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HASANUDDIN UNIVERSITY, Makassar Indonesia

A COMPACT AND ROBUST TELEMETRY SYSTEMS CONSTRUCTION FOR ENVIRONMENTAL OBSERVATIONS

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UNHAS
Telecommunication, Radio and Microwave Laboratory (TMRL), Hasanuddin University, Makassar, Sulawesi Selatan, Indonesia

Outline of Talk

1. Introduction (1)

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Why and how is "Telemetry System" ?

➔ **Telemetry** is the highly automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring

http://medical-dictionary.thefreedictionary.com/telemetry **[29 October 2014]**

➔telemetry /te·lem·e·try/ (tĕ-lem´ĕ-tre) the making of measurements at a distance from the subject, the measurable evidence of phenomena under investigation ...

➔ http://www.wisegeek.org/what-is-a-telemetry-unit.htm [29 October 2014]
A telemetry unit is a unit in a hospital where patients are under continuous electronic monitoring. Telemetry, the practice of sending electronic signals from one place to another, is a tremendously useful tool in hospitals, as it allows hospital personnel to monitor heart rate, heart rhythm, breathing, and other things both by the patient's bed and at a remote location like a nursing station.

1. Introduction (1)

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Why and how is "Telemetry System" ?

http://www.britannica.com/EBchecked/topic/585928/telemetry **[29 October 2014]**

➔ **Telemetry,** highly automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring, display, and recording.

Wire vs Wireless

http://www.merriam-webster.com/dictionary/telemetry **[29 October 2014]**

telemetry /te·lem·e·try/ (tĕ-lem´ĕ-tre) the process of using special equipment to take measurements of something (such as pressure, speed, or temperature) and send them by radio to another place

Full Definition of TELEMETRY

1 : the science or process of telemetering data
2 : data transmitted by telemetry
3 : BIOTELEMETRY

1. Introduction (1)

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Why and how is "Telemetry System" ?

Currently, the telemetry systems are widely applied in the broad wireless technology applications to perform various different measurement tasks from a remote location.

Some of the serious tasks are including to mapping the potential natural resources (e.g. minerals and biological) using the remote sensing techniques; for sub-marine observations; for the real-time monitoring of the environment conditions (e.g. temperature, relative atmospheric humidity, air quality, the power and direction of the wind flows and weather forecasting); and for predicting and mitigating the potential disaster impacts of various natural phenomena such as the extreme weather changes and others.

Telecommunication, Radio and Microwave Laboratory, Department of Electrical Engineering and Center of Technology (COT), Faculty of Engineering, HASANUDDIN UNIVERSITY, Makassar Indonesia … We have developed two classes of telemetry systems:

short distance range telemetry VS long distance range telemetry

- **Telemetry ➔ *Military and Civil Applications***
- **Determine the reliability of various applications**

