LED/LCD Reaction Time With and Without Dissonance

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Introduction

- **Experiment:** Compare reaction times between LED colors and LCD words, with and without dissonance and reproduce the experiments morning and evening

- **Motivation:** Study choice reaction time (CRT) rather than simple reaction time (SRT), understand why some tests yield longer times than others, and assess one's reaction time at various times of the day

- **Hypothesis:** Introducing dissonance will increase reaction time, and reading and processing words will increase reaction time

  - Expected fastest to slowest reaction time:
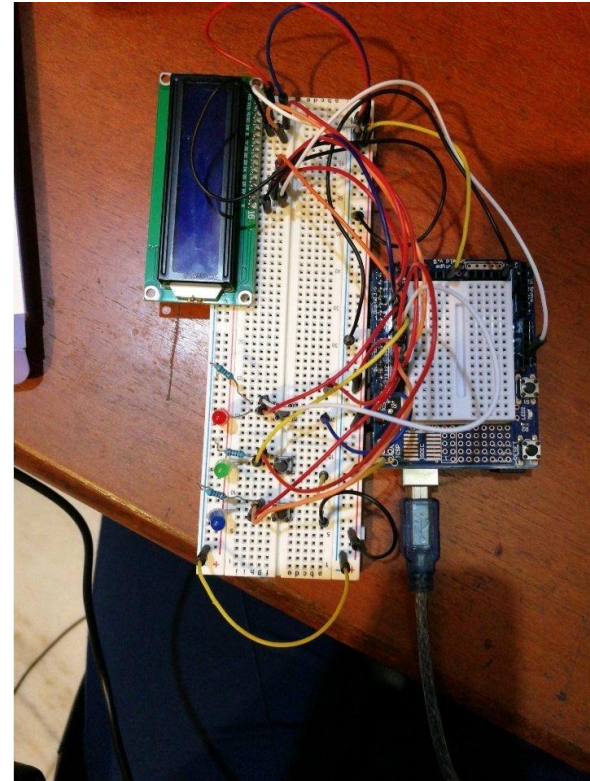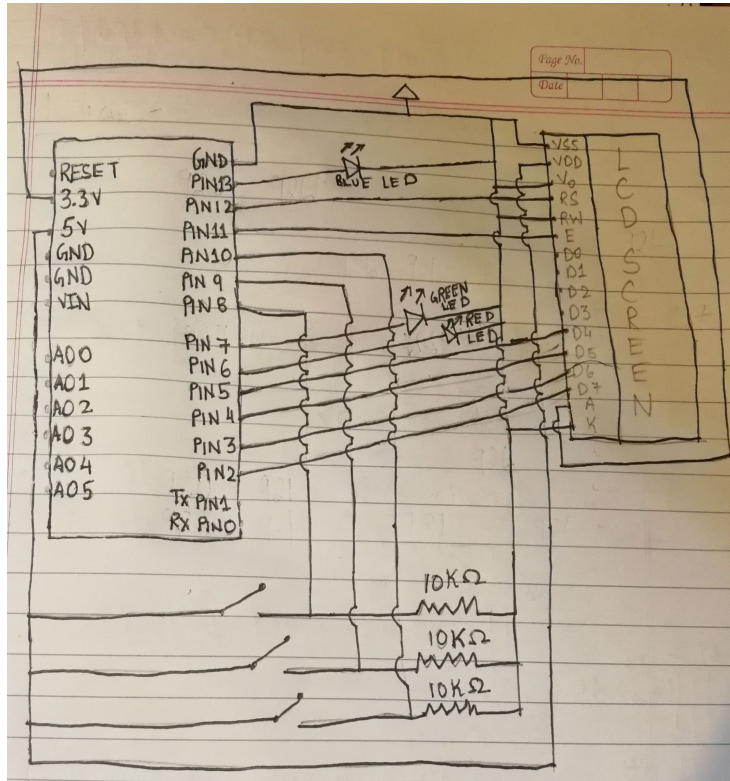   1. LED only   2. LED w/ dissonance   3. LCD only   4. LCD w/ dissonance

  Reaction times will differ in length if done in the morning or in the evening

Materials

- LED Lights (Red, Blue, Green)

- Buttons

- Jumper wires

- Breadboard

- Uno R3 Controller Board with Expansion

- A power source (Laptop)

