Project title: Automated Safety Spotter

Group Number: 15
Group Members:

- Yanlin Ye (Electrical Engineering)
- Angel Morfa (Computer Engineering)
- Chris Weech (Electrical Engineering)
- Aaron Larson (Electrical Engineering)

Desired customers: Athletes, Health Clubs, Rehabilitation Centers, Athletic Departments.
No sponsors (as of 1-30-20).

Project description

The Automated Safety Spotter is an add-on tool used to help weightlifters in barbell exercises. With this tool, there would be no need for a spotter, thus increasing the safety for solo-gym goers by eliminating the risk of possible human error (distraction, reaction time, lack of judgement, etc.) while spotting. The product consists of two hydraulic arms with an embedded laser-break system, a camera, and a display/controller. The two hydraulic motors will sit right behind the barbell's path of travel, the motors will lift the barbell from the weightlifter when they become fatigued. The camera will be directly behind the weightlifter to track the barbell's movement in real time with the utilization of computer vision software. If the weightlifter (from here on, called *user*) is stuck and the camera detects that the bar's movement has stopped in a determined area, the motorized arms will rise to meet the bar and relieve the user from the weight. The product needs to be highly accurate, given that not reacting on time could be fatal.

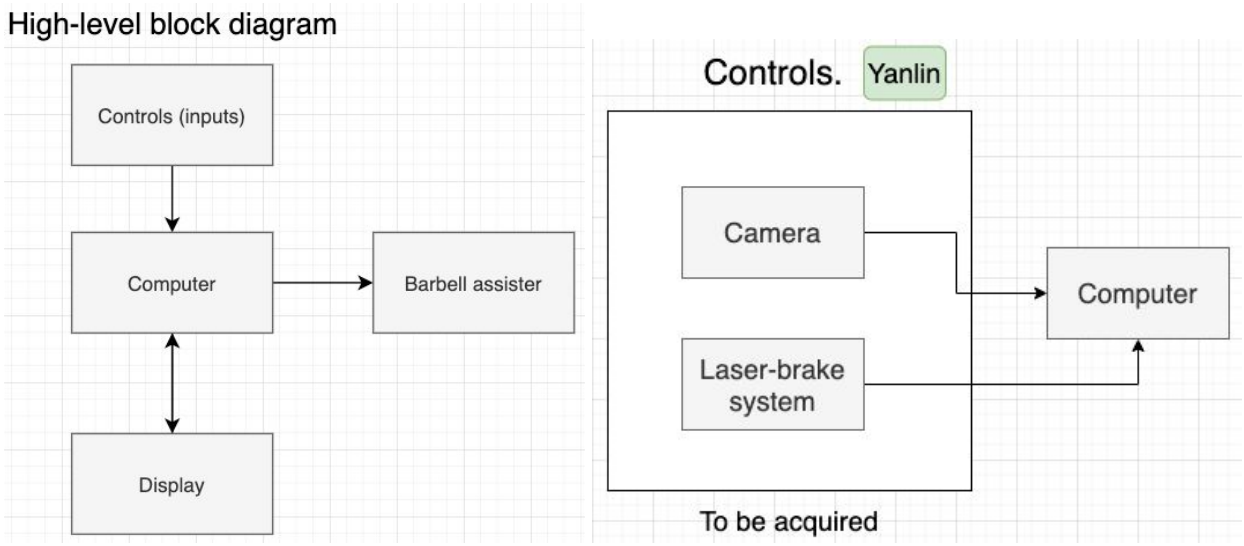
The motivation for this project comes from the recognition of weightlifters desire to lift increasingly heavier weights and/or go to failure yet are unable to do so because of the potential risks of training without a spotter, or training with an unreliable one.

