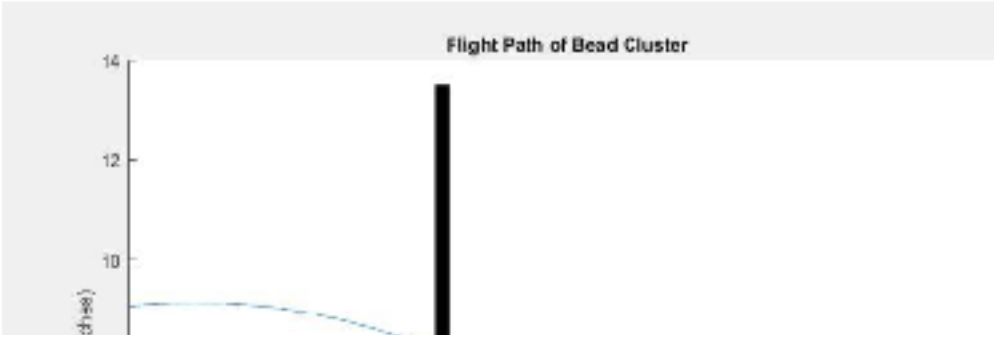
Shooting Mechanism Signoff

Tuesday, January 25, 2022 10:43 AM

The shooting mechanism is a vital aspect of the overall design, bein
way that the team will be gaining points. It will need to be able to aerially l
horizontal distance of between 5 and 6 inches and a vertical distance of bet
inches. It is desirable that the beads reach their "apex" height near the midd
the net. To accomplish this objective, the team has designed a conveyor sys
to launch the beads at the required distance and height.

To better understand the trajectory of the beads, a MATLAB progra
the flight path of the beads with different parameters. The parameters that v
edited were the launch angle in degrees, the distance from the end of the co
inches, and the RPM of the motor that is driving the conveyor. Changing th
and observing how they affected the flight path of the beads allowed the tea
better understanding of how the conveyor should be designed. An example
program is shown below.



ng that it is the primary
launch beads a
ween 6 and 13.5
dle of the diameter of
stem that will be able

am was created to plot
were allowed to be
onveyor to the net in
hese three parameters
am members to gain a
of the output of the

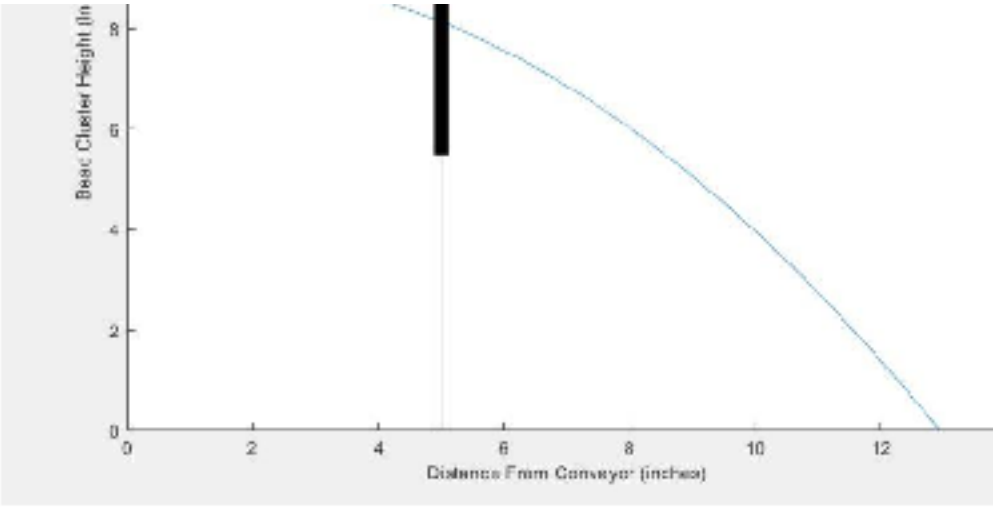


Figure. Example Output of Bead Flight Path Simulatio

The example above is using 8 degrees for the launch angle, 700 RPI speed, and 5 inches for the distance to the net. It is clear to see that with the achievable to launch the beads into the net. The limiting factor in the actual conveyor will be the speed of the motor.