- LCD board

- 10K Ohm Resistors
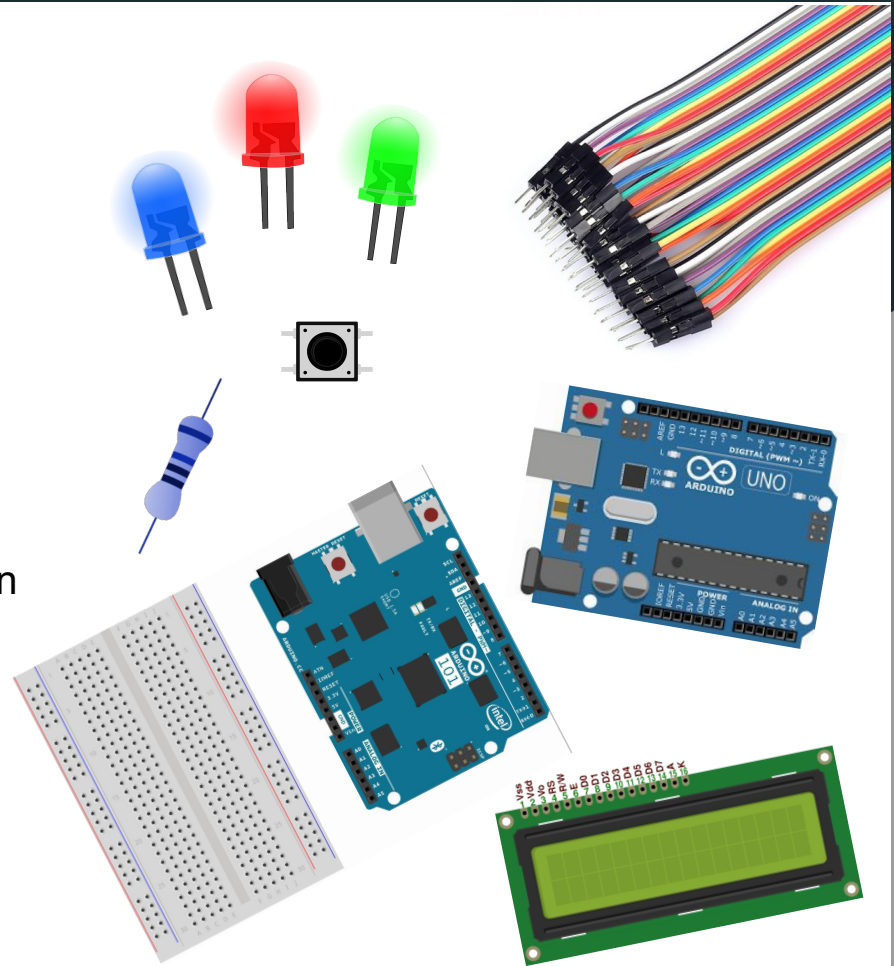
Arduino Setup

LED Analysis

- We will be conducting experiments on the reaction time (measured in ms) for a simple stimulus with a blinking color via the assembled Arduino kit

- Red, blue, and green LED lights will be attached to the Arduino kit via 10K Ohm resistors, to act as visual stimuli for this portion of experiments

- The Arduino code uploaded will then light up different LED lights randomly and document our reaction times based on when the light lit up and our clicking of the button

- This experiment gives us the data set for the simple color stimulus portion.
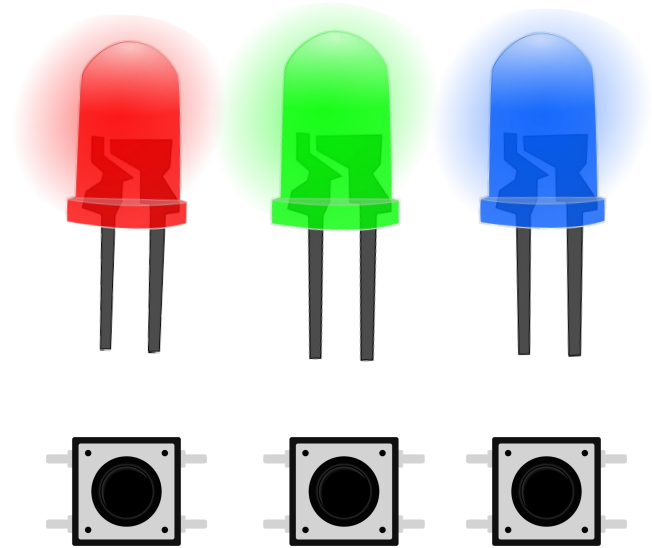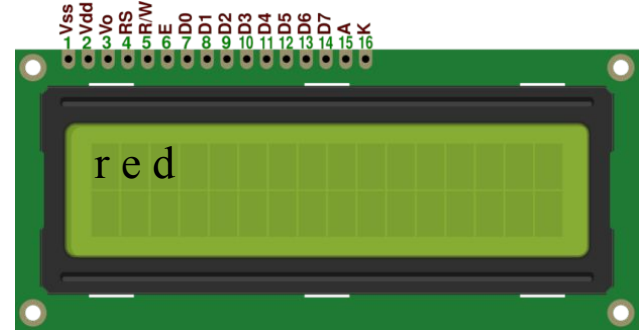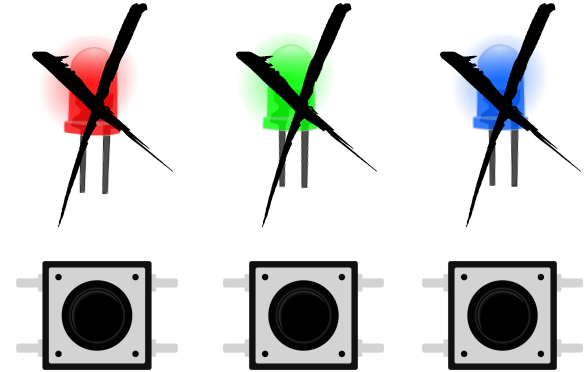
LCD Board Analysis

