Arduino for ODROID-GO - Battery

- Make sure that you've followed these guides:
  - Getting started with Arduino
  - Arduino for ODROID-GO - Hello World

- Refer to the Arduino official documents. This provides useful **common functions** with great instructions.
  - https://www.arduino.cc/reference/en/
- Refer to the ESP32 official programming guide. Most of **ESP32 specific functions** are introduced here.
  - https://esp-idf.readthedocs.io/en/v3.0/

We will learn how to get the status of the battery with Arduino in this guide.
The LCD will display how much battery voltage remains in volts.

Get the status of the battery

ODROID-GO has a ~3.7V battery module.
We can read the battery level through one of the **12-bit SAR ADCs** which are integrated in ESP32.

These ADCs are:

- ADC1: 8 channels, attached to GPIOs 32-39.
- ADC2: 10 channels, attached to GPIOs 0, 2, 4, 12-15, 25-27.

There are some restrictions for an application's use of ADC2.

The battery is attached to GPIO pin number **36**, so we should read a value from that using **ADC1**.

There is a library to control ADC for ESP32 and is called **adc.h**.
In this guide, we're going to use that to read the current battery level in volts and display it on the LCD.

First, prepare the code like below to display on the LCD.

```
#include <odroid_go.h>

void setup() {
  // put your setup code here, to run once:
```

```
  GO.begin();

  GO.lcd.setTextSize(2);
}

double readBatteryVoltage() {

}

void showBatteryVoltage(double voltage) {
  GO.lcd.clear();
  GO.lcd.setCursor(, );

  GO.lcd.printf("Current Voltage: %1.3lf V \n", voltage);
}

void loop() {
  // put your main code here, to run repeatedly:
  showBatteryVoltage(readBatteryVoltage());
  delay(1000);
}
```

We defined two functions in advance:

- **readBatteryVoltage()**: returns completely calculated voltage.
- **showBatteryVoltage()**: receives that voltage and print that on the screen.

Set the channel up to the proper values as we designed.

Before setting it up, its important to know the GPIO battery voltage is divided by 2 due to the input limitation of the integrated ADC.
So, if the original value coming from the battery is 3.7V, then the input value to the GPIO pin will be about 1.85V.
Thus, we have to **multiply the value by 2** to know the actual voltage.
We use **12 bit SAR ADC** for the channel with **11 dB attenuation**. We should use these rates to calculate the result as well.

Now, let's get it started again.
First of all, define that extra value as a Preprocessor macro and include necessary libraries to use ADC on ESP32.

- **driver/adc.h**: to get a raw ADC value about the voltage.
- **esp_adc_cal.h**: to calculate a correct voltage by using the AP.

Then, set the channel with the proper value by using two functions:

- **adc1_config_width()**: configures width of the ADC.
- **adc1_config_channel_atten()**: configures attenuation of the channel. GPIO pin number 36 uses channel number **1**.

To get an accurate ADC voltage, calibration is needed. The ADC reference voltage is originally **1.1V by default** but actually differs slightly on every ESP32 module. The manufacturer writes the calibration data in **efuse**.

- **esp_adc_cal_characterize()**: returns a characteristic of its AP as a structure.

The **readBatteryVoltage()** function reads an ADC value with the **adc1_get_raw()** function. It returns a calculated voltage as a double type value using the **esp_adc_cal_raw_to_voltage()** function.

So, the codes become like shown below:

```
#include <odroid_go.h>
#include <driver/adc.h>
#include <esp_adc_cal.h>

#define RESISTANCE_NUM    2
#define DEFAULT_VREF      1100

static esp_adc_cal_characteristics_t adc_chars;

void setup() {
  // put your setup code here, to run once:
  GO.begin();

  GO.lcd.setTextSize(2);

  adc1_config_width(ADC_WIDTH_BIT_12);
  adc1_config_channel_atten(ADC1_CHANNEL_0, ADC_ATTEN_DB_11);
  esp_adc_cal_characterize(ADC_UNIT_1, ADC_ATTEN_DB_11, ADC_WIDTH_BIT_12,
DEFAULT_VREF, &adc_chars);
}

double readBatteryVoltage() {
  return (double) esp_adc_cal_raw_to_voltage(adc1_get_raw(ADC1_CHANNEL_0),
&adc_chars) * RESISTANCE_NUM / 1000;
}

void showBatteryVoltage(double voltage) {
  GO.lcd.clear();
  GO.lcd.setCursor(, );

  GO.lcd.printf("Current Voltage: %1.3lf V \n", voltage);
}

void loop() {
  // put your main code here, to run repeatedly:
  showBatteryVoltage(readBatteryVoltage());
  delay(1000);
}
```

Optionally, we can calculate more accurately by **multi-sampling** the ADC value.
Read the value 64 times, and divide that by the repetition count.

