

Temperature, Humidity and CO2 monitor using thingspeak mqtt

Part 1 - SHT40 and CO2 sensor data to thingspeak

Codes:

Node to BLE kit - https://github.com/Goyalrahul1516/Grasp/tree/main/node_sht_co2

BLE kit to thingspeak mqtt - https://github.com/Goyalrahul1516/Grasp/tree/main/central_node

Modules

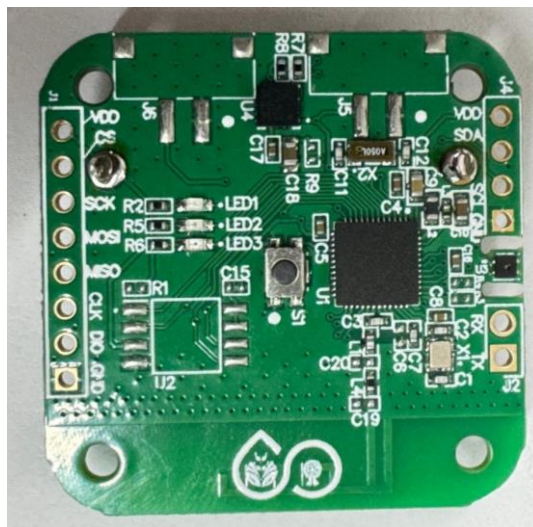


Fig: BLE Node nRF52dk_nRF52832 (SHT40 Embedded)

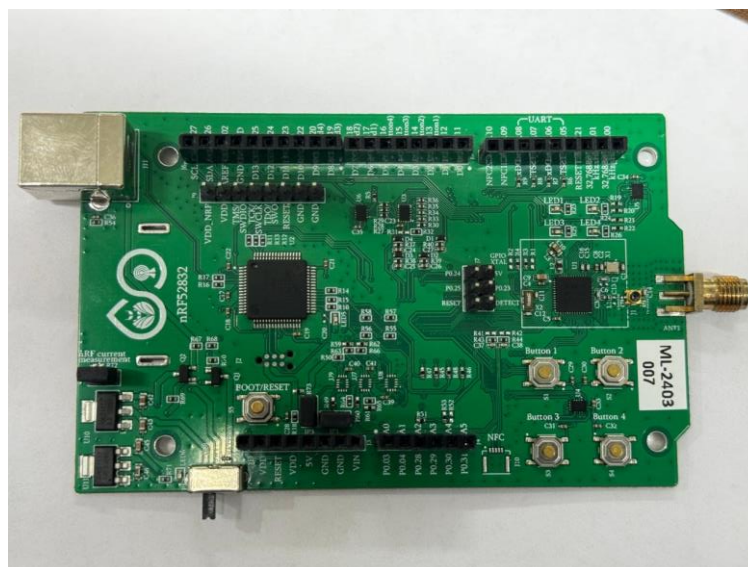


Fig: BLE Kit nRF52dk_nRF52832

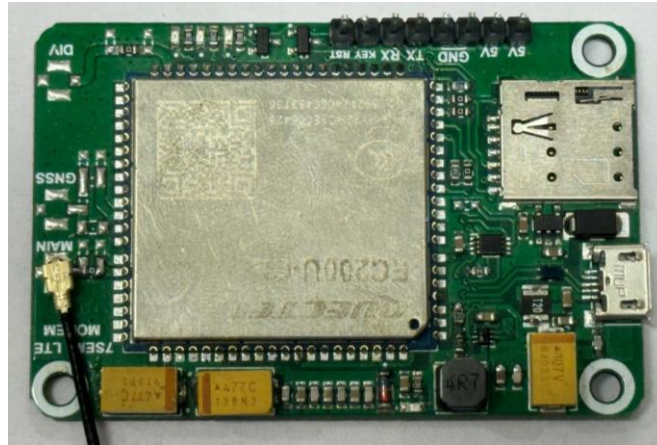


Fig: GSM Module QUECTEL EC200U-CN

Connections

1. SHT40 and co2 to node

Node	SHT40(inbuilt)
No Connections	
Node	CO2
Rx	Tx
Tx	Rx
----	Gnd (external 5v supply Gnd)
----	+5v (external supply +5v)