In order to choose an appropriate motor, the potential torque load th experience needs to be approximated. There are a few different factors that load, including the mass of the beads and the friction of the ball bearings th mounted to. It is not expected that the conveyor belt itself will contribute m the fact that it is both pushing and pulling the rollers at the same time, effec this force. In addition, the friction of the ball bearings is expected to be neg specifically designed to be able to rotate with minimal friction. It is anticipa

contributor to the load will be the mass of the bead bracelets. Being that the bracelet being used, the mass has been estimated at around 0.822 grams per

14

on

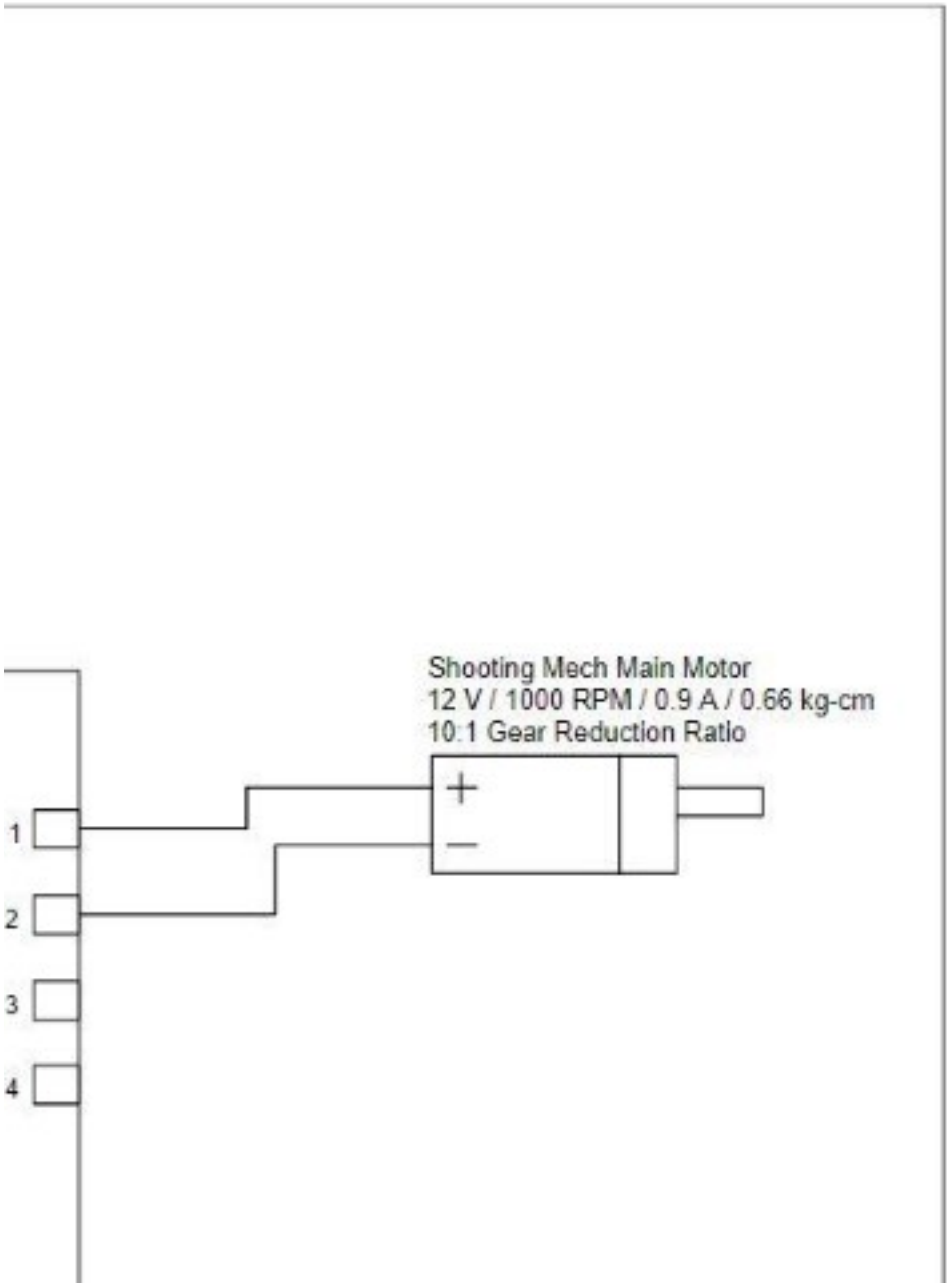
M for the motor
ese parameters, it is
l design of the

hat the motor will
affect the overall
hat the conveyor is
much to the load due to
ctively cancelling out
gligible, as they are
ated that the main

