Tangible User Interface Design for Lower Limb Disabled Children

A composite function of toy accompanying children at home

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This study describes the requirements forlower limb disabled children, regarding their limitations for movement in the nowadays environment. Following the emergence of ubiquitous computing, this research uses a tangible user interface as a toy for accompanying children at home. This system combines the ubiquitous computing concept for helping them control the electronic equipment so that they can support themselves and improve the quality of their lives.

Keywords: *disability; tangible computing; user interface; children; ubiquitous computing.*

Introduction

Children with disabilities experience limitations in their movement and are known to develop relatively poor spatial skills. Nowadays, it is more necessary and important than ever before to improve living conditions in order to avoid hazards within the context of a home's physical environment, particularly for families with disabled children. Normal family also needs to improve non-hazardous physical environment.

Lower limbs disabled children staying at home experience inconveniencies in activities like picking up the phone or controlling electric appliances. Since it is not easy to improve the physical environmental conditions, we need to find another way to help limb disabled children to be self sufficient and to earn their own living.

The concept of ubiquitous computing may aid these children at home in making it more convenient for them to be self-sufficient. In recent years, many researchers have worked on developing "tangible user interfaces" for interactive experiences. It would be really helpful for lower limb disabled children, if they could bring with them a toy they trust anywhere at home , and if that toy could let them answer the phone, control the electric appleances and if they fall down and get hurt, this toy could notify parents and hospital.

Related reviews

Ubiquitous computing encompasses the notion of computing being woven into the backdrop of natural human interaction (Mark, 1993). People with disabilities often experience difficulties that arise from their interaction with electronic equipment, above and beyond the usual risks involved in these activities. It is often not realized that many everyday products originated as inventions to aid people with disabilities (Allan, et al. 1994).

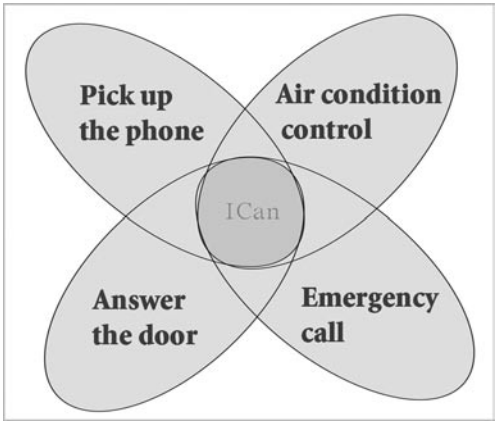

Figure 1
***ICan** functions. **ICan** combine four functions together which are Emergency call, control air condition, answer the phone and door..*

There are many systems developed specifically for various categories of disabled people, such as people with visual disability or hearing disability. Unfortunately, mainstream commercial system development or interior design tends to ignore the specific requirements with regard to lower limb disabled children. In order to address such concerns, interoperability among different media for different disabilities would be a goal worth pursuing (Peter and Michael, 2005).

As technologists, we must be much more proactive in understanding the nature of problems and in identifying potential approaches towards improving a problematic situation (Peter and Michael, 2005). There is an increasing level of recognition that those needs must be met in the design of new interfaces (Ephraim and Bryant, 1992). Tangible User Interfaces (Allison, et al. 1999, Jaime, et al., 2004, Mitchel, 1998, Nigel, et al., 1997, Scarlatos and Landy, 2001, Zuckerman and Resnick, 2003) may provide ways of helping disabled children earn their living. Designing for exceptional users has a much broader significance than is often assumed (Allan, et al., 1994).

Methodology

It is important to create environments that can react to children and help them develop their abilities, otherwise children may feel helpless (Zhong, 1998). Every child needs to receive some reaction to their own activities during their lives; for example, a hug from their mother when they crying. We can provide children with a toy that can react to them and this is not as hard as it seems. If we can make a simple reactiveworld for these children, we may not only stimulate their abilities but we can also help them realize what they can do and help them improve their experience in everyday life skills.

Nowadays, children usually have the habit of relying on others. In this project, the tangible user interface is designed so that children can carry it with them, anytime and anywhere, within their home environment. A common creed of human-computer interface designers is "Know the User"(Allan, et al., 1994).

We interviewed lower limb disabled children whose age ranges from 5 to 10-year-old as well as their parents who really understand their needs. On the positive side, addressing the needs of special populations can result in interfaces that are easier for everyone to use (Peter and Michael, 2005).

