On Developing a Platform for Mobile Outdoor Gaming for Children

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Abstract. In this paper we describe the development of a platform for creating Head Up Games. Nowadays, technology is becoming more and more ubiquitous, but in the field of pervasive gaming it seems that development is mostly centered on smart phones. We argue that for outdoor games for children this might not be the best medium; and we propose the design of our platform that is designed to better support outdoor, active games.

1 Introduction

The concept of Head Up Games (HUGs) was proposed by Soute and Markopoulos (10), as a new pervasive play experience for children that stimulates physical activity en encourages social interaction. Head Up Games are games that combine play-elements of 'traditional games' (e.g., tag, hide-and-seek) with technologies of pervasive games, to create new, fun, children's games.

So far, we have developed several games, e.g. Camelot (12), Stop the Bomb (7), and HeartBeat (8). For each game dedicated hardware was developed from the ground up. Now, with the experience of developing these games and the corresponding hardware, we are building a generic platform to be able to more rapidly develop outdoor, pervasive games for children. In this paper we describe the process of developing the first prototypes of this platform.

2 Related Research

Research in pervasive gaming is growing, and several games have been developed. Most games have been developed using GPS-enabled PDAs or smart phones as a platform, e.g. *Feeding Yoshi* (4) and *Interference* (6). Children's pervasive games are less common, two notable examples are *Savannah* (5) and *Ambient Woods* (9). Although not games per se, interactive objects for open ended play (3) aim to achieve similar play behaviors as HUGs.

Development of platforms for pervasive games seems mostly focussed on developing middleware (software) for game deployment on smart phones (e.g., (11)), though Akribopoulos et al. (1) have developed both hardware and software for a platform for developing pervasive applications and interactive installations.

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3 The Head Up Games Platform

From our previous experiences of designing HUGs, we learned what kind of interaction mechanisms and what corresponding technologies are useful for these the type of games, and we argue that smart phones are not the ideal medium to play these games with. In our opinion, the affordance of a screen on a smart phone directs, during design, the game designer towards screen-based interactions and distracts, during play, the player from interacting with other players. Thus, we aim to create a platform that offers other types of interactions besides screen-based interactions.

Another requirement for the platform is that the devices need to be small, portable and robust, as they are intended for children in an outdoor environment.

Furthermore, our aim is that game designers and developers can quickly adopt the platform, without needing a thorough understanding of the embedded electronics or software. Finally, our budget is fixed to approx. €5000, which we aimed to develop around 10 devices with.

3.1 Technology

The following list presents the most important components that were integrated in the device:

- Battery
- Arduino ATMega processor
- RFID reader
- XBee Module
- Accelerometer
- Sound chip and speaker
- SD card reader
- Microphone
- Real time clock
- Rotation encoder
- Touch area
- Push button
- 4 RGB LEDs and 3 white LEDs
- Mini USB socket
- Extra headers

All components are integrated on a dedicated printed circuit board (PCB), to keep the size as small as possible , see Figure 1. The PCB's size is now approximately 15cm by 4cm, which is just small enough to be portable for children. Of course, smaller is technically possible, but would not have fit our budget.

Especially the battery was carefully chosen to fit our requirements, as it needs to be small, portable and powerful at the same time. Also, it must be easy to recharge and be protected against deep discharging. Charging of the battery is done through the USB connection, which is also used to upload new software to the device.

Next, the heart of the device is the processor. We selected to base the device on the Arduino Mega (2), as this processor offers many input/output channels. Also, this platform is often used within our department, and on the internet an active user community exists that exchanges experiences. The Arduino can be programmed in C/C++ and we provide designers with small examples of code for each component.

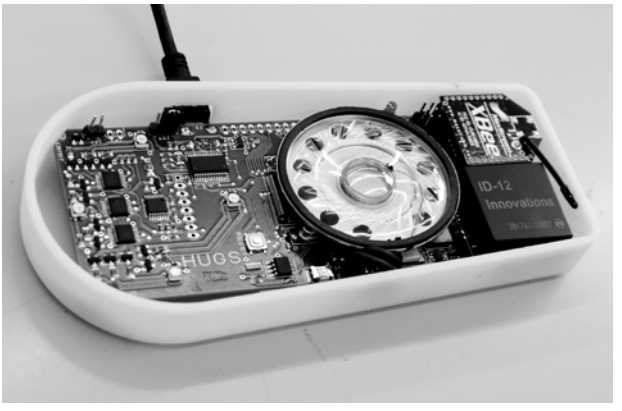

Fig. 1. Printed Circuit Board (PCB) with some of the components

What might seem striking is that we decided not to incorporate a GPS receiver and/or a WiFi module. Both components are very often used in pervasive gaming applications. However, we argue that within the Head Up Games concept it is not absolutely necessary to have exact location information available. In contrast to adults, who might play games that are played on a large geographical area, children play co-located games; meaning that they are relatively close together within the same area. For the HUG games we have designed so far, we have only needed relative location information, i.e. information on how far players are apart. This can be achieved by using for example the signal strength measured from the xbee modules. Admittedly this information is not as precise as information from a GPS receiver, but it is sufficient. Finally, children often play in areas where there is no WiFi covering, and since we aim the devices to be take-up-and-play-anywhere, adding a WiFi module is superfluous.

3.2 Casing

While developing the electronics of the devices, we simultaneously started designing the casing, as choices that concern the electronics components influence the exterior design - and vice versa. We decided to develop hardware and casing in such a way, that they can be easily separated. So, if a developer wants to create a casing specifically for his game, he can easily do so.

In Figure 2 the first prototype of the casing is shown. Clearly visible is the wheel, which can be turned unlimited in both directions, backlit by 4 RGB LEDs. The light of the LEDs is visible both in the wheel as well as at the sides of the device. Not yet visible in this prototype is that there will be a speaker below the wheel. Furthermore, means for attaching the device to a key-cord will be added.

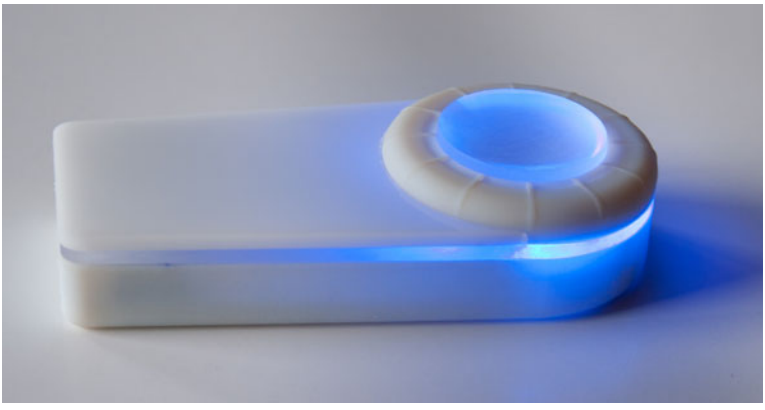

Fig. 2. First prototype of the exterior design

4 Conclusion

The very first prototype has been tested for its functionality, and we are now in the process of making minor changes to the PCB; subsequently ten PCBs will be produced and assembled. Also, the design of the casing will be completed. Then we can start developping games based on the prototypes and evaluate them with children.

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