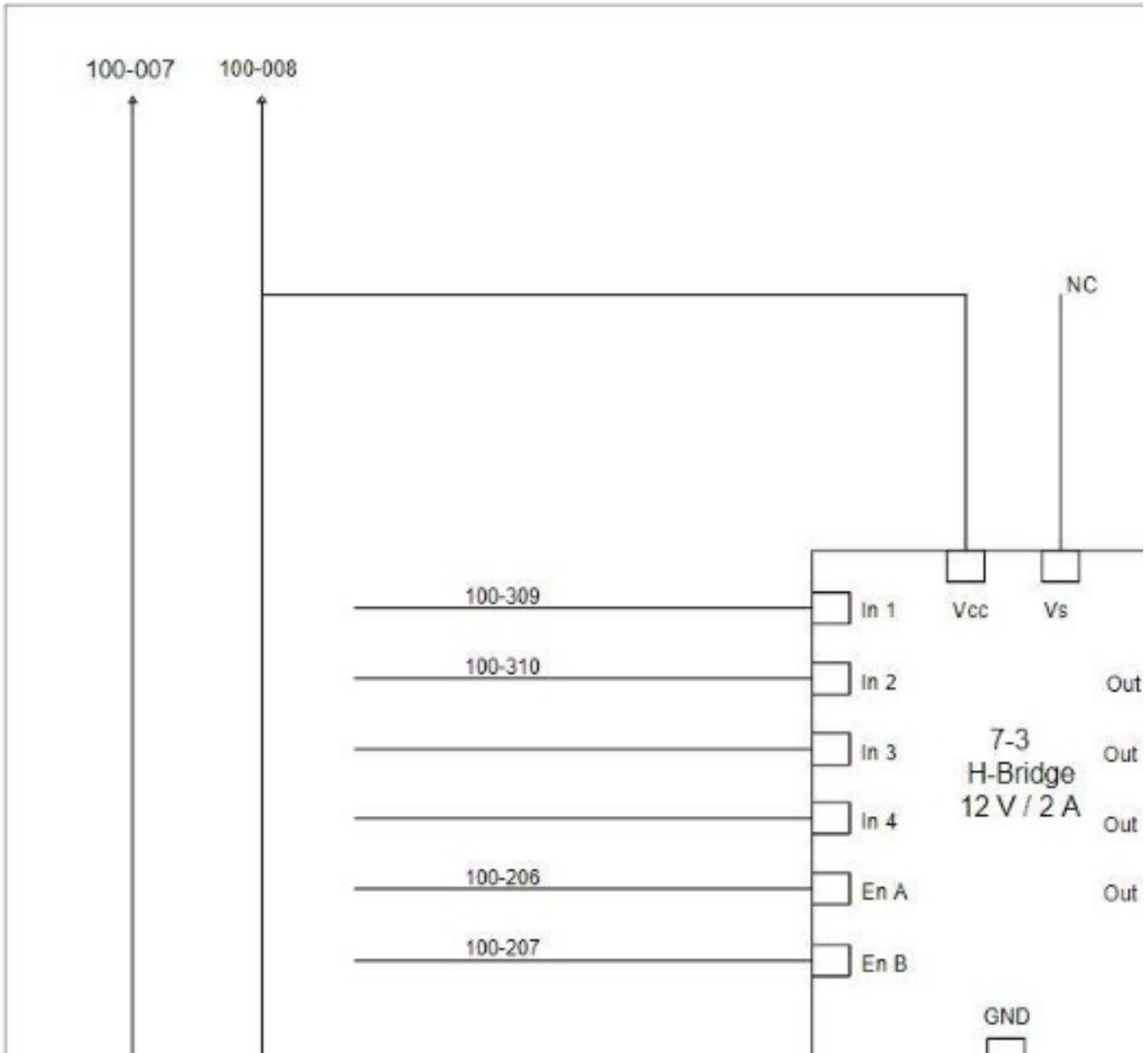
ere is no official bead
r bracelet. This

number was based on similar products from Amazon. The maximum numb
competition will be 30, giving a potential total mass of 24.66 grams. The ap
the conveyor will be 22.86 centimeters. Using these values to approximate
value of 0.5637 kg-cm. The motor that has been selected for this task is ma
and can be found at this link: https://www.pololu.com/product/4748/specs.
torque of 0.66 kg-cm, which exceeds the estimated required torque for the
a rated speed of 850 RPM, which has been proven using the MATLAB sim
enough to launch the beads into the nets. It will be coupled to the rotary sha
set screw motor couple, which can be found here: https://www.robotshop.c
set-screw-shaft-coupler.html. The motor will be controlled through an H-br
method of control was chosen because it gives the team the ability to chang
motor if necessary. The team already possesses an extra H-bridge that can
purpose. A circuit diagram of the motor and H-bridge is shown below.

er of bracelets in the
pproximate length of
the load returns a
nufactured by Pololu
The motor has a rated
belt. In addition, it has
ulation to be fast
aft via a 4mm to 5mm
om/en/4mm-to-5mm-
ridge via PWM. This
ge the speed of the
be used for this


