Design and Simulation of a COTS-based Electrical Power System for HABs in Stratospheric Environment

A Preliminary Study

Josué Aldana

Micro-Macro Observatory
Don Bosco University
El Salvador

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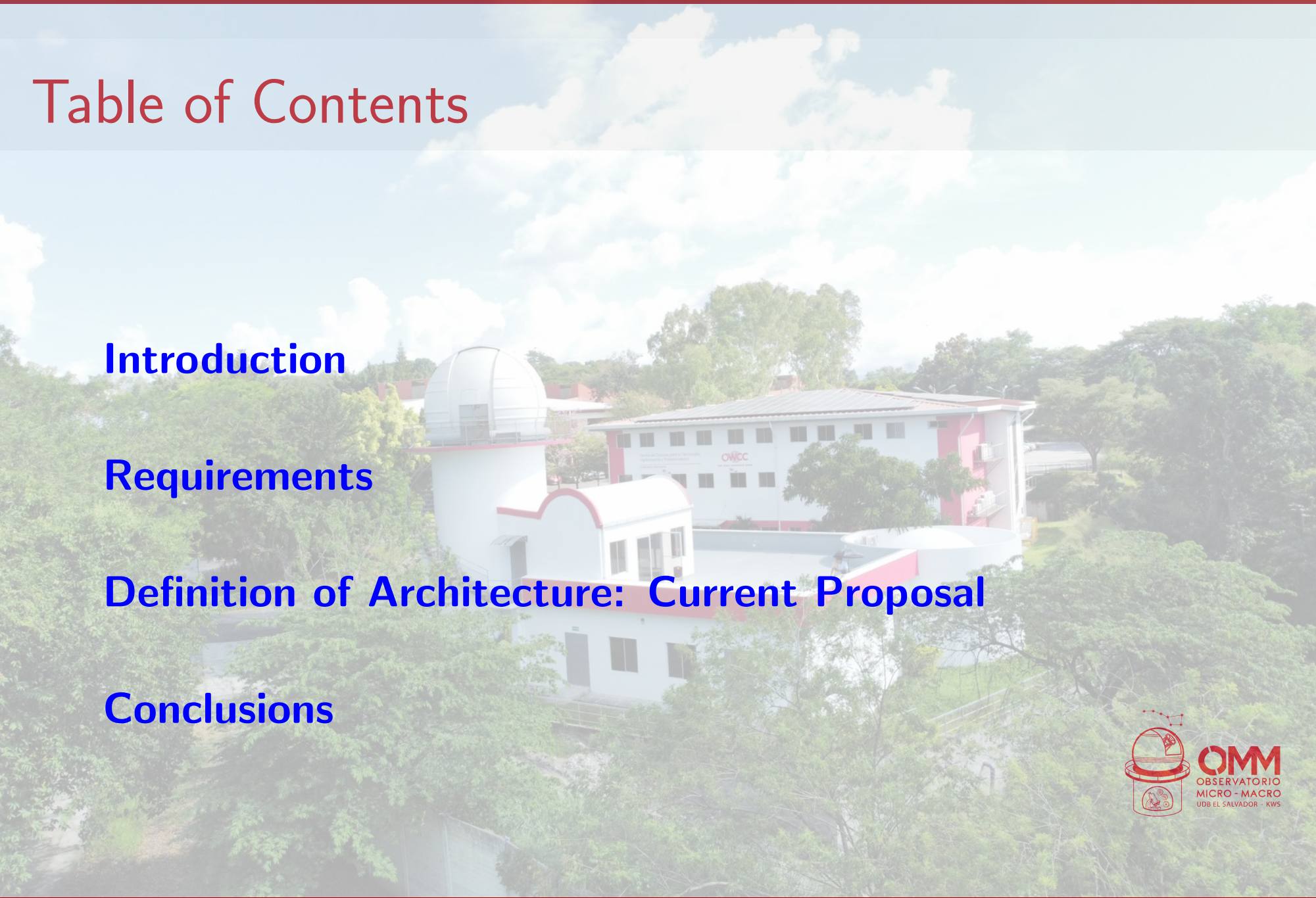

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Introduction

High-Altitude Balloons provide a strategic path for space exploration. My work centers on enhancing EPS for brief missions, employing NASA's V-model methodology.