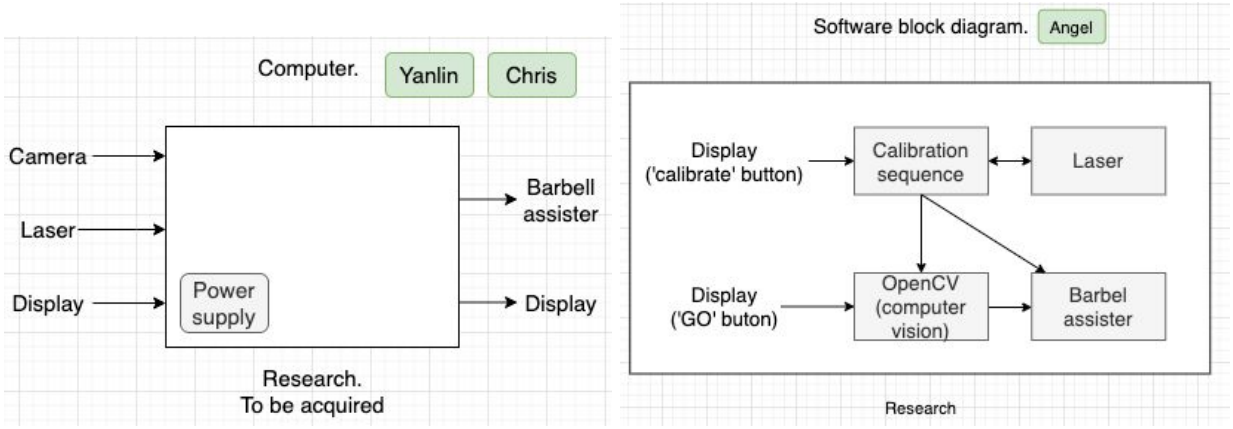
Requirements

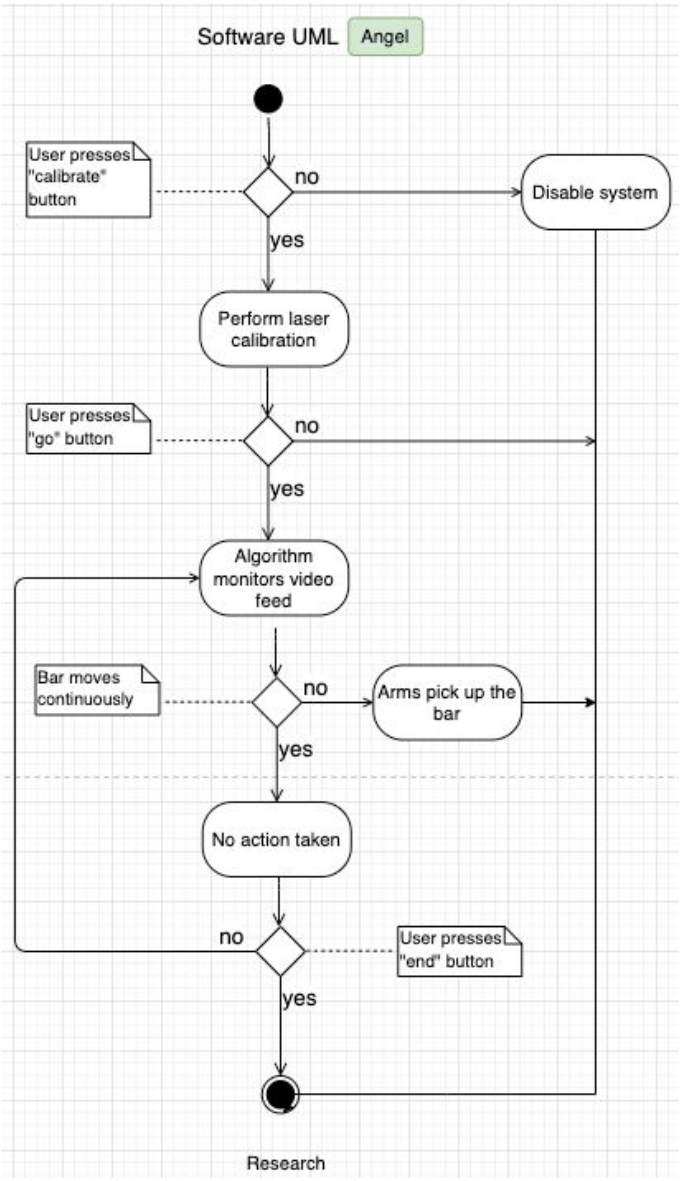
- The system shall consist of two independent hydraulic arms, a laser-break system, a display and a camera.
- The hydraulic motors shall stand on the floor and have an attachment to the rack.
- The system shall be connected to a CPU that will process the signals from the camera and laser-break system.
- The system shall have a maximum load capacity of 200lb or more.
- The system shall have a display that allows initiation of calibration sequence, shows the number of repetitions (reps) and elapsed time for the exercise.
- The system shall be disabled until the calibration sequence is completed
- The calibration sequence shall determine the low point of user's rep by utilizing a laser-break system located on the inside of the motorized arms.
- The calibration sequence shall be performed by lowering the hydraulic arms to determine the high point of the user's chest, this location will be used as the point at which the system will not allow the barbell to drop below.
- After the calibration rep, the exercise is initiated with the user selecting a "GO" button on the display which shall cause the hydraulic arms to unrack the bar.

- Once the bar is lifted from the hydraulic arms they shall drop to the calibrated low point.
- The camera system shall monitor the bar path.
- The hydraulic arms shall assist the user if the bar stops moving within a range specified by the calibrated low point height and the rack height.
- The display shall have a “DONE” button that disables the system until the next user completes the calibration process.

