Paving the Way for the Successful Development of Mobile Phone Games using Java ME

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Abstract: The aim of this paper was to develop an Action Adventure Game with AI (Computer Operated Player) for mobile devices. It is a 2D top view single player game where the main character has to roam around and complete the objectives of the game. The main objectives are to find a weapon to be able to attack, collect the different artifacts scattered across the map, kill the computer operated players, and most of all stay alive until all has been completed. The game features four directional movements of computer/human players, an attack mechanism, a method of collecting artifacts, score and health counters, and independent interactivity of the computer player. The goal is to provide entertainment on mobile devices which have become important tool in today's society. Almost every adult and many children own a mobile device and most of them are equipped with the Java ME environment. The game was achieved using Java ME IDE applications such as Net Beans, Eclipse Mobile Tools for Java and the Java ME Wireless Toolkit. Texture and sprites were created and modified using Adobe Photoshop CS2. An incremental software process model was used to develop the game and all the game specifications have been successfully met. However on a higher level, the game could have been taken further to a multiplayer level via the Bluetooth technology. It could also have been created using the new 3D Graphics API for mobile devices. This paper will help game developers to have a solid foundation in Java ME so that they can develop exciting and innovative games using the currently available technologies.

Keywords: games; mobile phones; Java ME; Artificial Intelligence; 2D graphics

I. INTRODUCTION

A. Games

A Game is a way to provide entertainment or amusement. It is an effective way to relax and reduce stress. It can also turn into a competition where players play against each other respecting a specific set of rules or protocols. Some games may not require any equipment to be played whereas other may require equipment in order to play it. In all games there are winners/losers. Games can be based on points system where the one who scores most points in a certain period of time wins. It can also be a knockout. For example in a race the winner is qualified for the next race whereas the loser is disqualified [1].

B. Video Games

A video game is an interactive game which is controlled by electronic devices. The machines or "platforms" on which games are played are personal computers, arcade consoles, video consoles connected to home television sets, and handheld devices. The term *video game* can be used to represent the totality of these formats. Nowadays there are several video game platforms available and they have greatly improved since the first games [2].

C. Mobile Games

A mobile game is a video game played on a mobile phone, Smartphone, PDA, handheld computer or portable media player. This excludes games played on handheld devices such as PlayStation Portable, GameBoy or Nintendo DS. The first game that was created for mobile phones was known as Snake. And it was only found on selected Nokia Phone models in 1997. Snake had become very popular since its creation and it

was available freely as it was pre-installed on the phone itself. It became the most-played videogame since it could be played on the go. Over a billion people have played this game around the world. Nowadays, cell phones' games have greatly improved since mobile phones themselves have also been upgraded allowing the use of new features. Their graphics are almost the same as the ones you will find on a 4th or 5th generation game console. This may not look like a big upgrade but it is however considered a great improvement as the game is played on a cell phone which has a lot of restriction such as processing power, battery life, memory size and display constraint. Mobile games have a tendency to be small in size and are more based on good gameplay rather than having better graphics.

II. MOBILE DEVELOPMENT PLATFORMS

There exist several types of platforms that can be used to develop mobile phone games. Many of these platforms was looked into to find a suitable one. The platform needs to meet the minimum requirements for the game. The platform that we will consider for the game is Java ME. It was previously known as J2ME.

A. Java ME

Java ME can be described as the most ubiquitous platform that exists for mobile products. It offers a robust and flexible environment that allows application to run smoothly on mobile or embedded devices. These devices include phones, PDAs, printers, Set-up boxes for TVs. It also has built in network protocols, good security and good user interfaces. Applications built on Java ME can be used on different devices but its performance depends on the device's capabilities [4]. Sun's

version of Java targets devices with limited hardware capabilities. It is mostly aimed at portable devices with low amount of memory such as 128KB of RAM. It also targets devices with low processing power rather than processors used on standard desktop PCs or server computers [7]. Java ME consists of a set of profiles. Each profile is created for a specific type of device and contains a minimum set of class libraries that the device requires. It also has specification for the Java Virtual Machine required to support the device. The virtual machine in a profile might not be the same as the virtual machine used in Java 2 Standard Edition (J2SE) and Java 2 Enterprise Edition (J2EE). A profile just defines the specification. Profiles are implemented with a configuration. A configuration is an implementation of a profile designed for a specific type of portable device such as a mobile phone. There are two main types of configurations that are available:
1. Connected Device Configuration (CDC)
2. Connected Limited Device Configuration (CLDC)

