Editorial Corner

CubeSat as a Tool for Hands-on Engineering Education and Research

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A CubeSat is a cube-shaped pico-satellite typically made up of one or more 10 cm × 10 cm × 10 cm units. Each of these units has a mass of roughly one kilogram. In addition, its developer often uses Commercial Off-The-Shelf (COTS) electronic and structural components to reduce development costs. The history of CubeSats began in 1999. The initial design specifications were proposed by Jordi Puig-Suari of California Polytechnic State University and Bob Twiggs of Stanford University. The specifications have changed over time, and the current ones can be found online [1]. The original objective of constructing CubeSats is to provide students with experience in designing, building, testing and operating real satellites. The first group of CubeSats were launched on June 30, 2003 from the launch site in Plesetsk, Russia [2]. Nowadays, approximately 1,027 CubeSats have been launched [3]. Many of them are boasted as nation's first satellites.

This article is based on lessons we learned from KNACKSAT project [4]. KMUTNB Academic Challenge of Knowledge SATellite (KNACKSAT) is a 1-Unit CubeSat funded by Broadcasting and Telecommunications Research and Development Fund for the Public Interest, Office of The National Broadcasting and Telecommunications Commission (NBTC), Thailand. It is the first satellite entirely built in Thailand and also entirely by a university-student team. The satellite was successfully deployed into 575-km sun-synchronous orbit on December 3, 2018 [5]. The first signal was received about nine hours after deployment.

This three-year project demonstrated that Cubesat is an effective tool for training our students to become hands-on engineers and for establishing some research foundation in space systems related fields. The possible research fields include power system management, antenna design, attitude control, miniaturized attitude sensors, attitude micro-actuators and intelligent flight software.

In our team, there were over 20 students from different engineering disciplines – these include Aerospace, Mechanical, Electrical, Computer, Communication, Mechatronic and Industrial Engineering. They were assigned to be research assistants in the fields related to their disciplines and had been working as a team to achieve one single challenging goal. They had to explore many feasible designs before building a real satellite. Students from one discipline often proposed their best by-the-book solution without considering implementation difficulties from the other disciplines. They would later learn to compromise and come up with a design that satisfied every team member, from every discipline involved. We believe that this is one of the most important skills for engineers and researchers in this industry-4.0 age, since most of their works will inevitably be multidisciplinary in nature. After designing, the students also built and tested their own designed satellite. This is an essential step for the students to become hands-on engineers and researchers. Additionally, since satellites are maintenance-free systems, the students also learned how to work meticulously to achieve zero fault tolerance.

Finally, not only the technical aspects but also the management skills were a key to success of KNACKSAT project. In our project, the students learned to manage their own sub-team and also participate in project management. These help to build the management skills of the students, which will be beneficial for their future works.

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