



# Using LEDs for Visible Spectrum Color Therapy Along a Temporal Axis

Author: Kelly Hwang

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## Introduction

Traditionally, Hawaiians believe that the rainbow is a pathway between the two worlds of the physical and the spiritual. Spiritually, the origin story of rainbows designate them as sad omens by Kahalaopuna, and also signify the presence of aura of ali'i. Rainbows were also used as communal weather forecasts, such as the kuhonu, the “male” upside-down rainbow, predicting flash floods, and six consecutive east facing rainbows predicting the 1931 Halema'uma'u crater eruption(1). Rainbows are created by water droplets refracting light, and it is this scientific explanation that gave initial inspiration to this project. Influenced by this Hawaiian culture focus, the personal project that is engineering related and also has a sustainability aspect is an LED panel that outputs various colors following Hawaiian mysticism according to time of day. This project was inspired by how mood rings are affected by a temperature variable and translates itself into different visual color. This color idea was expanded to visual representations on a RGB LED depending on the variable of time. Other variables such as the temperature and luminosity sensor were not appropriate due to Hawaii's relatively temperate climate and potential light interference respectively. From further research into chromotherapy(2) and Hawaiian mysticism, specifically targeting colors at different intervals were chosen depending on the scheduled activity. Each individual color has a unique therapeutic benefit and Hawaiian mystic effect on the human body, mind, and soul. By creating and using this LED code, a daily schedule would eventually become optimized for the user.

There was experimentation regarding the loop statements for the code, and it was decided that 'if statements' were to be used over 'switch statements' due to 'if statements' benefits of having a range of values and its flexibility. Starting from practicing coding to produce different colors at specific seconds intervals, the code graduated to blending colors between those intervals using 'for statements', which then extended to the full 16.5 hours of RGB LED screening (Figure 3). Some problems encountered during the coding process were regarding the conditional statements for timeMinutes, stacking if and for statements, and the errors occurring in conversion of the code to FastLED for the LED panel.

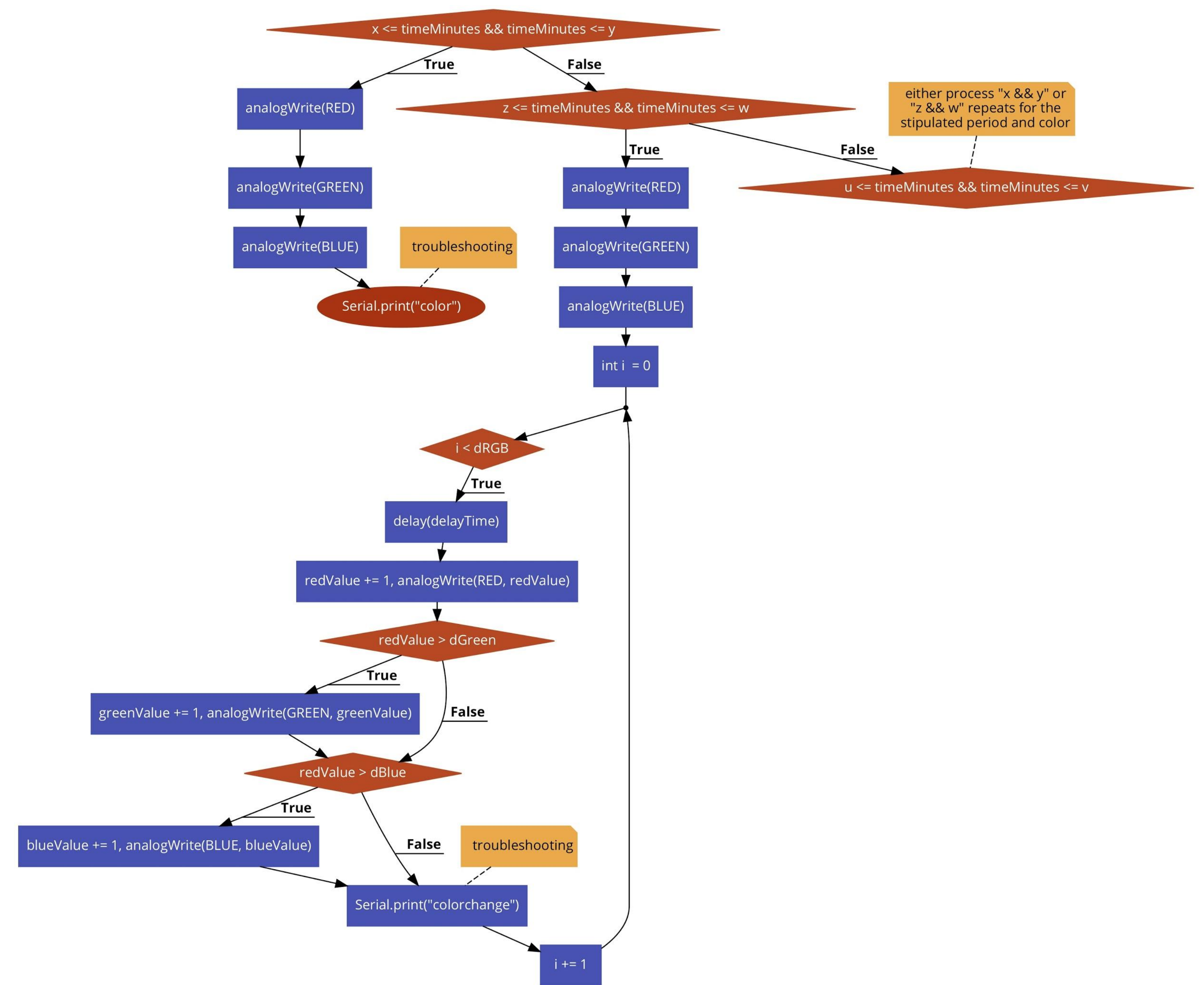


Figure 3) Code flowchart for RGB LED according to timeMinutes

All colors were specifically chosen due to their relevance in chromotherapy(2) and Hawaiian mysticism(3) (Figure 4). The visible spectrum of light's unique wavelength and oscillations heal both the physical and etheric bodies(2). Amber is a good warming, radiant color to wake up to, is also a “brighter” hue and infuses aura with warmth. For the times that required concentration and discipline, such as MATH243 and the SCI295VI, there would be shades of lapis and navy blue. Red is a color that stimulates the basic self, so light red is a suitable follow up after PEEC and ruby red raising physical energy is beneficial for workouts. For the evening, grounding colors were chosen, turquoise for the physical level, brown for the vibrational level, magenta for the spiritual level, and forest green for the mental level.

Start	Hour	Minute	Sum	End	Hour	Minute	Sum	Activity	Mins	Color	Hexcode	R	G	B	ΔR	ΔG	ΔB	Largest Δ	delayTime
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7:30	7	30	450	7:49	7	49	459		19	off-amber									
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8:30	8	30	510	8:39	8	39	519		9	green-orange									
8:40	8	40	520	8:29	8	29	509	Energize	49	Orange	#FF7F00	255	127	0					
8:30	9	30	570	8:59	9	59	599		29	orange-lapis									
8:30	9	30	570	12:59	12	59	779	Study	209	Lapis	#28619C	38	97	156					
13:00	13	0	780	13:09	13	9	789		9	lapis-off									
13:10	13	10	790	13:49	13	49	829	Lunch	39	OFF		0	0	0					
13:50	13	50	830	13:59	13	59	839		9	off-yellow									
14:00	14	0	840	14:24	14	24	864	Pickup	24	Yellow	#FFD700	255	223	0					
14:25	14	25	865	14:29	14	29	869		4	yellow-navy									
14:30	14	30	870	15:59	15	59	959	Study	89	Navy Blue	#000080	0	0	128					
16:00	16	0	960	16:04	16	4	964		4	navy-red									
16:00	16	0	960	16:54	16	54	1014	Calm	54	Light Red	#FF69B1	255	105	97					
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21:00	21	0	1260	21:09	21	9	1269		9	turquoise-brown									
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22:00	22	0	1320	23:09	23	9	1389	Unwind	69	Magenta	#CA1F7B	202	31	123					
23:10	23	10	1390	23:19	23	9	1399		9	magenta-green									
23:20	23	20	1400	23:49	23	49	1429	Sleep	29	Forest Green	#228B22	34	139	34					
23:50	23	50	1430	23:59	23	59	1439		9	fgreen-off									
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Figure 4) Spreadsheet of times with timeMinutes, activity, and chosen color, along with RGB values, change in R, G, B, and delayTime

From the initial single RGB LED system, the final iteration of the project was created by coding and connecting the WS2812B panel (8x32 pixels), made from using the FastLED library and an external power adaptor (Figure 5 & 6). Indeed there were some initial difficulties in the transition of coding libraries and the circuitry required, but eventually the panel was successfully turned on and functioning.