Shooting Mech Main Motor
12 V / 1000 RPM / 0.9 A / 0.66 kg-cm
10:1 Gear Reduction Ratio
+
−
1
2
3
4


100-008


100-007
100-008
NC
100-309
100-310
100-206
100-207
In 1
In 2
In 3
In 4
En A
En B
Vcc
Vs
Out
Out
Out
Out
7-3
H-Bridge
12 V / 2 A
GND


GND
GND

After speaking with Dr. Pardue of the Mechanical Engineering Dep
altered the structural design of the conveyor. The rollers will be 3D printe
team to control bore precision. The surface of the 3D printed material also
amount of friction to turn the belt. The diameter will be 1.5 inches with a b
to match that of the bearings and axles. The rollers will need to be attached
the supporting structure. To attach the rollers to the surrounding support st
bearings will be utilized. The pillow block bearings have outward-facing m
holes will allow for mounting as well as adjusting the angle of the conveyo
bearings can be found at this link. https://www.mcmaster.com/pillow-block
bearings/for-shaft-diameter~3-16/. Brass wells will be inserted into slots in
hold the bearings in place. The brass wells can be found here:
https://www.mcmaster.com/93495A130/. Additional nuts and screws will b
the wells to the bearings. The rotary axle will pass completely through the
mounted on each side to the bearings/motor. It will have a 3/16-inch diame
the bearing and roller. The rotary axis can be found here: https://www.mcm
shafts/rotary-shafts-5/diameter~3-16/. The belt material thickness was chos
the conveyor height at a minimum. Rubber has been chosen for the belt ma
tackiness. The belt material can be found here: https://www.amazon.com/I
Conveyor-Length/dp/B08GTV6DGD/ref=pd_di_sccai_2/141-4281628-
1256060?pd_rd_w=CQnik&pf_rd_p=c9443270-b914-4430-a90b-
72e3e7e784e0&pf_rd_r=MEGGCQVSGX06EWB4QYCZ&pd_rd_r=3fd1
bcf4-2c1fd090d0ee&pd_rd_wg=tYtQr&pd_rd_i=B08GTV6DGD&psc=1#
The team also added room in the conveyor design to attach 1" protrusions
slip if it is an issue. The belt will be held to the rollers by its own tension.
of the conveyor will be made of acrylic, the same material as the rest of the

The shooting mechanism will also need a method to reload, as there
nets. As each new net is found, the next set of beads to be fired off will nee
the belt. The team has designed a reloading mechanism that will be fixed a
mechanism. This mechanism will contain three compartments with a slab
able to be moved, and in turn allowing each set of beads to be dropped. The
toothed rack on its side and will be moved by a motor attached to a gear. B
3D-printed, it is expected that the torque required to move it will be minisc
motor will be used in this application to have precise control over the slab

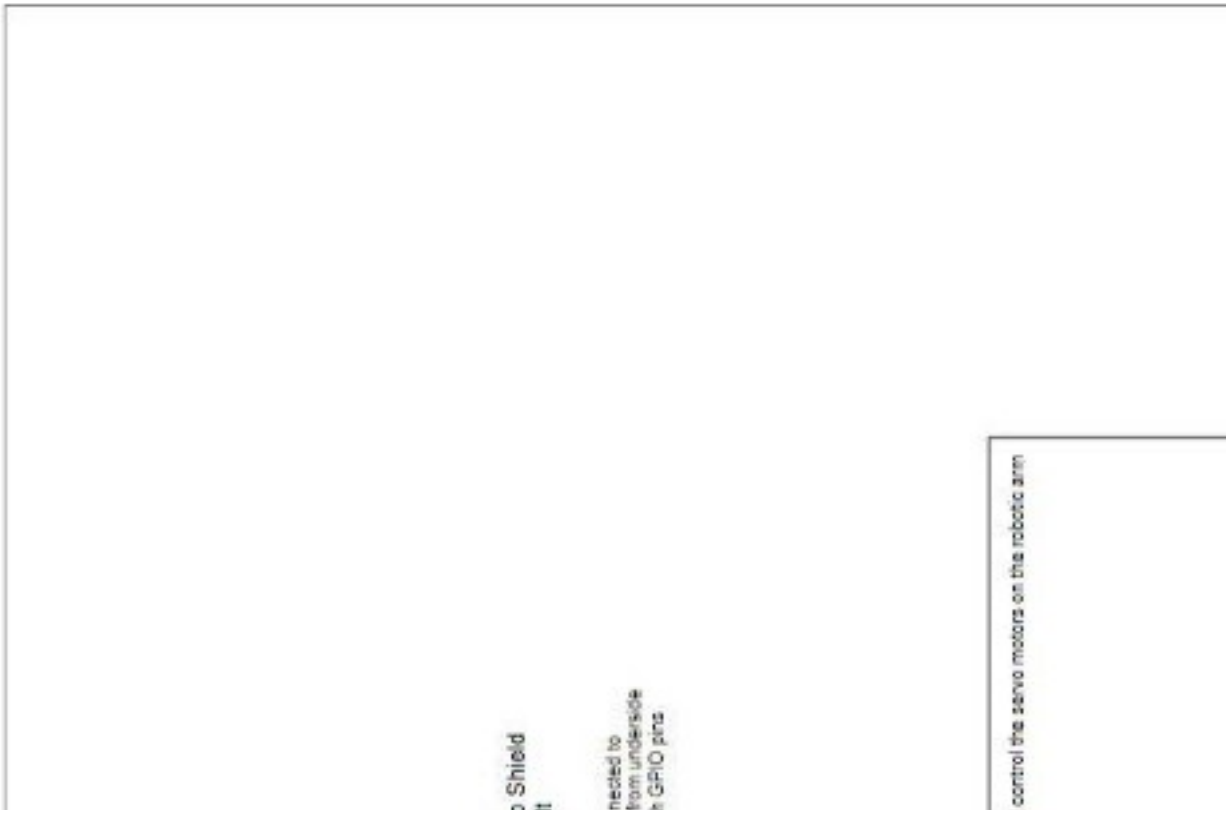
artment, the team has
d, which will allow the
provides a good
ore size of 3/16 inches
via ball bearings to
ucture, pillow block
ounting holes. These
r. The pillow block
k-mounted-ball-
the acrylic in order to