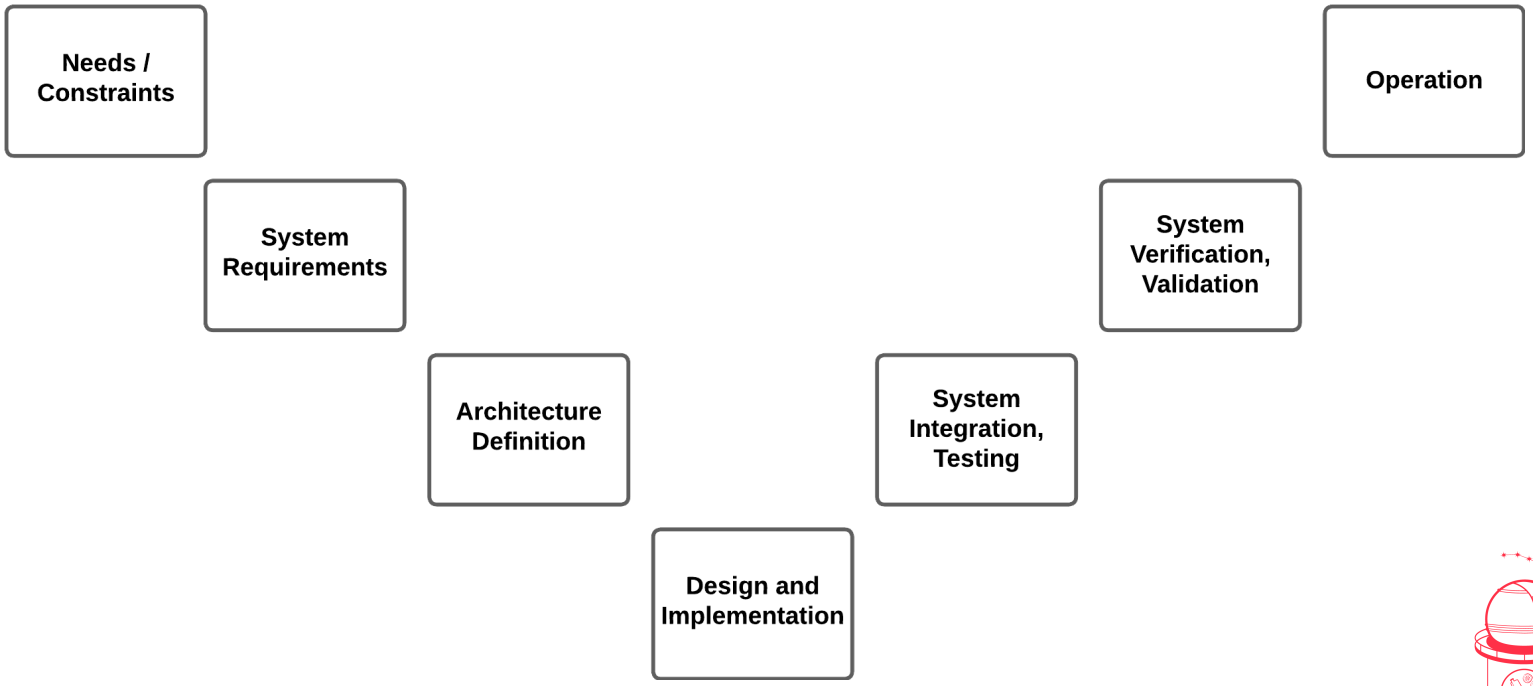

Fig. 1: V-model based on NASA Systems Engineering Handbook (2016)

