Tangible Media Player with embedded RF tags*

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Abstract

We present a new type of media system, nomadic Tangible Media System (*n*-TMS), which allows users to play or control digital media by adopting tangible interface. In order to replace conventional interface such as mouse or keyboard, we introduce two types of RF-enabled objects, i.e. media and control objects. We first attach RF tag to each content object and then retrieve media data using the media object. Using the control object, user plays digital media at any networked computer with RF tag reader. According to experimental results, it offers a simple and intuitive interface with tangible objects for those who are not familiar with computers. The proposed *n*-TMS can be applied to various applications such as interactive education, entertainment, smart toys, etc.

1 Introduction

Rapid development of computer and communication technologies helps people access multimedia over network. Since the concept of "Ubiquitous Computing [1]" was introduced in early 90's, there have been various research activities supporting Weiser's idea, i.e. integrating computers seamlessly into the real world as parts of the environment. Meanwhile, manipulating a media player in a computer is still inconvenient for people who are not familiar with computers even though interactions are largely confined to Graphical User Interface (GUI). Recently, research activities on Tangible User Interface (TUI) have paved a new way to overcome such inconvenience in connecting human and computer. For example, stimulated by Weiser's idea, Ishii et al. looked forward to exploiting physical objects as new interface to access digital information. The "Tangible Bits [2]" allows users to "grasp & manipulate" bits in the user-centric views by coupling the bits with everyday physical objects and architectural surfaces. Tangible bits also enables users to be aware of background bits at the periphery of human perception using ambient display media such as light, sound, airflow, and water movement in an augmented space. Such activities on new interface will provide easy, aesthetically pleasing and emotionally engaging access to digital information even for those who are not familiar with computer.

As explained, Tangible Bits provides intuitive interface for people to control media data by adopting physical objects to access digital information and vice versa. The advantage of Tangible Bits is that they bridge the gaps between cyberspace and the real world, as well as the foreground and background of human activities. For example, the musicBottle [3], genieBottles [4], and MusiCocktail [5] projects are representative applications weaving Tangible Bits into music player. The musicBottle and genieBottles present an interface to access digital information (music or story) using glass bottles as "containers" and "controls". The design gives digital contents to bottles and exploits the human senses of touch and kinaesthesia. While, MusiCocktail allows users to influence certain parameters of a piece of music in the way they mix their beverages. MusiCocktail can enhance the interaction in a social space by providing a new and entertaining

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form of interaction with music, by strengthening the sense of community through collaboration. However, all the interactions are focused on the opening and closing of bottles to release virtual contents and the manipulation is taken place only in the special installation table. In addition, the systems also have limited choice of music and stories.

To overcome such disadvantages, we propose a new type of media system, nomadic Tangible Media System (*n*-TMS) with RF-enabled objects. In order to replace conventional interface such as mouse or keyboard, we introduce two types of RF-enabled objects, i.e. media and control objects. We first attach RF tag to each content object (e.g. CD case, poster card, toy, etc.) and then retrieve media data using the media object. The control object plays the retrieved media in the networked computer with RF tag reader. The proposed *n*-TMS offers a simple and intuitive interface with tangible objects for those who are not familiar with computers to easily play or control digital media in computer or over Internet without using mouse and keyboard [6]. The proposed *n*-TMS can be applied to various applications such as interactive education, entertainment, and smart toys.

This paper is organized as follows. In Section 2 we describe the proposed *n*-TMS. The implementation and experimental results are explained in Section 3 and 4, respectively. Finally, the conclusion and future works are discussed in Section 5.

2 Nomadic Tangible Media System

As shown in Figure 1, this system consists of Tangible Object (TO), RF Module (RFM), and Tangible Media Player (TMP). TO contains information about digital media and controls for media player in RFID tags. RFM plays a role in reading or writing the information in a RFID tag, and TMP plays digital media according to the information.

