Section 3: Week 5: IoT and Special Needs

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# IoT and Special Needs

The Internet of Things (IoT) attempts to widen the interconnectivity of computers to include interconnectivity of objects (Commission of the European Communities, 2009). These objects expose sensors that can be 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 are receiving 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 challenges that are marketable to a broad audience. Though, 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 there are 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 sounds for the user. Though, what if the user cannot speak the language? Only increasing the volume does not address the root cause of the disability. Instead, a ‘babel fish’ could be placed in the person’s ear to translate in realtime. 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. To ensure the alignment happens, the development team needs to collect market research through surveys, interviews, and recording observations. 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. propose using IoT sensors around public places as a mechanism to collect anonymized telemetry. A local library might offer Braille resources and wants to improve their 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 are they exploring the materials.

The data might suggest that (a) patrons are not entering the area or (b) there are 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 problems.

There are merits to using IoT sensors to gather telemetry data for specific scenarios; though it is dismissive to assume that few of these 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 professions can collect observations, then why cannot systems designers?

# Expanding Existing Scenarios

Computerized systems are already used to 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 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 cost to develop. 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 is too heavy, or the battery lifespan is insufficient. Reducing the size of the cameras while ensuring the resolution is detailed enough could run into cost restrictions.

Aside from physical limitations, there is 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) fits within the existing ecosystem, and (3) it can be manufactured economically (Delicato, et al., 2013). If the device needs to predict intent, then 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 being blind or deaf. This largely untapped market has enormous potential for financial gain and to improve 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. Prioritized enhancements to these products can be determined. Afterward, create a plan for measuring success and reducing risks to deliver the product.

# References

Commission of the European Communities. (2009). *Internet of Things — An action plan for Europe.* Retrieved from http://eurlex.europa.eu/LexUriServ/site/en/com/2009/com2009\_0278en01.pdf

Delicato, F., Pires, P., Batista, T., Cavalcante, E., Coasta, B., & Barros, T. (2013). Towards an IoT Ecosystem . *SESoS 2013 Montpellier, France*.

Ferati, M., Kurti, A., Vogel, B., & Raufi, B. (2016). Augmenting Requirements Gathering for People with Special Needs using IoT: A Position Paper . *2016 9th International Workshop on Cooperative and Human Aspects of Software Engineering*, 48-51.

Koreshoff, T., Robertson, T., & Leong, T. (2013). Internet of Things: a review of literature and products. *CHI’13, November 25 - 29 2013, Adelaide, Australia*.

Morris, J. (2008). *Disability Research and Policy Current Perspectives.* Taylor & Francis e-Library.