Development of Nano Satellite for Education and opportunity to use Kibo space lab

Riza Muhida

SURYA UNIVERSITY

Presented at The 1st Space Exploration and Kibo Utilization for Asia Workshop Thursday, 28 May 2015,
LAPAN Headquarters, Jakarta, Indonesia

Presentation Outline

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- Conclusion

SURYA UNIVERSITY

Abstract

- Surya University is doing research to design and develop the first prototype of a Indonesian university nano satellite. This project presents a nano satellite with a mission to achieve scientific and educational objectives;
- The process of this project has been done through basic design and alpha model. The nano satellite has been tested use High Altitude Balloon and results shows that telemetry, GPS and data communication have been work 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.

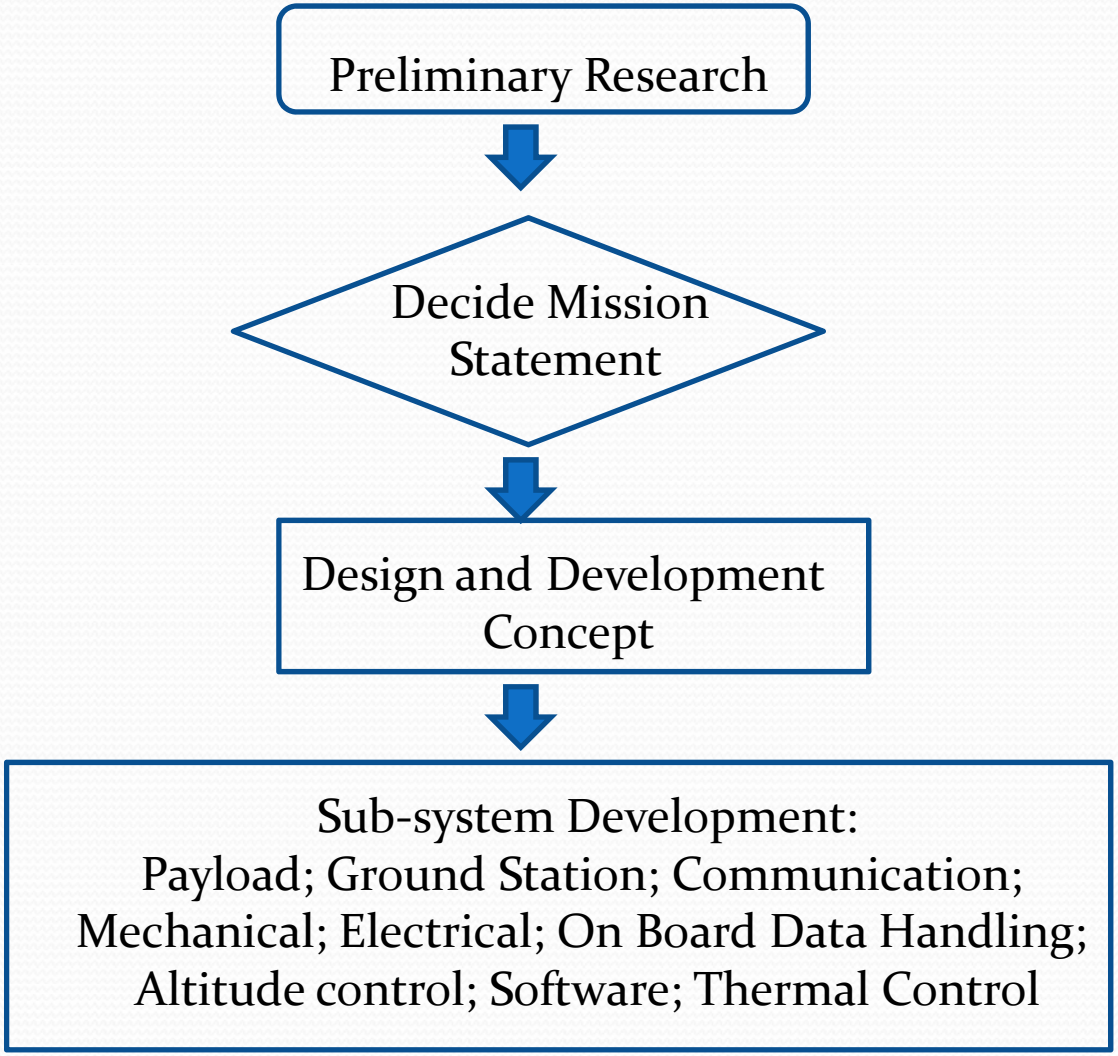
Objectives

- 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

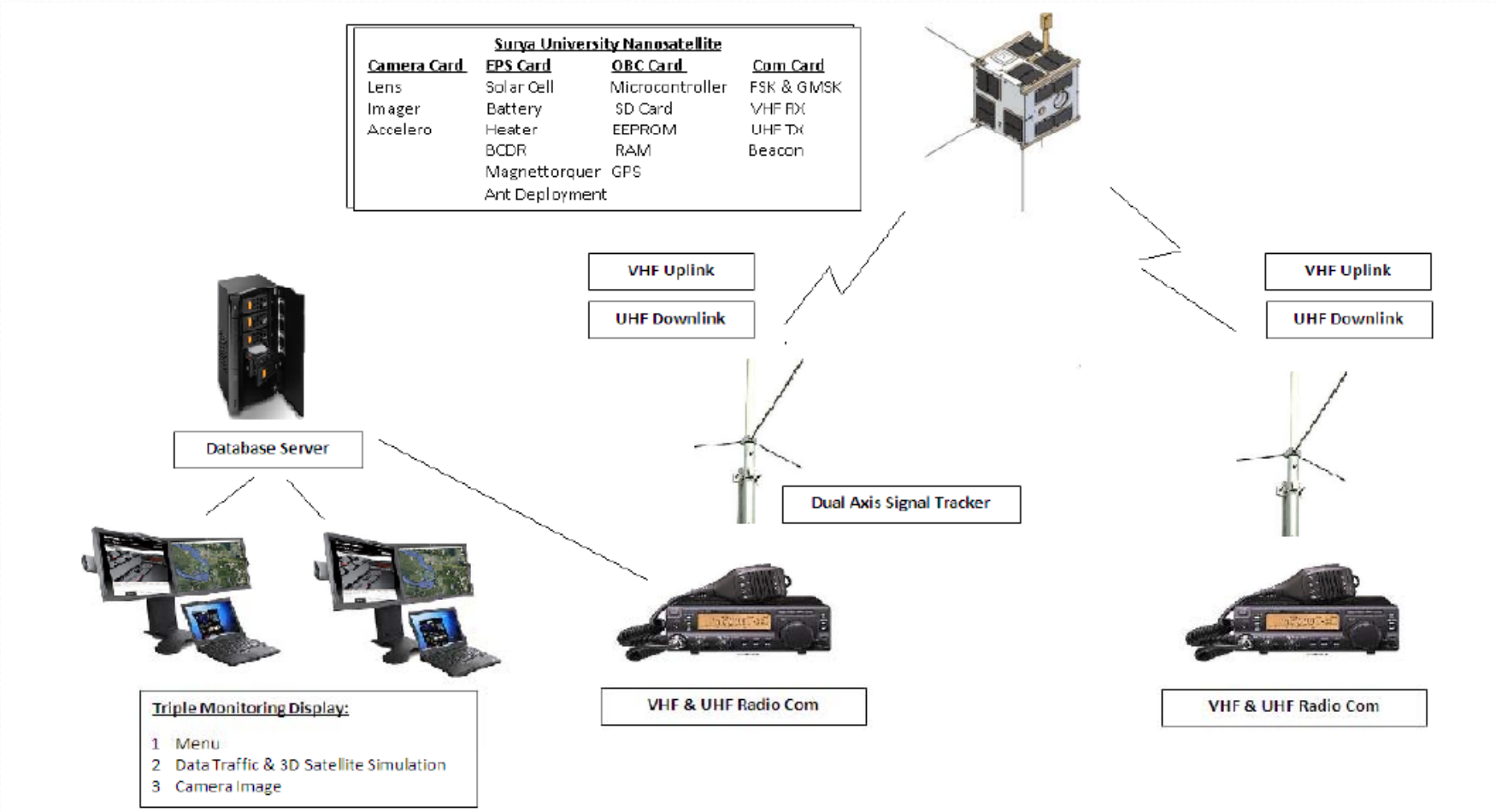
- The project mainly focuses on designing a nanosatellite (to be named SuryaSat).
- Mission of this satellite is to test telemetry data in satellite and send to ground station.
- Test a system communication and repeater to send and receive a short data (like SMS) between 2 ground stations.

