Collaborative Location-Based Mobile Game with Error Detection Algorithm

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Abstract—**In the recent years, there has been an evolution in game input medium. From just using buttons, players can now interact with games through a wider spectrum of inputs which includes touch screen, camera, light sensor, accelerometer, compass and GPS. This is driven by the availability of these modules and sensors within mobile devices that are omnipresent nowadays. As a result, there has been a creative breakthrough on how games are played today where gaming experience can be made more intuitive and immersive. Localization is one of the input medium where the player's physical location is used as part of the gameplay. This paper proposes an original gameplay schema that utilizes indoor mobile Wi-Fi localization technique as game input that does not require additional infrastructure. The game takes advantage of the weakness of Wi-Fi localization where environmental influence is significant and makes it part of the gameplay. A simple error detection algorithm is also introduced to maximize the game playability value by balancing game responsiveness and accuracy level.**

Index Terms—**Game Technology; Wi-Fi Localization; Location-Based Games; Pervasive Games.**

I. INTRODUCTION

Input for mobile games has seen a drastic evolution from just interacting through buttons towards the application of more advanced input modules which includes the accelerometer, compass and camera. This allows greater flexibility in the design, usage and interaction of mobile games and opens up numerous possibilities for innovation. Games could be played more intuitively and improve overall immersion and satisfaction of players [1]. One of the game input medium that had seen an increase of attention from both game developers and players is player location.

Player location is used within these games either to show the movement of a player based on the real world map or to show relative movement on a created virtual space. This is done through the usage of Global Positioning System (GPS) that utilizes signals from four or more satellites that have a clear line of sight of the player. The need to have an unobstructed line of sight had prevented location-based games to be played indoors especially with the presence of high rise buildings, large malls and intricate subway systems that are an important part of major cities nowadays. Thus, there is a motivation to look for an alternative localization system aside GPS that would enable location-based games to be played indoors.

Elaborate researches have been conducted upon components within the current smartphone technologies for potential systems that could enable indoor localization for navigational purposes. Among the methods that are looked upon are Wi-Fi, RFID, Bluetooth, sonar, visual and multi-modal approach [2]. These methods however produce low accuracy output and as a result made navigation harder and more confusing than without using the navigation system [3]. Accuracy can be improved through installing signal transmitters along the pedestrian pathway every few meters as in [4] but this increases the overall cost of using the system and is seen as not feasible.

There are a number of differences between localization for the purpose of navigation and gaming. Localization for navigation requires the location data to be supplied instantaneously, available in all types of pedestrian environment and the navigation process needs to be very accurate [5]. On the other hand, localization requirement for gaming purposes are more relaxed in nature and relied mostly on the gameplay of the game. Therefore, methods that had been explored for indoor navigation can be investigated and adapted towards location-based games. Wi-Fi localization is chosen for the purpose of this research because it is present on most recent smartphones and considerable amount of research work has been done about it.

Playability is a measure for the quality of a game which envelopes its level of easiness to be played and the amount of time that the game is playable. The focus of the discussion in this paper is to measure how easy it would be to produce the location information and how accurate is the location information. Strategies implemented to overcome the shortcomings of Wi-Fi localization to achieve practical gaming experience are outlined. Lastly, a Proof of Concept mobile application is made to demonstrate the potential of the proposed system. Comparison of accuracy is done between location data obtained with and without using the strategies in order to understand its contribution.

II. RELATED WORK

As the idea of using location as game input is categorized as pervasive gaming, related works on pervasive games will be discussed. Current development on location-based games is investigated and techniques that are used in Wi-Fi localization for navigational purposes are also reviewed in this section.

A. Pervasive Games

Pervasive games are a way of gaming where the game is played in both real and virtual world. Games are played not only limited on the computer screen but also involve real world substances [6]. There are various implementations of pervasive games such as using a board game, real world