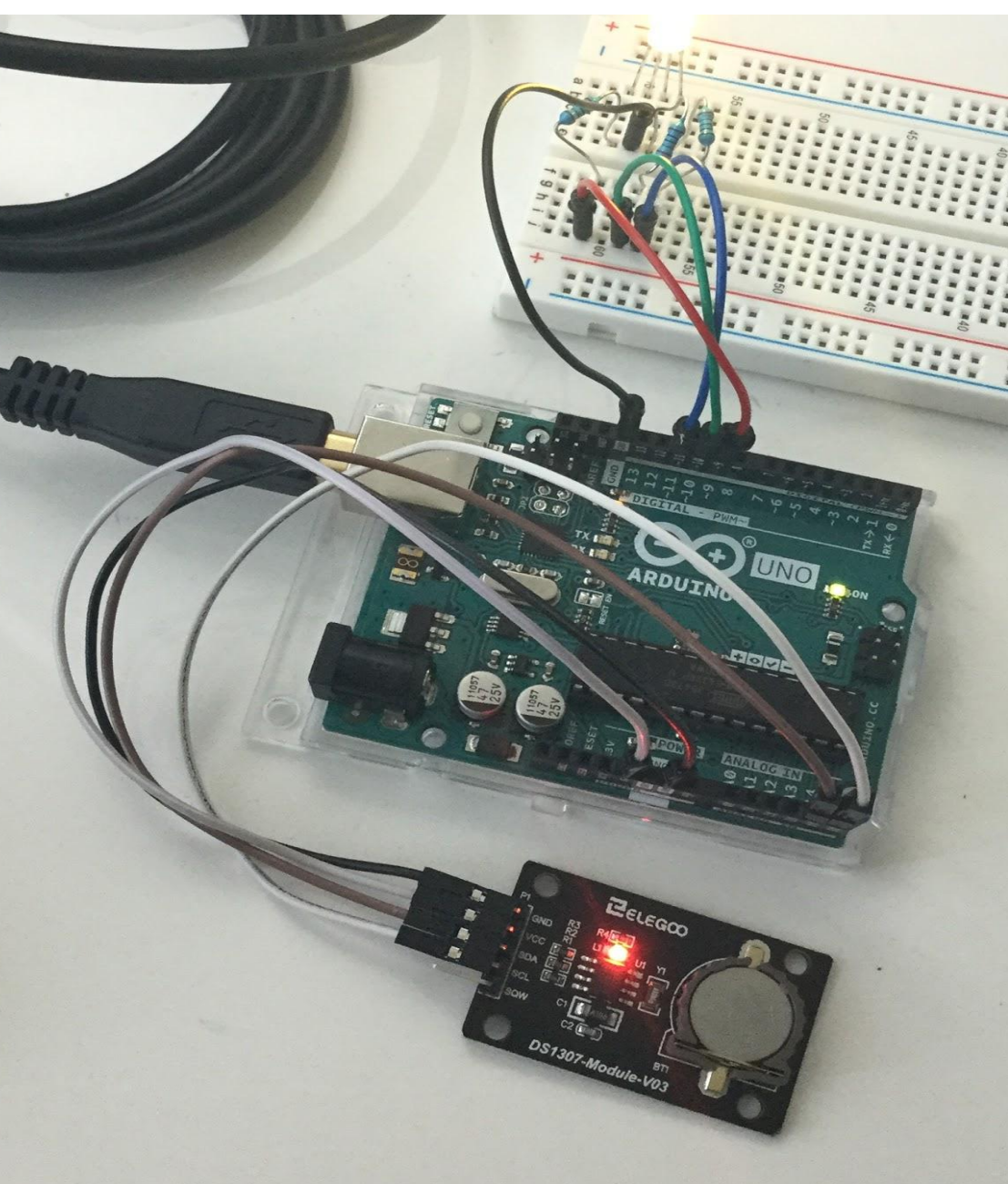


Figure 1) Set up circuitry of Arduino, RGB LED, DS1307 RTC

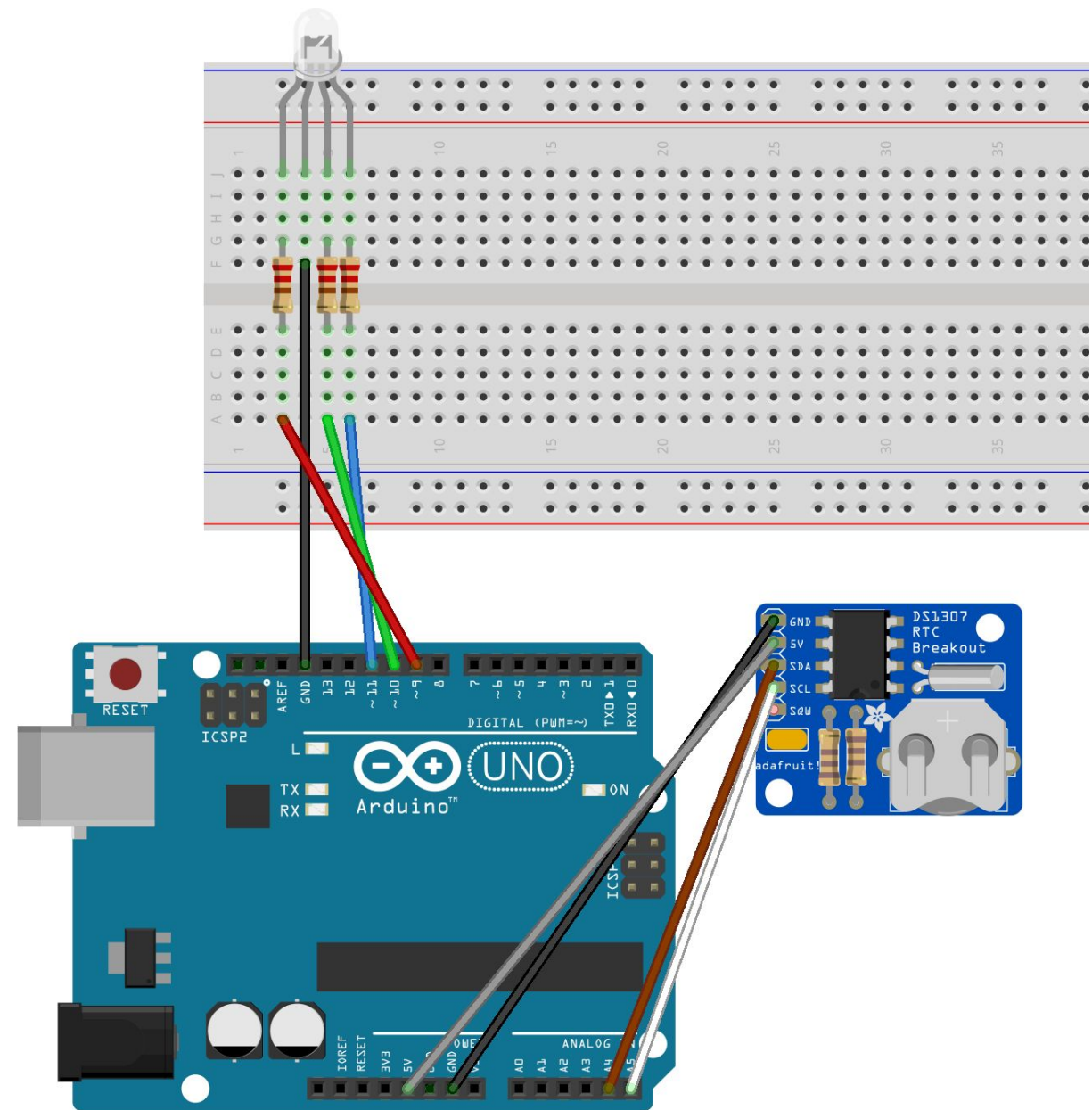


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Throughout the process, there were many new techniques and technical skills learnt, including but not limited to, basic circuitry, sensor usage, and Arduino coding. The final code for the first iteration of the project originated from two base codes, one for the DS-1307 RTC (real time clock) module and the other for RGB LED, both from the Elegoo Arduino files. This was then collated into a single sketch and successfully ran simultaneously (Figure 1 & 2).

