iCare: An Interface Design Model for Remote Communicating and Monitoring of Children Care

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Abstract. School children from 6 to 12 years have characteristics of trying new things, lack of complete reasoning ability and staying in a group. It is easier for them to be in dangerous situations during this stage, which concerns parents. However, parents do not have enough time to accompany and monitor children the whole day. In this paper, we propose an interface design model for remote communicating and monitoring of children care to meet parents' requirements. After describing this model, we discuss the situation awareness and group proximity inference as implicit input in details, which is a crucial part of iCare model. Finally, we prospect prototyping and evaluation based on this model.

Keywords: Interface model · Children care · Situation awareness · Group proximity inference · Mobile computing

1 Introduction

The school children from 6 to 12 years start an independent life comparing spending all day with parents. They like trying new things and staying in a group. However, they do not yet develop a complete reasoning ability, which makes them hard to distinguish dangerous situations [3]. This concerns parents. Previous technology cannot support the monitor requirement of parents. With the development of wearable computing, the intelligent, natural, and intuitive interface turns into reality. It is interesting to instruct interface design that meets requirements of parents. This paper will first briefly introduce the needs that the school children and their parents or guardians might have. As an alternative solution, we propose a model called iCare model for interface designers. In this model, we investigate dimensions of actors, inputs, outputs and devices. As an important and innovative research point, we explore situation awareness and group proximity inference as implicit inputs. Other potential questions and features required in school children care are also involved. Finally, we discuss the future work, including prototyping and evaluation based on iCare model.

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2 Related Work

In this section, we outline the relevant research work that helped inspire this study on monitoring school children beyond parents' view in relation with ubiquitous computing. Since ubiquitous computing covers a large number of aspects, we only address interface for children, situation awareness, and proximity interaction.

2.1 Interface for Children

We looked into the premier conferences like the ACM Conference on Human Factors in Computing Systems (CHI), Extended Abstract (CHIEA) and the ACM Conference on Interaction Design and Children (IDC) from 2009 to 2014 as the target source to explore the topics on children and related sensing technologies. The sources included different types of publications such as full papers, short papers, doctoral consortium, and demos. Besides the two conferences we mentioned, we also survey the related work from other sources. From literature reviews, we find that most prior studies mainly focus on intuitive children interface design, disabled children support, children health monitoring, etc., but without exploring how to eliminate parents' concerns and meet their monitoring requirement using wearable interface. Existing research work on children care and monitoring can be classified as two categories: activities monitoring [2] and physical information monitoring [8]. However, the topics on situation awareness and inference are rarely involved and discussed, which are essential for protecting school children and releasing parental concerns when children are in dangerous situations remotely.

2.2 Situation Awareness and Inference

Supporting parents to know situations of children remotely is an effective method to protect children from risks. Context awareness and inference has been regarded as one of the most important research points in ubiquitous computing for the past decade [4,10]. Both mobile sensors that can be taken or worn by users, and environmental sensors that are embedded in the environment, are used to perceive the context like temperature, light, noises, etc. Besides context detection, researchers also focused on applications and services using inferred information from context data. Applications using location inference and fused information from other sensors are discussed as an active topic. Compared with traditional explicit input and generated information from users like clicking and typing, the information generated from context are named as implicit information [6] and related sensor inputs are referred as implicit input [7].

2.3 Proximity Interaction

Proximity interaction has been introduced in the paper [1] in 2011 and discussed afterwards. Existing proximity interaction researches focus on device to device

connectivity via proximity sensing and interaction [5]. We extend these prior work and let sensing information can be used by parents, so that monitors like parents can obtain information of partner of their children, inferred by proximity location of partners.

3 ICare Model

In this section, we will discuss characters of children from 6 to 12, and needs and concerns of their parents or guardians at first. Then we propose the model named iCare, including the dimensions of actors, input, output, and devices.

Children enter school from 6 years old generally. Between the ages of 6 and 12, child's world expands from family and is shaped and impacted also by friends, teachers, etc. They have general characteristics as follows [1]: curiosity and expanding knowledge, growing independence, developing reasoning ability, physical change, stay in group. Parents also have concerns with children during this stage and requirements of tool. During this stage, child has more willingness to be with friends or left away from parents than before. They are also lean to explore new areas outdoor and play games there. However, they are not built complete logic and reasoning mental system to avoid risks when in middle childhood. It's important to support parents to help children avoid unsafe situations and carry out self-care.

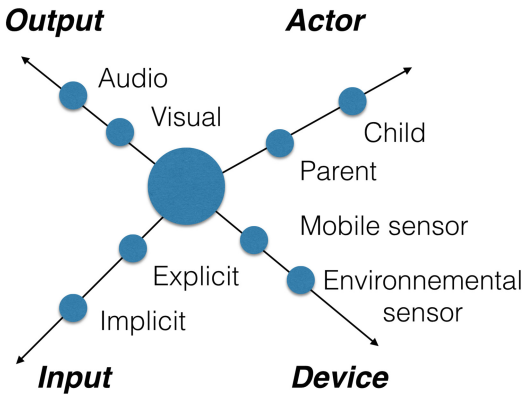

Fig. 1. Overview explanation in spider form of iCare model.

