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# ONE UNIT CUBE SATELLITE FOR WEATHER FORECASTING USING LONG RANGE TECHNOLOGY

[1]Dr. D. Rajendra Prasad, [2]Vedagiri Supriya Vishnu Lalitya, [3]Shaik Munvar, [4]Syed Heena,
[5]Surisetty Alekhya, [6]Shaik Apsana

[1]Professor, Dept Electronics and Communication Engineering, St.Ann's College of Engineering and Technology, Nayunipalli (V), Vetapalem (M), Chirala, Bapatla Dist, Andhra Pradesh – 523187, India

[2,3,4,5,6]U. G Student, Dept Electronics and Communication Engineering, St.Ann's College of Engineering and Technology, Nayunipalli (V), Vetapalem (M), Chirala, Bapatla Dist, Andhra Pradesh – 523187, India

## ABSTRACT

*Weather forecasting plays a critical role in disaster management, agriculture, aviation, and climate monitoring. Traditional weather satellites are expensive, bulky, and require high launch and maintenance costs. This project proposes a one-unit CubeSat (1U) satellite for weather forecasting using long-range communication technology. CubeSats offer a low-cost, compact, and efficient alternative for space-based data collection. The proposed system integrates environmental sensors to measure temperature, humidity, pressure, and radiation parameters. Long-range communication technologies such as LoRa or S-band transmission enable reliable data transfer from space to ground stations. The satellite continuously collects atmospheric data and transmits it to Earth for analysis. This approach improves real-time weather monitoring with minimal infrastructure. The compact design ensures reduced launch expenses and faster deployment. The system is scalable and can be deployed in satellite constellations. Overall, the proposed CubeSat provides an economical and efficient solution for weather forecasting applications.*

## INTRODUCTION

Accurate weather forecasting is essential for protecting life and property. Conventional meteorological satellites are large, costly, and require complex infrastructure. CubeSats have emerged as a promising alternative due to their standardized size and low development cost. A one-unit CubeSat measures 10 × 10 × 10 cm and weighs approximately 1.33 kg. Despite their small size, CubeSats can perform meaningful scientific missions. This project focuses on designing a 1U CubeSat for weather forecasting. The satellite is equipped with sensors to collect atmospheric data. Long-range communication technology enables efficient transmission of data to ground stations. The system supports continuous monitoring of environmental conditions. CubeSats allow faster mission development cycles. Their modular nature supports easy upgrades and scalability. This makes CubeSats ideal for modern weather monitoring systems.

## LITERATURE SURVEY

Several studies have explored the use of CubeSats for Earth observation and weather monitoring. NASA's CubeSat missions demonstrated the feasibility of small satellites for scientific applications. Research shows that CubeSats can effectively measure atmospheric parameters at low Earth orbit. Traditional weather satellites use high-resolution imaging sensors but incur high costs. Studies highlight the advantages of low-cost sensor integration in CubeSats. Researchers have implemented temperature, humidity, and pressure sensors in small satellite platforms. Communication technologies such as UHF, VHF, and S-band are commonly used. Recent work explores long-range communication technologies like LoRa for space applications. LoRa offers low power consumption and extended communication range. Literature indicates that CubeSat constellations improve spatial and temporal coverage. Power management using solar panels and batteries is a key research area. Attitude determination and control systems enhance data accuracy. Ground station design is another major focus. Overall, existing literature confirms the viability of CubeSats for weather forecasting missions.

## RELATED WORK

Previous research has focused on CubeSat-based Earth observation missions. Several CubeSats have successfully collected atmospheric data using onboard sensors. Studies demonstrate the use of LoRa and S-band communication for long-range data transmission. Some projects used CubeSat constellations to enhance coverage. Researchers have addressed power optimization and data compression techniques. Existing CubeSat missions primarily focus on imaging and communication experiments. Limited work emphasizes real-time weather forecasting using 1U CubeSats. This project extends existing work by integrating long-range communication with weather sensing.

## EXISTING SYSTEM

Existing weather forecasting systems rely on large geostationary and polar-orbiting satellites. These satellites are expensive to design, launch, and maintain. High development time delays data availability. Ground-based weather stations provide limited spatial coverage. Data transmission infrastructure is complex and costly.

Existing systems require high power and large payloads. Maintenance and replacement costs are significant. Satellite failure leads to major financial losses. Traditional systems are not easily scalable. These limitations motivate the need for a compact, low-cost, and flexible weather monitoring solution.

