

**Course** : Diploma in Electronics & Computer Engineering (EGDF20)

**Module**  : Connected System Design Project (EGE205)

**Laboratory No**. : SDL Lab 2

**Laboratory Title** : Movement Related Sensor

**Objective** : To connect hardware click boards, install python library and write python code

to read different types of movement related sensor click boards.

**Hardware Boards** : BBBW Board with USB Cable x1

: MikroBus Cape x1

: 9DOF Click x1

: IR Gesture Click x1

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# **9 DOF Click**

## Understanding of 9DOF Click Hardware Connection

**9DOF Click** board carries ST’s LSM9DS1 inertial measurement module that combines a 3D accelerometer, a 3D gyroscope and a 3D magnetometer into a single device outputting so called nine degrees of freedom data (3-axis acceleration, angular velocity and heading), in 16-bit resolution. It communicates with the target MCU through the mikroBUS I2C interface (SCL and SDA) with additional functionality provided by the programmable Interrupt (INT) pin, as well as the Enable (EN) pin. The IC has multiple interrupt lines which can be accessed through jumpers on the click board. I2C addresses are specified in the same manner and the board uses a 3.3 power supply only.

9DOF Click and its respective schematic are shown in the Figure below.



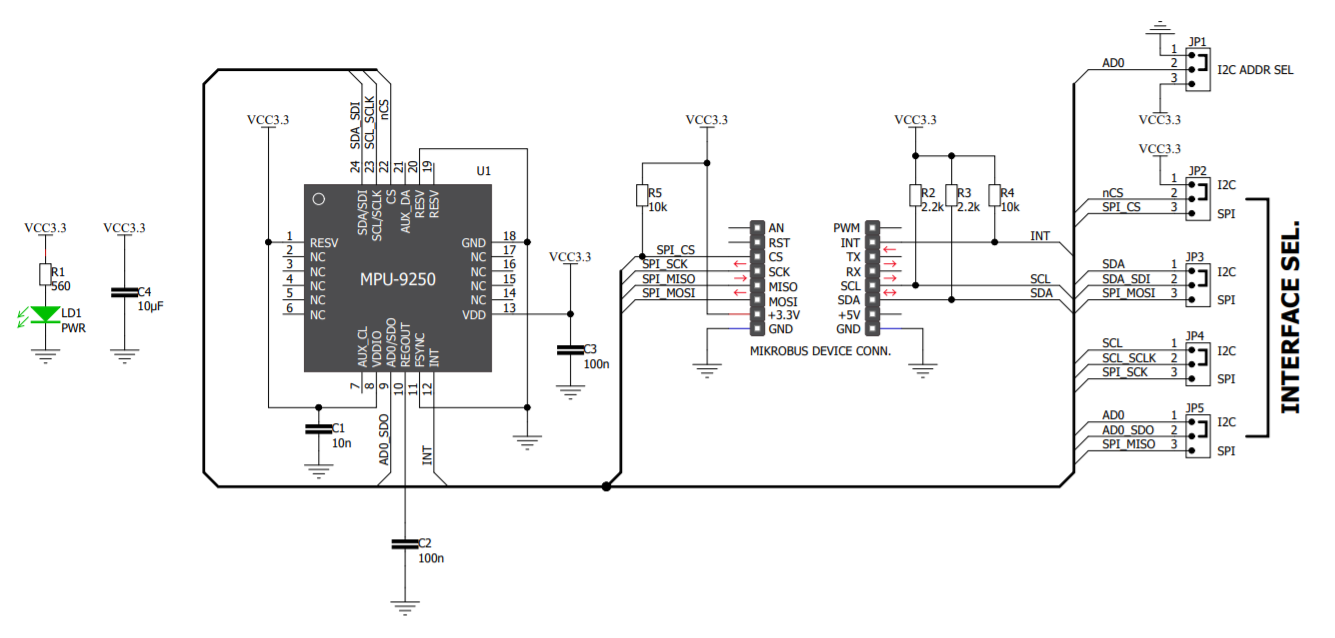


Figure 1.1a: 9DOF Click and Schematic

1. **Connect** the 9DOF Click to the mikroBUS cape and BBBW board as shown in the Figure below.