To meet requirements of parents, we propose iCare, which is the model instructing and facilitating design of friendly and intuitive interface, with the aim of supporting remote communication and monitoring for parents. The iCare model contains four dimensions: actors, input, output and devices. Figure 1 gives an overview of iCare model.

Actors. iCare model serves for two actors as users: child and parent. Based on the model, child and parent are supported with respective interfaces, including

input, output and functionality. On the one hand, with regards to characteristics of children during middle childhood as we stated above, mobile and physical interface is proposed as the interface design principle based on the iCare model. Children can be supported with the ubiquitous wearable device like pendant, bracelet, etc. Physical interface provides evident physical feedback, which is perceived in a clearer way than virtual interface by children. Therefore, all interactive items are proposed with physical properties. The primitive contains <point> and the control [9] would be <point physical button>. In addition, urgent interactive items and normal interactive items are designed separately. When urgent risks happen, urgent items could be triggered directly. However, in the case of normal situation, these urgent items are more difficult to trigger than normal items. The functionality of child interface includes demanding help and communication, leveraging explicit input and implicit input that we will discuss in the sub sections of input. The functionality considering parent actor contains communication, situation awareness, gourd proximity awareness, and physical state awareness, employing only explicit input from parent's perspective. On the other hand, interface for parents can be instantiated from iCare model as virtual interface. Interaction is accessible via mobile interface with mobile devices like tablet, or via fixed interface with devices like personal computer. Merely virtual interactive items are involved for parent character. The primitive for parents leverage multitouch gestures, audio commands, mouse pointing, etc., supporting intuitive and natural input.

Input and Output. Inputs are not limited to explicit input when computing escapes from the desktop constrain. We propose explicit input and implicit input in iCare model. Explicit input refers to the inputs that are conducted explicitly by users like click, drag-n-drop, etc. Implicit input refers to the input that processed and performed from sensors, which will be discussed in the next section. The output can be conducted as visual output and audio output depending on users' requirements.

Devices. The term devices in this sub-section are defined as sensors. The child interface is equipped with diverse sensors to collect context and physical information. With regards to child actor, devices require sensors like GPS sensor obtaining geolocation for outdoor use and temperature sensor gaining temperature of environment and body for context use and physical use respectively. Sensors are classified as mobile sensors that can be equipped on body, and environmental sensors that are installed in the environment for indoor use.

4 Implicit Input

Context data that is inferred via implicit input is used to infer dangerous situations and recognize group members with permission. The general procedure of information inference is shown as in Fig. 2. Take situation awareness as example, diverse information is collected from sensors like geolocation sensor, temperature sensor, etc. Then information is sent to be fused and transformed to identify situation sequences using algorithms. Finally, dangerous situations are selected based on algorithms and represented in a notification form from interface.

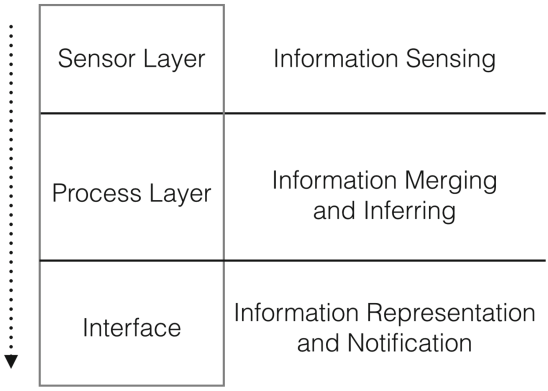

Fig. 2. Procedure of information sensing, inferring and representing.

4.1 Situation Awareness

Location is considered as one of the most important context data to know children's state. Location logging without any filtering or transforming does not help parents obtain more information about children. In addition, amounts of raw data cluster will lower user experience. Therefore, it is important to classify situations, infer situations based on locations, and notify parents in a friendly way. With regard to classification, we propose to log locations of children and define frequent areas as the familiar and safe areas. Other areas are classified as unfamiliar areas. If children enter into unfamiliar areas, a notification will send to parents as the alarm. Parents can decide this area as safe or uncertain safe. Then this additional data will be added into database for further training. The classification is based on children's location history and parents' decisions.

4.2 Group Proximity Inference

Since children in middle childhood like staying together in a group, it is interesting to let parents know location of children's partner in a dormant way. However, the information is implicit that who children's partners are. Thus, children's interface should have ability to detect other frequently surrounding children, who also worn the same devices, and to obtain permission of identification from them. Compared with active notification, the logging of locations of children's junior partner can be represented in a silent way, that is, parents can check out this information by themselves instead of receiving alarm. Group proximity detection and inference can reinforce the protection of children if children do not take devices with them or lost connection.

5 Conclusion and Future Work

In this paper, we proposed a model called iCare that is to guide for design space of interface with the aims of supporting remote monitor and care of children

from 6 to 12 years. We first discussed the characteristics of children in middle childhood and requirements of parents or guardians. We then describe iCare, the model instructing the design of interface for both children and parents as users. We thirdly focus on two aspects of implicit input as part of iCare model in details: situation awareness and group proximity inference. Finally, we prospect prototyping and evaluation in the future. In the next step, we will take consideration the details of prototyping and evaluation with the help of iCare. User-centered design (UCD) and evaluation methods will be employed in the future work. UCD can conduct to control the process of prototyping and evaluating and regards end-users involvement as the key of design.

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