Exploring Context-aware Mobile Games

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Abstract. Advances in mobile technologies led to the development of various applications and games for mobile phones. Different types of context data provided by mobile phones have been used while developing different applications especially games for mobile devices. In this paper we introduce a context-aware platform called Gatherer, which is a system level platform for mobile phones that provides contextual information to developers and frees them from the process chain of collecting, preprocessing, storing, and interpreting raw sensor data. With the advantages of this platform we implemented a context-aware mobile game.

Keywords: context, mobile phone, mobile game, mobile game

1 Introduction

Mobile phones as ubiquitous devices have become a widely adapted powerful computing platform with multimedia and network capabilities. The built-in cameras, microphones, and color displays plus different types of sensors such as the GPS and accelerometer offer various options to create sophisticated user interfaces and implement different types of applications such as games. The most popular example is to use the accelerometer sensor data on the phone to control games. Basically, people play mobile games to kill their time [1]. Various projects have looked at mobile gaming but most of them assume a physically very active user, e.g., [2, 4, 5]. The initial experience shows that these are not the mainstream mobile gaming scenarios as most people are not very active physically when playing mobile games [3]. In this research we focus on using context information available on mobile phones to develop games that work everywhere and motivate people to exploit their context. To achieve our goal we implemented a platform called Gatherer, which runs on top of existing infrastructure in a mobile phone. This platform enables the developers to access context information and frees them from developing the whole process chain of collecting raw sensor data, preprocessing, storing, and interpreting data.
2 Gatherer: A platform to support contextual games

Basically, the Gatherer platform is a Python-based application running as a background process (server) on mobile phones and handling the whole process of sensing, preprocessing, storing, interpreting, and formatting context data. This system can be installed and used on mobile phones that include the Python interpreter such as Nokia Symbian phones. In the design stage it was decided to separate the subprocesses of the platform due to ease of maintenance and expansion. Thus, a modular microkernel-like design was chosen for the software architecture. This speeds up the development process and new features can be easily added to the system. The system is divided into four layers: (1) the device abstraction layer, (2) the persistency layer, (3) the context conversion layer, (4) and the formatting layer (see Figure 1).

Fig. 1 The Gatherer platform consists of 4 different layers

Device Abstraction Layer. This layer contains the actual sensing mechanism, which is a simple data pulling from the available sensors on the mobile phones. When no preprocessing is needed, then sensed raw data are written and stored in the database. Otherwise some small computations take place. The supported sensors are the physical sensors such as an accelerometer sensor to capture orientation and movement data, informational sensors like GSM cell IDs, battery level, or nearby Bluetooth enabled devices, computational sensors like statistics on incoming and outgoing SMS and calls. This layer is also responsible for formatting the sensed data in such a way that the persistency layer can store it.

Persistency Layer (database). This layer enables the Gatherer platform to save sensed context data for later retrieval and provides the context history. Though the data is distributed in several tables, the main data type of this platform is a name value tuple. Dey et al. [6] have shown that this is a suitable data type for context-aware applications and that it avoids unnecessary complexity.

Context Conversion Layer. This layer includes all data access methods. It processes all requests from client applications and produces a collection of tuples, which then is passed to the formatting layer.

Formatting Layer. This layer takes a collection of tuples as input and formats the data based on what is specified in the requests. The formats already provided are XML, JSON, and CSV.

On the other side, context-based applications (clients), which want to use the Gatherer platform, should setup a connection to a specific port on the localhost of the mobile phone and send requests. In the requests required context information and data format are specified. Then clients can extract the context information from the
responses. Finally, the clients close the connection in order to let the Gatherer platform know that it can clear the temporary data.

3 ContextInvaders

To explore how the usage of context information in combination with traditional games can change the compelling and fun part of a game experience and in addition to evaluate the Gatherer platform, the ContextInvaders game was developed. ContextInvaders is basically based on the Space Invaders game\(^1\) – one of the first arcade shooting games released in 1978 – which uses the context information to modify the game’s parameters. In the original game the player’s mission is to save the earth from aliens’ invasion by shooting their spaceships with a laser cannon before they reach the earth. However, the aliens also shoot the player. Yet, the player can take cover behind the defense bunkers placed between the player and the aliens.

As the Gatherer platform handles context acquisition, representation, interpretation, we just focused on developing the game. The following information provided by the Gatherer is used in the game logic:

- The average movement, captured by the accelerometer sensor, modifies the player’s movement speed in the game.
- The current GSM cell ID and duration spent in a location influences the number of lives, the number of spaceships, and the number of points the player receives for shooting a spaceship. There are more aliens who are worth more points and the player has fewer lives if the game is played in a GSM cell that was not visited often. In contrast to this, the player has more lives when he plays in a cell he already visited a few times. But as he was defending this cell for several times now, there are less aliens and they are worth only a few points because they are the weak ones that were left behind to try to break through this heavily secured space.
- The current time modifies the background and spaceship’s color to simulate day and night transitions.
- The battery level information changes the amount of the player’s shots. The higher the level is, the more shots are available.
- The duration the player spends in the current GSM cell influences the number of available bunkers. The longer the player stays in one cell the more bunkers are destroyed by the alien invaders.

4 Preliminarily study

The ContextInvaders game was evaluated with ten participants, five males and five females (age range 19-24), who all had a gaming background. The game together with the Gatherer framework was installed on a Nokia N95 and used for the study. The

\(^1\) http://en.wikipedia.org/wiki/Space_Invaders (accessed April 2009)
users played both the classical Space Invaders and ContextInvaders for three days and provided feedback through a questionnaire.

Based on the results, though all users understood the concept and meaning of context-aware games, not everybody was able to find out how the sensed context information changed the game. The main reason might have been the lack of context parameters visualization in the game. Interestingly, just three of the participants stated that this encouraged them to play the game at different locations in order to achieve more scores. This can be partially attributed to the fact that mobile games are mostly played when there is some time to kill between events of interest [14]. The question whether the context enhanced mode was more challenging to play than the normal mode divided the group into half. This is probably the result of the usage of context parameters, which makes the game harder or easier based on the phone’s status. Another important factor can be the different gaming experiences the participants had. Some of the features are only available and more feasible when using the game for a longer period of time and thus going through more of the defined generic situations.

5 Conclusion and Future Work

In this paper we presented Gatherer, a platform for mobile phones that handles the whole process of sensing, preprocessing, storing, interpreting, and formatting context data available on mobile phones. Based on its flexible core and system structure, this platform can be extended easily and run on various mobile OSs. To evaluate the platform a context-based game called ContextInvaders was implemented and evaluated. The game’s logic uses different types of context information provided by the Gatherer to modify its parameters.

For our future work we plan to integrate Gatherer into an infrastructure in order to share context information between users and additionally use this to implement other types of context-based game applications. Furthermore, we plan to investigate the privacy aspect of such games.

References

4. Broll, G., Benford, S. Seamful Design for Location-Based Mobile Games. ICEC’05. 2005