Media Clips: Implementation of an Intuitive Media Linker

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Abstract— **This paper introduces Media Clips, a novel platform that merges technology and methods ranging from near field communications (NFC) to tangible user interfaces (TUI). Media Clips will enrich the user's end experience and improve the ease of use in media data handling. Media Clips are compact, and easily manufactured. They are low cost devices with acceleration sensors and displays, while also utilizing near field communication. They can collect, transfer and share media data through intuitive user interaction by using NFC and server-client network systems. They can also merge several types of media data by shaking Media Clips together, which enables the users to feel like they are physically handling virtual media. With the server-client network solution, Media Clips transfer and store only the tag information of media data, which are very small in size. This method significantly reduces the media delivery times, compared to the traditional way of transferring the full size of the data. The architecture of Media Clips, application usage examples and its implementation results will be outlined.**

Index Terms— **consumer electronics, multimedia systems, multimedia communication**

I. INTRODUCTION

THE methods of collecting and transferring media data have always undergone constant development, ever since humans have found a way to store data in certain substances, an example being magnetic materials. The first generation products that handled media data were analog. The gramophone, long playing records, cassette tapes and videotapes can be good examples, but could only contain relatively limited content size, and could also be worn out from use.

The second generation was mainly in the domain of digital media, such as the Compact Disc, Digital Versatile Disc (DVD) and the Blu-ray Disc (BD). This generation showed a technologically improved, higher density media, which was significantly higher in quality than the previous generation. This digital generation was a breakthrough point from the analog generation. This type of media also shared a characteristic of being noise free, except for quantization noise, and was possible for user to perform simple actions such as fast forward, rewind, and to choose a specific play list.

We have come to the point where we need to explore the question of what criteria the next generation in handling media data should contain, to break apart from the current generation. There are four characteristics that will set apart the way media data will be handled.

First, the media must be unlimited in capacity. The capacity of BD, which have been developed with the latest technology, can contain up to 128 GB worth of data. This capacity limitation needs to be broken through.

Second, the media transfer time must be instantaneous. Many of the technological devices these days focus on high speed data transfer, but in order to truly become next generation, this transfer time must be kept down to a distinguishable point, because the end users don't want to wait for a long time transferring high quality media data.

Third, the user must be able to collect, transfer, and play the media data intuitively, through simple interaction. Traditionally, a user inserts a media disc into a player specifically made for playing that type of media. Another way would be for the user to turn on their computer or TV, and then find the suitable media from a browser, in order to play it. This process can be reduced with a new method of handling media.

Last, it is important that the new method should provide the user with enjoyment and new experiences. A tangible user interface (TUI) that allows the user to "grasp and manipulate" media data, is a good example. This TUI can bridge the gaps between cyberspace and the physical environment, as well as the foreground and background of human activities [1].

In this paper we will introduce a small device called "Media Clip" and explain it in terms of how it will be applied in applications based on the four characteristics mentioned above. Media Clips can collect, transfer, share and shake media data with an intuitive user interaction. The system implementation, example applications and test results will be presented.

II. RELATED WORK

This paper places a lot of emphasis on intuitive interacting, tangible interfaces and media data linker with ambient characteristics on small hand-held devices.

In order to help consumers experience different ways of handling media data, researchers have proposed a variety of user interfaces. The TUI [1, 2] has emerged as a popular and

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powerful concept for blending digital data with the real world. Pick-and-Drop [3] uses a physical tool to transfer digital data directly between information devices. Tool Device [4] is similar to Pick-and-Drop in that they are both used to move media files between networked computer displays and computers, while differ by providing local haptic feedback. Slurp [2] provides haptic and visual feedback while extracting and injecting pointers to digital media between physical objects and displays. Its smart-office scenario is closely related with this paper as a media linker. However, we were able to compensate for a weakness that exists in the older generation of devices, which had characteristics of lacking information. This is because the user had to wait until the device was turned on and the information to be displayed, while with the application of the EPD display, that problem is resolved.