Requirements

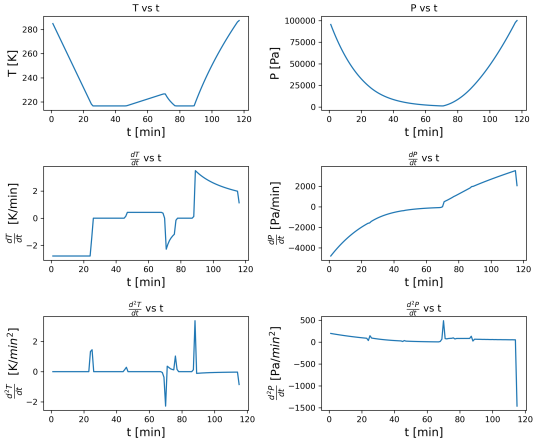

Fig. 2: Environmental Variables

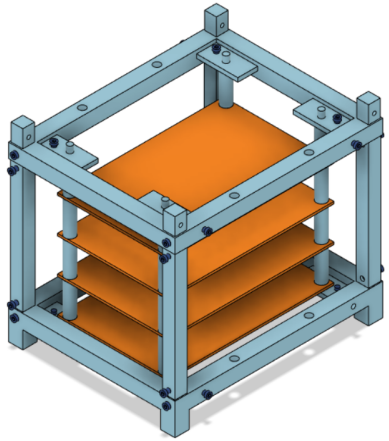

Fig. 3: 3D Printing Module

Fig. 4: Trajectory simulation

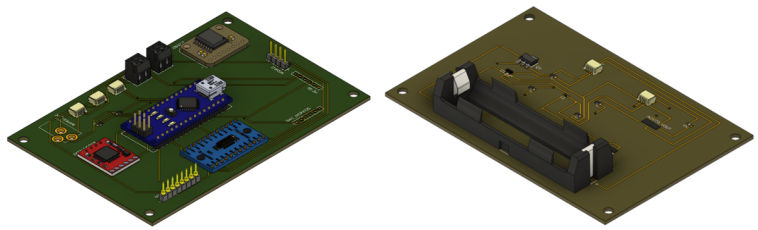

Fig. 5: Battery Test circuits

Requirements

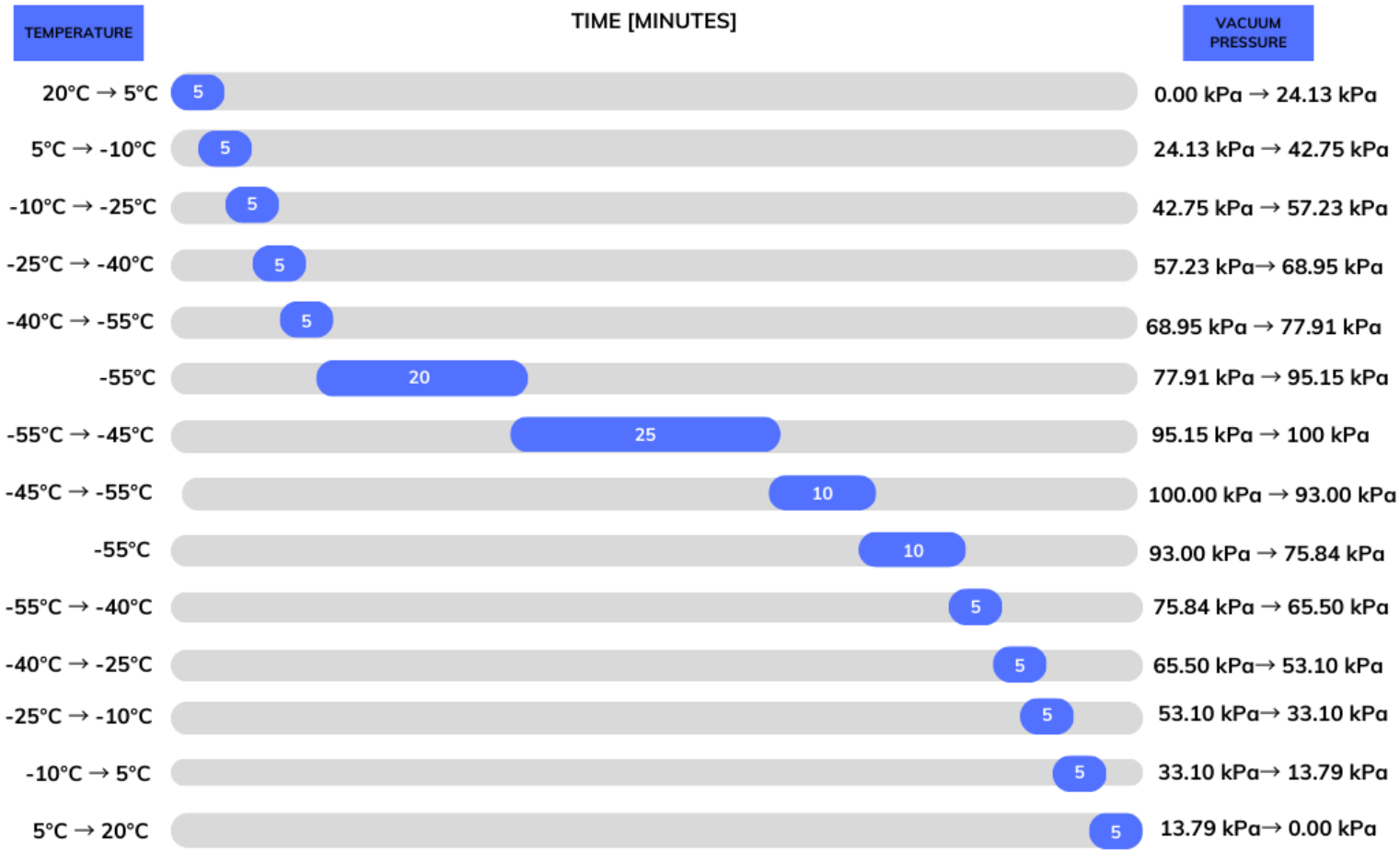

Fig. 6: Environmental variables in a HAB trajectory

Requirements

ID	Description	Justification	Verification Mechanism
R1	Vacuum thermal resistance	Simulation results	Thermal vacuum test
R2	EPS should provide a 3.3 V $\pm$ 1% power line with a maximum current of 983.1 mA $\pm$ 1%	Power bus	V and I measurement
R3	EPS should provide a 5.0 V $\pm$ 1% power line with a maximum current of 396.30 mA $\pm$ 1%	Power bus	V and I measurement
R4	Max. 600 g	Mass limitation	Weighing measurement
R5	Max. 2 module levels	Space limitation	Observation
R6	Record V [V] and I [mA]	Mission objective	Data recording test
R7	Record T [°C] and P [atm]	Mission objective	Data recording test
R8	Capture IR images	Mission objective	Data recording test
R9	I2C communication	Subsystem integration	I2C communication test
R10	Load modulation	EPS operation modes	Modulation test

