CSE 564 Project Report Number 2

Team 21

Team Member Names:

1. Parv Shah

2. Monil Prajapati

3. Alexander Chittim

4. Prathit Barot

5. Brenden Martinez

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# Executive Summary

1. The Challenge
   * The challenges faced by disabled individuals and their caregivers are multi-faceted and profound.
   * Mobility limitations, communication barriers, and the struggle to access vital information create daily hurdles that can often seem insurmountable.
   * These issues reach into every corner of life, from personal relationships to education and employment opportunities to something as fundamental as their ability to move freely.
2. The Solution
   * Our envisioned CPS emerges as a beacon of hope, offering practical solutions to these multifarious challenges.
   * It's not merely a product but a transformative force. Universally designed, it caters to the specific needs of people with mobility, communication, and sensory impairments.
   * The user interface is a model of accessibility, featuring keyboard shortcuts and voice commands to cater to diverse needs.
3. User-Centric Design
   * User-centricity is at the core of our approach. We understand that each individual faces unique challenges, and our aim is to provide comprehensive solutions.
   * To achieve this, we are actively engaging with stakeholders, including disabled individuals and caregivers, to ensure that our system is not just a technical marvel but an intuitive, user-friendly companion.
4. Compatibility with Assistive Technologies
   * Our system doesn't exist in isolation. We are actively ensuring compatibility with a wide array of assistive technologies, such as screen readers and speech recognition software.
   * This will enable our users to seamlessly integrate our CPS into their daily routines, effectively breaking down the barriers they face.
5. Operational Excellence
   * Our system doesn't just work; it thrives in diverse environments, from extreme temperatures to various modes of transportation.
   * Maintenance is performed seamlessly over the internet, with a dedicated support team ready to assist users with troubleshooting and device usage.
6. Environmental, Organizational, and Technical Impact
   * Beyond its technical prowess, our CPS will have a profound impact on various fronts. It considers the environment, striving for sustainability in terms of energy use and materials.
   * Job creation and training are part of the equation, ensuring that our project leaves a positive mark on the job market. We're also at the forefront of technological innovation, pushing the boundaries of what's possible.
7. Continuous Improvement
   * Our commitment to improvement doesn't end with the product launch.
   * User feedback is a treasure trove of insights that will guide our development process, ensuring that our system remains relevant and effective throughout its lifecycle.
8. The Way Forward
   * This report is just the beginning, a roadmap for our journey towards enhancing the lives of disabled individuals, caregivers, and those grappling with communication impairments.
   * Our system isn't just about technology; it's about making the world a more inclusive and accessible place for all.
   * As we delve into the subsequent phases of development, we remain open to innovations and improvements, ensuring that our mission stays true and our impact profound.

# Customer Problem

* 1. Disabled Individuals

Mobility Limitations

* Cannot move around in the easiest way possible

Communication Barriers

* Obstruction in effective communication and inability to express thoughts.

2.1.3. Access to Information:

* Accessing data information is intangible and providing an accessible format is a must for their livelihood.

2.1.4. Affordability and Accessibility:

* Costly materials used in this system make it unaffordable, and many times not accessible due to their scarcity.

2.1.5. Daily Living Support:

* Difficulties with daily tasks can result in expensive caretakers.
* Or require family members to utilize their time for assistance.

2.1.6. Security and Safety:

* Their disabilities can leave them vulnerable.

2.1.7. Education and Employment:

* Social perception has negative impacts on both education and employment.

2.1.8. Socially not included:

* Difficulties in movement and communication result in social isolation.

2.1.9. Medical:

* Increased prevalence of diabetes, obesity, and cardiovascular disease.
  1. Caretakers (Family Members):

2.2.1. Information to take care of disabled family members

* Need access to the information to understand the person with the disability
* Information will change depending on the disabling condition

2.2.2. Caregiver Support

* Resources and tools to assist in providing care, including caregiver training and respite services.
* Reducing the physical and emotional burden on caregivers through support groups and counseling services.

2.3. Communication-Impaired Individuals:

2.3.1. Effective Communication

* Accessible communication tools and technologies, such as speech-generating devices and sign language interpretation services.
* Overcoming speech impediments and language barriers with speech therapy and AAC (Augmentative and Alternative Communication) solutions.

2.3.2. Affordable Assistive Communication Devices

* Access to affordable communication aids, including text-to-speech apps and communication boards.
* Availability of communication devices in various formats to cater to different communication needs.