Researches on interaction techniques, such as multi-finger and multi-hand touch interaction [5, 6] techniques have increased over the years. Proposals to use the back of small touch devices for interaction have been made [7]. These techniques are suitable for multi function devices where the user needs to select appropriate functions. We think these techniques will be considered a strong option when Media Clips are used as an embedded function of NFC enabled mobile phone [8] in later projects.

For device to device or device to real world interactions, pointing and scanning is used frequently [9]. This technology enables the user to collect information from physical objects [10], while also making information exchanges between devices possible in the most minimal effort [11]. Media Linker was strengthened by adapting these technologies. Furthermore, unlike the products that exist today or research results, we propose creating a simple and cost effective device that could enable the end user to own multiple devices.

III. THE MEDIA CLIP

The Media Clip is a compact device that handles media data, able to be manufactured at low costs. The main components consist of a micro processor, NFC chip, acceleration sensor and a display. Fig. 1 shows its components, and Fig. 2 shows the system block diagram.

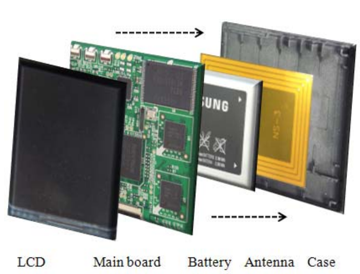


Fig. 1. The components of Media Clip

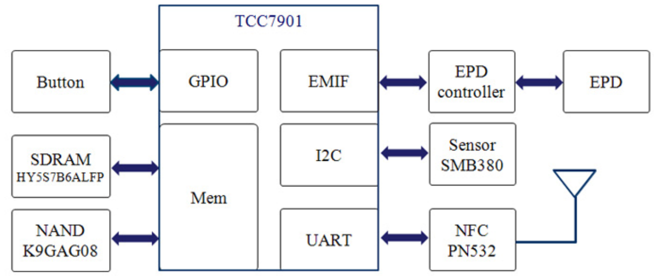


Fig. 2. System architecture of Media Clip

In order to truly lead the way in becoming the next generation of devices that handle media data, we focused on making a device that had an instant media transfer rate, had an unlimited capacity, and able to interact intuitively, giving the users a new tangible experience. Furthermore, to make it a portable mobile device, we tried to design it so that there was almost zero power consumption, while still be able to be manufactured at low costs.

A. *Server-client model*

The Media Clip runs under the server-client model. To provide the users with an instant media transfer time and unlimited capacity, it is not desirable to transfer the full amount of data. When the Media Clip receives the media data, the original media data is sent to a dedicated data location in a server and its thumbnail image and the uniform resource locator (URL) information from the server are stored to the Media Clip. Both personal and public servers can be used to store the original media data. The Transmission Control Protocol / Internet Protocol (TCP/IP) and home networks such as Digital Living Network Alliance (DLNA) technology can be used to support server-client model. In this project we used a personal computer as a server with Microsoft Windows share folder and Linux share folder functions. With this server-client model, around 30~40 Kbytes worth of data need to be transferred to the Media Clip, effectively reducing media data transfer time. Also, the original media data is stored on the server; it is easy to become free from the capacity limitations.

B. *Near field communication*

To apply the NFC technology, we used the PN532 chip from NXP semiconductor. The PN532 is a highly integrated transmission module for wireless communications. Using the NFC peer-to-peer mode, Media Clips can support wireless communication at speeds up to 424 Kbits/s in both directions. When Media Clips get in range (about 50mm) to host devices such as a computer or TV, they start to transfer selected data, so users can transfer media data intuitively.

In regards to power consumption, NFC currents run up to 150mA. However, when being used, Media Clips transfer between 30~40 Kbytes of data, which takes about 1 to 2 seconds, and then go into sleep mode. Assuming that the Media Clip is not used frequently, but 4~5 times per day, the total power consumption per day in working mode is:

$150 \text{ mA} \times 2 \text{ seconds} \times 5 \text{ times} \times 3.0 \text{ V} = 4.5 \text{ Ws/day}$

The power capacity of normal mobile phone battery is

2.96Wh. With this battery we can use the NFC function for:

2.96 Wh × 60 × 60s / 4.5 = 2368 days

The sleep mode power consumption is an important factor. PN532 supports Soft Power Down mode, which consumes only 25uA. The PN532 can be woken up from a Soft-Power-Down mode when an enabled event occurs on one of the wake up sources. The wake-up source that we implement is radio frequency (RF) field detected. With this policy NFC parts consume a very small amount of power.