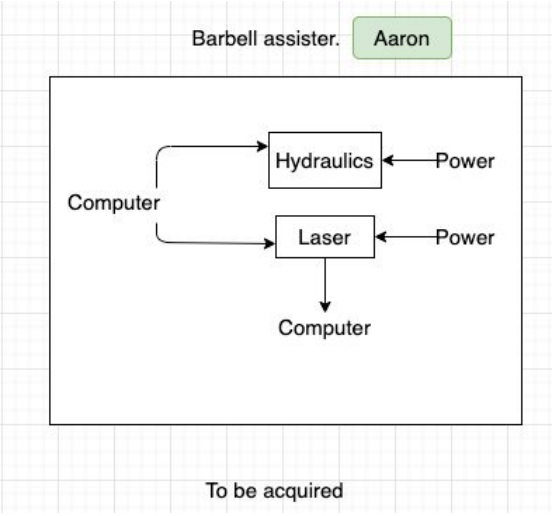
Block diagrams



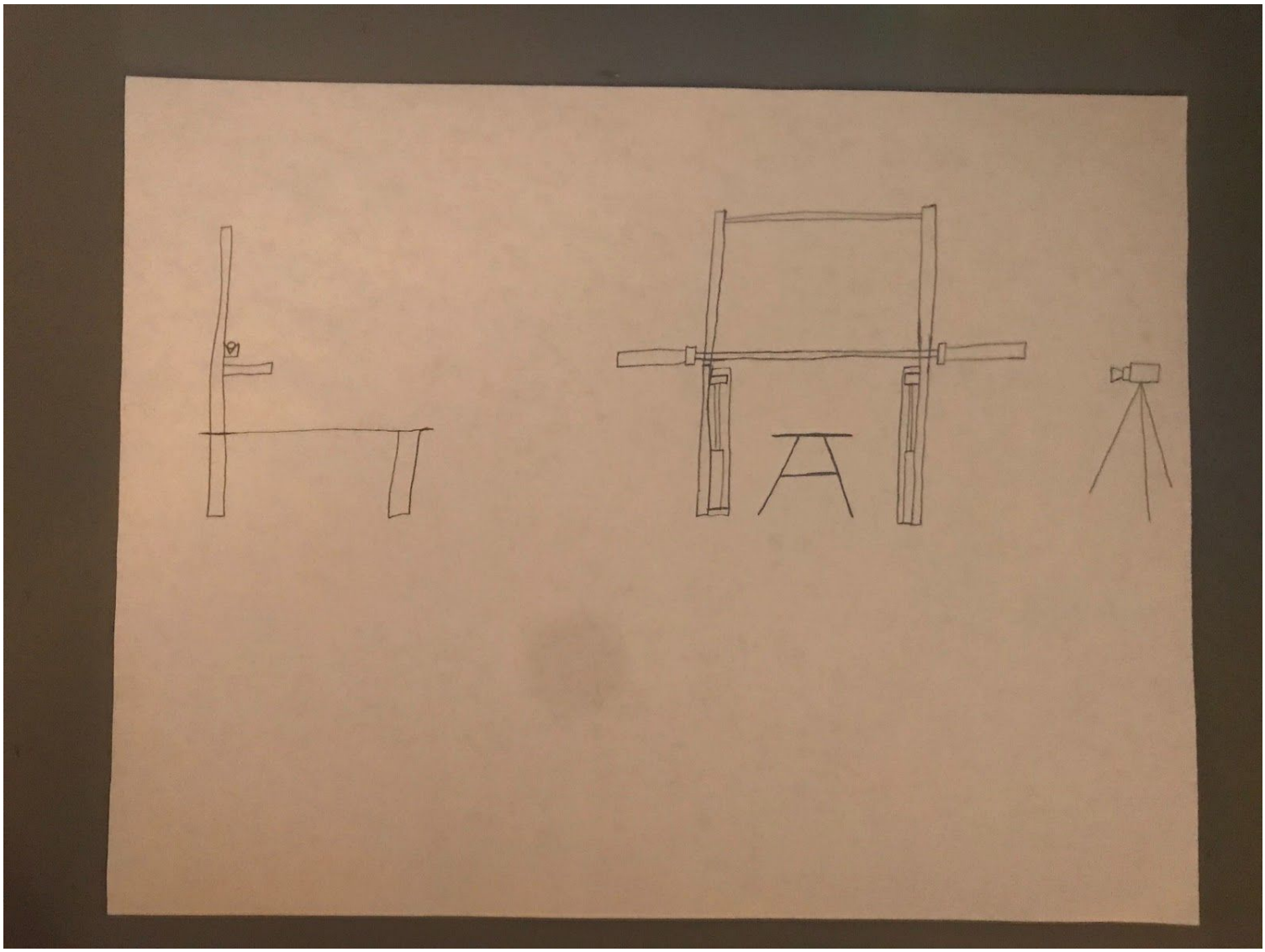




Research



To be acquired



Project sketch.

Financing

The group is seeking sponsorship, but as of January 30th 2020 the project is being self-financed by the group members.

Items	Price estimate ($)
2 hydraulic motors	350
Camera	50
Computer	50
Laser-break system	5
Power supply	20
Display	40
Hydraulic housing & arms	50

Project milestone

Number	Milestone	Planned Completion
1	Brainstorming	January 1 - January 30
2	Research & Design	January 30 - March 15
3	Documentation (100 page report)	March 1 - April 20
4	Order parts	April 21 - April 30
5	Build prototype	May 15
6	Troubleshooting / Testing	May 15 - July 15
7	Presentation & final report	July 15 - July 27