- This experiment consists of a simple stimulus with a word appearing on the LCD board via the assembled Arduino kit

- Red, blue, and green words will appear on the Arduino kit via 10K Ohm resistors, to act as visual stimuli for this portion of experiments

- The Arduino code uploaded will then make the board show the different words at random and document our reaction times based on when the word appeared and our clicking of the button

Setup:

LCD/LED Board Analysis With Color Dissonance

- Similarly, the second set of experiments will document our reaction time, and it will consist of two data sets.

- In the first one, the stimulus will consist of an LCD board that randomly displays the color of interest while there are LEDs of corresponding colors that flash random colors to introduce dissonance

- Once the corresponding button is clicked, our reaction times will be documented as well

Setup:
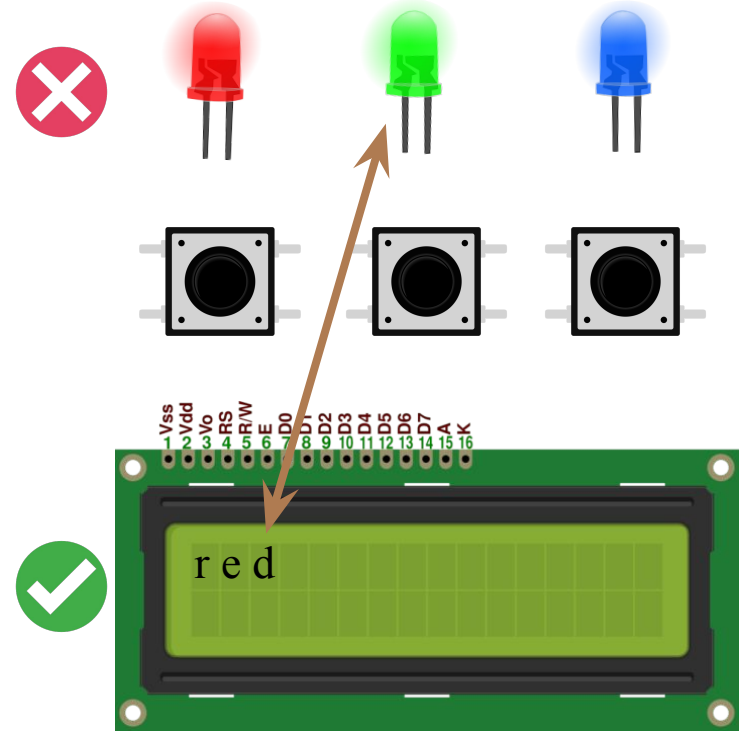
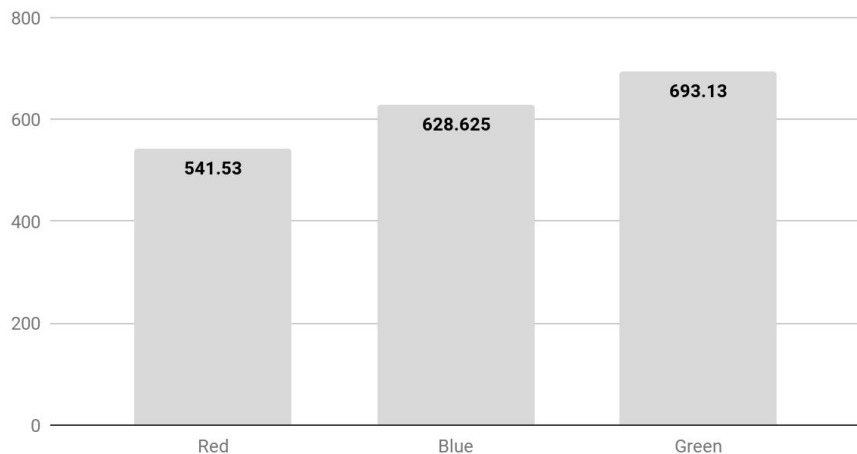# LCD/LED Board Analysis With Word Dissonance