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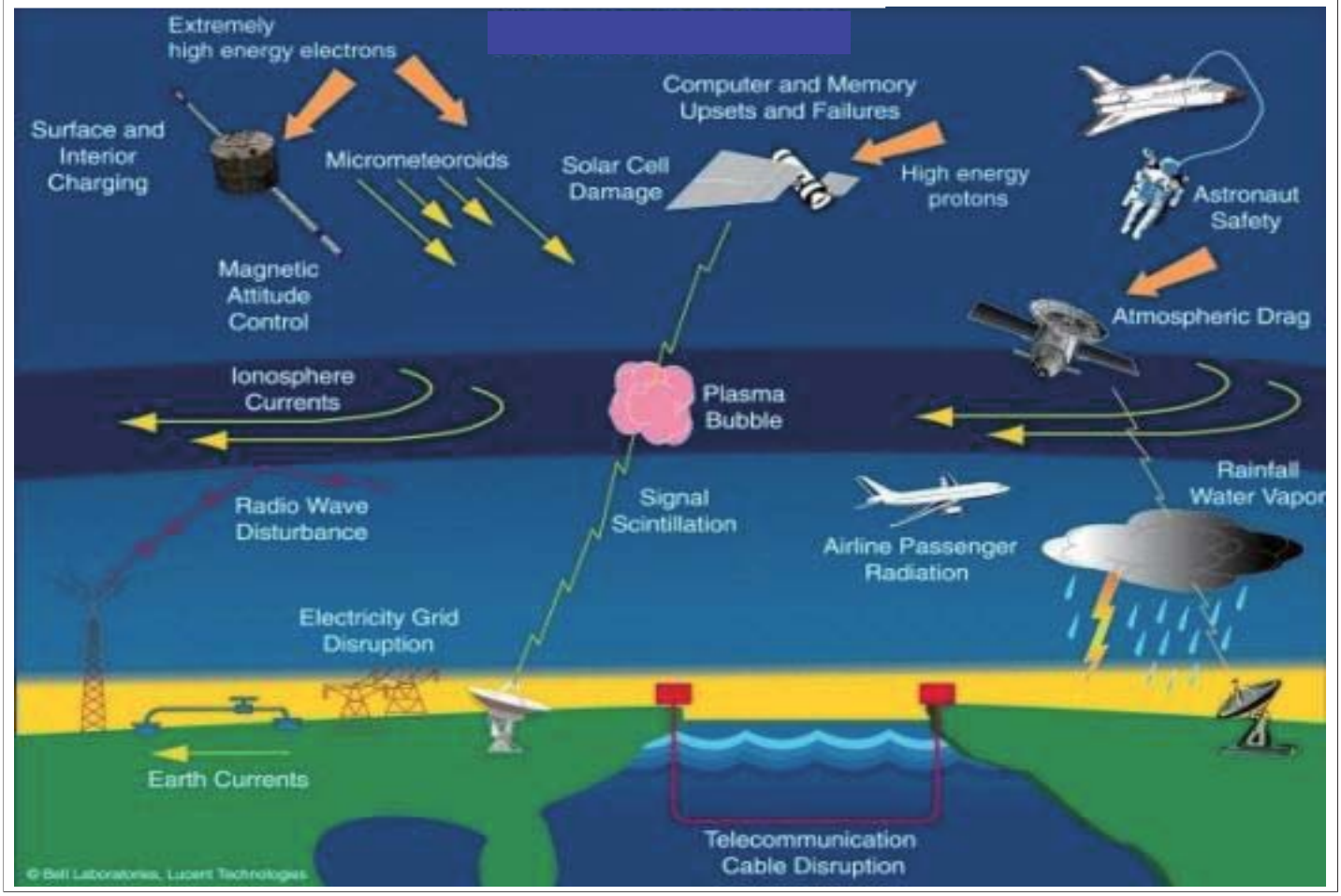

2. Various Developments of Telemetry Systems

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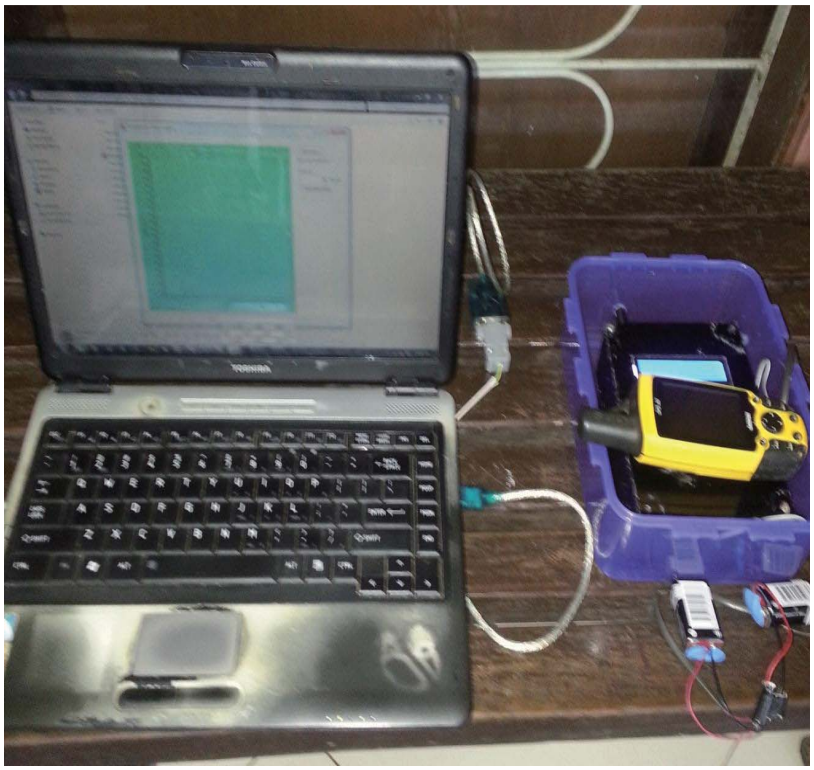
❖ ***First Design:*** **433 MHz Telemetry System for Submarine Environmental Monitoring and Observation**



