UNIVERSITY OF MICHIGAN

JOINT INSTITUTE

交大密西根学院

# Capstone Design Team #14
# Healthcare Telepresence Robot


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# Project Intro

**Problems**

When caregivers are far away from the Elderly:

- Inconvenience for Medicine Care
- Lack of Video Calls
- Sense of Loneliness of the Elderly

**Needs**

- In-time Basic Medicine Care
- Video Call Support
- Improvement in the Elderly's Sense of Happiness

Healthcare Telepresence Robot[1]

# Project Intro

**Current Product**

- High cost, more than $5000
- Function Failure
- Firewall Interruption
- Heavy Video Frame Drop
- Heavy Drive Lag

Figure 1: Giraffe Robot in Use[2]

# Project Intro

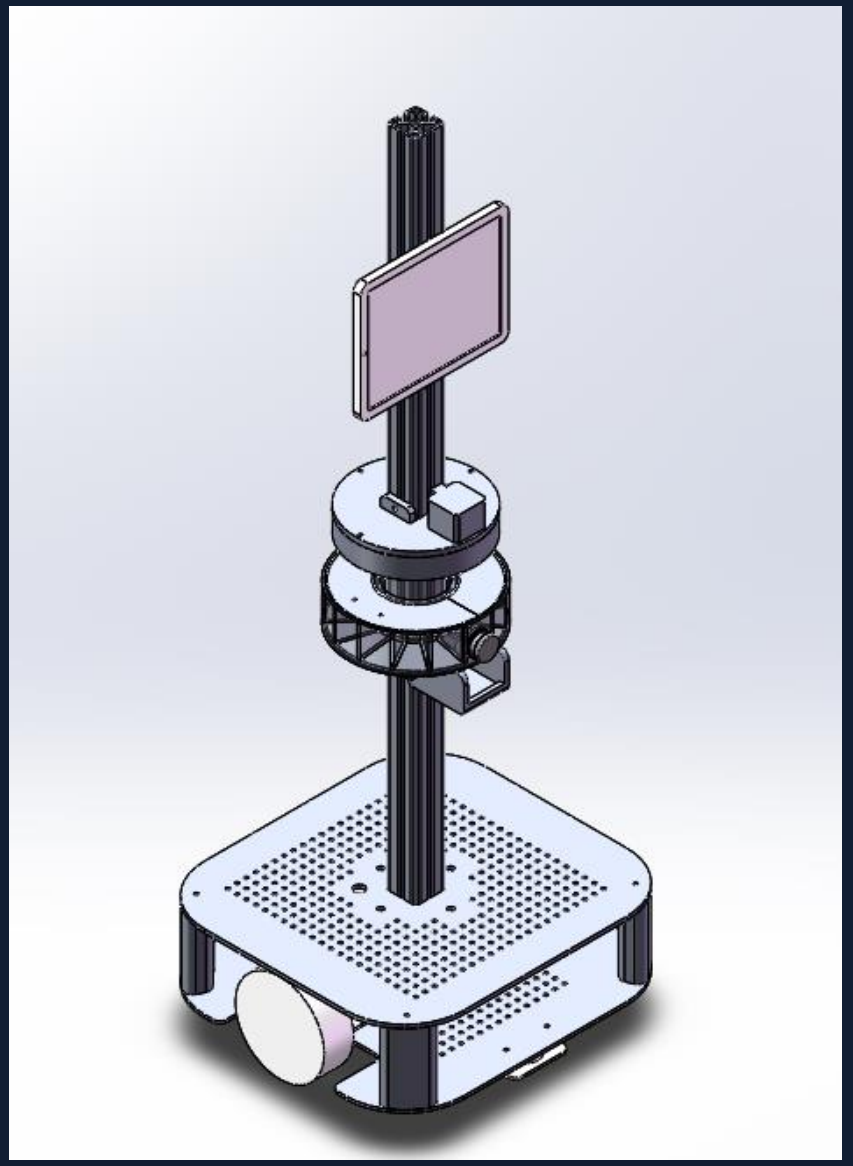


Figure 2: Overview for the Robot

## Solution:

***"An affordable Healthcare Telepresence Robot that supports instant video calls, smart medicine dispensation and remote control."***

