

Design Issues and Product Lifestyle Management:

SAiNT

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Introduction

Throughout the design process of the SAiNT, there were many different design issues that needed consideration. Several hurdles needed to be overcome in order to produce a successful design. There are also many elements that could be improved upon. This paper will specifically discuss product lifecycle management, universal design, as well as safety, and the design issues surrounding them.

Product Lifecycle management

Product Lifecycle Management (PLM) has become critical in today's society as the need for data driven processes in product development continue to grow. During the development of the SAiNT, PLM was used during every step, ensuring that project requirements were met. Several factors have had a major impact on the lifecycle of SAiNT. These factors include design, production, distribution, consumption and retirement.

There are several physical and technical aspects of SAiNT that can be improved using PLM. Product design has been a major factor in the lifecycle of the SAiNT. One of the key characteristics of the SAiNT is portability. Currently information from our key logger and audio recording circuit must be retrieved separately. Fitting the entire device into a standard keyboard would be a major improvement. This could be accomplished through assembly modification by combining both the key logging and audio recording circuit into one compact circuit. This would allow data transfer from both circuits to be retrieved simultaneously. Reducing the size of audio recordings is a technical aspect of the design which may also be improved. Currently, SAiNT stores raw audio data. By compressing the audio stream, the size of the audio recordings could be significantly reduced. This would allow for a higher volume of use without interruption.

Another goal of SAiNT was to be low cost, so it is widely available to all consumers. There are several areas in which the production cost of the SAiNT could be cut and increase distribution. The biggest expense of the device is the key logger. By developing our own key logger rather than using existing technologies, cost could be greatly reduced. Another way to improve production cost would be to store keyboard and audio data into one mass storage device, rather than two separate devices. This would not only decrease production cost, but also save the consumer cost on 3rd party purchases for the SAiNT.

SAiNT is marketed towards those with sight disabilities. However, the concept of the device is also appealing to a wide variety of audiences. Many device features have been considered in order to increase the distribution of the SAiNT. Further development of the software interface would increase the attractiveness of the device. This would include simple feature enhancements, such as the ability to add markers as timestamps. Also, simple audio editing features, like the ability to trim audio files, would be desirable. The compact size of the device increases the appeal to those who travel often throughout the day, such as college students.

The way in which consumers use the SAiNT plays a big role in PLM. As a result, consumption of the SAiNT has some key areas which could be improved. In order to analyze this aspect, we must consider how the SAiNT is actually used in the field, rather than thinking from a theoretical standpoint. Power consumption has been taken into consideration through every stage of the SAiNT development. There are several ways in which this area can be further improved. Currently, the MSP430 is being used to achieve audio recording, this device has several complex features which can be utilized to maximize efficiency. Reliability has also been important in the consumption of the SAiNT. Selecting simple components which only specialize in a specific task helps to repair and maintain the device over a longer time period.

Usability has played a major role in the lifecycle of the SAiNT. Several usability aspects can be improved. Expanding the functionality of the SAiNT to work with a wider range of keyboards would be a great improvement. People with sight disabilities use special keyboards, known as accordion keyboards, which are currently not compatible with the SAiNT. In addition, allowing for different types of mass storage devices, such as USB flash drives, would increase usability. Currently, the SAiNT will only accept SD cards for storage.

There is much that can be improved before the SAiNT reaches a state of retirement. In addition to all the factors mentioned before, many areas of the Software Interface could be improved. Since one of the critical design goals of the SAiNT was to target persons with sight disabilities, increasing the accessibility of the software would be a high priority. This would include increasing the software compatibility with existing screen reading technologies. There are several physical aspects of the device which can be improved to increase accessibility. Having voice activated controls to assist the blind would be an ideal goal before the retirement of SAiNT is reached.

Universal Design

The ultimate goal of the SAiNT project is for it to be accessible to the visually impaired. Therefore, throughout the SAiNT design process, universal design needed to be considered. Some important accessibility features which can assist those who are visually impaired include audible notification of when the product is operating, easy start-up, and intuitive design. These goals provided many unforeseen design challenges for which the final product will be improved upon.

