

## **Prototyping of Digital Ink E-Mail System Based on a Common Ink Format**

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This paper describes the prototyping of a digital ink e-mail system based on a common ink format. This e-mail system can deal with handwritten figures and text strings on a same electronic paper.

Digital ink is useful to express one's message on electronic paper (digital paper). Because digital ink is similar to real ink used on real paper, it is easy to use even for the end user. But on existing e-mail systems, most messages are written in text only. We think that the e-mail system must be made more user-friendly and useful if digital-ink is to be easily used on it. To deal with digital ink on an e-mail system, we have designed a new document format "HandsDraw" which can be used for text, simple figures and digital ink. This format is so simple that it is easy to implement software which can deal with it on any computer system. We also have made a prototype digital ink e-mail system. This system uses "HandsDraw" to exchange handwritten messages by e-mail.

We think the digital ink e-mail system allows e-mail users to express their messages more quickly, directly and intuitively.

### **1. INTRODUCTION**

#### **1.1. Using Digital Ink on E-mail**

On real paper, handwritten figures are often used by people to express their idea. However most of the messages are just written as text on digital paper (Figure 1). To use figures on digital paper like on real paper, digital ink is necessary. Digital ink makes digital paper as easy and intuitive to use as real paper.

Now, digital paper is used for remote communications via e-mail. E-mail allows fast communications between people over long distances than letters. This is one of the most valuable aspects of e-mail communication. Digital ink could make an e-mail more powerful and useful tool for remote communications.

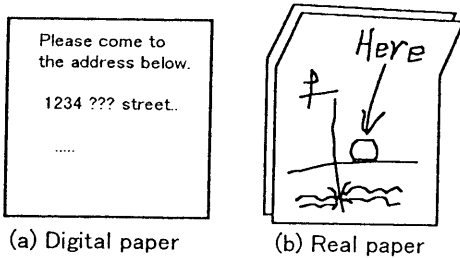


Figure 1. Messages on former digital paper and real paper.

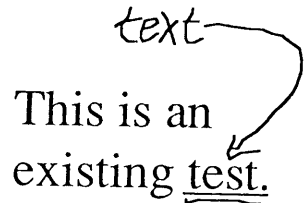


Figure 2. Handwritten comment on an existing text.

## 1.2. Ink Format

Digital ink is not very popular in network communications because there are no effective common data formats which deal with digital ink. In the following description, we refer to the document data format which can deal with digital ink as the “ink format.”

An ink format is considered to be “effective” if it is useful and suitable for use in digital ink e-mail messages. On an e-mail system, a message sent by a user may often be edited by another user. So the ink format used in e-mail systems must be easily editable. For example, Adobe PostScript is a very powerful document format (language) used to express images on digital paper, but a document described in PostScript may be very difficult to edit after it has been created. As another example, image data formats such as GIF or JPEG can be used to express handwritten image data. But such image data formats can become very large when expressing digital papers. Also the image format is not very useful for handwritten comments on an existing text message (Figure 2).

The “common” ink format is free and easy to use for anyone. The specification of the ink format must be completely open and must be simple enough to implement easily by any programmer who has any normal programming skills.

While there are some existing document formats that can deal with digital ink, there are no “effective” and “common” ink formats. Therefore, we have designed a new ink format called “HandsDraw.”

## 2. HANDSDRAW

### 2.1. Overview of HandsDraw

HandsDraw is a kind of “draw” data format. A HandsDraw document has several pages, and there are some primitive objects placed on each page. Each primitive object represents a specific figure (Figure 3). Digital ink is represented as a group of handwritten stroke objects.

The HandsDraw document is described by text strings (Figure 4). Each description of primitive figures is written in sequence according to the order of the layer in the document page. In other words, an object on the lower layer is described earlier in the HandsDraw description. In Figure 4, the “Oline” is placed on a lower layer than “Oval.”

### 2.2. Preservation of Time Information

At the time when a document is created, the order of object layers is the same as the order in which the objects were created. But after modification of the object layer, the order may be

different. Because the handwritten stroke order is important (as used in character recognition), time information must be preserved itself independent of object layer information.

