KENNESAW STATE UNIVERSITY

CPE 4040: Data Collection and Analysis, Spring 2023

Laboratory Report #5
Lab 5: Ultrasonic Sensor Application with Node-RED

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I. Objective

In this lab we had to interface with the SR-04 Ultrasonic Sensor. Also, we had to learn how to run and use the NODE-RED tool on the Raspberry Pi to interface with the sensor.

II. Material List

1. Raspberry Pi 3 or 4
2. Power supply adapter
3. Micro SD card (16+GB)
4. Ethernet cable
5. (optional) USB Keyboard, mouse and HDMI monitor or TV
6. Install Putty, Advanced IP Scanner and WinSC
7. Ultrasonic sensor (SR-04)
8. LED and resistors

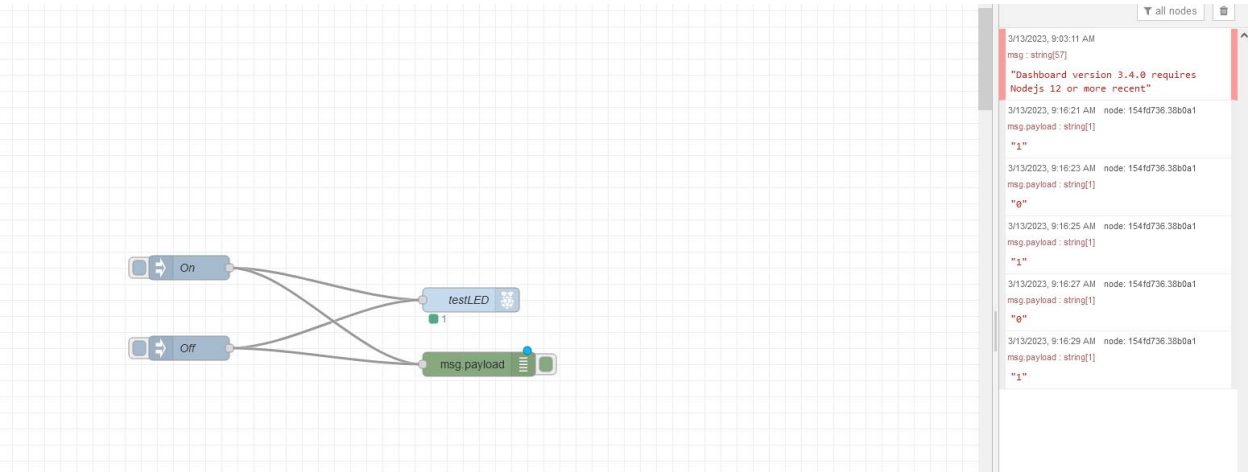
III. Lab Procedures and Results

1) After booting up and updating the packages to your raspberry PI, we need to get the package node-RED package by inputting the command "**sudo apt-get install nodered**" after this we must start the Node-RED by typing "**node-red-start**"
2) Next open a web browser and input the following address to bring up a Node-RED development environment in the browser.

   http://your RPi's IP address:1880 (ex. http://10.100.125.75:1880)

3) After accessing the menu for Node-Red, go to "**Manage Pallette"** to allow you to modify the nodes on the left of the screen, and install *Node-RED-node-pisrf* and *Node-RED-dashboard.*
4) On the board to test the nodes, connect a green LED with a 330Ω resistor into GPIO16 (PIN36) on the Pi and connect ground.
5) In the node palette, you will now need to scroll down to find the ***rpi –gpio*** in and ***rpi –gpio*** out nodes. The first node on the list is for the input, to identify it has a raspberry icon on the left. The second node that has the raspberry icon to the right is used for output. Move an output node to the working area in the middle.
6) Then start by double clicking on the output node to open a configuration box. We will change the GPIO pin to GPIO16 and then click Initialize pin state. The pin state will need to be set to low. After this, assign a name to the node and then click "done" when finished.

