Open Drifter Components

1. General Overview

The “Open Drifter” (OD) is a small river drifter developed by the Centre for Biorobotics at Tallinn University of Technology. The OD is an IoT device that can provide real-time estimates of position, travel speed, accelerations, orientations, or magnetic fields using mobile or radio communication at 1 Hz as well as onboard recording at 5-10 Hz. These properties make the drifter an ideal tool for the instantaneous characterization of small to large river streams.

The OD is developed with low-cost open source software and hardware which makes affordable the scalability of its production.

Figure 1. First prototype of the Smart Geo Particle drifting in the Pirita River.

2. Specifications

The OD consists of two well-differentiated modules: 1) The sensing and onboard data logging module and 2) the data transmission module. The first one manages the data collection from the GNSS (Global Navigation Satellite System) and the IMU sensor (Inertial Measurement Unit) and it saves in a SD card at 5 to 10 Hz in ASCI text file format. The second module is subscribed to the data collected by the first modulo via serial communication and it transmits via a GSM (Global System for Mobile Communication) at 1 HZ using MQTT protocol (a machine-to-machine communication protocol) or via Radio to a Gateway.

Using the GSM and MQTT protocol any number of machines (Computer or other microcontroller boards) can be subscribed to the messages sent by the drifter. When using the radio de gateway will collect the data and transmit it to the MQTT network if the internet connection is accessible.

Table 1 list all the components of the drifter. Future versions of the OD may differ in components.

Table 1. Electronic components of the OD.

Microcontroller	Atmel ATSAMD21G18, 32-bit ARM Cortex-M0+
GNSS module[1]	NEO-M8T / NEO-M8N
Inertial measurement unit	BNO005
Real time clock	DS3231
Storage sampling rate	5-10 Hz
Capacity	Up to 256 GB

Battery	Default: 2 X 18650 rechargeable lithium batteries
Voltage	3.7 v (lithium batteries)
Battery duration	>24 h
Weight	0.35 kg
[1]Cheaper GNSS modules can be used alternatively	

Table 2. GSM communication module.

Communication module - GSM	
Microcontroller	Atmel ATSAMD21G18, 32-bit ARM Cortex-M0+
GSM module	SIM800L
Transmission Sampling rate[1]	1 Hz

Table 3. Radio communication module.

Communication module - Radio	
Microcontroller	Atmel ATSAMD21G18, 32-bit ARM Cortex-M0+
Radio module	RFM95
Transmission Sampling rate[1]	1 Hz

The housing may vary according to the characteristics of the river stream. In the current configuration the electronics are in a 70 x 102 x 12 mm case (IP68). Alternative housing could be easily accessible plastic food containers.

The reader is pointed out to the datasets of the modules to have the accuracy characteristic of each component.

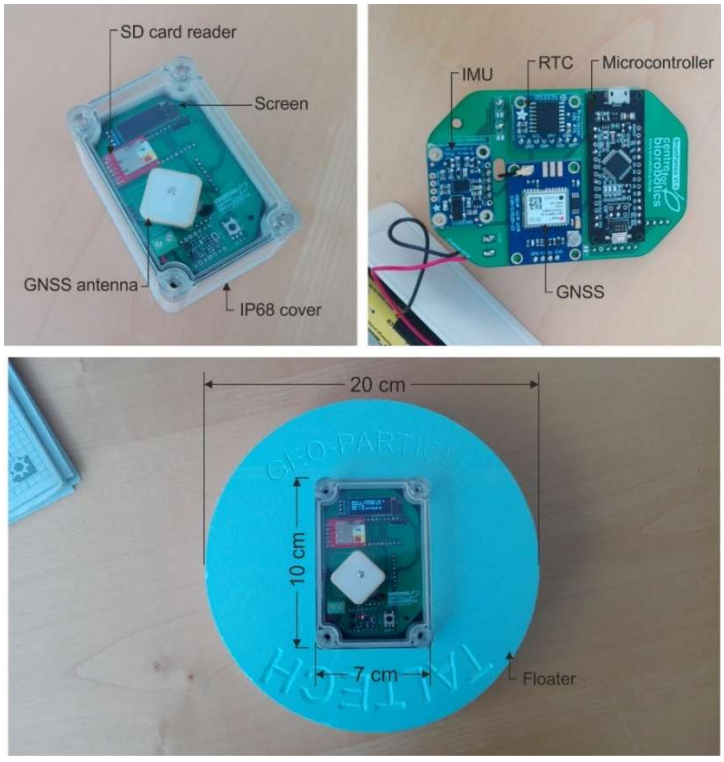

Figure 2. Principal Component of the OD.

Cost and components

Table 4 summarizes the cost of the components to mount one OD. It is worth mentioning that the GNSS module can be easily substituted by a GPS module NEO-M8N of 9.60 EUR and it will reduce the cost exponentially (Total = 87.25 EUR).

Table 4. Cost analysis of the SGP.

Module	Price (EUR)	Origin	Link
GY-GPSV3-M8T (GNSS)	68.52	AliExpress	web
SAMD21 Mini	8.03	AliExpress	web
LCD Display	1.89	AliExpress	web
Pololu	3.98	TME	web
RTC 3231	12.18	Mouser	web
Battery holder	4.14	Mouser	web
2 batteries 18650	21.74	Keeppower	web
PCB	2.30	ALLPCB	web
BN055	7.96	AliExpress	web
Push bottom	0.50	Mouser	web
SD holder	0.54	AliExpress	web
SD	8.00	AliExpress	web
Cover	6.40	AliExpress	web
TOTAL	**146.17**		

The total component cost of the communication modules is summarized in the following tables,

Table 5. Cost analysis of the communication GSM module

Module	Price (EUR)	Origin	Link
Itsy bitsy	10	Mouser	web
PCB	2.30	ALLPCB	web
SIM800L GPRS GSM Module	3.68	AliExpress	web
TOTAL	**15.98**		

Table 6. Cost analysis of the Radio module.

Module	Price (EUR)	Origin	Link
Feather Lora module	30.52	Mouser	web
TOTAL	**30.52**		