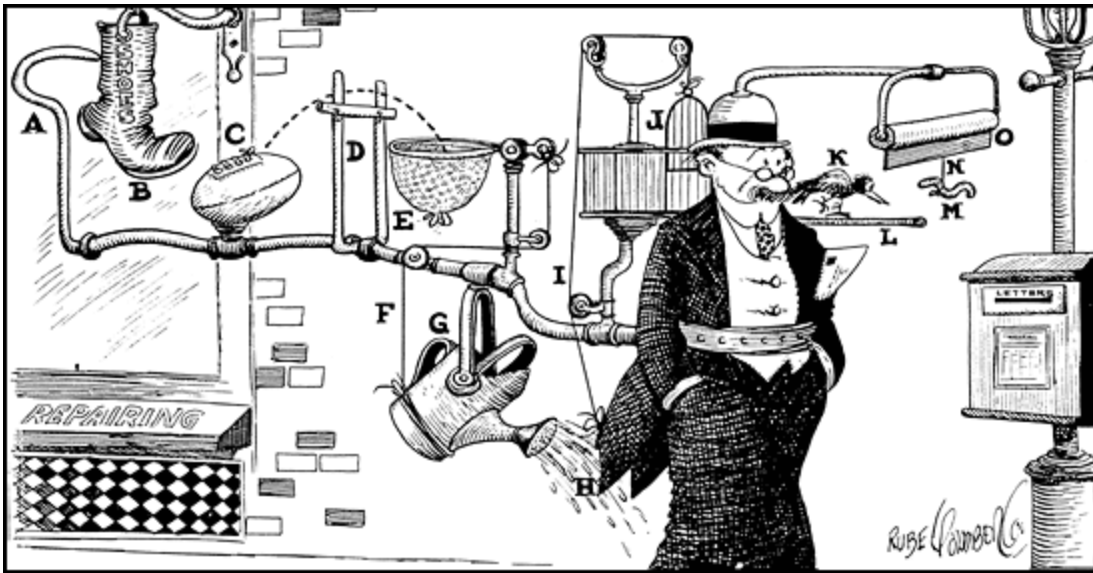


A mechanical robot- Tennis ball dispenser

Mechanical devices which are designed to perform a single function are popular with young and old engineers. Designing these is a hobby that could lead to an invention or at a minimum, to producing lasting memories with your child/grandchild (most hobbyists are people who work in their basements/garages). Rube Goldberg demonstrates this concept, albeit to the extreme, in his cartoons. "Rube Goldberg gets caught in a revolving door and becomes dizzy enough to dope out an invention that keeps you from forgetting to mail your wife's letter."



As you walk past the cobbler shop, hook (A) strikes suspended boot (B), causing it to kick football (C) through goal posts (D). Football drops into basket (E), string (F) tilts sprinkling can, (G) causing water to soak coattails (H). As coat shrinks, cord (I) opens door (J) of cage, allowing bird (K) to walk out on perch (L) and grab worm (M) which is attached to string (N). This pulls down window shade (O) on which is written, "YOU SAP, MAIL THAT LETTER." A simple way to avoid all this trouble is to marry a wife who can't write.

A **Rube Goldberg machine** is an exceedingly complex [apparatus](#) that performs a very simple task in a very indirect and convoluted way. It first appeared in [Webster's Third New International Dictionary](#) with the definition, "accomplishing by extremely complex roundabout means what actually or seemingly could be done simply." The expression has been dated as originating in the US around 1930^[1] to describe [Rube Goldberg's](#) illustrations of "absurdly-connected machines".^[2] Since then, the expression's meaning has expanded to denote any form of overly confusing or complicated system. For example, recent news headlines include "Is Rep. [Bill Thomas](#) the Rube Goldberg of Legislative Reform?",^[3] and "Retirement 'insurance' as a Rube Goldberg machine".^[4]

Mechanical Robot Score Sheet - 2009

Challenge:

You will build a mechanical robot. This robot will include a ramp where a descending ball will trigger a racket which then will hit the falling ball into a box located at a predetermined location. You must build your own ramp as part of your device. No electronic devices may be used for this project.

Sequence of events:

You will release a ball onto a ramp which is fixed at 45 degrees. Upon release of the ball, you may not touch your robot again. The descending ball will trigger a release mechanism which is connected to a tennis racket. The ball must hit the releasing mechanism when it is in free fall. This will release the tennis racket which is held under tension by a spring. The tennis racket will then hit the falling ball into the target box. Only one ball will be used for each trial.

Your mechanical robot is to be built from the following materials:

- 1- Lumber 2X4
- 2- A ramp
- 3- Two springs (i.e. a mouse trap is considered to be one spring), you may not substitute a spring with rubber bands, bungee cords.
- 4- A tennis racket (standard)
- 5- A release mechanism
- 6- A mechanism for holding the tennis racket under tension

Not all materials need to be used. The mechanical robot cannot be touched once the ball is released.

Safety:

If a section of your Release Mechanism is ejected, your team will be disqualified.

Size of your robot:

Your robot's dimensions may not exceed: H= 3 ft, W = 3 ft, and L = 3 ft.

