

Problem Statement

Our client, Gabriel, suffers from Color Vision Deficiency which makes it difficult to detect which light is on at a traffic signal. This creates an inequity for people with CVD.

Figure 1-Signal Designs

Figure 2-Color Contrast



Many traffic signals design make it difficult to learn the position of each color.

Here are different ways that people with CVD view traffic lights

Objective

- Our primary objective is to make traffic signals more equitable for people that have a Color Vision Deficiency (CVD) free of cost to Gabriel.
- Our secondary objective is to make something that doesn't replace the current traffic signals.
- The factors needing to be addressed are:
 - Equity: Accessible to all drivers.
 - Ease of Use and Safety/Legislation Regulations-meets the Manual on Uniform Traffic Control Devices rules.
 - Cost Efficiency: According to Soogyu Lee, Las Cruces' head traffic engineer, it would cost the city a quarter of a million dollars to replace each traffic signal.

User Requirements

- Our client needs something easy to see or recognize.
- Our client would like something that uses words, shapes, sounds or numbers; preferably a phone app.
- Our client would like the product to be affordable.

Testing Process

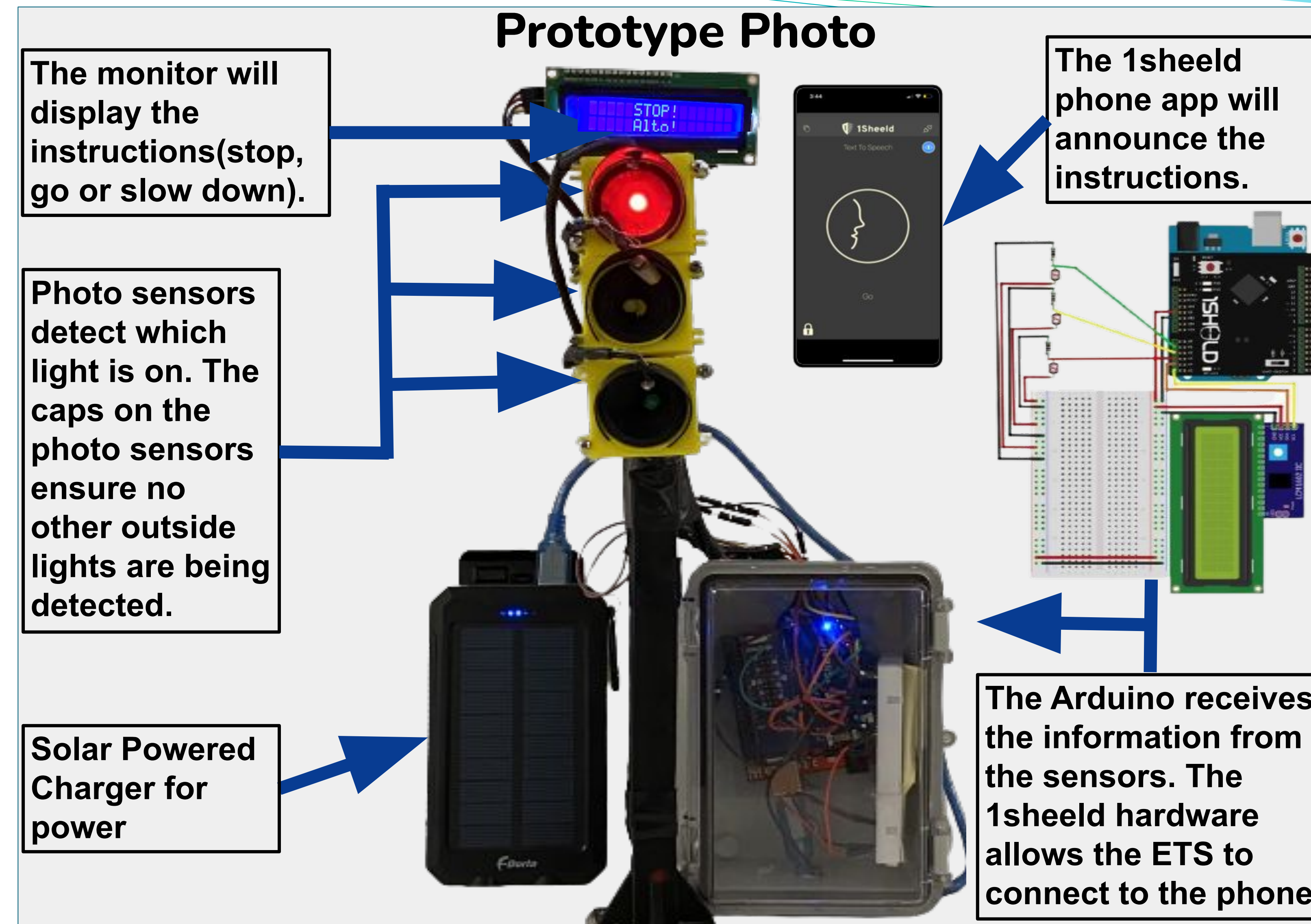
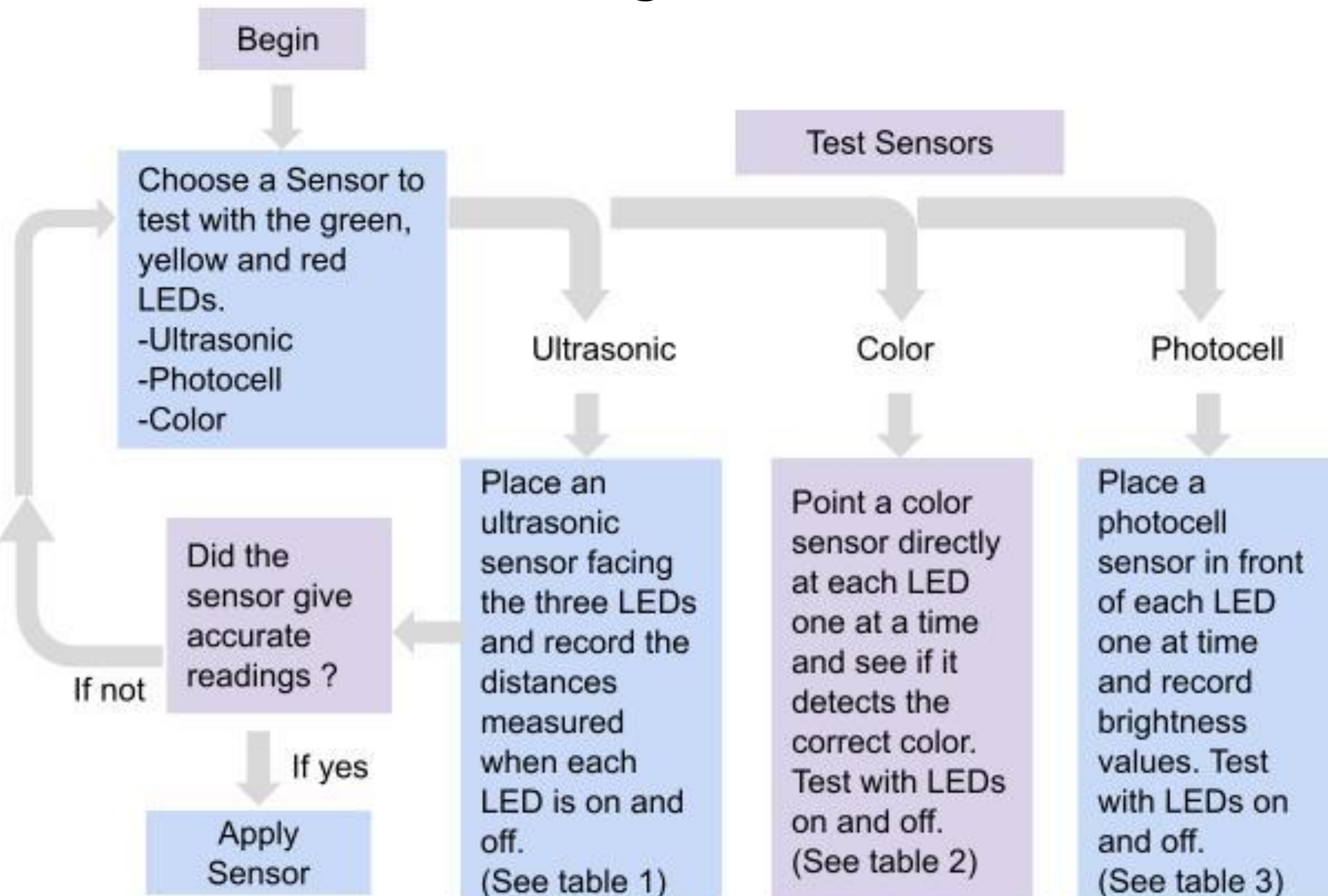