2.4. Information-Deprived Individuals

2.4.1. Access to Information

* Accessible formats for written, visual, and auditory information, including screen readers, Braille materials, and captioning services.
* Affordable resources for accessing critical information, such as reduced-cost library memberships and digital literacy programs

2.4.2. Inclusive Education and Employment Information

* Access to information on educational and employment opportunities for individuals with disabilities, including scholarship information and job placement services.
* Overcoming social stigma and discrimination through public awareness campaigns and inclusive workplace policies.

2.5. Daily Living Support

2.5.1. Daily Living Assistance

* tools and technologies to aid in daily tasks, such as home automation systems and personal care robots.
* Reduced dependence on costly caretaker services through assistive devices that promote independence.

2.6. Security and Safety

2.6.1. Enhanced Safety

* Safety measures to protect individuals with disabilities, such as accessible emergency evacuation plans and personal safety devices.
* Prevention of accidents and abuse through awareness campaigns and community support networks.

# Concept of Operations

* 1. Introduction
     1. Background
* Address the various challenges faced by people with disabilities:
  + mobility limitations
  + communication barriers
  + access to information
* Develop a Cyber-Physical System (CPS) that is:
  + affordable
  + accessible
  + user-friendly
* Overall goal is to develop a CPS that helps people with disabilities in their daily lives
  + 1. Assumptions and Constraints
* Assumptions
  + The technology needed to do the system exists and mature enough
  + Construction and development of the system will be sequential and in successive stages
* Constraints
  + Must be usable for people with a multitude of disabilities
  + Must be reasonably affordable
    - Many with disabilities are in poverty

3.1.3. Overview of the Envisioned System

* Improves mobility
* Facilitates effective communication
* provide seamless access to information
  1. Documents
     1. Applicable Documents
* <https://www.hhs.gov/hipaa/for-professionals/privacy/index.html>
* <https://sfl.himsschapter.org/sites/himsschapter/files/ChapterContent/sfl/HIMSS%20Stage%207.pdf>
* <https://www.healthit.gov/topic/interoperability/standards-and-technology>
  + 1. Reference Documents
* <https://ballardbrief.byu.edu/issue-briefs/challenges-for-people-with-disabilities#:~:text=A%20variety%20of%20societal%20barriers,life%20for%20people%20with%20disabilities>.
* <https://www.commonwealthfund.org/publications/fund-reports/2019/apr/challenges-living-disability-america-and-how-serious-illness-can>
* <https://www.nist.gov/cyberframework>
* <https://courses.cs.washington.edu/courses/cse503/06sp/design-reliability.pdf>

3.3. Description of Envisioned System

3.3.1. Needs, Goals and Objectives of Envisioned System

* Device Expectations:
  + Helps with mobility limitations
  + Helps with communication
  + Helps with daily living activities
  + Help facilitate more social interactions
    - In turn helping reduce their risk of some diseases
  + Is reasonably affordable
  + Is user friendly
    - People with different disabilities can learn to utilize the device

3.3.2. Overview of System and Key Elements

* Assistive Technology
* User Interfaces
* Communication modules

3.3.3. Interfaces

* Assistive Devices
* Networks
* Mobility Devices

3.3.4. Modes of Operations

* Admin mode for diagnostic checks
* Default for day to day operations

3.3.5. Proposed Capabilities

* Help facilitate communication
* Improve mobility
* Defend against outside intrusion when connected to networks
* Admin mode that is used to validate the system is working as intended

3.4. Physical Environment

* Should handle a multitude of environments
  + Hot and cold/freezing temperatures
  + Dry and Humid
  + Varying elevations
* Should handle daily use and wear and tear of day to day life
* Should handle different modes of transportation
  + Cars, trains, airplanes, boats

3.5. Support Environment

* Updates would be performed over the internet
* Maintain a support team throughout the life of the device
  + Help with troubleshooting and device usage

3.6. Operational Scenarios, Use Cases and/or Design Reference Missions

3.6.1. Nominal Conditions

* A person struggling with a physical disability
  + They are going through their morning routine
    - They put on the CPS
    - The device assists them in the physical activities such as:
      * getting out of bed
      * getting dressed
      * brushing their teeth
      * making their bed
      * leaving their house
* A person struggling with communication
  + They are need to communicate with a coworker
    - They have the CPS on
    - The device assists them communicate their:
      * feelings
      * thoughts
      * problems
      * needs

3.6.2. Off-Nominal Conditions

* Each time something off-nominal is encountered it is logged with sufficient details
* The details will be put in as a ticket and compared to other tickets to see if they match
* The ticket with the most similar ones will be tackled first to understand why it is happening
* After it is understood appropriate planning and step will be taken to fix the issue
* Test will then occur to make sure the fix does not break other systems and cause no new errors