C. Display

Selecting the proper display was very important due to power consumption. Usually, displays consume almost half the total power consumption in mobile devices. To let the user easily identify information the Media Clips currently have, the display had to show the contents continually, which in conventional displays would need a lot of power. This is why we use Electronic Paper Displays (EPD) as a display for the Media Clips. An EPD is a display that possesses a paper-like high contrast appearance, and has ultra-low power consumption levels, while also being thin and light. The EPD has a bi-stable characteristic, so it can hold spread images even when power is removed (see Fig. 3). This characteristic helps reduce the power consumption of Media Clips drastically.

Fig. 3. Bi-stable characteristic of the EPD

D. Acceleration sensor

An acceleration sensor is used to be aware of user actions. When a “shake” action is detected, Media Clips merge different types of media data together to make a new type of media data. This function is required for Media Clips to be able to distinguish the user shaking it from ordinary roll and pitch as a result of the user just walking around with it. We logged data from field tests and set the threshold.

E. Prototype

We made several prototypes of Media Clips to see determine the usability on different platforms. Making a low cost device was one of our goals, but for this prototype we used a powerful micro processor which was over the specification, because we wanted to determine the feasibility of it being used. Using test results, we could estimate the computing power, and later chose a suitable micro processor.

Table I shows the list of main components. We planned on using a 1.9” sized EPD display, however only 5” sized, 800x600 resolution EPD’s are available in the market today. Using a 5” sized EPD significantly hinders the mobility of Media Clips, but we also couldn’t test the usability of Media Clips without a display. We decided to make two prototypes. The first has a 2.01” sized liquid crystal display (LCD) with 176x220 resolutions. The second has a 5” sized EPD, and we tested the usability of the Media Clips in both cases. Fig. 4 shows the two prototypes.

TABLE I
MAIN COMPONENT OF MEDIA CLIP

Components	Details
CPU	TCC 7901 (Telechips)
EPD controller	S1D13521 (Epson)
EPD	ED050SC3 (PVI)
LCD	CT020TN10 (Samsung)
Acceleration sensor	SMB380 (Bosch)
NFC	PN532 (NXP)
OS	Linux

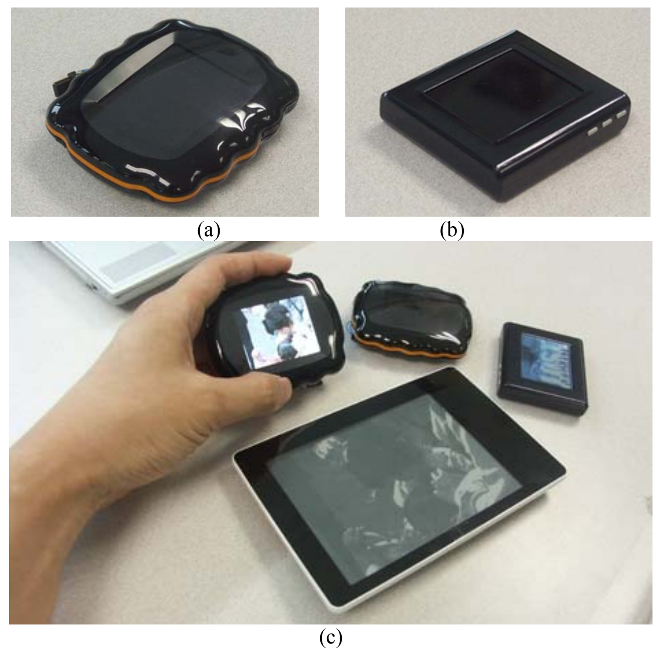


Fig. 4. Several types of Media Clips; (a) Normal, (b) Slim, (c) Using the EPD

F. Software architecture

A Media Clip interacts with host devices such as computers and TVs. For demonstration purposes, we prepared two notebooks as host devices, which were connected to the internet. They were also connected to the PN532 evaluation board, to interact with the Media Clips. Fig. 5 shows the S/W architecture we implemented on the Media Clips. The operating system is a Linux, and has both LCD and EPD display drivers, which were used selectively for testing purposes. Fig. 6 shows the S/W architecture of the host device, having implemented both Microsoft Windows and Linux systems (kernel 2.6.24). When there is a request for information, the media data information is sent to the Media Clips. The host device also receives media data information from the Media Clips, and plays the media, for which the source can be found on the server.