2. BLE kit to gsm module

Kit	GSM
P0.08	Tx
P0.06	Rx
Gnd	Gnd
----	Vdd (External power supply)

Process

- A. For BLE Node
 - a. nothing to change in main.c (though you can change the advertising interval of your node)
 - b. All configurations are done in prj.conf file
 - c. Flash the code
- B. For BLE Kit
 - a. In main.c change the credentials and channel ID to your thingspeak channel and mqtt device

- b. All configurations are done in prj.conf file
- c. Flash the code

Thingspeak mqtt publish setup in Central node Observer.c

Fill credentials in observer.c

```
"AT+QMTCFG=\"recv/mode\",0,0,1\r\n",
"AT+QMTOPEN=0,\"mqtt3.thingspeak.com\",1883\r\n",
"AT+QMTCONN=0,\"<ClientID>\",\"<Username>\",\"<password>\"\r\n"
```



```
240
241 // Array of test strings
242 const uint8_t *test_strings[] = {
243     "AT+QMTCFG=\"recv/mode\",0,0,1\r\n",
244     "AT+QMTOPEN=0,\"mqtt3.thingspeak.com\",1883\r\n",
245     "AT+QMTCONN=0,\"KxsxCgMeBiYMJxMgIgk1BDg\",\"KxsxCgMeBiYMJxMgIgk1BDg\",\"j5UcciTBw1jlqc5vVv3k8q50\"\r\n",
246 };
247
```

Fig: Change credentials in observer.c of Central node

Fill channel id in payload

For Single field

AT+QMT PUBEX=0,0,0,0,\"channels/<channelID>/publish/fields/<field_no>\",2\r\n %d \r\n

Eg: "AT+QMT PUBEX=0,0,0,0,\"channels/2345234/publish/fields/field1\",2\r\n %d \r\n", value

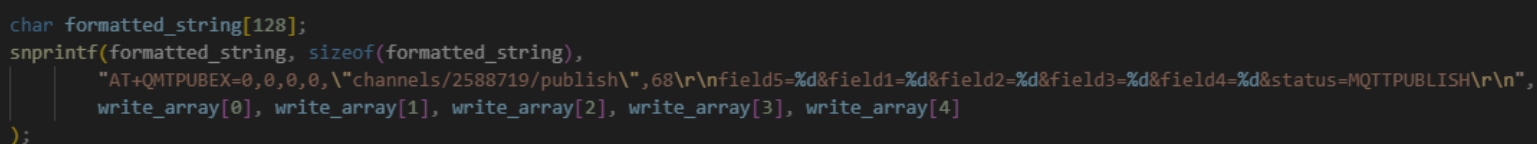
For multi fields

AT+QMT PUBEX=0,0,0,0,\"channels/<channelID>/publish\",<payload_length>\r\nfield1=%d&field2=%d& status=MQTTPUBLISH\r\n

Eg:

AT+QMT PUBEX=0,0,0,0,\"channels/2342344/publish\",68\r\nfield5=%d&field1=%d&field2=%d&field3=%d&field4=%d&status=MQTTPUBLISH\r\n

Here <payload_length> is length of string "field1=%d&field2=%d& status=MQTTPUBLISH" and 68 is the length of "field5=%d&field1=%d&field2=%d&field3=%d&field4=%d&status=MQTTPUBLISH"