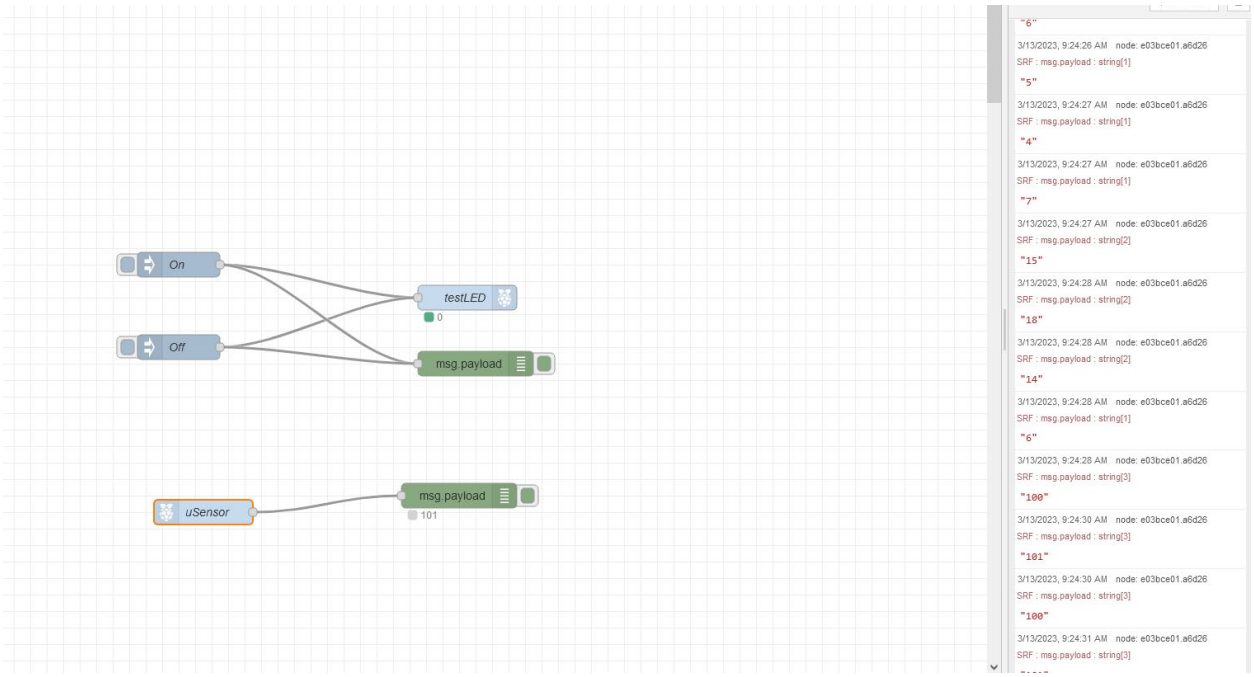
7) We will need an input node to turn the LED off and on. Luckily, with the use of Node-RED we can inject messages into the flow which will cause things to happen as a result. Move an inject node into the flow, double click on the inject node and then use the drop-down menu next to the Payload to change the data type to “string” and then type “1’ in the payload box. After that, type “On” in the name box then “Done”. Repeat this step to create another inject node but this time type “0” as the payload message and name it “off”.



