

# Practical #02

## Controlling physical objects

### Aims:

- Assignment
- Controlling real LEDs based on body temperature values.

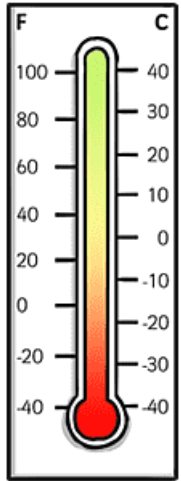
## Assignment

**Objective:** To turn on an LED when measured temperature ( $T$ ) is greater than a user defined temperature ( $T1$ ) and turn on another LED of a different color when the measured temperature ( $T$ ) is less than a user defined temperature ( $T2$ ).



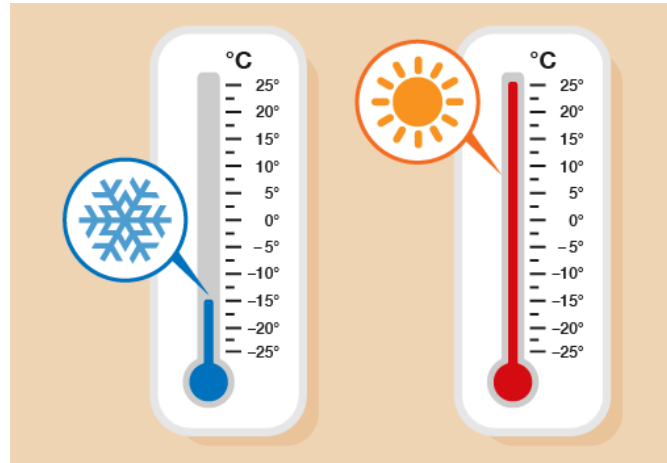
# Operations in instrumentation:

## Measure



Measure temperature

## Analyze



Is it cold?

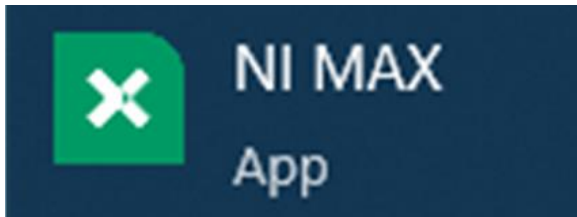
## Control



Turn on the radiator

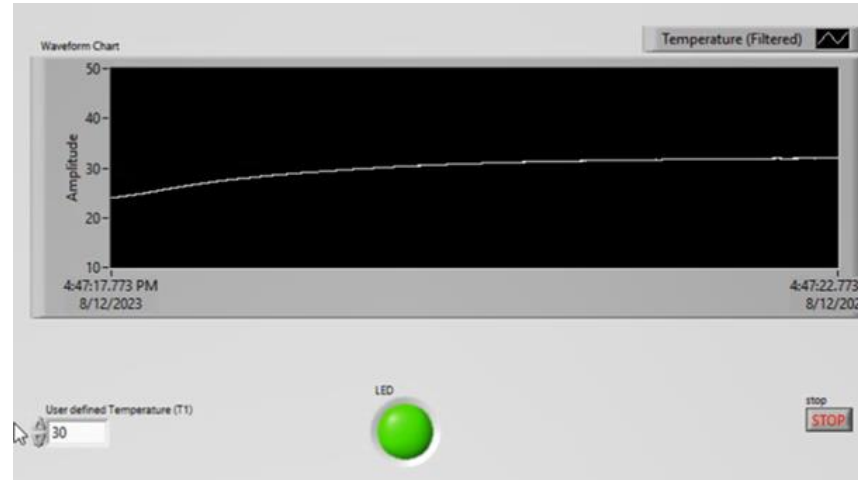
# Operations in instrumentation:

## Measure



We measured temperature Using a Thermistor, NI-DAQ (USB 2009) and NI-MAX application.

