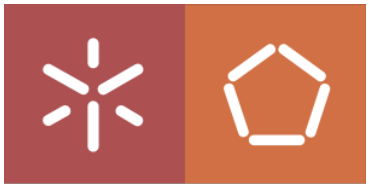

Universidade do Minho
Escola de Engenharia

Master's in Industrial Electronics and Computers Engineering

University of Minho

5S Drifter

Sensoring System for Surface Sea Streams

Integrative Project in Industrial Electronics and Computers

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Acronyms

UART Universal asynchronous receiver/transmitter

LTE Long-Term Evolution

ADC Analog to Digital Converter

IMU Inertial Measurement Unit

PCB Printed Circuit Board

CMEMS Center for Microeletromachanical Systems

STM32

DMA Direct Access Memory

IoT Internet of Things

GPS

Jason

DB Data Base

Chapter 1

Project Plan

This chapter will briefly talk about the 5S Drifter project motivations as well their function as a product developed by the Minho's University

1.1 Introduction

Under the course unity of Integrative Project in Industrial Electronics and Computers the students must apply for professors projects in order to integrate unde their respective laboratories and start to undertand the pace demanded on the Master's final paper.

This project is given by the professor Luis Gonçalves and Sergio Lopes unde the CMEMS laboratory has the main porpouse to create a drifter for data aquisition. As a multi-themed project, this report will explore multiple areas, as the PCB design for hardware and firmware manufacture, software design under the idea to optimize the execution allowing for better performance. The main goal is to have the final product afloat at the end of the simester.

1.1.1 Problem Statement

The ocean is one of the man greatest mistery even before the written history. Humanity made the world ours over the water, from the Portuguese greatests discoveries, braving the raging ocean to the newst oil tanker demanding ever newer technology in order to tame the sea for safer and smother sailing.

Nowadays cientists belive only 5% of the ocean is discovered with the actual technology witch means that humanity know as much about our so grate sky as our own seas. 5S ocean drifter is a equipament made to acquire date from superficial sea streams and expand the oceangrapgh knowledge about it.

Better knowledge of the ocean lead to further development in diverse areas. Granting safety, security and efficiency.

Transport

Sadly, ins't incommun to see transport accidents be reported and even worse for it to be a gigant problem. Some of them are caused from the poor mapping of sea conditions. Tankers spiling oil, fishing vessels getting capsized causing deaths. Even when there are no accidents, the poor knowledge from the tides lead to higher consumes of energy once the route is setted against the streams.

A solution would be to create optimized shipping routes, minimizing accidents, and improving energy consumption in order to traverse the waves.

A famous example of area to be carefull would be the Nazaré Canyon's as their unic shape create enormous waves.

Ecology

Fishing efficiency
Habitats
Renewable Energy

Oceanograpy

Better undertanding of the Iberian Poleward Current (IPC)

Geology

Know where the sedimentation is leading to

Sports

1.1.2 Problem Statement Analysis

vila do conde + ou - 10km mar adentro 2g 4g

mapa de alcance na costa

atenção ao clima

latencia / sampling / tamanho do cartão sd
autonomia de NO MINIMO 5 DIAS
consumo max 30mA
distancia da antena e da água
IMU caso tenha espaço para o consumo
SD memoria local
ADC a bateria
sensor de temperatura
database mongo db

Chapter 2

Analysis

2.1 Requirements and Constraints

2.1.1 Requirements

- Search and selection of hardware components.
- Software design.
- PCB design.
- 5S outer shell 3D design.
- Actual product realization.
- Laboratory tests.

2.1.2 Constraints

- The project must be presented for avaluation within deadline.
- The project has to be valitated at the ocean.
- The pretended autonomy has to be of a mouth at minimum.

2.2 State of the art

2.2.1 Economy

2.2.2 Ecology

2.2.3 Sports

2.3 Market Research

2.4 System Architecture

Chapter 3

Design

3.1 Analysis Review

3.2 Hardware Consumption

Here will be discused wicht hardware is best sued for the task. The hardware will be evaluated by their autonomy, the comunication protocol

3.2.1 Autonomy

As for the autonomy there are two main factors to consider, the batteries and the board consumption

Batteries

google sheets

Board Consumption

table

SIM7600 table 6 and 34 (pg 20 and) same voltage 2 SIM7020 peak 2A 20u in sleep mode 150mA

SIM7000 (GPS por NB-IoT e 2G fallback) Consome: 11mA

SIM7080G - Nb-IoT Quectel BG77

Quectel BG95-M3

GPS MAX-M10S

IMU BMI088 IMU Sensor accelerometer 15uA / and Gyroscope 2.7mA ISM330BX 0.19mA / 0.6mA BMI270

Unix Steptime

3.2.2 Communication protocol

table EVKITST87M01-1 nb-iot SIM7600 2g 3g 4g LTE CAT4

simbase chip availability

europe coast 2g 4g

Portugal	2G	3G	4G	5G	LTE	NB-IoT
Meo	V	V	V	–	–	–
Nos	V	V	–	–	–	–
Vodafone	V	–	V	V	V	–

