# IR Room Temperature Scanner


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## FUTURE DIRECTION

**Temperature mapping involves using wireless data loggers or thermocouples to monitor and record temperature and humidity levels at various points in each environment, such as freezers, ovens, or storage areas. This data is then analyzed to identify areas of temperature deviation or hotspots, allowing you to take corrective action and maintain product quality(figure 1).**

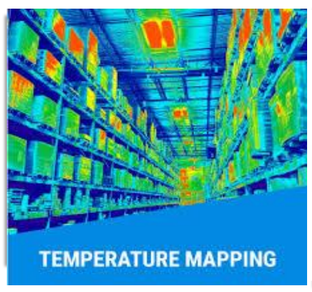



**Figure 1**

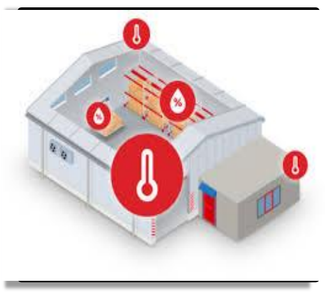


**Figure 2**

**As the types of food become more diverse, it has become important to keep food and maintain freshness. One of the ways to keep food from spoiling is to keep the temperature in the right condition (figure 2).**

**In addition, problems can be prevented by checking the temperature and finding, recording and showing the error.**

## PROPOSED SOLUTION

A solution for this problem is a device that monitors the temperature of an area and its position relative to the devices position. Using an existing IR thermometer from the educational robot BetterBots, a device can proof this concept. By using the Betterbots Differential amplifier and improving its parameters, our team can create a device that captures temperature data from a thermopile, amplify the small input, and display the information to an LCD. Getting multiple data points would involve rotating the thermopile to read in degree increments. The device should have a subsystem that also self calibrates as an initiation step.

## FUTURE DIRECTION

- In the future, the current sink resistor values could be tuned to meet this limitation rather than account ahead of it
- Adding multiple thermopiles in different directions to remove the stepper motor all together.
- a system for setting boundary temperatures could be included in future design iterations, notifying user when outside boundaries.

## SYSTEM DESIGN

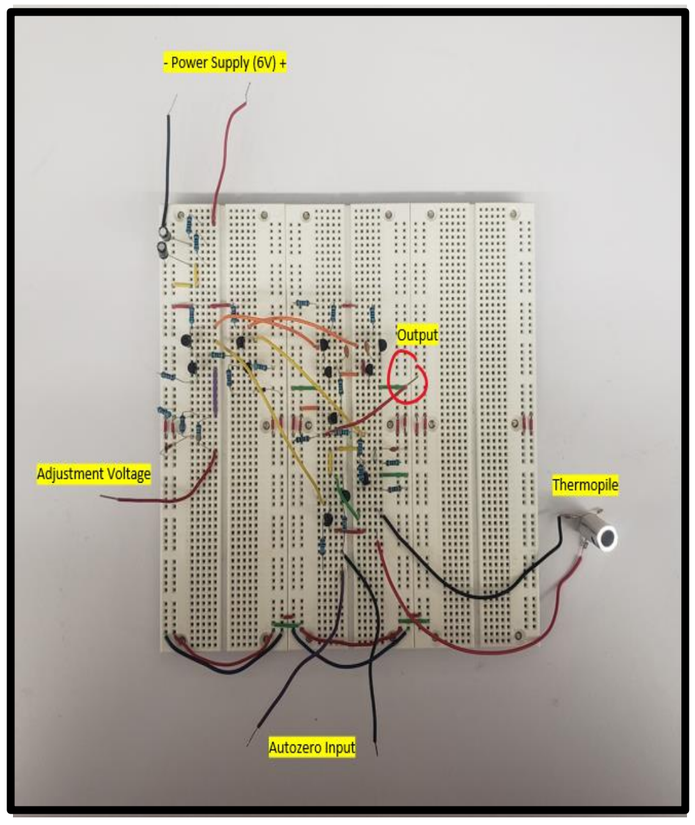



**Figure 3**

### Compensation Capacitance

Compensation Capacitance is a capacitance that is added to an amplifier circuit to improve its stability and performance.
To improve this, we should change our settling time which is the amount of time it takes for the system to transition from the thermopile input to common mode. Originally, this capacitance value was 220pF. As this value decreases, settling time improves, figure below shows a comparison of 220pF and 1pF(Figure 4). Red line represent 1pF and cyan line represent 220pF.