Local Data Collector: **an antenna system, a temperature sensor LM35, a microcontroller ATMega 8535 and Transceiver chip YS1020-UA**

Central Data Monitoring: **an antenna system, Transceiver chip YS1020-UA , Laptop set installed with the designed Delphi 7 software ➔ data plotting/displaying, recording and analysing**

2. Various Developments of Telemetry Systems

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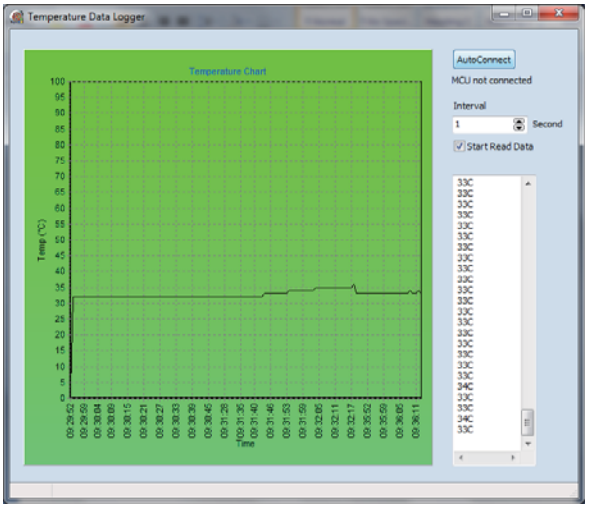

