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Towards Mobile Collaborative Exergaming

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***Abstract*—Today's high calorie diets and low physical activity levels contributes towards childhood obesity. Exergaming, a combination of "exercise" and "gaming" was conceived as a means of addressing this problem. Fundamental to the success of exergaming is to successfully harness conventional mobile computing technologies to deliver platforms for games that are adaptive to the exercise requirements of individual children. This paper presents the design of one such platform that enables gaming to occur in mobile, collaborative contexts.**

***Keywords*-mobile computing, exergaming, pervasive health;**

I. Introduction

In recent years, childhood obesity has become a major problem in many countries. The reasons for obesity include high calorie diet and the serious lack of physical activities in children's daily life. Video games are considered the main reason for physical inactivity [1]. Such games do not need any serious physical effort and they consume time from the young population that could be better spent in physical activities like playing out-doors. Also, these games do not need any collaboration, and the players generally prefer to play them alone, which contributes to antisocial children [2].

The exergaming concept searches for ways to combine exercising and gaming by disguising the tiresome side of working out with the uplifting side of playing to make the exercise process more attractive, not only for the younger population but also for anybody suffering from physical exercise deprivation [3]. Thus, mobile collaborative exergaming forces players to collaborate and communicate with each other, while implicitly encouraging them to increase their physical activity levels while playing but without inducing boredom.

A. Motivation for Exergaming

People that weigh more than their expected weight are termed overweight or obese. According to several researchers obese people have an increased risk for many health conditions and overweight children can more easily become overweight adults [4] [5]. There are approximately 17.6 million children worldwide aged less than five, which are estimated to be overweight. Most of the research about the treatment of obesity recommends an increase in physical activity combined with a controlled low calorie diet [6]. Nutrition researchers at UNC-Chapel Hill [7] surprisingly demonstrated that the lack of physical activity, but not increased energy intake, is also responsible for obesity among youths aged 12-19.

Exergames aim to encourage their players to undertake physical movement during the game play. These moves are combined with the challenges in the game and are also necessary for the game to continue, which motivates the player. Optimistic results about physical activity levels have been demonstrated [8], but all these systems are console dependent. On the other hand, studies [9] [10] show that mobile games are estimated to reach 60 million consumers in 2009 and the mobile collaborative gaming industry is seen as an area with great potential.

B. Related Research

Evidence exists that the incorporation of activity into computer games has potential health benefits. In [23], it has been demonstrated that playing active video games increases energy expenditure in children. However, further research is needed to determine the long term effects on weight and body mass index [21]. In a study that compared perception of exertion and enjoyment between exergaming and standard treadmill exercise, subjects reported a significantly higher rating of enjoyment in the case of exergaming [22].

Realising exergaming in the outside world is an attractive proposition in light of the previous discussion. As a step towards this, the use of mobile and location-aware technologies has been proposed and demonstrated [19] [20] [18]. The potential of these and other prototypes have prompted certain researchers to investigate the underlying frameworks and design principles of exergaming [17] [16]. Research in exertion interfaces is also relevant to this domain [15]. In the case of this paper, the issue of collaboration and how it might be achieved in outdoor contexts is of particular importance.

II. Lutfen - Game Strategy

Lutfen is designed to be played in the campus of University Collage Dublin (UCD). At present, it is a standalone game. Zones and routes are defined, and the player is encouraged to move between the different zones.

A. System Architecture and Design

The two key components are the Lutfen Game Server (LGS) on the network, and the Lutfen Mobile Application

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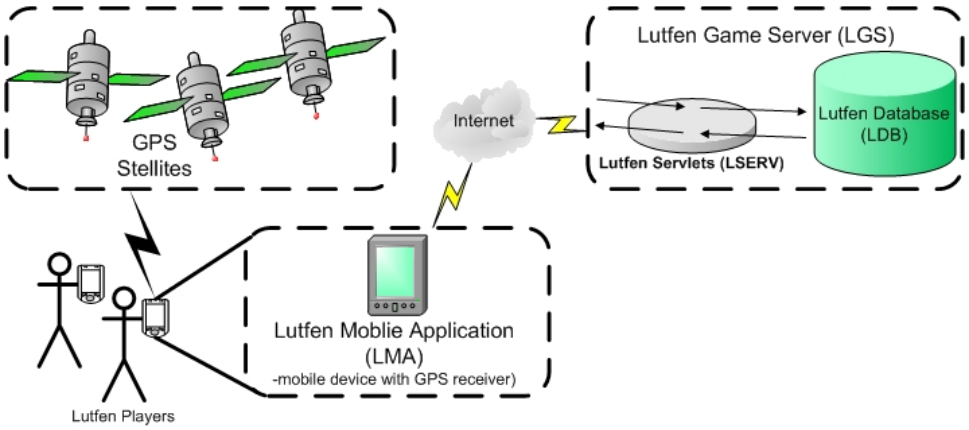

Figure 1. General overview of Lutfen system architecture.