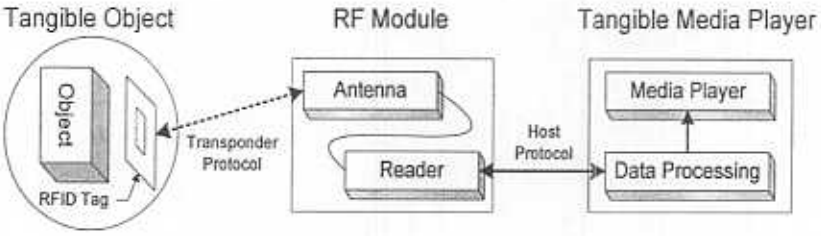
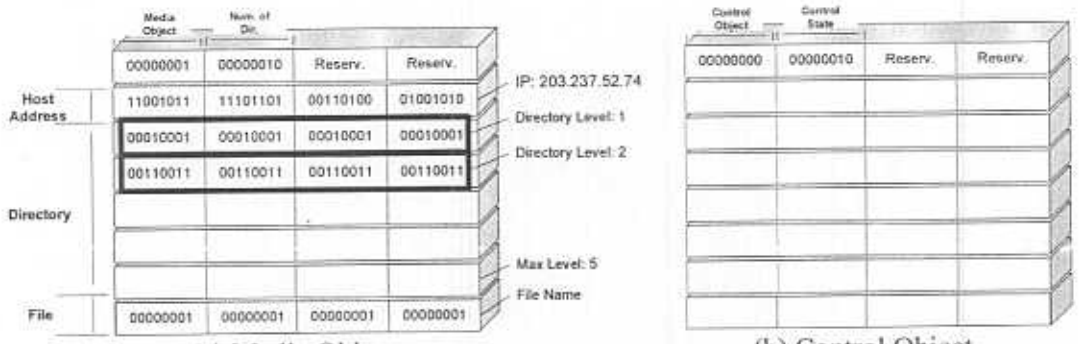


Figure 1: Component of *n*-TMS

2.1 Tangible Object

TO combines cyber space and real world by attaching RFID tags to the objects in real world. RFID tag is a thin and flexible "smart label" which can be laminated between paper and plastic, and contains eight memory blocks, where each block consists of four bytes, as shown in Figure 2. If first block in TO is '00000000', it is a control object, while '00000001' indicates that it is a media object.

As explained, we introduce two types of RF-enabled objects, i.e. media and control objects. As shown in Figure 2(a), Media object (e.g. CD case, poster card, etc.), containing the URL of the multimedia in a RFID tag, consists of number of directory, host address, directory, and file. The number of directory represents the depth of directory of digital media in a remote computer. For example, if the number of directory is 00000010, it means that first two memory blocks and last block, respectively, contain the name of the directories and the file name of the media. Meanwhile, control object (e.g. dice or toy) controls the retrieved media with RFID tags representing 'Play, Stop, Pause, FF, RW, VolumeUp, and VolumeDown' according to the data of control state, as shown in Figure 2 (b).



(a) Media Object (b) Control Object

Figure 2: RFID Tag for Media/Control Object

2.2 RF Module

The RFM consists of a tag antenna and a tag reader. To transfer signal from TO to TMP, RFM uses two protocols: transponder protocol and host protocol.

Transponder protocol defines a way to communicate between a tag reader and RFID tags. The transponder protocol is activated when a RFID tag is inside the working area of the tag antenna. Then the antenna transmits the frequency to supply the operating energy and to transmit the data from the tag reader to the tag. The tag derives the operating energy from the transmitted frequency to response to the reader and returns the requested data. The antenna receives the coded signal from the tag and the reader starts to communicate with the host computer.

Host protocol defines a way to communicate between the host system and the tag reader. It is designed for point-to-point, half-duplex communications, with the host controller acting as primary station and the reader as secondary station. Host protocol also is a binary and bytecount-oriented protocol. In most cases, it consists of request/response pairs where the host waits for the response before continuing. The host computer initiates all communications using the host protocol. A command from the host computer to the reader contains coded instructions and parameters. The responses contain the status information and resulting data.

2.3 Tangible Media Player

TMP consists of data processing module and media player. Data processing module transforms the RFM signal in a media object to the URL or RFM signal in a control object to the command of TMP and vice versa. It also allows users to easily make a media object through the 'writing' command. Media player automatically retrieves with the URL and plays the media according to the commands in control object, e.g. Stop (00000000), Pause (00000001), Play (00000010), FF (00000011), RW (00000100), VolumeUp (00000101), VolumeDown (00000110), etc. As shown in Figure 3, the hash table is referred by media player to determine the directory and file name in the media object.