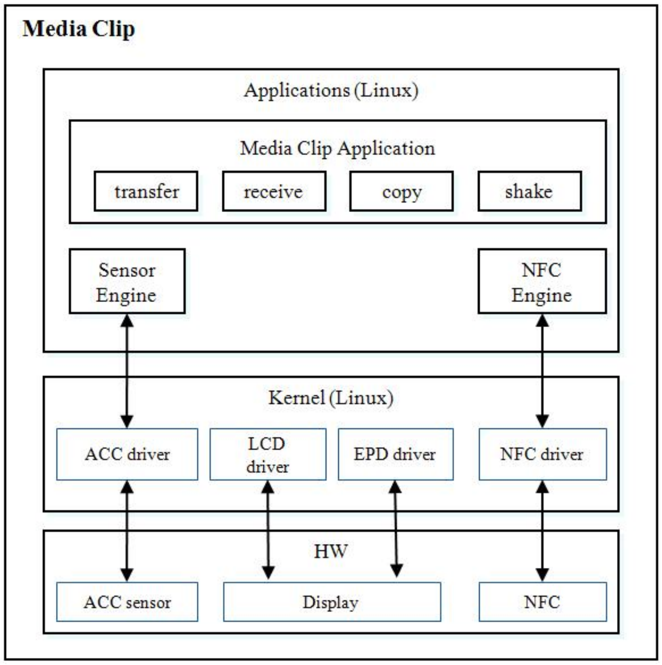


Fig. 5. S/W architecture of Media Clips

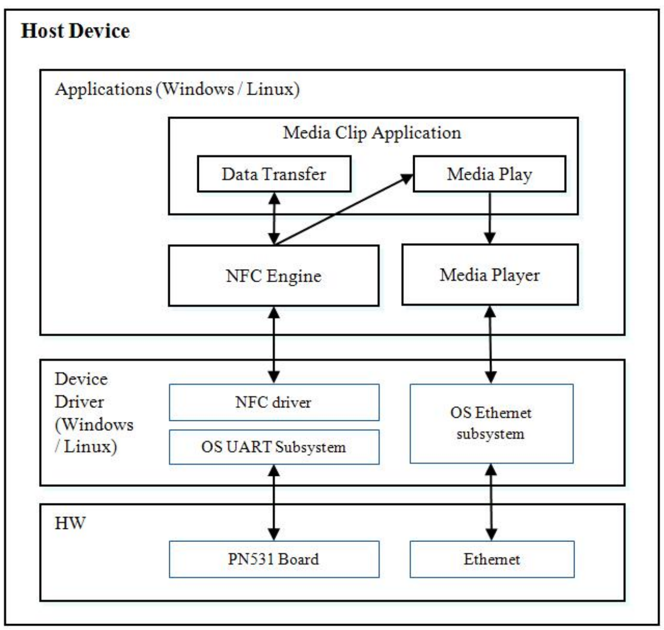


Fig. 6. S/W architecture of host device

IV. EXAMPLES IN APPLICATIONS

Several examples of the usage of Media Clips in applications will be outlined next. Fig. 7 shows the initial flow chart when a Media Clip is turned on. If it already contains data, the contents will be displayed and then go into sleep mode, waiting for interaction. If there is no data in the Media Clip, the display is turned off and then goes into wait mode.

