Project Deliverable B

Problem Definition, Concept Development and Project Plan

GNG2101–INTRODUCTION TO PRODUCT DEVELOPMENT & MANAGEMENT FOR ENGINEERS & COMPUTER SCIENTISTS

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# Introduction

The goals for the Voice Activated Remote prototype project are outlined in this introduction, with a focus on the phases of problem definition, concept development, and project planning. This project's main goal is to address client needs and issues and to create a solution that satisfies or surpasses the target requirements.

During the problem identification phase (B.1), our team will work together to identify and prioritize customer problems and needs. Through careful analysis and collection of relevant information, we will create a comprehensive problem statement that clearly defines the nature of the problem, the target audience facing the problem, and the form of solution. To effectively measure the success of our solution, we will develop a list of demand-based metrics with the right units and benchmarks against existing similar solutions. This will allow us to understand the current context and gather information for our design. Visual aids such as descriptions and images will be used to enhance the clarity of our benchmarking results. In addition, we will establish a set of target specifications that describe both ideal and acceptable values, providing justifications for our selections. These specifications will serve as a benchmark against which to evaluate the feasibility and effectiveness of our prototype designs.

Moving on to the concept development phase (B.2), our team will create the final prototype concepts for each subsystem, as well as the fully assembled system needed to solve the problem. By analyzing and evaluating these concepts against predefined target specifications, we will make informed decisions using computation, simulation, or other appropriate methods. The selected concepts will then be developed, either by integrating or modifying promising solutions or by creating an entirely new concept derived from the selected ideas. Visual representations, such as sketches, diagrams, or CAD models, will be created to illustrate the overall design concept. In addition to showing the relationship between the concept and the intended specifications, we will provide an assessment of its advantages and disadvantages.

Finally, during the project planning phase (B.3), we will update our existing project plan from deliverable project A to incorporate any missing tasks or responsibilities based on the feedback received and our better understanding of the project. We'll cover subtasks in more detail and refine task start and end dates for more accuracy. The updated project plan will serve as a roadmap for effectively implementing the project and achieving its goals.

# B.1: Problem Definition

## Client Needs

* Client suffers from ALS Amyotrophic lateral sclerosis, also known as Lou Gehrig's disease
* Has no motricity in hands, unable to operate a regular remote control for their Golden Technologies Lift Chair
* Needs a voice activated remote control to accomplish five functions on lift chair: Legs up, legs down, back up, back down and lift up
* Has an unclear voice, we do not know the extent of this or if the voice is clear enough to activate Alexa, Siri or other home assistants
* Client has an occupational therapist; we do not know how much supervision the client has in a 24-hour period
* The remote must accomplish its functions in increments so as to not completely extend or fold the chair with one command

|  |  |  |  |
| --- | --- | --- | --- |
| **Need no.** |  | **Function** | **Priority (scale 1-5)** |
| 1 | The remote | Is voice activated | 5 |
| 2 | The remote | Accomplishes five functions | 5 |
| 3 | The remote | Is hardwired as to not run out of power | 3 |
| 4 | The remote | Is light | 1 |
| 5 | The remote | Is visually appealing | 2 |
| 6 | The remote | Is small | 2 |
| 7 | The remote | Provides feedback when commanded | 2 |
| 8 | The remote | Has memory with set positions for client | 4 |
| 9 | The remote | Operates incrementally | 5 |
| 10 | The remote | Works through Alexa | 3 |
| 11 | The remote | Is compatible with Golden Technology chair | 5 |
| 12 | The remote | Is affordable | 2 |
| 13 | The remote | Is portable | 1 |
| 14 | The remote | Operates with Wi-Fi | 5 |
| 15 | The remote | Operates manually | 3 |
| 16 | The remote | Is accessible | 4 |
| 17 | The remote | Is easily replaced | 4 |

## Problem Statement

Design a voice-activated remote control for a Golden Technologies lift chair for a client suffering from ALS with limited hand function.

## Metrics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Need no.** | **Metric no.** | **Metric** | **Priority (1-5)** | **Units** |
| 8, 9 | 1 | Lift and lower functions have set time | 4 | seconds |
| **12** | 2 | Remote cost | **2** | **$** |
| 4 | 3 | Remote weight | 1 | grams |
| 6 | 4 | Remote size | 2 | mm |
| 2 | **5** | Number of functions on remote | 5 | Functions |
| 10, 11 | **6** | Compatibility | 5 | yes/no |
| 16, 14 | **7** | Accessibility and range | 1 | meters |

## Competitor analysis:

# **SwitchBot Smart Switch Button Pusher**

Link: <https://shorturl.at/hiR03>

Product description: This button pusher is compatible with Alexa, google home and other voice activation devices. It can be installed to walls or remote with a piece of 3M sticky tape and is used to push/pull light switches.