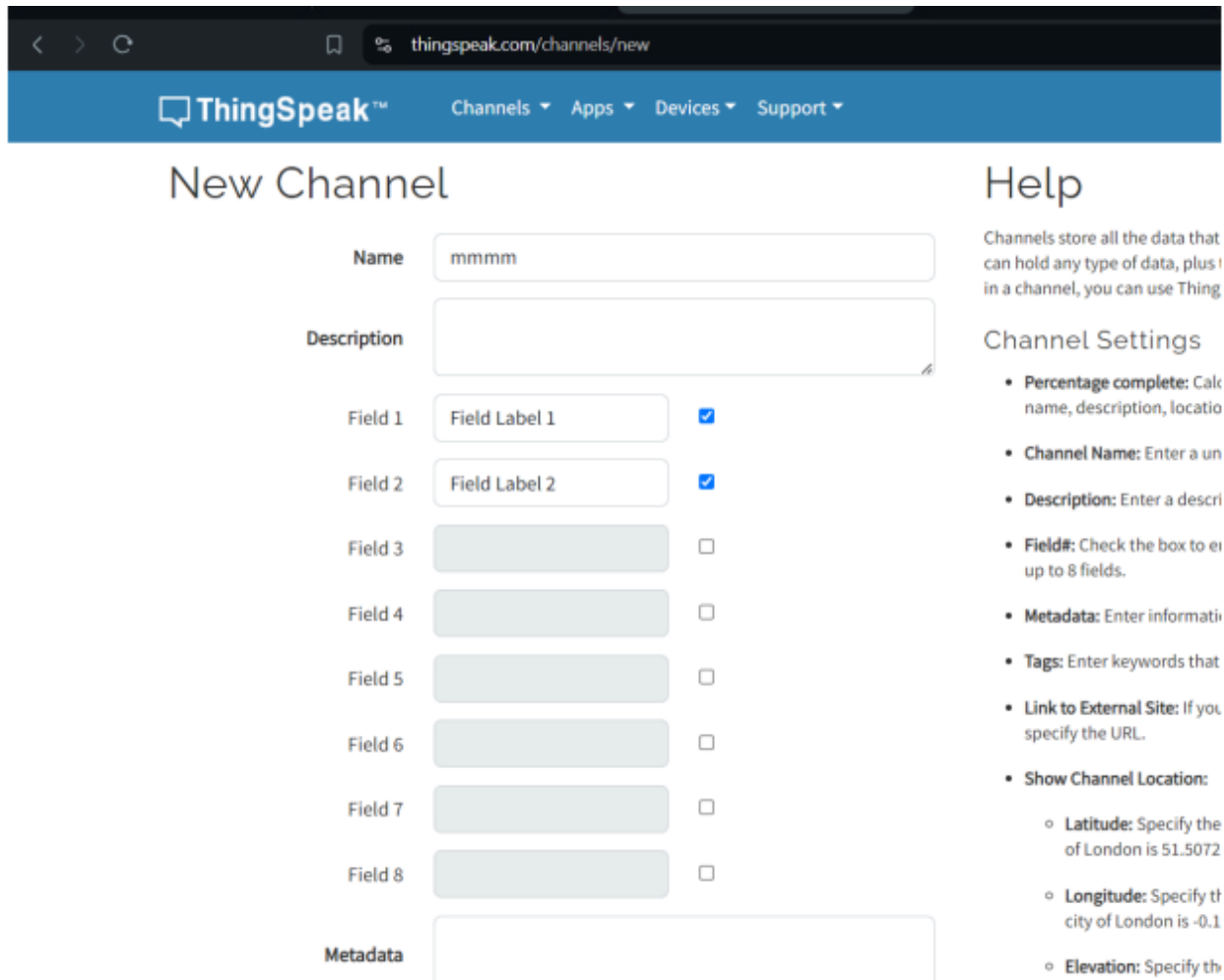
```
char formatted_string[128];
snprintf(formatted_string, sizeof(formatted_string),
    "AT+QMT PUBEX=0,0,0,0,\"channels/2588719/publish\",68\r\nfield5=%d&field1=%d&field2=%d&field3=%d&field4=%d&status=MQTTPUBLISH\r\n",
    write_array[0], write_array[1], write_array[2], write_array[3], write_array[4]
);
```

