is the main reason for choosing this environment for developing SilvesterMob. Through GameBuilder, it is possible to visually construct all scenes and sprites of the game. Figure 2 shows the Game Builder Sprite Editor.

FIGURE. 2
GAME BUILDER SPRITE EDITOR.

Analysis and Design of the Game

It is important to note that the game has only few classes due to the fact that mobile programming doesn't allow the excessive use of OOP (Object Oriented Programming) because devices have limitations of memory and processing. Then, in many cases it is better to adopt the faster processing solution, which is not necessarily the most elegant, robust and expandable. Thus, as much as possible, the creation of not fundamental entities were avoid as much as the use of more costly OOP resources, such as polymorphism and inheritance.

SilvesterMob, at the present version, has nine classes: *Silvester* (the main class), *SplashScreen, MenuScreen, GameScreen* and *EndScreen* (the view package classes), *Agent, State* and *StateMachine* (the AI package classes), and, finally, the *Persistence* class. *Silvester* is the main class of the game, controlling the game flow and

containing the game loop. The view classes extends from *Canvas* class of J2ME MIDP 1.0, except the *SilvesterGameCanvas* that extends from *GameCanvas* class of J2ME MIDP 2.0, allowing the use of better resources for the game itself. *Agent, State* and *StateMachine* are the classes that implements the intelligence of the game. They're used for controlling all NPC actions. Finally, *Persistence* is a class that keep the data saved in the mobile phone, using the RMS (Record Management Store) package of J2ME API. Figure 3 shows the SilvesterMob's classes diagram.
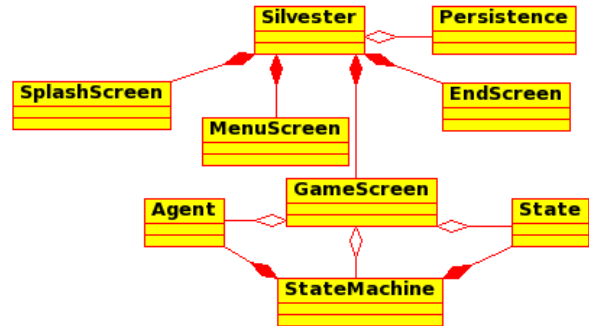

FIGURE. 3
SILVESTERMOB'S CLASSES DIAGRAM.

THE GAME

The game has four areas, as shown in Figure 4. To finish the game, the player must explore all areas, some of them more than one time. Each area has it own missions and they are often related to other areas. This makes the game more interesting, increasing its longevity and its challenge's level. The four areas of the game are:
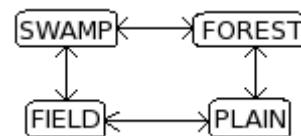

FIGURE. 4
AREAS OF THE GAME AND THE TRANSITIONS BETWEEN THEM.

- **Field:** a field refers generally to an area of land enclosed or otherwise which could be used for agricultural purposes;
- **Plain:** a plain is an area of land with relatively low relief – meaning that it is flat. Prairies are types of plains, and the archetype of plains is often thought of as a grassland, but plains in their natural state may also be covered in shrublands, woodland and forest;
- **Forest:** there are many definitions of a forest. But, what is common to all of them is that a forest is an area with a high density of trees;

- **Swamp:** a swamp is a wetland featuring temporary or permanent inundation of large areas of land, by shallow bodies of water.

Results

The player starts in the Field. In this area, he has to go fishing, sell the fishes and buy a pickaxe. With the pickaxe, he will be able to find a spaceship piece and also change five stones for a sword. After giving the sword for the bridge guardian, the ET will be able to go to the Plain. The Figure 5 shows the Field in which the points labeled from A to H correspond to places, things and NPCs that the ET will interact to. In A there is a store where the player can sell his fishes and also get an important tip about the localization of a piece of his spaceship (C). The direction is indicated by a NPC using the concept of cardinal points. B represents a NPC that says where exactly is the piece, but the place is indicated using the limit concept. D and E are stores, F and G are other NPCs and, finally, H is the fishing rod.
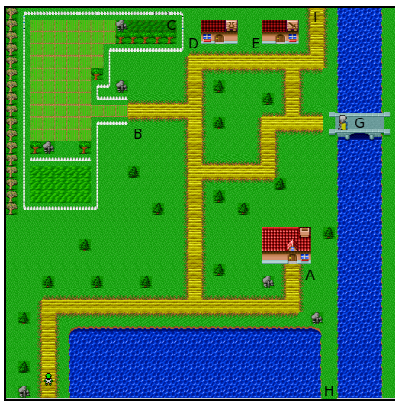

FIGURE. 5
THE FIELD.