- In the second data set, the corresponding LEDs will flash the correct colors while the LCD Screen displays a random color in order to introduce dissonance

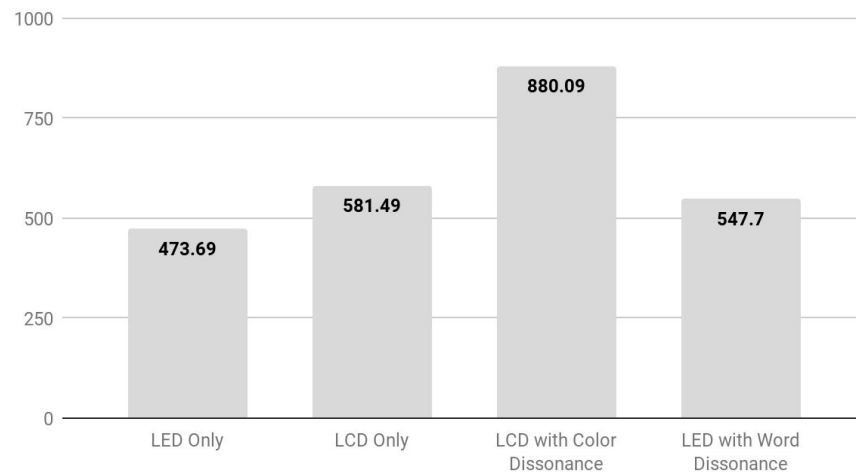- Our reaction time to each LED flashing is documented as well

Setup:

r e d
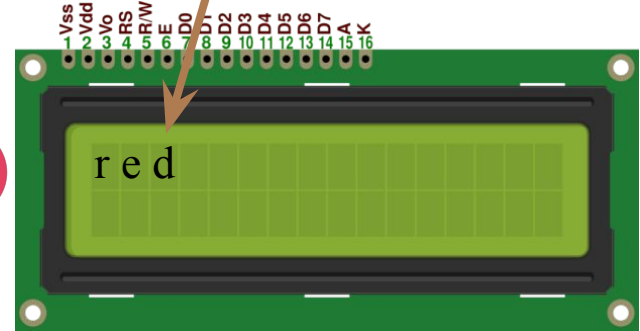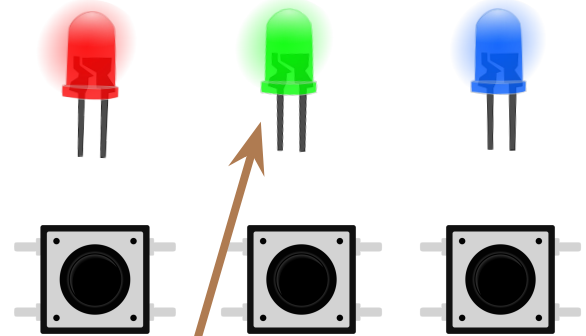
Morning Results (Tables)

Time Averages for Color in ms

Time Averages for Experiments in ms

Evening Results (Tables)
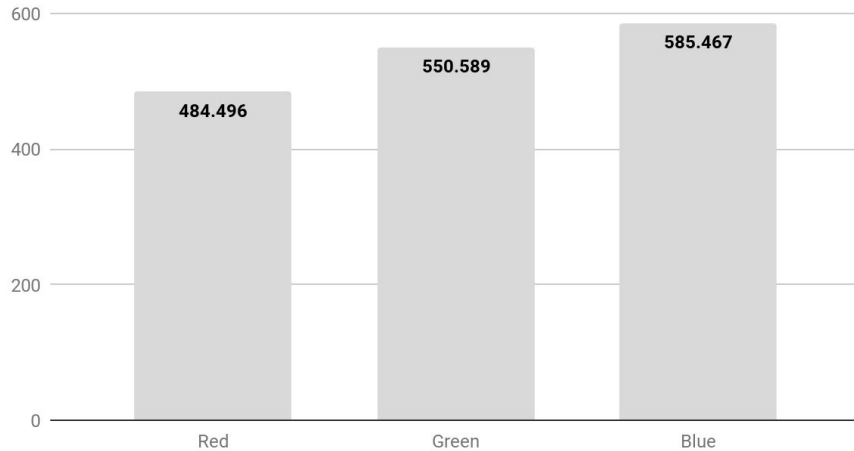
Time Averages for Color in ms