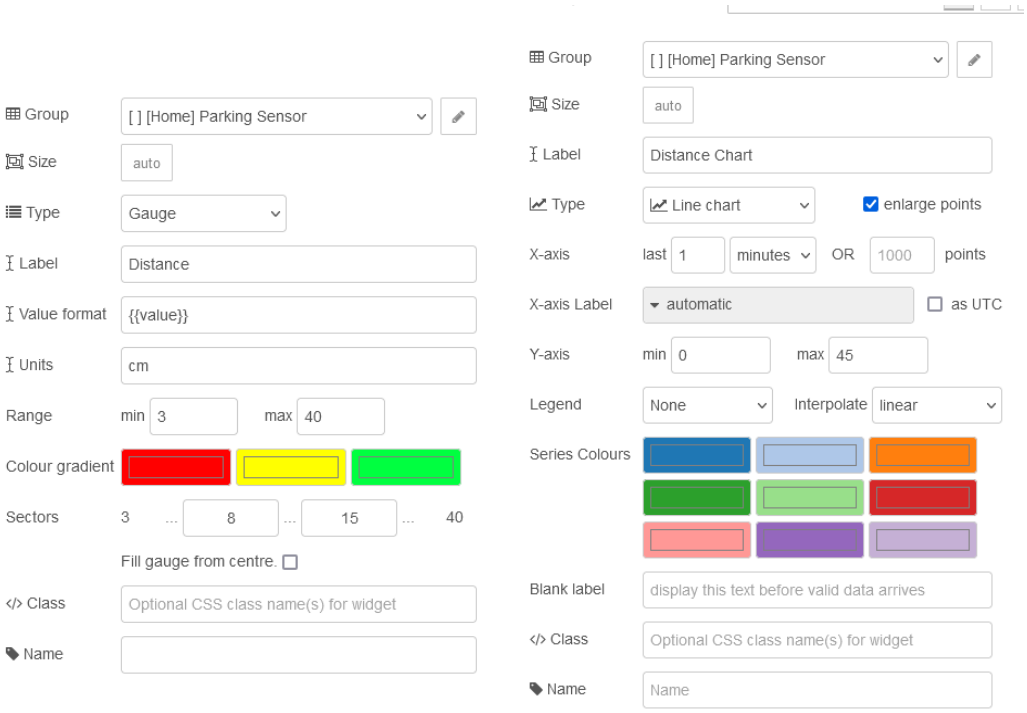
8) Click and drag the grey dot on the right side of the one and off node to the *testLED.* It should look like the photo below. Afterward, click “Deploy” in the upper right-hand corner. A message should pop up and say, “Successfully Deployed”. When testing, click the square on the right side of the On and Off nodes to send “1” from the On node or “0” for the off node to control the LED as shown in the video:
    - https://www.youtube.com/watch?v=W9-Crr8X57s&ab_channel=PhozyVault

9) After testing the LED, to see what the nodes are sending we must put in a debug node to the workspace. On the left side of the screen, at the top of the node selection click and drag debug onto the workspace. Just like Step 8 connect the debug node to the On and Off nodes to broadcast the numbers being sent to GPIO16.
10) We now need to insert the Ultrasonic Sensor into the bread board. Start by connecting the 5V and GND to the RPi connector. Then connect the Trigger input to GPIO23 (pin 16) and finally Echo needs to be connected to GPIO24 (pin 18)
11) After connecting to the RPi connector, scroll down the node palette menu and drag the ***rpi srf*** node and a debug node into the flow area. Then connect the nodes together.

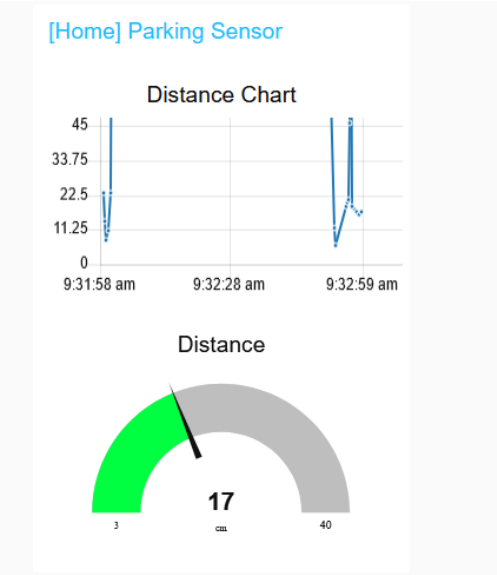
12) You then need to double click on the ***rpi srf*** node to open its configuration settings. We will set pins to “16,18” which correspond to GPIO 23 and 24. After this, open the debug node configuration settings and then check the debug window as well as node status options. This will show the last message that was sent.
13) To wrap up the first section, deploy the flow and you will now start to see numbers appearing below the debug node. These numbers are distance measurements in centimeters. You can change the frequency of these measurements inside of the ***rpi srf*** node. Finally, you can see also see the entire measurement history by looking in the debug tab.