# Engineering Specifications

## Customer Requirement

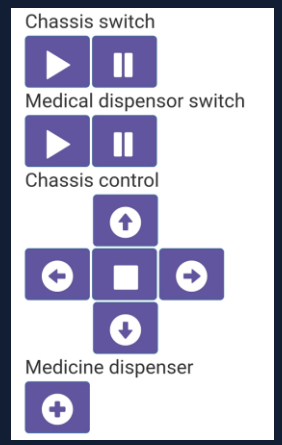
- Low Budget
  - Under $1000
- Essential Functions
  - Video Call Support
  - Smart Medicine Dispenser
  - Individual Customization
- Stable Remote Control
  - Short Lag
  - Security guarantee
- Long Duration
  - Long Pad Duration
  - Long Robot Duration

| Quantitative Specifications | | |
|---|---|---|
| Budget ($) | | <1000 |
| Moving Speed (m/s) | | 0.2-0.5 |
| Lag (s) | Video Lag | <1 |
| | Control Lag | <0.5 |
| Duration (hrs) | Pad Duration | >3 (playing videos) |
| | Robot Duration | >1 (moving) |
| Loudness (dB) | | >70 |
| Inaccuracy of Medicine Dispenser (#Block/Round) | | <1 |

Table 1: General Quantitative Specifications

# Concept Diagram

Caregiver's PC/Pad/Phone



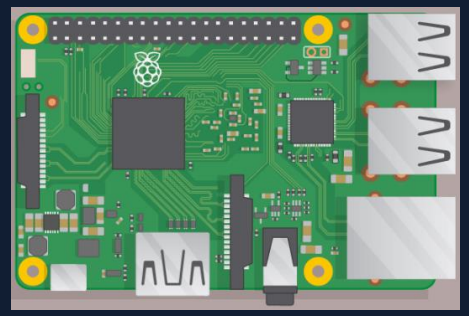

User Interface

TeamViewer

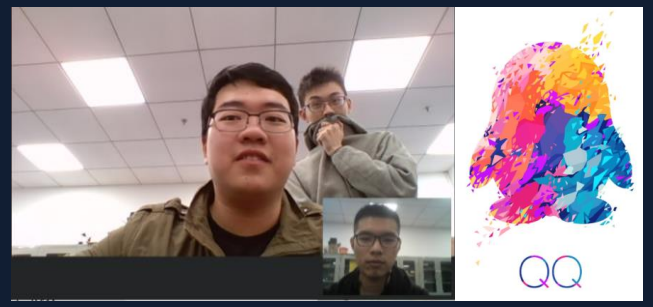
TeamViewer

Pad on the Robot

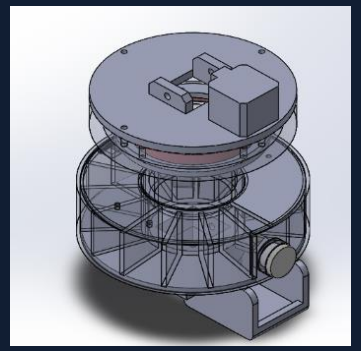

PuTTY(OpenSSH)
(Optional)



