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Cube Satellite

M. Dharshan[1], S. Dheenadhayalan[2], A. Jayaprakash[3], Mr. J. Jebastin[4]
BE ECE (Final Year), Jeppiaar Engineering College, Chennai.

Abstract: A Cube Satellite is a small, lightweight satellite designed for low-cost space research, environmental monitoring, and communication applications. This project focuses on the development of a ground-based Cube Satellite model that demonstrates satellite communication and real-time environmental data monitoring. The system uses LoRa (Long Range) communication, with one transmitter and two receiver units for reliable wireless data transmission. The satellite model is designed to collect parameters such as temperature, humidity, air pollution (CO_2 and NO_2), forest fire conditions, and crop health. The collected data is transmitted to ground-based receiver stations for monitoring and analysis. The proposed system provides an affordable and efficient platform for understanding satellite communication, remote sensing, and environmental monitoring, while demonstrating the basic concepts involved in CubeSat technology.

I. INTRODUCTION

This project focuses on developing a ground-based Cube Satellite model that demonstrates the basic working principles of satellite communication and environmental monitoring. The system consists of one transmitter and two receiver units, using LoRa (Long Range) communication to transmit collected sensor data over a long distance. The proposed Cube Satellite system can monitor important environmental parameters such as temperature, humidity, CO_2 and NO_2 levels, forest-fire conditions, and crop health. The collected information is transmitted to ground receiver stations, where it can be monitored and analyzed. The project provides practical knowledge about satellite communication, sensors, wireless data transmission, remote monitoring, and environmental sensing. It also demonstrates how CubeSat technology can be used as a cost-effective platform for developing innovative solutions for environmental and agricultural applications.

II. SYSTEM OVERVIEW

1) Sensor Interfacing: Sensor interfacing involves connecting environmental sensors to the Cube Satellite system to measure parameters such as temperature, humidity, CO_2, NO_2, forest fire conditions, and crop health. The sensor outputs are processed by the microcontroller for further transmission.
2) Preparing Power Supply Unit: The power supply unit provides the required regulated DC voltage to the sensors, microcontroller, LoRa transmitter, and receiver modules. Proper power management ensures stable and reliable operation of the Cube Satellite system.
3) Microcontroller Programming: The microcontroller is programmed to collect sensor data, process the measured values, and control communication between the transmitter and receiver units. It manages the overall operation of the Cube Satellite model.
4) Reading and Processing Sensor Data: The microcontroller reads the data received from the connected sensors. Analog signals are converted into digital values using the ADC (Analog-to-Digital Converter) when required, and the processed information is prepared for wireless transmission.
5) LoRa Communication and Testing: The processed environmental data is transmitted from the Cube Satellite transmitter to two ground-based receiver units using LoRa technology. The system is tested to verify communication range, data accuracy, sensor operation, and reliable transmission.
6) Test, Debug and Submission: The complete Cube Satellite prototype is tested under different conditions to identify and correct hardware and software errors. After successful testing, the completed prototype is submitted to the faculty guide for review, demonstration, and presentation.

III. WORKING PRINCIPLE

The Cube Satellite system is designed to collect environmental data using various sensors and transmit the information to ground-based receiver stations. The sensors measure parameters such as temperature, humidity, CO_2, NO_2, forest fire conditions, and crop health. The microcontroller processes the collected sensor data and sends it through a LoRa transmitter. The transmitted data is received by two ground-based LoRa receiver units for monitoring and analysis. This demonstrates the basic principles of satellite-based environmental monitoring and long-range wireless communication.

IV. ADVANTAGES

The Cube Satellite provides a low-cost and compact platform for environmental monitoring and communication applications. It can collect multiple environmental parameters and transmit the data over a long distance using LoRa technology. The system requires relatively low power and can support reliable wireless communication. It is suitable for educational and research purposes and provides practical understanding of sensor interfacing, microcontroller programming, LoRa communication, and satellite technology.

V. APPLICATION

The Cube Satellite system can be used for environmental monitoring, agricultural monitoring, weather observation, air-quality monitoring, and forest-fire detection. It can help monitor temperature and humidity in remote areas and measure air-pollution parameters such as CO_2 and NO_2. Crop-health monitoring can also support precision agriculture. The system can be further developed for remote sensing, disaster monitoring, and scientific research applications.

VI. EXPERIMENTAL RESULTS AND DISCUSSION

This chapter presents the implementation and testing results of the ground-based Cube Satellite model. The system integrates environmental sensors, a microcontroller, LoRa communication modules, and receiver units. Various tests were conducted to verify sensor readings, data processing, wireless transmission, and reception. The results demonstrate that the system can successfully collect environmental parameters and transmit the measured data from the transmitter to the two receiver units. The prototype demonstrates the feasibility of using CubeSat concepts and LoRa communication for environmental monitoring applications.

VII. FUTURE SCOPE

Future improvements can include developing a fully functional space-ready CubeSat with advanced communication and sensing systems. GPS/GNSS can be added for accurate location tracking, while IoT and cloud platforms can enable remote data visualization. Solar panels and advanced battery-management systems can improve power availability. Additional sensors, onboard data storage, image-processing cameras, and AI-based data analysis can further enhance environmental and agricultural monitoring capabilities.

