Project: Automatic Controlled Metal Trebuchet[i]

1 The main task

An automatic metal trebuchet or catapult is designated to design. The prototype is made with provied components and other neccessary materials.

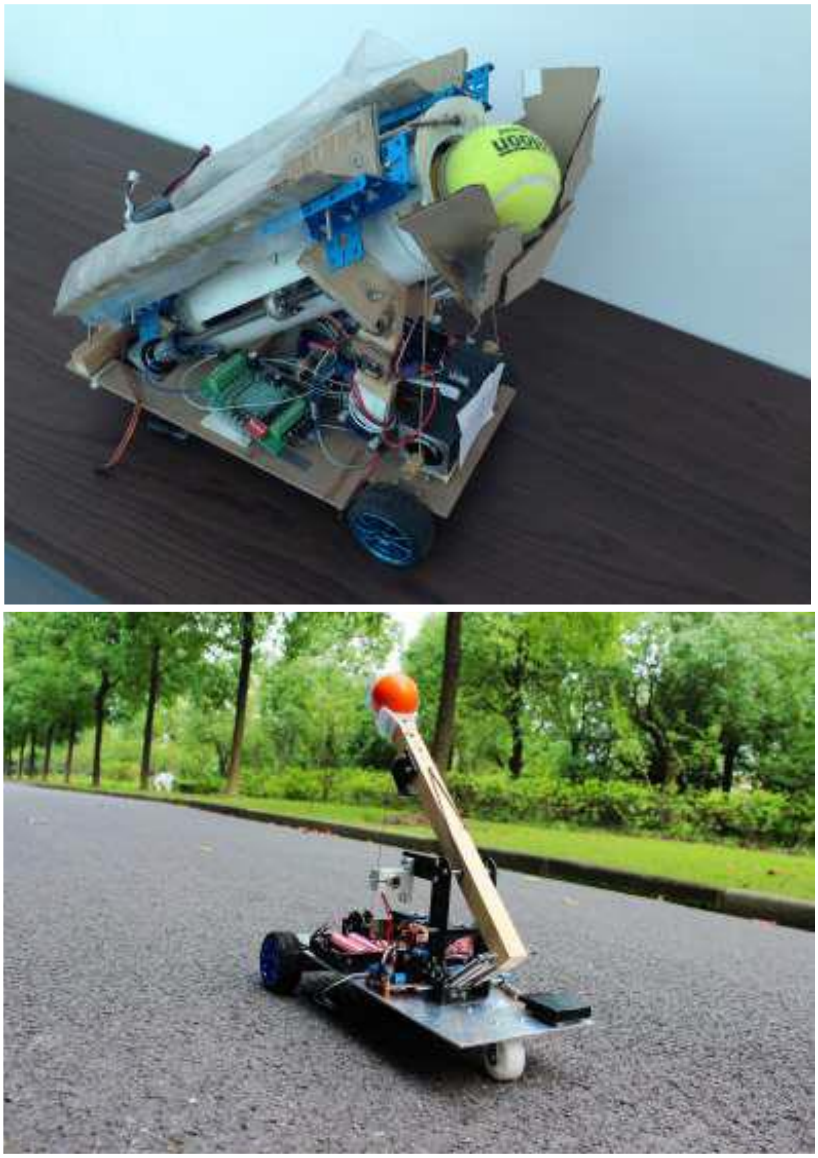

Figure 1: Prototypes of Trebuchet and Catapult

2 Requirements for the Prototype

Size: the prototype must be fit into a box with 35cm long, 20cm wide and 35cm high in any condition (with all components other than shot balls).

Movement: The prototype must be powered by at least one DC motor with batteries. There is no requirement for the speed of the prototype, but there is a total time limit to finish the game which will be described later in this document.

Control: The prototype must be controlled by a remote controller for its movement (forward, backward, turn left and right, shoot the ball, etc.). Reloading (at least one type of) balls should also be done in a remote controlled way.
Although we do not want to specify how you implement the functions, the major parts will include 1 or 2 metal parts (at least 1 metal part, the metal part design should be finished by 8th May). The assembly is required.

