

SmartPen

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ABSTRACT

In our work, we describe a new writing device created by Livescribe: the Smartpen. This is an intelligent pen that is very much used now, especially in the academic community. It distinguishes itself from the ordinary pens due to its innovative and computational functionalities, because this type of pen allows the user to record his notes, audio files and also gives him moments of leisure with the many different applications. In this work, we also suggest some improvements that we consider important, according to our experiments, as well as some different features.

Keywords

SmartPen, Livescribe, Technology, Infrared, Augmented Reality.

INTRODUCTION

In this paper we talk about an increasingly common writing technology called Smartpen.

Being one of the latest and useful gadgets on the market today, this practical tool's only purpose is to make our life easier. It is small and compact, it is helpful in more than one way and it can be used by just about anyone. The Livescribe Echo Digital Smartpen is a very ingenious pen that not only can write but records too [6].

This pen not only writes like any other pen but it also hears and keeps the information we know that is important and do not want to forget. Recording is done by simply tapping the record button in the notebook to start and tapping again to stop. Through the standard cable it is possible to connect the pen to the computer, which passes all the recordings and also turns possible the search to find both verbal and written notes [1].

This useful tool is perfect for anyone who writes and needs to keep track of any type of information. The pen not only has a great looking, ergonomic design, it also has a soft rubber grip to make sure your fingers do not slip. Replaceable ink cartridges are available, a standard 3.5mm earphone jack is a standard feature and we can use either an Echo 3-D headset or our own.

There are language applications to help with translations, a dictionary with a thesaurus, to assist with studying and productivity and, of course, games. The music application would be great for anyone who can compose or read music simply by writing in our writing pad. There are

over 100 applications available, making this SmartPen a great device to be used in the day-to-day living [2].

INVENTION OF THE SMARTPEN

History and Creation

Since people started to use goose feather for writing, then passing through the pen cartridge and reaching the simple ball pen, the way people wrote had passed through a major evolution. It is now possible to have a pen with more features than the simple writing.

The company called Livescribe [8], which was founded by Jim Marggraff, had developed a tool that can be used by any person. For that, it was based on the model of a normal pen, making then a new redesign and adding some electronic features. By this way, it was created a multi-function writing tool called SmartPen [7]. This innovative pen is considered the most significant evolution that has happened to the regular pen since the advent of the computer. It contains a small OLED display which shows the user the information about what had been written and what had been stored or collected from an application.

This idea came up when Jim Marggraf was still working at the LeapFrog company and after he had developed the FlyPen, which was technically impressive and with computerized devices. However, this new pen was not commercially attractive, resulting in its failure due to the need of a special paper (Fly Paper) so the pen could read what was being written [8].

Purpose of the invention

The Smartpen is quite useful in several situations, such as saving notes of a certain phone call so the user can hear it later, or even to record some contents discussed during a conference in order to allow withdrawing notes whenever necessary. This pen, beyond writing on regular paper, has many different features when writes on a special paper made with microdots, created by Livescribe. Thus, the smart pen can write, can record and it can also play audio. The playbacks of previous recordings can be performed directly on the smart pen because it has a small microphone and a speaker which allows the user to record and play whenever he needs to. It is also possible to transfer

all the data stored in the smart pen's memory to a computer via a USB cable [8].

There are a large number of accessories available, such as paper and ink cartridges, all created by Livescribe. The unique characteristics of the functionality and the creativity that these pens provide are ideal for a personal or a professional utilization. The soft rubber tip and the ergonomic design fit comfortably in either hand, and its size is based on standard measures.

The interaction between the Smartpen and the computer allows the computer to store, to search and to play notes or recordings. It also allows the user to consult, organize and manage all the notes that were previously written and then export audio files [8].

This device is a pioneering venture into new territories, which will bring new ideas and better products.

FUNCTIONING OF THE SMARTPEN

SmartPen's features

The SmartPen is able to write, to record, to replay audio files and also to transmit information to other devices. Beside these basic features, the SmartPen has other applications such as a translator demo, a dictionary, games, and it also possible to personalize it in the way that the user wants.

With this device, it is possible to perform translations by simply selecting the language and then directing the pen over the desired word that the user wants to translate in order to hear it. One of the main features of this pen is the possibility to define the meaning of a word or even solve some mathematical problems [3][4].

Among the many existing applications, either included in the smart pen or downloaded from the internet, the pen has a piano simulator, which gives orientations to the user on how to draw the keyboard of the instrument on the paper sheet. Then, the pen also asks the user to write the letters *i* for instrument and *r* for the rhythm. After the draw is done, it is only necessary to point the pen and press it into each keyboard position previously designed, in order to listen to the correspondent sound of the musical notes. This demonstrates the ability of the paper to recognize all the positions on the paper.

