Methods for Mapping Neighborhood Heat Patterns

1. Overview

This study aimed to measure and compare surface temperature variations across ten predetermined locations within the neighborhood during peak summer months. Data was collected during June and July of both 2024 and 2025, providing two consecutive summer datasets for analysis.

2. Equipment and Materials

- Arduino Uno R3
- microcontroller for sensor and display control.
- MLX90614 Infrared Temperature Sensor – for non-contact surface temperature measurements.
- 0.96" OLED Display – to display live readings in the field.
- Half-size Breadboard – for circuit assembly.
- 9V Battery with Barrel Jack Adapter – for portable power.
- Connecting Wires – assorted male-to-male jumper wires.
- Custom-built Enclosure/Platform – to hold components securely during fieldwork.

3. Data Collection Protocol

3.1 Site Selection

Ten sites were selected to represent a mix of surface types and environmental conditions, including unshaded asphalt, shaded asphalt, concrete sidewalks, grassy areas, tree-covered zones, and rooftops (accessible locations only).

3.2 Measurement Schedule

Measurements were taken three times per day to capture diurnal variations: Morning (8:00 AM), Afternoon (2:00 PM), and Evening (8:00 PM). For each site, the infrared sensor was held at a fixed height of approximately 1 meter above the surface to ensure consistent readings.

3.3 Instrument Calibration

Before each field session, the MLX90614 sensor was allowed to stabilize for 60 seconds. The device was tested on a controlled surface to verify reading accuracy.

4. Data Processing

- Recording: Temperature readings were recorded manually into a field log sheet and later entered into an Excel dataset for organization.

- Data Cleaning: Outliers due to brief sensor interference (e.g., passing pedestrians) were identified and removed.

- Analysis: Mean, median, and standard deviation were calculated for each location and time slot. Locations were grouped by surface type to determine average heat retention.

- Visualization: Individual site graphs, combined comparison graphs, and an interactive Google My Map were used for presentation.

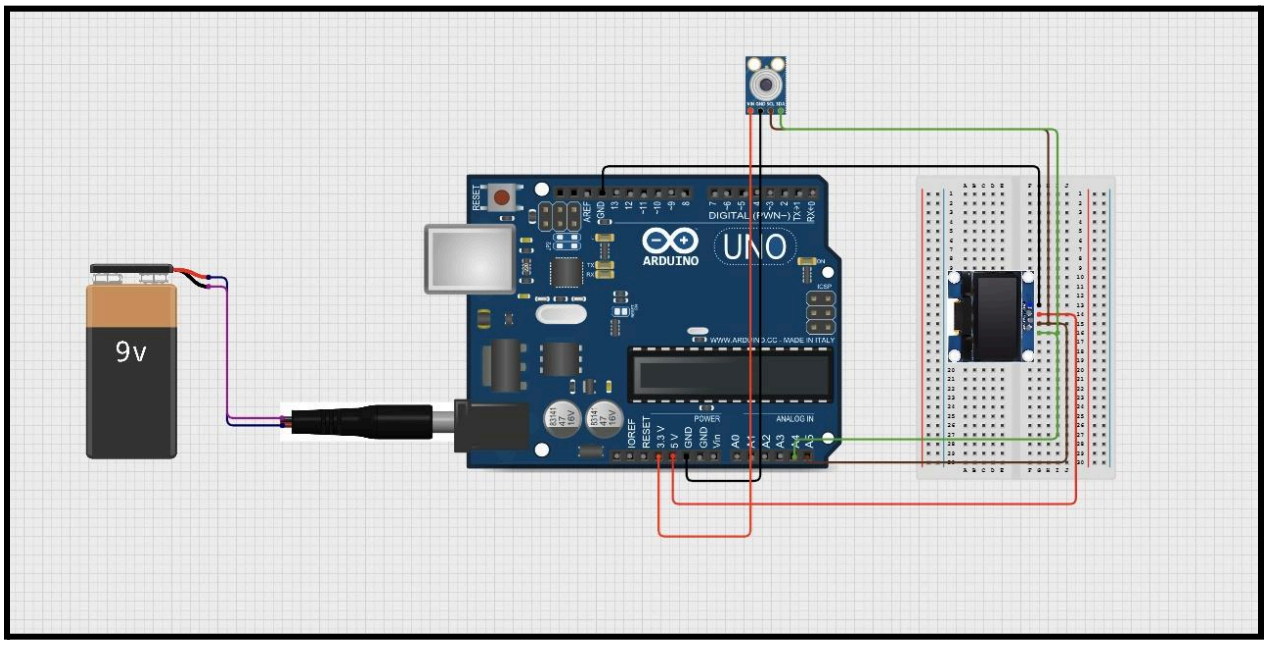
5. Limitations

- Measurements are limited to two summer months per year, which may not capture seasonal variation.