Methodology



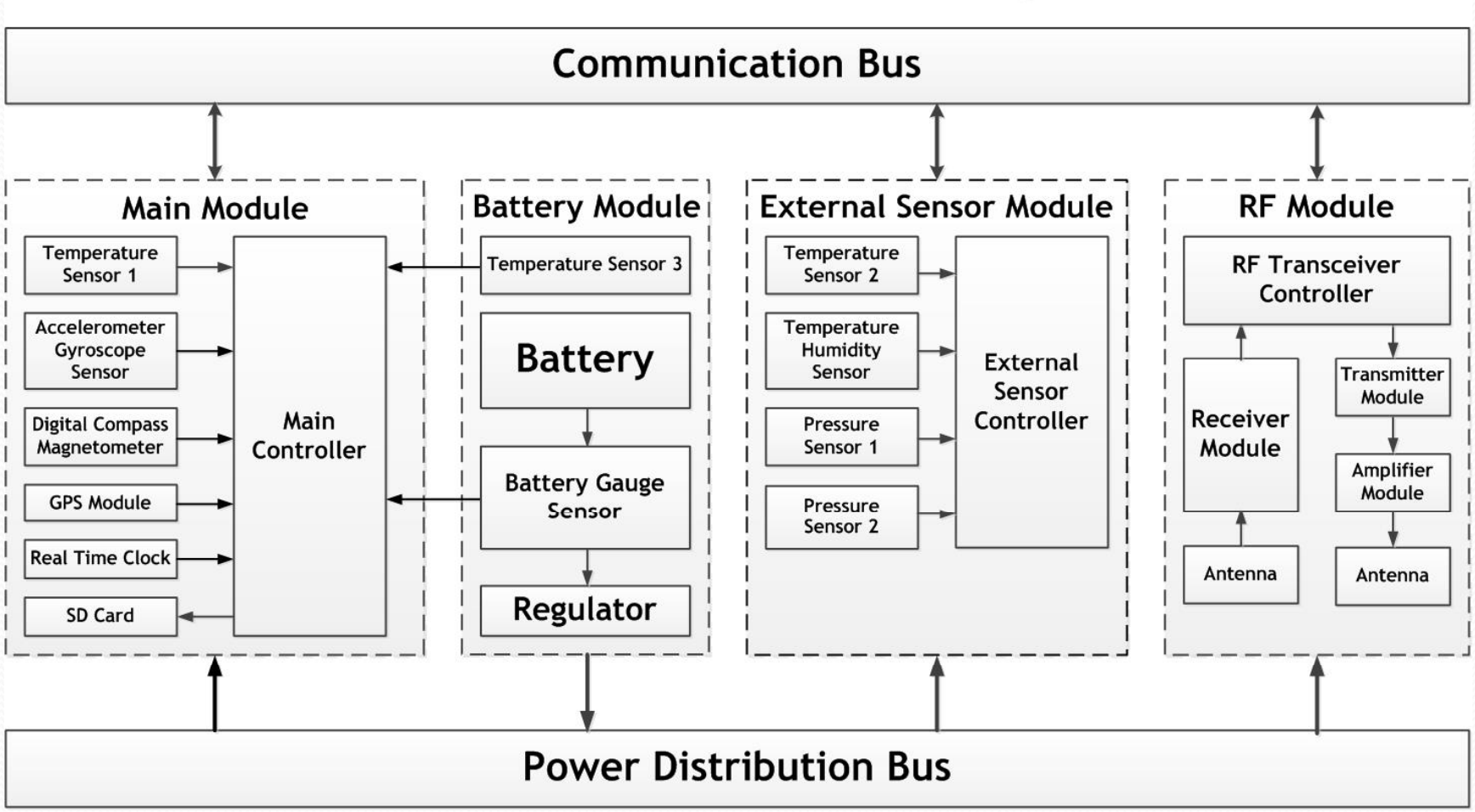
CONCEPT

Block Diagram



CONCEPT

Block Diagram



TECHNICAL SPECS

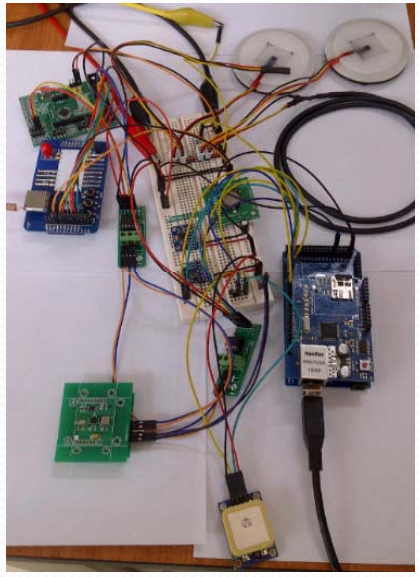
- **Size satelite: 100 mm x 100 mm x 100 mm**
- **Power: 1- 2 Watt. (By solar cells and Battery)**
- **Weight: 1 Kg.**
- **Planning for Orbital duration is 2 years**
- **Height orbital is 650 km**
- **Ground stations system**
- **Communication:**
- UHF band 420 - 460 Mhz
- Full Duplex (separate frequency 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

