Section 3: Week 5: IoT and Special Needs

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TIM-7010: Computer Networking and Mobile Computing

July 28th, 2019

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# IoT and Special Needs

The Internet of Things (IoT) attempts to widen the interconnectivity of computers by interconnecting objects (Commission of the European Communities, 2009). These objects expose sensors connected to web services to provide personalized data feeds. Both academia and commercial vendors have only scratched the surface with their offered products and features. The Healthcare and Wellbeing product lines receive significant attention; however, they primarily focus on measuring simple body metrics (Koreshoff, Robertson, & Leong, 2013). Creating value through body metrics such as calories burned, steps taken, and blood sugar levels are simple marketable challenges to a broad audience. Due to the collection and reporting being a solved problem, there is significant competition among commoditized solution providers.

Addressing Special Needs with IoT represents a sizeable untapped segment within the Healthcare and Wellbeing problem space. Globally, over one billion people with a disability, where one of their primary sensors – smell, taste, touch, hear, see and say – does not reliably work. IoT devices can collect these missing senses and represent their values in other forms for the user. Hearing aids have been available for hundreds of years; they attempt to amplify or filter users' sounds. Though, what if the user cannot speak the language? Only increasing the volume does not address the root cause of the disability. Instead, placing a ‘babel fish’ in the person’s ear to translate in real-time. Similar scenarios exist for other senses, such as (1) computer vision to provide hints to the blind and (2) giving mutes a voice. These capabilities unlock these users from their isolated world and *interconnect* them with the broader community.

# Gathering Requirements

A product that meets the needs of its audience is more likely to be successful than one that does not. The development team needs to collect market research through surveys, interviews, and recording observations to ensure alignment. It can be difficult to gain these insights into special needs due to (1) limitations in communication methods; (2) identifying these individuals requires a membership arbitrator; (3) personal privacy concerns; and (4) regulatory requirements may prohibit the use and sharing of the information (Ferati, Kurti, Vogel, & Raufi, 2016).

Ferati et al. (2016) propose using IoT sensors around public places to collect anonymized telemetry. A local library might offer Braille resources and improve its discoverability and usability. By placing sensors around these resources, the librarians can quantify (1) are patrons entering that section, (2) how much time do they spend on the devices, (3) how extensively they are exploring the materials. The data might suggest that (a) patrons are not entering the area or (b) frequent visitors for only a few minutes. Scenario (a) would suggest that additional efforts are required to make the materials discoverable, versus (b) indicates that the contents are not very usable. Different solutions for (a) and (b) are needed as they are distinctly different.

There are merits to using IoT sensors to gather telemetry data for specific scenarios. However, it is dismissive to assume that few disabled persons will participate in requirement gatherings. In the same article, Ferati et al. mention that 16% of the population has some disability. How can 1 in 6 people be affected and yet invisible? Perhaps the researchers are not aligning their goals with the participants, or the mechanism for advertising the research is inefficient. Maybe the disconnect comes from highly technical individuals being unaware of methods from other scientific disciplines. For instance, multiple universities offer degrees in (1) Special Needs in Education; and (2) numerous areas of physical medicine. If these professionals can collect observations, then why cannot systems designers?

# Expanding Existing Scenarios

Computerized systems enhance information and make it accessible to individuals with disabilities. Joshi and Morris provide numerous examples across a spectrum of impairments, such as (1) augmented reality to improve lip-reading; (2) sensors to detect hard tremors and improve input accuracy; (3) computer vision systems to infer the intent of children paralyzed with cerebral palsy; and (4) virtualized educational environments for students with learning disabilities (Morris, 2008).

Researchers are likely to find that expanding on an existing system provides more immediate value and reduces the development cost. For example, an augmented reality system can improve lip reading from long distances. While this is a natural ‘lift and shift’ paradigm that deaf individuals naturally do, it might not be the most efficient. Users might gain more value from AI, transcribing the words into a mixed reality experience. Like comic books, the words could appear inside of thought bubbles. Additional visual signals, such as music notes, could provide more context to the viewer.

## Risks to Project Design

There are several risks to the project, such as the mixed reality headset being too heavy or insufficient battery lifespan. Reducing the size of the cameras while ensuring the resolution is detailed enough could run into cost restrictions. Aside from physical limitations, there are also risks that the end-users dislike the product. Additional market research with deaf individuals might result in entirely different solutions.

## Measuring Effectiveness

There are three dimensions to the success of IoT devices; (1) it efficiently performs the desired task, (2) it fits within the existing ecosystem, and (3) it can be manufactured economically (Delicato et al., 2013). If the device needs to predict intent, those predictions must be accurate. Even if those devices are highly reliable, but no one can afford them – then the product will not reach critical mass.

# Conclusions

Just as the Internet has interconnected computers, the Internet of Things will interconnect objects. Many innovations into the IoT movement are taking place in the Healthcare Wellbeing segment. However, these innovations are focusing on the commoditized industry of body measurements. Meanwhile, one in six people suffers a sensory disability, such as blind or deaf. This largely untapped market has enormous potential for financial gain and improves the quality of life for many people. To tap into that market, researchers need to understand the requirements of the end-users and what products already exist. Determining prioritized enhancements to these products becomes possible. Afterward, create a plan for measuring success and reducing risks to deliver the product.

# References

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