User Manual

This comprehensive guide has been crafted to assist you in understanding, operating, and maintaining your GeoPosBall device effectively. Whether you are a novice user or an experienced developer, this manual provides step-by-step instructions, essential precautions, and detailed insights into the functionalities of the GeoPosBall.

About the GeoPosBall: The GeoPosBall is a geospatial data acquisition device, specifically designed to meet the unique needs of underwater exploration. Developed to address the necessity of acquiring precise points on the water's surface, the device caters to the requirements of a diver who needs to capture points during resurfacing from underwater dives. By harnessing technologies such as the WTGAHRS2 module, M5Stamp S3 microcontroller, and SD card storage, the GeoPosBall offers a versatile and reliable solution for a diverse range of applications, particularly aiding submariners in their data collection endeavors.

How to Use This Manual: This manual is divided into three main parts, each addressing crucial aspects of the GeoPosBall experience. In the first part, we guide you through the device's usage, precautions, and the valuable insights you can gain from the recorded data.

The second part provides a detailed explanation of the contents of the recorded Excel file.

In the third part, we delve into the process of updating the device's software. From installing the Arduino IDE to modifying the code for customization, these steps empower you to adapt the GeoPosBall to your specific project requirements.

Part I: Device Usage

1. **Opening the Device:**
    - To open the device, unscrew the record button screw on the cap
    - Always open and close the device from the cap without the record button screw to avoid impact on button connections.

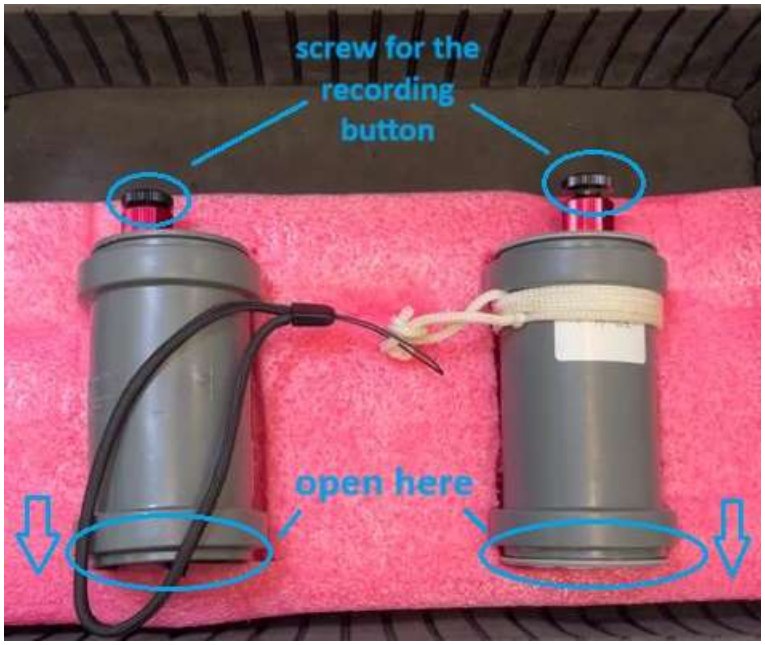

Figure 1: Opening the device

2. **Device Startup:**

- Once opened, power on the device by pressing the button on the PCB connected to the battery.
- Check battery charge through 4 white LEDs; a red LED, in the M5Stamp S3, indicates no recording due to the absence of a micro-SD in the SD card reader.

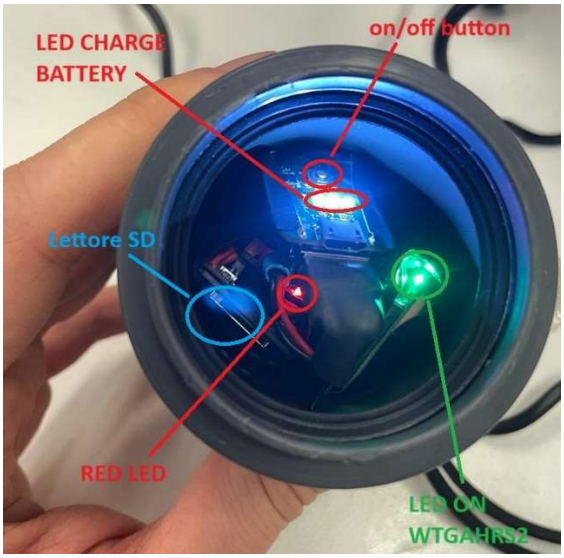

Figure 2: GeoPosBall Device

- Insert the micro-SD with tweezers, ensuring the correct orientation and a click sound. Within 5 seconds, the red LED turns blue, indicating recording.