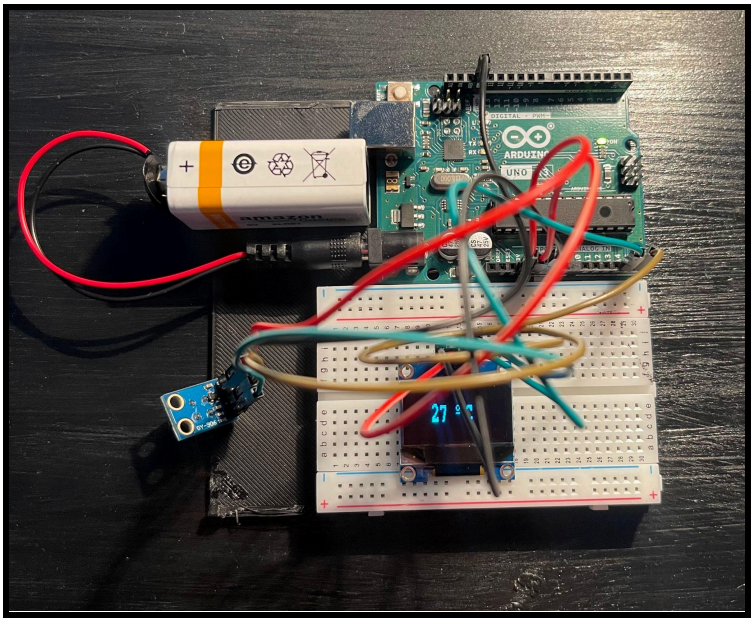
- Certain sites were influenced by transient factors (e.g., recent rainfall, parked cars).

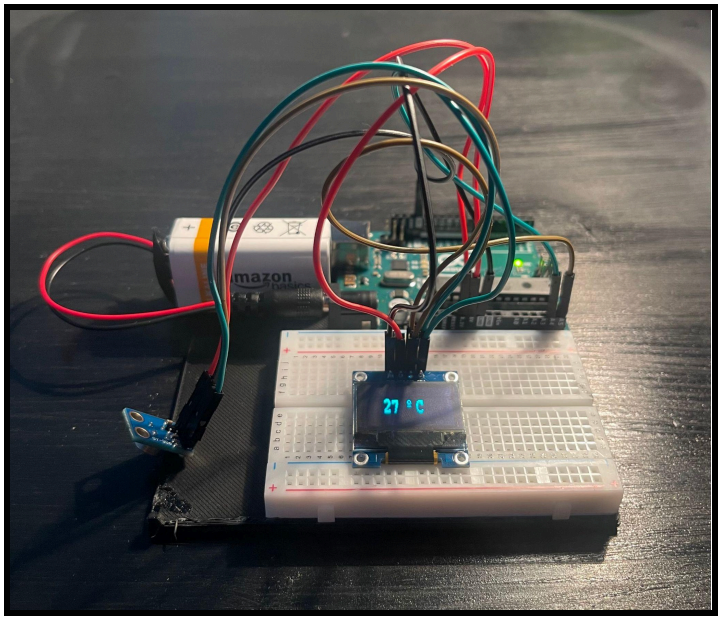
- Sensor readings are affected by angle and distance from the target surface.