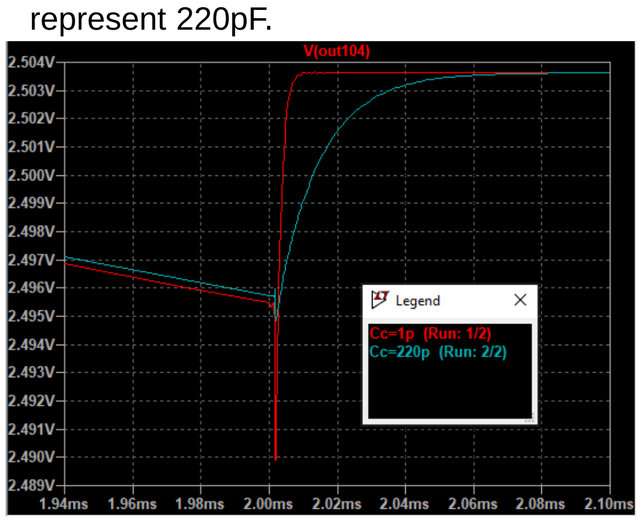



**Figure 4**

### Auto Zero

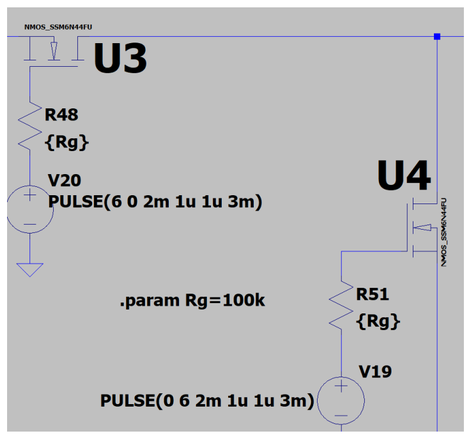



**Figure 5**

When U3 is active and U4 is inactive, output is reading thermopile.

When U4 is active and U3 is inactive, output is reading common mode of differential amplifier.

In this second mode, we try to drive output to reference voltage (1.8V on breadboard) to eliminate offset voltage with adjustment voltage.

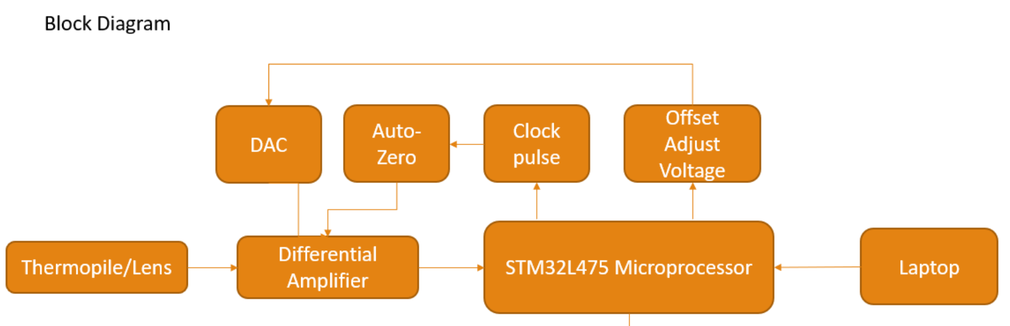
### Adjustment Voltage

Adjustment voltage is applied to a current sink of differential amplifier. Applying voltage can drive the offset of the transistors to zero, increasing accuracy of measurements.

A limitation of the design is its adjustment voltage range. The original circuit could only compensate for an offset of around -9mV to 9mV.

An improvement of adjustment range was achieved to now account for -21.5mV to 20mV.

### Microcontroller




The STM32L475 microcontroller is used to record and display the data. This is also how the device will actuate or rotate to capture multiple data points. It will also perform calibration steps like calculating and outputting an adjustment voltage and activating the auto-zero.

### LCD

To display temperature on an LCD screen, a temperature sensor is usually used to measure the temperature and send the data to a microcontroller or microprocessor. The microcontroller then converts the temperature reading into a digital format and sends it to the LCD screen for display.

### Step motor

A stepper motor is used to change the angle of the thermopile to record temperature at different angles, achieving measurements of the device's surroundings.

### Calibration

To achieve accurate measurements, the device needs to be calibrated before the device starts its captures. This can be done by activating the auto-zero, reading the output and sweeping the adjustments voltage till the output is reading reference voltage.

## REFERENCES


BetterBots: https://www.betterbots.com/
Easy EDA: https://easyeda.com
LTspice: https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html/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