3.2.3 Conclusion

3.3 Case Construction

3.4 Hardware Specification

3.4.1 SDCard

3.4.2 STM32

STM32L010K4T6 microcontroler ADC UART SPI ONEWire

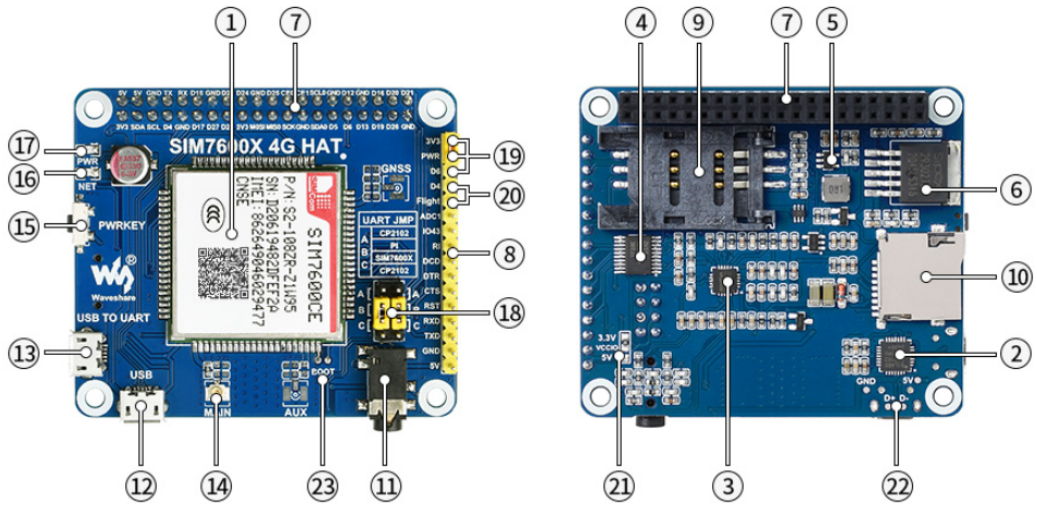
3.4.3 BMI088 IMU Sensor

gyroscope and acelerometer

3.4.4 SIM7600E-H

The module SIM7600E-H, developed by SIMCom, is a 4G/3G/2G LTE module that comunicates via UART commads using an intern parser described on the module datasheet. The waveshare Board with the module, comes with a set of extra functionalities for extra support to the module normal usage.

The following image, taken from the Waveshare board datasheet, lists the hardware features.



1. SIM7600CE-CNSE
2. CP2102 USB to UART converter
3. NAU8810 audio decoder
4. TXS0108EPWR voltage translator
   - translates 3.3V/5V into 1.8V
5. MP2128DT power chip
6. SPX29302 power chip
7. Raspberry Pi GPIO header
   - for connecting with Raspberry Pi
8. SIM7600 control interface
   - for connecting with host boards like Arduino/STM32
9. SIM card slot
   - supports 1.8V/3V SIM card
10. TF card slot
    - for storing data like files, messages, etc.
11. 3.5mm earphone/mic jack
    - for audio actions like making telephone call
12. USB interface
    - for testing AT Commands, and so on
13. USB TO UART interface
    - for serial debugging, or login to Raspberry Pi
14. MAIN antenna connector
15. Module power switch
16. Network status indicator
17. Power indicator
18. UART selection jumper
    - A: access Raspberry Pi via USB to UART
    - B: control the SIM7600 by Raspberry Pi
    - C: control the SIM7600 via USB to UART
19. PWR selection jumper
    - PWR - 3V3: auto startup on power-up
    - PWR - D6: startup/shutdown by the Raspberry Pi D6 pin
20. Flight mode selection jumper
    - NC by default, no flight mode control pin
    - Flight - D4: flight mode is controlled by the Raspberry Pi D4 pin
21. Operating voltage selection jumper
    - VCCIO - 3.3V: set operating voltage as 3.3V
    - VCCIO - 5V: set operating voltage as 5V
22. USB connector solder pads
23. BOOT forced programming solder pads

Figure 3.1: SIM7600 datasheet

The hardware configurations, as idicated on the datasheet should follow the leading steps.

As for the UART communication, the list of commads are listed on the datasheet. As for better flow, here are listed the commadsused along the project and their functionalities.

3.4.5 Temperature

DS18B20

3.5 Tools and COTS

3.5.1 Tools

3.5.2 COTS

GPS and 4G module

Inkscape

draw.io

STM32 CUBEmx

LaTeX

3.6 Software Specification

3.7 Theorical Concepts

Chapter 4

Implementation

4.1 Hardware

4.2 Software

use DMA to sample withou using the cpu
separar funções do IMU e GNSS para não atrapalhar um ao outro.

4.2.1 DataBase Comunication

Mongo db
JASON

Chapter 5

Conclusion

5.1 Gantt Diagram

5.2 Bibliografy

5.3 Special Greatings

At last it's important to add the support from the CMEMS labs personal as well of the professor Tiago Matos for his support with hardware decisions and previous knowledge from similar projects.