## Analyze



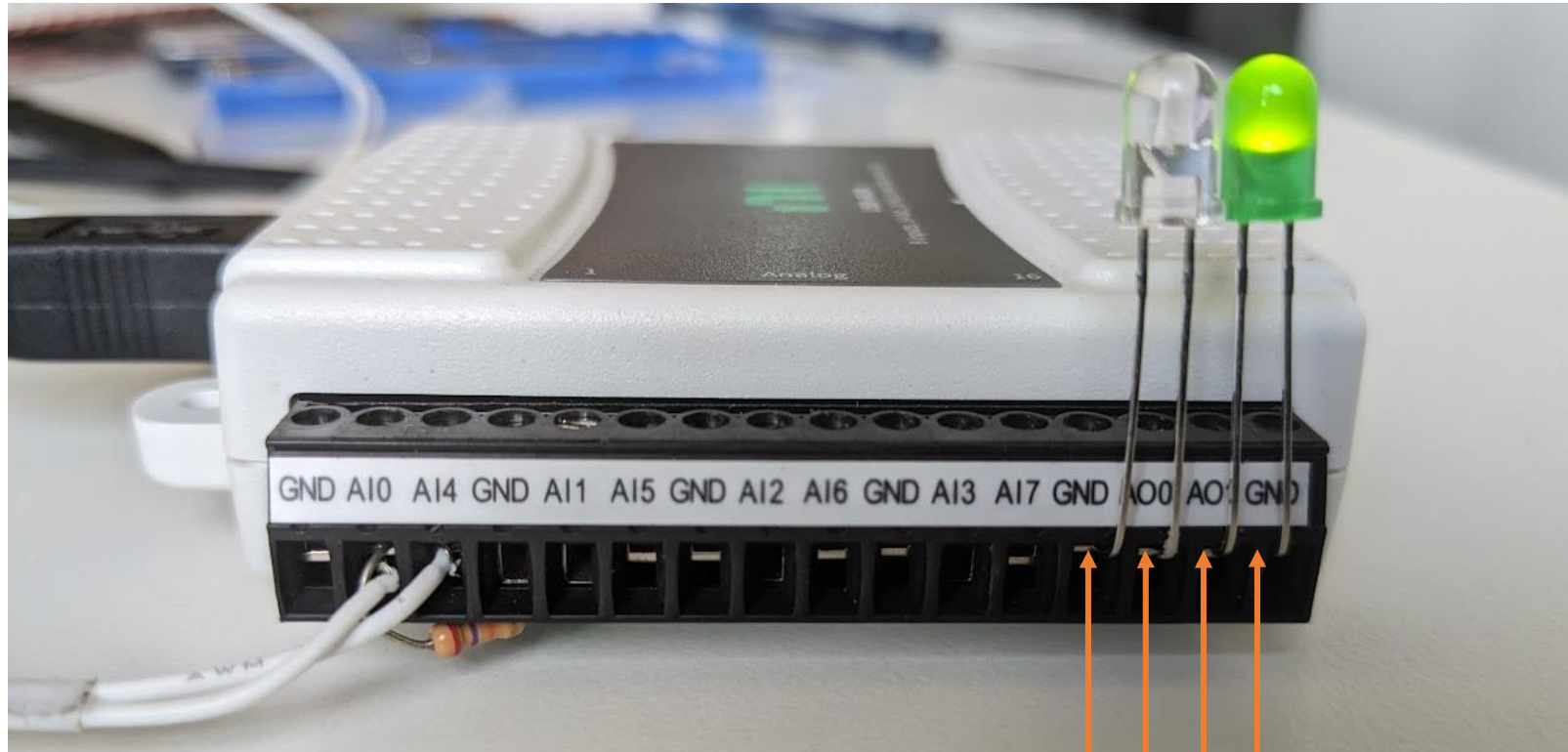
We analyzed the data obtained from thermistor via LabVIEW programming and defined a cut-off value.

## Control



We will turn on a physical LED analogues to turning on a switch to control a physical instrument