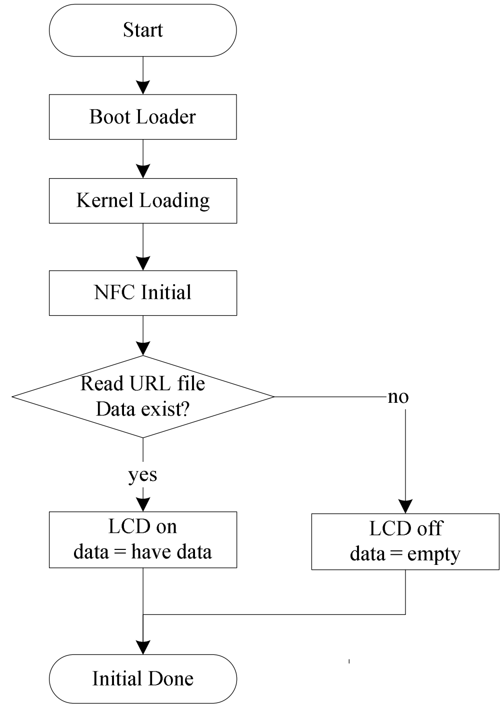


Fig. 7. Initial flow chart of Media Clip

Fig. 8 shows the basic working flow chart of transferring, clearing and showing data.

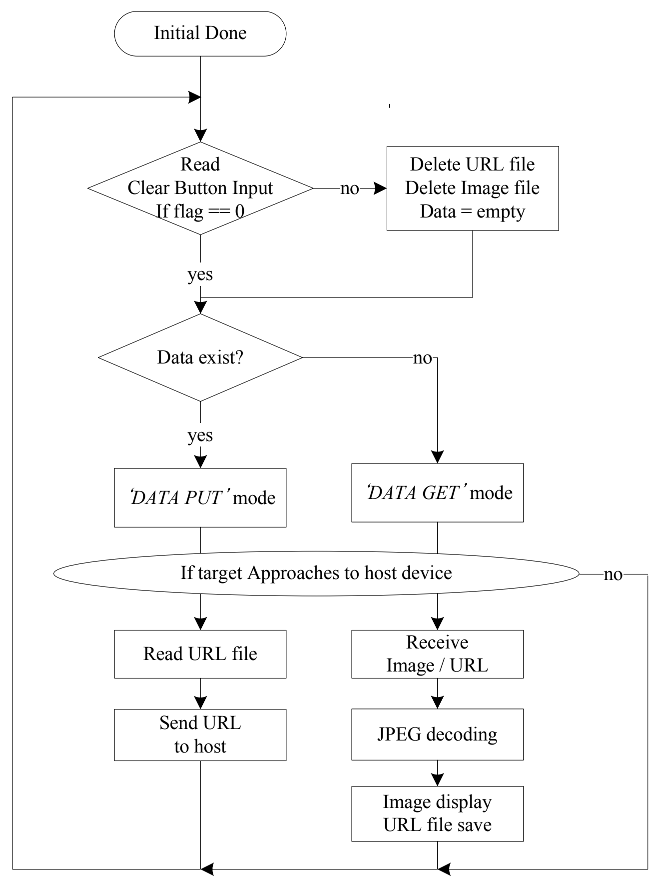


Fig. 8. Basic working flow chart

Collecting

Users can collect media data into their Media Clips just by touching their devices or approaching their empty devices to a host device. With several Media Clips, the user is able to possess virtual media data stored in the invisible space as a device with a physical form (see Fig. 9). If the Media Clip doesn't contain any data, it sends a "data get" message to the host device when approached within 50mm. The host device forwards the request for the media data to a server, and gets the URL information from the server. It then reads the URL information and thumbnail image of the selected media data, and sends the data over to the Media Clip. The Media Clip stores both kinds of information to the memory, and displays the thumbnail image to inform the user.

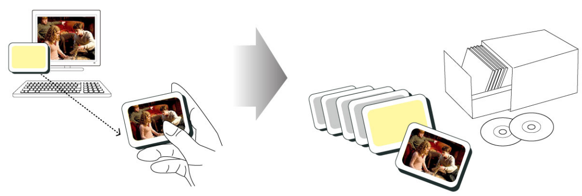


Fig. 9. Collect media data from host device

Playing

Users can play the media data by touching or approaching the Media Clips to host devices (see Fig. 10). This is a simple process, compared to conventional methods that could include having to search through files in a browser, then playing the wanted content. When the Media Clip is close to the host device, it sends a 'data put' message, which includes the URL information. The host device then connects to the server with the URL information and then plays the dedicated media.