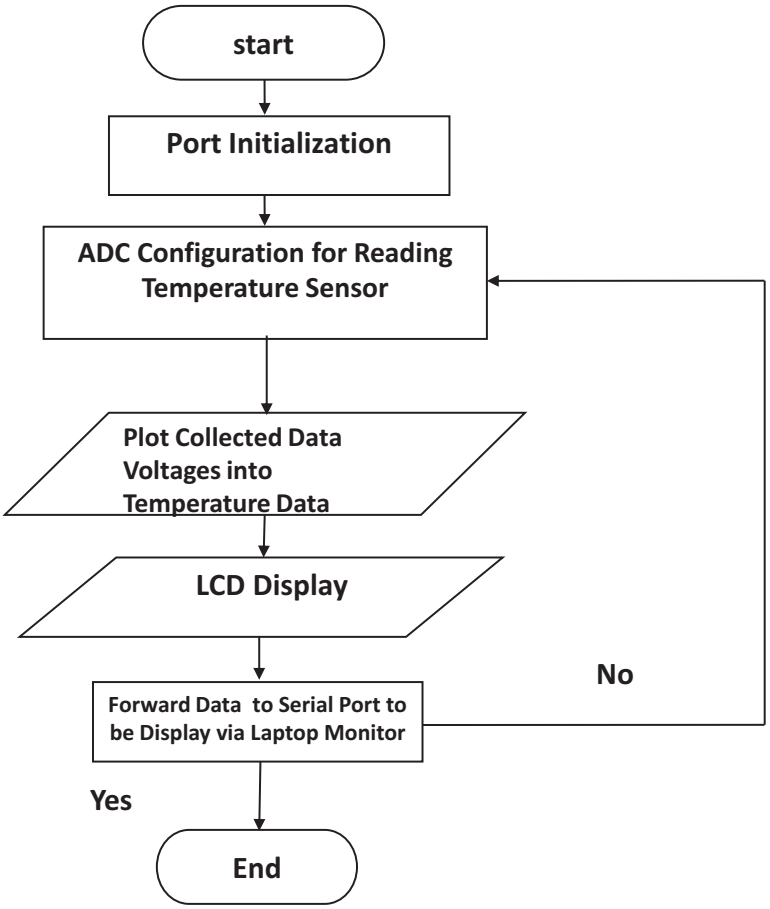

2. Various Developments of Telemetry Systems

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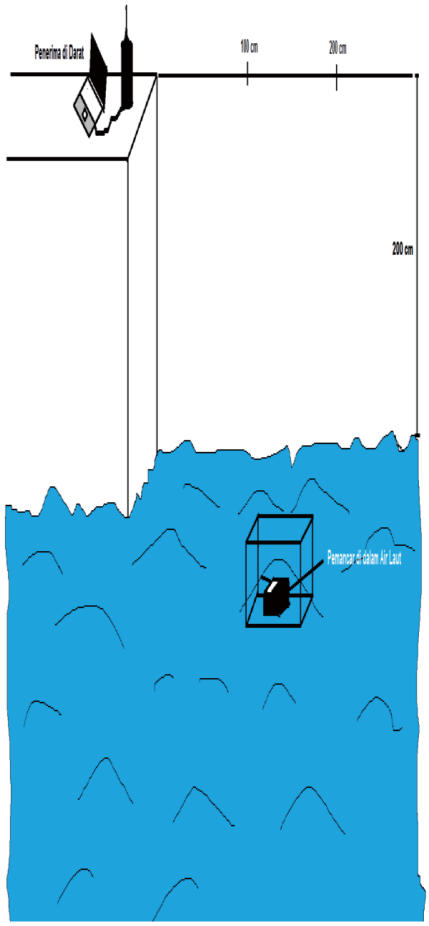

No	Height of Central Station Position relative to Sea Surface *Hcs* (cm)	Distance Separation between Local Data Cllector and Central Station on Sea Surface *Ds* (cm)	The depth under Sea Surface *Dus* (cm)	Distance between Local data collector and Central Collector Station *Dlcc* (cm)	Time (am)	Temperature (°C)
1	200	100	0	223,60	9:17:51	36
			25	246,22	9:36:11	33
			50	269,25	9:40:10	34
			75	292,61	9:41:48	34
			100	316,22	9:43:42	34
			125	340,03	9:46:40	36
			150	364	9:49:16	Off
2		200	0	282,84	9:32:17	35
			25	301,03	9:39:12	34
			50	320,15	9:41:18	34
			75	340,03	9:42:26	34
			100	360,55	9:45:10	33
			125	381,60	9:48:16	37
			150	403,11	9:52:01	Off