Table 1: Ultrasonic Testing shows no difference in distances.

	Green LED Measurement Detected		Red LED Measurement Detected		Yellow LED Measurement Detected	
	LED ON	LED OFF	LED ON	LED OFF	LED ON	LED OFF
Trial #1	2 inches	2 inches	2 inches	2 inches	2 inches	2 inches
Trial #2	2 inches	2 inches	2 inches	2 inches	2 inches	2 inches
Trial #3	2 inches	2 inches	2 inches	2 inches	2 inches	2 inches

Table 2: Color Sensor Testing shows inaccurate colors detected.

	Green LED Color Detected		Yellow LED Color Detected		Red LED Color Detected	
	LED ON	LED OFF	LED ON	LED OFF	LED ON	LED OFF
Trial #1	Green	Blue	Yellow	Yellow	Red	None
Trial #2	Green	Blue	Yellow	Yellow	Red	None
Trial #3	Green	Blue	Yellow	Yellow	Red	None

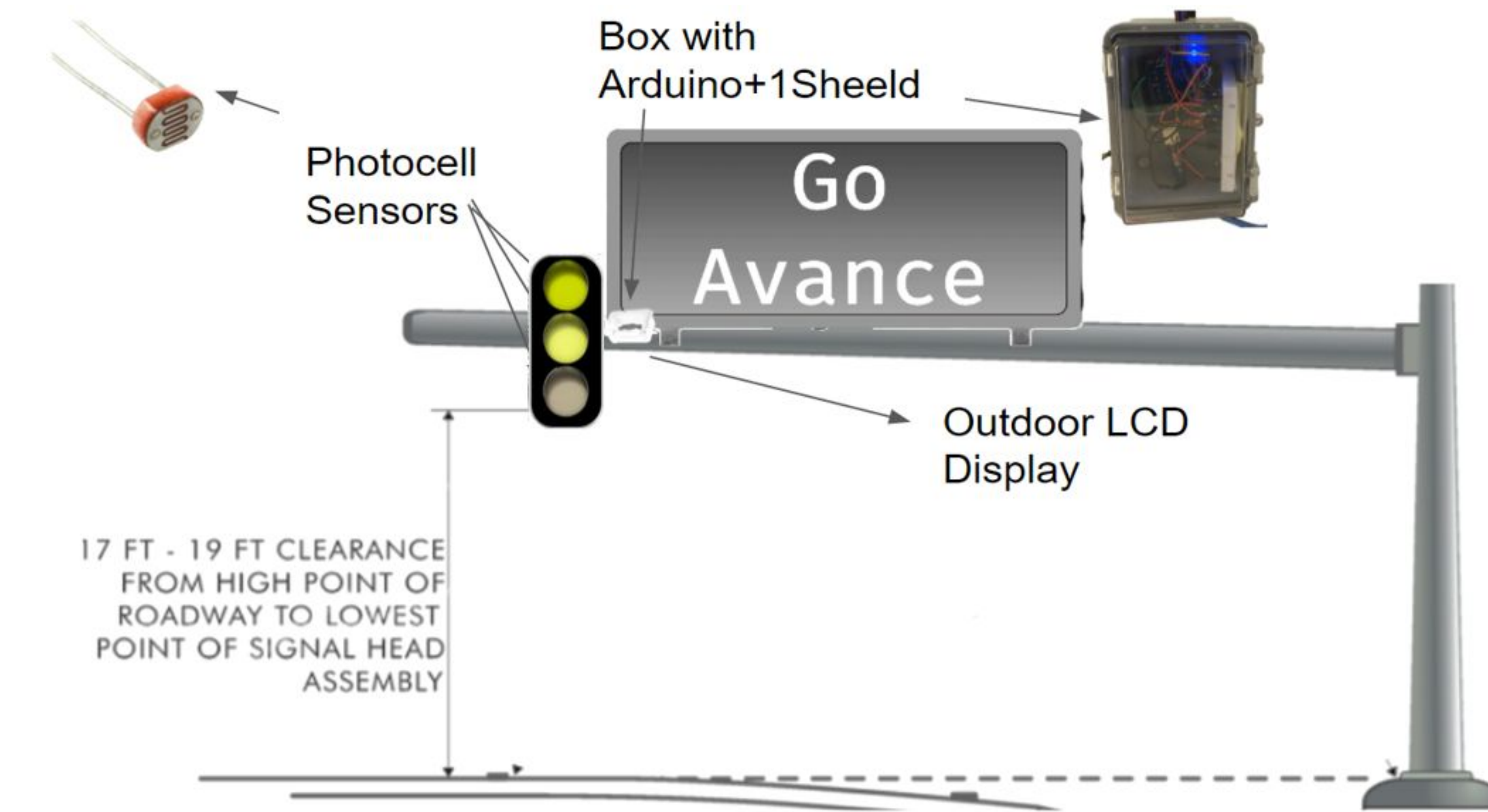
Table 3: Photocell Testing shows differences in brightness values.

	Green LED		Yellow LED		Red LED	
	LED ON	LED OFF	LED ON	LED OFF	LED ON	LED OFF
Trial #1	490	6	228	13	481	16
Trial #2	490	7	227	10	484	14
Trial #3	494	5	224	12	491	15
Average	491.33	6	226.33	11.67	485.33	15

Design Iterations

Iteration #1	Iteration #2	Iteration #3	Iteration #4	Iteration #5
<ul style="list-style-type: none"> Ultrasonic sensor Three LEDs (green, red and yellow) Arduino Uno 	<ul style="list-style-type: none"> Replaced ultrasonic sensor with color sensor 	<ul style="list-style-type: none"> Replaced color sensor with photocell sensor 	<ul style="list-style-type: none"> Added two more photocells (one for each LED) Added a display monitor. 	<ul style="list-style-type: none"> Added a 1sheeld that would allow the Arduino to connect to the 1sheeld phone app. Put electronics in a box.

