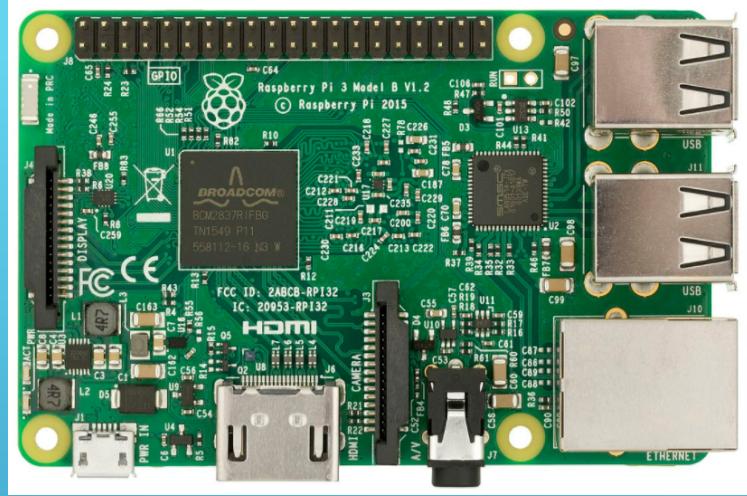


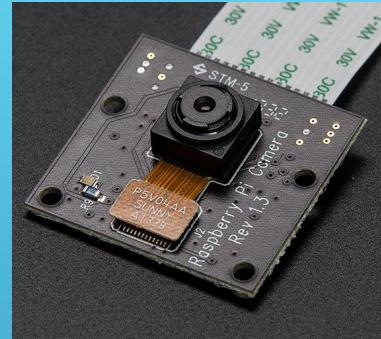
RASPBERRY PI



- ▶ Credit-card sized computer with 1.2GHz ARMv8 CPU and 1GB RAM
- ▶ Linux Operating System or custom Windows 10
- ▶ Open Source Software and large development community
- ▶ 4 USB ports, Camera Interface(CSI), HDMI port, Ethernet port, 40 GPIO pins(3v3 Digital)
- ▶ Python and C/C++ are recommended programming language

PORABLE SENSING DEVICE

- ▶ Project I: Near-Infrared Detector
 - ▶ Pi NoIR Camera (without infrared filter) ⇔ Camera Interface
- ▶ Project II: Gas Sensing Monitor
 - ▶ Up to 4 Gas sensors: MQ-7, MQ-131, MQ-135, TGS-2600 (All are 5V Analog Output) ⇔ GPIO pins
 - ▶ 5V-3V3 level shifter and Analog to Digital Converter chip are required.
- ▶ Project III: 2D Temperature Measurement Device
 - ▶ Seek Thermal Camera (Resolution: 206x156 thermal sensor) ⇔ USB port
 - ▶ USB webcam ⇔ USB port



PROJECT I: NEAR-INFRARED DETECTOR

Existed Problems:

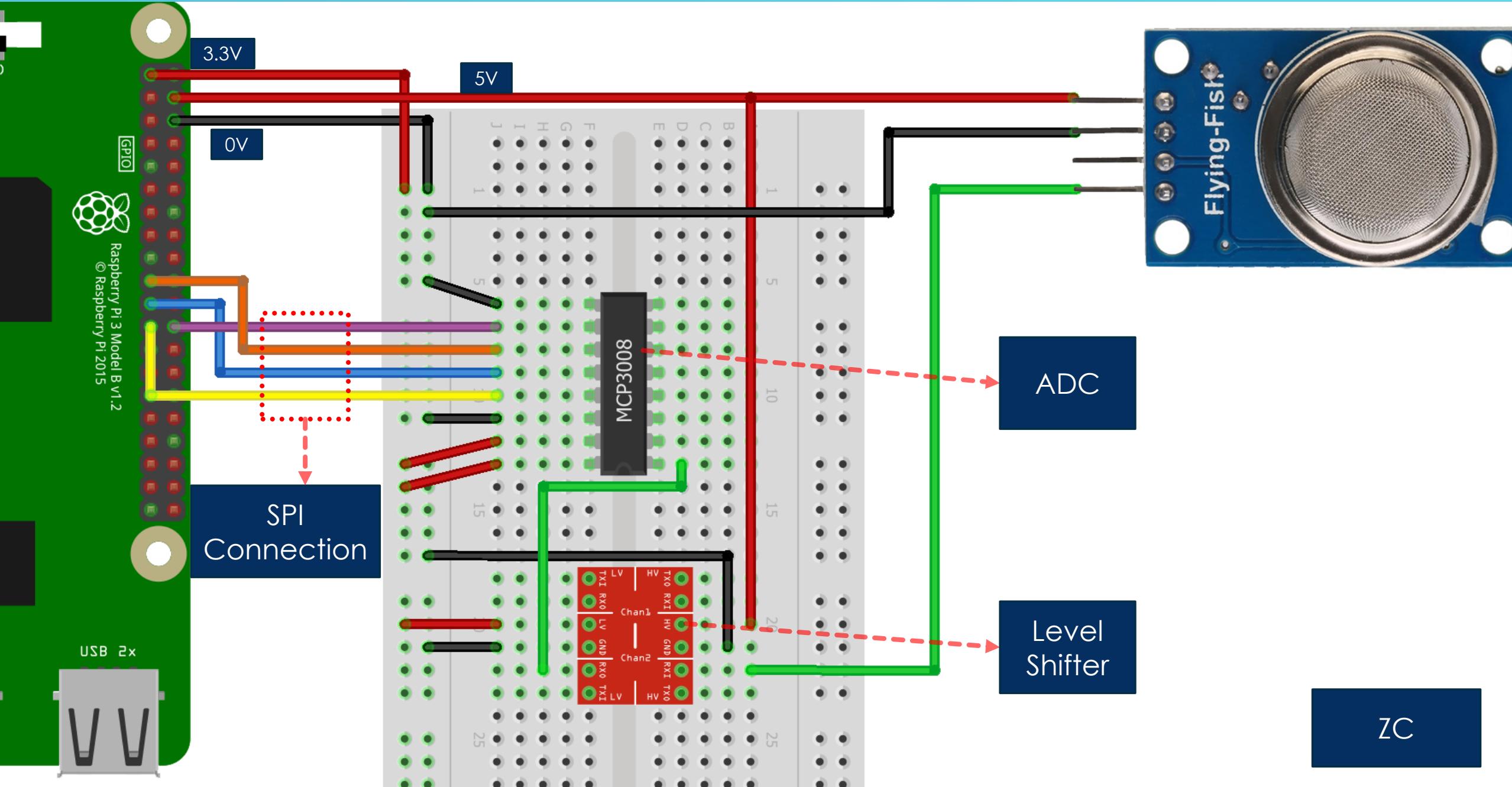
- ▶ Screen Rotation
 - ▶ Chang system configuration file to rotate screen
 - ▶ Recalibration of the PiTFT touchscreen
- ▶ Couldn't show video in full-screen
 - ▶ Frame setting and icon positon
- ▶ White Screen
 - ▶ Connection loose => **No**
 - ▶ Software crash => **No**
 - ▶ Low input current => **Yes!**

