

KineRatics: Do Rats Understand Physics?

Engineering a Robotic Arena to Test Rodent's Instinctual Physics Engines and Surprise Response

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Arena Design

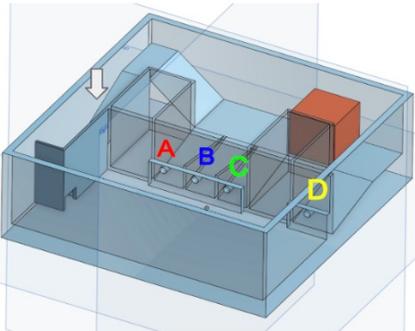
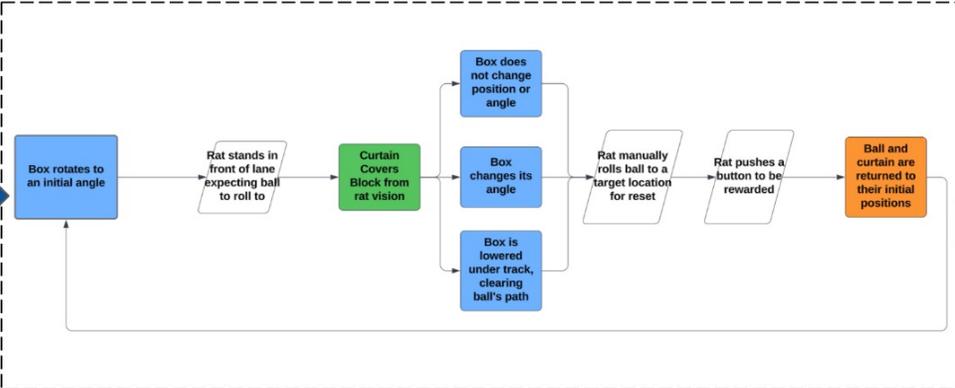


Figure 1: CAD model of the arena. The white arrow points to the ball reset mechanism, and the rotatable box is colored red. The curtain which covers the box is not shown, nor is the nosepoke which rewards the rat's ball retrieval. The box rotates to deflect the ball into one of 3 lanes (A-C), or is removed from the ball's path, allowing it to move to lane D.

Experiment Flowchart



Data Collection and Analysis

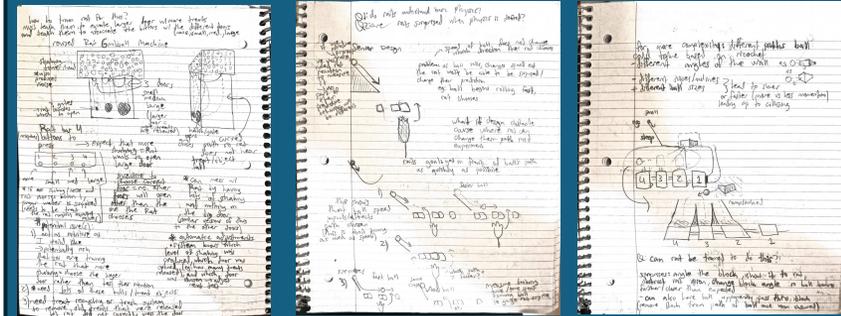
Rat Prediction Accuracy



Control Group vs Surprised Rat Looking-Time



Iterative Design: Examples of How Ideas Evolve



From left to right: original idea "Rat Gumball Machine", second idea "Rat Obstacle Course", final design for arena

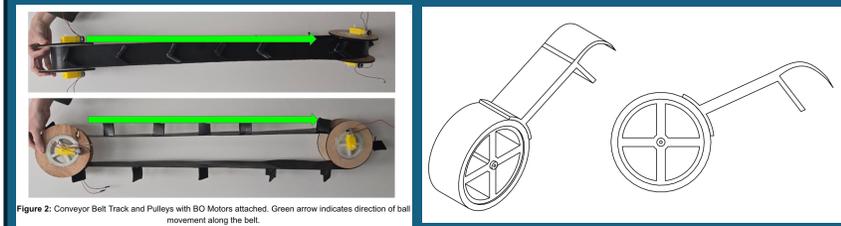


Figure 2: Conveyor Belt Track and Pulleys with 90 Motors attached. Green arrow indicates direction of ball movement along the belt.

Two designs to reset the ball's position: Conveyor Belt (left) and "Ball Scooper" (right)

Preliminary Data

Table 1: Percent accuracy and time to reach goal location for ball dropped on moving conveyor belt. Percent accuracy reflects the number of successful trials (all reaches on the belt) over total number of trials. Time-to-goal location was measured starting once the ball was dropped, and concluding once the ball reached the end of the belt (averaged over number of successful trials).

Power Supply Voltage (V)	Percent Accuracy (%)	Average Time to Goal Location (s)
2.5	100	12.44
6	100	8.21
12	40	3.11

Conveyor Belt Performance

Table 2: Percent accuracy and precision of ball landing position for different box angles. The mean landing position is measured as the distance from the center of the intended target zone along the track axis, with standard deviation (SD) indicating spread.

Angle (°)	Percent Accuracy (%)	Mean Landing Position (in) ± SD (in)
0	85	1.5 ± 3.7
30	90	1.1 ± 2.4
45	100	0.3 ± 1.2

Box Reset Mechanism