Fig: Change channel ID in observer.c of central node

Thingspeak setup

1. SIGNUP to thingspeak using university account if available

2. Create a new channel



The screenshot shows the 'New Channel' page on the Thingspeak website. The browser address bar shows 'thingspeak.com/channels/new'. The page has a blue header with the Thingspeak logo and navigation links: Channels, Apps, Devices, and Support. The main content area is titled 'New Channel' and contains several input fields: 'Name' (with 'mmmm' entered), 'Description', and eight 'Field' inputs (Field 1 to Field 8). Field 1 is labeled 'Field Label 1' and has a checked checkbox. Field 2 is labeled 'Field Label 2' and also has a checked checkbox. Fields 3 through 8 are empty and have unchecked checkboxes. Below the fields is a 'Metadata' input field. On the right side, there is a 'Help' section with text explaining that channels store all data and can hold any type of data. Below the help text is a 'Channel Settings' section with a list of settings: 'Percentage complete' (Calc name, description, location), 'Channel Name' (Enter a unique name), 'Description' (Enter a description), 'Field#' (Check the box to enable up to 8 fields), 'Metadata' (Enter information), 'Tags' (Enter keywords that describe your channel), 'Link to External Site' (If you specify the URL), and 'Show Channel Location' (which includes sub-options for Latitude, Longitude, and Elevation).

Thingspeak™ Channels ▾ Apps ▾ Devices ▾ Support ▾

New Channel

Name

Description

Field 1 ☒

Field 2 ☒

Field 3 ☐

Field 4 ☐

Field 5 ☐

Field 6 ☐

Field 7 ☐

Field 8 ☐

Metadata

Help

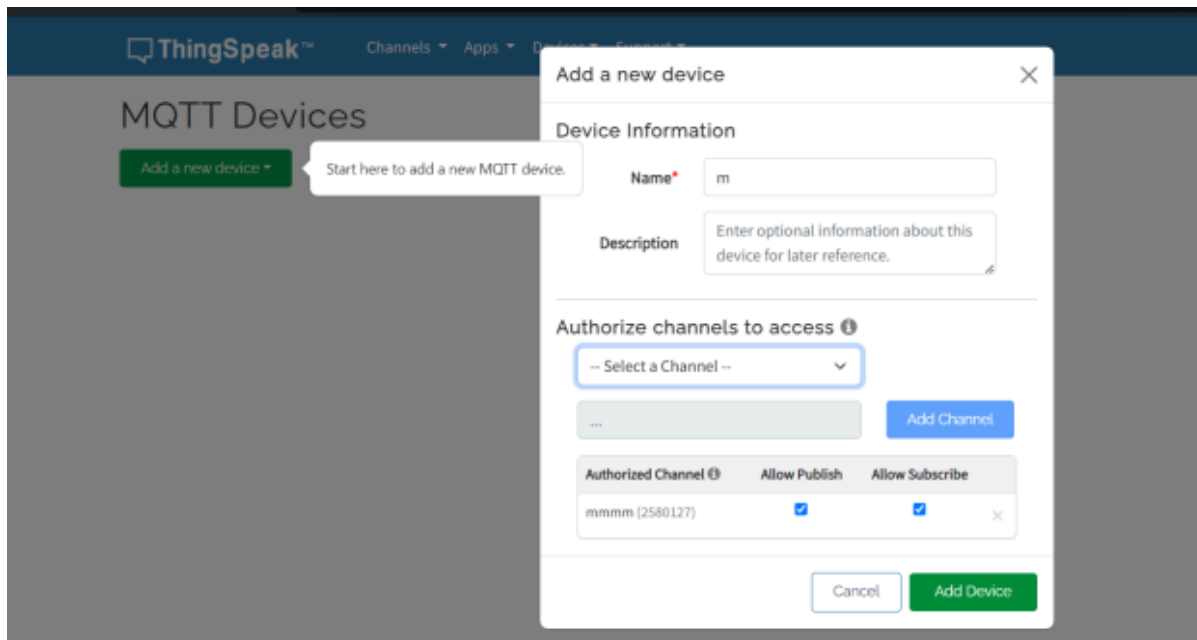
Channels store all the data that can hold any type of data, plus in a channel, you can use Thing