(LMA) on the mobile device (see Fig. 1). LGS consists of the Lutfen Database (LDB) that maintains the game status and the Lutfen Servlets (LSERV) which allows the LMA to access and modify the game databases. During the game, locations of all players are obtained from built-in GPS receivers on the mobile devices. LMA uses these data to continuously update the game scenario. It communicates with LGS via LSERV and accesses to LDB or makes updates on it if it is necessary.

B. Implementation

A single player version of Lutfen is implemented using Agent Factory Mobile Edition [14]. Intelligent agents have been successfully deployed in many mobile computing domains including tourism [11] and mobile commerce [12] and their characteristics make them a particularity apt solution for applications that must operate robustly in complex and dynamic environments. Specifically, the Lutfen Mobile Application (LMA) has been coded using AFME's BDI-style agents. During runtime, an AFME Perceptor continuously reads the GPS data and updates its belief set concerning the state of the player and the game itself. The Game Agent in the LMA uses these beliefs to make logical commitments for the game play - for example, identifying those zones into which the player should move. In this case, the LMA would generate an audio alert and show the new objective to the player (Figure 2). Note that players can see their objectives during the game by pressing the *Objectives!* button (Figure 3).

Figure 2. The Player is notified that they have a new objective.

III. Ongoing Research

Lutfen provides a basic but robust implementation of the exergaming paradigm. While constrained in practice to a mobile phone, there is significant opportunity for enhancing the game from a number of perspectives. Firstly, the game should be personalized to the requirements of the players. A one-size-fits-all approach does not exploit the full potential of exergaming. Secondly, the environment in which the game is played may not be harnessed fully in terms of its potential for exercise. Thirdly, a social element must be introduced that enables multiple players collaborate.

Lutfen is also being augmented with a toolkit that will enable the game be deployed rapidly in new physical environments. The possibility of using virtual agents as players is also being investigated. The strategies that drive such agent-player behaviour would not be competitive or selfish; rather they would be governed by the exercise requirements of the

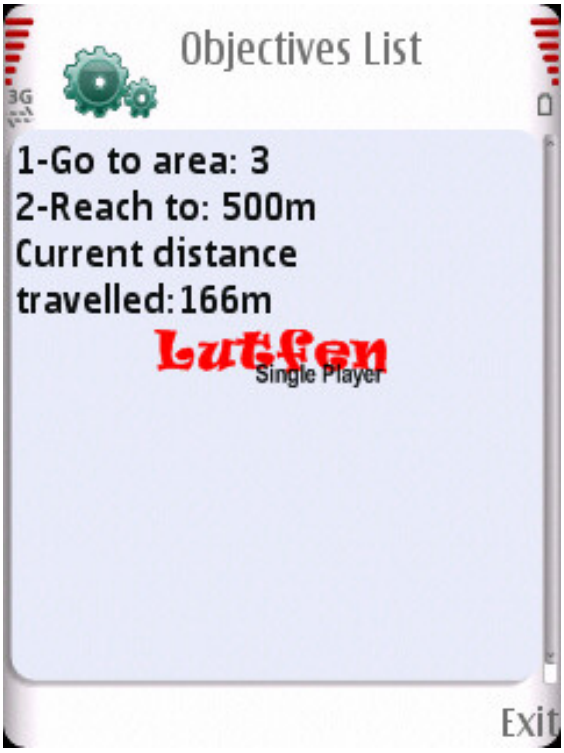

Figure 3. Objectives can be reviewed at any time.

constituent team members.

IV. Conclusion

In this paper, a practical implementation of a mobile exergame was introduced. Exergaming is likely to become an important tool in the fight against obesity. Though aimed at children, this gaming paradigm is equally applicable to adults whose lifestyle may tend to be sedentary in nature, either as a result of choice or as a side effect of their professional lives.

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