be needed to mount
roller bore and be
ter to match that of
naster.com/bearing-
sen to be 1/8" to keep
terial because of its
nch-Cover-Black-

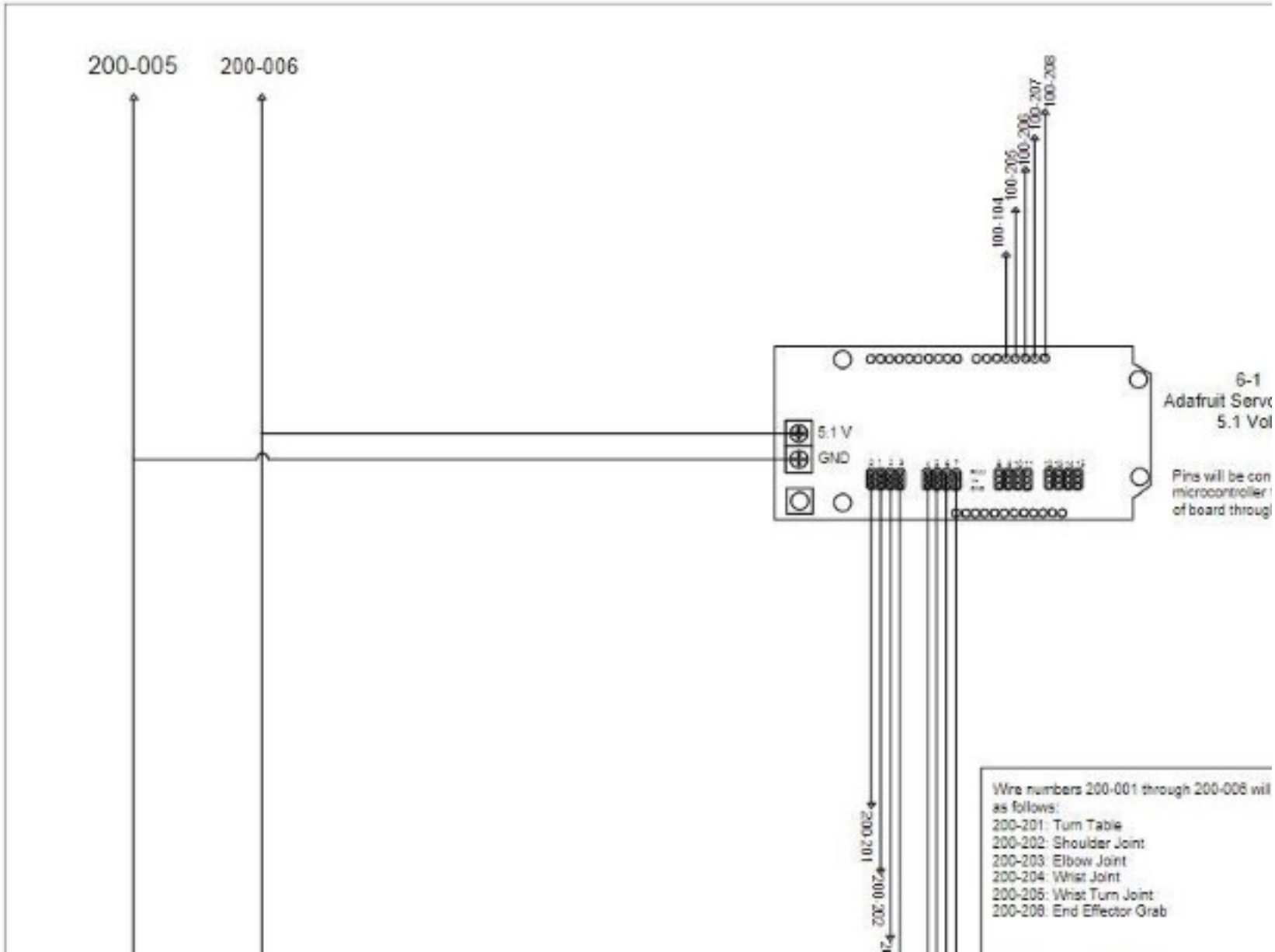
169e-b066-4338-
customerReviews.
on the belt to prevent
Finally, the supports
chassis.