3.7. Impact Considerations

3.7.1. Environmental Impacts

* It considers the environmental impact of the system during its lifetime.
* How the operation of the system affects the environment
  + electricity used
    - how much does it cost
    - using solar or city-supplied energy
    - or both
  + Land system is stored on
    - built in the middle of the city or on the ground
      * and how the new building will affect the environment
  + materials used to make the product
    - how materials are collected
      * Do mining methods affect the environment?
  + Will the cooling system affect the environment?
    - air or otherwise cold
      * if another path is destroyed by a certain method

3.7.2. Organizational Impacts

* Jobs created
  + encoders
  + system administrator
  + data collector
  + System Assistant (answer customer questions)
  + How many new people should be hired?
    - employees can now fill the position
* Training
  + will train the staff
    - it will be internal or external
      * if there is internal demand, the training time will affect the ability of the trainer to work in the system
      * and outside, what time and money cost

3.7.3. Scientific/Technical Impacts

* What technology is needed for the project
  + if so, from where it will be issued
    - It costs money
    - who knows how this technology works
      * Does anyone know if anyone will be brought to the project?
  + If the technology does not exist what is the plan to create the product
    - what team will be assigned to create it
      * how much time and money is need to create the technology
    - Is this technology internal only or will there be opportunities to sell to others?
* To save data for the project, you must log in to the center

3.8.0. Risks and Potential Issues

* User Training and Support
  + Amount of time it takes to train someone in usage of device
  + Support system that can help those struggling with the device
* Legal and Regulatory Compliance
  + Making sure legal and regulatory requirements are met
* User Feedback and Improvement
  + Making sure we collect user feedback
  + Making sure we can utilize the feedback and improve the system
* Security and Privacy
  + Making sure that the devices are protected from outside interference
  + Making sure that measurements collected remain confidential

# Initial Received Requirements

4.1 Accessibility Advocates and Organizations

* Project influenced by input from accessibility advocates, organizations, and reputable sources.
* The initial project phase focused on accurately capturing these requirements.
* Emphasis on avoiding bias and aligning with stakeholder insights.

4.1.0 Universal Accessibility

1. Accessibility advocates stress universal design principles for our system.
2. Aim to meet the needs of individuals with disabilities.
3. Emphasis on incorporating universal design for inclusivity.
4. Adherence to Universal Design Principles
   1. Detail Point 1: The system must adhere to universal design principles, guaranteeing accessibility to individuals with mobility, communication, and sensory impairments.
   2. Detail Point 2: The user interface must provide alternative means of interaction, such as keyboard shortcuts and voice commands, to accommodate various needs.
5. User-Centric Design
   1. The system must prioritize user-centric design by conducting regular usability assessments and gathering user feedback for continuous improvement.
   2. Usability assessments should focus on ensuring that the system is intuitive and user-friendly for individuals with different disabilities.
   3. Second Key Requirement - Compatibility with Assistive Technologies
   4. Our second key requirement, influenced by the insights from accessibility advocates and respected sources,
   5. It relates to ensuring compatibility with a wide range of assistive technologies. The following key points have been identified:
6. Support for Multiple Assistive Technologies
   1. The system should offer support for various assistive technologies and devices, including screen readers and speech recognition software.
   2. It must be compatible with widely used assistive technologies such as JAWS and VoiceOver.

1. Consistent Navigation
   1. The system should provide consistent and predictable navigation, particularly for screen reader users, to enhance user experience and accessibility.
   2. Navigation within the system should be intuitive and user-friendly for individuals with diverse disabilities.

* Initial requirements shaped by input from accessibility organizations, and trusted sources.
* These requirements form a strong foundation for the project.
* Future phases of Requirements Engineering will refine and expand upon these requirements.
* Goal: Ensure the system effectively meets stakeholder needs.