Picture:

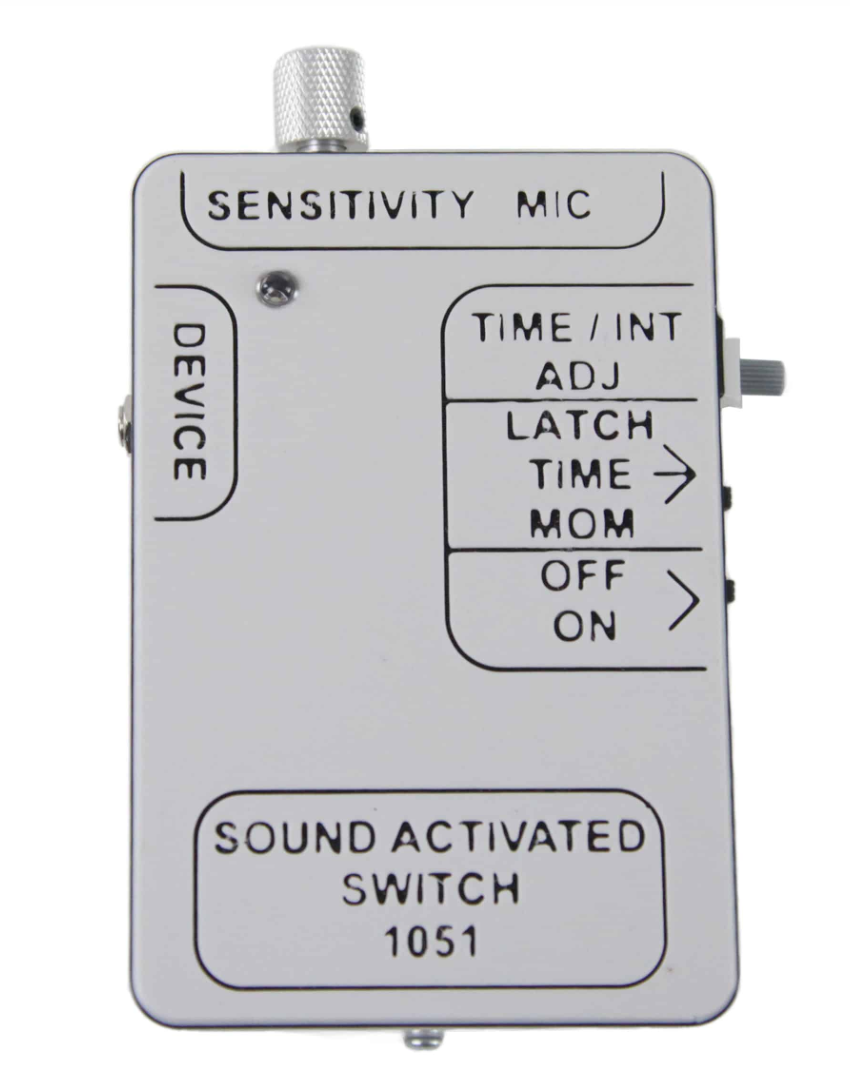


**Enabling Devices: Sound/Voice Activated Switch**

Link: <https://enablingdevices.com/product/sound-activated-switch/>

This switch promotes a solution for people with restricted mobility as it activates devices with a sound. *Enabling Devices* promotes a sensitive microphone for people with speech impediments. This is a good solution, but lacks many features that our client needs.

Picture:



## Target Specifications

|  |  |  |  |
| --- | --- | --- | --- |
|  | Metric | Units | Value |
| 1 | Lift and lower functions have set time | seconds | <30 |
| 2 | Remote cost | **$** | <100 |
| 3 | Remote weight | grams | <150 |
| 4 | Remote size | mm | <50 |
| **5** | Number of functions on remote | Functions | 5 |
| **6** | Compatibility | yes/no | yes |
| **7** | Accessibility and range | meters | <10 |