	Red	Green	Blue
Value	484.496	550.589	585.467

Time Averages for Experiments in ms

	LED Only	LCD Only	LCD with Color Dissonance	LED with Word Dissonance
Value	430.739	608.237	677.446	488.02
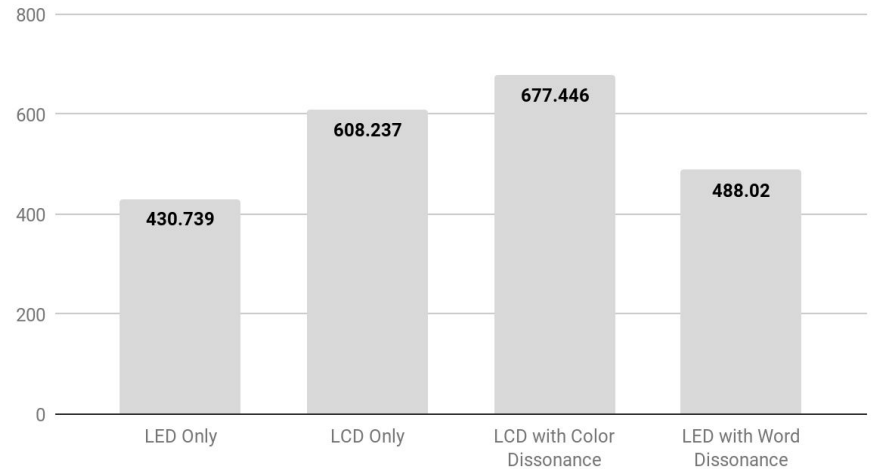
Morning Results (Tables)

Analyzed Data Sets (T-Test)	P Value
LED Only vs LCD Only	3.383871595448568e-07
LED with Word Dissonance vs LCD with Color Dissonance	7.361220947215447e-18
LED Only vs LED with Word Dissonance	0.007858952341227243
LCD Only vs LCD with Color Dissonance	1.1414147864512168e-09

Evening Results (Tables)

Analyzed Data Sets (T-Test)	P Value
LED Only vs LCD Only	4.562557791599376e-07
LED with Word Dissonance vs LCD with Color Dissonance	3.115198033676408e-11
LED Only vs LED with Word Dissonance	0.1982521017651913
LCD Only vs LCD with Color Dissonance	3.840467734780897e-09

LCD Only Results
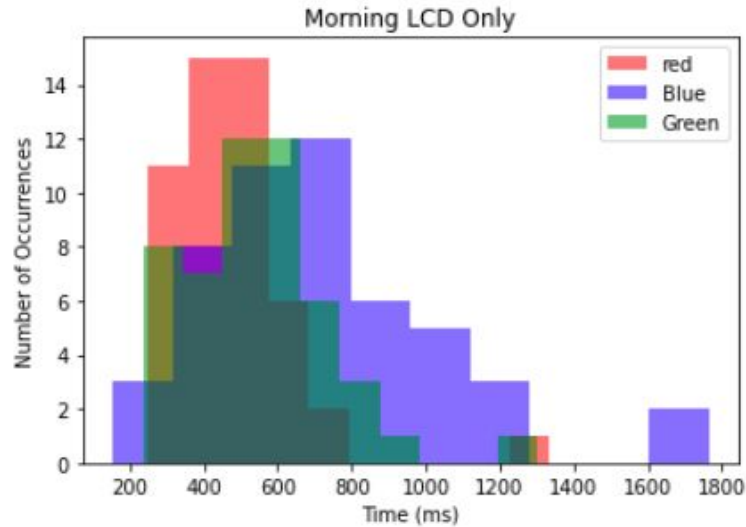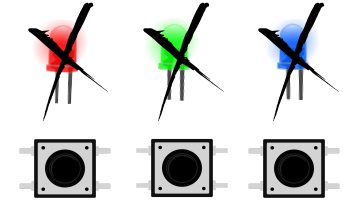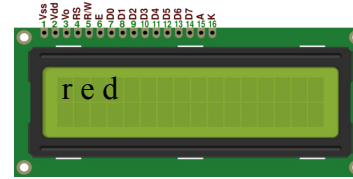
Average = 581.49 ms
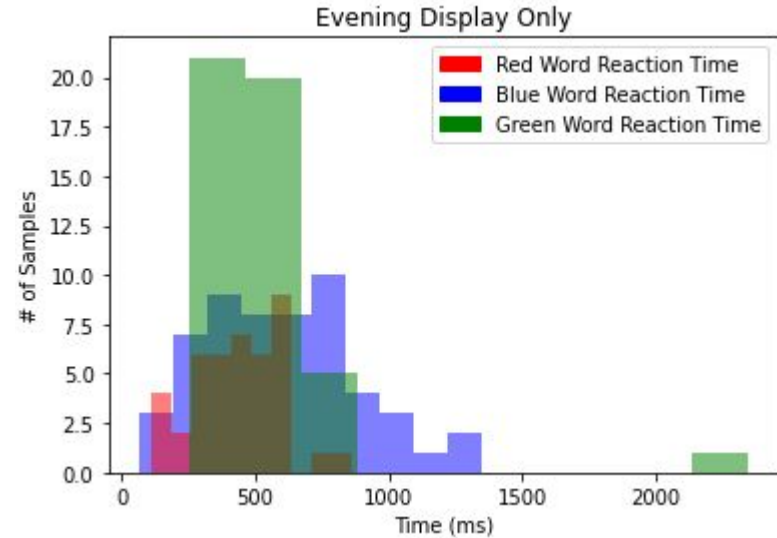
Average = 608.237 ms