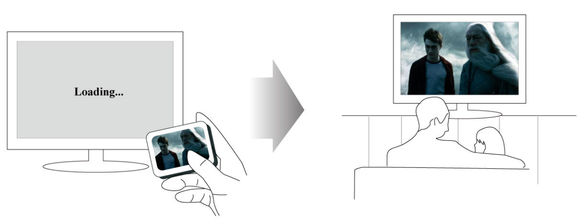


Fig. 10. Play media data using Media Clip

Sharing

It is possible for a user to share media data with others by giving them the Media Clip(s) (see Fig. 11). Because we focused on designing a very low cost device composed of minimal parts, it is possible for users to trade them with friends, just like sharing books or DVD titles. Their friends can play the Media Clips in their homes by interacting with it using their home devices. The devices would receive the URL information from the Media Clip, and play the media. Media Clips also support copying to other Media Clips by touching them together (see Fig. 12). If a user presses the copy button on the Media Clip, it goes into copy mode. The URL information and thumbnail image data will be copied over to the other Media Clip.

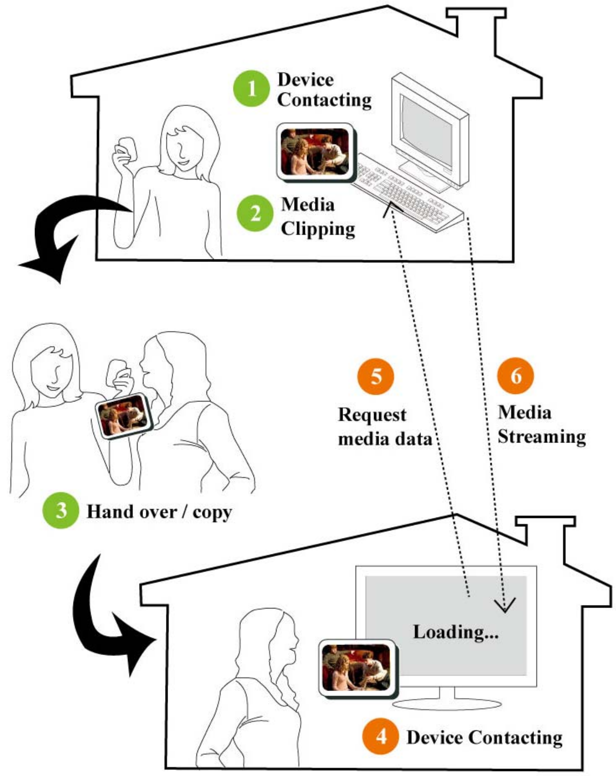


Fig. 11. Example of sharing media contents

Fig. 12. Copying to other Media Clips

Shaking

The shaking mode is a newly proposed, tangible way to give users a new experience in handling media data (see Fig. 13). Shaking is similar to making a cocktail. This function allows users to mix two kinds of media data together by "shaking" Media Clips physically, to get a new type of Media Clip. For example, one Media Clip has music content inside and another one has images. These two types of media can be merged into one by shaking them together, and the amalgamated media data will be stored as another form of media type, in each of the Media Clips. When the shaken contents in the Media Clips are played, both images and music will be played together.