Channel Settings

- **Percentage complete:** Calc name, description, location
- **Channel Name:** Enter a unique name
- **Description:** Enter a description
- **Field#:** Check the box to enable up to 8 fields.
- **Metadata:** Enter information
- **Tags:** Enter keywords that describe your channel
- **Link to External Site:** If you specify the URL.
- **Show Channel Location:**
 - **Latitude:** Specify the latitude of London is 51.5072
 - **Longitude:** Specify the longitude of London is -0.1
 - **Elevation:** Specify the elevation

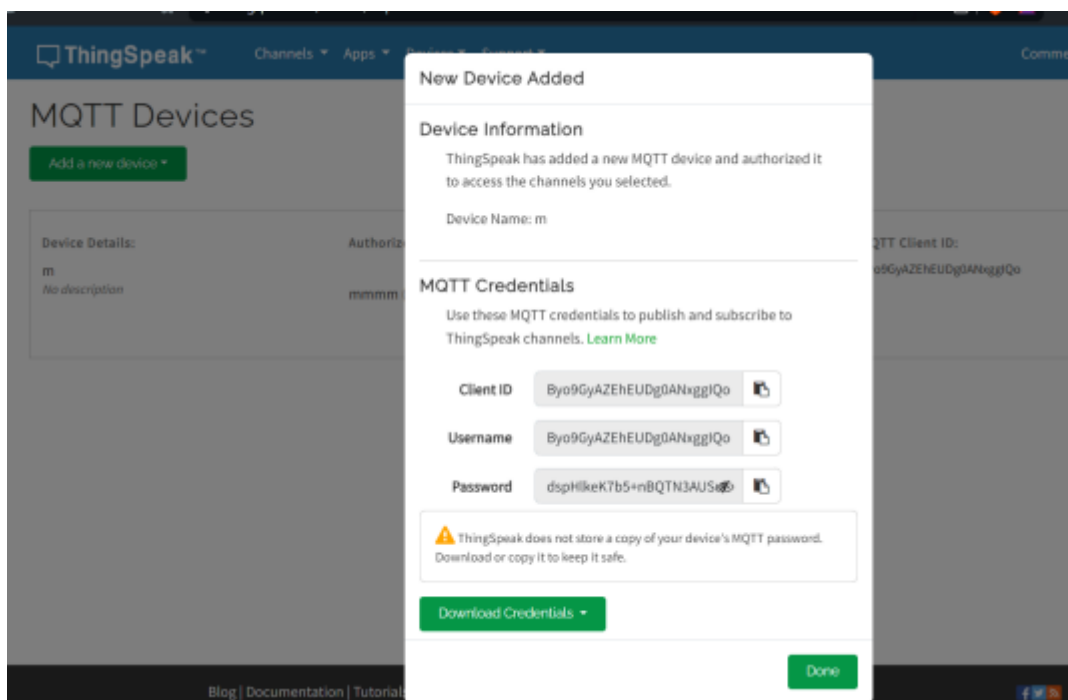
3. Go to devices > MQTT > Create a new device > add this channel to that device

4. Give Publish and subscribe permissions



5. After Adding the device , you will get the following credentials , download them.

6. These will be used in the AT commands mentioned and similarly in the code



This is how your channel would look like

ThingSpeak™

Channels ▾ Apps ▾ Devices ▾ Support ▾

My Channels

New Channel

Search by tag

Name ▾	Created ▾	Updated ▾
<div><div>Grasp</div><div><div>Private</div><div>Public</div><div>Settings</div><div>Sharing</div><div>API Keys</div><div>Data Import / Export</div></div></div>	2024-07-01	2024-07-04 16:40