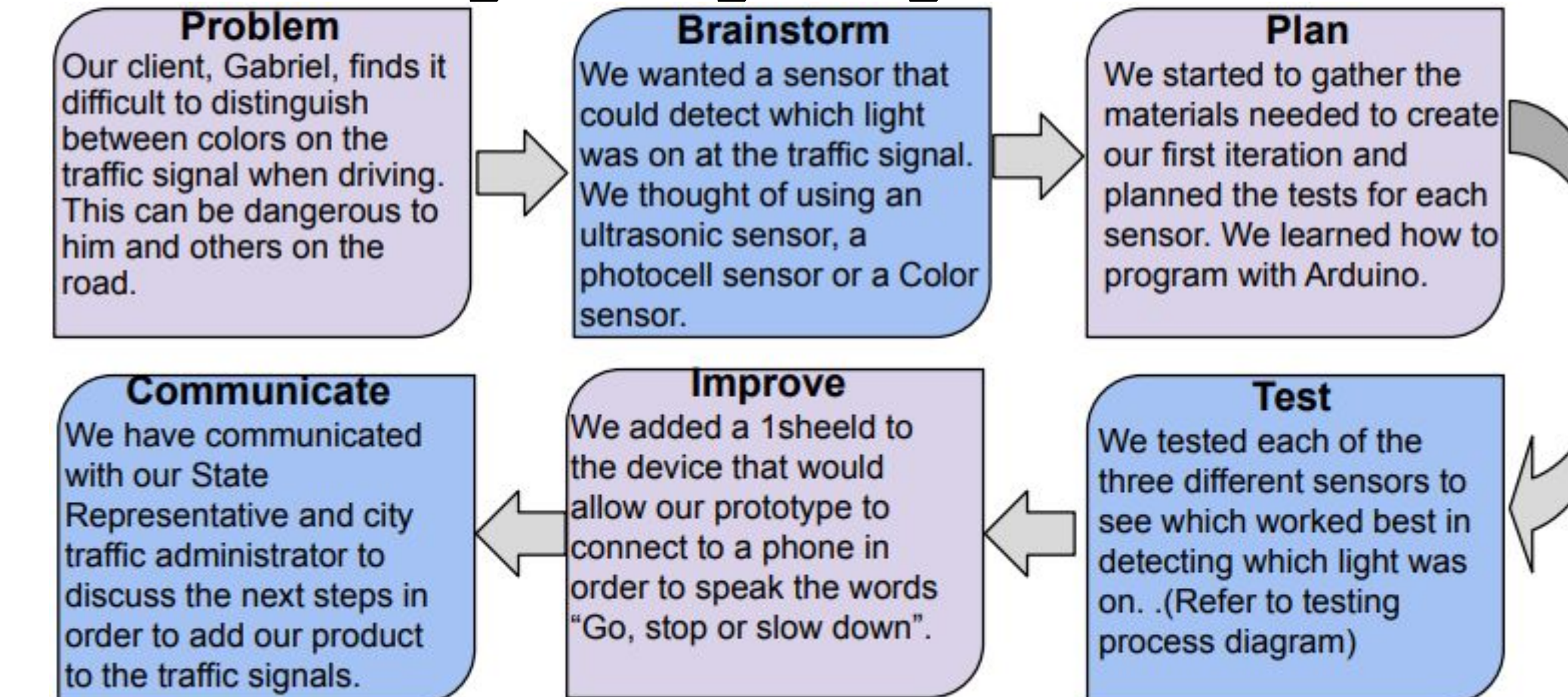
Figure 3-Traffic Signal Diagram



Results

- After testing and making iterations, our product ETS achieves equity for Gabriel because the photocell sensor, LCD and phone app allows the device to relay information to him and other CVD drivers without the use of colors.
- The photocells sensors detect the light that is on, allowing Gabriel not to depend on the position of the lights.
- The Arduino and 1sheeld send the information to the LCD and phone app allowing Gabriel to receive the information in equitable ways.

Engineering Design Process



Conclusion/Next Steps

Our display monitor makes instructions easy to see and recognize. The LCD monitor will display the words "stop", "slow down" or "go". The user can also use the app that the 1sheeld connects to in order for their phone to verbally say the instructions. Both the display monitor and phone app use words to give instructions in English and Spanish. ETS will cost the city approximately \$620 and be attached to any existing traffic signals, but it will be absolutely free for Gabriel and other drivers. Our future improvements/next steps are:

- Add more sensors to make it work for multiple traffic signals.
- Work with google maps to integrate our systems together so the app will know which way our car is traveling.
- Obtain approval and funding from legislature.