TAG-CON: A REAL OBJECT INTERFACE USING MULTIPLE MANIPULABLE RFID TAGS

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Abstract

In this paper, we propose a real object interface using multiple RFID tags. Usually, one tag is attached to one object. As a result, only two interactions could be used, to get the tag close to the reader, or to get it away from the reader. Although, sometimes rotations and sides of objects create different meanings such as dice, cards or the signs hung on the doorknobs. Those kinds of contexts aren't used in the RFID technologies. By using multiple tags, it is able to use the physical posture of the object for interaction. Compared to sensors, the power supply isn't required and also they are considerably low cost. We have developed a cubic type that could be controlled by rotation and a card type that could be controlled by pressing the buttons.

1. Introduction

Recently, RFID technologies are used in many opportunities such as electronic moneys and new applications are being developed in human-computer interaction using RFIDs. Compared to sensors, the power supply isn't required and also they are considerably low cost. Usually, one RFID tag is attached to one object. As a result, only two interactions could be used, to get the tag close to the reader, or to get it away from the reader. Although in some cases, rotations and sides of objects create different meanings such as dice, cards or the signs hung on the doorknobs. Those kinds of contexts aren't used in the RFID technologies.

Also among several RFID tags, although they sometimes contain similar terms or related information, they are not classified and grouped. In many cases, interfaces using RFIDs have different objects containing a singular tag, and when each are placed on the reader, some kind of information are displayed related to the tag. Even though they might be closely related, such as,"kitchen", "living room","bathroom", they exist as a different object. As a result, the number of objects increases and in order to handle many objects, the interaction becomes complicated.

We will propose a new real object interface"Tag-Con"by attaching multiple tags to an object and switching them according to the physical posture. We have developed a cubic type that could be controlled by rotation and a card type that could be controlled by pressing the buttons.

2. Related Works

One of the research works using multiple RFID tags is RFIDice[1]. In this research, RFID tags are attached to each side of the cubic die and also a metallic layer is added to prevent the reader from picking up tags on the side or at the top of the die. Compared to this, we designed a new method by

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actually forcing a tag to touch a metal. By using this switching mechanism, it is possible to activate only the tag that is meant be read and could prevent the tags on the side of the cube to be read accidently. We expect a better accuracy than the related work.

MouseField[2] is a device that considered the fact that a single RFID can handle only one function and lacks flexible control. By combining a RFID reader with an optical mouse, it can handle movements of the object after the tag has been read. Our idea differs from this by using multiple tags in one object and handling the three-dimensional movement of the object. However, by combining these two methods, it is able to use the three-dimensional movement and the movement among a single surface.

Also, ToolStone[3] is a device that contains integrated coils of a pen tablet and it is possible to determine the position and the rotation of the device. Another study shows that the position of tags could be positioned from RF response rate with software algorithms[4]. These are very interesting approaches, but we considered the possibility of using RFID as a switch. In our approach, not only by rotations or positions, users can select the tag to be read consciously and making an input by pressing the buttons as in the card type.

There are other possibilities to realize the system like Z-agon[5] or Cube-Browser[6] using sensors. With sensors, it is possible to use the device alone without a infrastructure like a RFID reader, but they require power supply, and there are difficulties for electric wiring and also the cost of the object would be much higher than RFIDs. It may be possible to use RFIDs or sensors inside devices with chargeable batteries such as cellphones, but we are expecting to use this inside non-electronic objects with plastics or wooden materials so the fact that it is powerless and low cost is an advantage. Ubiquitous sensor nodes[7] work with low energy but still need battery exchange. Pin&Play[8] also works with powers from infrastructure, but we considered the advantage in non-contact usage and portability with RFIDs.

Using cameras and image processing is also possible, but the movements wouldn't be recognized if something gets in the way. Also in some cases, there need to be some kind of barcodes printed on the surface, which restricts the design of the object.

3. The Design of Tag-Con

3.1. Cubic Type Tag-Con

Using Texas Instruments HF-I Midrange Reader, we developed a prototype of Tag-Con. We focused on the nature of the RFID tag that a contact with a metal material prevents it from getting read. By putting a tag inside a container with an aluminum foil attached to one side, depending on the rotation, the tag moves inside the container. When it moves to the side without the aluminum foil, it gets activated and can be read by the RFID reader. By attaching this piece to each side of a cube and also activating only the one on the bottom side, it is possible to detect the rotation of the cube.

We have developed several sample applications using the cubic type Tag-Con. We developed an application to control the channel of the TV. By assigning channels to each sides of the cube and also the status of the cube away from the reader, we assigned the 7 main channels in Tokyo metropolitan area. We used Crossam2+ in this system, which is a programmable remote controller that could be attached to PCs. By using Tag-Con as a TV remote controller, it is possible to controlling and also recognizing the current channel very easily. Moreover, by using a tactile surface it could be possibly used as an interface for people with visual impairment.