PROJECT I: NEAR-INFRARED DETECTOR

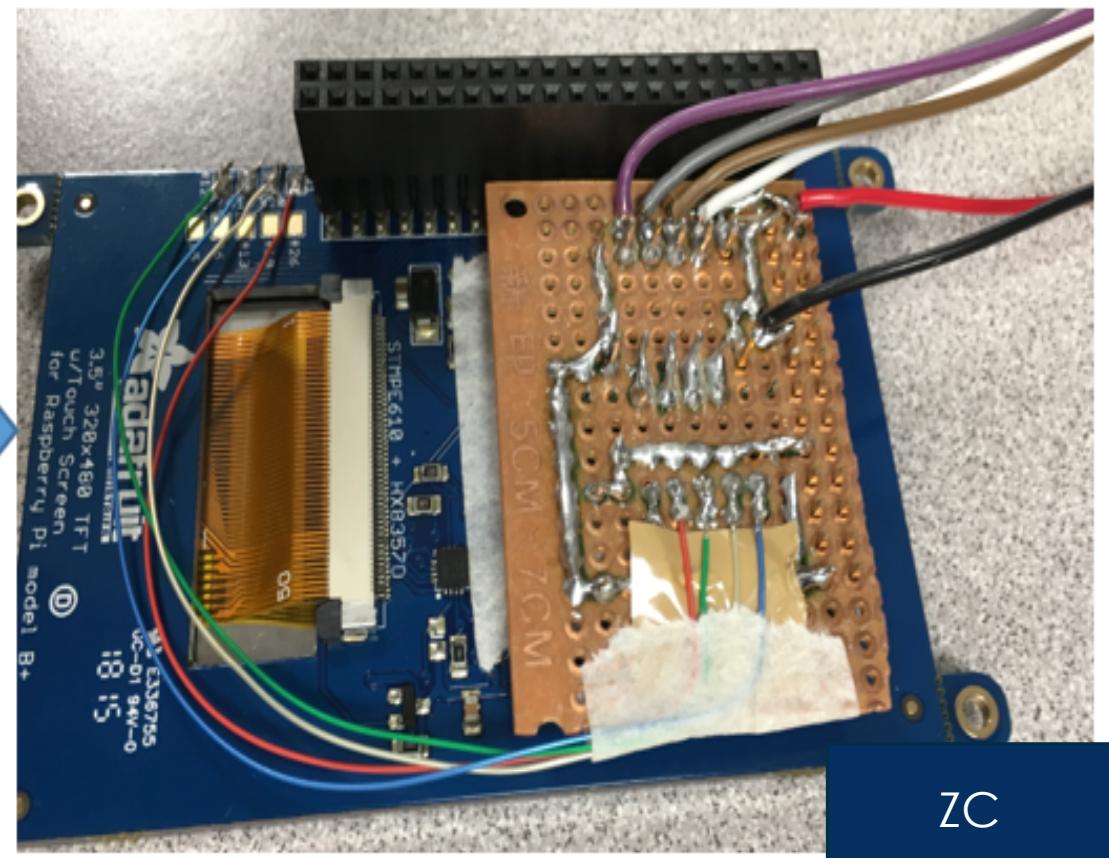
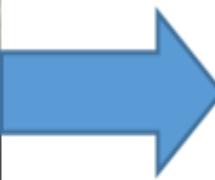
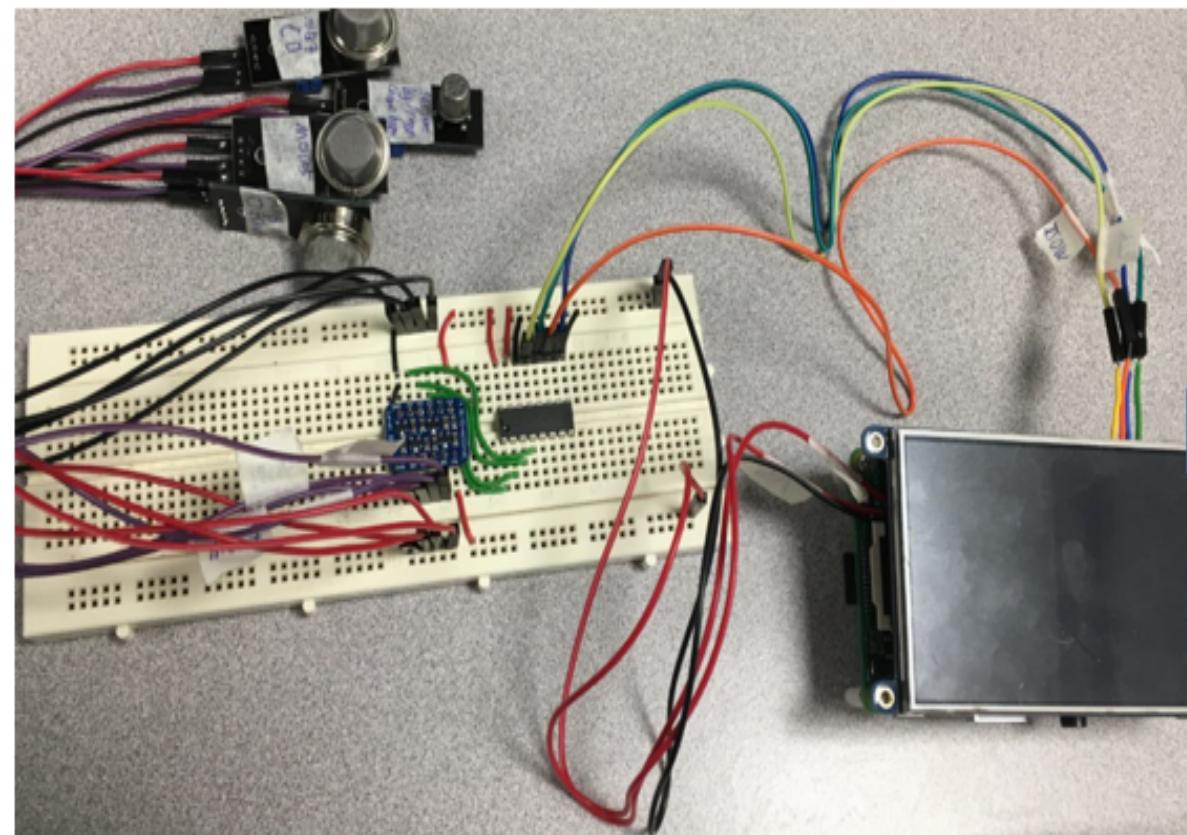


