Project H.I.K.E. – Heat Island Kartographic Environment

1.09 – Heat Island Map 2

Our project is a portable data logger that tracks temperature, humidity, location, and time. The data is stored locally, then transferred to a cloud-based storage system and displayed on an interactive heat map.

Why is it Important?

- City planners will be able to identify "hot-spots" to determine methods of integrating heat-dispersing features for the development of heat-conscious cities.
- This grows increasingly relevant, as per the EPA[1], excessive heat is responsible for increased energy consumption and decreased public health.

Requirements

- Records temperature, humidity, time, position (GPS) locally with ease of access for uploading to cloud storage.
- 40 x 40 x 100 mm max size, 150g max weight.
- 4 hour / 48 hour battery life (operating / idle).
- Rich information display via webapp overlaid on a map

Cost and Budget

Original Unit Cost Requirement: $30.00/unit

Unit Cost to Date: $31.72/unit

Next Steps

- Reduce unit cost
- Determine best sampling rates for GPS
- Implement the Interactive map
- Determine and test battery level indications
- Perform and document tests of individual subsystems
- Integrate all subsystems into final design
- Collect data sets for data validation
- Ensure device can handle physical tests of rain simulation and dropping
- Test low power mode duration and limitations
- Build multiple prototypes for Spring 2023 Senior Design Day

Meet the Team

Project Manager: Jeremy Hester, *Scheduler and Interactive Heat Map*
Team Members: Leigh Cross, *Sensors (Temperature, Humidity, GPS)*
Jack Hotchkiss, *User Interface and Data Management*
Samuel Osagie-Aruya, *Power Storage and Distribution*