2. Various Developments of Telemetry Systems

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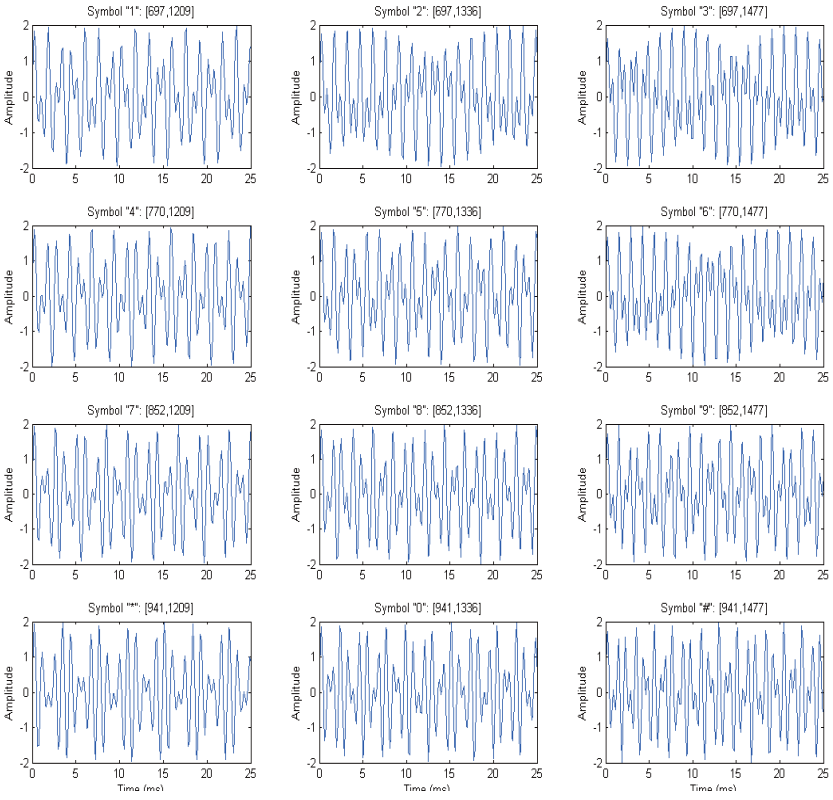
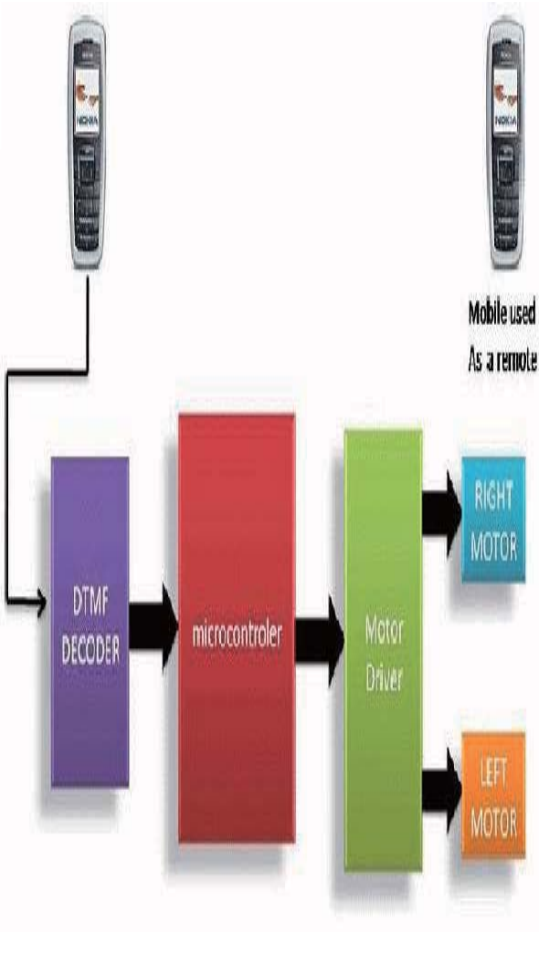
❖ **Second Design: 875-925 MHz/1800 MHz GSM Application for steering a mobile object movements ➔ DTMF**





2. Various Developments of Telemetry Systems

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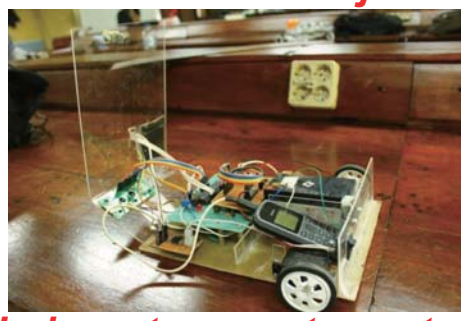
❖ 875-925 MHz/1800 MHz GSM Application for steering a mobile object movements

Steerable mobile object:



Underwater remote controller:

No	Water Depth (cm)	Mobile Response (Receiver)	Condition of LEDs (Receiver)
1	5	OK	Light
2	10	OK	Light
3	15	OK	Light
4	20	OK	Light
5	25	OK	Light
6	30	OK	Light
7	35	OK	Light
8	40	OK	Light
9	>40	OK	Light