Then we analyzed the results, in order to obtain what kind of functionality was needed to be designed into this tangible interface. However, it would require significantly greater attention to achieve high interface standards and in some cases this fact presents a formidable technical challenge (Peter and Michael, 2005).

There are four kinds of function which were designed into this tangible interface:

1. pick up telephone,
2. turn on/off the air condition,
3. answer the door, and finally
4. an emergency call.

Children can use these functions to control electronic appliances at home. They can carry the ***ICan*** doll to everywhere they want. They won't worry about how to turn on/off the equipment or be afraid that they may be late for picking up the phone. They can stay at home and live like normal children.

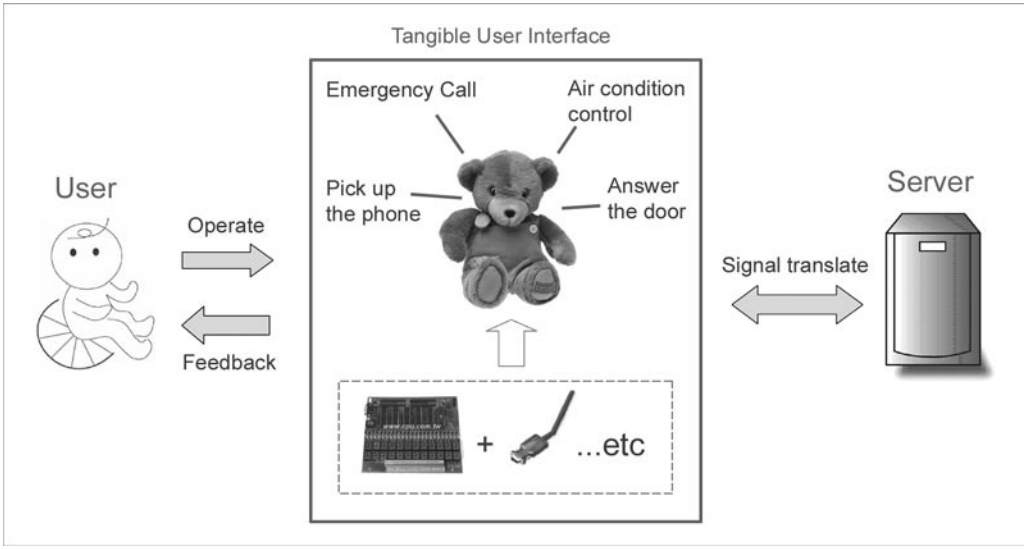

Figure 2
Interactive diagram. User can operate the tangible user interface which has four functions and combine the IO9624 card and EP-132B wireless terminal. The TUI translates the signal to server and the server the response back. Them user can get the feedback from the TUI.

Implementation

This tangible user interface was named ***ICan***, which implies that it enables lower limb disabled children do those things that normal children can do too. In this project, a server needs to be setup inside the house, and the use of an IO-9624 control module guarantees complete wireless remote control. This device supports wireless communication, so in this house the server can receive the signal from everywhere inside this house.

The ***ICan*** toy, also has a wireless function via using an EP-132B wireless Ethernet that transmits the signal to the server. The shape of ***ICan*** is like a bear doll. Inside it has a sensor that controls the signal in its nose, hand, mouth and back. When children press the nose or twist bear's hand, this action triggers and starts the server, and this action enables children to interact with the equipment.

A simple scenario example

Angelly is an 8-year-old girl. She has a bad left leg and it is not convenient for her to walk. Today she holds her ***ICan*** doll and stays at her room. Suddenly, the phone rings, she presses the ***ICan*** doll's mouth and the doll starts to speak: hey, Angelly, it's me, daddy, how about school? Angelly says: it's funny; teacher said my picture is very beautiful. And then daddy hangs up the phone. Later Angelly feels a bit hot, so she presses the ***ICan*** bear's nose once, and then the air-condition starts to work. Angelly feels that today is a really nice day.

Conclusion

The goal of this research is to help designers understand the requirements of children with disability that have to be met by tangible user interfaces systems. This may enable designers to identify appropriate ways of helping people with special needs be self-sufficient and earn their living, by making use of tangible user interfaces in combination with ubiquitous computing.

As technologists, designers have a responsibility to consider such standards when designers design systems, products or spatial interfaces. In this study, the proposed system combines few functions that are easy for children to use In the future, we plan to

extend these to more composite function for a wider spectrum of people with disability.

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