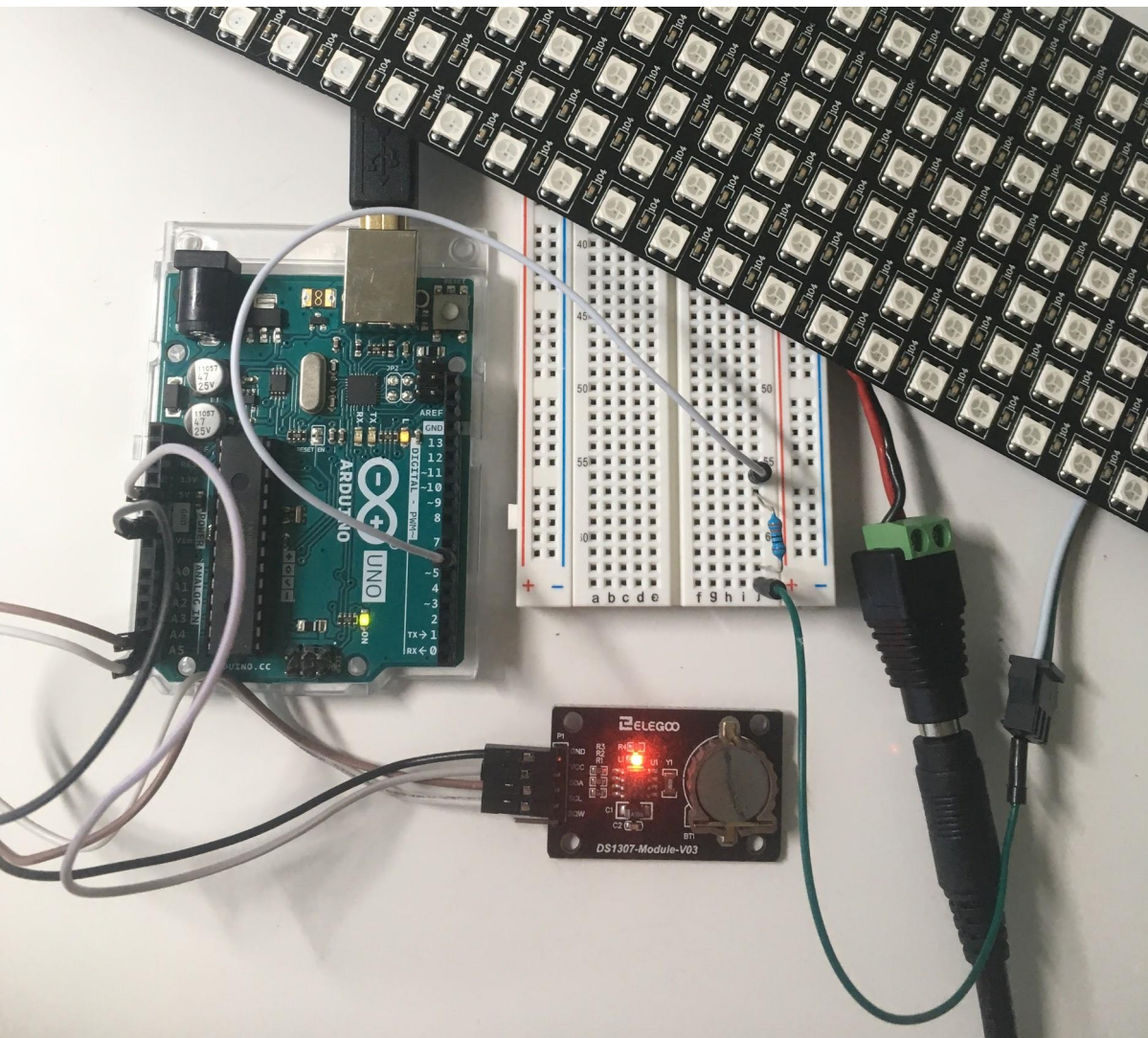


Figure 5) Set up circuitry of Arduino, DS1307 RTC, and WS2812B panel

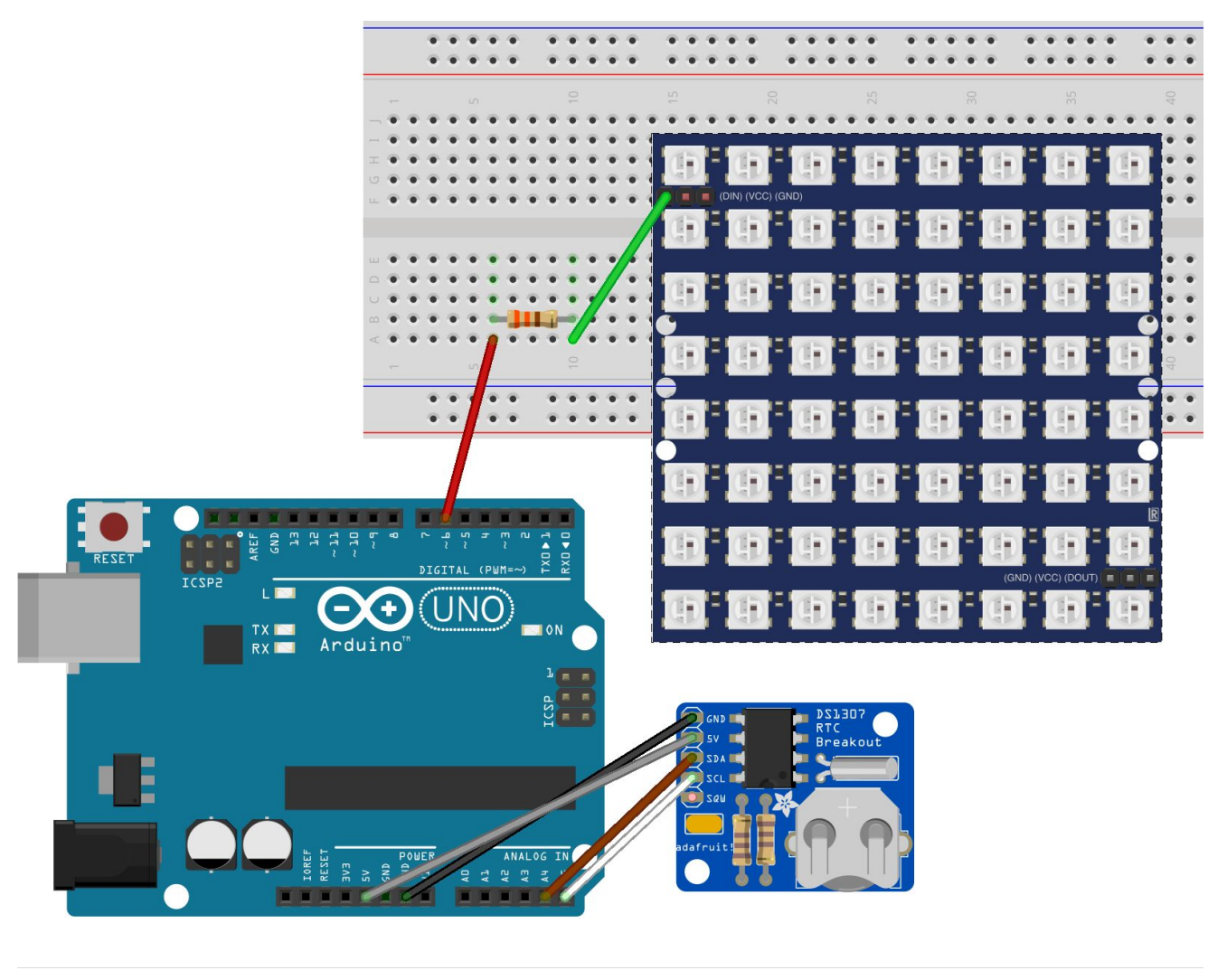


Figure 6) Diagram of Figure 5 set up of Arduino, DS1307 RTC, and WS2812B panel

## Conclusion

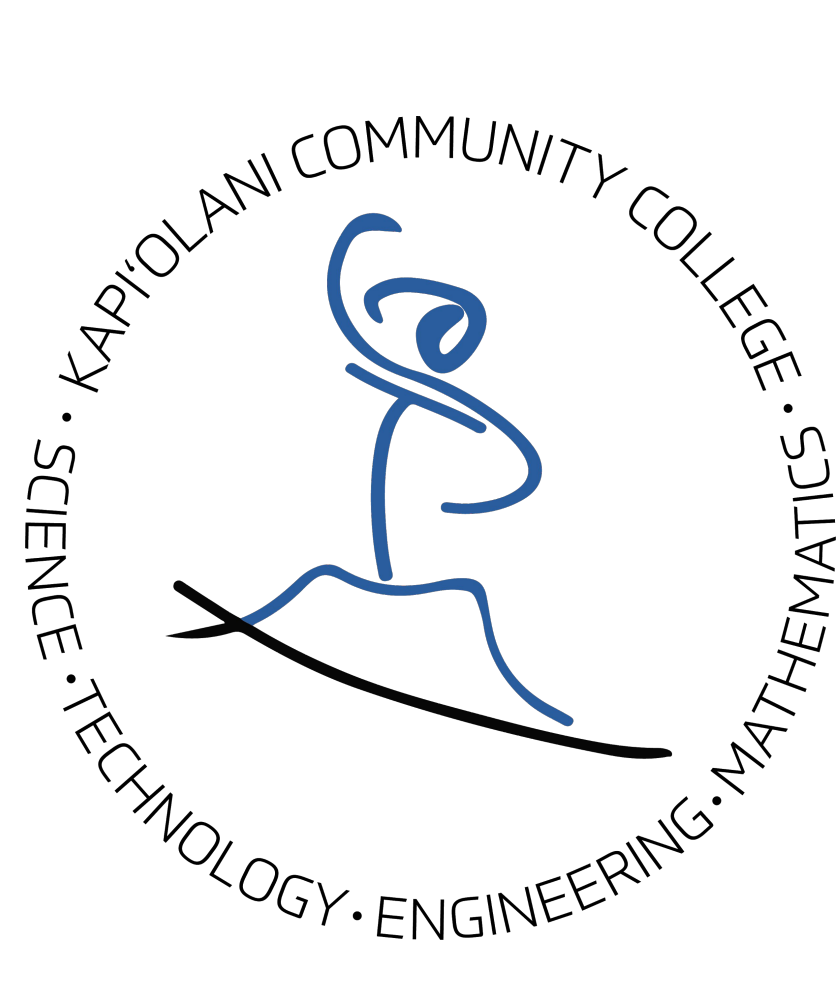
Through this project, deeper appreciation and understanding of Hawaiian mysticism along with technical knowledge of electrical engineering and coding was gained. Successfully resolving problems as they arose throughout the process also helped in the research experience. Visualizing time in terms of color has been a good alternative to the traditional clock and helped regulate the summer schedule; the initial goal of optimizing the user's schedule has been achieved.

## References

- (1) Aalto, A., (2012, Dec). Signs & Wonders. *Hanahou*. 15(6).
- (2) Azeemi, S. T., & Raza, S. M. (2005). A critical analysis of chromotherapy and its scientific evolution. Evidence- based complementary and alternative medicine : eCAM, 2(4), 481–488. <https://doi.org/10.1093/ecam/neh137>
- (3) Berney, C., (2012). *Fundamentals of Hawaiian Mysticism*. Crossing Press, Berkeley.