However each profile defines a particular set of Java class libraries. So it is not possible to take a Java program designed for one profile and try to run it on a device that does not support the same profile. Applications can only run using the Java classes present in the Java class library that is available in the target device's profile [3].

B. J2ME Components and Architecture

Connected Limited Device Configuration (CLDC) is designed for small wireless devices with around 160KB or more and for devices with 16/32-bit processors. CLDC virtual machines are limited and are not able to support all J2SE standard libraries.

Connected Device Configuration (CDC) is designed for slightly more powerful wireless devices with a minimum of 2MB of memory and 32-bit processors. CDC can support a fully featured Java 2 VM and as a result supports most of J2SE libraries.

Mobile Information Device Profile (MIDP) and PDA profiles are based on CLDC and are designed for mobile phones and PDAs.

The Foundation Profile is based on the CDC and provides more utility, network, and security functions for embedded devices, but no GUIs.

The Personal Profile is found on top of CDC and Foundation profiles. It provides J2SE Abstract Windowing Toolkit (AWT)-compatible GUI APIs for high-end PDAs and wireless Internet appliances [4].

C. Limitations of Mobile Phones

Mobile phones were designed to facilitate communication among people mostly businessmen who had to move all the time but needed a way to communicate with their company or associates. The first mobile phone to be released commercially by Ericsson in 1956 was called MTA (Mobile Telephone System A). It was the first mobile phone but its disadvantage was that it weighted 40 kg! Since then mobile phones have greatly evolved. Mobile phones are now a vital communication tool both socially and for business. Nowadays it is not only used for basic communication but also as an entertainment device. Mobile phones now can be used as a portable music player or for internet browsing, video viewing, for taking snapshots and of course for gaming.

The basic limitation that we need to consider when creating mobile games is the phone's lack of memory. So in order to overcome this we need to compress images and reduce their

file size. This also helps in terms of processing power as it takes less processing power to run the games if the images/textures are small. We also have to consider the battery life time of the phone so that it does not use up all of the phones battery when running a game [5].

So to sum up, the limitations of mobile phones is as follows:
   Limited Memory Space
   Small Processing Power
   Battery Life is constrained
       Screen size is limited and varies for different
       mobile phones

III. BACKGROUND STUDY

A. Platform Games

The **platform game** or **platformer** is a type of video game that has action features such as jumping on platforms or jumping over obstacles. There must be a way to control these jumps and the character should be able to fall from platforms or miss jumps. The most vital element of a platform game is the ability to jump. There are also other ways to perform different styles of jumps such as swinging from extendable arms or ropes etc. The first platform game was created in the early 1980s, and later 3D games reached the market in the mid-1990s. The term platform itself describes the game where jumping on platforms is an integral part of the gameplay. But, it does not limit itself to this and is very commonly mixed with features of other types of games, such as the shooting features in ***Contra*** or the adventure elements of ***Flashback***. Platformers became the most famous genre of video game for a certain time. Since 2006, the platformer lost a bit of its popularity.

B. Top View Games

Topview games are games where the angle at which the game is played is from the top. A terrain/map is designed where the character can roam around and complete the quests/objectives. Earlier topview video games were mostly only board games such as Chess or Checkers game. Nowadays most topview games are known as Real Time Strategy (RTS) games.

In an RTS, as in other war games, the participants position and maneuver units and structures under their control to secure areas of the map and/or destroy their opponents' assets. It can also be an Adventure game. An adventure game is a video game in which the player assumes the role of a protagonist in an interactive fiction that is driven by exploration and puzzle-solving instead of physical challenges such as combat. Combining Action and Adventure is where we add combat to an exploration game.

