

Wheelchair Mounted Basketball Launcher

Objective

The goal of our project is to design and build a semi-automated basketball launcher that can connect with a power wheelchair. The launcher will allow the user to control aim and fire functions to launch a basketball, allowing them to participate in popular basketball games like H.O.R.S.E and other basketball shooting activities.

Potential Solutions

In designing the Basketball launcher, a functional decomposition model was used to come up with a bunch of different ideas to find the best one that would work. The launcher was split up into different sub-systems: the launching system, rotational control, pitch control, and the user control systems. The top three ideas for each sub-system were pulled from the functional decomposition and a decision matrix was then created with the three ideas. The decision matrices provided the best option for the launcher. The final design included using two pitching machine wheels mounted vertically. The rotational control uses a motor and gear system with a Lazy-Susan bearing. The pitch control system will use a small winch and the force of gravity to change the pitch of the launcher. Finally, the user control systems will utilize a joystick to control the rotational and pitch control, a potentiometer to control the speed of the wheels, and a button to launch the basketball.

Final Design

The final design of our basketball launcher is composed of a launching system, pitch and rotational control systems, and a base that houses the batteries to power the device and provides the connection to the wheelchair.

The launching system uses two 16in diameter pitching machine tires that are mounted vertically. In order for the ball to be launched, there will be a gap of eight inches so the basketball will be compressed and launched when the wheels are spinning. These wheels are powered individually by $\frac{1}{4}$ hp motors. The wheel speed will be controlled by the user via a sliding lever. The loading mechanism will be housed behind the wheels. This mechanism is a three sided box where the basketball can be loaded from the top or the side. A spring loaded plate will be pulled back by whoever is assisting the user. The plate will then be locked into place by an electric latch. Once the ball is placed inside the box, the user will be able to unlock the plate with his fire button. The plate will slide along the rails mounted to the bottom of the box, thus pushing the ball into the wheels to launch it.

A joystick will be used to control the pitch and rotation of the launcher. The pitch control will use a winch system that uses the force of gravity to rotate the wheels anywhere between 0° and 85° . This winch is mounted at the back of the pitch control base and the wire rope will run to the front of the base where it connects to a pulley. This pulley will guide the wire rope to the bottom of the cross member that holds the wheels. The rotational control uses a Lazy-Susan

bearing that attaches the pitch control to the base. A motor will be attached to the bottom of the pitch control that will have gears on it to rotate the entire pitch control system.

The base will be mounted on top of four caster wheels that will allow the base to move in all directions when connected to the wheelchair. To connect the base to the wheelchair, two latch action toggle clamps will be used. The other end of these clamps will be permanently attached to the tow mounts on the wheelchair. The base will also house the batteries and other electrical components that are used to control the different components.

The launching, pitch control, and rotational control sub-systems will all be controlled by Arduinos with motor shields. This will allow for a feedback driven system that can be easily controlled by the user via the proper controls. The feedback includes two optical sensors, one for each wheel to give feedback on each wheel's current speed. Figure 1 shows the final 3D model of the launcher.

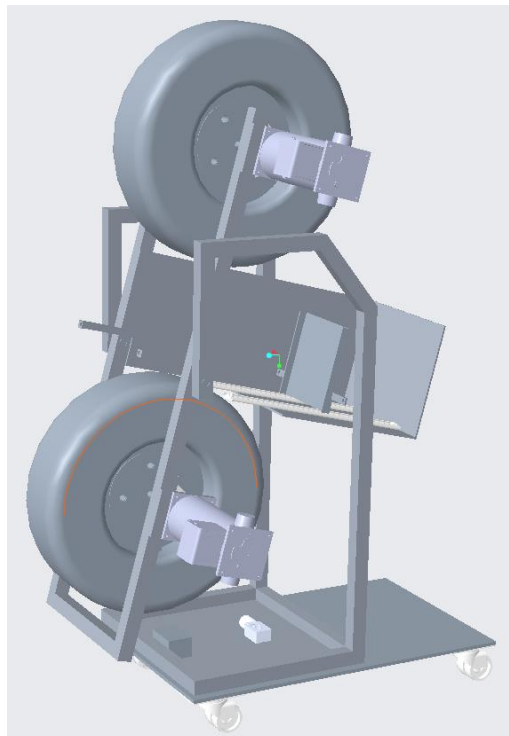


Figure 1: Final 3D Model

Manufacture

The frame of the launcher is made out of aluminum sheets and aluminum tubing. Since the frame was designed to be welded together, material and welding services have been donated to our team by an outside source. Beyond the frame, the rest of the assembly (wheel mounts, electrical wiring, etc.) will be done by our team in house.

Testing

After the build is complete, various tests will be done to ensure the launcher works as expected and meets the needs of our client. These tests and their corresponding goals can be seen in Table 1.

Table 1: Test Plans

Test	Goal
Accuracy and Precision	Determine the accuracy and precision of the launcher
Battery Life	Testing how long the launcher can be used consecutively at the maximum load
Range	Determine how far the launcher can launch the basketball
Reload Fire Speed	How fast after the first shot can the ball be reloaded and fired again

The launcher must be both accurate and precise so the client is able to make a basketball from a wide variety of spots. The battery life will be tested to determine if it behaves as expected and lasts long during the clients use. Since the client requested to be able to shoot as far as he could, the range of the launcher will be tested to verify that it meets our client’s wishes. The reload speed of the launcher will also be tested to verify how long the client will have to wait between shots.

All of these performance tests will be done post build once the launcher is completely built and all necessary programming is completed. These tests will be used to analyze the launcher’s performance. After they are completed, any adjustments that need be made to the launcher will be done. The tests will then be performed again if time permits.