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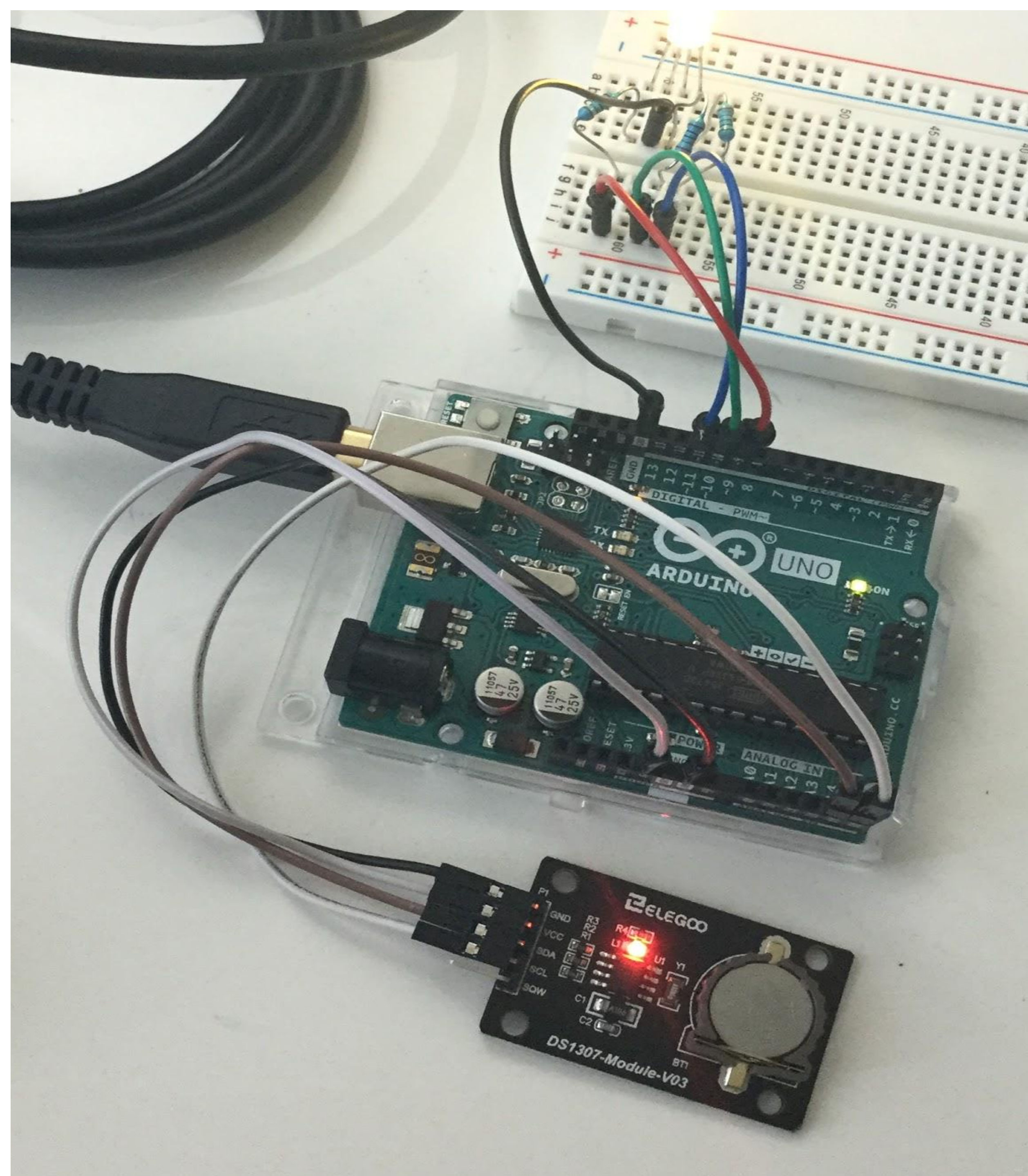


Figure 1) Set up circuitry of Arduino, RGB LED, DS1307 RTC

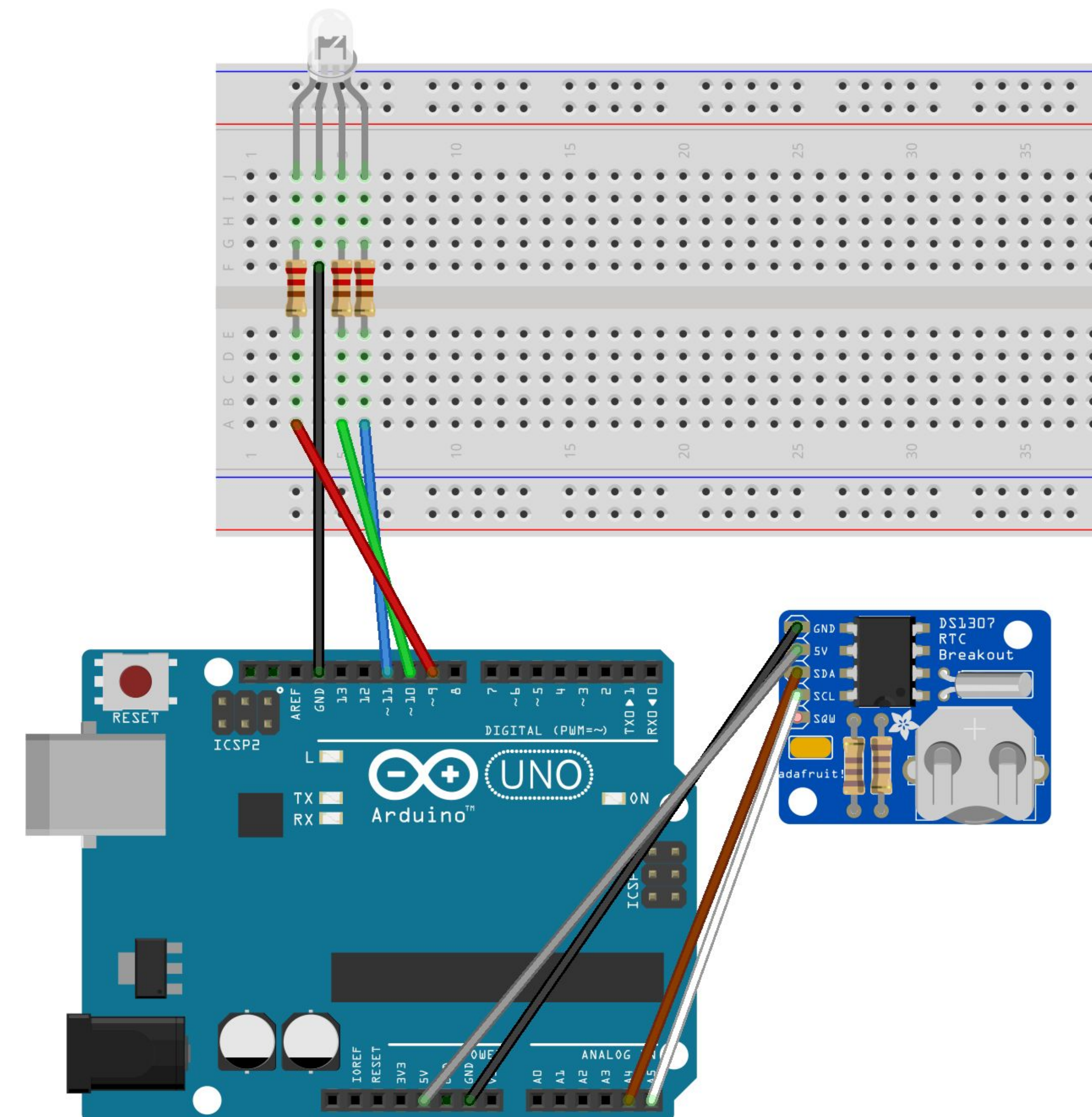


Figure 2) Diagram of Figure 1 set up of Arduino, RGB LED, and DS1307 RTC





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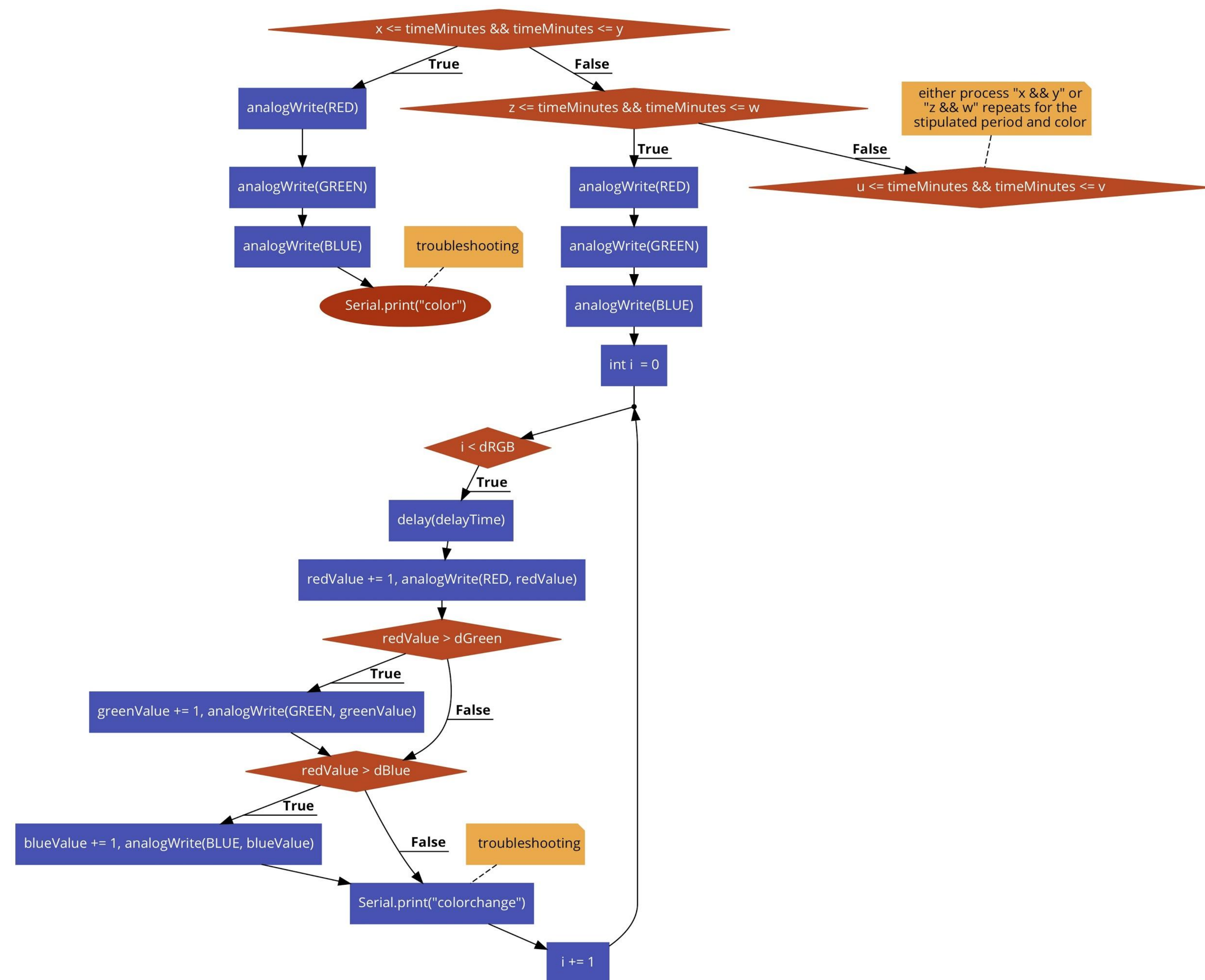


