Santa Monica Goats United

Objective

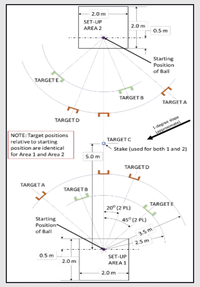


Figure 16: Court Specifications

Objective:
Create a device that propels rubber balls through a series of wickets in a 1 minute time frame. We must score as many points as possible.

Rules & Restrictions:

- There are 5 wickets (miniature soccer goals) which are the targets
- Targets B and E are worth 10 points each
- Targets A and D are worth 20 points each
- Target C is worth 30 points
- Balls must be launched without any external force (striking motion, no physical push from a person)
- Must utilize safe energy sources
- There's a specific order that balls must be followed (from the highest multiplier to the lowest)
- Blue ball has a 3x multiplier
- Red and Yellow balls have a 2x multiplier
- Green and Orange balls have a 1x multiplier
- All 5 balls must be launched within 60 seconds.

Our Device:
To accomplish the task at hand, many revisions have been made. Ultimately the build team opted for the use of a 6 inch pvc pipe followed by a wooden ramp where the ball would smoothly be guided to the wickets. Other design choices utilized would be the inclusion of a swivel mechanism on the base that would allow for quick direction adjustments, as well as laser pointer mounted onto the ramps end point to help improve accuracy.

Final Product

Our final design incorporates aspects from each of our previous iterations. After abandoning the pvc tube tunnel (Figure 11) we settled on a ramp made from thin sheets of plywood as shown in figure 4. This design allows us to make fine modifications to the trajectory of the ball. The ball, which is suspended by a flexible zip tie, is stored near the top of the rails. Additionally, the final iteration uses a simple, gravity fed, launching mechanism which is highlighted in figure 6. It consists of a pvc tube with a smaller diameter metal pipe inside. After removing a pin, the metal pipe propels the ball down the ramp.

Figure 1

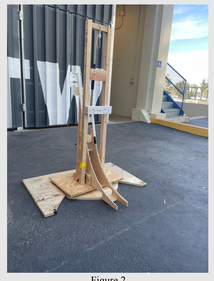


Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Prototype Design

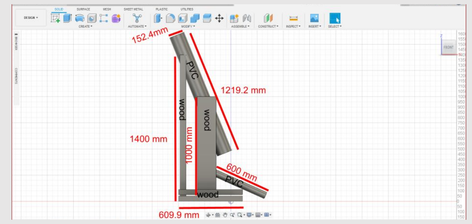


Figure 9

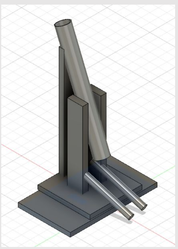


Figure 10

Figure 11

This 3D design created in CAD served as a reference for building the physical design, an was the final step before beginning the physical build. Although aspects have been revised the core outline has remained the same.

Design Process

Define Problem:
Create a device that effectively launches balls in a concise and accurate manner. Must be done without external force.

Brainstorm:
Using gravity as a source of momentum would allow for a higher consistency in results and would simplify the physics at work.

Prototype:
The prototype for the design used was created in a 3d modeling software. This allowed for a referenceable design during construction.

Test Solution:
Following testing, the design was altered to use a pin mechanism to release and activate the striking motion. The design was also altered to no longer use a tube, instead opting for a ramp for consistency.

Results:
More consistent results and accuracy. A laser pointer is added to help aim the ball, and fine tuning features begins to fully optimize the design for competition. However, the ramp has a drop at the end which occasionally leads to inaccurate launches

Cost Analysis

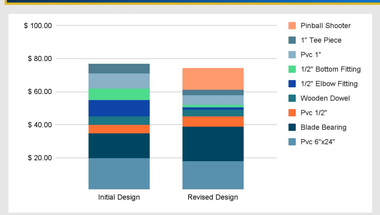
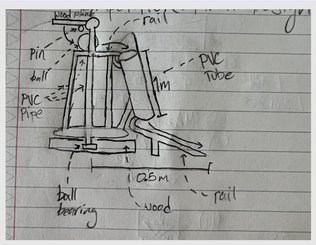


Figure 12: Material Costs

Figure 13: Labor Costs

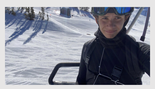
Using the average salary of a construction laborer for two months of work ($8,478) and multiplying it to our group size, as well as determining the the total material costs for the design. We were able to determine the net cost for the entirety of the project ($42,465).

Initial Design



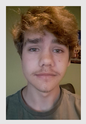
The initial design for the device utilized a pendulum striking motion to propel the ball. It would also make use of a swivel at the base for quick adjustments for the varied wicket placements.

Group Members



Jacques Barnett

Responsible for component research and physics analysis. Contributed to physical design.



Kazimer Bernota

Responsible for the completion of the poster. They also contributed to the research document.

Maximus Bruozis

One of the Main contributors for the Commercial project. Along with this, he worked actively with the build team.

Thomas DiGaetano

Part of the build team. Helped see the design to completion by acquiring materials.

Matthew Liberman

Responsible for the completion of the Commercial project. Also helped the project in its early form.

Aurelio Paltera

Dedicated to the Build team, and the completion of the physical design through the whole course of the project.

Sebastian Soja

Helped aid in the completion of the poster. Contributed to the efforts of the Build team.

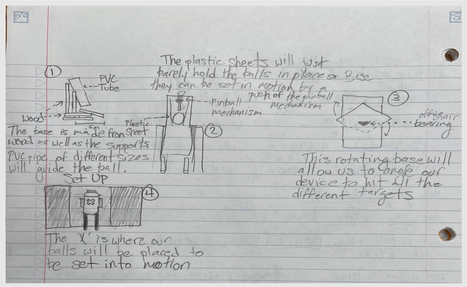
Lucas Schweighofer

Responsible for the completion of the component research document. As well as finding and analyzing physics behind the design.

Nikolas Wheeler-Quintanilla

Responsible for the build completion. Actively aided in build efforts.

Revised Design

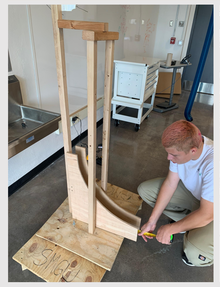


The measurements and structure was finalized for the revised design concept, with a better understanding of how the bearing works to rotate the base. The starting mechanism was also changed to include a pinball mechanism pushing through plastic sheets instead of a hammer so as to not worry about creating a supporting base.

Equipment

With this project being primarily made out of wood and PVC piping, it was found that the most common array of tools used were saws to cut the wood into the necessary shapes and sizes needed, as well as electric power tools for the less malleable materials used.

Testing



This project went through many revisions, as such testing was a vital part to our process. Frequent accuracy and speed tests were done to gauge the effectiveness of new changes. Additionally, many models of strikers were tested before reaching our conclusion.

Physics Analysis

$$v = \sqrt{\frac{10gh_0}{7} + \frac{5kx^2}{7m}}$$

The final equation with the velocity with respect to the initial height.

Variables from figure 6:
D_1 = 796.5 mm
D_2 = 1219.2 mm
D_3 = 600 mm
D_4 = 914.4 mm

Figure 14: Diagram of Device Analysis Geometry

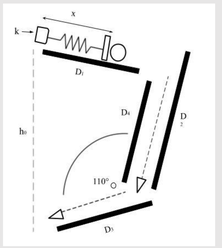


Figure 15:Theoretical Performance with Initial Height (H0) and Velocity (V)