HandsDraw has a structural field and a data field in each page area. In the structural field, object creation order is preserved away from the object data.

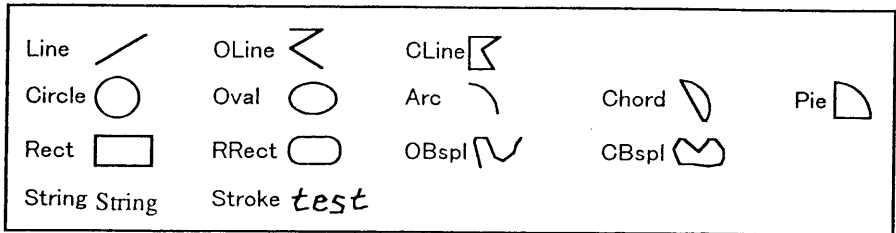


Figure 3. Examples of primitive objects.

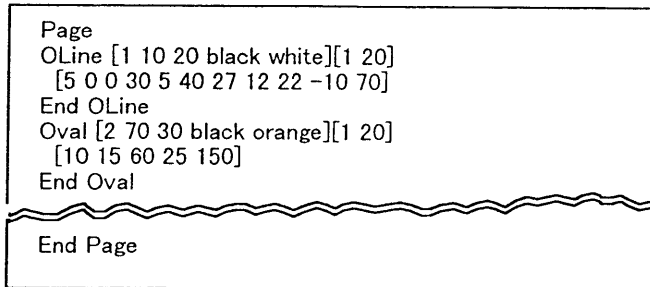


Figure 4. Example of HandsDraw description.

### 2.3. Preservation of String Width

Because HandsDraw may be used in many kinds of situations, some character fonts used in a HandsDraw document may not exist on a computer system. If another font is used, the character position may be changed. As shown in Figure 5, while a circle is drawn over the character "A" on the original (Courier font) string, the circle is at "st" on the next (Times Roman font) string. If a user wants to point out "a" by circling it, the Times Roman example does not agree.

For instance, Adobe PDF files can include font information in the document itself, so it can avoid this difficulty. But this font information is too heavy to send by e-mail.

HandsDraw solves the problem by keeping the whole string width. In the third example (revised), the string width is equal to the width of the first string (Courier). The string width is adjusted by the gaps between each character. Of course, each character position is not completely fixed, but is in almost the same as the original position.

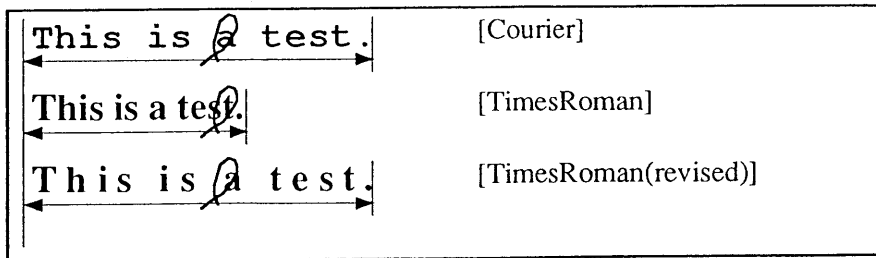


Figure 5. Font Width Revision

### 3. PROTOTYPING OF DIGITAL INK E-MAIL SYSTEM

We have made a prototype program for digital ink e-mail systems. This program can send a HandsDraw document to the mail server by SMTP (simple mail transfer protocol; rfc821) and receive it by POP (post office protocol; rfc1081). Usually, an ink e-mail message is encoded by MIME to tell the recipient that the message is written by HandsDraw.

On the Internet, there are some mail environments which cannot keep MIME headers. In such cases, binary files cannot be sent via the Internet. But HandsDraw mail can be sent in such environments because they are written only in text.

### CONCLUSIONS

We have designed a new document format "HandsDraw" which can include digital ink with text and simple figures on the same digital paper. The main feature of the format is that it is completely open and is simple to implement easily by any programmer.

We have made a digital ink e-mail system using this format. We think that this format will make e-mail systems more friendly and useful for end users.

### ACKNOWLEDGMENTS

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