2. Various Developments of Telemetry Systems

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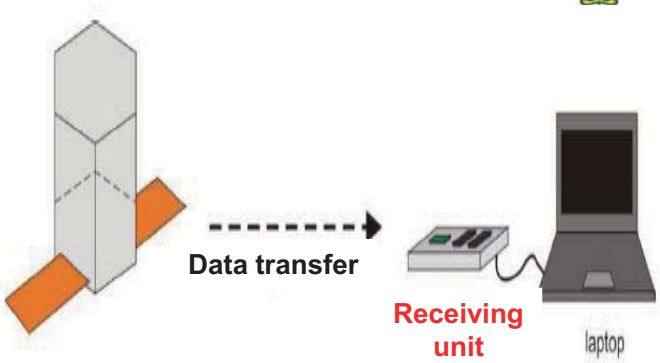
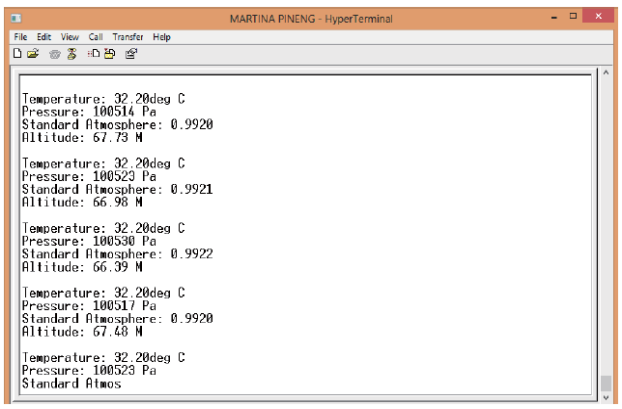
Platform	XBee-ZB	XBee-PRO ZB	Programmable XBee-PRO ZB
RF data rate	250 Kbps		
Indoor/Urban range	40 m	90 m	
Outdoor/RF Line of Sight Range	120 m	3200 m/1500 m	
Transmit Power	1.25 mW(+1 dBm)/2 mW (+3dBm) boost mode	63 mW (+18 dBm)/Int'l 10 mW (+10 dBm)	
Receiver Sensitivity (1% PER)	-96 dBm in boost mode	-102 dBm	

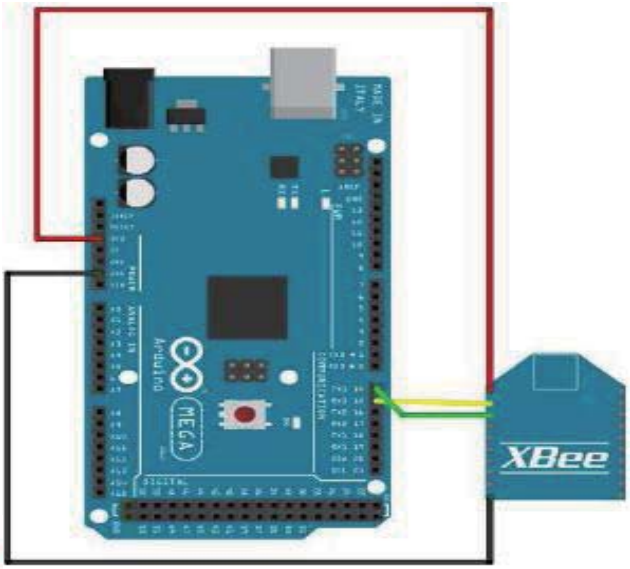




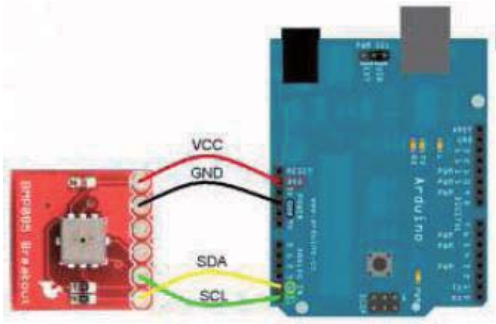
❖ **Third Design: 2400-2500 MHzTelemetry System deployed on the constructed small satellite**

2. Various Developments of Telemetry Systems UNHAS

Arduino Mega2560 integrated with Xbee-Pro Chip Tranceiver



BMP085 Digital pressure sensor



❖ **2400-2500MHz Telemetry System deployed on the constructed small satellite**

2. Various Developments of Telemetry Systems UNHAS

Environmental Sensors Module

Ground station based PC/Laptop

❖ **Error percentage (%)**

Temperature (3.27%)

Free space pressure (0.69%), Height/Altitude (1.26 %)