C. CLDC: Lower end devices

CLDC is a J2ME configuration intended for devices with as low as 512 KB memory available for Java environment and its applications. CLDC is for the kilo Virtual Machine (KVM). It is an optimised JVM designed for battery operated devices with 16/32 bit microprocessors and with a memory of around 160 - 512 KB for Java.

The standard memory required for the storage of the KVM and its libraries is approximately 128KB. As for networking, CLDC aims at devices with limited wireless connectivity.

Applications that can run on J2ME CLDC must be able to run on other higher end Java Virtual Machine as long as the libraries are available. Profile layers also contains user

interface definitions specific to devices such as pagers, mobile phones, and PDAs. Mobile Information Device Profile (MIDP) is a J2ME profile that defines the user interface-related specifications for devices using the CLDC configuration.

D. Mobile Information Device Profile

The MIDP profile is a very important component of Java 2 Platform Mobile Edition. MIDP offers a standard Java environment when it is combined with the CLDC. It allows features such as networking, local storage on the CLDC itself and also user interface capabilities.

It is mainly targeted towards mobile phone devices which have limited display and memory. As a result it offers a simple user interface with networking support based on HTTP 1.1. It provides for the main application functionalities needed by mobile applications. It is now widely used as the best platform to run mobile applications [6].

Specifications
MIDP 1.0 (JSR 37)
> The original specification.
> Provides core application functionality required
> by mobile applications.
> Basic user interface and network security.

MIDP 2.0 (JSR 118)
> Revised version of the MIDP 1.0 specification.
> New features that include an improved user interface, multimedia and game functions.
> A more extensive connectivity.
> End-to-end security.
> MIDP 2.0 is backward-compatible with MIDP 1.0.
> Continues to target mobile devices like mobile phones and PDAs.

D. MIDlets

MIDlets are small MIDP applications. It got its name as a continuation of applets and servlets. J2ME optimized servlet APIs are known as MIDlets. The Applications range of MIDlets begins from calendar contact managers to games. MID application is also a term used to describe a MIDlet. Technically it is a group of classes that is designed to run and to be controlled by the application software [7].
The three possible states of a MIDlet are:
> *Paused* - MIDlet is inactive.
> *Active* - MIDlet is active.
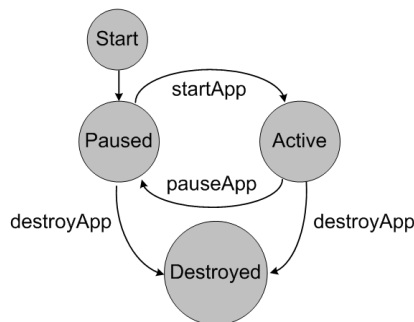> *Destroyed* - MIDlet has been terminated

Figure 1. States of a MIDlet

IV.   THE ACTION ADVENTURE GAME

The action adventure game that we have developed has a top view layout, that is, the angle at which we will be playing is from the top of the map. There is a main character who can move around in a full 4 directional manner. The main quest of the game is to collect the most artifacts and defeat the most AI so as to score more points.

The character will be positioned randomly somewhere on the map and will roam around in search of artifacts and it also has to find the gateway to the next level. On his way he will stumble upon AI bots which will attack him. On the maps there will also be obstacles such as walls and guarded gates which will prevent the character from moving. It will then have to find his way around these obstacles in order to meet its goal.

The game consist of:
Maps where the character can roam around .
A Character that can move in all 4 directions.
AI characters who purpose is to attack.
Health counter for the character .
Score keeping counter.
Artifacts scattered on the Maps for collecting.
Background music & SoundFX.

Screens of a few Maps

A. Desert Storm

Figure 2. Desert Storm Map

Desert Storm map is a 30 (rows) x 50 (cols) tile-wise map set in a desert/forest décor with trees, shrubs, grass, sand and a pyramid.