LED Only Results

Morning LED Only

Average = 473.69 ms

Evening Colors Only
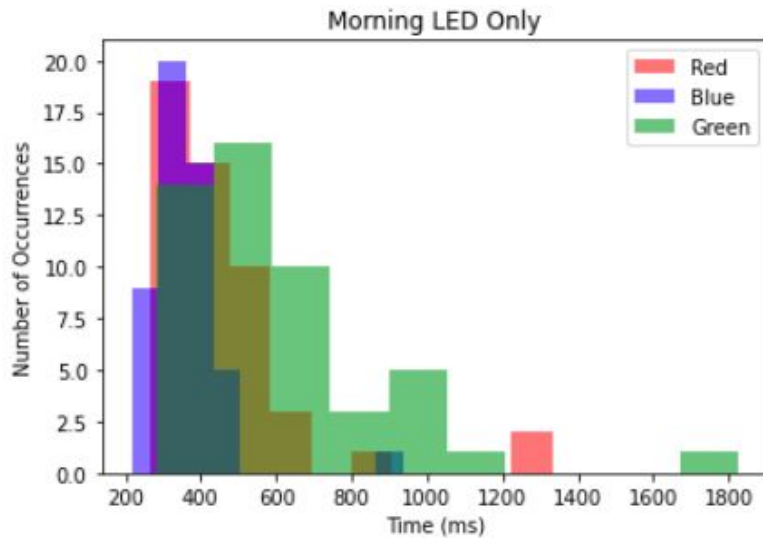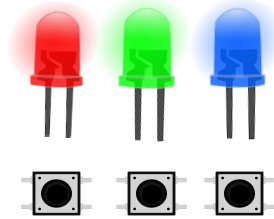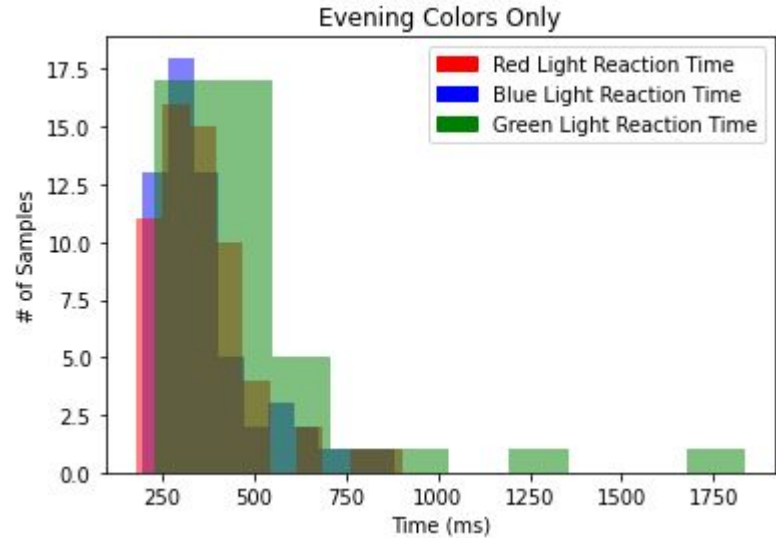
Average = 430.739 ms

LCD with Color Dissonance Results

Morning LCD With Dissonance

Legend: Red, Blue, Green

Y-axis: Number of Occurrences
X-axis: Time(ms)

