Title: Using MATLAB to control Analog Discovery.  
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### Abstract

Since the online learning coming to be major role in 2020 which will disconnect the student from the real lab environment. So, this research is making to help student participate on IoT lab experiment with little to no effort circuit knowledge requirement.

### Background

Thing Speak is a cloud database platform that easy send and get data with real time and a medium to connected by many devices.

Temperature Sensor which is a device that monitor the temperature of its environment and converts data to electronic data to record and monitor. There are many different types of sensor, but in this research, we using integrated circuits temperature transducer (AD-592)

### Procedure

#### Components:

* Analog Discovery part kits
* Digilent Portable analog circuit design kit
* Temperature sensor (AD-592)
* MATLAB application
* 1k Ohm resistor
* 4 Diodes 1N914

#### Circuit Schematic:

Because the temperature sensor is using DC voltage source only, if we use AC source then, we must converse back to DC with 4 diode and capacitor

Figure 1: Schematic of using temperature sensor with AC voltage source:

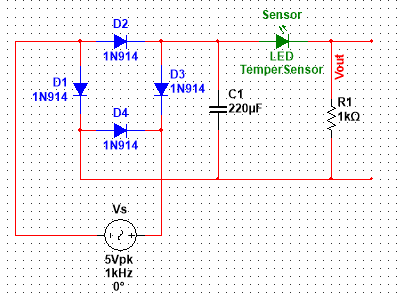
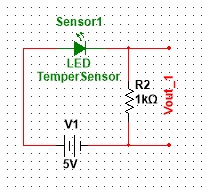


Figure 2: Schematic of using temperature sensor with DC voltage source:



#### Set up

First choosing the power source that available (AC or DC), then connected to the breadboard as schematic in figure 1 if you choice AC and figure 2 if you choice DC.

For the voltage source connect the W1 (yellow wire) and ground to any black wire in the Analog Discovery and at the Vout terminal to 1+ (orange) and 1- (orange with white) terminal.

After that, the circuit part is finish. We move to the MATLAB part. Open MATLAB application and on the top utilities bar (figure 3) and click on Add-on then get Add-on (home >> Add-on >> get Add-on). The Add-on window will pop up (figure 4).

Figure 3: utilities bar

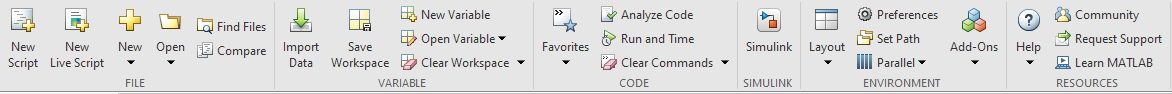
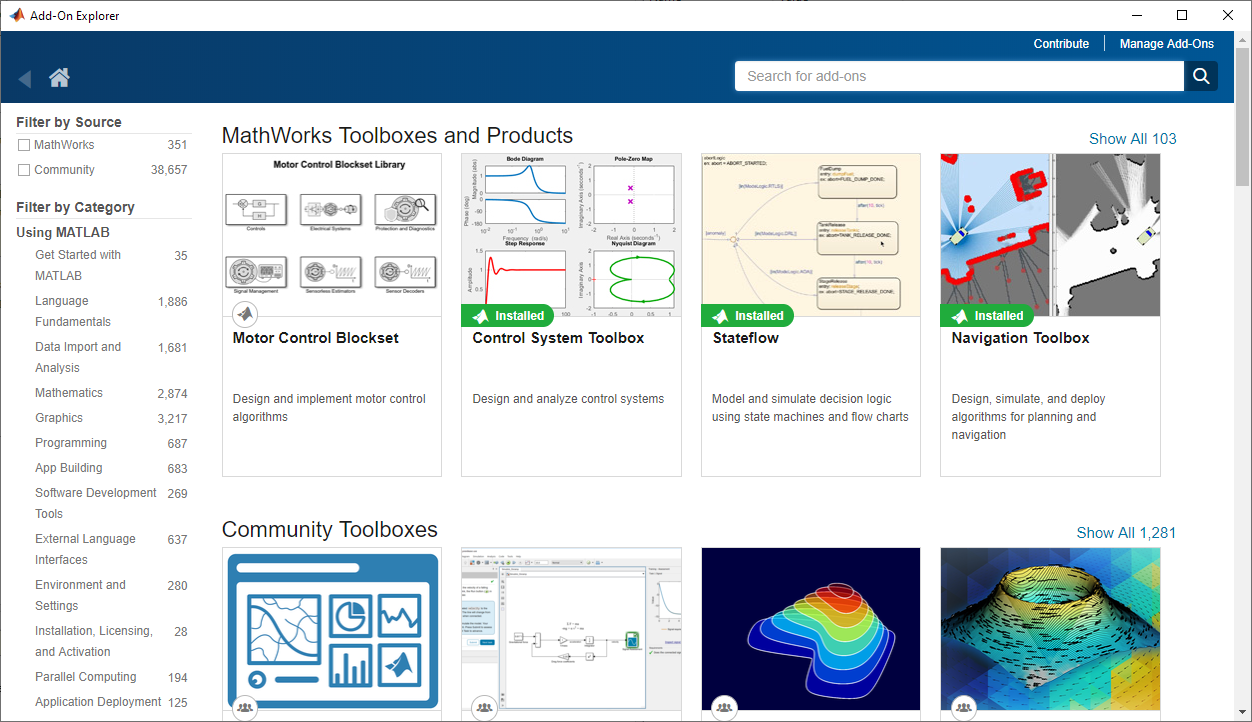