Alpha Model of Nano Satellite

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

Results

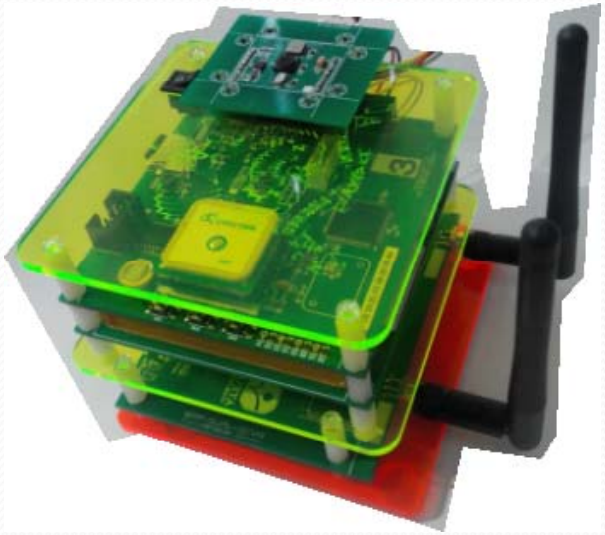


Communication Board

- 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

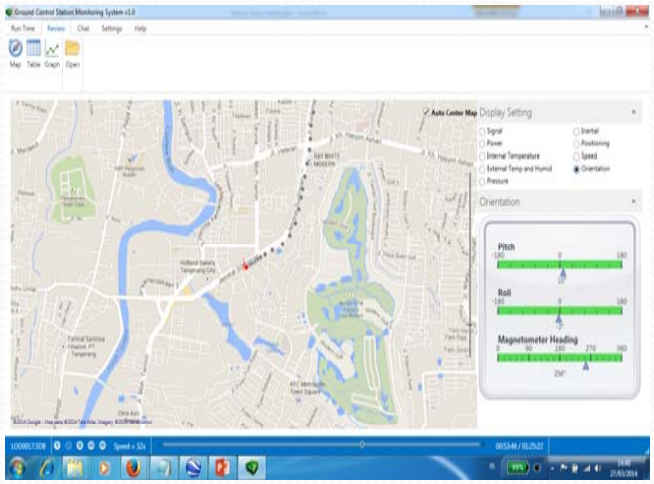
Results



Payload for Balloon

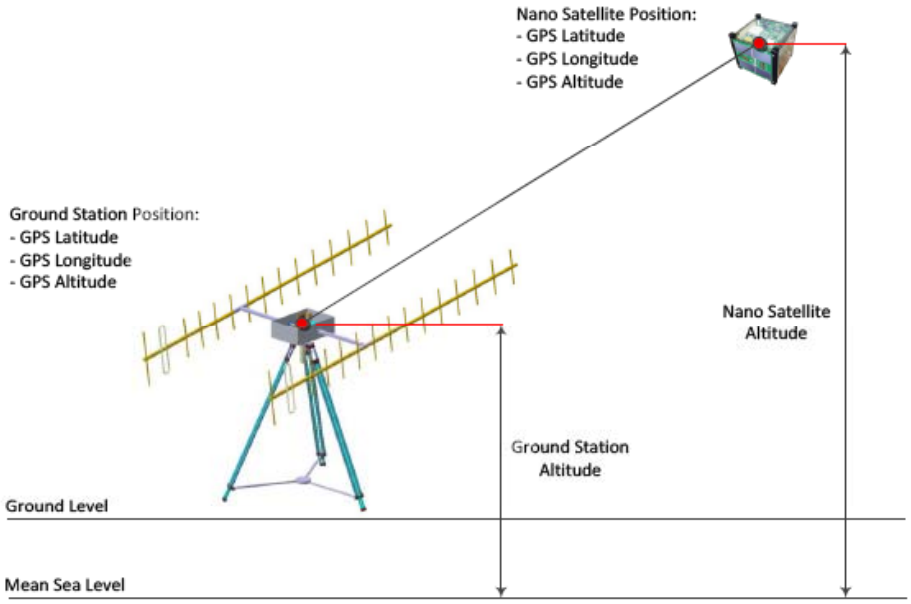
GUI Software

- 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.