2.1 Tasks to Accomplish

1. **Concept Design**
   Conduct a conceptual design to implement the functions of a machine which can throw three different types of balls to into a specified basket located in the middle of the play yard.
2. **Prototype of the machines**
   Manufacture a prototype of the designed concept using the provided components and raw material, applying machining techniques discussed in the lectures.
3. **Design Review**
   Attend two design reviews that organized by the instructor and TAs to discuss the progress of the project and exchange the necessary requirements, information, and suggestions.
4. **Final project report**
   Write a final report for this project, including all details of the conceptual design and prototyping
5. **Oral presentation and a competition**
   Give an oral presentation at the end of the semester and we will have a competition for the prototyped machines

2.2 Performance of Prototyped Machines

The grade of the prototyped machines will be determined based on several criteria described in the attached file at the end of this document. The competition is scheduled on 3rd June 2021.

3 Final Project Report Format

The final written report, a very important component of the course project is due on 10th June, 2021 before 10:00 am. You are required to submit an electronic copy of your entire final report (including all related documents, e.g., design review slides, presentation slides, etc.), in a single pdf file. Your final report must follow closely the project format given here. Your report will be partly graded based on how closely you follow the instructions in the project format. The project format for the report is as follows. Starting with the cover page: give a title you're your project together with your names, course number (Vm250), semester (Summer 2021), and submission date of 10/06/2021 (center all of these items). The final report must be typeset on an A4 paper with a 12 point times-roman font (double spaced with one-inch/2.54 cm

margin all around), page numbered, and have the following sections:
Table of Content (with page number for all sections listed)

Abstract (about 200 words)

1. **Introduction**. Provide a short introduction of some related technical issues and the overall goal of your project.
2. **Concept Design**. Problem definition, PDS, CRs, ECs, QFD, concept generation and selection, material selection, CAD works and all other related issues.
3. **Manufacturing**. Embodiment design, all details related to the manufacturing process for the prototype, metal shop works and all other related issues.
4. **Cost Estimation**. Estimate the cost for materials, manufacturing and other issues.
5. **Conclusion**. Provide a 100-150 words of concluding remarks.
6. **Cited References**. List only references that you are referring to in the text of your report.
7. **Nomenclature**. Define all symbols used in the reports.
8. **Acknowledgement.**

Appendix I. All sketches in concept design
Appendix II. All engineering draws with Solidworks
Appendix III. Product Design Specifications
Appendix IV. Details of Prototyped machines
Appendix V. other related works

Vm250 Project Game

As a part of the project in Vm250, we have this catapult competition tentatively scheduled on 3rd June during the lecture session. Followings are the regulations for this game.

Judge panel: Dr. Kai Wu, TAs
Participators: All students in Vm250 2021 in group base.
Place: (D1 Hall)

Details of grading on the project competition:
Game Setup:
Basket: 20×20×20 cm, placed at the center of the circled zones;
Forbidden zone: a half circle with 2 meter radius;
Shooting zone: a half circle with 3 meter radius;
Shooting points: three red spots (20cm diameter) evenly distributed in the middle of the shooting zone;
Safe zone: outside of the shooting zone;

Balls: Type A: table tennis balls, each having 0.4 credits if shot into the basket;
Type B: racket balls; each having 0.8 credit if shot into the basket;
Type C: tennis balls; each having 2 credits if shot into the basket;

The game will be held in Room (D1 Hall) with one play yard set up as shown in Figure 2 below.

2. Game Rules:
Each prototyped catapult is required to shoot different types of balls into the specified basket, standing away from a certain distance. The rules are described below.

1. No catapult or team member can get into the forbidden zone;
2. No team member can get into the shooting zone;
3. Each team starts their catapult from the starting zone (which is a 40×40 cm area shown in the figure below) at the beginning of the game or after the time-out.
4. The catapult can only shoot the balls in the shooting zone;
5. The team member can only manually set up or touch the catapult in the safe zone; when the catapult gets into the shooting zone, it can only be controlled remotely;
6. The team members CANNOT run holding the catapult no matter where;
7. The catapult has to shoot at least three balls from three shooting points (the catapult is on or touches the red spot), one for each. There will be penalty if the catapult only shoot at one or two red spots as: the final credit = (No. of spots used) × (total credits)/3.
8. The catapult can only shoot one ball at a time by one trigger; the automatic loading system is required to be used at least for one type of balls.
9. Different balls have different credits.