Figure 4: Add-on pop-up window



At the search box on the type in “Data Acquisition Toolbox Support Package for Digilent Analog Discovery” then download and install it.

When finish it, at the top utilities box, open the new Script. Copy the code below to connect the DIGILENT analog discovery (make sure the USB is connected).

daqlist("digilent")

dq = daq("digilent")

then set up the output and input signal to the Digilent analog discovery

addoutput(dq, "AD1", "1", "Voltage");

ch\_out = dq.Channels(1);

ch\_out(1).Name = "AD1\_1\_out";

addinput(dq, "AD1", "1", "Voltage");

ch\_in = dq.Channels(2);

ch\_in(1).Name = "AD1\_1\_in";

rate = 300e3;

dq.Rate = rate;

After that setting the output frequency and define the output frequency (Note: Since the Digilent package support is not a fully supported of data Acquisition class in MATLAB, so the output frequency needs to set by using Fourier’s Theorem to generate wave signals.)

f = 1000;

totalduration = 15;

n = totalduration \* rate;

t = (1:n)/rate;

output = 5\*cos(0\*pi\*f\*t)';

[data, startTime] = readwrite(dq, output);

\* NOTE: f is frequency; totalduration is amount of time that send signal out. the longer the duration the better result.

The code below is to read the input data and plot out to matlab figure:

plot(data.Time, data.AD1\_1\_in);

Now to next step of setting up. Now Set up Think speak data base to MATLAB.

1. Go to <https://thingspeak.com/> then create an account there.
2. Then click on new channel and create new channel.
3. In the channel just create click on API keys. Copy the API key and channel ID
4. Then back to MATLAB add-on download and install “ThinkSpeak Support ToolBox”
5. After that copy the code below to send data to ThinkSpeak.

thingSpeakWrite(IDs,temperature,'WriteKey',APIkey);

\*For the full code, please check the Appendix A.

### Results

After the data was collected from circuits, it push the data to thinkspeak.

### Discussion

There are still a huge disadvantage of Analog discover kits which is the limited of output voltage from -5V to 5V and input voltage is from -25V to 25 V. In case of using op-amp and any parts that need more than 5V then we need to make voltage booster to increase to desire voltage.

Another disadvantage of this connection of MATLAB thingspeak and analog discovery is thinkspeak only real time value.

### Appendix

%% Discovery Digilent Device

% Discover Digilent devices connected to your system using |daqlist|

daqlist("digilent")

%% Create a DataAcquisition for a Digilent Device

% Discover Digilent devices connected to your system using |daqlist|

dq = daq("digilent")

%% Add an Analog Output Channel

% Add an analog output channel using the listed Digilent device with ID

% |AD1|, channel ID |1|, and measurement type |Voltage|.

addoutput(dq, "AD1", "1", "Voltage");

ch\_out = dq.Channels(1);

ch\_out(1).Name = "AD1\_1\_out";

%% Add an Analog Input Channel

% Add an analog input channel with the same device and measurement type

% |Voltage|.

addinput(dq, "AD1", "1", "Voltage");

ch\_in = dq.Channels(2);

ch\_in(1).Name = "AD1\_1\_in";

%% Set DataAcquisition Properties and Define an Output Waveform

% Set the generation rate to 300 kHz.

rate = 300e3;

dq.Rate = rate;

% Specify a 1000 Hz sine wave for 15 second.

f = 1000;

totalduration = 15;

n = totalduration \* rate;

t = (1:n)/rate;

output = 5\*cos(0\*pi\*f\*t)';

%% Generate and Acquire Data

% Generate a sine wave with amplitude 1 V on channel 1 and amplitude 2 V on

% channel 2 and acquire timestamped data at the same rate.

[data, startTime] = readwrite(dq, output);

%% Plot Acquired Data

plot(data.Time, data.AD1\_1\_in);

xlabel('Time (s)');

ylabel('Voltage (V)');

title(['Clocked Data Triggered at: ' datestr(startTime)])

%% spend data to thingspeak

dataIn1 = data.AD1\_1\_in(10001:end,1);

dataLength = length(dataIn1);

dataMean = mean(dataIn1);

APIkey = '\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*';

IDs = \*\*\*\*\*\*;

temperature = round((dataMean \* 1000) - 273.15, 2);

thingSpeakWrite(IDs,temperature,'WriteKey',APIkey);