Raspberry Pi




Video
Call/Navigation
via QQ



Medicine
Dispenser

Medicine Dispensation

Chassis

Robot Movement

Figure 3: Concept Diagram

# Circuit Design

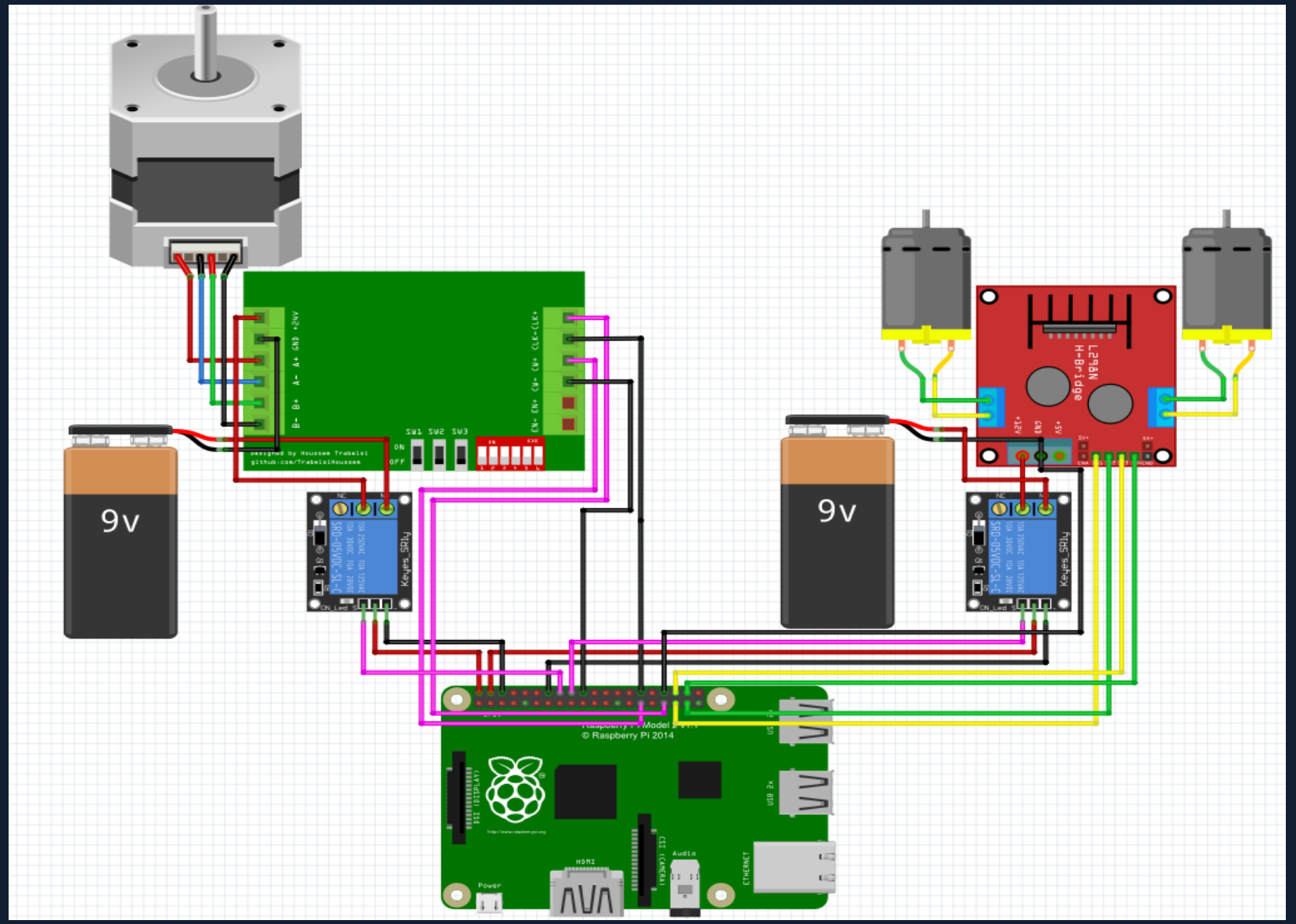



Figure 4: Circuit Design

# Chassis Design

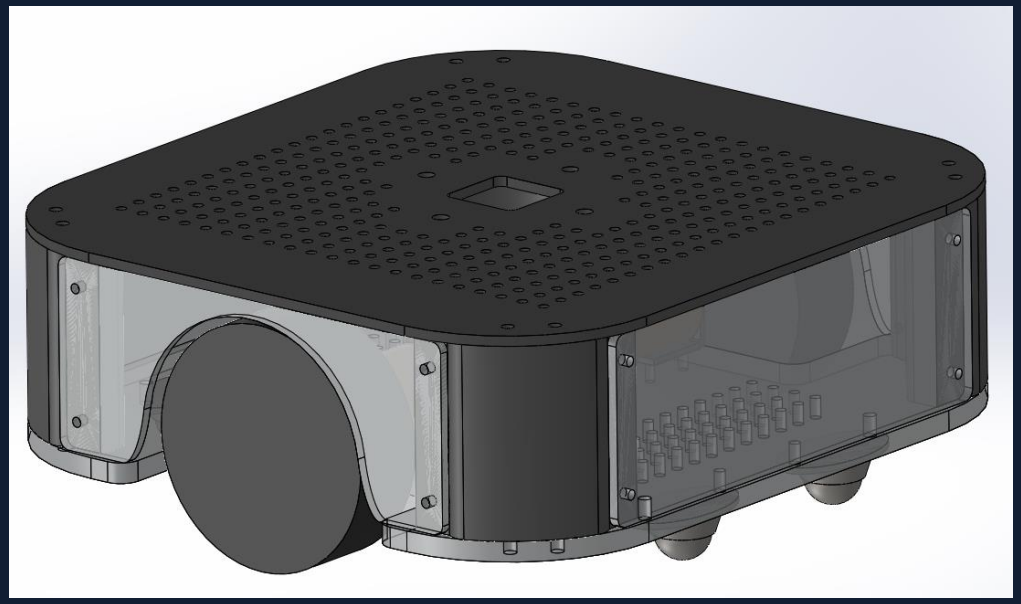