e will be three separate
ed to be dropped onto
top the shooting
on the bottom that is
e slab will contain a
ecause the slab will be
ule. A small servo
movement. The servo

can be found at this link https://www.robotshop.com/en/parallax-futaba-co
servo.html. This servo will be controlled through the Adafruit servo shield
gear will be 3D printed and attached to the servo motor shaft. The wiring d
servo shield is shown below.



ntinuous-rotation-
via PWM. A custom
iagram of the Adafruit


200-005
200-006
100-208
100-207
100-206
100-205
100-104
5.1 V
GND
6-1
Adafruit Servo
5.1 Vol
Pins will be con
microcontroller
of board throug
200-201
200-202
Wire numbers 200-001 through 200-006 will
as follows:
200-201: Turn Table
200-202: Shoulder Joint
200-203: Elbow Joint
200-204: Wrist Joint
200-205: Wrist Turn Joint
200-206: End Effector Grab

200-207: Chassis Turntable
200-208: Shooting Mechanism Reload

200-208
200-207
200-206
200-205
200-204
00-203

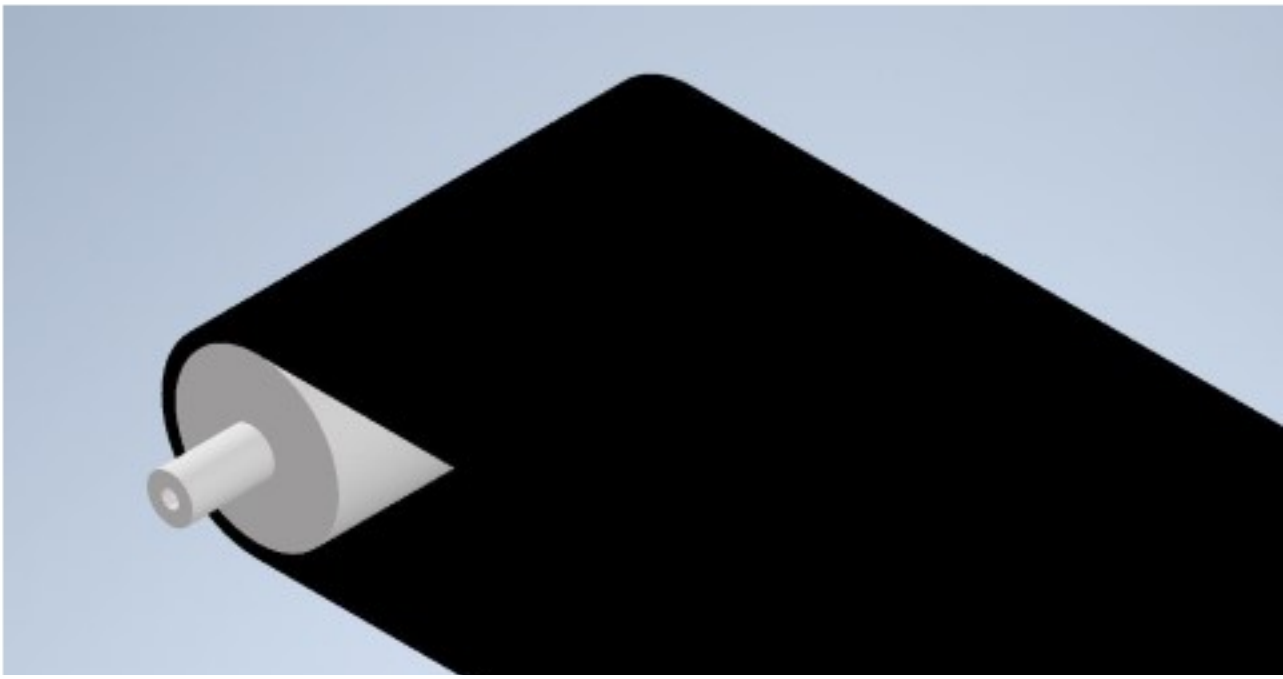
The total BOM is shown below

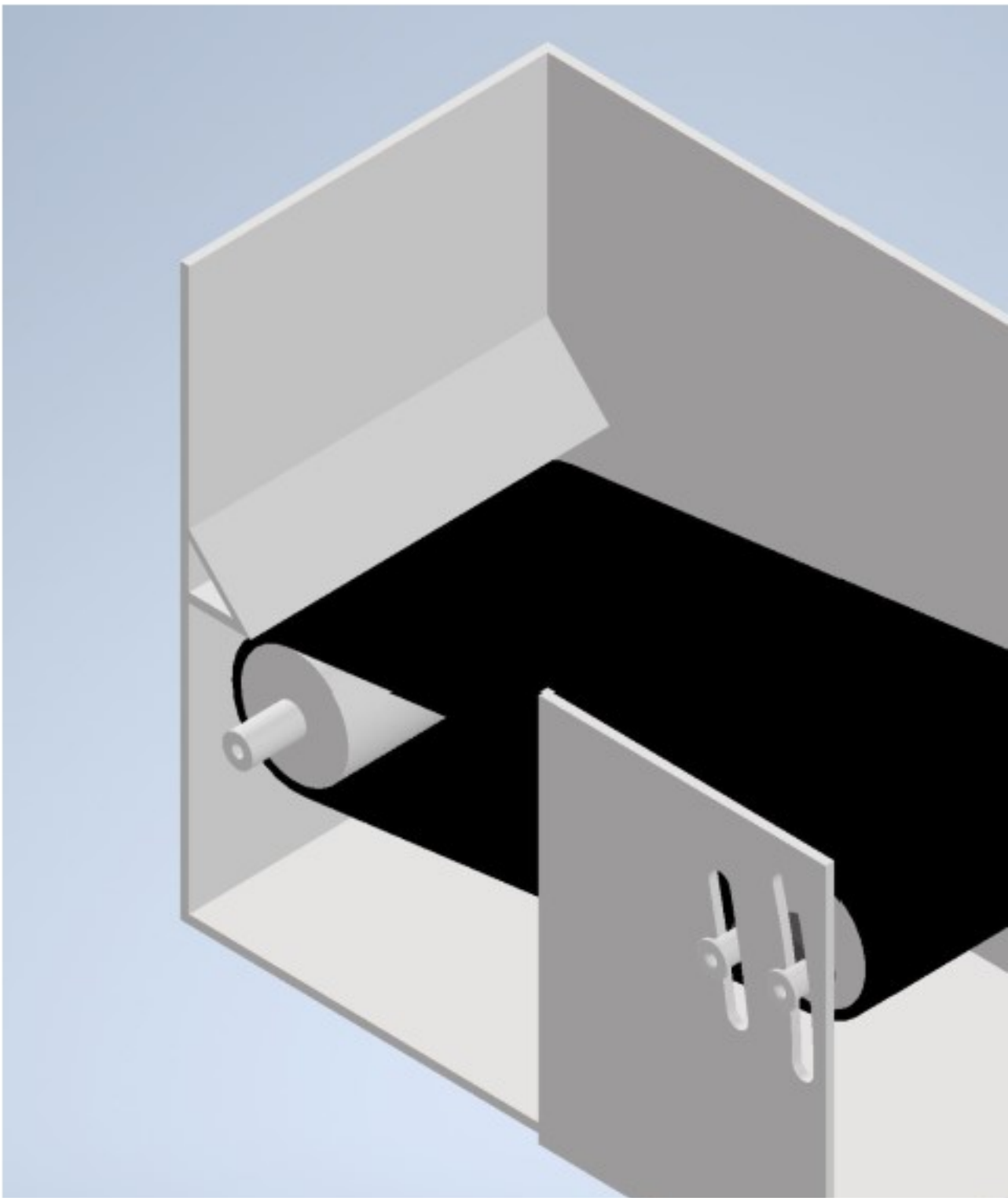
Item	Description	Unit Cost	Qty
Conveyor Motor	Pololu 12 V 1000 RPM DC Motor	$24.95	1
Pillow Block Bearing	Pillow Block Bearing 3/16" Bore	$9.56	3
Bearing Rotary Shaft	Rotary Shaft 3/16" diameter 1ft long	$8.02	2
Motor Coupling	4mm to 5mm Motor Coupling	$4.99	1
Conveyor Belt Material	1/8" 5 ft long PVC 120	$20.98	1
Reloading Motor	Parallax (Futaba) Continuous Rotation Servo	$19.95	1
			Total:

