Cuddly: Enchant your Soft Objects with a Mobile Phone

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1. Introduction

We are surrounded by soft objects such as plush toys, cushions etc. in our daily lives: people often hug soft objects when they are feeling emotional such as while watching movies, or they tend to punch or throw objects when they are feeling frustrated. From the psychological point of view, soft objects can highly influence people's lives and behavior [Ackermann et al. 1999]. Research shows that it can help reduce stress as well as increase effectiveness. Because of that, soft objects are often used in different fields such as medical therapy, communication, gaming purposes etc. Our research group has also created FuwaFuwa [Sugiura et al. 2011], a sensing module which uses soft object as an interface in the past.

However, in order to develop and commercialize these soft interfaces and robots for the society, developers require users to purchase the device. When choosing a pet from a wide variety of animals or just choosing, for example, a pet dog based on its breed, people make their choices based on their own likes and dislikes. Similarly, when choosing soft objects, the same rules apply. Taking this into account, it can be seen that for the creations of a well-accepted and loved soft object, one needs to provide either many varieties, as with the case of "Furby", or re-design repeatedly until universally accepted, as with the case of "Paro". This shows what huge leap there would be between the initial development stage and final manufacture for sales.

Currently, the majority of our society is not aware of the usefulness of soft interfaces. Therefore, by providing a system which users can easily obtain and experience at low cost, we can spread the benefits of soft interface. We believe that this is important to discover new human needs and playing methods. Based upon which, this research, entitled Cuddly, aims to utilize a device, which a majority of us are equipped with, to create interaction with soft objects which we already have in our home.

Cuddly utilizes a smart mobile phone, which has had very high sales in recent years, to create an application to enhance user's interaction with their soft objects (Figure 1). This is done by embedding the mobile phone into a soft object. Cuddly then utilizes the mobile phone's camera and flash light (LED) to detect the surrounding brightness value captured by the camera. When one integrates Cuddly with a soft object and compresses the object, the brightness level captured by the camera will decrease. Utilizing the measurement change in brightness values, we can implement diverse entertainment applications using the different functions a mobile phone has such as animation, sound, Bluetooth communication etc.

2. Principle

Soft objects are usually encapsulated with soft, fluffy materials such as cotton, wool, feather etc as their padding. These materials have many spaces in between the atoms allowing a flow of light to be spread out.

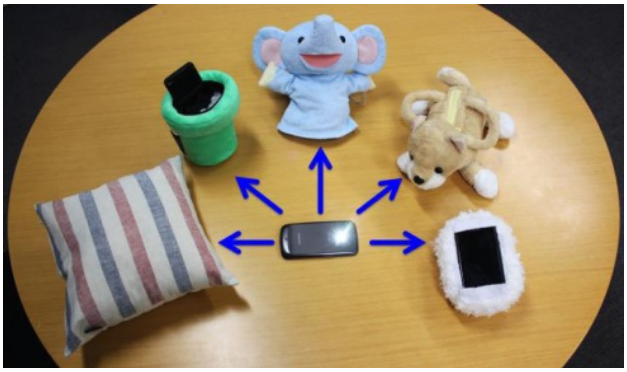

Figure 1: *Implement with many soft objects*

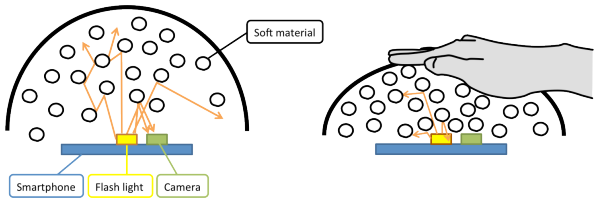

Figure 2: *Brightness detected by camera is high at low density (left) and low at high density (right)*

Previously, our research group has created FuwaFuwa, a sensor module which uses photoreflectors sensors to detect the changes in brightness when integrated with soft objects. These sensors consist of an infrared emitter and transistor side-by-side whereby the transistor detects the infrared light reflected back to it. From this concept, we discovered that this measurement is possible even when the two components are at varied distances apart, until a maximum distance. As a note, the measurement method is the opposite of FuwaFuwa: the brightness sensed increases with compression for FuwaFuwa, while when the two components are apart for Cuddly, the brightness sensed decreases with compression.

We then implemented our test with a mobile phone by making use of its camera and flash light. This camera will detect the brightness of the surrounding area by distinguishing the change in density of the padding. The flash light will act as the source of light and the camera will detect its reflection. When there is no pressure applied to the soft material, the surrounding is bright and numerous external light sources can enter the phone (Figure 2 left). However, when the soft object is compressed, the density of the material surrounding the light source increases, reducing the light reflection – thus, reducing the surrounding brightness (Figure 2 right).