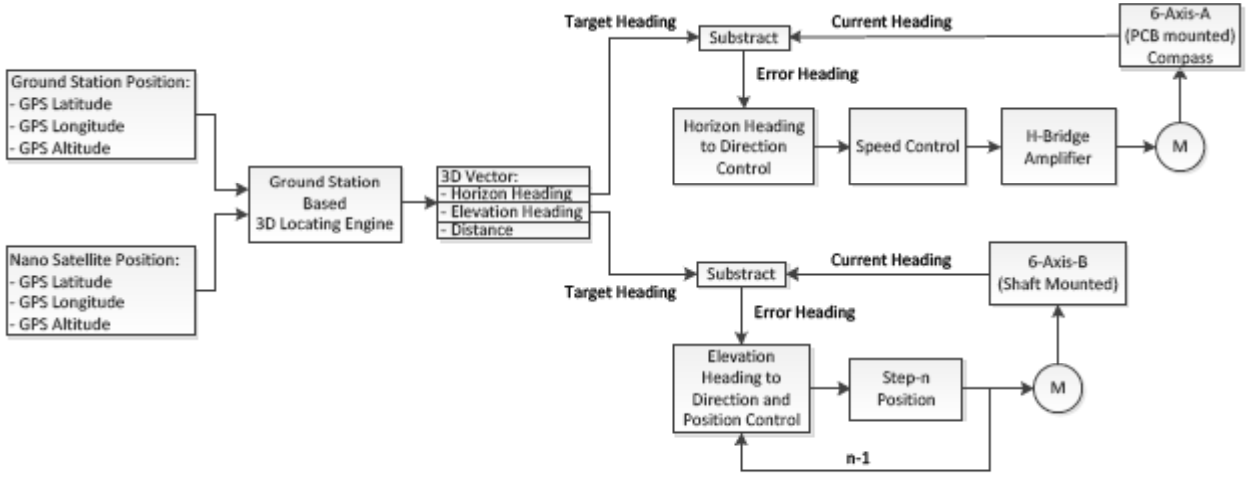


Results

Antenna Tracker for HAB Experiment



Antenna Tracking Algorithm – Concept Illustration

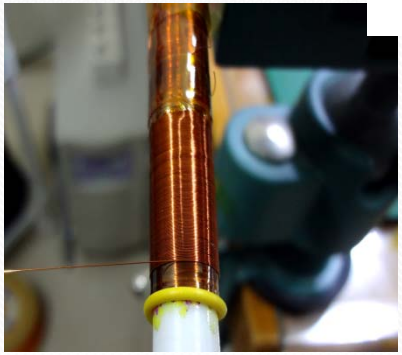


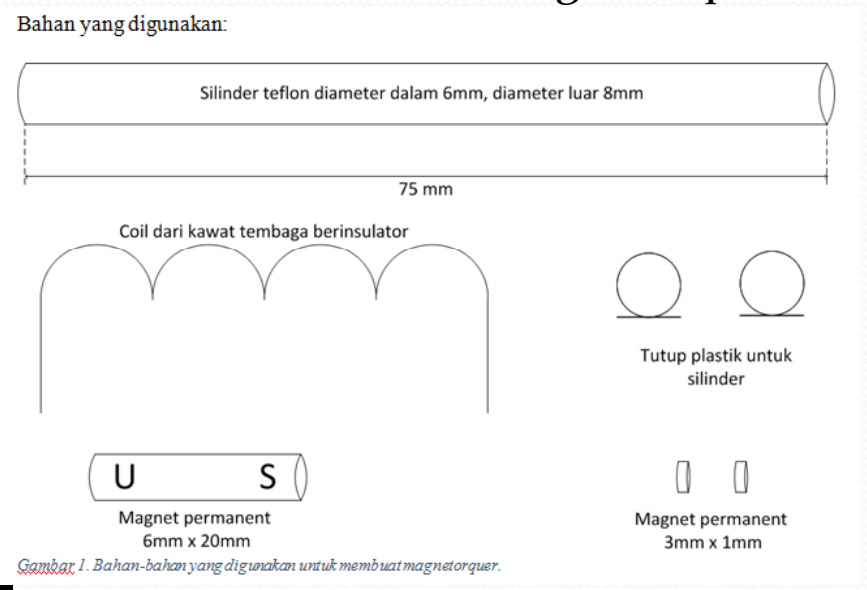
Antenna Tracking Algorithm – System Flow

Opportunity To Use KIBO Space lab

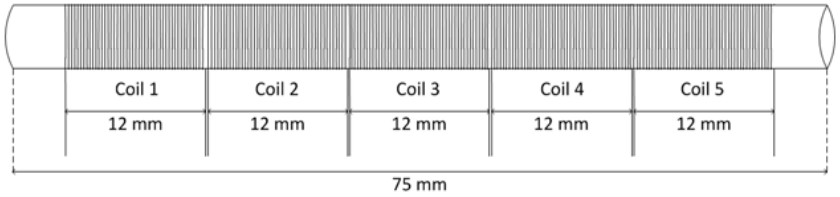
Same experiment we can proposed:

1. Launching our Nano Satelitte
2. Control of Kinetic moving of Nano satellite use Magnetics