The second area of the game is the Plain. There, the player has to find a pair of boots and then go back to the Field and give it to a NPC to get access to the Swamp. The Figure 6 shows the Plain, where A is a NPC that asks what the geographical concept threshold is. If the player choose the wrong answer, the NPC gives him another chance and gives a tip to him. A second error results in game over. Otherwise, if he choose the right answer, the NPC tells him where the pair of boots is (C), using cardinal points. B is another NPC that helps the player telling where he can find another piece of his spaceship.

The third area of the game is the Swamp. It is the most exciting area because there are several monsters in there. The player has to find a piece of the spaceship, defeat some monsters until he gets an axe and then he should give the axe to the SwampMan. After receiving the axe, the SwampMan will allow the ET pass to the Forest.
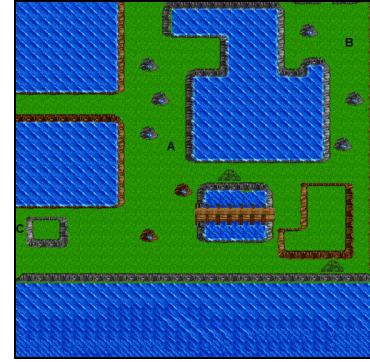

FIGURE. 6
THE PLAIN.

The Figure 7 shows the Swamp where A is a NPC that asks what a Swamp is. As in the other challenges, if the player choose the wrong answer, he will receive a tip and another chance. Otherwise, the NPC tells him where is the piece of the spaceship. In B, the NPC asks about the geographical concept intensity. If the player's answer is correct, the NPC tells him how to get an axe. C is the piece of the spaceship and D is a NPC that will allow the ET pass to the Forest if the ET gives him an axe.

FIGURE. 7
THE SWAMP.

The fourth and last area of the game is the Forest and in there has monsters too. It is divided in two parts: the left one, accessible only by the Swamp, and the right one, accessible only by the Plain. In the Forest, the player has to find a piece of the spaceship and buy another, the last one, from a local store. To get enough money for buying the piece, the player will have to defeat many monsters, distributed in all the area. The Figure 8 shows the Forest, divided in two parts and it is possible to see the two parts of the forest, indicated by the numbers 1 and 2. In the second part, A is a NPC that asks what density is. If the player choose the right answer, the NPC tells him where

is a piece of the spaceship (F), using cardinal points. In the first part, there are some monsters. B is a NPC that asks the player information about bushes. If the player answers correctly, the NPC gives him important information about how to get the last piece of the spaceship. E is another NPC that also give tips about the piece. C is a store where the player can buy important items for surviving in the Forest. Finally, D is a store where rare items are sold, including the last piece of the spaceship. It is very expensive. If the player buys this piece, and has all others, then he finished the game.

FIGURE. 8
THE FOREST.

The final result achieved is the educational RPG with enjoyable elements like cash, items, monsters and others that make the game fun. Figure 9 shows the game running at Sun Java Wireless Toolkit 2.5.2, but it was also tested on several devices with successful portability.

FIGURE. 9
SILVESTERMOB FIELD AREA.

CONCLUSION AND FUTURE WORKS

The game presented in this paper focused on entertaining the player as much as possible, so that the educational content could be transmitted slightly. This is the most important factor in an educational game, which should never lose its playful aspect, because this is what motivates the players.

The version of SilvesterMob presented here is not the final one. There are much more stuff that can be added to it: an efficient battle system, minor puzzles and addition of items that ET can use for several purposes like running faster, swimming and so on.

The main objective of this work was achieved: the construction of a learning method to be used by the teachers in schools, as an interesting tool for helping the children to learn geographical contents.

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