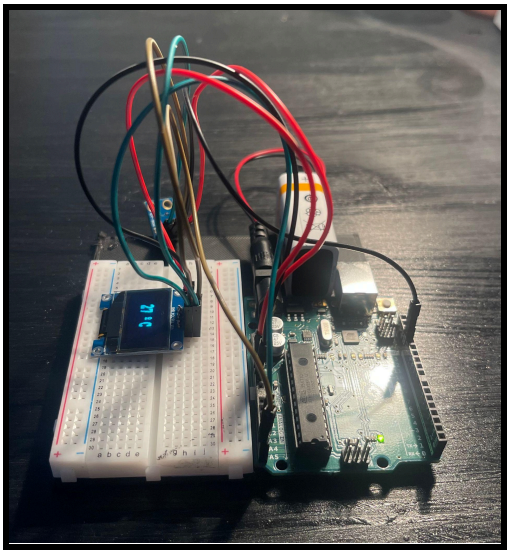
Device Wiring Diagram

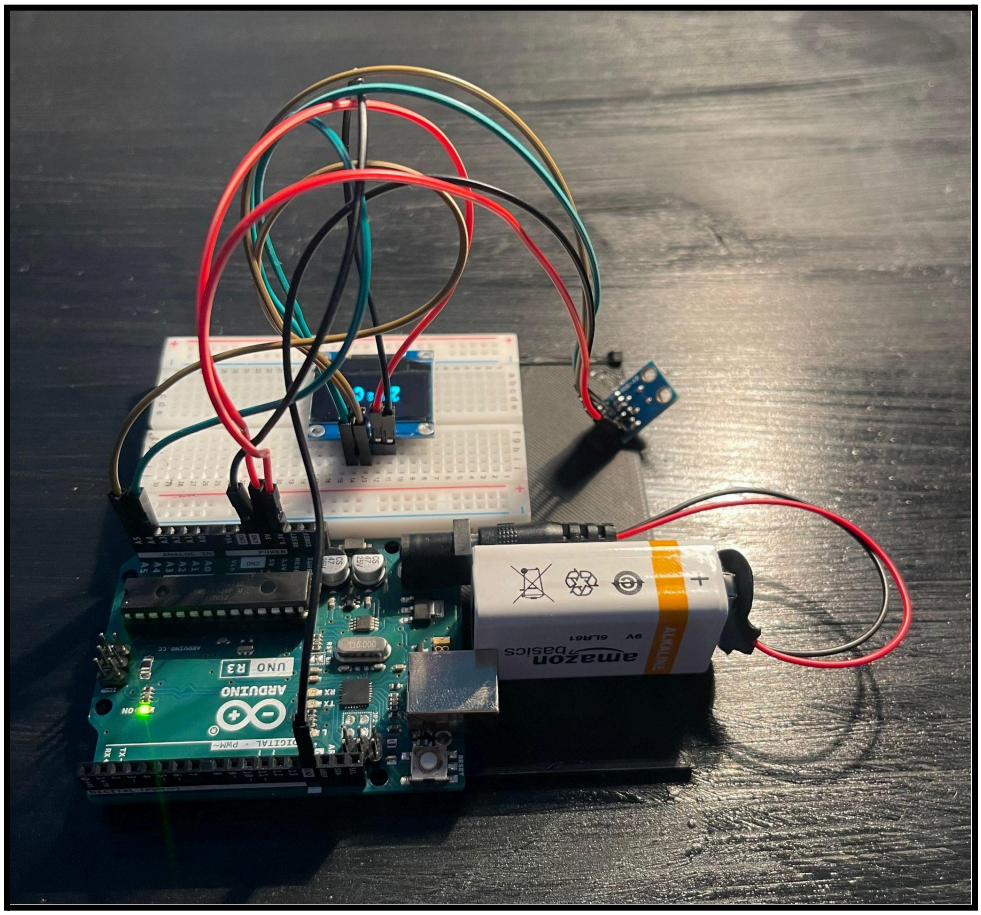


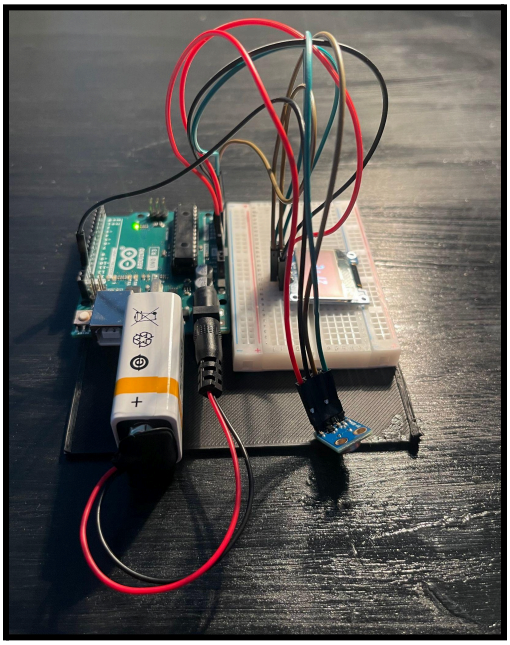
Device Images


ARDUINO
UNO
27 °C


27 °C




ARDUINO
UNO R3
amazon basics



Device Code

```
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <Fonts/FreeMonoBold9pt7b.h>
#include <Adafruit_MLX90614.h>

#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 32
#define OLED_RESET -1

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

Adafruit_MLX90614 mlx = Adafruit_MLX90614();
int temp;

void setup()
{
  delay(100);
  display.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  display.clearDisplay();
  display.setTextColor(WHITE);
  mlx.begin();
}

void loop()
{
  temp++;
  if(temp > 43)
  {
    temp = 0;
  }

  temp = mlx.readObjectTempC();

  display.clearDisplay();

  char string[10];
```

```
  dtostrf(temp, 4, 0, string);

  display.setFont(&FreeMonoBold9pt7b);
  display.setCursor(7,20);
  display.println(string);
  display.setCursor(75,20);
  display.println("C");
  display.setFont();
  display.setCursor(63,10);
  display.cp437(true);
  display.write(167);

  display.display();
}
```