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7:30	7	30	450	7:49	7	49	469		19	off-amber					255	191	0	255	4470.59
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09:30	9	30	570	09:59	9	59	599		29	orange-lapiz					-217	-30	156	217	8018.43
09:30	9	30	570	12:59	12	59	779	Study	209	Lapis	#26619C	38	97	156					
13:00	13	0	780	13:09	13	9	789		9	lapiz-off					-38	-97	-156	156	3461.54
13:10	13	10	790	13:49	13	49	829	Lunch	39	OFF		0	0	0					
13:50	13	50	830	13:59	13	59	839		9	off-yellow					255	223	0	255	2117.65
14:00	14	0	840	14:24	14	24	864	Pickmeup	24	Yellow	#FFDF00	255	223	0					
14:25	14	25	865	14:29	14	29	869		4	yellow-navy					-255	-223	128	255	941.18
14:30	14	30	870	15:59	15	59	959	Study	89	Navy Blue	#000080	0	0	128					
16:00	16	0	960	16:04	16	4	964		4	navy-lred					255	105	-31	255	941.18
16:00	16	0	960	16:54	16	54	1014	Calm	54	Light Red	#FF6961	255	105	97					
16:55	16	55	1015	16:59	16	59	1019		4	lred-rred					-100	-88	-67	100	2400.00
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23:50	23	50	1430	23:59	23	59	1439		9	fgreen-off					-34	-139	-34	139	3884.89
0:00	0	0	0	0:00	0	0	0		0	OFF		0	0	0					

Figure 4) Spreadsheet of times with timeMinutes, activity, and chosen color, along with RGB values, change in R, G, B, and delayTime



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## Methods

From the initial single RGB LED system, the final iteration of the project was created by coding and connecting the WS2812B panel (8x32 pixels), made from using the FastLED library and an external power adaptor (Figure 5 & 6). Indeed there were some initial difficulties in the transition of coding libraries and the circuitry required, but eventually the panel was successfully turned on and functioning.