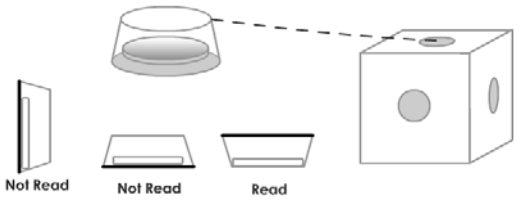

Abbildung 1. The Idea of the Cubic Type Tag-Con

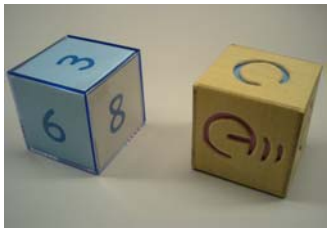

Abbildung 2. Cubic Type Tag-Con (Left:TV Controller• Right:MSN Live Messenger)

Also, we developed an application to control the status of the MSN Live Messenger. We assigned 6 statuses, “Online”,“Away”,“Busy”,“Be Right Back”,“Out To Lunch”,“On The Phone” and also by putting the cube off of the reader, it could be turned to “Offline”.

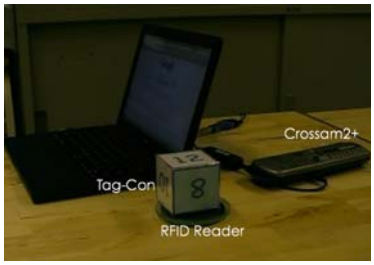

Abbildung 3. TV Controller Application

Abbildung 4. MSN Live Messnger Application

3.2. The Card Type Tag-Con

In addition to the cubic type using rotation movement, we examined a card type that could be controlled by pressing buttons. For some conditions such as portable usage, button type can be suitable than the cubic type. We developed a prototype of a button type and also a card type using a label type RFID tag. By pressing the button, the distance between the tag and the aluminum foil comes apart and the tag gets activated. We used 3 tags for the card prototype and these could be switched by pressing each buttons.

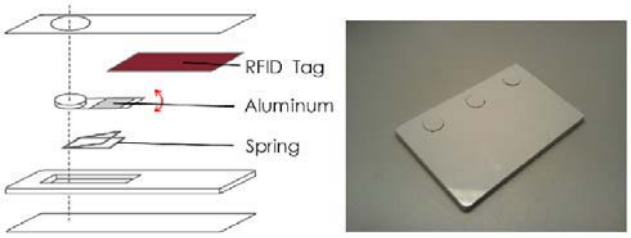

Abbildung 5. Card Type Tag-Con

Card type Tag-Con can be used for practical use. For example, nowadays, there are several electronic money services, but users cannot hold several RFID cards in a wallet due to collision problems between the cards. Using Tag-Con, users can intentionally select the one they choose to use. Also the fact that none of the RFID tags are activated when the buttons are not pressed, this connects to preventing

unlawful data skimming by others. By activating a singular tag at a time, they can also be used as an ID with an input. For example at an office, it could be used for identification and also by pressing the button, it could mean like “Attendance” or “Leaving Office”. We are planning to develop an specific application using these two types.

4. Conclusion and Future Work

RFID technologies are used in many opportunities and new applications are being developed in human-computer interaction using RFIDs. Compared to sensors, RFID tag does not require power supply and also they are considerably low cost. However, usually in RFID technologies, one RFID tag is attached to one object and contexts such as rotations of physical posture of the object aren’t used. Also among several RFID tags, although they sometimes contain similar terms or related information, they are not classified and grouped so the number of objects increases and in order to handle many objects, the interaction becomes complicated. In this research, we proposed an new interface “Tag-Con”by switching multiple RFID tags according to the object’s rotations or the pressed buttons. We developed a cubic type that could be controlled by rotation, and a card type that could be controlled by pressing the buttons.

We are planning to develop more practical applications, along with other types of Tag-Con. We are also planning to conduct tests to evaluate Tag-Con by comparing Tag-Con with other existing interfaces.

Literatur

[1] S. Hinske and M. Langheinrich. RFIDice - Augmenting Tabletop Dice with RFID, Proceedings of 4th International Symposium on Pervasive Gaming Applications, 2007.

[2] T. Masui, K. Tsukada, and I. Siio. MouseField: A Simple and Versatile Input Device for Ubiquitous Computing, UbiComp2004, Springer LNCS3205, pp. 319-328, 2004.

[3] Jun Rekimoto and Eduardo Sciammarella. ToolStone: Effective Use of the Physical Manipulation Vocabularies of Input Devices, Proc. of UIST 2000, 2000.

[4] K. Fishkin, B.Jiang, M. Philipose and S. Roy. I Sense a Disturbance in the Force: Unobtrusive Detection of Interactions with RFID-tagged Objects, IRS-TR-04-013, 2004.

[5] T. Matsumoto, D. Horiguchi, S. Nakashima, and N. Okude. Z-agon: mobile multi-display browser cube, CHI • 06 extended abstracts on Human factors in computing systems, pp. 351-356, 2006.

[6] CubeBrowser. http://cubebrowser.openkhm.de/

[7] M. Beigl, A. Krohn, T. Riedel, T. Zimmer, C. Decker, M. Isomura. The uPart experience: Building a wireless sensor network , IEEE/ACM Conference on Information Processing in Sensor Networks (IPSN) pp. 366-373, 2006.

[8] K. Laerhoven, A. Schmidt and H. Gellersen. Pin & Play: Networking Objects through Pins, Proceedings of the 4th international conference on Ubiquitous Computing, Springer LNCS 2498, pp. 219-228, 2002