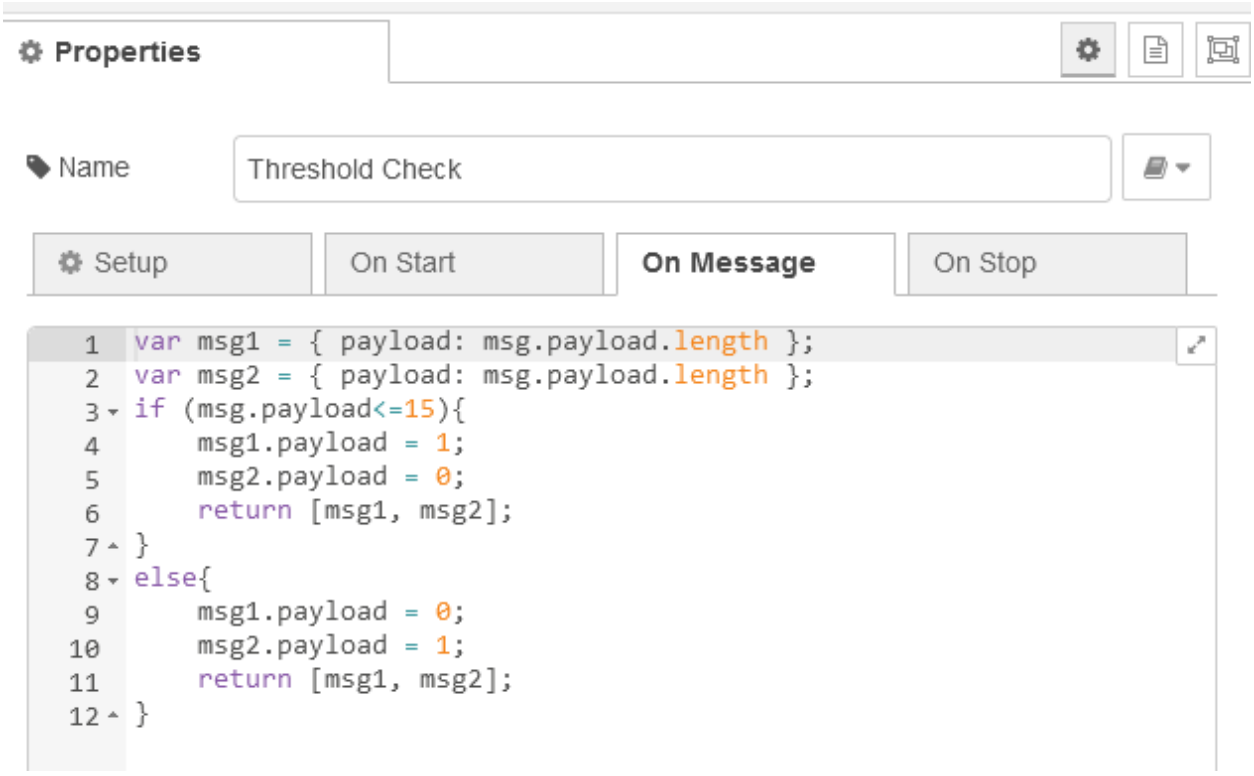
14) For the second section, scroll down to the “*dashboard*” of the nodes on the left side and insert a gague node and a chart node. Double click the nodes and make edits in the boxes the photos below:



15) Once done editing open a new window with the address http://yourRPi'sIPaddress:1880/ui. You will see two different graphs on the screen showing the distance of the ultrasonic sensor. One will be charting the distances captured, and the other will be displayed as a gauge.