2. Various Developments of Telemetry Systems

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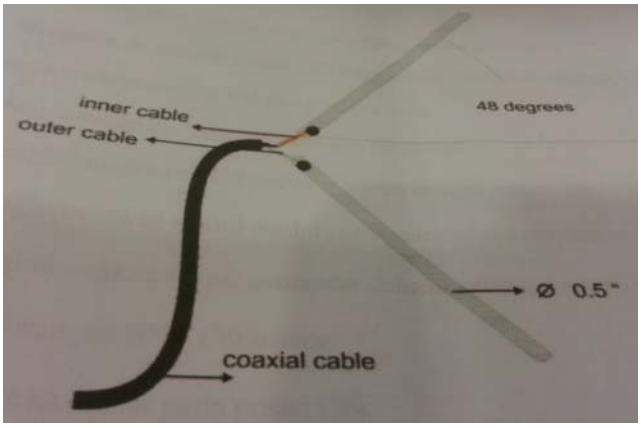
❖ **Fourth Design: A Compact FM Telemetry System**



2. Various Developments of Telemetry Systems

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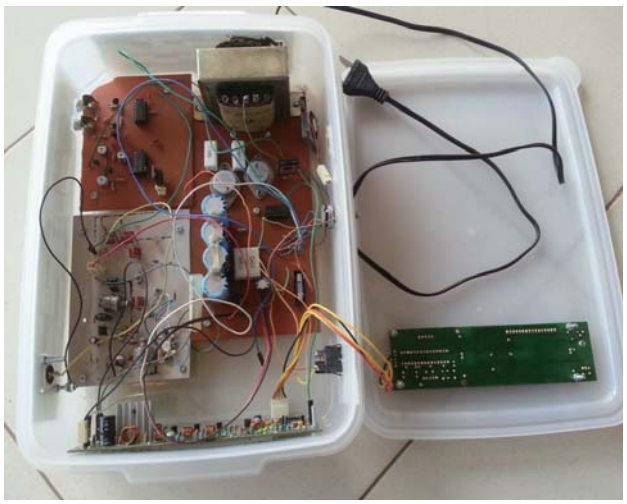
Platform	Specifications
Frequency Operation Range	88 MHz- 175 MHz (88-108 MHz)
RF Power Amplifier using Transistor 2SC1946A	30 Watt
Antenna Type	V dipole
Antenna Gain	10 dB
Coaxial Cable	RG58 (50 Ohm)



No.	Transistor Types	Pout (Watt)	Note
1	BLF244 MOSFET	15	Good load stability
2	BLF245 MOSFET	30	C Class RF Amplifier up to 200 MHz
3	MRF315	45	
4	2SC2782 Toshiba	80	NPN Silicon Transistor
5	BLF177 MOSFET	150	Low distortion, Easy power control
6	BLF278 MOSFET	300	Good load stability, Easy power control
7	BLF574 MOSFET	600	RF Amplifier up to 225 MHz, 50 V, I_{DQ} = 1000 A

3. Constraint Factors and Future Works

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➔Limited RF Power for the transmission and reception tasks (Essential issue to cover a long range data transmission ➔ to boost the telemetry performance) ➔ Environmental Monitoring and Observations

➔ Lack of the appropriate design of the electrical power supply system supporting the constructed telemetry systems e.g. for mini satellite prototypes (high altitude communication system, automobile under water objects (sub marine observation and monitoring etc… ➔ RES

➔ Lack of the appropriate electronic components available in the local market ➔ difficult ➔ compact and powerful telemetry systems

3. Constraint Factors and Future Works

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➔Limited high quality electronic instruments for performing various measurement activities (e.g. for measuring the developed under water communication stuffs ➔ requires more R&D collaborations ➔ Universities, Industries and Business sectors

➔ The frequency operation selections ➔ must be applied and choose more appropriately

➔ Require more attention on the circuit design and fabrication to obtain more robust telemetry systems and proportional physical size

Conclusions

4. Conclusions

- ➔ Further R&D activities should address some constraint factors on advanced developing steps ➔ the more robust, compact, and applicative telemetry systems (Essential elements for various applications ➔ civil and military applications) ➔ Environmental Monitoring and Observations
- ➔ More R&D collaborations are very welcome to initiate and to strengthen the MoU between Chiba University and UNHAS especially, and improve the mutual cooperation in academic and research amongst Indonesia Universities, in general

VI. References

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Wassalamu ‘Alaikum Warrahmatullahi Wabarakatuh

Thank you so much

Terima kasih

Gracias

Ko pun ma krab