   Purpose to control position of nano satellite or robot use magnetorque





Gambar 1. Bahan-bahan yang digunakan untuk membuat magnetorquer.



Gambar 6. 5 buah Coil dengan panjang masing-masing 12 mm

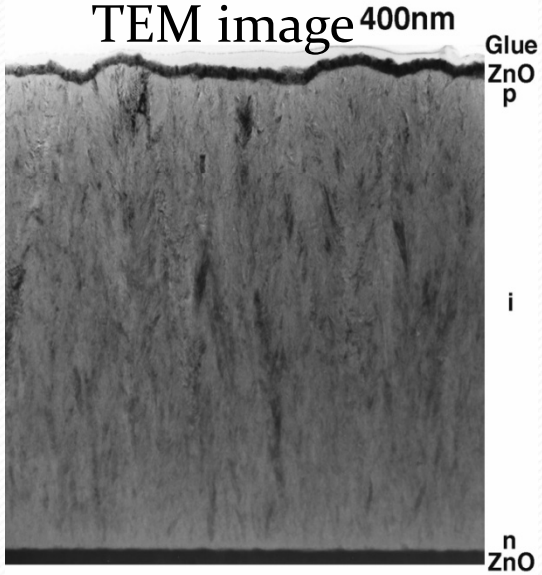
Opportunity To Use KIBO Space lab

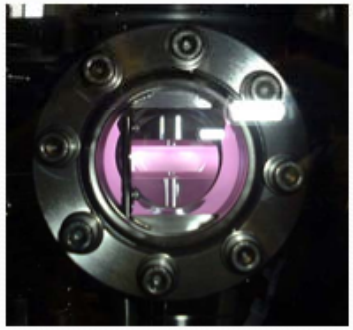
3. Control of crystal grow of silicon under microgravity

Application:

1. To make electronics device in 3D Fabrication, with direction can be controlled
2. Make crystal orientation and control of amorphous condition

