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| C:\Users\user\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\D05AF64.tmp | Fall term 2018  IoT Project |

Documentation

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# **1 Task**

For this project, we were task to gather data from a sensor(s) using a Raspberry Pi and store it in a local database. The same data is also supposed to be send to a cloud. Other considerations for the project would be adding features like security and data retention. For this project we decided to focus on the temperature sensor.

# **2 Set Up**

## 2.1 Controlling the Raspberry Pi

In order to work with the Raspberry Pi (RP), we used a VNC Server to remote control it from our own computers. We set up VNC Server on the RP and VNC Viewer on our own laptops. An HDMI cable was plugged into the RP to a monitor. We established a direct connection from our devices by discovering our RP’s private IP address and entering it into the VNC Viewer.

Each member could then connect to and remote control the Raspberry Pi using VNC Viewer. This allowed us to work on the project efficiently.

## 2.2 Sensor and RedBoard

First, we set up the temperature sensor on the breadboard.

A screenshot of a cell phone

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Figure Pin outs of the temperature sensor

(Source: https://learn.sparkfun.com/tutorials/activity-guide-for-sparkfun-tinker-kit/circuit-9-temperature-sensor)

We hooked up the sensor on the breadboard and connected it to the RedBoard as shown on the SparkFun Tinker Kit guide. Using jumper wires, we connected the Signal leg to Analog Pin 0, GND leg to GND on the RedBoard, and +V to 5V.

A circuit board

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Figure Circuit diagram

(Source: https://learn.sparkfun.com/tutorials/activity-guide-for-sparkfun-tinker-kit/circuit-9-temperature-sensor)

A circuit board

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Figure Final set up

Once that was done, we connected the RedBoard to the Raspberry Pi to start recording data.

# **3 Gathering Data**

The code to record the data is written into Arduino IDE.

The code to read and write the output was gotten from the SparkFun Tinker Kit guide. The results are given into four values: raw value of temperature, value converted into voltage, value converted into Celsius, and value converted into Fahrenheit.

In a python code, we import serial and the commands .Serial( ) and .readline( ) to get the current data.

import serial

ser = serial.Serial('/dev/ttyUSB0',9600)

read\_serial = ser.readline()

print read\_serial

A screenshot of a computer screen

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Figure The Python code and the printed results

In the current implementation, the RP will record data continuously until told to stop.

# **4 Storing Data**

To store data locally, we open a file called “tempdata.log” or create one if the file does not exist yet. We then write onto the log using the string read\_serial from above. We also imported datetime in order to tell the reading aparts by knowing when each reading was taken.

import time

import datetime

logfile = open('tempdata.log', 'a+')

~ ~ ~

timeCap = str (datetime.datetime.now())

read\_serial = timeCap + ": " + ser.readline()

logfile.write(read\_serial)

Like with the collection of data, the log will continuously be updated with each new reading until the program is told to stop.

# **5 Sending to Cloud**

In order to send the collected data to the cloud, we register the Raspberry Pi to Azure. In the IoT hub navigation menu on Azure, we register the device by adding a new device and gave it an ID. We then ran the temperature application by using:

sudo node index.js '<YOUR AZURE IOT HUB DEVICE CONNECTION STRING>'

where the string was the Hub’s hostname, the Device ID, and the Share Access Key.

From the Cloud shell, we could then start and view the program on the shell by using the following command:

az iot hub monitor-events --device-id Group08 --hub-name iotprojecthub

A screenshot of a computer

Description automatically generated

Figure Data is stored in the tempdata.log and send to the cloud

For testing purposes, we created our own IoT hub, like described above. “Group08” is the name of our device and “iotprojecthub” is the name of our Azure Cloud Hub. For the assignment we will use the given connection string.

# **6 Main Code**

The program starts by initializing a client with the host, device ID, and share access keys as a single string and the protocol. It then enters a loop where it will start recording data from the serial port and converting it to a string that can be sent to the cloud and a local file. Here is what our main looks like:

|  |
| --- |
|  |
| # IoT Project Group08 ABC | |
|  |  | |
|  | from iothub\_client import IoTHubClient, IoTHubTransportProvider, IoTHubMessage | |
|  | import time | |
|  | import serial | |
|  | import sys | |
|  | import datetime | |
|  |  | |
|  | CONNECTION\_STRING = "HostName=iotprojecthub.azure-devices.net;DeviceId=Group08;SharedAccessKey=cVe0Z/aRyhebmdXIlKzuSaBR9YlNui+hprfaIYsI35A=" | |
|  | PROTOCOL = IoTHubTransportProvider.MQTT | |
|  | ser = serial.Serial('/dev/ttyUSB0',9600) | |
|  | logfile = open('tempdata.log', 'a+') | |
|  |  | |
|  |  | |
|  | def send\_confirmation\_callback(message, result, user\_context): | |
|  | print("Confirmation received for message with result = %s" % (result)) | |
|  |  | |
|  |  | |
|  | if \_\_name\_\_ == '\_\_main\_\_': | |
|  | client = IoTHubClient(CONNECTION\_STRING, PROTOCOL) | |
|  | print("Message transmitted to IoT Hub") | |
|  |  | |
|  | while True: | |
|  | # Capture timestamp | |
|  | timeCap = str (datetime.datetime.now()) | |
|  | # Read data from serial port | |
|  | read\_serial = timeCap + ": " + ser.readline() | |
|  | # Convert into IoTHubMessage and send to Hub | |
|  | message = IoTHubMessage(read\_serial) | |
|  | client.send\_event\_async(message, send\_confirmation\_callback, None) | |
|  | # Log message | |
|  | logfile.write(read\_serial) | |
|  | time.sleep(1) | |
|  |  | |