A Robotic Eye System Using Artificial Muscles

Project L.E.N.S.

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I. Purpose

Understanding the human eye is an important goal across multiple fields of research. Thus, there is a need for an apparatus to model human eye kinematics which cannot be accurately achieved through typical servos and linear actuators. This project aims to use recently developed artificial muscle technology to produce realistic eye actuation through a robotic eye model.

II. System Architecture

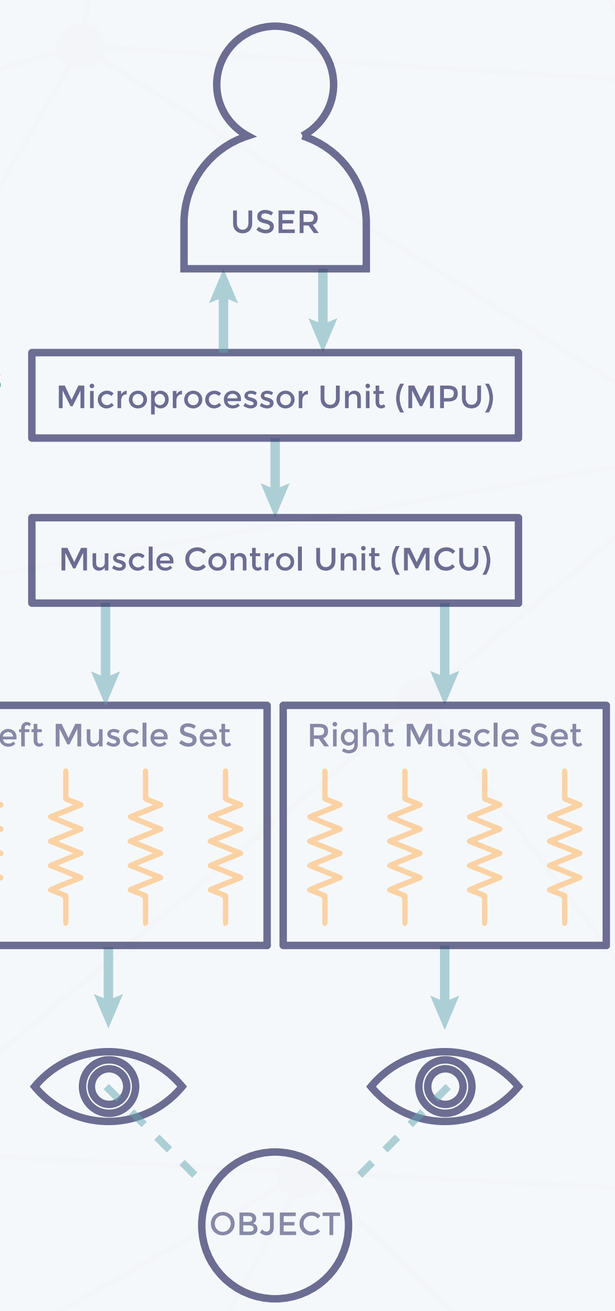
User
- Provides object for system to track
- Configures system settings
- Records system performance

Microprocessor Unit (MPU)
- Processes images from eye cameras
- Sends 3.3V control signals to MCU
- Displays video feed to monitor

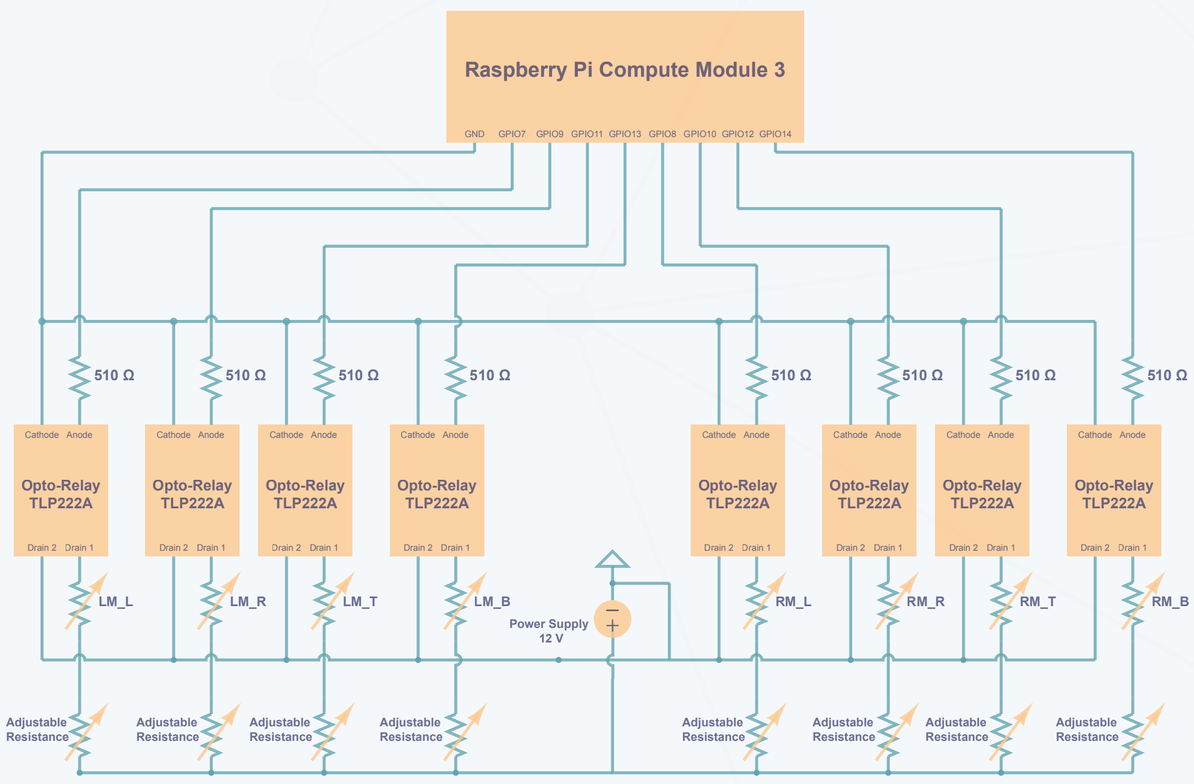
Muscle Control Unit (MCU)
- Receives control signals from MPU
- Amplifies control signals to 12V