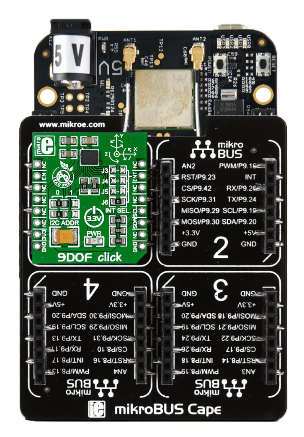


Figure 1.1b: Connecting 9DOF Click to mikroBUS Cape and BBBW Board

## Reading the Sensor Value from the 9DOF Click using Python Code

**Downloading and Installing Adafruit\_CircuitPython LSM9DS1 Python Library**

1. **Log in** to the BBBW board through SSH using the default username “**debian**” and password “**temppwd**”.
2. **Type** in the command “**iwconfig**” and **hit** the “Enter” key to ensure that the wlan0 is connected to a particular Wi-Fi’s SSID.
3. **Type** in the command “**pwd**” and **hit** the “Enter” key. It is observed that the current working directory “**/home/debian**” is returned.
4. **Type** in the command “**ls**” and **hit** the “Enter” key. It is observed that the PythonLibrary folder has been created earlier.
5. **Type** in the command “**cd PythonLibrary**” and **hit** the “Enter” key to accesses the PythonLibrary folder.
6. **Type** in the command “**git clone https://github.com/nypege205/Adafruit\_CircuitPython\_LSM9DS1.git**” and **hit** the “Enter” key. **Type** in the github username “**nypege205**” and password “**ghp\_Dr3jDaeKJ8fgDH06ZrtG1qUKgsmKux3XffG5**” and **hit** the “Enter” key again to clones a copy of the Adafruit\_CircuitPython\_LSM9DS1 Python Library repository from github.
7. **Type** in the command “**ls**” and **hit** the “Enter” key. The Adafruit\_CircuitPython\_LSM9DS1 Python Library folder is returned.
8. **Type** in the command “**cd Adafruit\_CircuitPython\_****LSM9DS1**” and **hit** the “Enter” key to access the Adafruit\_CircuitPython\_LSM9DS1 folder.
9. **Type** in the command “**sudo python3 setup.py install**” and **hit** the “Enter” key to install the Adafruit\_CircuitPython\_LSM9DS1 Python Library. Please note that the installation may take up to 5 minutes to complete the whole process.

**Executing the Python Program**

1. **Ensure** that the BBBW board is powered up and connected to the computer through a USB cable. **Open** the web browser (preferably Chrome browser) and **type** “**http://192.168.7.2:3000**” in the address bar.
2. **Right click** on the folder “**MyFirstPythonProject”** and **select** the “**New File**” from the drop-down menu to create a new python file. Name the file as “**9dof.py**”.
3. **Double click** on the newly created file “**9dof.py**” and enter the following code into the file under the Editor section.

|  |
| --- |
| import time  import board  import adafruit\_lsm9ds1  #Create sensor object, communicating over the board's default I2C bus  i2c = board.I2C()  lsm9ds1 = adafruit\_lsm9ds1.LSM9DS1\_I2C(i2c, 0x1C, 0x6A)  while True:  #Read acceleration, magnetometer, gyroscope, temperature.  accel\_x, accel\_y, accel\_z = lsm9ds1.acceleration  mag\_x, mag\_y, mag\_z = lsm9ds1.magnetic  gyro\_x, gyro\_y, gyro\_z = lsm9ds1.gyro    #Print values.  print("Acceleration (m/s^2): ({0:0.3f},{1:0.3f},{2:0.3f})".format(accel\_x, accel\_y, accel\_z))  print("Magnetometer (gauss): ({0:0.3f},{1:0.3f},{2:0.3f})".format(mag\_x, mag\_y, mag\_z))  print("Gyroscope (rad/sec): ({0:0.3f},{1:0.3f},{2:0.3f})".format(gyro\_x, gyro\_y, gyro\_z))  time.sleep(1.0) |

1. **Click** on the “Run” button located beside the Menu Tab to execute the “**9dof.py**” file. It is observed that the acceleration, magnetometer and gyroscope values are printed at the Cloud9 console window.