Average = 880.09 ms

Evening Dissonance w/ Focus on Words

Legend: Red Word Reaction Time, Blue Word Reaction Time, Green Word Reaction Time
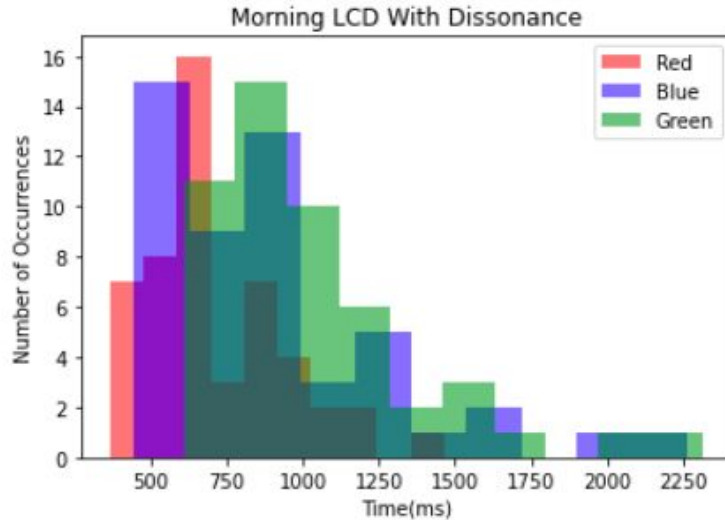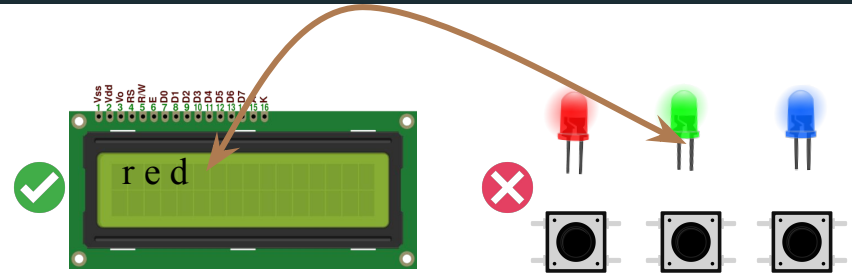
Y-axis: # of Samples
X-axis: Time (ms)
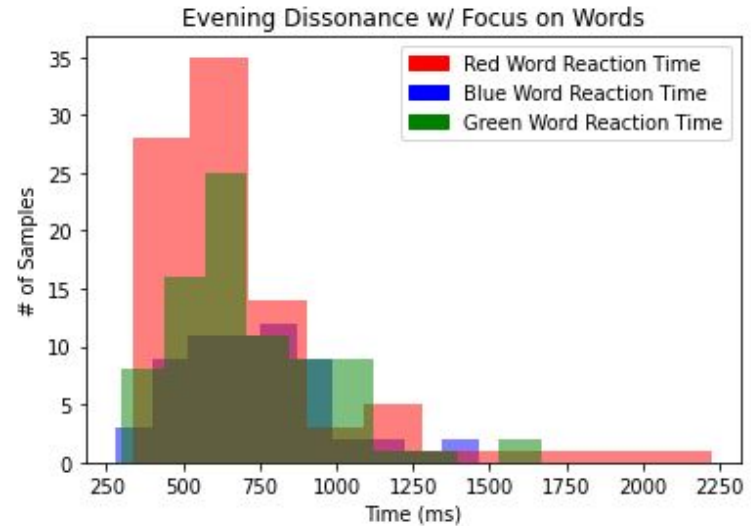
Average = 677.446 ms

LED with Word Dissonance Results

Morning LED With Word Dissonance

Average = 547.7 ms
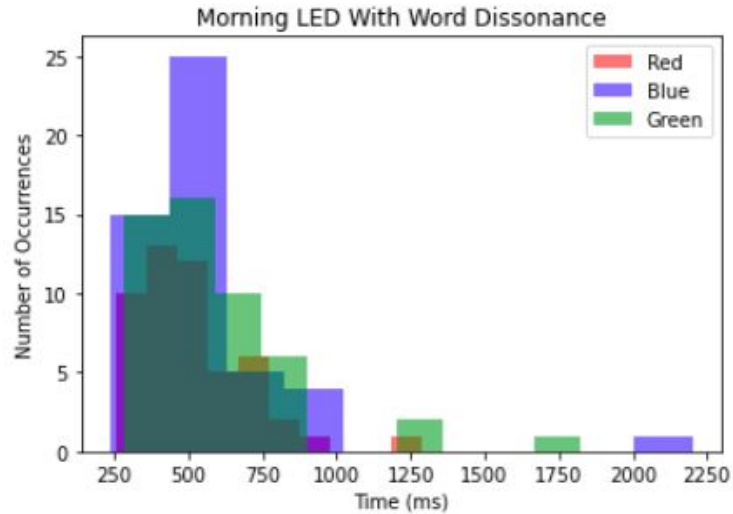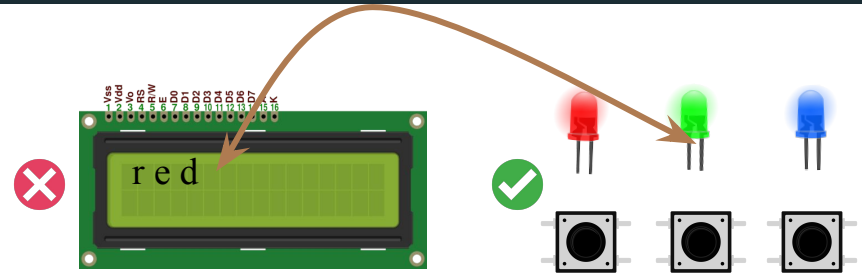
Evening Dissonance w/ Focus on Lights
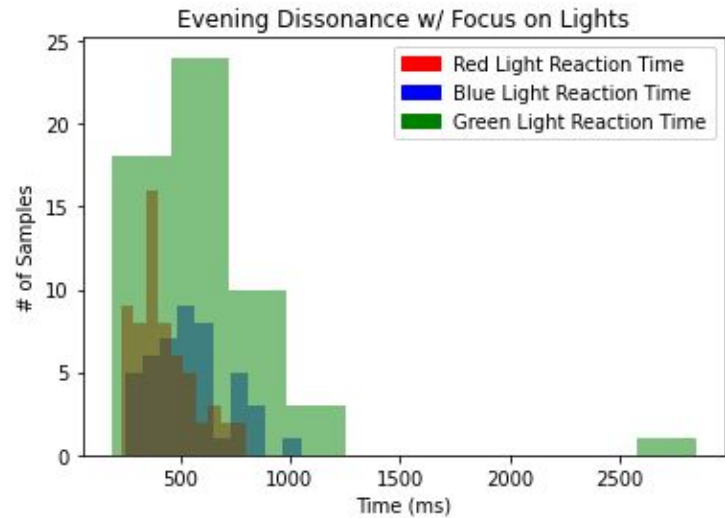
Average = 488.02 ms

