Development of Nano satellite for Education in Indonesia

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Presentation Outline

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Abstract

Surya University students and lecturers are taking up the challenge to design and develop the first prototype of a Indonesian university nano satellite, (SuryaSat). The mission of this project is to achieve scientific and educational objectives in development of lab scale nano satellite.

Using provided modules and a combination of self-designed payloads will initiate students to become creative and practicing an engineering environment system as well as the components connection of a nano satellite.

The process of this project has been done through basic design and Engineering model. The nano satellite has been tested use High Altitude Balloon and results shows that telemetry, GPS and data communication have been work well based on design objective.
Background

• The initial idea of the project based from our observation that most of the famous universities worldwide have initiated projects to develop micro and nano satellites.
• The design and building of a nano satellite provides an excellent opportunity to integrate and apply the knowledge and skills acquired through the study of engineering.
• Although micro and nano satellites are physically very small, they are nevertheless complex and exhibit virtually all the characteristics of a large satellite - but in a microcosm. With design a nano satellite also can give opportunity to know how to design a large satellite.
Objectives

- Provide students and lecturer the opportunity to learn, design, develop and build nano satellite systems to suit the mission. And involve in satellite construction.
- To create a platform for future scientific space missions and technology development.
Project Scope

- The project mainly focuses on designing a nanosatellite (to be named SuryaSat).
- Mission of this satellite is to test telemetry data in satellite and send to ground station.
- Test a system communication and repeater to send and receive a short data (like SMS) between 2 ground stations.
Methodology

Preliminary Research

Decide Mission Statement

Design and Development Concept

Sub-system Development:
- Payload
- Ground Station
- Communication
- Mechanical
- Electrical
- On Board Data Handling
- Altitude control
- Software
- Thermal Control
Involving the students, in workshop organized by LAPAN and ORARI

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Block Diagram

[Diagram showing various components and connections related to a satellite system, including camera cards, EPS cards, ORC cards, and VHF/UHF radio communications.]
Block Diagram

Communication Bus

Main Module
- Temperature Sensor 1
- Accelerometer Gyroscope Sensor
- Digital Compass Magnetometer
- GPS Module
- Real Time Clock
- SD Card

Battery Module
- Battery
- Battery Gauge Sensor
- Regulator

External Sensor Module
- Temperature Sensor 2
- Temperature Humidity Sensor
- Pressure Sensor 1
- Pressure Sensor 2

RF Module
- RF Transceiver Controller
- Receiver Module
- Transmitter Module
- Amplifier Module
- Antenna

Power Distribution Bus
TECHNICAL SPECS

- **Size satelite:** 100 mm x 100 mm x 100 mm
- **Power:** 1-2 Watt. (By solar cells and Battery)
- **Weight:** 1 Kg.
- **Planning for Orbital duration is 2 years**
- **Height orbital is 650 km**
- **Ground stations system**
- **Communication:**
  - UHF band 420 - 460 Mhz
  - Full Duplex (separate frequency channel for Tx and Rx)
  - 40 Channels Frequency (1Mhz separation)
  - 9600bps RF transmission using GFSK, 2GFSK, 4GFSK
  - x : +20dB Rx : -127dB
- **Support up to 250 nodes ID**
- **Custom protocol and Encrypted.**
- **Orbit target:** Equatorial.
- **Control Station:** Surya University.
Results

Engineering Model of Nano Satellite

- Size: 10cmx10cmx10cm
- Weight: 1-2 Kg.
- Power Consumption: < 0.5W (kondisi normal)
- RF Power: 1-3W
- Payload: GPS, Battery, Environment Sensor.
- Sensors: GPS, sun sensors, temperature, humidity, pressure, compass, 6-axis motion
- Have been tested used High Altitude Balloon ~32km.
Communication Board

- UHF band 420 - 460 Mhz
- Full Duplex (separate frequency channel for Tx and Rx)
- 40 Channels Frequency (1Mhz separation)
- 9600bps RF transmission using GFSK, 2GFSK, 4GFSK
- Tx : +20dB Rx : -127dB
- Support up to 250 nodes ID

Ground Station:

- UHF band 420 - 460 Mhz
- Full Duplex (separate frequency channel for Tx and Rx)
- 40 Channels Frequency (1Mhz separation)
- 9600bps RF transmission using GFSK, 2GFSK, 4GFSK
- Tx : +20dB Rx : -127dB
- Average Transmission range 4km LOS
- Support up to 250 nodes ID
- Direct USB powered
Results

GUI Software

- A. Map View for position tracking & Location (Customised parameters)
- B. Table list View for detail each parameters of the payload
- C. Chart View for data analysis, plotting & comparing
- D. Automatic channel search and setting
- E. Relayed Chatting features to information exchange between ground stations, Logs & Replay feature for history & data analysis.

Payload for Balloon
Results

Antenna Tracker for HAB Experiment

Antenna Tracking Algorithm – Concept Illustration

Antenna Tracking Algorithm – System Flow
Launching Plan

Surya University – LAPAN – JAXA - ORARI

Prototype 2014 → Flight Model 2016 → Rocket JAXA Launching & Operation 2017
Conclusion

1. Using provided modules and a combination of self-designed payloads will initiate students to become creative and practicing an engineering environment system as well as the components connection of a nano satellite. The process of this project has been done through basic design and Engineering model.
2. A flat form of nano satellite for education has been designed and tested use High Altitude Balloon, and the results shows the payload and module work successfully.