Each team has 10 minutes to finish their game and each team can only have 10 A balls, 5 B balls and 2 C balls (all balls will be given to the team when starting the game, and balls cannot be reused after the shot even it does not get into the basket). The team wins the game by achieving the highest credit. If more than one team obtains the same highest credit after the game, all those team will shoot B balls one by one to determine the championship until there is a difference happening in the score.

During the 10-mintue game, each team can apply one 1-minute time-out in case the vehicle malfunctions. This time-out will not affect the evaluation. During the time-out, the team member can get into the shooting zone to take their vehicle outside, but cannot fix the problem within the shooting zone. As long as the time-out is applied, the vehicle has to start again from the starting zone.

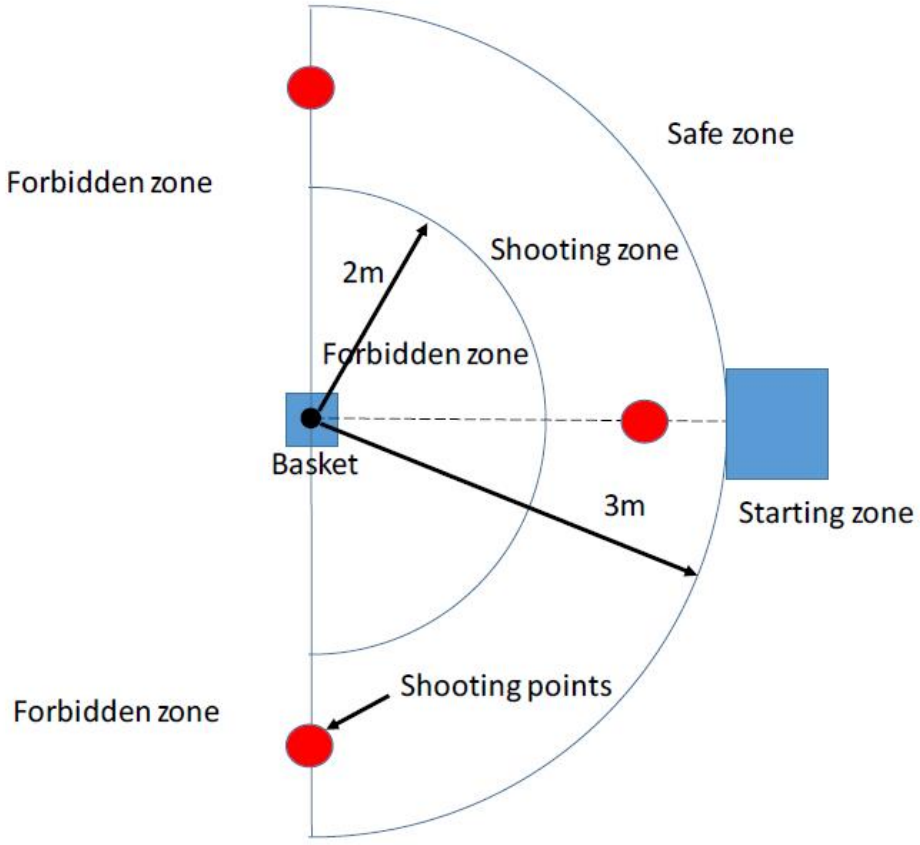

Figure 2: Game set up

3. Evaluation (20% total):

The evaluation of the prototypes consists of two parts: the functionality and performance, as specified below.

a) **Functionality (8%)**:

1) Movement
2) Shooting
3) Remote control
4) Adjustable to different balls

5) Size: within 35×20×35 (cm^3)
6) Design: mechanism (shooting, loading, etc.), material, manufacturing, assembly, etc.

b) **Credits (12%) :**

If all A, B and C balls are shot into the basket, the team will obtain 12 credits, which is equivalent to 12% for the final evaluation.

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[i] This is a tentative version and it is subject to change depending on the progress and feedback from students.

Acknowledgement：The contents of this course project have been adopted from the materials of Prof. Li, Mian