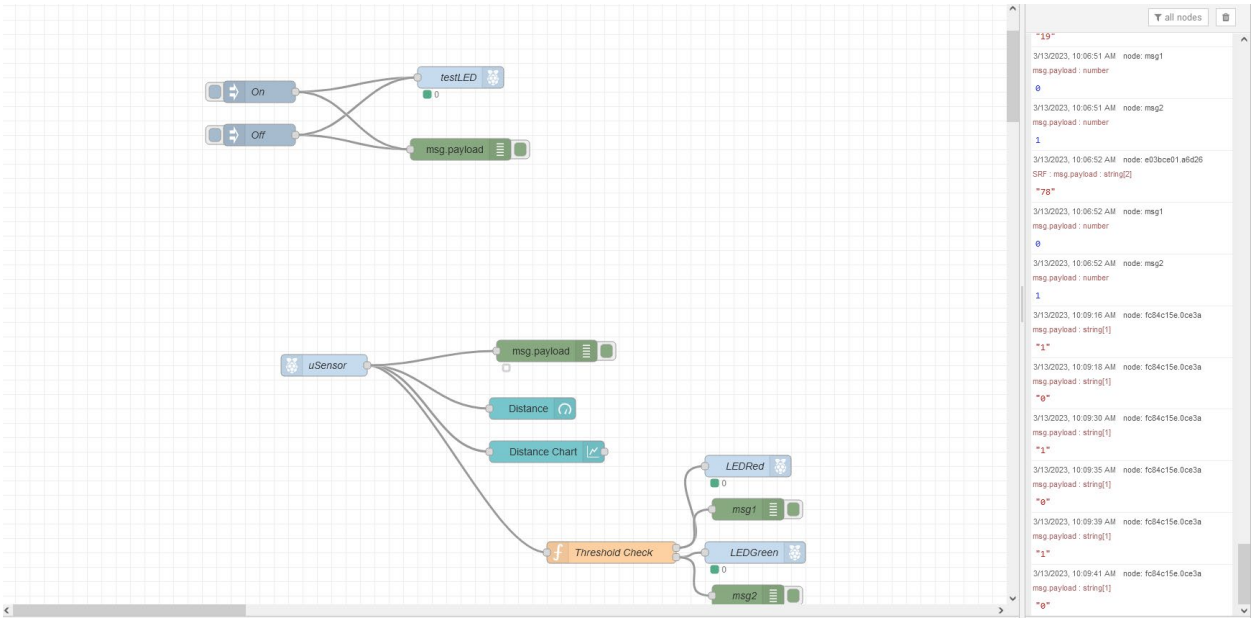


16) Afterward, add a function node to the workspace and connect them all to the uSensor node as shown in the photo. Once connected, double click on the function node and insert the code under the "**Message"** tab. Also, change the number of outputs within the node to two and connect them *LedRed* and *LedGreen* nodes to be outputted along with their respective debug nodes.



17) For the final step, Enter the settings of GPIO nodes and change the names to LEDRed and LEDGreen with pin settings of GPIO16 and GPIO21. You then need to edit the debug nodes to change their names to msg1 and msg2. The code that we enter in the function node will be used to read distance value at the input and turn on the green LED if the value of is greater than 15 cm. If it is less than 15 cm, then the red LED will turn on like shown in the video:

- https://www.youtube.com/watch?v=sGWhKcbOkbI&ab_channel=PhozyVault



IV. Conclusion

In conclusion, the lab overall was not that hard to complete. Honestly, it reminds me of the development tool called Scratch given the nodes and dragging things on the screen to work. NODE-RED was a very nice throwback to that, and we hope we can use it more in the future to interface with more sensors. As far as interfacing with the sensors, there was no real challenge, and it shows another way to use the sensor in a different form than what we learned in Sensors and Actuators having a similar lab to this, except it was all code and none of the nodes.