This type of pen also presents features to entertain its users. There is a great variety of entertainment applications, since games or utilities, among many others more. For example, the piano application already pre-installed in the SmartPen Echo allows the user to draw an eight keyboard piano, and play it directly on the notebook [9].

As said before, the letter *i* represent the instrument and the letter *r* represent the rhythm. When each of them is pressed, it changes to the next instrument or to the next rhythm installed on the smart pen. Piano, vibraphone, steel drum, violin or flute are some of the instruments the user can choose, selecting at the same captivating rhythms to follow the music.

The SmartPen can be personalized by the user, since its microprocessor uses JAVA technology, which allows the

developers to build their own applications. This feature takes out the limitation of the pen, that is, the user can have more software than only the pre-installed ones, giving him a bigger variety of applications. Since this technology is in constant evolution, the Livescribe Company has launched a set of tools to enable the users to create their own applications [1].



Figure 1

Internal Operation

The SmartPen is available with several memory flash capabilities, since the 1GB to the 16GB.

The SmartPen Livescribe Echo appears like a regular pen, being however more thick, but not constituting a limitation to the user. This pen has a good design for an efficient interaction with the user because it contains a small soft rubber on the edge, so the fingers do not slip during its use.

Approximately in the central part of the pen, it presents a built-in microphone and a speaker, just nearby the OLED display. The microphone captures all the audio information in a clear way, while the speaker allows this information to be heard. The OLED display is bright and clear and it shows a good graphic quality, where the brightness can be adjusted. This display shows the navigation between the applications, giving the user a feedback of all of his actions through the speaker.

The new version of the Smartpen has the capability to storage until 800 hours of recorded audio: the Livescribe 4 GB Echo Smartpen storages 400 hours and the Livescribe 8 GB Echo Smartpen storages 800 hours [10].

Augmented reality and the Smartpen

The Augmented Reality is an environment that evolves either the virtual reality as the elements of the real world, creating a mixed environment in real time.

The Augmented Reality (AR) is related with the Ubiquitous Computing (UC) and with the domains of the wearable computing. Mark Weiser had determined that the Ubiquitous Computing tried to express the opposite concept of the virtual reality (Mark Weiser's personal communication, Boston, March 1993). The most remarkable distinction made between the AR and UC is that

the second does not focus on the disappearing of the conscientious and intentional interaction, as much as the AR focuses. The UC systems, like the diffused computational devices, keep the concept of the interaction very explicit and intentional, which is involved in a typical work of AR, as Ronald Azuma's [11].

The Smartpen is a real object which we can interact computationally, becoming an Augmented Reality tool. This smart pen, besides writing like a regular pen, presents some technological features that allow the user to play a piano with it and with a draw on his dot paper notebook.

RESULTS

After we had tested all the available applications in the SmartPen Pulse, we had registered some observations.

Starting with piano application, we found it very explanatory because the pen itself informs the user about what he has to do. We tested all the different rhythms as well as all the existing instruments. For that, we used the symbols r for the rhythm and i for the instrument, stating its good efficiency.

The second application that we tested was the Paper Replay. Initially we had some difficulties when we wanted to replay a recorded session. Since we had never used this type of pen before, in our first utilization we found the navigation between the menus a little confusing, and only after some interactions we could understand and use this application quit well.

We had also noticed that when we were trying to record a session, the smartpen only recorded the audio and did not allowed recording what was being written simultaneously on the notebook.

The third application tested was the Translator Demo. In this application we did not find any difficulties on accessing it. However, we had noticed that the number of words that it is possible to write and therefore being translated is very limited, as well as the number of languages. We also observed that it is not possible to neither record the text nor write big texts. This could be explained due the fact of the application be a demo version. During our research on the newest models of the SmartPen, namely the Echo version, it has much more possibilities in this type of application.

After several utilizations of the menu navigation commands, we verified that the navigation was a little difficult. Sometimes it was necessary to click more times on the navigation arrows on the notebook so we could go to following option. In order to solve this inconvenient problem, we had to change to the next page and use a "fresh" navigation menu.

When we tested the Bookmark application, we realized that it was a quick way to access the smartpen main menus. However, we had noticed that this application contained some useless options, which could be replaced by some useful functions. This happens due the fact that the most available shortcuts existing on the footer of the

notebook had almost the same function, as will be explained in the following subtopic.