# Requirements Elicitation

1. Disabled Individuals and Caregivers
   1. What specific mobility limitations do you face in your daily life, and how do they impact your mobility and independence?
      1. By understanding the specific mobility challenges faced by disabled individuals, we can tailor our solution to address these limitations effectively.
         * Mobility limitations may vary among individuals, and a detailed understanding will help us design adaptive mobility solutions.
         * Gaining insights into the impact on independence will guide the development of assistive devices.
   2. How do communication barriers affect your ability to express thoughts and interact with others?
      1. Identifying the challenges related to communication will enable us to create effective communication aids and technologies.
         * Different disabilities may result in various communication barriers, such as speech impediments or language barriers.
         * Understanding these challenges will help in the development of accessible communication tools.
   3. Could you elaborate on your access to information and the difficulties you face in obtaining essential data and services?
      1. Learning about the information needs of disabled individuals will guide us in making data accessible and ensuring that our system caters to these requirements.
         * Access to information is critical for daily living, and we need to identify the barriers to accessing information.
         * Developing accessible formats for information will enhance the lives of disabled individuals.
   4. What are the major affordability and accessibility issues you encounter when seeking assistive technologies or mobility aids?
      1. Identifying affordability and accessibility challenges will help us create cost-effective and widely available solutions.
         * Costly materials can be a barrier to access, and we need to explore ways to reduce costs.
         * Ensuring widespread availability of assistive technologies is essential.
2. Communication-Impaired Individuals and Information-Deprived Individuals
   1. How do communication barriers affect your daily life, and what types of assistive communication devices have you found effective?
      1. Understanding the impact of communication barriers and effective communication aids will guide our efforts in developing suitable solutions.
         * Different communication barriers require different solutions, and we need insights into their experiences.
         * Identifying effective communication devices will inform our development process.
   2. What challenges do you face in accessing written, visual, and auditory information, and how can we make this information more accessible?
      1. Learning about the challenges in accessing information will help us design accessible formats and services.
         * Identifying barriers to accessing information will guide the development of accessible formats.
         * Providing affordable resources for accessing critical information is essential.
         * These questions are designed to gain detailed insights into the specific needs and challenges faced by disabled individuals, caregivers, communication-impaired individuals, and those deprived of information.
         * These insights will serve as the foundation for the development of our project, ensuring that our solutions are tailored to meet their unique requirements.
         * As we progress through the subsequent phases, the gathered requirements will be used to derive specific design and implementation criteria.

# Conclusion

1. Addressing Customer Problems
   1. Understanding Customer Problems
      * Our project addresses a range of customer problems, including mobility limitations, communication barriers, and access to information, impacting the lives of disabled individuals, caregivers, and communication-impaired individuals.
      * By acknowledging these problems, we underscore the importance of creating a solution that is affordable, accessible, and user-friendly.
   2. Detail Item 2: Stakeholder Involvement
      * Engaging with stakeholders such as disabled individuals and caregivers is crucial for tailoring our system to their specific needs.
      * Recognizing the diverse challenges they face, our project aims to provide a comprehensive solution.
2. Concept of Operations
   1. Assumptions and Constraints
      * Our project operates under key assumptions, including the usability of our system for various disabilities and the importance of maintaining affordability.
      * Recognizing constraints, such as the need for widespread usability, guides our development process.
   2. Description of Envisioned System
      * The envisioned system focuses on assisting with mobility limitations, communication barriers, and daily living activities while remaining user-friendly and affordable.
      * Understanding the key elements, including assistive technology, user interfaces, and communication modules, lays the foundation for our system's design.
3. Operational Considerations
   1. Physical Environment
      * Our system must function in diverse environments, from extreme temperatures to varying elevations and transportation modes.
      * Durability and adaptability are vital considerations for accommodating users' daily lives.
   2. Support Environment
      * Updates and maintenance will be performed over the Internet, ensuring the system remains up to date.
      * A dedicated support team will assist users with troubleshooting and device usage, enhancing their experience.
4. Risks and Potential Issues
   1. User Training and Support
      * Efficient user training and robust support systems are essential to ensure users can effectively utilize our device.
      * Addressing legal and regulatory compliance is crucial for the system's success.
   2. User Feedback and Improvement
      * Continuous collection and utilization of user feedback are integral to our development process, allowing us to enhance the system continually.
      * Identifying and mitigating risks, such as technology challenges and organizational impacts, ensures a smoother project progression.
5. Items for Future Consideration

* In future phases, we must explore potential additional features or aspects of our system that emerge during the development process.
* Flexibility and adaptability will be key as we move forward, keeping the door open for innovations and improvements.

Citation:

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# Appendix A: Credit Sheet

| Team Member Name | Contributions |
| --- | --- |
| Parv Shah | * Generated Executive summary (section 1). * Contributed to requirements elicitation (section 5). |
| Monil Prajapati | * Contributed to Requirements Elicitation (section 5). * Produced Conclusion (section 6). |
| Prathit Barot | * Did research on initial received requirements. * Contributed to Received Requirements (section 4). * Educated myself about accessibility guidelines. |
| Alexander Chittim | * Contributed to ConOps (Section 3). * Citation. |
| Brenden Martinez | * Contributed to Customer Support (Section 2). * 3.6.2. Off-Nominal Conditions * 3.1.2 Assumptions and Constraints (Assumptions) |