# B.2: Concept Development

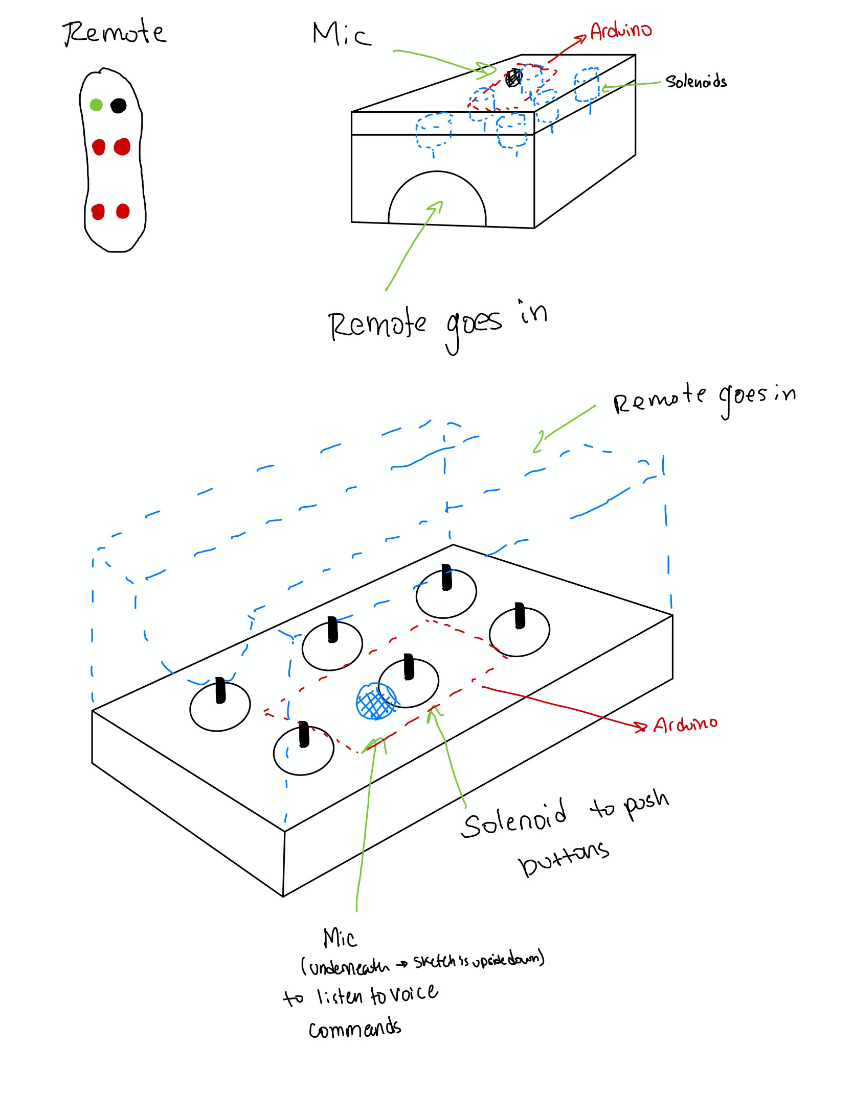
## Final Prototype Concepts:

* Casing for remote with manual button pushers
* Incremental operations for lifting and lowering functions
* Use of 3rd party device like Alexa or Siri
* Use of microcomputer like Raspberry Pi or Arduino
* Remote is removable from casing for easy replacement or manual use

## Concept Analysis:

Concept 1: A hard body remote casing with mechanical button pushers

This design consists of a remote “case” or box that will be able to press the buttons on the remote when a voice command is stated. The box will contain a microcontroller that has a microphone attached to hear for voice commands. This microcontroller will send signals to the proper solenoid to press the appointment button.



|  |  |
| --- | --- |
| Pros | Cons |
| * Remote is easily accessible in case it needs to be taken out or replaced * The remote hardware does not need to be played with (hacking) * The buttons can be pressed or held with the solenoids * Mechanisms used are simple * Power source will be plugged into the wall eliminating the need for batteries * Does not need a Wi-Fi connection * Does not rely on Alex or Siri, it contains a standalone voice command system. | * The box will be big and bulky * Solenoids might need replacing in the future |

Concept 2: A “hacked” remote, re-wired and activated by an Arduino device.

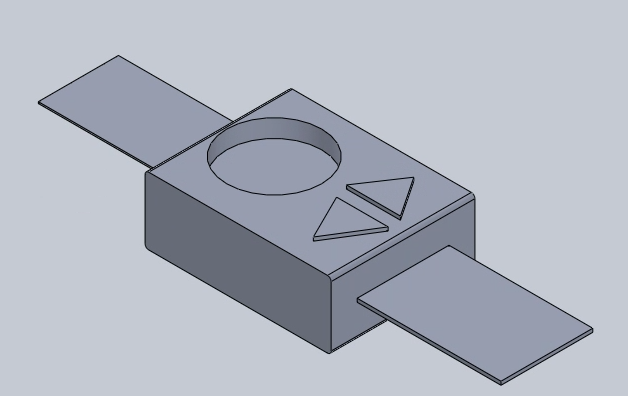
For this concept, the remote would be rewired and activated using an Arduino microcontroller instead of the original remote buttons. We would connect the microcontroller to a third device such as Alexa, Siri or Google Home, which would translate the voice input to a command which would activate the chair via the new remote.