E

7. Click on the private button

ThingSpeak™

Channels ▾ Apps ▾ Devices ▾ Support ▾

Commercial

Private View

Public View

Channel Settings

Sharing

API Keys

Data Import / Export

+ Add Visualizations

+ Add Widgets

Export recent data

MATLAB Analysis

Channel Stats

Created: 5 days ago
Last entry: about 21 hours ago
Entries: 1737

Field 1 Chart

Grasp

Temperature

75

50

4. Jul

12:00

5. Jul

12:00

Date

ThingSpeak.com

Field 2 Chart

Grasp

humidity

100

80

15:05

15:10

15:15

Date

ThingSpeak.com

This channel ID will also be used while publishing to MQTT You can add widgets to your dashboard too

Part 2 – Published data analysis

1. Create a MATLAB analysis script to send back alert/message or any other reaction to the incoming data in fields of channel and save it

My analysis code

The screenshot shows the ThingSpeak web interface. At the top is a blue navigation bar with the ThingSpeak logo and links for Channels, Apps, Devices, and Support. Below this is a breadcrumb trail: Apps / MATLAB Analysis / Send request to thinghttp code / Edit. The main content area has a 'Name' field containing 'Send request to thinghttp code'. Below that is a 'MATLAB Code' section with a text area containing the following code:

```
1 pause(5)
2 import matlab.net.*
3 import matlab.net.http.*
4 r = RequestMessage;
5 uri = URI('https://api.thingspeak.com/update?api_key=QZ4EKEEHZZRB2PXT&field6=1');
6 resp = send(r,uri);
7 status = resp.StatusCode
```


Note: You need to learn about read and write Api keys of Thingspeak channels and how they work, in this code the api_key used is a write one which writes data to field number 6 channel

See this to know more : <https://in.mathworks.com/help/thingspeak/matlab-analysis-app.html>

2. Create an event identifier to check incoming data at regular intervals using React app
 - a. Open apps section and choose react

The screenshot shows the ThingSpeak web interface with the 'Apps' menu open. The navigation bar at the top is the same as in the previous screenshot. Below the navigation bar, there are tabs for Private View, Public View, and Channel Settings. The 'Apps' dropdown menu is open, showing a list of applications: All Apps, MATLAB Analysis, MATLAB Visualizations, Plugins, ThingTweet, TimeControl, React (which is highlighted), TalkBack, and ThingHTTP. On the left side of the page, there is a 'Channel Stats' section showing 'Created: 5 days ago', 'Last entry: about 21 hours ago', and 'Entries: 1737'. There are also buttons for 'Add Visualizations' and 'Add Widgets'.

b. Create new react

 Channels ▾ Apps ▾ Devices ▾ Support ▾

Apps / React

Help

New React

React wor
channel d
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house, ha

- c. Enter all necessary details for the react app to activate and call the analysis code, then save the app

see this <https://in.mathworks.com/help/thingspeak/react-app.html>

ActionMATLAB Analysis▾

Code to executeSend request to thinghttp code▾

Options☐ Run action only the first time the condition is met☒ Run action each time condition is met

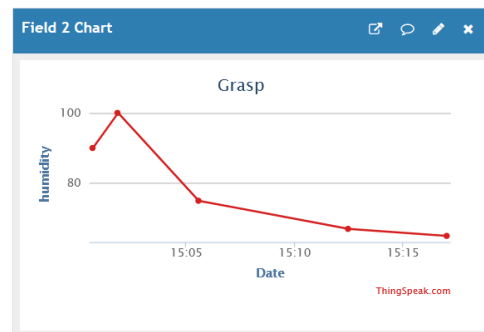
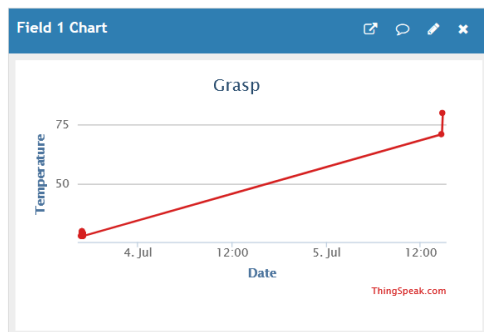
Save React