Artificial Muscles
- Contract with higher current
- Hold length with lower current
- Move eyes to track object

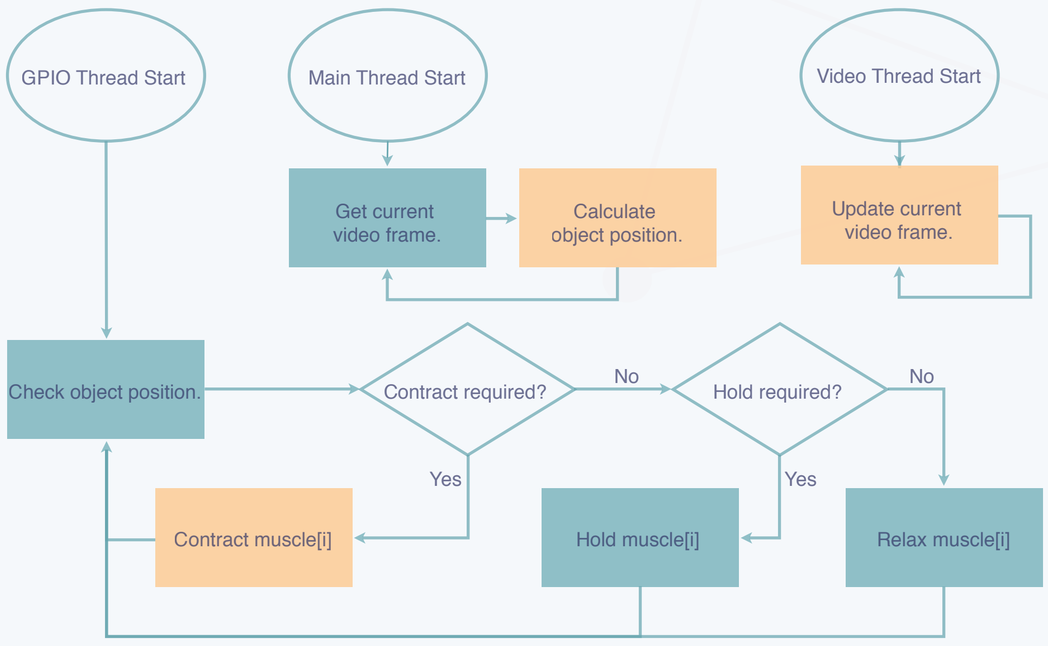
Eye Cameras
- Captures images of tracked object
- Sends image data to MPU