Figure 3: Blue led

3. **Wi-Fi Connection:**

- Connect to Wi-Fi named "Automa 2" with password "12345678."
- Run MATLAB code “wifi_reciver.m” for data reception after connecting. View received data in the command window.

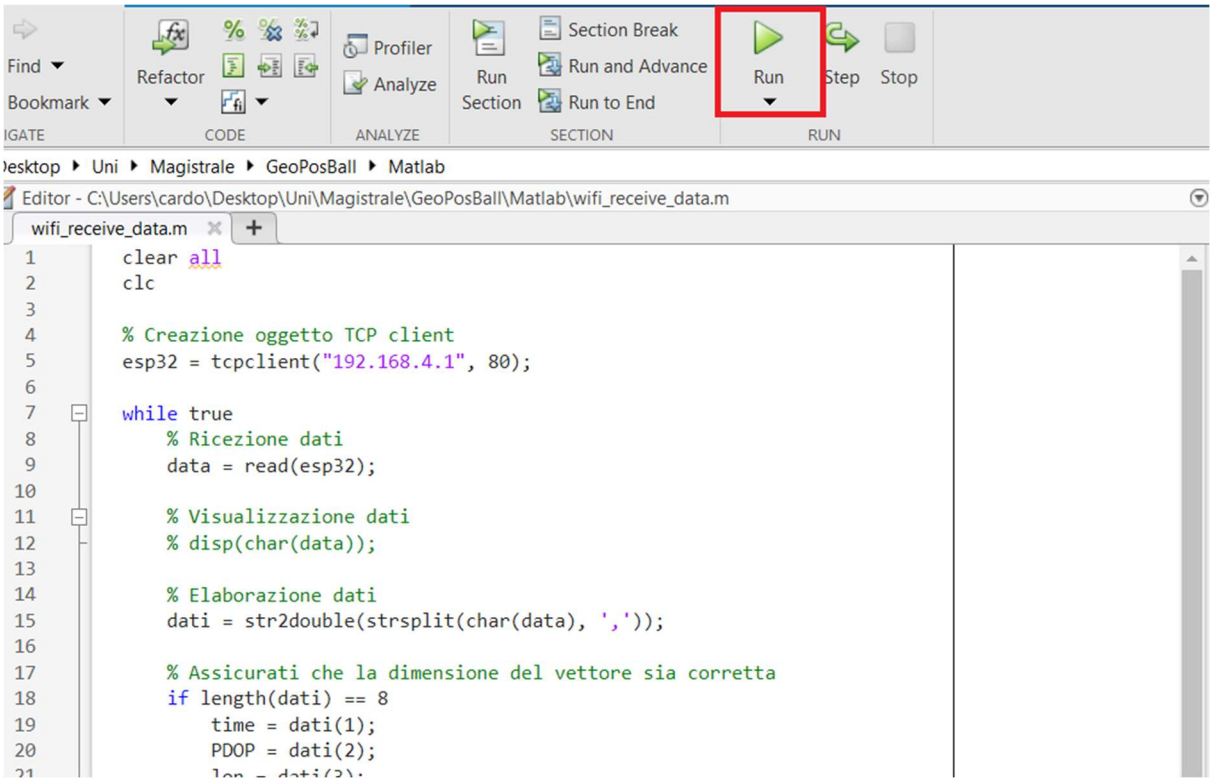

Figure 4: wifi_reciver.m

4. **Closing the Device:**
    - Close the device gently; if necessary, apply lubricant to the seal.
    - Once the cap is insert, screw the screw the record button screw.
    - The device continues recording on SD while connected to Wi-Fi; data can be viewed in MATLAB.
5. **Wi-Fi Range and GPS Signal Quality:**
    - Wi-Fi connection is available up to 20 meters.
    - In MATLAB, view GPS signal quality using PDOP: PDOP = 25.5 (no signal), PDOP 4.0-25.5 (unacceptable), PDOP < 4.0 (acceptable). Lower PDOP values indicate a better GPS signal.
6. **Record Button Usage:**
    - Unscrew the record button screw one turn to start.
    - Screw the record button screw fully to mark a point in saved coordinates in the Excel file on the SD.
7. **Shutting Down:**
    - After testing, ensure the device exterior is dry, and always open from the cap without a button.
    - After opening (same as step 1), double-click the power button to turn off.
    - Safely extract the SD and view data in Excel through an SD reader.