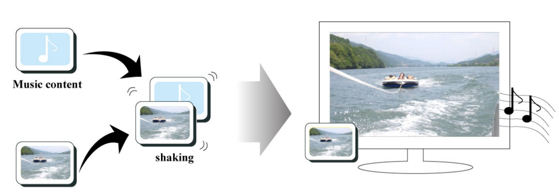
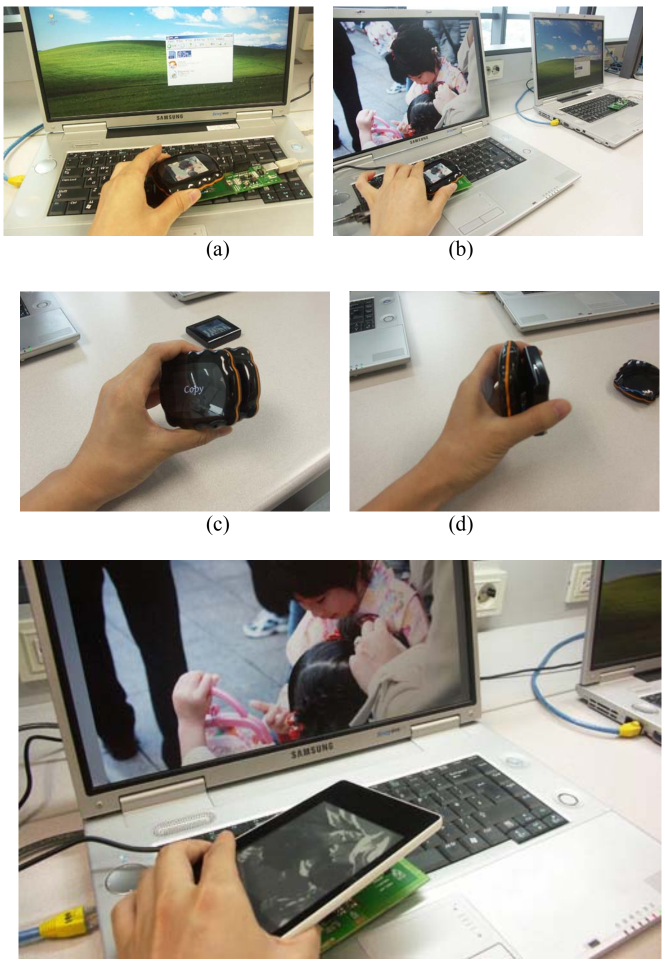


Fig. 13. Mixing media content

V. TEST RESULT

To determine everyday usability of the Media Clip, collecting, playing, and copying times were measured (see Fig. 14). For each case, the test was run 20 times, and 3 kinds of media data were used for the transfer test. In both collecting and copying tests, thumbnail images and media URL information were transferred. For the playing test, only the media URL information was transferred. TableII shows the results, showing that it usually takes around 1~2 seconds for collecting and copying media data, and around 1 second for playing.



(a) (b) (c) (d) (e)

Fig. 14. Media Clips example application; (a) collect, (b) play, (c) copy, (d) shake, (e) play with EPD clip

TABLE II
DATA TRANSFER TIME

Contents	Collect	Play	Copy
Image	1.65s	0.84s	2.45s
Video	1.75s	0.90s	2.48s
Music	1.49s	0.80s	2.22s

The relation between the distance of each devices and the success ration of transferring data by NFC was also tested.

Fig. 15 shows the results. NFC runs well when the distance between devices is shortened to within 45mm for collecting and playing, while for copying data, the distance had to be shortened down to under 30mm.

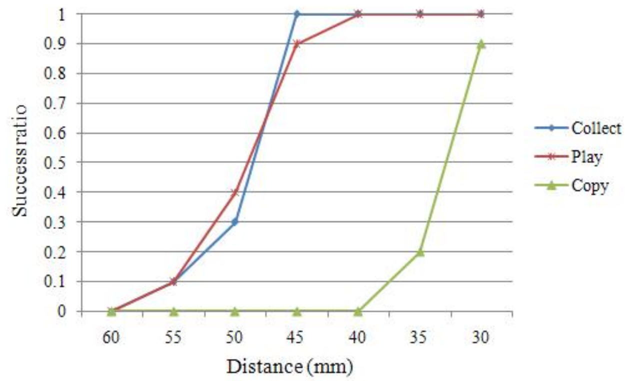


Fig. 15. Relation between distance and success ratio

To find out user satisfaction score for Media Clip scenarios, 30 people were asked for evaluating the Media Clips. Fig. 16 shows the results. Elder people like collect & play and sharing scenario most, whereas younger people have more interest in shaking scenario.

