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EMBEDDED HARDWARE DESIGN AND DEVELOPMENT GUIDE OF AN ON-BOARD COMPUTER FOR ACADEMIC CUBESAT MISSIONS

Abstract

The democratization of space was improved with the release of the CubeSat standard, which has enabled a wide range of developing countries to design, develop and launch satellites into space in a very accessible and affordable way. Initiatives such as the KiboCUBE program, a partnership between the United Nations Office for Outer Space Affairs (UNOOSA) and the Japan Aerospace Exploration Agency (JAXA), have played a crucial role in promoting the New Space, by providing research institutions in developing countries with opportunity to deploy their CubeSat from the International Space Station (ISS). Awardees include Guatemala's Quetzal-1 (launched in 2020), and MRZ-SAT.

In the development of CubeSats missions where there is a lack of expertise in satellite design, the use of commercial off-the-shelf (COTS) parts in critical subsystems is essential to ensure the scientific mission fulfillment and to facilitate it development. One of the critical subsystems of a CubeSat is the On-board Data Handling (OBDH), considered the brain of the CubeSat in charge of the interconnection of all the subsystems, managing all the data. One of the main components of OBDH is the On-Board Computer (OBC), which consists of multiple electronic components such as a microcontroller/microprocessor for data processing, volatile/non-volatile memories for data storage, and the connector to the backplane, among others. In the design of the Quetzal-1 and MRZ-SAT CubeSats, the use of OBC COTS was chosen.

This paper provides a starting point for the development of the embedded hardware of a OBC for a 1U CubeSat so that it can be implemented in future academic CubeSat missions. The design of the embedded hardware of the OBC starts with the analysis of the data budget, processing budget, storage budget, and transfer budget of the CubeSat, in order to establish the minimum requirements of the electronic components that will conform the OBC, without leaving behind the consideration of the power budget. This will be followed by the design, fabrication and validation of the printed circuit board (PCB) of the OBC. Finally, the key aspects of the other components that make up the OBDH, the backplane and flight software, will be briefly discussed.