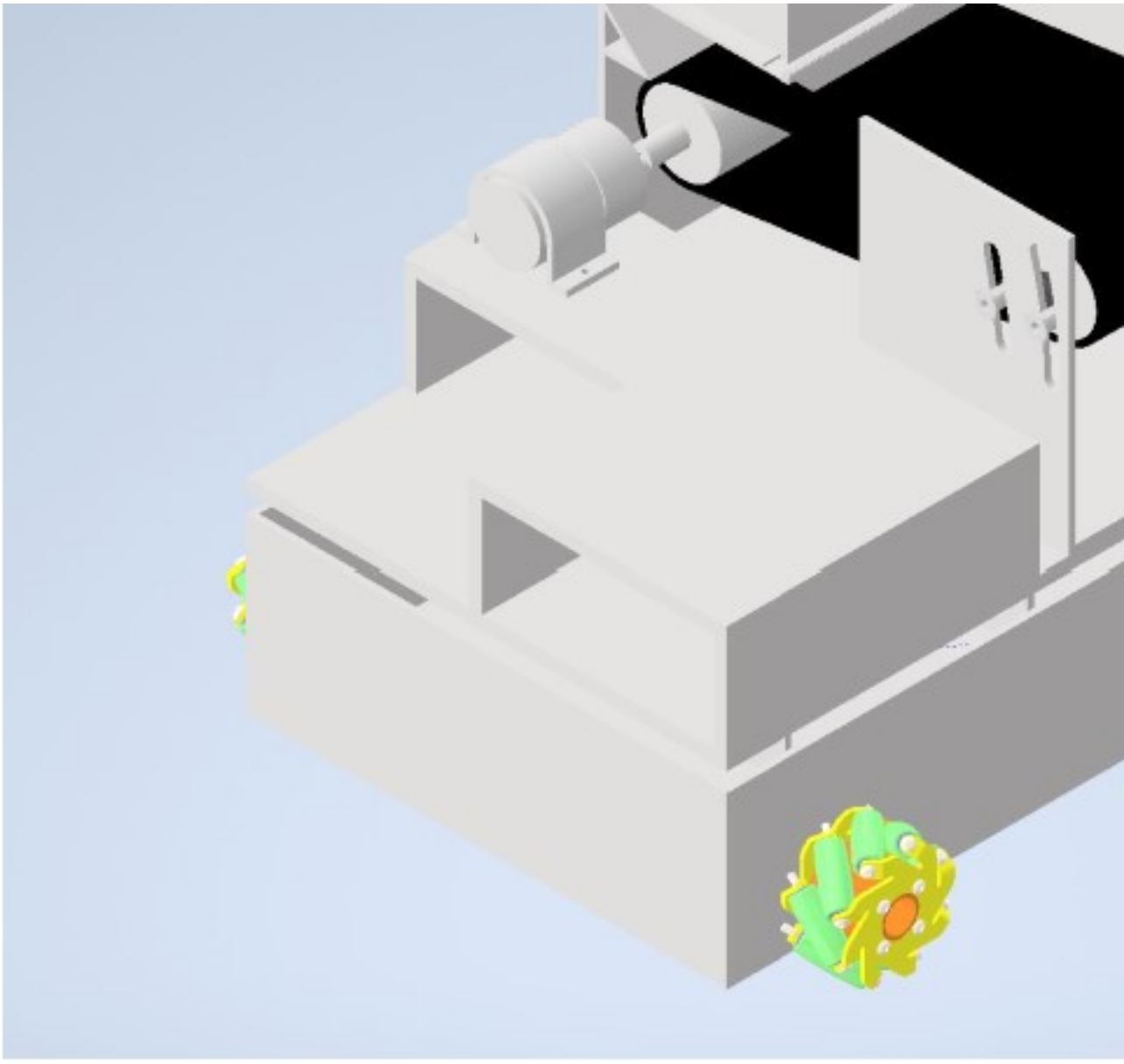
The 3D schematics of the shooting mechanism are shown on the fol

	Total Cost
	$24.95
	$28.68
	$16.04
	$4.99
	$20.98
	$19.95
	$115.59

llowing pages.







NOTE: THE ROBOT ARM WAS REMOVED FROM THIS PICTUR
VISUALS

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