VIII. CONCLUSION

The Cube Satellite system was successfully developed as a ground-based prototype for environmental monitoring and long-range wireless communication. The system uses multiple sensors to collect parameters such as temperature, humidity, air pollution, forest-fire conditions, and crop health. The collected data is processed by a microcontroller and transmitted using LoRa technology to two receiver units. The project provides a cost-effective platform for understanding CubeSat technology, sensor-based monitoring, and wireless communication, with potential applications in environmental, agricultural, and remote-monitoring systems.

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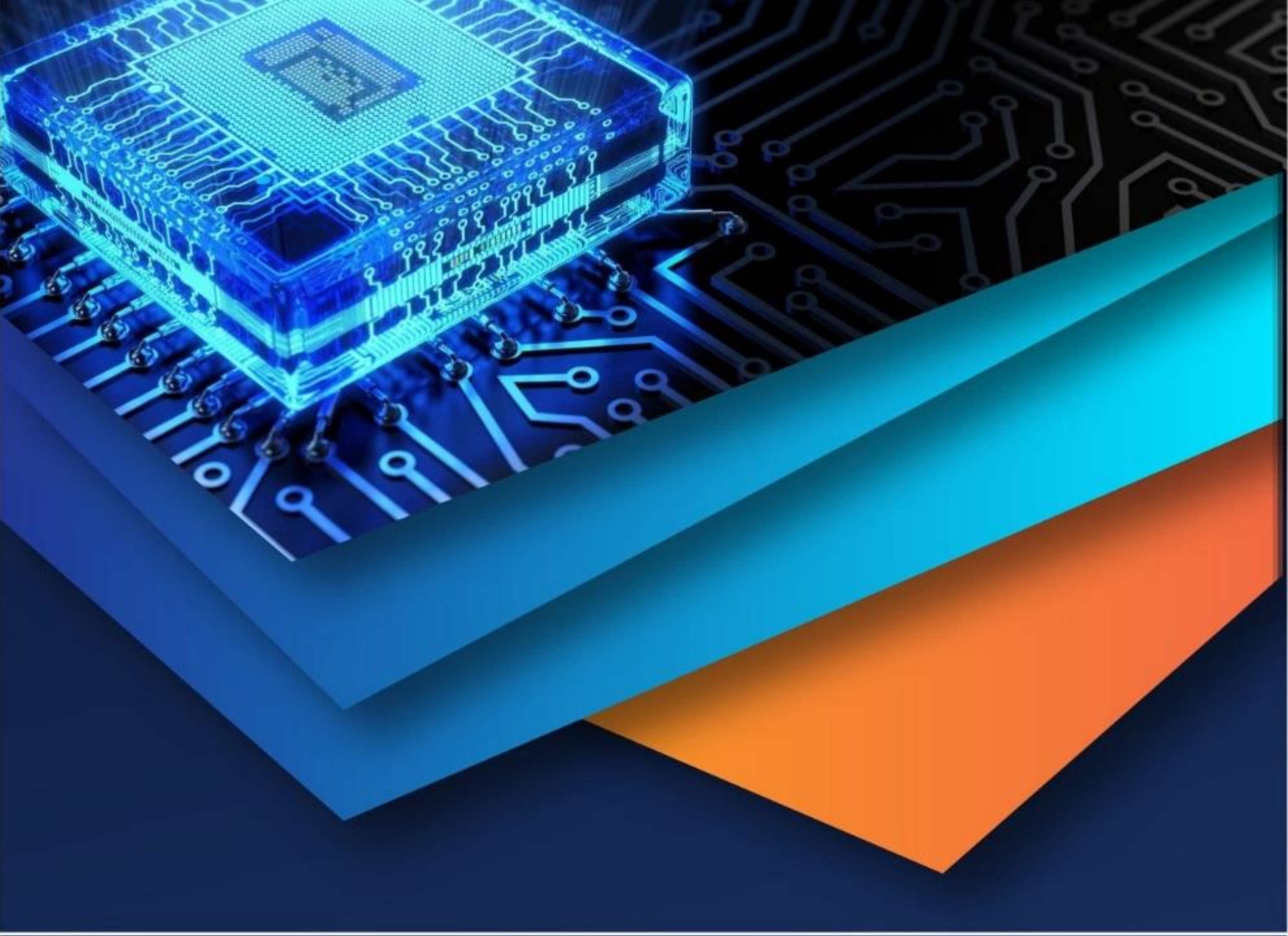
REFERENCES

[1] National Aeronautics and Space Administration (NASA), “CubeSat 101: Basic Concepts and Processes for First-Time CubeSat Developers,” NASA, 2017.
[2] California Polytechnic State University and California Polytechnic State University, “CubeSat Design Specification,” Revision 14.1, 2022.
[3] European Space Agency (ESA), “CubeSats,” ESA Education and Space Engineering resources.
[4] J. Bouwmeester and J. Guo, “Survey of Worldwide Pico- and Nanosatellite Missions, Distributions and Subsystem Technology,” Acta Astronautica, Vol. 67, Issues 7–8, pp. 854–862, 2010.
[5] J. Puig-Suari, C. Turner and W. Ahlgren, “Development of the Standard CubeSat Deployer and a CubeSat Class PicoSatellite,” IEEE Aerospace Conference, 2001.
[6] Semtech Corporation, “LoRa and LoRaWAN: Technical Overview,” Semtech, for long-range low-power wireless communication technology.
[7] M. Swartwout, “The First One Hundred CubeSats: A Statistical Look,” Journal of Small Satellites, Vol. 2, No. 2, pp. 213–233, 2013.



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