Acknowledgements

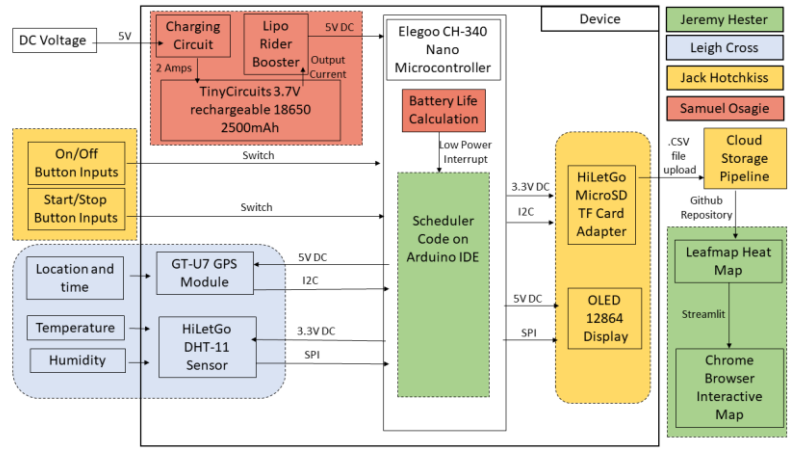
Sponsor: Lee Hinkle

Faculty Advisor: Lee Hinkle

D2 Mentors: Kayla Adderley, Ryan Fassnidge, AJ Holley, Skylar Roath

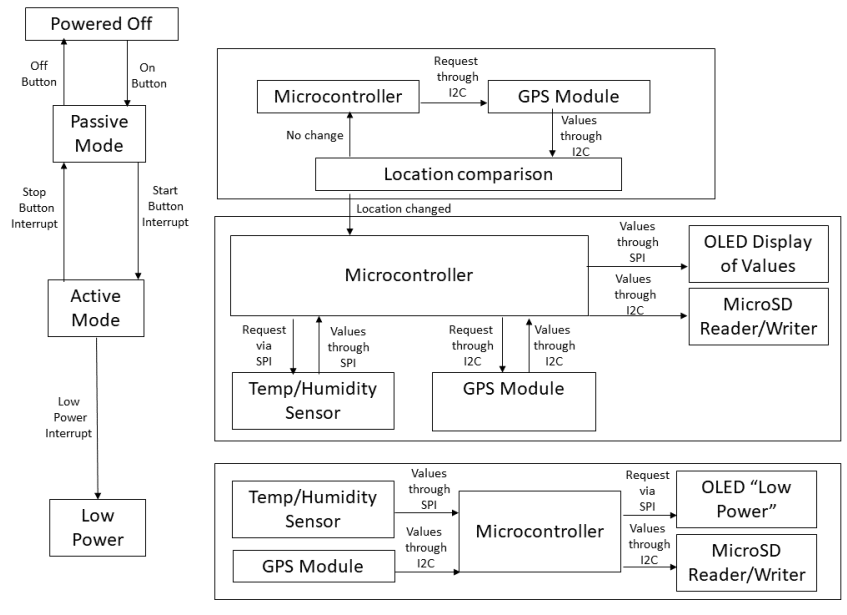
[1] *EPA*. [Online]. Available: https://www.epa.gov/heatislands/learn-about-heat-islands#impacts. [Accessed: 28-Sep-2022].

Functional Block Diagram

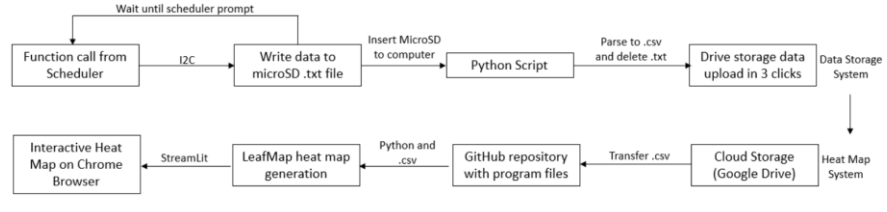


Scheduler Flow Chart

The scheduler is a state machine that regulates the timing of individual subsystems.



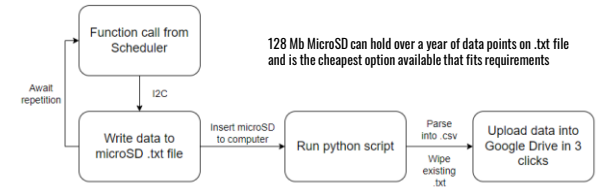
Data Storage to Interactive Map Flow Chart



User Interface

Model 12864 - 0.96 inch OLED	
Pixel Count	128x64
Operating Voltage	5V

Data Storage and Management



128 Mb MicroSD can hold over a year of data points on .txt file and is the cheapest option available that fits requirements

Sensors

DHT11 – Temperature / Humidity Sensor	
Communication Protocol	One-wire / Digital Pin
Supply Voltage	3 to 5.5V DC
Temperature Range	0 to 50ºC (-32ºF to 122ºF)
Accuracy	+/- 2ºC (at 0 to 50ºC) [+/- 3.6ºF (at -32º to 122ºF)]
Response Time	Range ≃ 6 - 15 sec.

GT-U7 – GPS Module	
Communication Protocol	One-wire / SPI
Time to First Fix (Cold Start)	26 – 32 sec.
Time to First Fix (Hot Start)	≈ 1 sec.
Velocity Accuracy	+/- 0.1 m/s
Heading Accuracy	+/- 0.5º

Power Budget

Power Allocation			
Components	**Current (mAh)**	**Voltage(V)**	**Power(mWh)**
18650 Lithium-Ion Rechargeable Battery	2500	3.7	9250
Components	**Current (mA)**	**Voltage(V)**	**Power(mW)**
Arduino (Nano)	19	5	95
SD Card module	200	3.3	660
OLED Display	24	5	120
Temp Humidity Module	2.5	3.3	8.25
GPS Module	45	5	225
Total	290.5 mA	N/A	1108.25 mW
Battery Life Expected	**High Sampling Rate**	**Average Sampling Rate**	**Low Sampling Rate**
Active Use	6.4 hours	11.1 hours	17.6 hours
Passively On	28.8 hours	60.9 hours	84 hours