Testing Rules:

1. The box will be H = 7.5 inch, W = 25 inch, L = 29 inch.
2. The box will be placed 12 ft from the launch line.
3. The ball must land in the box; it may not touch the ground. (You must account for the height of the box.)
4. The ball may hit the edge of the box prior to landing in the box.
5. The mechanical robot must rest on the floor when fired (i.e. not hand-held or resting on a table).
6. The mechanical robot must not damage the floor.
7. The mechanical robot cannot be touched once set into motion.

Mechanical Robot Score Sheet - 2009

8. No tape or other adhesives may be used to attach the device to the floor.
9. All mechanical robots must pass a safety inspection prior to launching – judge’s decisions on safety are final - make it safe!
10. All team members must wear eye protection while in the firing area (bring your own).
11. The front of your mechanical robot will be placed at the launch line. The front of the mechanical robot is defined as the forward-most point in contact with the ground when in the “ready to fire” position.

Three types of balls will be tested:

- a. Tennis ball, approximate mass of 56 g
- b. Racquet ball, approximate mass of 94 g
- c. Super bounce ball, approximate mass of 41 g

Testing Procedure (See Figure 1 for testing schematic):

1. Each team must check in and have their robot examined for safety and proper use of materials before entering the testing area.
2. The team will have 3 minutes to re-set the robot for each new ball. Once the judge marks the scorecard and is ready, the team will set their spring to the proper tension for the next ball. Teams will NOT be allowed ANY mis-fires or mis-aims. All six attempts will be recorded. If a team is taking too long, it might not be able to take all six shots. A payload may not bounce off the “ocean” or floor into the target box.
3. In case of a tie, the teams with highest total scores (total six shots) will have to test their robots from a new launch line of 15 ft.
4. No coaches are allowed within the competition area.
5. All decisions are at the discretion of the judges and NOT at the discretion of fellow competitors.
6. **Teams found not to be practicing gracious professionalism will not be allowed to compete.**
7. A friction increasing device (i.e. rubber mats, carpet, etc.) may be placed under the launcher. However, NO adhesive will be allowed. If you choose to use such a device and it leaves ANY residue on the floor surface, your team will be assessed a penalty or disqualified from the event. NO chemicals of any kind (including water) may be placed on the floor. Teams or judges may wipe the floor clean with a dry towel. Any friction-aiding device used must be weighed with the launcher at time of check-in. Any friction-increasing devices other than rubber mats or carpet must be pre-approved prior to testing (i.e. - email mir@mtu.edu for approval).
8. Each team must remove its robot from the competition site at the end of competition.

Testing Score

Possible points for each shot is: zero, three or ten

You will earn three points if the ball hits the inside or outside of the box without bouncing off the ground

You will earn ten points if the ball lands in the box (even if the ball bounces out of the box after hitting the bottom of the target box you get ten points)

Maximum points for each shot is ten points

Mechanical Robot Score Sheet - 2009

School _____

Name _____

Team No. _____

Possible points for each shot is: zero, three or ten

You will earn three points if the ball hits the inside or outside of the box without bouncing off the ground

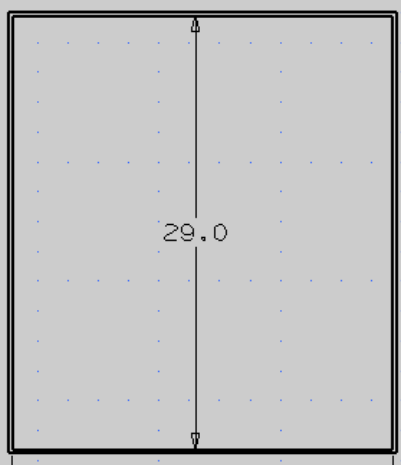
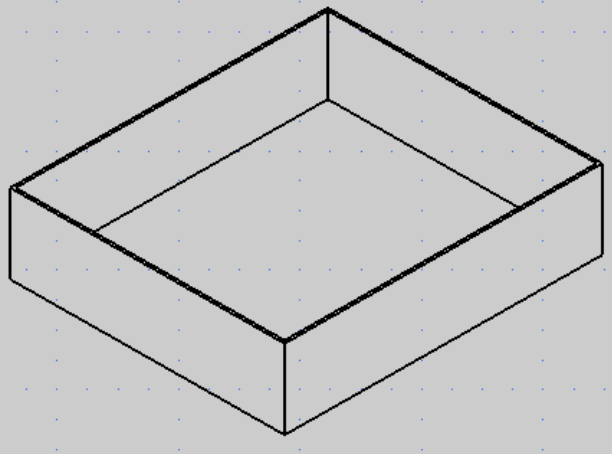
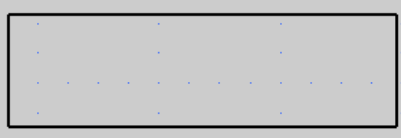
You will earn ten points if the ball lands in the box (even if the ball bounces out of the box after hitting the floor you get ten points)

Maximum points for each shot is ten points

Shot	Type of ball	Hit the box Inside or outside 3 pts	In the box 10 pts
First	Tennis		
Second	Tennis		
First	Racquet		
Second	Racquet		
First	Super- bouncing		
Second	Super- bouncing		
Total			

Team score

Mechanical Robot Score Sheet - 2009

 <p>29.0</p> <p>25.0</p>			
 <p>7.5</p>			
Michigan Technological University	Title:	Units: inch	
Engineer:	Team:	Date:	Sheet:

Mechanical Robot Score Sheet - 2009

