David Clyde

Dr. James Hamblen

Headgear for visually impaired

**Headgear Power System**

**Introduction**

Headgear is a fairly new and growing technology that is used for many different purposes. The most current and popular use of headgear is its use in virtual reality and augmented reality in video game systems. There are many other uses for headgear other than gaming and the big picture of this paper specifically talks about the use of headgear to aid visually impaired people navigate in their environment. The headgear will be able to scan the user’s environment and use haptic and audible feedback to alert the user of either a dangerous or safe path to follow. The specific aspect of the headgear this paper reviews is the power system and batteries required to operate the headgear technology.

**Battery types and options**

For embedded systems and devices that run on batteries choosing a proper battery is essential to the operability and lifetime of the device. The most common battery type is alkaline batteries which have been around for decades. Alkaline batteries are cheap and safe to use and come in many different sizes such as coin cell, AA, AAA, and 9 volt batteries. Although Alkaline batteries are cheap and safe to use they are not rechargeable, which leaves them best used for low power devices such as toys, alarms, and flashlights. Another low cost battery type is Nickel Metal Hydride or NiMH. NiMH batteries can also come in AA and AAA battery sizes, however unlike Alkaline batteries NiMH batteries are rechargeable. Lithium Polymer batteries are useful for higher powered embedded systems devices such as smartphones which predominantly use this type of battery [1]. Lithium batteries are made of sheets of cathodes and anodes coated in liquid electrolyte all inside a bag [2].

**Choosing a battery type**

There are a few parameters engineers use when deciding the proper battery to use in a particular device. The most common parameters used in assessing a battery type is the nominal voltage, energy capacity, energy density, and self-discharge rate. If a battery does not meet the required nominal voltage of the device batteries can be placed in series or parallel to meet this requirement. Energy capacity is the stored energy the battery holds. Energy density is the ratio of the size of the battery to the energy stored in the battery. In general the higher the energy density the more expensive the battery. The self-discharge rate of a battery is the parameter used to describe the batteries useful lifetime. Even when a battery is not being used there is always some small current leakage in the battery. Most batteries have a shelf life of anywhere between one and two decades [3]. As processing power goes up the battery power or energy density required to operate such devices also needs to go up. Lithium polymer or lithium ion batteries have the highest energy density of all other battery types, which is why they are used in most smartphones. The processing power of a portable device such as a phone is determined by the energy density of a battery. To make batteries smaller with the same energy density cell phone batteries have removed the protective layers of the battery and made them non removable [2].

**Optimizing Power Consumption**

Processing power of battery powered devices is limited to the technology of batteries. In the past twenty years processing power has increased a thousand fold whereas energy density has only increased three fold [2]. Choosing the perfect battery for a particular device isn’t always enough to keep up with the demand for processing power in current technology. Battery powered devices need an efficient way to consume battery power. One aspect of technology that consumes a lot of battery power is memory. The simplest model for memory is flat memory where data is stored in a single consecutive memory block. With the increase in memory size the power required is also increased. To reduce power consumption memory blocks can be divided into small sub blocks where each sub block of memory can be turned off when not being accessed in order to reduce power [4]. Clock frequency of a device is also a big parameter in power consumption in that power consumption increases linearly with clock frequency. A particular device must use the optimal clock frequency that can be supported by the battery used in the device [5].

**The Future of Battery Power**

A recent breakthrough in battery technology could lead to the redesign of all battery operated devices. This new battery technology is called structural batteries. Structural batteries are sheets of carbon composite materials that can be shaped into the very object the battery is intended to operate. Structural batteries can be formed to any complex three dimensional shape. Instead of wasting space to place a battery in a device the device itself can be formed using structural batteries. Structural batteries can be microscopically thin and formed into any fabric. They work like normal batteries and can be recharged at the mains or using solar energy. Further future developments of structural batteries will lead to lower lifetime cost to consumer devices by reducing the need to constantly buy new batteries [6].

**Citations**

[1] Contributors, “Battery technologies,” [Online]. Available: <https://learn.sparkfun.com/tutorials/battery-technologies>. Accessed: Oct. 22, 2016.

[2] N. Kedem, “Six things to know about smartphone batteries,” CNET, 2012. [Online]. Available: <https://www.cnet.com/news/six-things-to-know-about-smartphone-batteries/>. Accessed: Oct. 22, 2016.

[3] K. Odland and S. L. Inc, “Selecting the best battery for embedded-system applications,” EDN, 2010. [Online]. Available: <http://www.edn.com/design/power-management/4363832/Selecting-the-best-battery-for-embedded-system-applications>. Accessed: Oct. 22, 2016.

[4] Shariq Hussain, “Energy Optimization for Low Power Embedded Systems,” Journal of Information Engineering and Applications, vol. 5, no 8, 2015. [Online]. Available: <http://www.iiste.org/Journals/index.php/JIEA/article/viewFile/24734/25337>. Accessed: Oct. 22, 2016.

[5] Konstantin Mikhaylov, Jouni Tervonen, and Dmitry Fadeev, “Development of Energy Efficiency Aware Applications Using Commercial Low Power Embedded Systems,” in Embedded Systems – Theory and Design Methodology. Finland: INTECH, 2012. [Online]. Available: <http://cdn.intechopen.com/pdfs-wm/29219.pdf>. Accessed: Oct. 22, 2016.

[6] Imogen Reed, “Structural batteries: Building in power,” in altenergymag.com, 2012. [Online]. Available: <http://altenergymag.com/content.php?post_type=1889>. Accessed: Oct. 22, 2016.