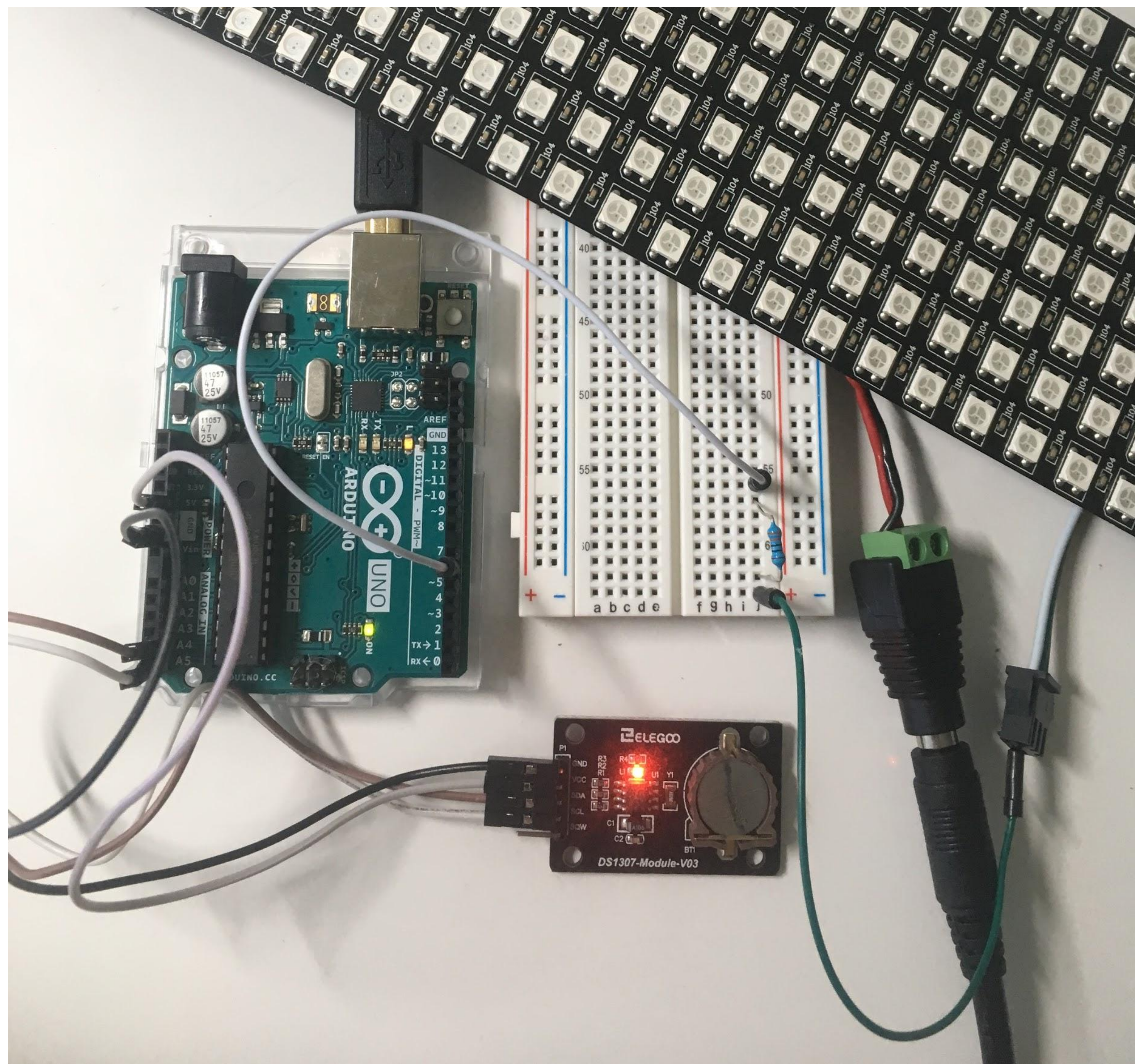


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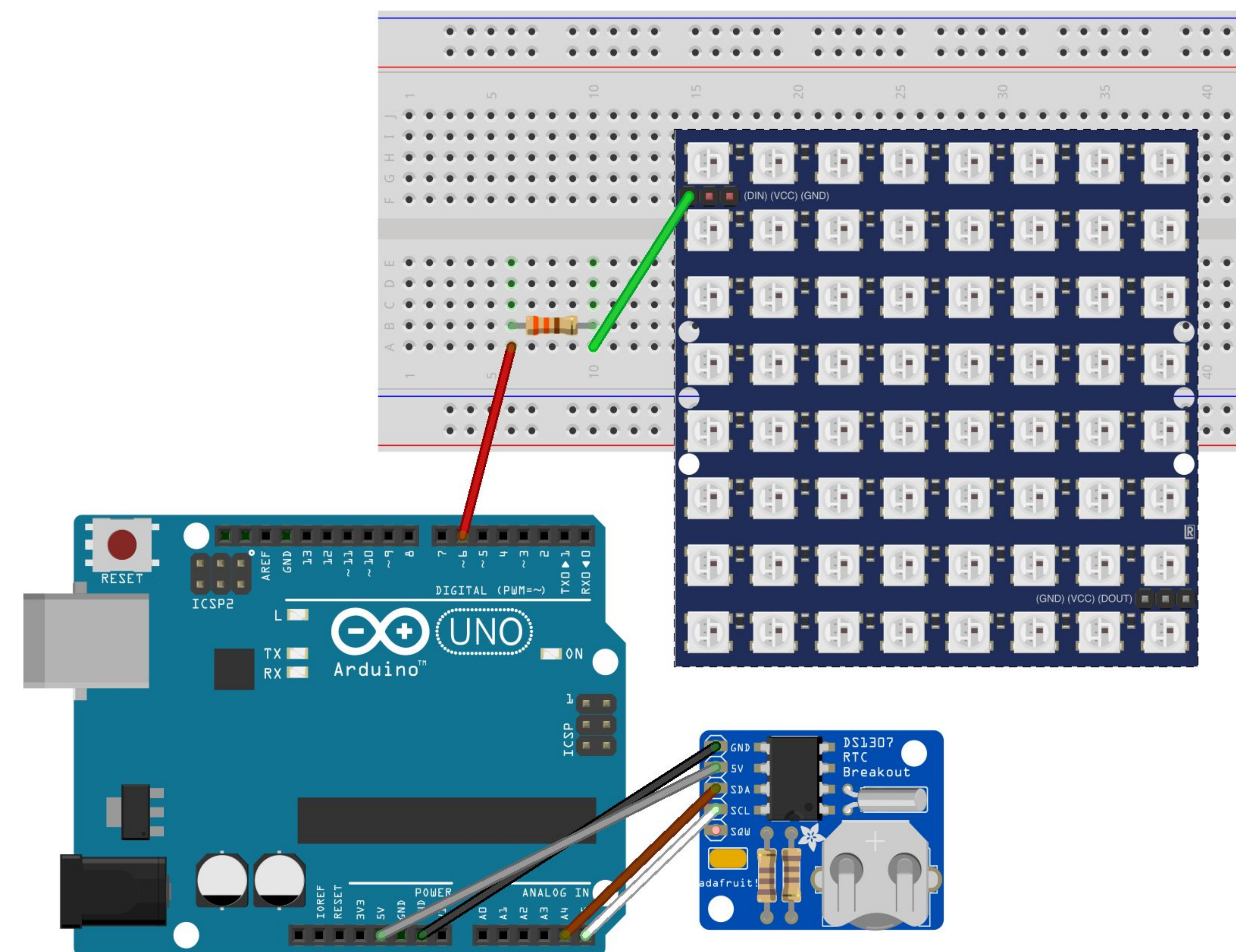
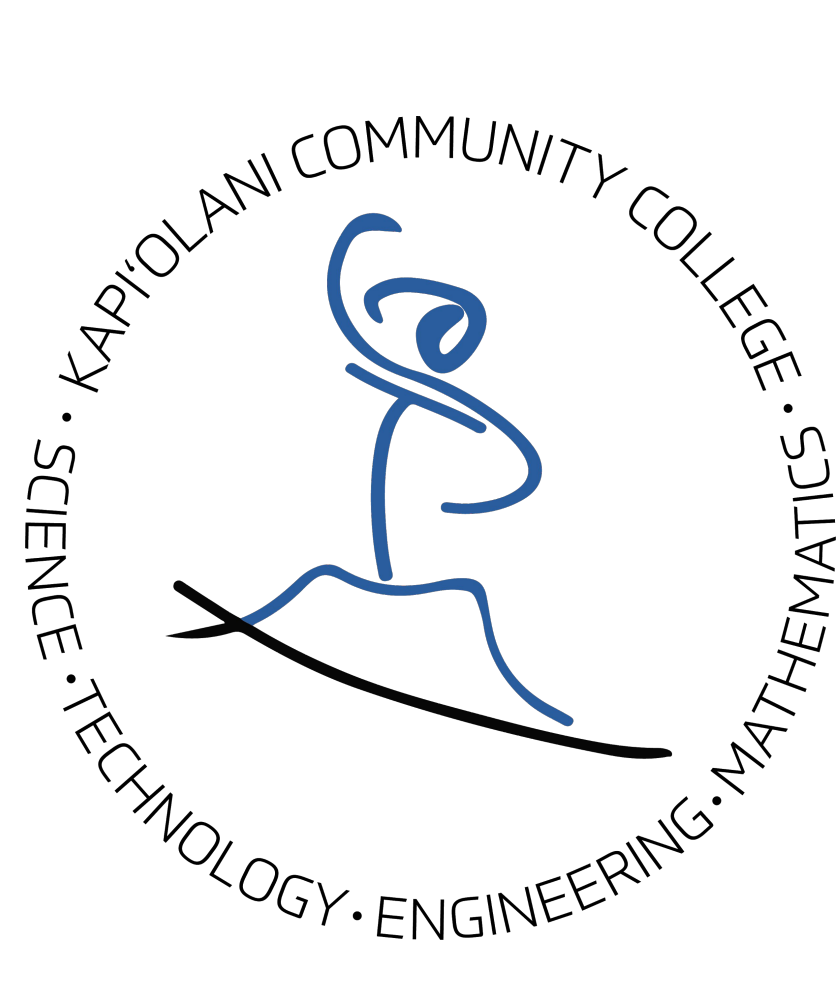


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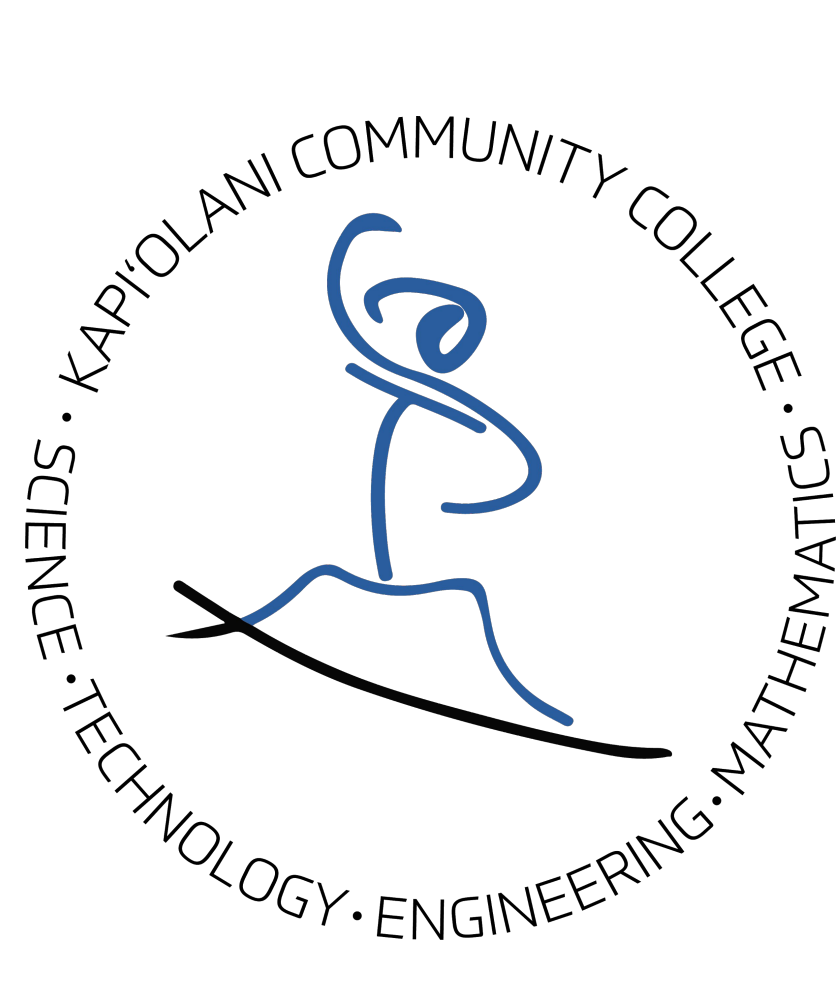
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## References & Acknowledgements

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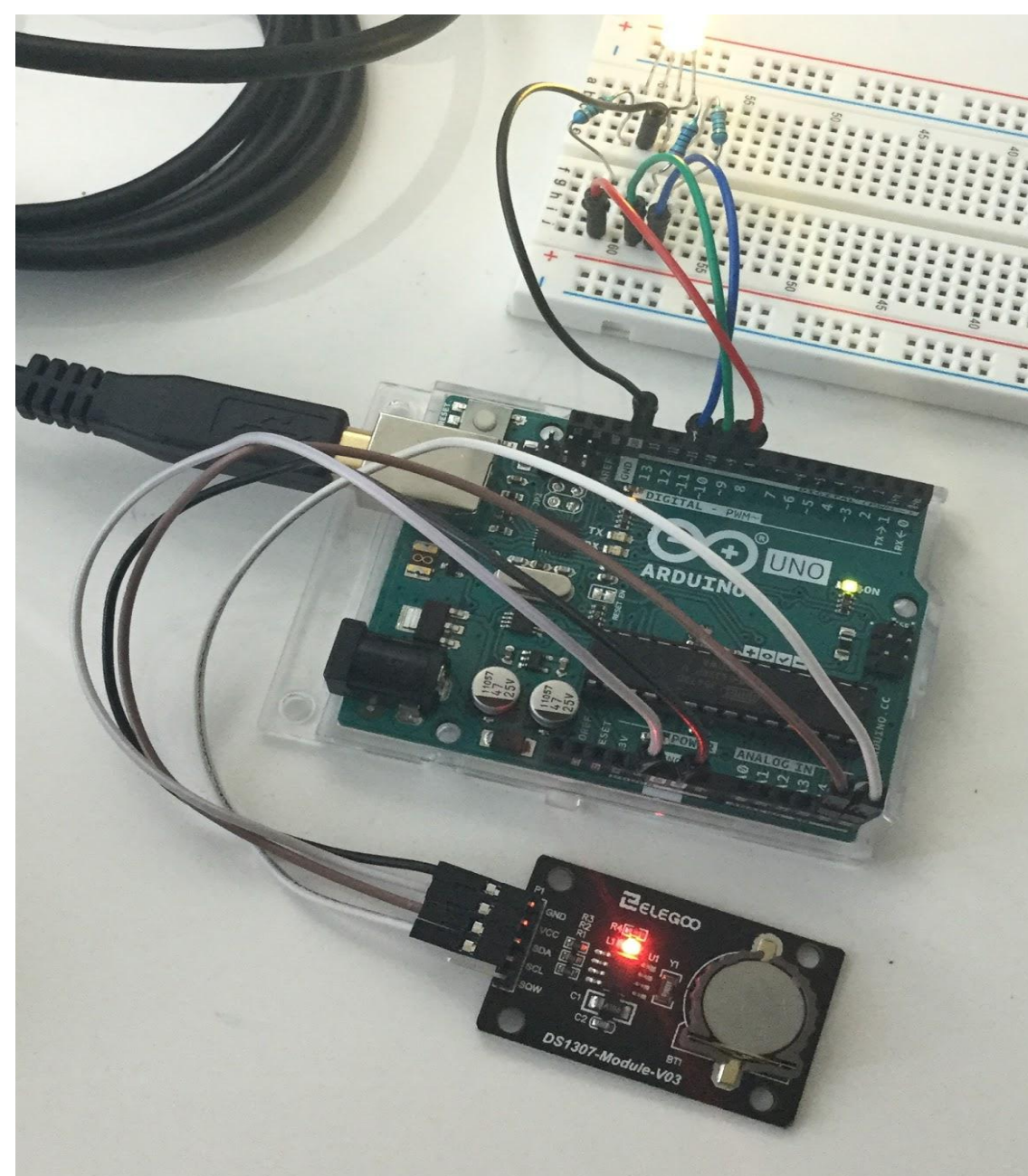


