Development of Wearable Device by Kid's Friendly Design for Kid's Safety

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Abstract. In this study, we develop a wearable device for kids under 6 years who are growing up so fast physically enough to face various experiences but low ability to describe the events by language exactly what they have experienced at nursery or kindergartens to share with their parents. This system will be linked with local safety network to let somebody react real time when a kid faced to any inexperienced events. We adapt biological information such as heart rates, physical information such as body movements, GPS and camera on the device. The data from the device could be shared to parents or teachers in the kindergarten afterwards or real time. We focus on designing the device has fascinated form giving, ease to wear and symbolic indication of "Protected" by wearing on. To keep kids enjoy wearing the device as like a pendant. In this paper, we introduce the user oriented development of the device which has kid's friendly design and useful function.

Keywords: Kid's friendly design, areal network, shared information

1. Introduction

In increasing crimes or accidents on kids, parents need to consider the way to protect them and predict what are going to happen to them to know their habits of ordinary behaviors or related people around them. In Japan, it is now very general to protect the children from the crimes, most of the primary school children put security alarm buzzer on their school bags. Some schools hand it out to the students as like textbooks. But many of the children do not give attention to it and no useful function except to make noses surround. No more security functions with the alarm buzzer but a simple toy.

In many cities, increasing working mothers' kids are being taken care by nurseries or kindergartens on their working days. They spend less than 3-4 hours with their kids before and after working per day. And under 6 year kids they are growing faster in physically but sometimes cannot describe their experiences by words to their parents even though those were scary, happy, surprise or sad.

But the responsibility of kids' security is on their own parents wherever, whenever or whatever. In this system, we construct a system which can help the parents can confirm their kids' behavior or experiences through a small and charm wearable device connected to social network with local support. This device can detect heart rates and behavioral movements of kids using heart rates detector and three axis accelerometers. It also has a camera which turns on only when the kid got a big change of heart rates or movements such as falling down or jumping down. And the visual information on the camera can be browsed at home through a secured program.

2. Development of wearable device for Kids

The device is developed by reversed order compare to ordinary development process, such as, designing first and put the advanced technology in a box next. The reason why designing first than the technology is, to make kids wear the device as their own willing being fascinating by attractive form giving and ease to wear. We call it, 'Kids Friendly Design'.

For 'Kid's Friendly Design', we first concern the weight and size of the device, and secondly about how and where to wear on kid's body. Concerning preferred graphical design for kids would be the last step.

2.1 Weight and size of the device

To fix the size of the device, we surveyed Kids' body scale based on Research institute of Human Engineering for quality life in Japan. They've reported all the size of average body scale of ages from 0 to 12 from Japanese kids since 2005 every year. The chest size of 3 year old kids is 164mm and 5 year is 176mm. From the chest size, the device should not be exceeded 100mm in any direction.

About the weight, we surveyed the toys which can be attached on kid's neck, most of them are between 30 to 50 grams and which can be attached on their waist, are less than 100 grams. And we also surveyed about the weight to mothers in the kindergarten, 75 percent of them answered under 100 grams can be applied to their kids. For references, the alarm buzzer has 45~60 grams and kids mobile phones have 130~150 grams.

2.2 How and where to wear the device

To attach on an appropriate position on kids' body, we should concern that it is not to bother kids' active movements. And at the same time, the camera on the device should be keep positioning well focused even they move around. Here we show examples of A and B on the figure 1 and 2.

2.3 Design development of the wearable device

a. Necklace Type

Based on example A, we suggest necklace type of ideas and mock-ups (Fig.3) .

We build up the mock-ups by 3D Printer (Dimension 3D Printer BST). This necklace type is not able to fix the camera focused and have a possibility to be fastened on kids' neck by accident.

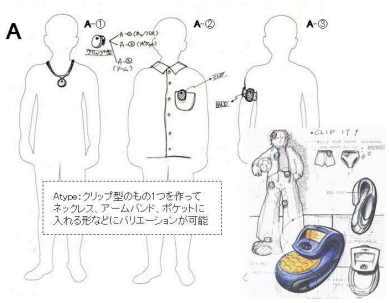

Fig.1 Example A (Clip type)

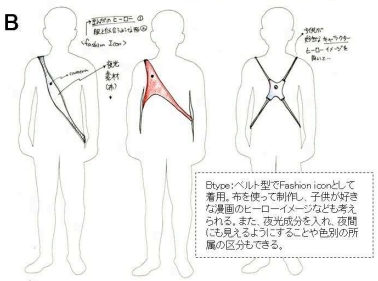

Fig. 2 Example B (Suspender type)

Fig.3 Necklace Type Design

b. Shoulder Sac Type

Based on example B on the figure 2, we suggested four kinds of ideas and mock-ups (Fig. 4). This shoulder sac type is more stable to put a camera on the device and have a diversity of positioning the sensors. Those are well attached on the body, so children feel lighter than a real weight. B-1 could be made with fabrics or covered with soft rubbers. It fits on the body but the camera position could be lower than other types. A kid's chest is high as grownups' knee. If the camera placed lower position on the device, we need to do to control the direction of lens. B-3 is updated idea of B-1. A support belt was added on the other side to improve the stability. B-2 has less space attached on the body than B-3. It has three corners on the shape and each corner connected with belts. And B-4 is applied idea of B-2. It has four corners to spread sensible weight better than others. Figure 4 shows the various shape of device design on kids around age of 4-5 body sizes.