PROJECT II: GAS SENSING MONITOR

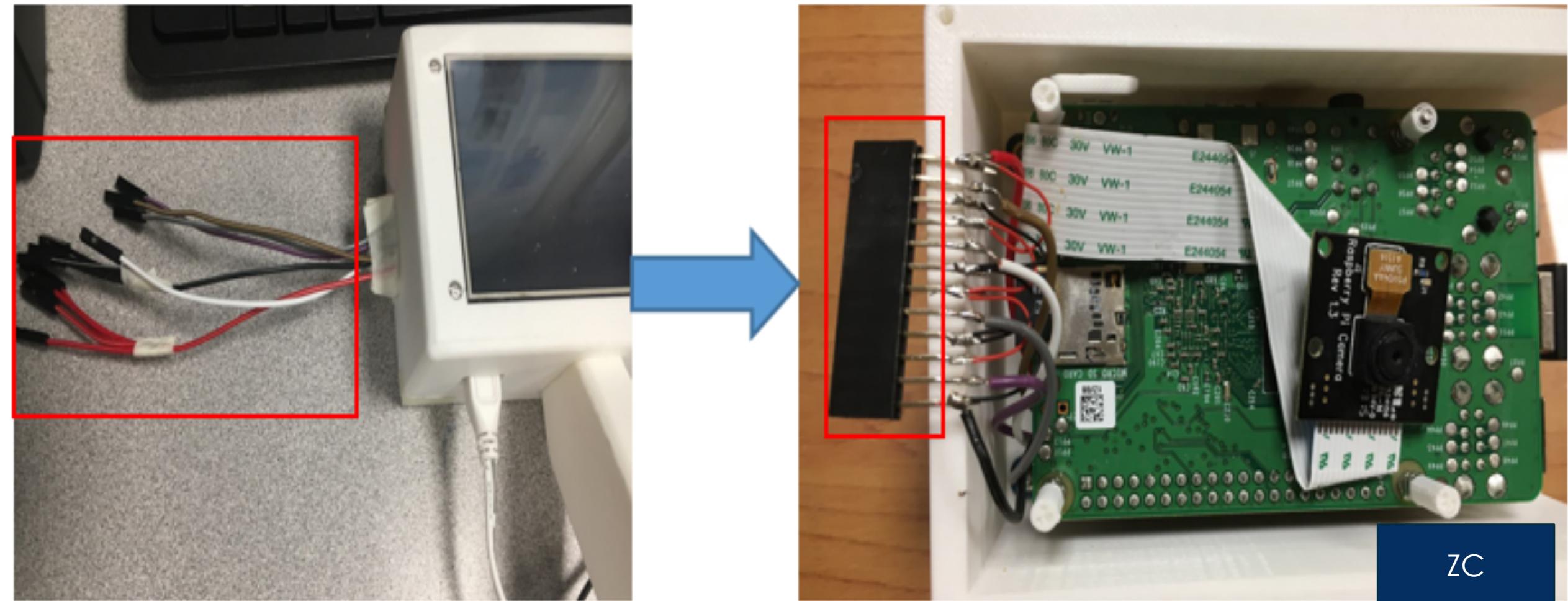
- ▶ Hardware:
 - ▶ MQ gas sensor
 - ▶ 4-channel Bi-directional Logic Level Converter – BSS138
 - ▶ 10 bit 8 channel ADC chip - MCP3008
 - ▶ Communicate with Pi by Serial Peripheral Interface(SPI), 4 pins(MOSI, MISO, CLOCK, SELECT) are needed
- ▶ Wiring Diagram