Figure 5: Chassis Design

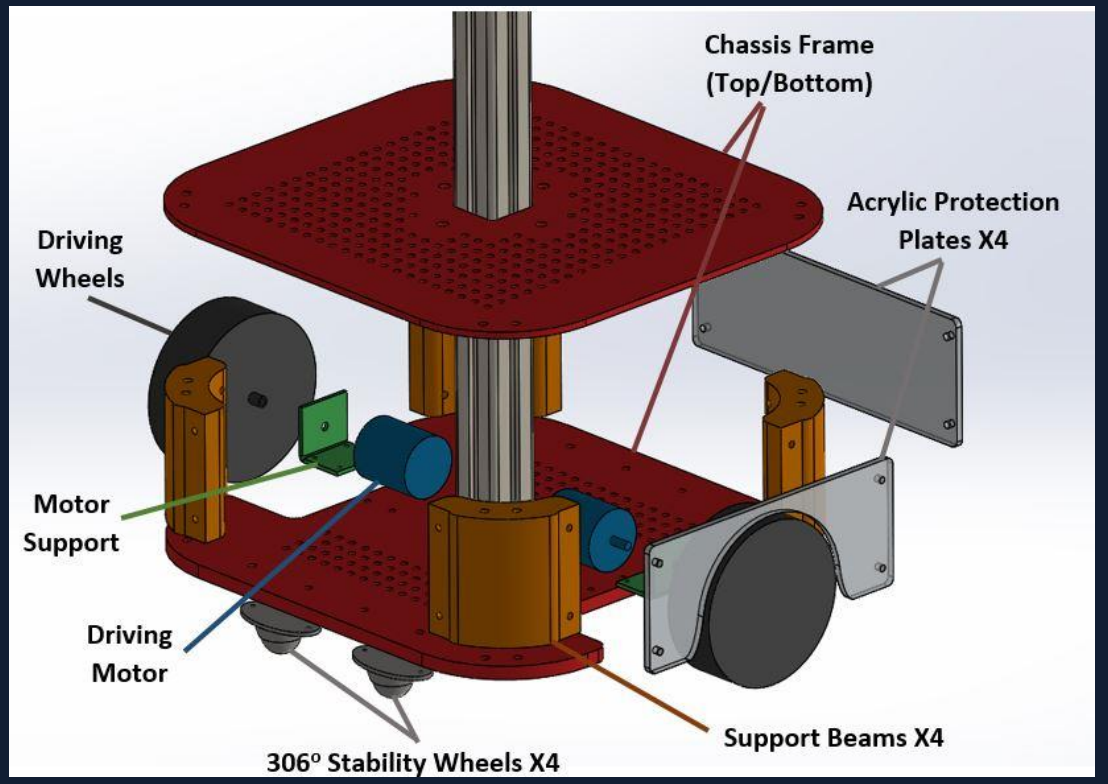



Figure 6: Explosion View of Chassis

# Remote Control Implementation

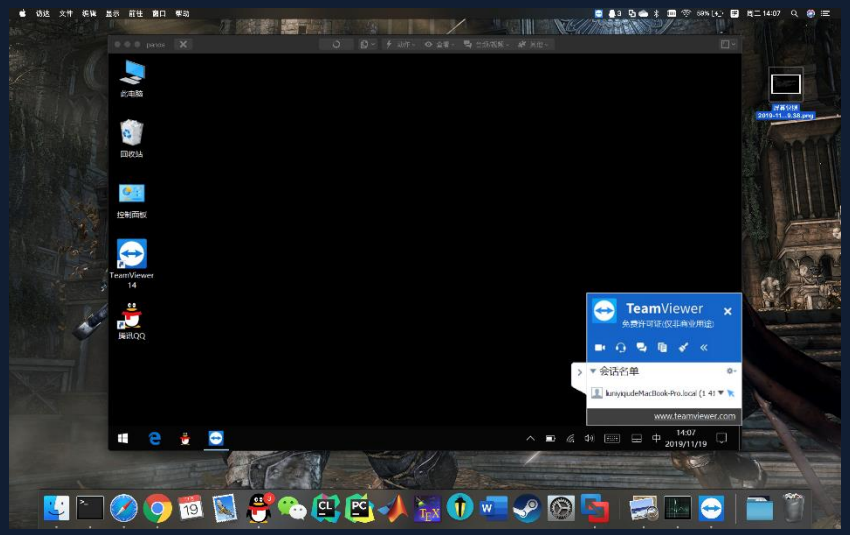



Figure 7: Control Pad on Robot by Mac


Figure 8: Control Raspberry Pi by Mac

| Item | Customer Requirement | Achieved by Prototype |
|---|---|---|
| User Interface | Graphic UI | Graphic UI |
| Security | Reliable Encryption | 256bit AES (the most safe) |
| Device Support | Multiple Devices | Phone, Pad, PC… |
| Video Lag | <1s in avg. | 0.8s in avg. |
| Control Lag | <0.5s in avg. | 0.1s in avg. |