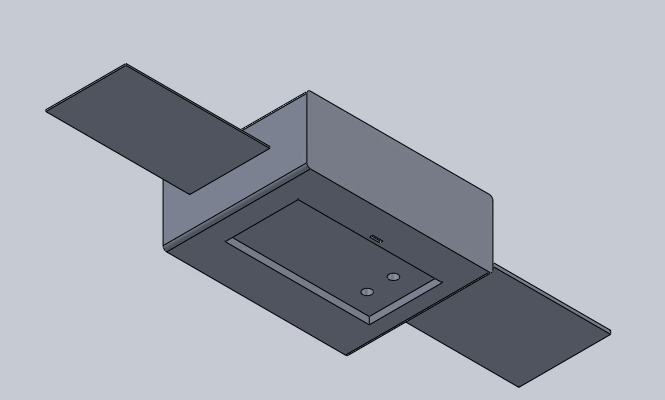


|  |  |
| --- | --- |
| Pros | Cons |
| * Remote will remain as is (size won’t change) * Does not need to rely on motors or any mechanisms that can fail. * No battery, runs off 110V outlet * Can be run through a home assistant (Google Home, Alexa, Siri etc.) | * Might affect warranty of the remote * Requires Wi-Fi * No longer able to use remote with buttons |

Concept 3: Velcro Attachable Remote Control

This design consists of a plastic casing with a circular opening that fits a google nest mini speaker which is voice controlled. The speaker is to be connected to a smart device to carry out the desired functions. On the back side there is an openable compartment which fits an Arduino UNO microcontroller as well as battery for power. There are also two buttons on the top side of the casing which allow for the user to move the chair up and down. The microcontroller on the bottom side has two small holes which go all the way through to the buttons on the top. Wires from the microcontroller are to be inserted through these holes and connected to the two buttons. One the two sides of the model, there are velcro straps which can be used to easily attach the remote to the armrest of a chair.





|  |  |
| --- | --- |
| Pros | Cons |
| * Easily attachable and consists of few parts, making it portable. * Does not need to be connected to an outlet or other power source. * Arduino UNO microcontroller is covered and protected from the outside environment. * Affordable * If one component is damaged, the component be replaced without replacing the whole system. | * Needs to be connected to Wi-Fi at all times. * Google Nest speaker is easily detachable, susceptible to falling out when not desired. * Slightly bulky, can take up lots of armrest space. |

Do each of the designs meet the metrics?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Metric | Units | Value | Design 1 | Design 2 | Design 3 |
| 1 | Lift and lower functions have set time | seconds | <30 | Yes | Yes | No, the lift and lower function only work when being pressed. |
| 2 | Remote cost | **$** | <100 | Yes | No, it will require an expensive microcontroller that is very small that is compatible with Alexa and Siri | Yes |
| 3 | Remote weight | grams | <150 | No, this design contains multiple solenoids and a big box, this weighs a lot | Yes | Yes |
| 4 | Remote size | mm | <50 | No, as mentioned above, the case will need to fit a microcontroller and multiple solenoids. | Yes | Yes |
| **5** | Number of functions on remote | Functions | 5 | Yes | Yes | No, currently there are only 2 buttons |
| **6** | Compatibility | yes/no | yes | Yes | Yes | Yes |
| **7** | Accessibility and range | meters | <10 | Yes | Yes | Yes |

# B.3 Project Plan.

<https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=eSEs3jZk86oQbSzRiNLSDjwDa0bKGJnv%7CIE2DSNZVHA2DELSTGIYA>

# Conclusion

In conclusion, the Voice Activated Remote prototype project entails a thorough method for resolving issues and creating new products. We generated a clear problem description and gained a profound grasp of customer needs by carefully addressing the problem definition phase. We laid the groundwork for assessing and contrasting viable solutions through benchmarking and the discovery of need-inspired metrics. The next phase of concept creation enables us to investigate novel ideas and choose the most promising concepts based on how well they fit the specified target requirements. We hope to offer a comprehensive solution to the noted issue by developing a global design idea that combines the best components from these proposals.

Finally, the project plan is a crucial tool for planning and managing all the project's tasks and milestones. We make sure that roles are clearly delineated, timetables are precise, and dependencies are recognized by regularly revising the plan and taking comments into account. The Voice Activated Remote may be finished on schedule because of the effective collaboration and coordination made possible by this comprehensive project plan.