Cross sectional TEM image





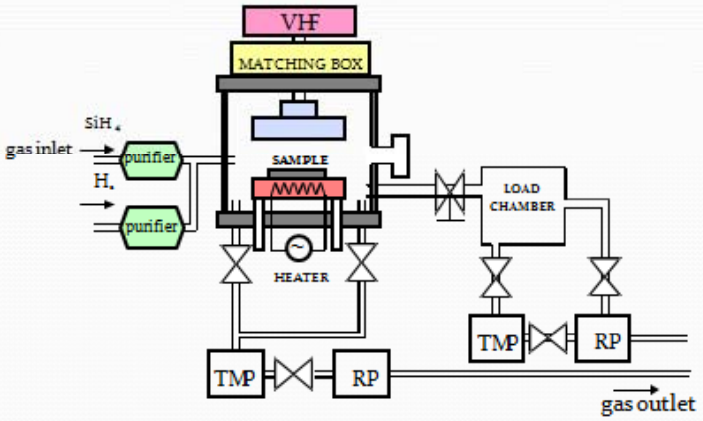
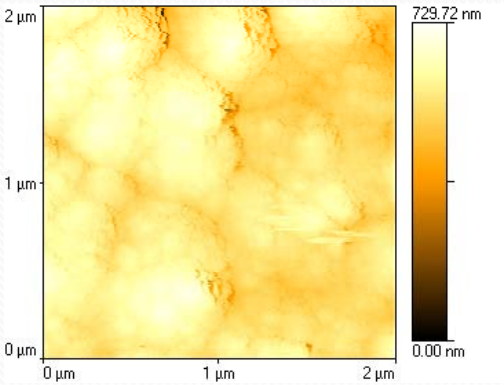
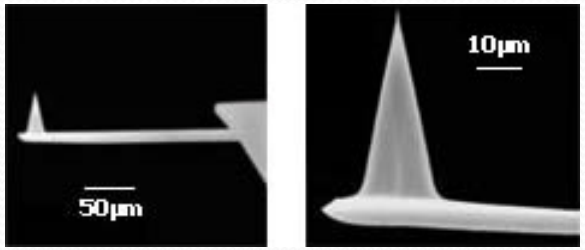
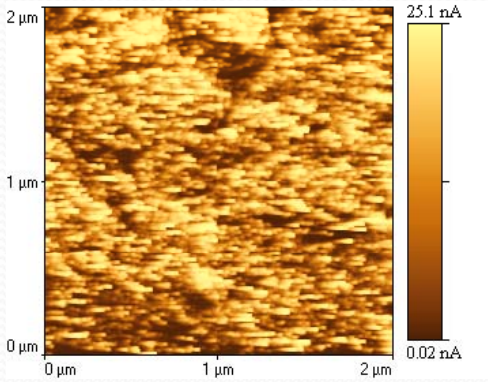


Diagram of VHF PECVD System

Conductive SPM measurement technique







Laser diode

Photodiode

Conductive cantilever (Si/Pt)

Topographic image

Computer

Computer

Current image

Feedback loop

A

Current Amplifier

ZnO

i-layer Poly-Si

Ag

Glass

AFM mode

Local Current Mode

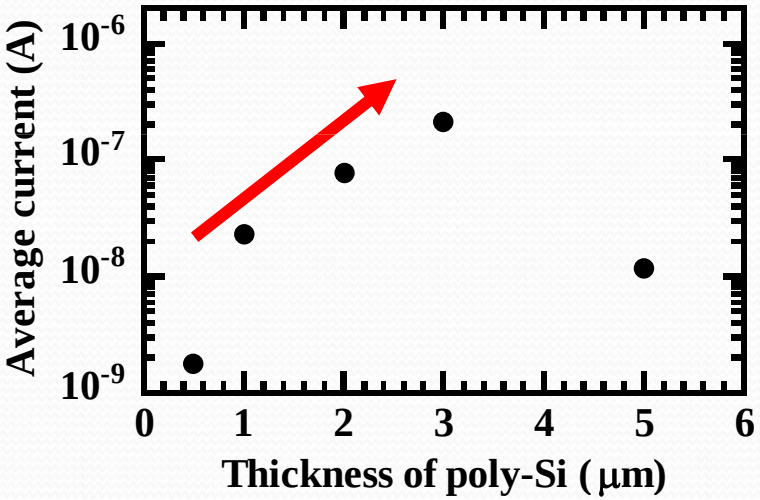
Indium Paste

Piezoelectric actuator (PZT)