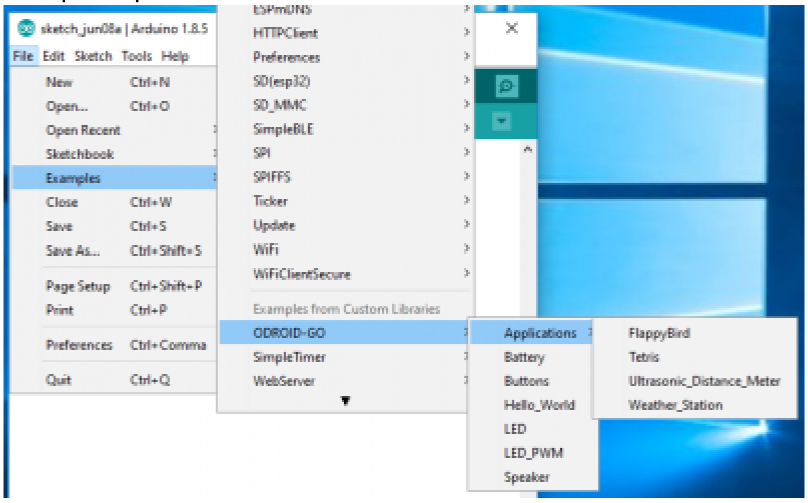
```
#include <odroid_go.h>
#include <driver/adc.h>
#include <esp_adc_cal.h>

#define RESISTANCE_NUM    2
#define DEFAULT_VREF      1100
#define NO_OF_SAMPLES     64

static esp_adc_cal_characteristics_t adc_chars;

void setup() {
  // put your setup code here, to run once:
  GO.begin();

  GO.lcd.setTextSize(2);

  adc1_config_width(ADC_WIDTH_BIT_12);
  adc1_config_channel_atten(ADC1_CHANNEL_0, ADC_ATTEN_DB_11);
  esp_adc_cal_characterize(ADC_UNIT_1, ADC_ATTEN_DB_11, ADC_WIDTH_BIT_12,
DEFAULT_VREF, &adc_chars);
}

double readBatteryVoltage() {
  uint32_t adc_reading = ;
  for (int i = ; i < NO_OF_SAMPLES; i++) {
    adc_reading += adc1_get_raw((adc1_channel_t) ADC1_CHANNEL_0);
  }
  adc_reading /= NO_OF_SAMPLES;

  return (double) esp_adc_cal_raw_to_voltage(adc_reading, &adc_chars) *
RESISTANCE_NUM / 1000;
}

void showBatteryVoltage(double voltage) {
  GO.lcd.clear();
  GO.lcd.setCursor(, );

  GO.lcd.printf("Current Voltage: %1.3lf V \n", voltage);
}

void loop() {
  // put your main code here, to run repeatedly:
  showBatteryVoltage(readBatteryVoltage());
  delay(1000);
}
```

Press **CTRL-U** to compile and upload the sketch.
The current voltage of the battery will be shown on the LCD.

A completed example

The complete example is available as follows:

Click the **Files → Examples → ODROID-GO → Battery** menu to import and press **CTRL-U** to compile/upload.


sketch_jun08a | Arduino 1.8.5
File
Edit
Sketch
Tools
Help
New Ctrl+N
Open... Ctrl+O
Open Recent
Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
Page Setup Ctrl+Shift+P
Print Ctrl+P
Preferences Ctrl+Comma
Quit Ctrl+Q
ESPmDNS
HTTPClient
Preferences
SD(esp32)
SD_MMC
SimpleBLE
SPI
SPIFFS
Ticker
Update
WiFi
WiFiClientSecure
Examples from Custom Libraries
ODROID-GO
SimpleTimer
WebServer
Applications
Battery
Buttons
Hello_World
LED
LED_PWM
Speaker
FlappyBird
Tetris
Ultrasonic_Distance_Meter
Weather_Station