Key	Value
00010001/00010001/00010001/00010001	Demo
00110011/00110011/00110011/00110011	Movie
01110011/01110111/01110011/01110011	Music video

(a) Hash for Directory

Key	Value
00000001/00000001/00000001/00000001	U-VR.meg
00000011/00000011/00000011/00000011	Rainbow.avi
00000111/00000111/00000111/00000111	Myheart.qt

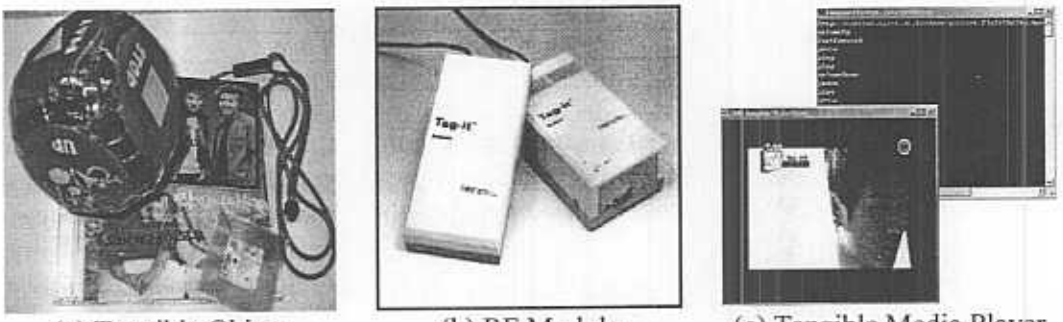
(b) Hash for File

Figure 3: An Example of Hash Table for Media Object

3 Implementation

The proposed n-TMS is implemented in the 'ubiHome', a testbed for ubiComp-enabled home applications [7][8]. The RFM of *n*-TMS is attached under the table in ubiHome, and it is connected to PC where TMP is installed through the RS232 serial port. The resulting media was displayed on TV in ubiHome.

As shown in Figure 4(a), there are two types of TO. A dice is used as a control object by attaching the RFID tags to each side and both CD case and photo of music video are used as media objects by sticking the RFID tag of media object on the objects. Figure 4(b) shows RFM (Texas Instrument's S600 Reader and Antenna Set-RI-K01-320A). TMP, as shown in Figure 4(c), is implemented in JMF (Java Media Framework) which supports some formats of digital media (e.g., .wav, .avi, .mpeg and .qt).



(a) Tangible Object (b) RF Module (c) Tangible Media Player

Figure 4: The Implemented Components of *n*-TMS

Figure 5 and Figure 6, respectively shows the implemented *n*-TMS and the corresponding working area of RFM in ubiHome.

Figure 5: The implemented *n*-TMS in ubiHome

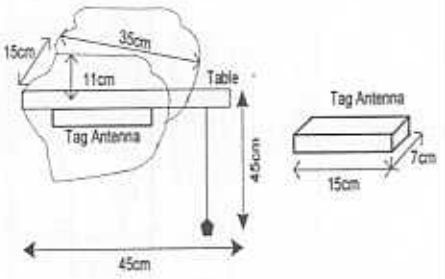


Figure 6: The working area of *n*-TMS

4 Experiments

To show the usefulness of *n*-TMS, we compared TUI-based system (n-TMS) with GUI-based system (WMP: Window Media Player). To perform subjective evaluation, ten volunteers were participated to test both systems. Half of them are above fifties (group A) who are not familiar with computer, while the remaining half (group B) are in twenties with good knowledge of computers. We provided them with the URL information of digital media. We measured the time duration from selecting a digital media to playing it. We also obtained the information about the user's satisfaction after they were given a chance to use with conventional means.

Table 1: The result of Group A

	WMP	*n*-TMS
Time duration	>> 30 min	2~3 min
Satisfaction	Low	High

As shown in Table 1, while most of the group 'A' felt difficulties in operating WMP with mouse and keyboard, they easily controlled *n*-TMS with tangible objects. All of them were satisfied with *n*-TMS as they did not feel any inconvenience to select digital media and control media player.

Table 2: The result of Group B

	WMP	*n*-TMS
Time duration	1~2 min	1~2 min
Satisfaction	Normal	High

As shown in Table 2, group 'B' took the same time duration to use both *n*-TMS WMP because they were familiar with operating PC. However, they were interested in the proposed easy and aesthetical interface of *n*-TMS, and enjoyed using tangible object in the form of a necklace.

5 Discussion

While the conventional Media playing systems use keyboard and mouse as GUI-based interface, the proposed *n*-TMS uses a physical object such as dice, CD case or photo of music video as TUI-based interface. According to some preliminary experimental results and subjective evaluation, we observed that the proposed *n*-TMS allows users an easy, aesthetically pleasing and emotionally engaging access to digital media. In addition, it offers a simple and intuitive interface for those who are not familiar with computers. Without loss of generality, we expect it can be applied to other general applications of PC such as e-mail and web browser.

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