PLC-Controlled Volleyball Launcher with Adjustable Ball Trajectory, Velocity, and Spin

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1 Design Requirments

1.1 Immediate Priorities

Use PLC ladder logic as a fundamental part of th design, using a program such as OpenPLC on the Arduino. Slide open and close the blinds and rotate open and close using the existing hardware via time of day or button input. Open and close the screen door, allowing for a "neutral" mode during waking hours using simple button input and time of day commmands.

It is also crucial that the projct be non-invasive, as this is an apartment. Thus, it will be required that the system connect to the existing hardware, and be easily removable, while still providing robust blind control.

1.2 Secondary Priorities

Add Homekit module as an input to the PLC, permitting the blinds to be controlled from the PLC in response to commands from Siri.

2 Conceptual Development

The heart of the project is the PLC (simulated by an Arduino).

2.1 Motors

There are three motors total in the project. One motor actuates the belt which linearly opens and closes the blinds, sliding the wand control along the rail. The second motor is attached to the wand control, where the wand would normally attach. The third motor

operates in a similar mannar to the first, except that it is connected to the sliding screen door.

All three motors will need to have some level of torque and speed, to be determined, and will likely need a slightly larger power supply than that supplied on the Arduino. Thus, a power amplifier will be necessary.

2.2 Calculating the Linear Actuation Motor Torque

A force reader was used to calculated the forces required to open and close the blinds. The force meter was attached to the end of the blinds, and the maximum force before the blinds started moving was recorded for multiple positions along the length of the open and close duration. The maximum recorded force was then used to determine the size of the motor. The torque for the motor was then calculated using

$$\tau = F \cdot d$$

2.3 Calculating the Rotational Actuation Motor Torque

To simplify the process, the gear to be used on the blinds was created and attached to the wand control. Then a string was attached to the gear and then attached to the force reader, which was pulled and the force was read. The motor torque was once again computed from:

$$\tau = F \cdot d$$

2.4 PLC

The PLC recieves input from limit switches and other sensors on the blinds, and sends output to the Arduino.

2.5 Arduino

The Arduino recieves input from the PLC as well as sensors, and sends output to power amplifiers.

3 Component Selection

3.1 PLC

Much research and care was given to chosing a PLC for the system. It was desired to chose a PLC which was industry standard, since gaining knowledge of the real thing is desired. It is also necessary that the product be reasonably priced and have an ideally free software.

Brand	URL	Price New	Software Cost	Industry-Grade
Seimens	link	$150+	$100+	Yes
ACE	link	$60	Free	No
Automation Direct	link	$70	Free	Maybe yes

Table 1: PLC Analysis

With the following in mind, and per recommendations from the PLC hobbiest community, a PLC from Automation Direct is the best compromise for an industry-grade product at a reasonable price.