Metal sample stage

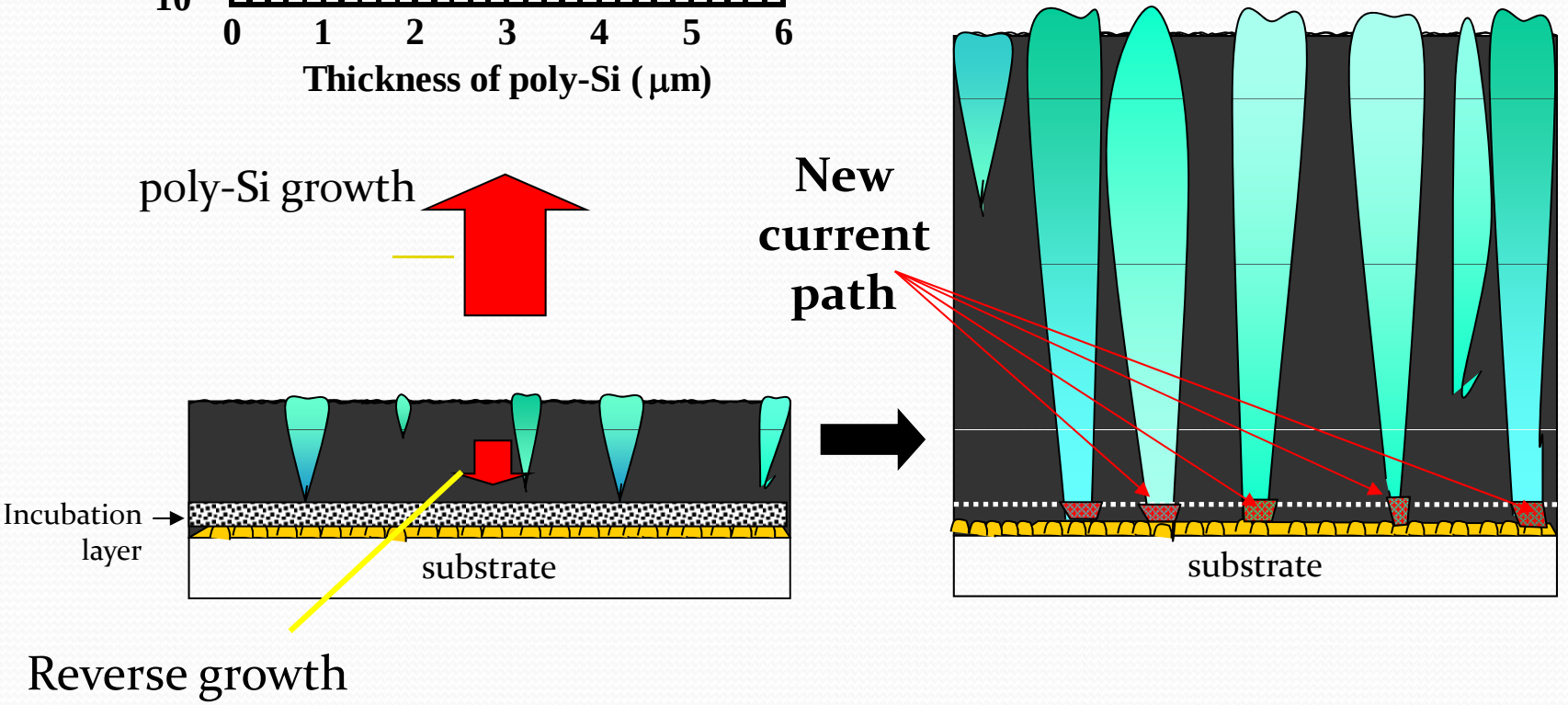
Bias voltage 1 V

Crystal growth model based on TEM and the conductive SPM results in Earth Gravity



Orientation based on Gravity

How about in microgravity?



Conclusion

1. A flat form of nano satellite for education has been designed and tested use High Altitude Ballon, and the results shows the payload and module work successfully.
2. A opportunity to use KIBO Space lab, is for launching our nano satelite and do experiment.