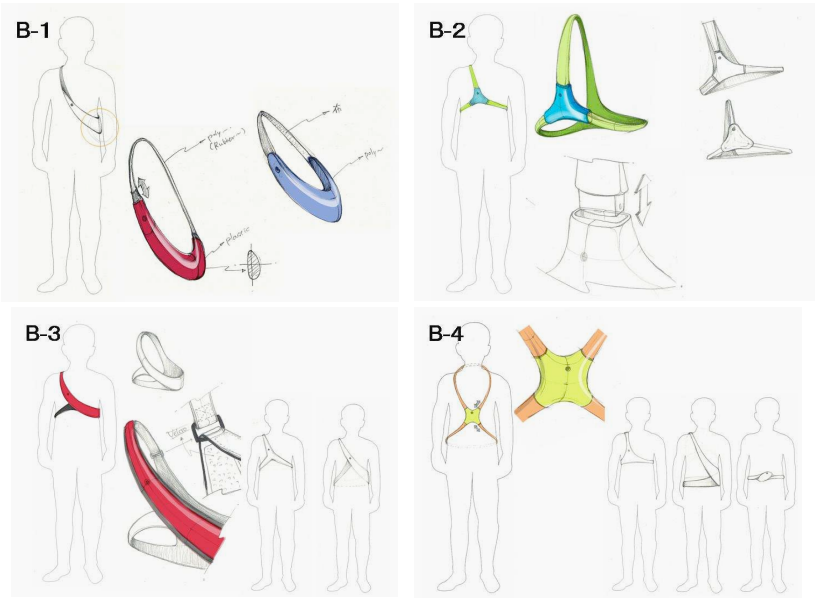

Fig.4 Development of various shape of wearable device design

2.4 Build-in mock-ups

From the shoulder sac types of design, we finally build the sensors based on the idea B-3. The total weight of the sensors which should be built in, would be at least 90 grams, the necklace type was rejected from the candidates, because it will be a big burden on their neck. Among four ideas of shoulder types, it offers relatively high position of camera and merit of ease to wear.

In detail, to decide the size of device, we made updated sketch of B-3(Fig.6) and made a 3D mock-up by 3D printer. To put the sensors safely in a box, the layout was decided after trials. On figure 7, solving the way to fix on the body, small connection parts were created on the corners. We named it 'Omusbi' (Fig.10), meaning of 'Rice ball' or 'Connection' in Japanese. 'Rice ball' is traditional snack for kids and any ages of people in Japan. 'Connection' is also meaningful function with this study to share information not only between kids and parents but also with local supports.

The on-off switch is on the back side in a tiny hole to turn with an originally designed stick only by their parents to prevent to be adjusted by somebody else.

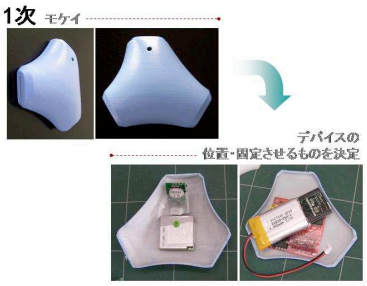

Fig.5 Built-in Device

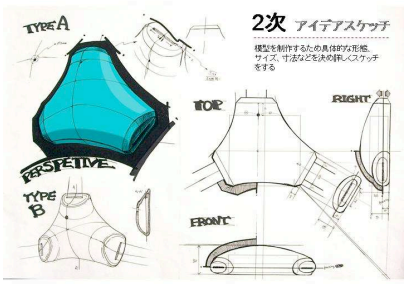

Fig.6 Updated Sketch of B-3

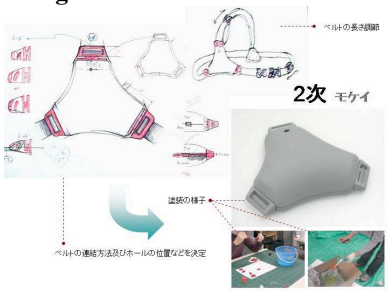

Fig.7 Design Sketches for final mock-up

Fig.8 Prototype of Device(Omusbi)

3. Discussion

3.1 Weight and size of the device

The goal of designing the devices in this paper, less than 100 grams and 100 mm in every direction for kids between ages of 2-6 was achieved. The model having three corners concluded as the final design for kids in this study. We adapted the sensors, such as heart rates detector, GPS, three axis accelerometers, camera and micro computer in the device and we still have a possibility that it could be lighter if the sensors we adapt will be lighter and smaller. The final prototype has 94 gram with out the belt.

3.2 Position of wearing the device

To take heart rates, kids will attach a set of wireless detectors on their left side of chest directly. Then the device should be positioned on the right side of chest on outside. The ‘Omusbi’ device has three corners to fix on the chest so, it does not bother to get signals each other. Figure 9 shows how kids wear the device.

Fig.9 Device attached On Kid's body **Fig.10** Omusbi

3.3 Graphical package for Kid's Friendly Design

Graphical package of device will be also very important for kids to make them want to wear the device by themselves. It will be also a symbolic indication of "Under Protected" when they wear the device. With friendly animal graphics or originally created hero characters would be preferred by kids. Figure 11 show the examples of graphic packages on the device.

Fig.11 Graphical package examples

4. Future Study

This study is under going to be linked with local safety network and usability test by kids in the kindergarten will be continued in the next stage. The design of Omusbi will be upgraded to be lighter and more fancy at anytime when the better sensors are developed. For user friendly design, various types of devices will be offered to parents. They can choose the functions on and off among the sensors to depends on their kids' condition. Each of them will have different experiences and different feeling on the events around them. The device will offer scenes of kids' daily experiences only when they were stimulated by unexpected events, to the network by pictures when parents access on secure system. And also staffs of kindergarten or nursery can also access when the kids got some changes on their physical conditions.

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