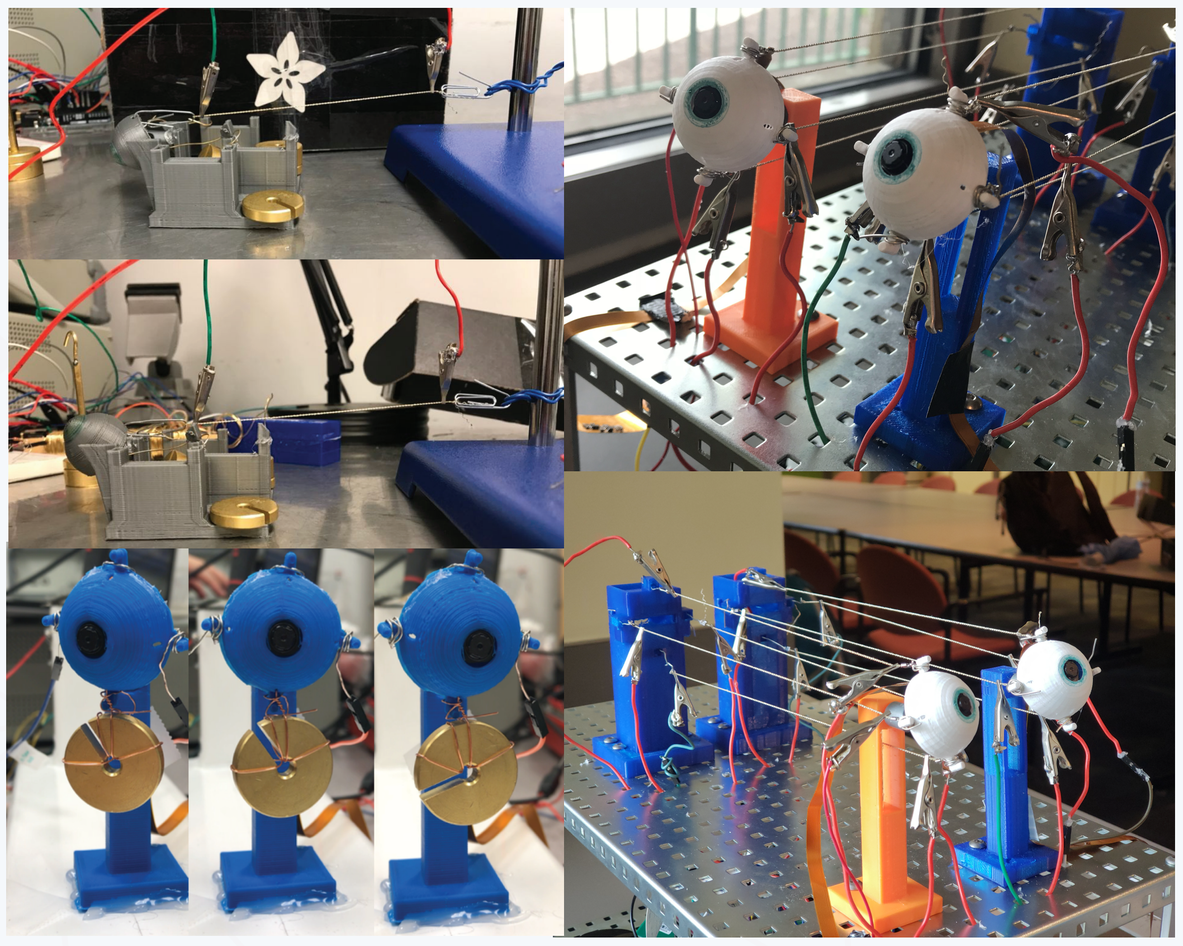
III. Circuit Diagram



IV. Software Flowchart



V. Early Prototypes and Final Design



VI. Results

The group conducted experiments to study the contraction behavior of the artificial muscles used. The contraction behaviors observed for muscles of various lengths are show in Figure 1.

The performance of the final system was evaluated by observing how well the two eyes were able to track an object moving along one of three paths. The graph in Figure 2 shows the results of evaluating the system with different error box sizes for each of the paths tested.

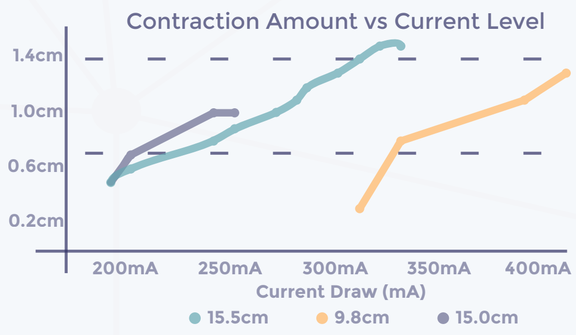


Figure 1. Different current levels applied to determine muscle contraction amounts.

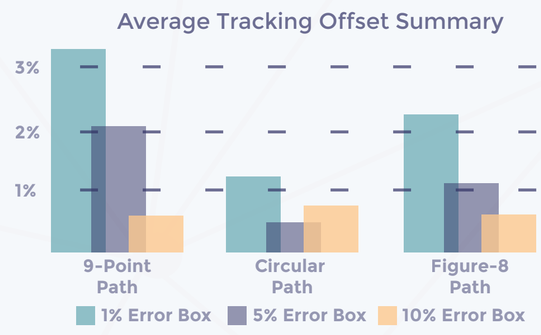


Figure 2. Summary of average offset distances between the center of the object, and center of vision for both eye cameras across paths.

VII. Conclusions

Achievements

In this project, the group was able to:
- Successfully develop artificial muscles with up to 1.4cm of contraction
- Use artificial muscles to move an robotic eye with 2 degrees of freedom
- Have the system track an object with a nearly 80% accuracy

Future Improvements

Future improvements made to this project could include:
- Improved synchronization between eyes
- Increased muscle contraction speed
- Addition of rotational motion to achieve of 3 degrees of freedom

VIII. Project L.E.N.S. Team

Team Members (Left to Right): Osaze Shears, Huy Dang, Tina Bui, Kaitlyn Bub, Vivian Le, Matthew Rheinstein.