Data Analysis

- Since all of the p-values are smaller than 0.05, we can safely reject our null hypothesis and say that there is a difference between reacting to words versus colors
    - This also shows that dissonance does affect ones reaction times
- Taking into account all of the experiments the color red seems to have the quickest reaction time.
    - In the LCD involved experiments: this can be due to the fact that red has the least number of letters
    - In the LED involved experiments: this can be due to the fact that red is interpreted as a danger cue and incites a faster reaction
- it seems that "LED only" yields the quickest response with the "LED with Word Dissonance" trailing close behind. The flashing of a color seems to stimulate the mind to quickly respond when compared to any experiments with dependency on the LCD.
- The results show that "LED with Word Dissonance" and the "LCD with the Color Dissonance" yields the smallest p-value therefore displaying that they have very discrete times
- There seems to be no significant difference between recording the LED light with or without dissonance in the evening, as shown by the large p-value
- Morning results yield the longest reaction times in comparison to evening results. This is due to the circadian rhythm of our central process which slows down during the night.

Evaluation of Significance

- 7 out of 8 p-values calculated were statistically significant (p-value less than 0.05)

  - Confirmed significant difference in CRTs; not coincidental or due to error

- Most to least significant:
  1. LED w/ dissonance vs. LCD w/ dissonance   2. LCD only vs. LCD w/ dissonance
  3. LED only vs. LCD only   4. LED only vs. LED w/ dissonance

- 1. Adding dissonance had greater effect on LCD compared to LED

- 2. Color dissonance substantially slowed down LCD choice reaction time

- 3. Reading words substantially slowed down choice reaction time compared to seeing color

- 4. Word dissonance only slightly slowed down LED choice reaction time, if at all

Conclusion

- Fastest to slowest CRT:

    - 1. LED only   2. LED w/ dissonance   3. LCD only   4. LCD w/ dissonance

    - Expected outcome

- Due to randomization, a more prevalent color during experiment may have skewed average CRT

    - Different colors have differing average CRTs

- Human reaction inconsistencies/outliers may have affected average CRTs

- CRT is important for measuring capabilities of pilots, doctors, athletes, etc

- These results can be used to show why we use traffic lights instead of traffic symbols, as well as flares as a means of communicating danger during war.

Future Prospects

- Add a greater number of colors and words

  - Compare CRTs within this greater variable number

  - Compare CRTs across different variable numbers (E.g. 3 words and colors vs. 4 words and colors vs. 5 words and colors, etc.)

- Repeat with different hand and hand positions (Anzola, Bertoloni, Buchtel & Rizzolatti, 1977)

- Repeat multiple times with one person, compare before and after "practicing" (Smith, 1968)

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- **Maria Chamieh** - Data collection, data analysis, slide set-up

- **Ardo Nashalian** - Data collection, data analysis

- **Ravi Varma** - Data collection, data analysis

References

- Anzola, G., Bertoloni, G., Buchtel, H., & Rizzolatti, G. (1977). Spatial compatibility and anatomical factors in simple and choice reaction time. *Neuropsychologia, 15*(2), 295-302. doi:10.1016/0028-3932(77)90038-0

- Smith, E. E. (1968). Choice reaction time: An analysis of the major theoretical positions. *Psychological Bulletin, 69*(2), 77-110. doi:10.1037/h0020189