Assistive Technology and Affordability

AP Seminar

September 2023

Word Count: 1,110

According to The American Psychological Association, Independence is the state of having freedom from the influence or control of other individuals or groups (n.d.) and as I.S. Kon States, there is no other personal quality as valuable as a person's independence (Kon, 1989). A person's independence relies on their ability to make and carry out decisions independently, without assistance from another individual (Kon, 1989). For many, having independence is simple in the early and early middle stages of life. But as people age into the late stages of life, Their independence may need to be assisted by external devices, or more formally, assistive technology. While many devices help individuals maintain their independence, There are barriers to their access, with the largest being cost. Technologies that improve the independence of individuals who are differently abled can be made affordable through modern technologies and efficient manufacturing.

The need for affordable assistive technology is greatly amplified in resource-limited locations like Bangladesh. In a scholarly and peer reviewed work, Borg and Östergren's study brings light to this issue by revealing that despite the awareness of the availability of assistive technology, affordability remains the main obstacle to their widespread adoption in the area (Borg & Östergren, 2015). In other nations, social protection systems are implemented to provide assistive technology to those who need it. These protections may be in the form of insurance, universal health coverage, or direct provision. However, these programs are often insufficient and leave many users with a financial burden, putting them at risk of poverty (Cote, 2021). It is essential to develop assistive technology that can be better afforded by social protection programs or by the users themselves to prevent them from falling into poverty and to allow them to maintain autonomy.

One of the first steps in making assistive technologies more affordable lies in the design of the product. In recent times, minimalist design has been experiencing a resurgence, calling back to its mid-19th century origins. It can be seen everywhere, from Apple's website to the design of the new Tesla Cybertruck (2021). This idea can be applied to assistive technology as well. A simpler design results in fewer materials and less time in the manufacture of the device. The

combination of these two factors can lead to a lower cost of production and, therefore, a lower cost of the device. The use of simpler manufacturing in assistive technology can be best seen in an engineering design report by the TTK Center for Rehabilitation Research and Device Development (R2D2), and published in the journal *Disability and Rehabilitation: Assistive Technology*. In their report, the team detailed that in the team's third iteration of a manual standing wheelchair, the minimalistic design of the wheelchair allowed for lower manufacturing and tooling costs, as well as making the user more visible to others while using the device (Shaikh-Mohammed et al., 2023). In the production-ready iteration of the wheelchair, the team was able to reduce its cost to around 210 United States Dollars. When released to the public, this reduction in cost can make the device more accessible to a wider range of individuals who require assistive technology.

The widespread adaptation of low-cost microcontrollers and single-board computers has heavily impacted the field of technology. These devices are increasingly becoming more affordable and can be used for a wide range of applications. Some applications include the collection of data for monitoring and automated crop management. The versatility, in combination with the low cost of these devices, opens up a wide range of possibilities for their use in assistive technology. In a case study presented by the Lassonde School of Engineering and published by Springer International, a team of students worked to develop an assistive device that would allow those who are challenged by verbal communication to communicate their needs better. Their goal for the device was to make it an affordable alternative to commercialized devices by prioritizing the use of durable, customizable, low-cost, and open-source components. In the final iteration of the assistive device, the team was able to achieve all of their goals using an openly designed accessibility-enhanced human interface device, a Raspberry Pi, and a speaker. The total price of the device was around 80 Canadian dollars, with all the assembly instructions and code being readily available online (Hamidi et al., 2014). One benefit of using open-source components is that they can be manufactured by anyone and modified to fit the needs of the user.

New Developments in assistive technology can take advantage of microcontrollers to

create more advanced products while maintaining a low cost. An example of a device that takes advantage of this is the development of a robotic smart cane for the visually impaired. This product incorporates an Arduino microcontroller, an array of components, and a DC motor to navigate the user around obstacles and enhance its capabilities through a smartphone application. The smartphone application allows someone, such as a family member or caregiver, to set a destination for the cane to navigate the user to. The combined cost of the components used in the device is around 60–80 United States Dollars, making it an advanced yet affordable option for the visually impaired (Varela-Aldás et al., 2020).

Another example of a device that takes advantage of single-board computing solutions is found in the design of smart glasses for those who are visually impaired. A conference paper presented at the 2022 International Conference on Communication, Computing, and Internet of Things (IC3IoT), describes the development process behind the device. The device is designed to assist people who are visually impaired in recognizing people around them through the use of a camera, a microphone, and a speaker connected to a Raspberry Pi and ESP32 microcontroller. The device features many algorithms that allow facial and recognition detection, hot word detection, and text-to-speech. The device is also capable of connecting to the internet, allowing the user to access a wide range of information from Google and other services. The device's total cost can be approximated to 150 United States Dollars, making it another highly advanced yet cost-effective option for the visually impaired (Kumar et al., 2022).

To conclude, the development of affordable assistive technology is essential to ensuring that individuals, especially those who are aging or in resource-limited locations, can maintain their independence. By making use of minimalist design principles and the endless possibilities of low-cost microcontrollers in conjunction with open-source components, the realm of the field of assistive technology can make significant strides toward providing a more inclusive and equitable future. This will allow for more individuals to maintain their independence and live a more fulfilling life.

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