Table 2: Remote Control Assessment

# Remote Control Validation

# Medicine Dispenser Design

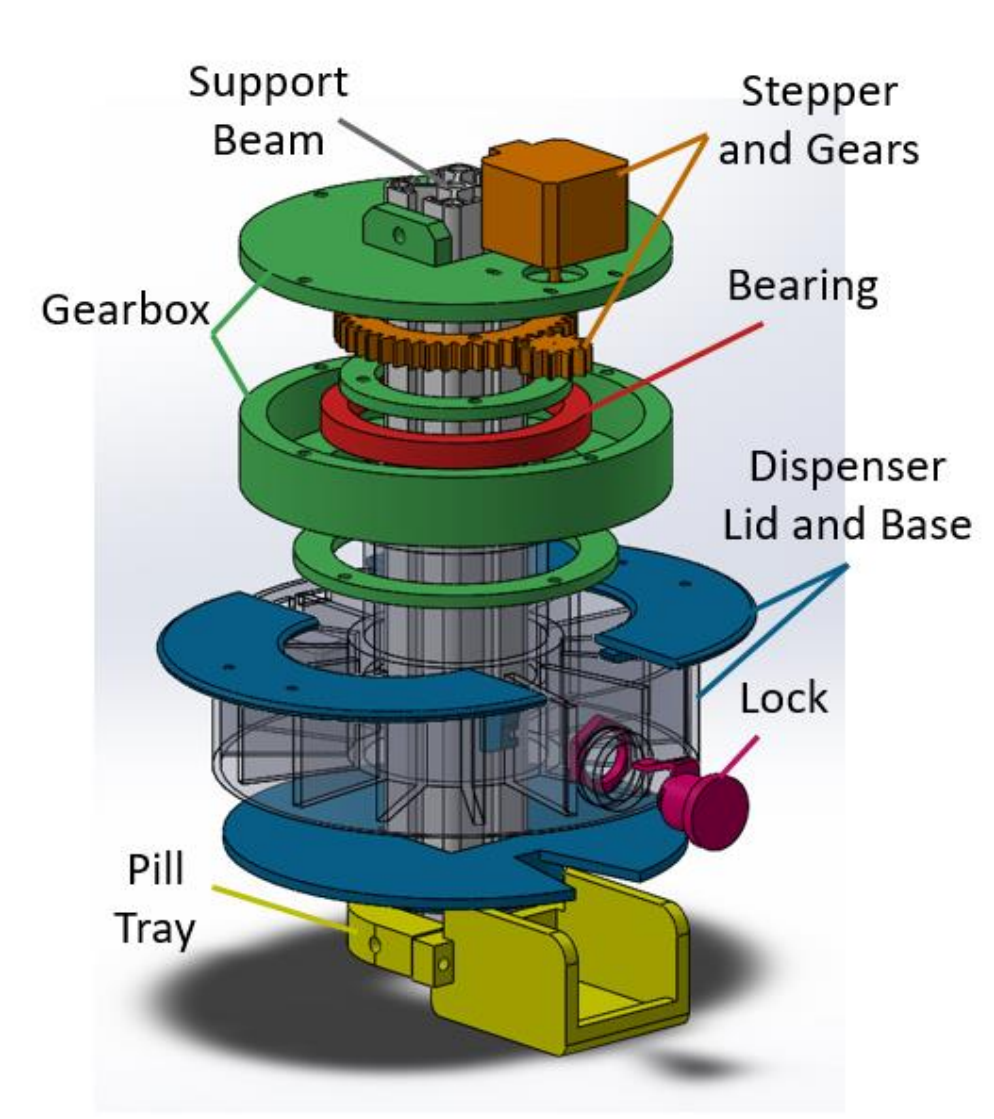



Figure 9: Explosion View of Medicine Dispenser

| Customer Requirement | Achieved by Prototype |
|---|---|
| Quiet Rotation | XX dB |
| Security | Lock & Key |
| Pill Waterproof | Individual Pill Box |
| Pill Dispensation | Individual Pill Box |
| Low Inaccuracy | <1 Block/ Round |

Table 3: Medicine Dispenser Assessment

# Medicine Dispenser Validation

# General Assessment

| Item | | Target Value | Achieved by Prototype |
|---|---|---|---|
| Budget ($) | | <1000 | 400 |
| Moving Speed (m/s) | | 0.2-0.5 | 0.2 |
| Lag (s) | Video Lag | <1 | 0.8 |
| | Control Lag | <0.5 | 0.1 |
| Duration (hrs) | Pad Duration | >3 (playing videos) | >6 |
| | Robot Duration | >1 (moving) | >2 |
| Loudness (dB) | | >70 | 50-90 (adjustable) |
| Inaccuracy of Medicine Dispenser (#Block/Round) | | <1 | 0.3 |

Table 4: General Specification Assessment

# Recent Progress

| Item | | Description |
|---|---|---|
| Hardware | Robot Stableness Improvement | New larger, thicker acrylic chassis installed<br>More Omni-Wheels (2 to 4) |
| | Remaining Component Installation | Two relays added |
| | Consumable Replacement | Substitutes prepared |
| | Wire Organization | Wires replaced & re-soldered |
| Software | User Interface Update | Buttons added & distribution updated |
| | Medicine Alarm Implementation | Functionalized on Pad on the robot |