In order to allow for the visually impaired to know when SAiNT is turned off, an audible tone should be played from one of the microcontroller output pins. This allows for the user to know when the device has been activated and is recording both text input through the keyboard and sound through the microphone. The startup process of SAiNT is very intuitive. In order to achieve proper functionality, the device merely needs to be turned on without any overhead configuration. Turning on SAiNT automatically initializes the SD card into SPI mode and begins recording audio samples to the SD card in a continuous stream. There are no other buttons or processes that need to be completed before beginning recording. The only problem with this method of operation is that every time SAiNT is turned on, the previous recording will be saved over.

One of the greatest design challenges was the implementation of an intuitive design to usability. This is an area where there is a tremendous window of improvement. SAiNT is able to record an audio stream. However, the audio stream is not stored as a recognizable file on the external memory source because a fully function FAT32 file system cannot be supported by our microcontroller. This means that the audio data needs to be manually extracted from the SD card using a HEX editor so each byte on the memory source can be analyzed. Once the data is extracted, it needs to be saved as a text file, imported into Audacity (a sound playing engine), saved as a .wav file, and then finally imported into the SAiNT user interface, allowing for the text to be synchronized to audio. All of these steps require a substantial amount of knowledge in regards to project functionality and where the data is being stored. Future improvements would include upgrading to a more advanced version of the MSP430 that would allow for a full FAT16 or FAT32 file system to be used. The operating system would then recognize the audio stream and the SAiNT GUI would easily be able to import the audio. Since the user interface was designed as in a cross platform manner, SAiNT should allow for installation on any operating system.

One of the future goals of the GUI includes compatibility with one of the many different screen reader programs. Screen reader compatibility allows for universal usability regardless of sight capabilities.

Safety

A product's reliability and safety are a major concern for all designers. Designers must consider safety problems as a top priority when designing a product. Throughout the design process of SAiNT, safety issues were a major concern.

Since user safety has always been our highest priority, the safety of the product has been analyzed at every stage since development began. As the designers, we must assume that all our users have either no engineering background or are inexperienced with electrical equipment. We considered all the possibilities that may cause harm. For example, incorrect operation of SAiNT could potentially cause electric shock, fire hazard, or explosion. Environmental factors, such as weather, could also cause product failure and be harmful to our users.

SAiNT is broken down into several parts. Power, as well as hardware design, is necessary for all electronic products. Incorrect implementation could be very dangerous and lead to incorrect functionality. For our project, we used a power supply and a step down voltage regulator which delivers 3.3V and 20mA current to drive the SAiNT's hardware. Although the current we are supplying is not high enough to cause cardiac arrest or death, it can still cause a discomforting shock or minor skin irritation. We need to ensure that the power supply and the voltage regulator will operate correctly without electric leakage. The power supply could be improved through the addition of a DC to DC converter. This would decrease power consumption by only drawing the necessary amount of current to power the device. This improvement would not only increase batter life, but also decrease safety hazards. Additionally, a DC to DC converter would reduce the amount of heat produced by SAiNT. Finally, since SAiNT will be operating on battery power, extra care needs to be taken in order to ensure the batteries do not overheat, melt, or explode during normal usage or while charging. To accomplish this, a simple fuse or similar protection circuitry could be implemented.

The physical composition of the SAiNT was also carefully considered. The SAiNT hardware consists of a combination of several different electrical components. As a result, there are a dense amount of wires which must be compacted to fit within a small enclosure. This is

dangerous since a simple short in the wiring could produce undesirable behavior. In order to prevent this, all wiring must be well shielded and carefully assembled. In addition, electrical testing must be conducted after inserting the hardware into the device enclosure. The hardware needs to be well mounted in the enclosure to ensure that electrical components do not shift during device usage or transportation. Since SAiNT has been designed using low power components, heat is not a major issue. Environmental operating conditions are also a lower priority concern since SAiNT is intended to be used in an indoor setting.

The major safety concerns surrounding SAiNT are listed above. Throughout the design process, these issues were considered and attempts were made to achieve the highest possible safety standards.

Conclusion

SAiNT can be improved in many different ways. Application of product lifecycle management to the SAiNT project should help to increase marketability throughout its lifespan. Data driven design techniques are a powerful tool to keep products competitive with other similar products. Along with product lifecycle management, universal design and safety considerations need to be made along the way. By applying all of these different design criteria to SAiNT, it will improve the integrity of the device and increase customer satisfaction.