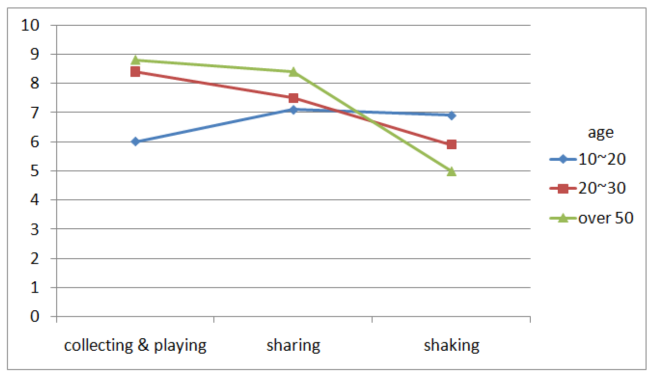


Fig. 16. User satisfaction score

VI. CONCLUSION AND FUTURE WORK

In this paper we discussed the key aspects of next generation media handling methods. Unlimited capacity, instant transfer speeds, and a new user experience in interacting with devices were the most important factors. With these factors in mind, we developed a novel device called Media Clip, which can collect, play, share, and shake media data with intuitive user interaction using NFC technology.

Media Clips support instant transfer and unlimited capacity based on the server-client model. Physically shaking Media Clips together through tangible methods to mix data provides users with a new experience. As an independent mobile device, power consumption is an important factor that we did not fail to miss, and utilized an EPD display, which is a change from the traditional devices that exist in the market. Due to the bi-stable characteristic, the Media Clip consumes minimal power in static mode, while still showing the contents. Considering the dynamic power consumption levels, we reduced the size of the transferring media data with the server-client model, effectively shortening the transfer time. With this power management system Media Clips require very low power consumption.

In conclusion, three issues were covered in this paper: (1) Media Clips, and the explanation of this novel prototype media handling device, (2) proposed new interaction methods with enhanced usability using NFC technology (3) presenting the architecture of the system, S/W architecture and application examples where these have been implemented into Media Clips.

As future work, we are planning on adapting 2” sized EPD displays and a proper microprocessor, so that we can implement the Media Clip to be manufactured at very low costs (under $5). The Media Clips are start point of our research on intuitive media handling device. We focus on developing targeted service scenario for elder people. Retrieving user evaluation for the device is also planned.

REFERENCES

[1] Ishii, H. and Ullmer, B., Tangible bits: towards seamless interfaces between people, bits and atoms. In *Proc. CHI 1997*.

[2] Zigelbaum, J., Kumpf, A., Vazquez, A., Ishii, H.: Slurp: tangibility spatiality and an eyedropper. *Ext. Abstracts CHI 2008*.

[3] Rekimoto, J. Pick-and-drop: a direct manipulation technique for multiple computer environments. In *Proc. UIST, 1997*.

[4] Ikeda, Y., et al. TOOL DEVICE: Handy Haptic Feedback Devices Imitating Every Day Tools. In *Proc. HCI International, 2003.*, pp. 661-665.

[5] Wilson, A.D. Playanywhere: a compact interactive tabletop projection-vision system. In *Proc. UIST 2005, ACM Press, 2005.*, pp. 83–92.

[6] Wu, M. and Balakrishnan, R. Multi-finger and whole hand gestural interaction techniques for multi-user tabletop displays. In *Proc. UIST 2003, ACM Press 2003.*, pp. 193–202.

[7] Baudisch, P., Chu, G. Back-of-Device Interaction Allows Creating Very Small Touch Devices. In *Proc. CHI 2009*.

[8] Tuikka, T. ‘ PhonePhone’ – NFC Phone as a Musical Instrument. In *Proc. CHI 2009*.

[9] Rukzio, E., Broll, G., Leichtenstern, K., Schmidt, A. Mobile Interaction with the Real World: An Evaluation and Comparison of Physical Mobile Interaction Techniques. In *Proc. AmI 2007*.

[10] Broll, G., Haarlaender, M., Paolucci, M., Wagner, M., Rukzio, E., Schmidt, A. Collect & Drop: A Technique for Physical Mobile Interaction. Adjunct In *Proc. Pervasive 2008*.

[11] Chavira, G., Nava, S. W., Hervás, R., Villarreal, V., Bravo, J., Martín, S., Castro, M. Services through NFC technology in AmI Environment. In *Proc. iiWAS2008*.