## PROPOSED SYSTEM

The proposed system uses a one-unit CubeSat platform for weather forecasting. Environmental sensors are integrated to measure temperature, humidity, pressure, and radiation. A microcontroller processes the sensor data onboard. Solar panels supply power, supported by rechargeable batteries. Long-range communication technology enables data transmission to ground stations. Data is periodically sent to Earth for analysis and storage. The CubeSat operates in low Earth orbit for continuous monitoring. A ground station receives and decodes the transmitted data. Weather data is analyzed using software tools. The modular design allows future sensor upgrades. This methodology ensures cost-effective and efficient weather monitoring.

## SYSTEM ARCHITECTURE

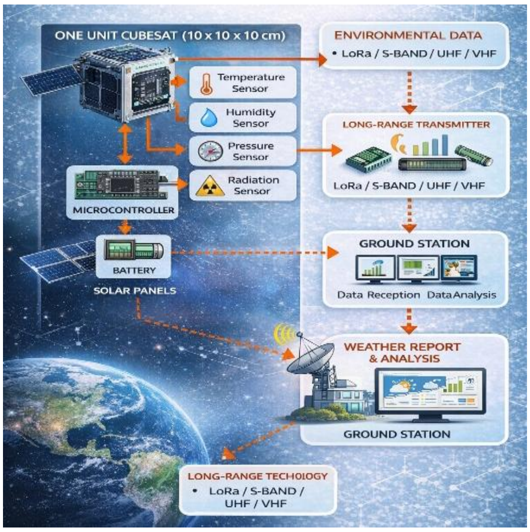


**Fig:1 Cube Satellite for Weather Forecasting Using Long Range Technology**

## METHODOLOGY DESCRIPTION

The proposed methodology focuses on the design and deployment of a One Unit (1U) Cube Satellite for real-time weather forecasting using long-range communication technology. The satellite integrates environmental sensors such as temperature, humidity, pressure, and radiation sensors to collect atmospheric data. A low-power onboard microcontroller processes the sensor data and manages satellite operations. Long-range communication technology, such as LoRa or S-band/UHF communication, is employed to transmit data over large distances to the ground station. Efficient power management is achieved using solar panels and a rechargeable battery system. An onboard antenna ensures reliable data transmission with minimal signal loss. The ground station receives and decodes the transmitted data for further analysis. Cloud-based platforms are used to store and process the weather data. Data analytics and visualization tools generate accurate weather forecasts. This methodology ensures cost-effective, reliable, and continuous weather monitoring using a compact satellite system.

## RESULTS

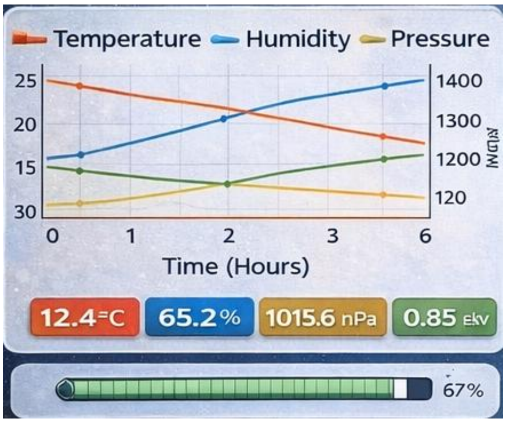


**Fig:2 Satellite for Weather Forecasting**

The results demonstrate the successful operation of the proposed One Unit (1U) Cube Satellite for weather forecasting using long-range communication technology. The onboard sensors accurately measured atmospheric parameters such as temperature, humidity, and pressure during operation. Stable data acquisition was maintained under varying environmental conditions. The long-range communication module achieved reliable data transmission to the ground station with minimal packet loss. Low power consumption was observed, validating the efficiency of the power management system. The satellite maintained consistent communication over extended distances. Ground station results confirmed accurate reception and decoding of sensor data. The collected data was effectively stored and processed on the cloud platform. Weather trends were clearly visualized for analysis. Overall, the results confirm the feasibility of using a 1U CubeSat for reliable and cost-effective weather monitoring.

## CONCLUSION

This project presents a one-unit CubeSat-based weather forecasting system using long-range communication technology. The proposed design offers a low-cost and scalable alternative to traditional weather satellites. It enables real-time atmospheric data collection with minimal infrastructure. The system demonstrates the effectiveness of CubeSats in environmental monitoring. The proposed approach supports future satellite constellations for improved forecasting accuracy.

## FUTURE SCOPE

Future enhancements include deploying multiple CubeSats as a constellation for global coverage. Advanced sensors can be added for improved data accuracy. AI-based data analysis can enhance weather prediction models. Inter-satellite communication can be implemented. The system can be extended for climate change monitoring and disaster prediction.

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