The camera will capture the video of the surroundings and convert the pixels into average RGB values. These values will then be converted into brightness value by averaging the RGB values. The data of this brightness value is used to create different applications.

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As this characteristic is possible for variable distances between the camera and the flash light, Cuddly can be used in many mobile phones.

3. User Experience

Interactive soft toys and puppets.
Kids like to play as if their plush toy is alive, by giving them voices or moving their limbs. We have designed a few applications by giving voices to different soft toys when the phone is inserted into the toy, such as dog barking sound for a toy dog, a character voice for a cute character and playback of different recorded voices for a puppet. Besides that, using this application, we can animate a soft object by creating visual faces on the screen itself (Figure 3).

Game.
We have also designed a gaming application which utilizes the screen while integrating part of the phone with a soft object. For example, depending on the brightness value, the character on the screen will jump at a different height (Figure 4).

Music and lighting.
We have designed an application whereby when a user inserts the phone into a pillow and presses the pillow, music will flow according to the compression strength. At the same time, the screen color changes according to the music. When this application is used in the dark with the pillow, it resembles the display of colorful lights.

Alarm clock.
We have designed an alarm clock system whereby the user will set the time as a typical alarm clock and insert into the pillow. User will then lie on the pillow. At the designated time, the alarm will ring and vibrate. When user lifts his head up, the alarm will stop. However, when user lies back down, it will ring again.

Multi-device interaction through Bluetooth communication.
Since mobile phones are embedded with a Bluetooth function, it can communicate with other mobile phones or Bluetooth devices. This can enhance interactions between two or more people. We have designed an application which connects a phone with a tablet. The phone is inserted into the pillow. When the user applies pressure to the pillow, the character on the tablet will receive the punch (Figure 5). Another Bluetooth application is for storytelling whereby multiple users will play together, such as creating a joint conversation between devices. When two people insert their mobile phones into their individual soft toy and one presses one's toy, both toys will play recorded script similar to telling a story. With this, users can create connecting stories with their soft objects.

4. Limitation and Future Works

One of the limitations is the size of the mobile phone. Currently most mobile phones are long in size, allowing Cuddly to be used only in objects bigger than the phone. In addition, the hardness of the phone may be a challenge if the soft object lacks stuffing in it. In this case, users may detect the phone when they are pressing the soft object. Another limitation is the power consumption due to the use of the flashlight causing Cuddly to be used only within a limited amount of time.

Currently, Cuddly is only programmed to take readings in one dimension. Therefore, a future work is to detect the change in density at different places by utilizing better image processing techniques. Besides that, for a large interface, one may insert multiple phones and communicate the data with each other to detect the brightness value at different spots. Another future work is to test out the possibility of other sensors in the phone.

5. Conclusion

Cuddly is a phone application that allows users to integrate their mobile phone with soft objects from their surrounding environment. This application works like a light sensor by making use of the mobile phone's camera and flash light. When the mobile phone is inserted into a soft object, the light from the flash light will be reflected into the camera. This camera will capture RGB values of the surroundings and convert it into brightness value. When a soft object is compressed, the material's density surrounding the mobile phone will increase and reduces the light reflection. This causes the brightness value detected to decrease, thus causing a range of value changes. Using these values, Cuddly can create feedback interactions with the soft objects. For example, sound feedback, light feedback, connection with other devices, etc.

6. Acknowledgement

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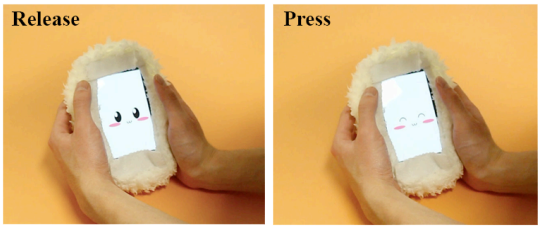

Figure 3: *Interactive soft object*

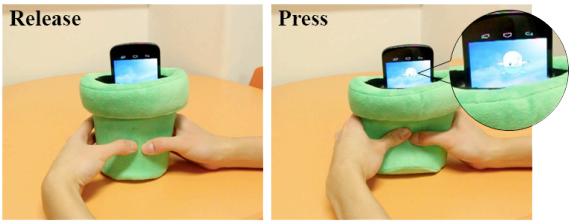

Figure 4: *Game*

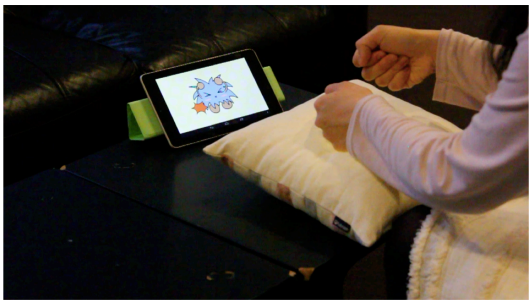

Figure 5: *Multiple device connection*

Reference

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