B. Iceland

Figure 3. Iceland Map

Iceland map is 30 (rows) x 40 (cols) in size and is set in an icy décor with snow terrain, frozen water platforms, with cracking ice and holes.

C. Labyrinth

Labyrinth map is 62 (rows) x 64 (cols) in size and contains many different terrain textures.

The map is divided in 4 quadrants but only one quadrant has the way out of the labyrinth.
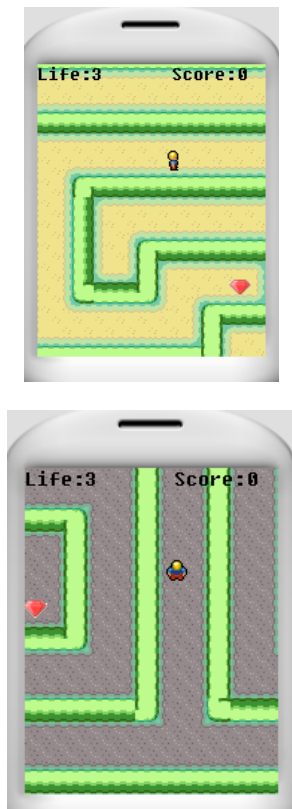

Figure 4. Labyrinth Map

D. Platformer

Platformer map is a 32 (rows) x 20 (cols) in size and is a particularly different map compared to the other ones. It uses 20x20 pixel tiles and is not a top view layout.

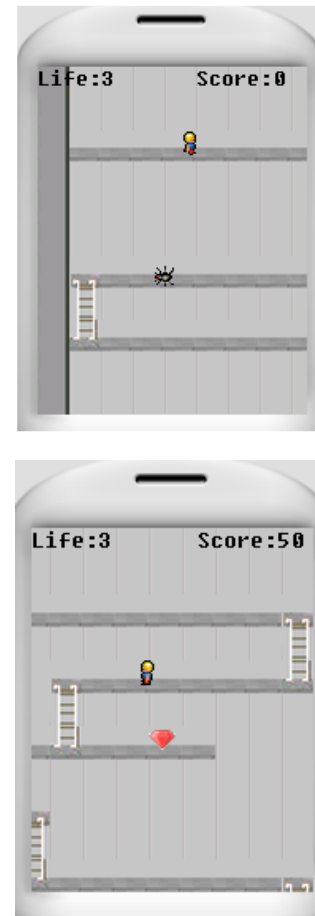The character moves from platform to platform and up/down ladders in order to collect the artifacts.

Figure 5. Platformer

V. CONCLUSION

Since mobile phones have become an important aspect of today's world and also its resources are getting higher every day, providing entertainment on these devices is becoming a must. Most of the mobile devices nowadays use the Java ME environment for application development; it has now become a standard. With further improvements in mobile phone technology, mobile gaming may reach a level that might compete with today's handheld gaming devices. Java ME can also be used for many different applications that can help us in our everyday life and it would be a complete waste not to take advantage of this technology.

A. Difficulties

Creating mobile games can take a lot of time specially when looking for proper textures or sprites which are not always readily available. Some textures had to be created from scratch and it is quite difficult as we have to deal with tiny image with limited colours so a lot of patience is needed.

B. Future Works

a) **Better 2D Graphics**

The 2D graphics used during the development is not top notch. This is due to the lack of availability of free textures or sprites. Nevertheless, some good textures were created using Adobe Photoshop CS2.

b) **3D Graphics**

A specification for 3D application on mobile devices already exist and is known as Mobile 3D Graphics API or MG3. It provides Java ME better capabilities and enables the creation of complex animated 3D scenes. Nowadays, we have several tools that allows us to develop games using the Mobile 3D Graphics API such as M3X, Wizzer Works M3G Viewer, M3GExport for Maya, Mascot Capsule M3G Exporter, Blender Exporter, and Blender Converter Earlier development of 3D applications were limited as development companies used their own specific tools. It would be a great challenge to create an Action Adventure Game using 3D Graphics.

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