At last, we also tested the Livescribe Desktop application. In our experiments, we observed that this application is only useful to the smartpen's owner or for who has their personal data, because it is not possible to perform any interaction with the computer; the application always requests for login authentication. This situation leads to a good principle of privacy and security. During our tests with this application, the only functionality that was allowed was to charge the smartpen's battery.

In general, when we use this smartpen for the first time, the navigation menu can be a little confusing. However, after some exploration and more usage of the menus, the user's options becomes simpler and more understandable, leading him to make less mistakes and get less confused.



Figure 2

Improvement suggestions

After several experiments with the smartpen, we concluded that this new type of pen could have more menus and more efficient ones. Therefore, we suggest a "play" button in order to reproduce the recorded sessions more quickly, and the elimination of the "jump" button (figure 2). This button causes some confusion about its function, and besides not being very clear, it is not very useful because it has practically the same function as the menu bar "jump to position".

We consider that it would be useful to have an instant access for each of the existing applications, or at least the most important ones, like the translator demo, the piano and also the settings (figure 3).

In order to preserve the menus and the icons presented on the cover of the notebook, we consider that the smartpen should not be able to write on it, because as we have seen in the navigation arrows, the more we use it the harder it becomes to navigate between menus.

Another functionality that we propose should be the possibility of the smartpen to have multi ink cartridge. This option would allow the user to change the color whenever they need.



Figure 3

New features

In this work, we also propose some new features to the Smartpen. One would be the inclusion of a multi-colored ink cartridge, which would help the user whenever we want to change the color of his notes. Another feature that we propose is to adapt the pen's tip to be used as an infrared pen on an interactive whiteboard [5].

An infrared pen is actually a very useful device that allows a computerized interaction on an interactive whiteboard. This interaction is made in a simple way, being only necessary an infrared pen, a computer, a projector and a whiteboard.

The communication with the interactive whiteboard is based in the transmission of an infrared signal to a receiving device. Then, this device sends the data via Bluetooth connection to the computer, and using appropriate software, it identifies the information that is being projected on a regular whiteboard, transforming it into an interactive whiteboard (figure 4).

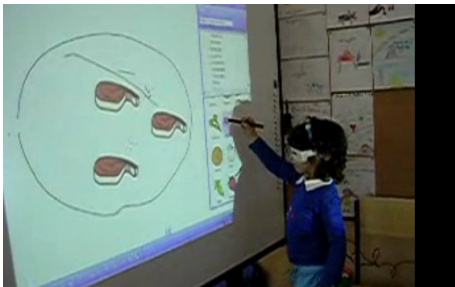


Figure 4

Therefore, we think that the Smartpen should also include this new feature. For that, it is only necessary a replaceable pen tip with an embedded infrared LED. As the new versions of the Smartpen has already Bluetooth connection, it is not necessary an additional receiving device besides the computer. By this way, the Smartpen itself would be capable of sending the data to the computer via Bluetooth connection, which in turn would be projected in a whiteboard (figure 5).

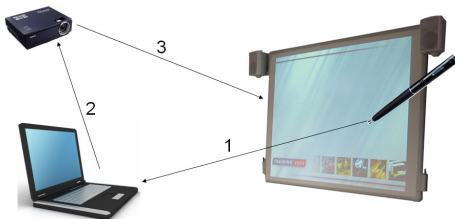


Figure 5

The above figure shows the interaction made between the infrared Smartpen with the interactive whiteboard. The following steps explain how his interaction works.

1 – Considering that the Smartpen has already a Bluetooth device, the infrared signs transmitted by the pen are

automatically sent to the computer via Bluetooth connection.

2 – Once the pen signs have been received, and using proper software to convert them, this information is resend to the projector.

3 – The projector sends the information transmitted initially by the pen to a white board, becoming therefore into an interactive whiteboard.

This process always works as a cycle, whenever the pen writes new information on the board.

DISCUSSION

Once we had concluded the verification of the Smartpen features, we can affirm that this pen has been improved over the years and becoming an extremely useful device to all kind of people, but particularly in the field of the education. This pen can be used in everyone's day-to-day, or even to professional purposes, such as conferences or lectures.

After this study had been done, we believe that the Smartpen that was used in our tests was a little limited because some of its features were just for demonstration. However, with all our research we found that the new versions of the Smartpen already are more evolved because they contain much more complex and even more useful features, which in turn makes people want to buy it. Even though the cost is a little high, we think that it does not represent a limitation to acquire the Smartpen. This new pen will be a tool with a constant evolution because it will have more and more beneficial features to the user.

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