Reaction Time Measurement Device

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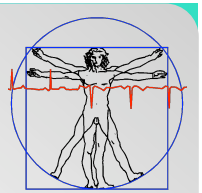

Abstract

In the case of simple reaction times, auditory stimuli yield faster reaction times than visual stimuli. A device was desired that could demonstrate this reaction-time phenomenon for school children in grades 1-8. Four alternative designs were evaluated in a design matrix to decide upon the Rube Goldberg as the final design. Fabrication was split into developing the mechanical Rube Goldberg components and building the electronic program powered by Arduino to functionally operate the device. Upon testing the final device, a sample size of 100 trials of both auditory and visual reaction times proved that auditory reaction indeed was quicker.

Background

Reaction times surround us all in everyday life. Whether we are commuting via bicycle or car, walking across the street, playing video games, or participating in athletics, reaction times truly are part of our world. A simple reaction time is a response time for a test subject to respond to a stimulus (such as sound or light). Research has shown that due to human anatomy and

Final Design- Mechanical

Figure 1: The final device when collapsed for transportation.

- Stand
  - Plywood & 2X4's
  - sturdy
  - collapsible
- Releasing Mechanism
  - 2 Half Pipes
  - acrylic
  - Lined with paper
- Trap Door Mechanism
  - Washer/Brass rod
  - Lever system
- Rube Goldberg portion
  - Winning side
    - Two Half Pipes
    - See Saw
    - Winning Marble
  - Losing side

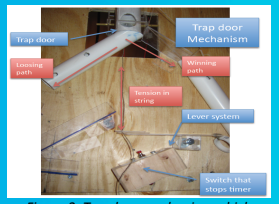

Figure 2: Trapdoor mechanism which redirects the marble to the winning (fast) pathway.

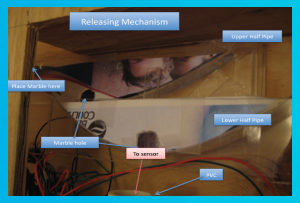

Figure 3: The Release mechanism with both the upper and lower half pipes. This mechanism is mounted inside the electronics box.

Testing

1. Randomization of the time it takes for a marble to drop from the releasing mechanism (Figure 6)
2. Accuracy of the trapdoor mechanism in separating fast enough trials from slow reaction trials. (Figure 7 and 8)
   - Gaussian distribution shows that the trapdoor mechanism accurately separates slow and fast trials.
3. Verification that the auditory stimulus yielded faster reaction times than visual stimulus reaction times.
   - 100 randomized trials for both auditory and visual stimulus.
   - The auditory stimulus trials yielded an average of 159.65 ± 29.52 milliseconds.
   - The visual stimulus trials gave an average of 186.8 ±25.52 milliseconds.
4. Full test conducted at Madison East high school (20 students).
   - device perceived as appealing and fun
   - improvements needed made clear

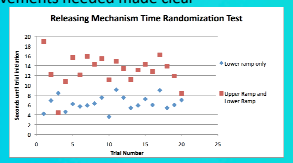

Figure 6: The ability to randomize the initiation time for release mechanism.

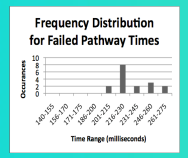

Figure 7: The distribution of time ranges for trials deemed failed (too slow) by the trapdoor mechanism.

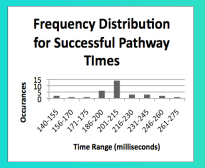

Figure 8: The distribution of time ranges for trials deemed successes (fast enough) by the trapdoor mechanism.

physiology, simple reaction times to auditory stimuli are faster than that of visual stimuli (by about 30 milliseconds). This phenomenon is important since it can impact the development of a wide variety of products being produced in the world.

Motivation

This design project has set out to build a demonstrative device for the client. The final device should demonstrate faster reaction times to auditory stimuli than visual stimuli. The client looks to use the device with students in grades 1 thru 8 in order to get them excited about math, physics and science at an early age.

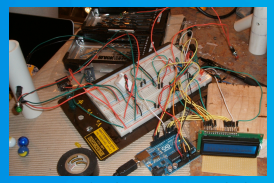

Figure 4: The electronics portion built with a breadboard.

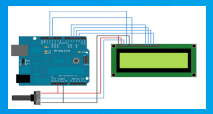

Figure 5: The schematic for interfacing the Arduino with the LCD display. [9]

Final Design-Electrical

- IR Emitter and Detector, Two Switches, Stop Button, LCD Display, Arduino Uno Atmega328 Microcontroller, LED's, Buzzer
- Operable from any USB power source.
  - Optional power adaptor
- Code easily changed to match lighting from the room testing is being conducted in
- Programming can be reset using button on Arduino
- All wires labeled to prevent confusion if they pull out
- Initially wired buzzer, led's and switches to breadboard
- Wired IR emitter and detector and programmed to functionality before combining with led's, buzzer and switches
- Wired LCD display and combined coding with the stop button
- Combined all the components on one breadboard to check for functionality
- Moved entire circuit to wood frame and taped components down for transportability

Adjustments

- Add additional acrylic piece to the top funnel on the losing side
- Add title
- Slow down marble out of trap door
- Handles
- Improve trap door
- Tip release mechanism
- Add Winning box

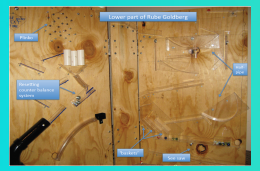

Figure 9: The lower Rube Goldberg was modified to ensure modified to ensure marbles didn't bounce off. Future improvements involve making sturdier components.

Future Work

- Build Sturdier frame and components
- Make easier to transport
  - Size, weight, way to carry it
- Eliminate all noise in release mechanism
- Accuracy of trap door
  - Trapdoor which would clearly send marbles down a specific pathway pending a specific time
- Color scheme, visual appeal and neatness
- Adding Arduino code that accounts for varying light intensities in the environment

Requirements

- Adhere to a budget of $200
- Allow for easy transportation in the back of a minivan
- Be able to set the device up or tear it down within a ten minute timeframe
- Ensure safety to directed audience
- Final device must be less than 20 kg
- Must measure simple reaction time with accuracy of milliseconds
- The device should prove that auditory reaction times are faster than visual.
- Be visually appealing so as to get students excited about the device

Budget

Item	Cost
Arduino Uno (Atmega328)	$34.16
Lumber(2X4, plywood)	$24.42
Acrylic and Weldon	$31.49
PVC	$2.69
Hardware	$47.45
Electronics (buzzer, LED's, wires, etc.)	$35.60
LED and LCD displays	$22.59
Total	**$198.46**

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