# Connecting LEDs to NI-DAQ's analog output (AO)



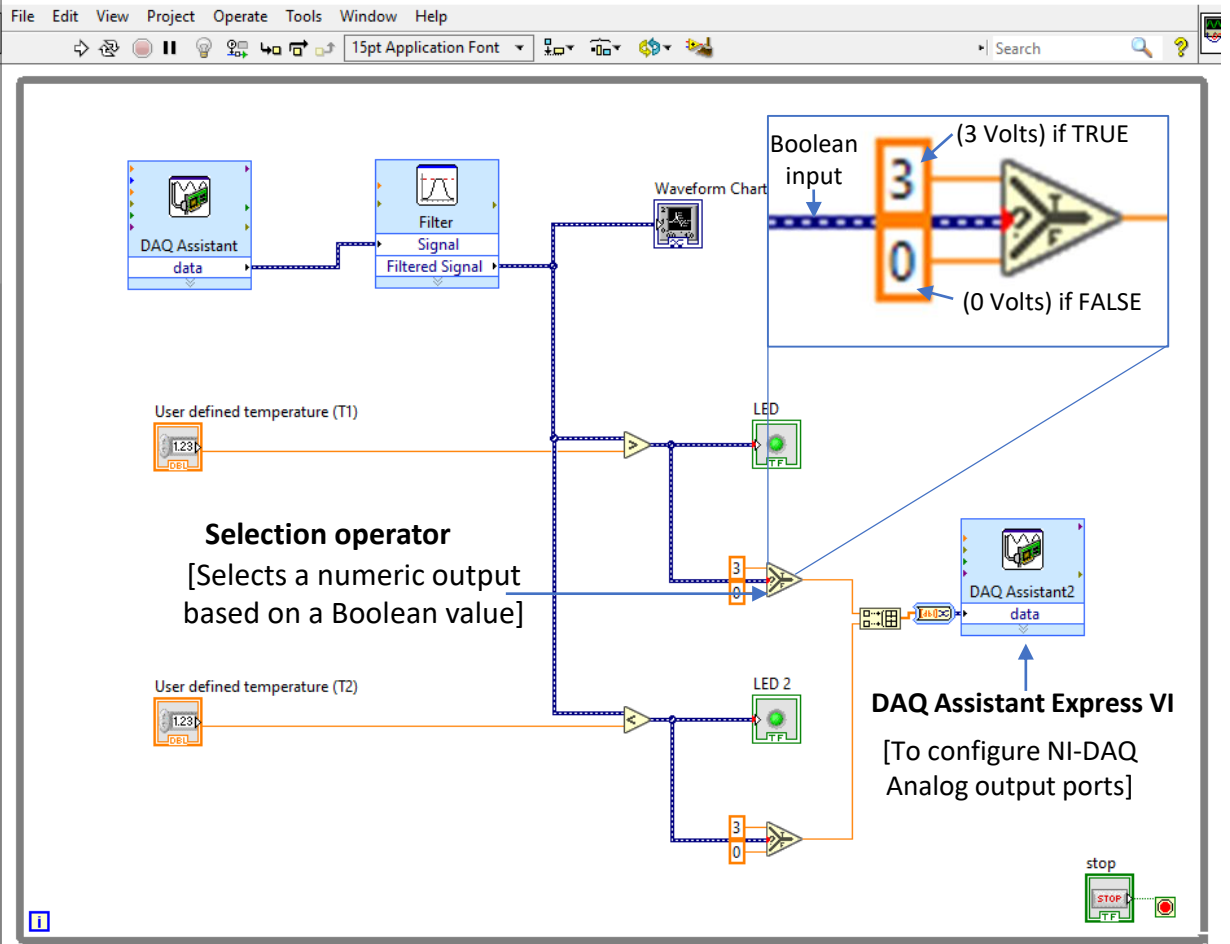
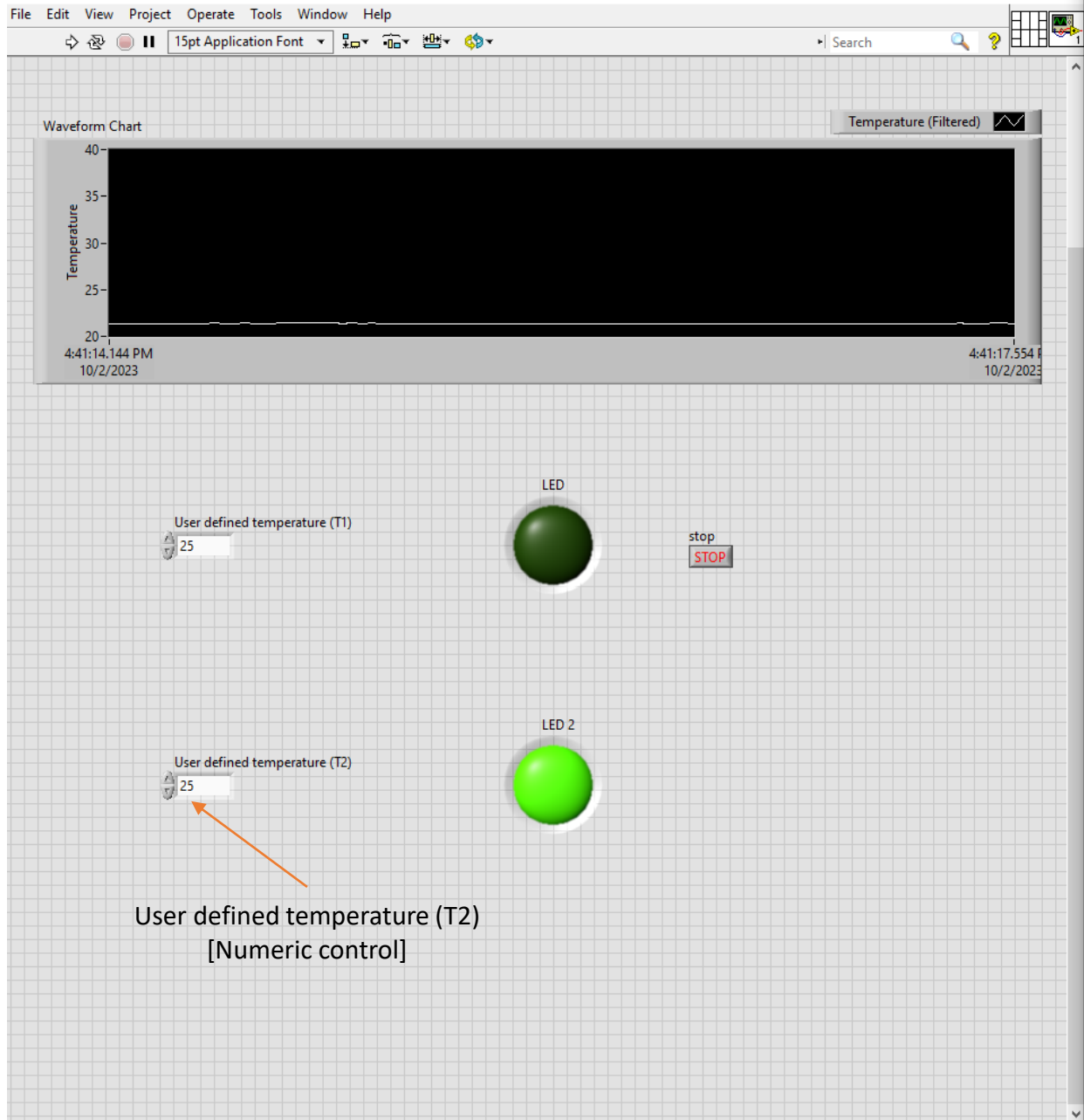
Analog Output (AO) 1 Ground

Analog Output (AO) 1

Analog Output (AO) 2

Analog Output (AO) 2 Ground

# VI to turn on real LEDs when thermistor temperature (T) > user defined Temp (T1) or < user defined Temp (T2)



T1 > T



T1 < T

\*Video in resource

## Summary:

### Property measured

- Body temperature

### Property controlled

- Voltage across an LED to turn it on when temperature exceeds user defined conditions (Thresholds)

### Tools used

- Thermistor (An electrical component whose resistance is dependent on temperature)
- NI-DAQ USB 6009 (A hardware device to acquire analog voltage singles from the thermistor and convert them to digital signals)
- Signal Filtering (Fourier transform or moving average)
- Signal Thresholding (Defining minimum and maximum values that a signal can take)

### Alternative approaches

- Similar to *generating voltage difference* across the LED when the measured temperature crossed a certain threshold, the *voltage difference across any switch can be generated to control any operation*. This instrumentation approach is widely used in life-science research equipment, for e.g. in incubation chambers (to maintain temperature, humidity, pressure etc.), PCR thermocyclers (to maintain temperature), fluorescence activated droplet sorting platforms (to generate high-voltage pulse to sort droplets of interest) etc.