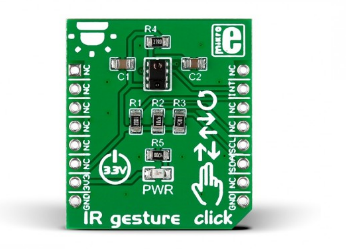
# **IR Gesture Click**

## Understanding of IR Gesture Click Board Hardware Connection

**IR Gesture Click** board is a mikroBUS add-on board that enables contactless gesture recognition, along with ambient light and proximity sensing capabilities with the APDS-9960 IC. This sensor integrates an LED and four directional photodiodes that receive the reflecting light. An internal gesture engine deduces the velocity, direction and distance of nearby objects (while cancelling the ambient light).

You can implement a variety of gestures, from basic directional swipes (up, down, left or right) to more complex combinations. Since the chip can work as a proximity sensor, the gesture engine can be configured to wake up automatically when a user’s hand approaches. The board communicates with the target board MCU through the mikroBUS I2C interface, with an additional hardware interrupt pin (INT). IR Gesture click uses a 3.3V power supply.

IR Gesture Click and its respective schematic are shown in the Figure below.



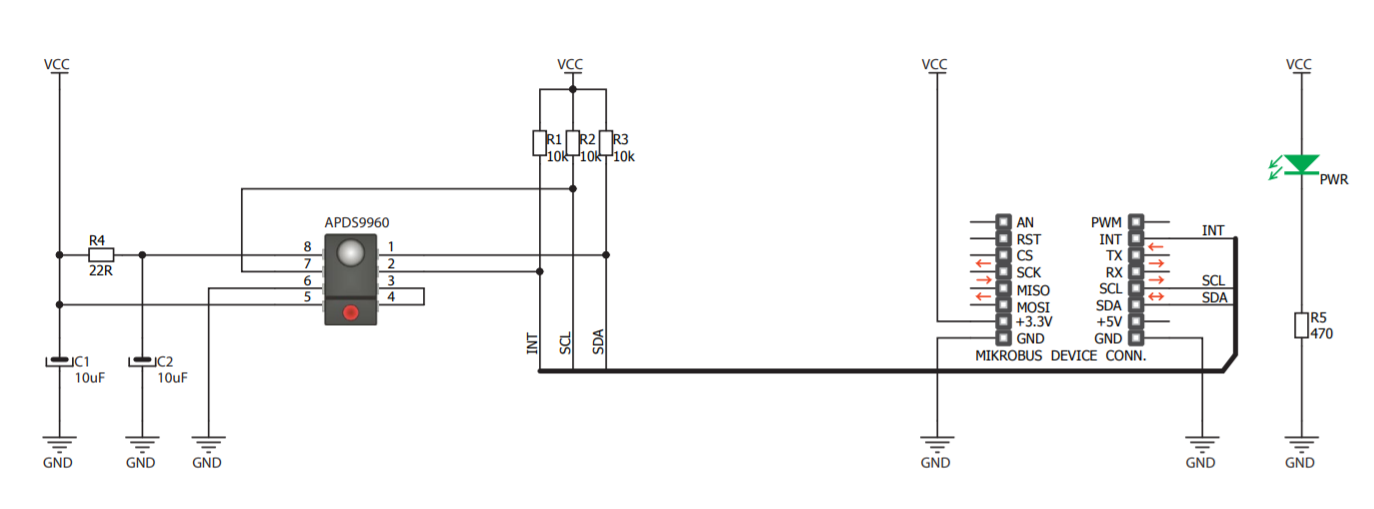


Figure 2.1a: IR Gesture Click and Schematic

1. **Connect** the IR Gesture Click to the mikroBUS cape and BBBW board as shown in the Figure below.