PROJECT II: GAS SENSING MONITOR



PROJECT II: GAS SENSING MONITOR

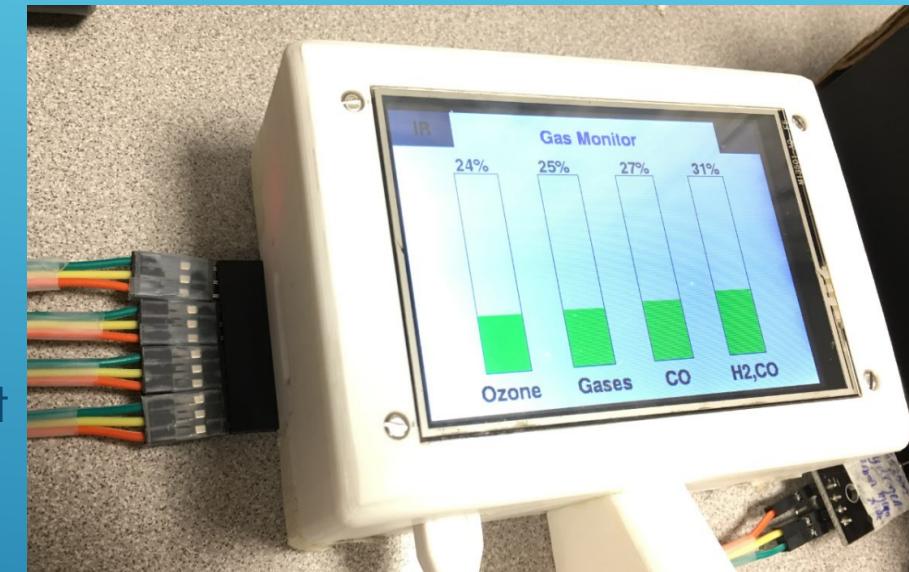


ZC

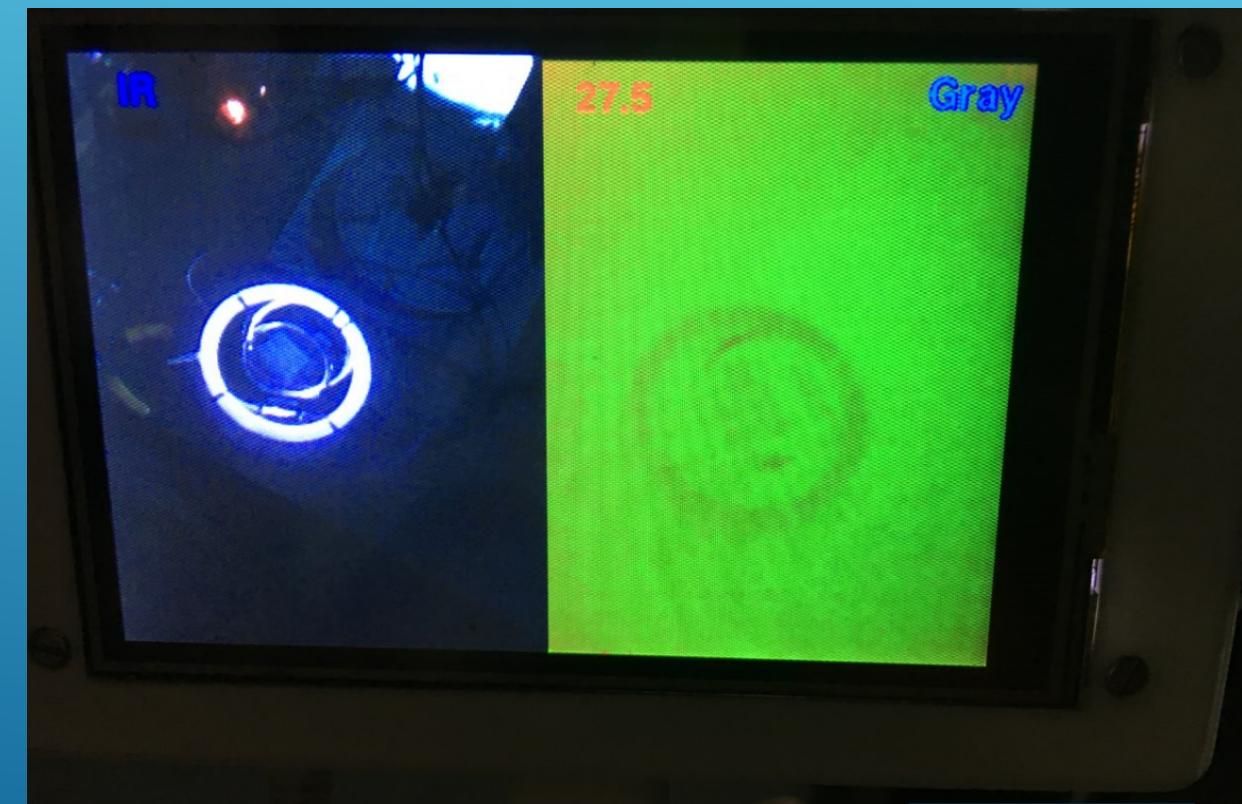
PROJECT II: GAS SENSING MONITOR

Software:

- ▶ How to read sensor value?
 - ▶ Install Python GPIO library and SPI development packet
 - ▶ One line code can read sensor value, fast response
 - ▶ Value = MCP3008(port 1)
- ▶ UI: gas bar's height changes with air condition.
 - ▶ Using GUI library pygame



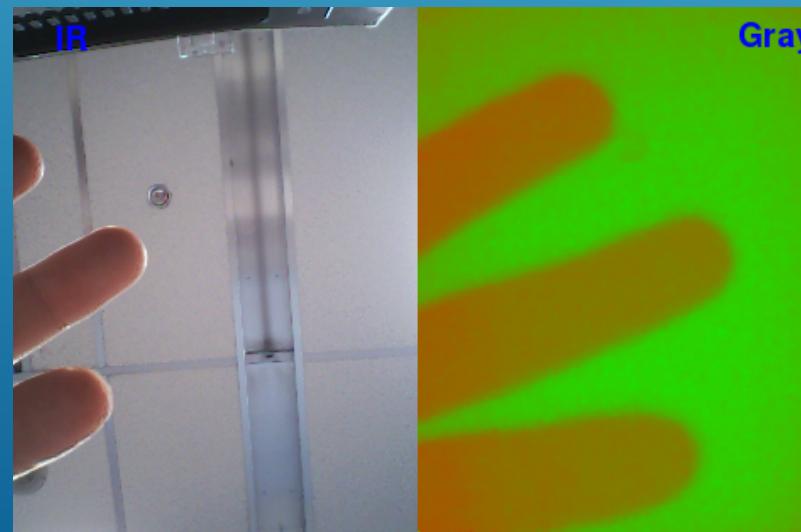
PROJECT III: 2D TEMPERATURE MEASUREMENT



PROJECT III: 2D TEMPERATURE MEASUREMENT

Software:

- ▶ Frame of normal webcam read by OpenCV2 Python library
- ▶ Get raw data of thermal camera by pyusb library => construct to an image (with some dead pixels) => median filter to minimize error of dead pixels => get grayscale image => colorscale image to get color image



PROJECT III: 2D TEMPERATURE MEASUREMENT

Temperature Estimation:

- ▶ No official document => can not get accurate temperature result
- ▶ Real temperature **vs.** pixel value of thermal cam raw data => linear