Table: Requirements of the EPS

Architecture Definition

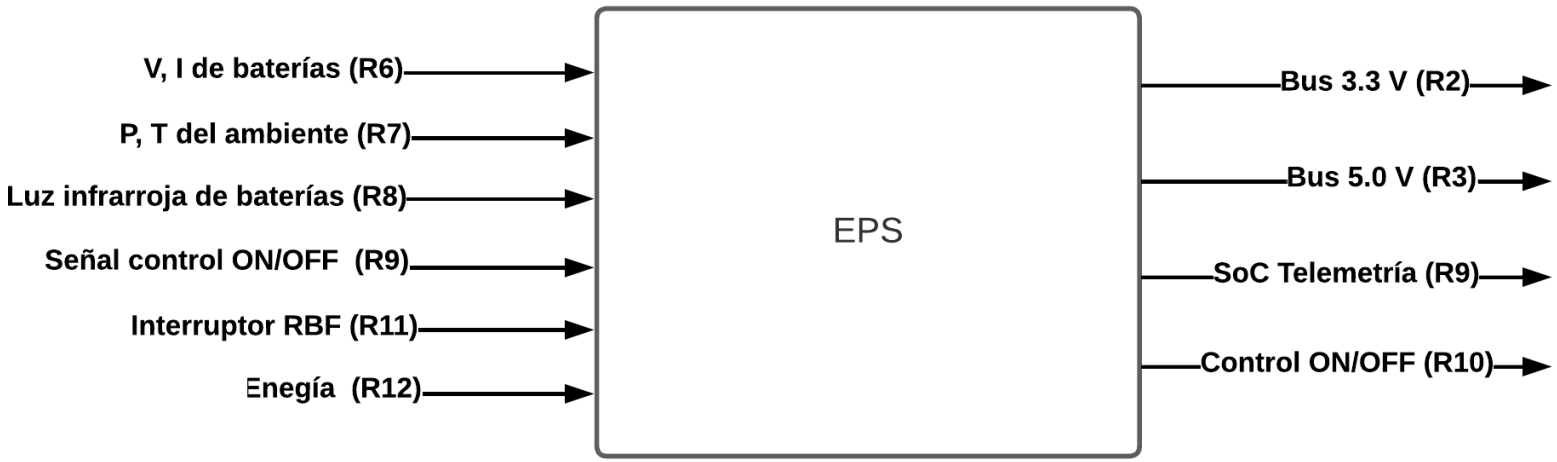

Fig. 7: Functional Decomposition Level 0

Architecture Definition

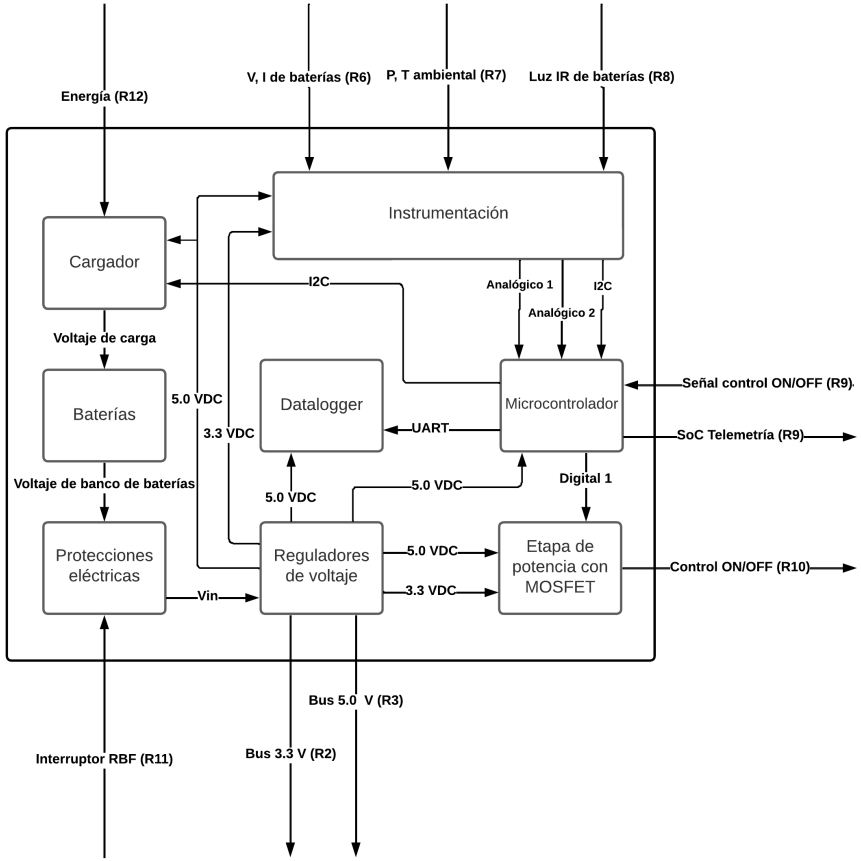

Fig. 8: Functional Decomposition Level 1

Architecture Definition