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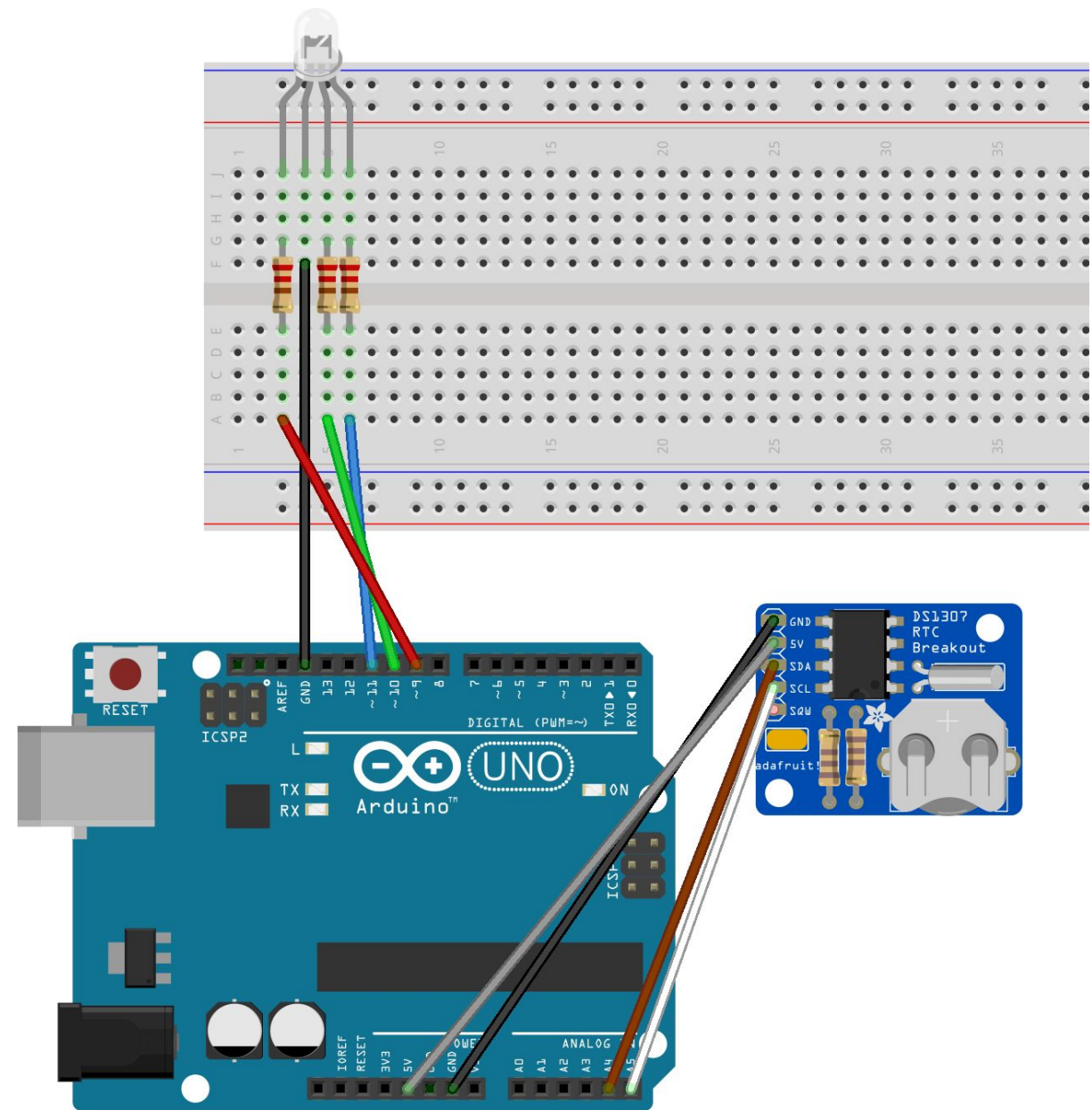


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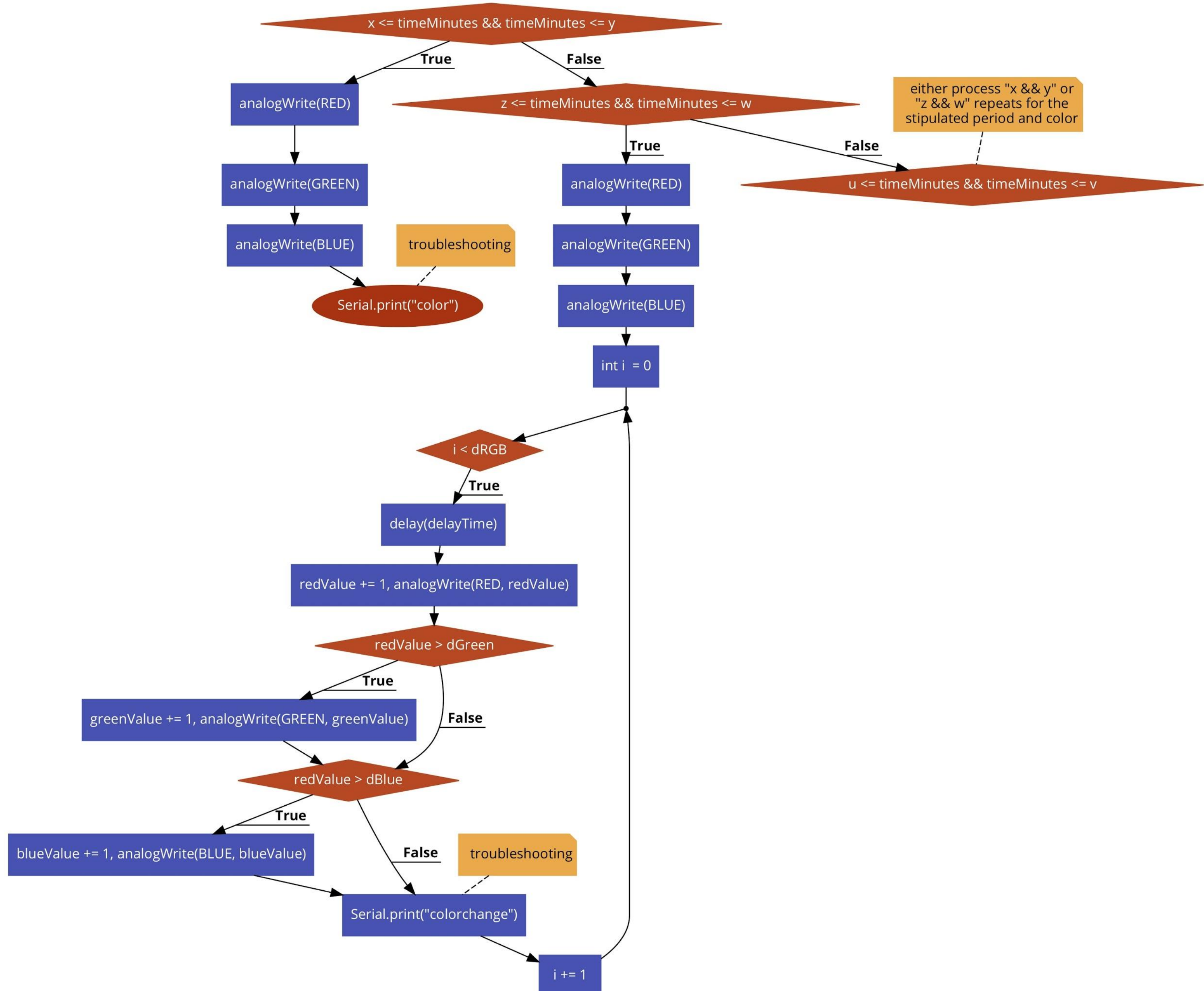


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8:30	8	30	510	08:39	8	39	519		9	green-orange									
08:40	8	40	520	09:29	8	29	569	Energize	49	Orange	#FF7F00	255	127	0					
09:30	9	30	570	09:59	9	59	599		29	orange-lapis									
09:30	9	30	570	12:59	12	59	779	Study	209	Lapis	#2B619C	38	97	156					
13:00	13	0	780	13:09	13	9	789		9	lapis-off									
13:10	13	10	790	13:49	13	49	829	Lunch	39	OFF		0	0	0					
13:50	13	50	830	13:59	13	59	839		9	off-yellow									
14:00	14	0	840	14:24	14	24	864	Pickup	24	Yellow	#FFD700	255	223	0					
14:25	14	25	865	14:29	14	29	869		4	yellow-navy									
14:30	14	30	870	15:59	15	59	959	Study	89	Navy Blue	#000080	0	0	128					
16:00	16	0	960	16:04	16	4	964		4	navy-red									
16:00	16	0	960	16:54	16	54	1014	Calm	54	Light Red	#FF69B1	255	105	97					
16:55	16	55	1015	16:59	16	59	1019		4	red-red									
17:00	17	0	1020	18:29	18	29	1109	Workout	89	Ruby Red	#9B111E	155	17	30					
18:30	18	30	1110	18:39	18	39	1119		9	red-off									
18:40	18	40	1120	19:19	19	19	1159	Dinner	39	OFF		0	0	0					
19:20	19	20	1160	19:29	19	29	1169		9	off-turquoise									
19:30	19	30	1170	20:59	20	59	1259	Study	89	Turquoise	#40E0D0	64	224	208					
21:00	21	0	1260	21:09	21	9	1269		9	turquoise-brown									
21:10	21	10	1270	21:49	21	49	1309	Calm	39	Brown	#994B00	150	75	0					
21:50	21	50	1310	21:59	21	59	1319		9	brown-magenta									
22:00	22	0	1320	23:09	23	9	1389	Unwind	69	Magenta	#CA1F7B	202	31	123					
23:10	23	10	1390	23:19	23	9	1399		9	magenta-green									
23:20	23	20	1400	23:49	23	49	1429	Sleep	29	Forest Green	#228B22	34	139	34					
23:50	23	50	1430	23:59	23	59	1439		9	fgreen-off									
0:00	0	0	0	0:00	0	0	0		0	OFF		0	0	0					