Table 4: Recent Progress

# Project Schedule

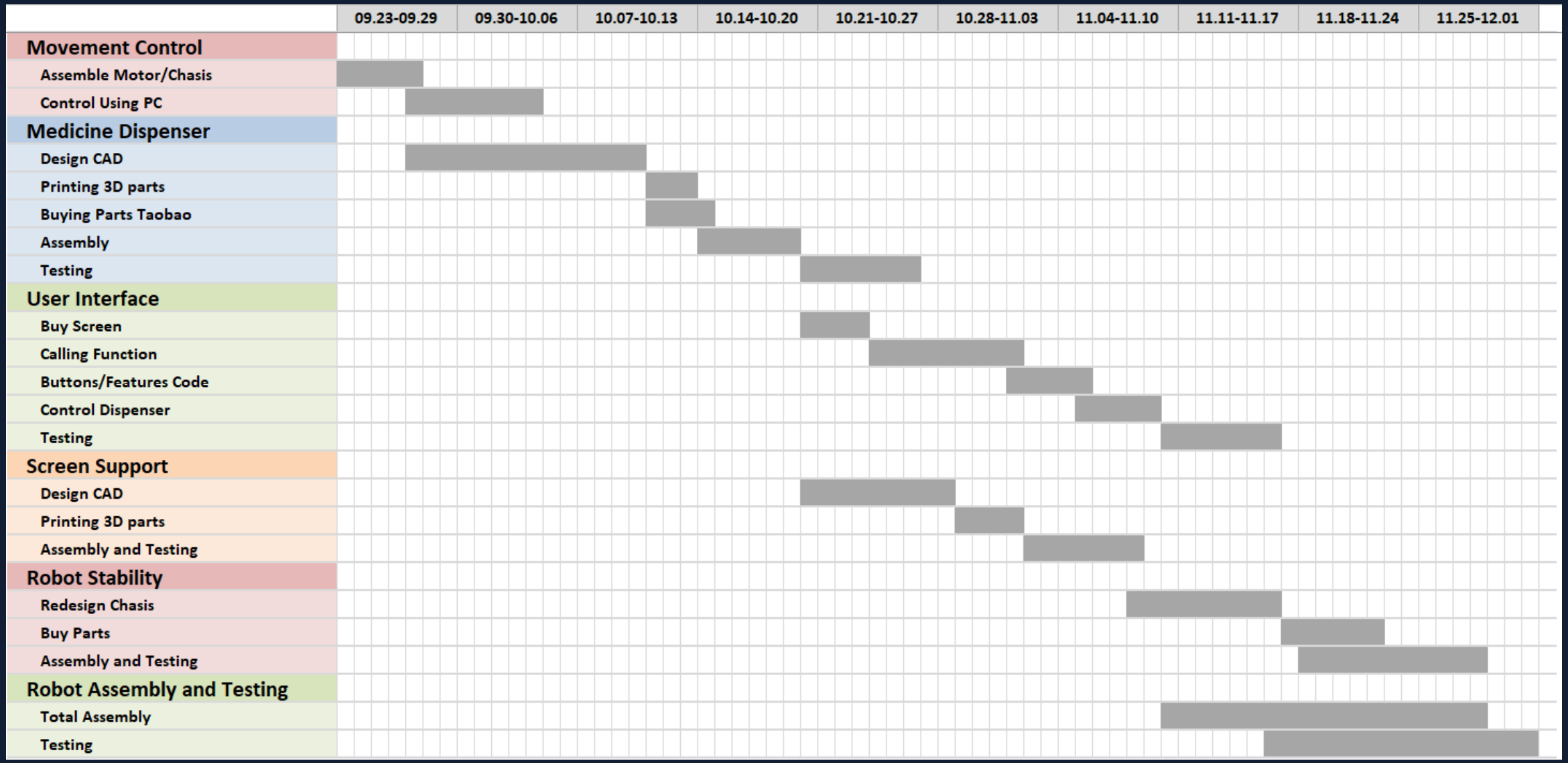



Figure 10: Project Gantt Chart

# Future Work

- Straight Movement Guarantee
  - Using PWM for DC motors
- Collision Avoidance Scheme
  - Add distance sensors (radars) to the robot
- Navigation Method Update
  - Install cameras for multiple angles of navigation
- Power Supply Integration
  - Make the number of power source one for easier connection and re-charging.

# Q & A

*Thanks for listening!*

# References


1. G. Zhang, J. P. Hansen, K. Minakata, A. Alapetite and Z. Wang, "Eye-Gaze-Controlled Telepresence Robots for People with Motor Disabilities," *2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, Daegu, Korea (South), 2019, pp. 574-575.
2. Donald Kerr, J Artur Serrano, Pradeep Ray, “ The role of a disruptive digital technology for home-based healthcare of the elderly: Telepresence robot ," *Digital Medicine*, Year 2018, Volume 4, Issue 4 [p. 173-179]