8. **Charging the Battery:**
    - Disconnect the USB 2.0 from the PCB.
    - Connect the micro-USB for battery charging.
    - Once all 4 LEDs have a steady light, disconnect the micro-USB, ensure the device turns off with a double-click on the power button, and reconnect the USB 2.0.

Part II: Data Recorded in Excel File

Upon opening the Excel file, users can explore the recorded data:

- ***Time of Each Acquisition:***
    - *Each row represents a data acquisition, displaying the corresponding timestamp.*
- ***Button Press Records:***
    - *The number of recordings increases with each button press.*
    - *A label indicating "Avvio registrazione numero *" appears when the button is pressed.*
    - *After 15 seconds, a label reading "Fine registrazione numero *" signifies the end of the recording.*

Part III: Software Update Process

In this section, we'll explore the process of updating the GeoPosBall device's software. There are various reasons why you might need to modify the Arduino code on the M5Stamp S3, ranging from personal customization to adapting the device to specific project requirements. Here are a few scenarios that might necessitate a code update:

a. Customizing Wi-Fi Settings:
    - You may need to change the default Wi-Fi credentials, such as the network name (SSID) and password, to align with your specific network configuration. Modify the code to reflect these changes and ensure seamless connectivity to your preferred Wi-Fi network.

```
40  // Set these to your desired credentials.
41  const char *ssid = "Automa";
42  const char *password = "12345678";
43
```

Figure 5: WiFi Credential in geoposball_v8.ino code

b. Adjusting Data Sampling Time:
    - The default data sampling time may not suit every project's requirements. Depending on your application, you might need to increase or decrease the time interval between data acquisitions. By modifying the code, you can tailor the device's behavior to match your desired sampling frequency.

```
16
17  const int save_interval = 60000; // Salva i dati ogni minuto
18  const int wifi_interval = 3000; //Invia i dati via WiFi ogni 3 secondi
19  const int save_time = 30; // numero di campioni salvati (con tempo di campionamento di 500ms) per una registrazione di 15s
20  const int recive_time = 500; // Ottieni i dati ogni 0.5 secondi
21  unsigned long last_send_time = 0;
22
```

Figure 6: parameters for data sampling in geoposball_v8.ino code

c. Incorporating Additional Features:

- As your project evolves, you might want to add new features or functionalities to the GeoPosBall device. This could include integrating additional sensors, enhancing data processing capabilities, or implementing advanced algorithms. Modifying the code allows you to tailor the device to evolving project requirements.

To modify the Arduino code on the M5Stamp S3, follow these steps:

1. **Install Arduino IDE:**
   - Download and install Arduino IDE from https://www.arduino.cc/en/software.
2. **Configure Arduino IDE for M5Stamp S3:**
   - Refer to the tutorial at http://docs.m5stack.com/en/quick_start/stamps3/arduino for setting up the Arduino IDE environment for M5Stamp S3.
3. **Modify Pin Configuration:**
   - On Windows, press Windows + R, search for the "AppData" folder, navigate to Local > Arduino15 > packages > m5stack > hardware > esp32 > 2.0.9 > variants > m5stack_stamp_s3.