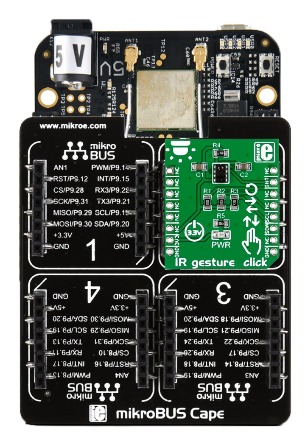


Figure 2.1b: Connecting IR Gesture Click to mikroBUS Cape and BBBW Board

## Reading the Sensor Value from the IR Gesture Click using Python Code

**Downloading and Installing Adafruit\_CircuitPython\_APDS9960 Python Library**

1. **Log in** to the BBBW board through SSH using the default username “**debian**” and password “**temppwd**”.
2. **Type** in the command “**iwconfig**” and **hit** the “Enter” key to ensure that the wlan0 is connected to a particular Wi-Fi’s SSID.
3. **Type** in the command “**pwd**” and **hit** the “Enter” key. It is observed that the current working directory “**/home/debian**” is returned.
4. **Type** in the command “**ls**” and **hit** the “Enter” key. It is observed that the PythonLibrary folder has been created earlier.
5. **Type** in the command “**cd PythonLibrary**” and **hit** the “Enter” key to accesses the PythonLibrary folder.
6. **Type** in the command “**git clone https://github.com/nypege205/Adafruit\_CircuitPython****\_APDS9960.git**” and **hit** the “Enter” key. **Type** in the github username “**nypege205**” and password “**ghp\_Dr3jDaeKJ8fgDH06ZrtG1qUKgsmKux3XffG5**” and **hit** the “Enter” key again to clones a copy of the Adafruit\_CircuitPython\_APDS9960 Python Library repository from github.
7. **Type** in the command “**ls**” and **hit** the “Enter” key. The Adafruit\_CircuitPython\_APDS9960 Python Library folder is returned.
8. **Type** in the command “**cd Adafruit\_CircuitPython\_APDS9960**” and **hit** the “Enter” key to access the Adafruit\_CircuitPython\_APDS9960 folder.
9. **Type** in the command “**sudo python3 setup.py install**” and **hit** the “Enter” key to install the Adafruit\_CircuitPython\_APDS9960 Python Library. Please note that the installation may take up to 5 minutes to complete the whole process.

**Executing the Python Program**

1. **Ensure** that the BBBW board is powered up and connected to the computer through a USB cable. **Open** the web browser (preferably Chrome browser) and **type** “**http://192.168.7.2:3000**” in the address bar.
2. **Right click** on the folder “**MyFirstPythonProject”** and **select** the “**New File**” from the drop-down menu to create a new python file. Name the file as “**irgesture.py**”.
3. **Double click** on the newly created file “**irgesture.py**” and enter the following code into the file under the Editor section.

|  |
| --- |
| import time  import board  import adafruit\_apds9960.apds9960  #Create sensor object, communicating over the board's default I2C bus  i2c = board.I2C()  apds9960 = adafruit\_apds9960.apds9960.APDS9960(i2c)  apds9960.enable\_proximity = True  apds9960.enable\_gesture = True  while True:  gesture = apds9960.gesture()  if gesture == 0x01:  print("up")  elif gesture == 0x02:  print("down")  elif gesture == 0x03:  print("left")  elif gesture == 0x04:  print("right") |

1. **Click** on the “Run” button located beside the Menu Tab to execute the “**irgesture.py**” file. Perform a up, down, left or right gesture movement on top of the click board using your palm. It is observed that the text up, down, left or right are printed at the Cloud9 console window when the gesture is successfully recognized.

*Congratulations! You have successfully completed the SDL Lab. Good job! Take a good break and stay tune for next lab. More exciting lab exercises coming to you!*