Figure 4) Spreadsheet of times with timeMinutes, activity, and chosen color, along with RGB values, change in R, G, B, and delayTime

From the initial single RGB LED system, the final iteration of the project was created by coding and connecting the WS2812B panel (8x32 pixels), made from using the FastLED library and an external power adaptor (Figure 5 & 6). Indeed there were some initial difficulties in the transition of coding libraries and the circuitry required, but eventually the panel was successfully turned on and functioning.

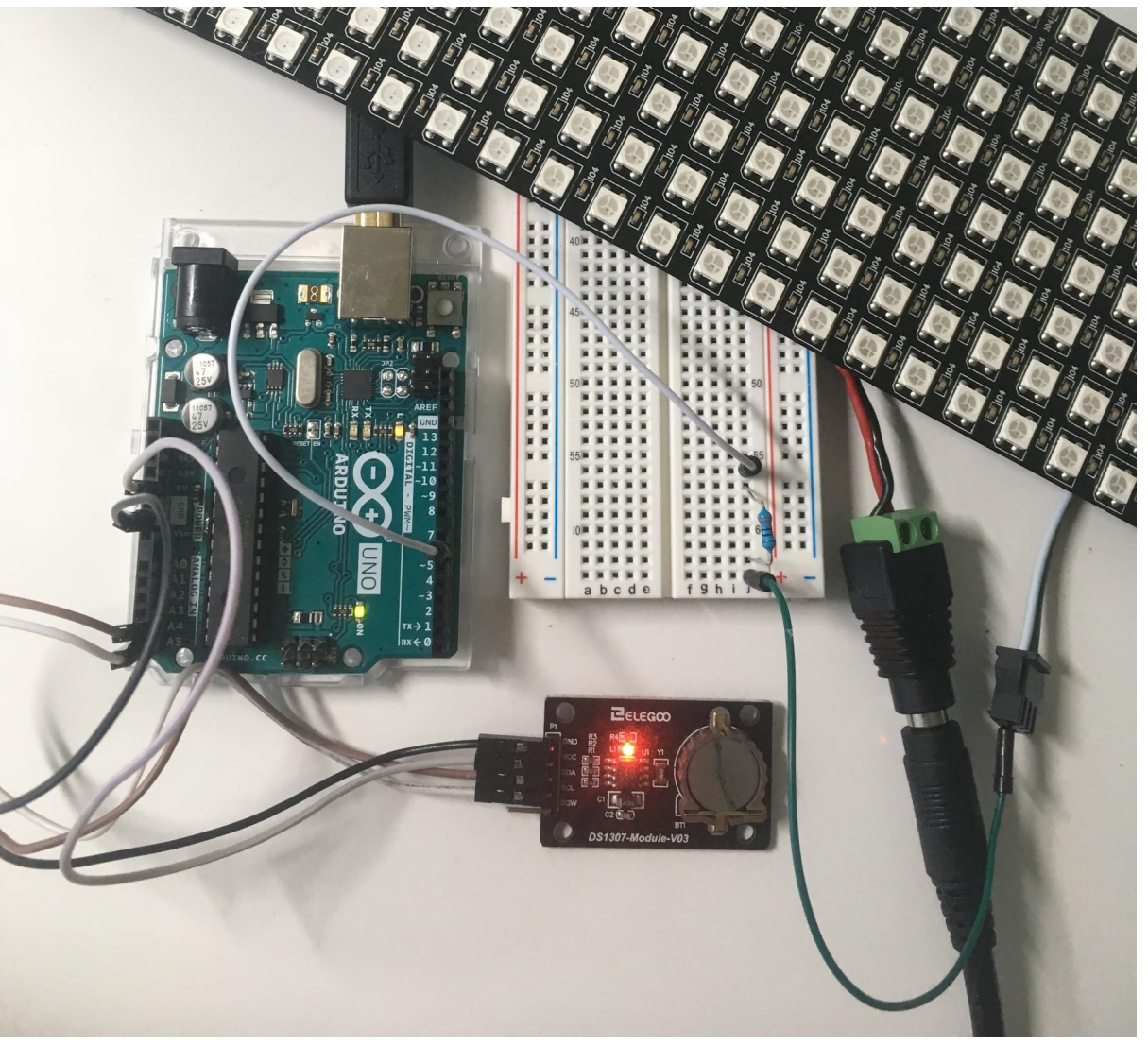


Figure 5) Set up circuitry of Arduino, DS1307 RTC, and WS2812B panel

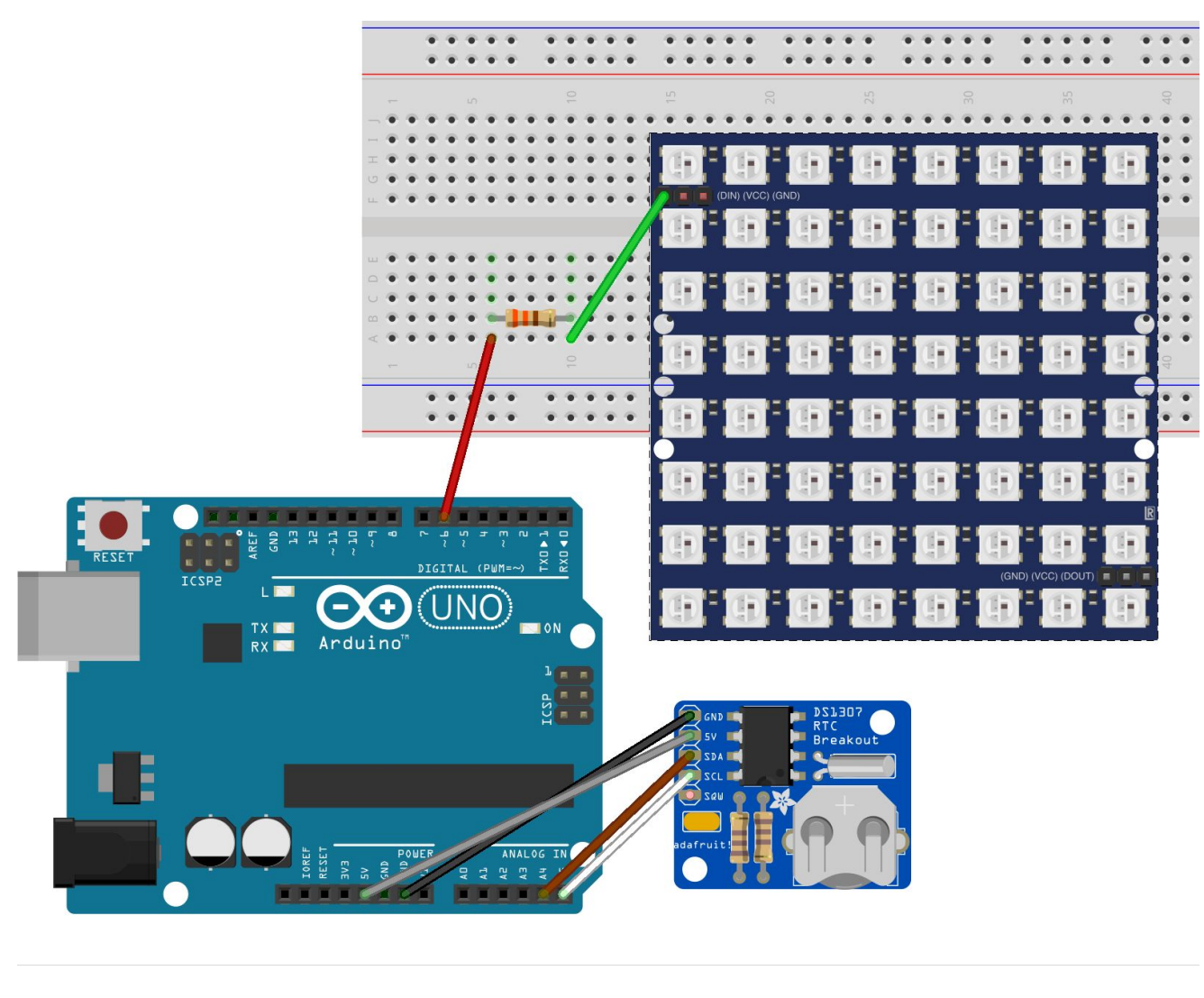


Figure 6) Diagram of Figure 5 set up of Arduino, DS1307 RTC, and WS2812B panel

## Conclusion

Through this project, deeper appreciation and understanding of Hawaiian mysticism along with technical knowledge of electrical engineering and coding was gained. Successfully resolving problems as they arose throughout the process also helped in the research experience. Visualizing time in terms of color has been a good alternative to the traditional clock and helped regulate the summer schedule; the initial goal of optimizing the user's schedule has been achieved.

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