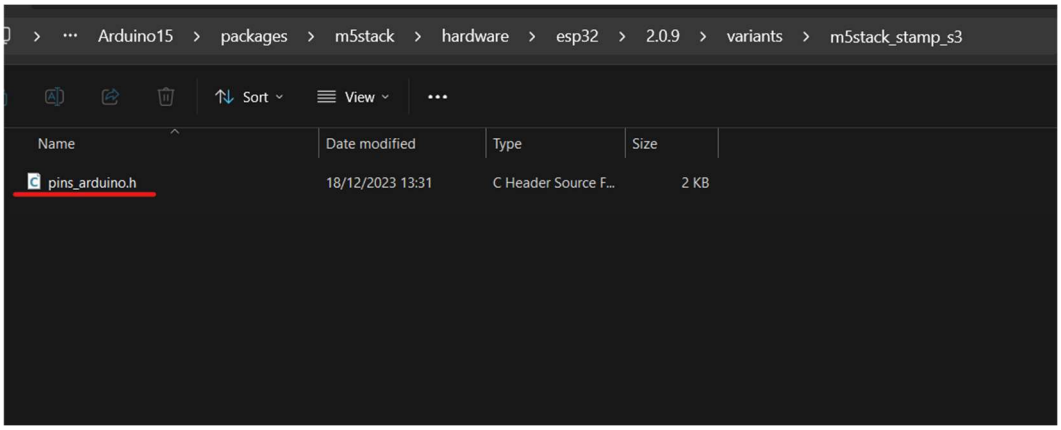

Figure 7: path pins_arduino.h

- Open "pins_arduino.h" and ensure that the pins are defined as illustrated in the Figure provided in the tutorial. Save the changes.

```
19  static const uint8_t TX = 43;
20  static const uint8_t RX = 44;
21
22  static const uint8_t TXD2 = 1;
23  static const uint8_t RXD2 = 2;
24
25  static const uint8_t SDA = 13;
26  static const uint8_t SCL = 15;
27
28  // Modified elsewhere
29  static const uint8_t SS    = 10;
30  static const uint8_t MOSI  = 11;
31  static const uint8_t MISO  = 9;
32  static const uint8_t SCK   = 12;
33
```

Figure 8: configuration pins

4. **Install WTGAHRS2 Data Processing Library:**
    - In the Arduino15 folder, go to libraries and insert the "JY901SerialMega2560" library for data processing of WTGAHRS2.

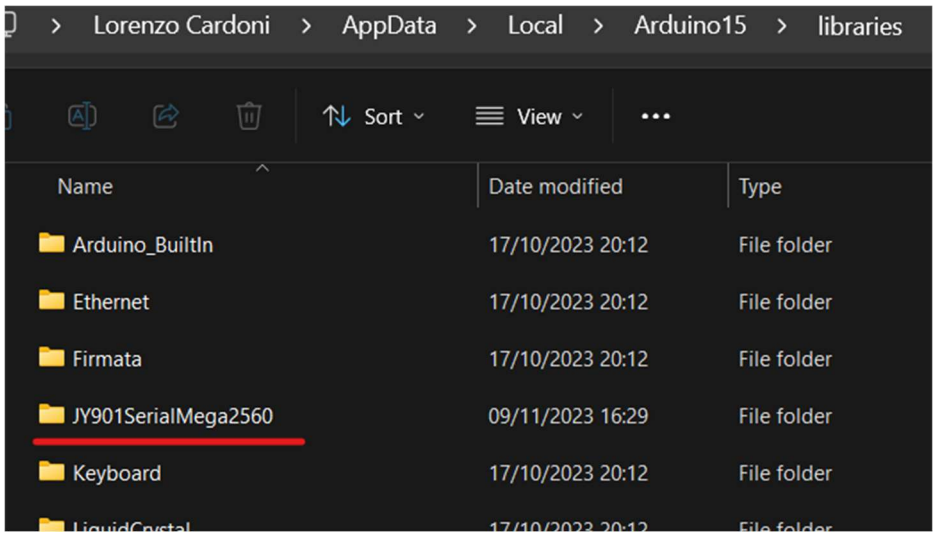

Figure 9: library to insert

Now you are ready to modify the GeoPosBall code. Follow these steps:

5. **Access GeoPosBall Code:**
    - Open the Arduino IDE and load the GeoPosBall code.
6. **Modify Code as Needed:**
    - Make necessary modifications to the code according to your project requirements.
7. **Upload the Modified Code:**
    - Connect the M5Stamp S3 to your computer using a USB cable.

- Select the correct board and port in the Arduino IDE.
- Click "Upload" to upload the modified code to the M5Stamp S3.

8. **Test the Device:**
    - After uploading the code, test the device to ensure that the modifications function as intended.

These steps guide you through the process of installing Arduino IDE, configuring it for M5Stamp S3, modifying pin configurations, and updating the GeoPosBall code. Make sure to follow each step carefully for a successful update.