To see data you can

1. use the visualizations

Channel Stats

Created: 5 days ago
Last entry: about 21 hours ago
Entries: 1737



2. Use python script to fetch data and save in csv file

Code : <https://github.com/Goyalrahul1516/Grasp/blob/main/mqtt.py>

```
mqtt.py x thingspeak_data.csv x
D:\data_fetch\mqtt.py data
1 Timestamp,Field1,Field2,Field3,Field4,Field5,Field6,Field7,Field8
67 2024-07-03 10:51:10 UTC,1668,28,78,4,0,26,
68 2024-07-03 10:50:55 UTC,1667,29,77,4,0,26,
69 2024-07-03 10:50:44 UTC,1666,29,76,4,0,26,
70 2024-07-03 10:50:39 UTC,1665,29,75,4,0,26,
71 2024-07-03 10:50:34 UTC,1664,30,76,5,0,26,
72 2024-07-03 10:50:29 UTC,1663,31,79,5,0,26,
73 2024-07-03 10:49:23 UTC,1662,28,79,4,0,26,
74 2024-07-03 10:49:18 UTC,1661,28,80,4,0,26,
75 2024-07-03 10:48:46 UTC,1660,28,79,4,0,26,
76 2024-07-03 10:48:36 UTC,1659,28,80,4,0,26,
77 2024-07-03 10:48:31 UTC,1658,28,80,4,86,26,
78 2024-07-03 10:48:26 UTC,1657,28,80,5,66,26,
79 2024-07-03 10:48:20 UTC,1656,28,80,5,44,26,
80 2024-07-03 10:48:15 UTC,1655,28,80,5,0,26,
81 2024-07-03 10:48:10 UTC,1654,28,80,4,96,26,
82 2024-07-03 10:48:05 UTC,1653,28,80,4,91,26,
83 2024-07-03 10:48:00 UTC,1652,28,80,4,90,26,
84 2024-07-03 10:47:54 UTC,1651,28,80,4,93,26,
85 2024-07-03 10:47:49 UTC,1650,28,80,4,96,26,
86 2024-07-03 10:47:44 UTC,1649,28,80,4,95,26,
87 2024-07-03 10:47:39 UTC,1648,28,80,4,99,26,
88 2024-07-03 10:47:34 UTC,1647,28,79,4,95,26,
89 2024-07-03 10:47:28 UTC,1646,28,80,4,93,26,
```

3. Use MATLAB

Code : https://github.com/Goyalrahul1516/Grasp/blob/main/data_fetch.m

```
Command Window

03-Jul-2024 16:16:57      28      79      4      90      26      NaN
03-Jul-2024 16:17:02      28      79      4      89      26      NaN

      :      :      :      :      :      :

05-Jul-2024 15:05:51      NaN      NaN      NaN      NaN      NaN      1
05-Jul-2024 15:12:30      NaN      67      NaN      NaN      NaN      NaN
05-Jul-2024 15:12:46      NaN      NaN      NaN      NaN      NaN      1
05-Jul-2024 15:17:03      NaN      65      NaN      NaN      NaN      NaN
05-Jul-2024 15:17:29      NaN      NaN      NaN      NaN      NaN      1

Display all 100 rows.

timeStamp1 =

struct with fields:

    ChannelID: 2588719
        Name: 'Grasp'
  Description: 'Temperature, humidity and CO2 data collection'
    Latitude: 30.9692
    Longitude: 76.4732
    Altitude: []
    Created: 01-Jul-2024 09:31:11
    Updated: 04-Jul-2024 16:40:26
  LastEntryID: 1737
FieldDescriptions: {'Temperature' 'humidity' 'co2' 'co2 decimal' 'Node ID' 'response from analysis'}
    FieldIDs: [1 2 3 4 5 6]
        URL: 'https://api.thingspeak.com/channels/2588719/feed.json?'

fx >>
```