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 IoT Devices

Computerized systems are already used to enhance information and make it accessible for 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. The words could be rendered as thought bubbles like comic books. Additional visual signals, such as music notes, could provide more context to the viewer.