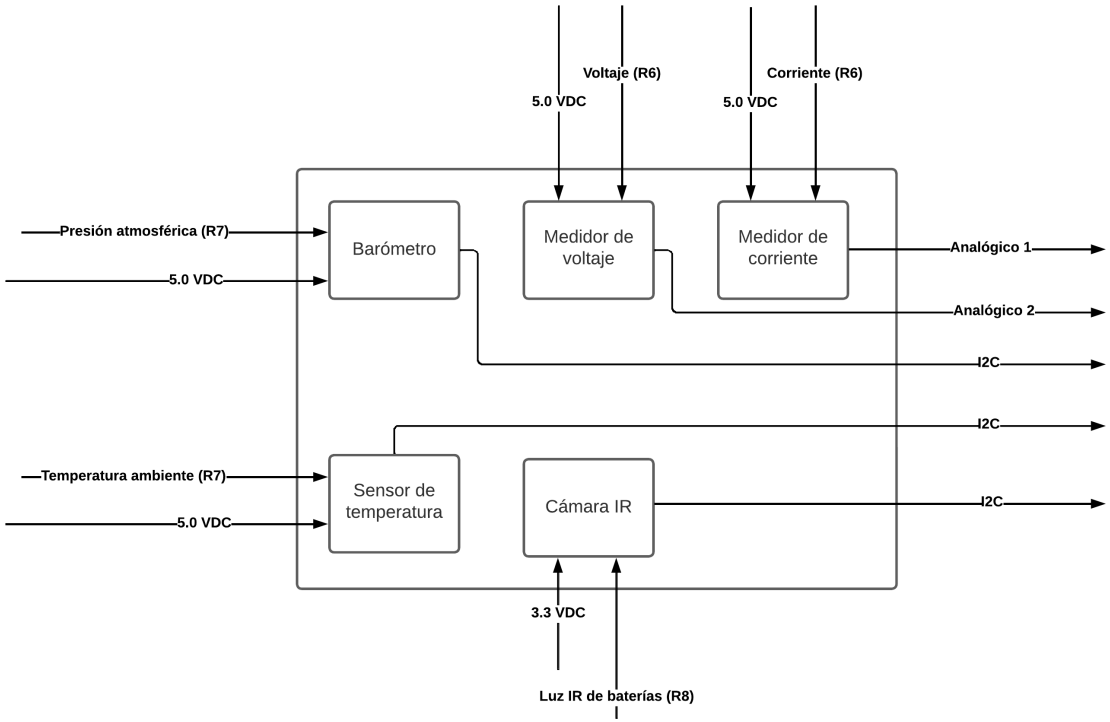

Fig. 9: Functional Decomposition Level 2

Thanks!

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Josué Aldana
Salvadoran student

Researcher in the Making...

Contact me:
jaldana.aguilar@ieee.org

Follow me:

AJ23A

@ajr23a

Josué Aldana