

DESIGN AND IMPLEMENTATION OF A SELF-SUSTAINING WEATHER STATION WITH WIRELESS COMMUNICATION FOR REAL-TIME ENVIRONMENTAL MONITORING

In this work, a low-cost weather station was developed to collect atmospheric data. The purpose of this system is to obtain real-time information. The weather station was designed in accordance with Mexican regulations, as it was installed in the San Bernabé Ocotepéc area. This location lies at a latitude of 19.2829 and a longitude of -99.2569, within the Magdalena Contreras borough in Mexico City.

The Magdalena Contreras borough is located at an altitude of 2,259 meters above sea level (MASL), between 19°13' and 19°20' north latitude. The local climate is predominantly semi-cold and subhumid with summer rainfall, characterized by a higher humidity level (51.59%). Other climate types present include semi-cold humid with abundant summer rainfall (11.30%) and temperate subhumid with moderate summer rainfall (0.19%).

In this design, an ESP32 microcontroller with integrated wireless connectivity was used. Additionally, four sensors were implemented: the BMP180 sensor for measuring atmospheric pressure, the DHT11 sensor for temperature and humidity, the MQ135 sensor for detecting air quality (airborne particles and gases), and the GY-302 sensor for measuring light intensity. The latter was used to adjust the brightness of the LCD display during data visualization.

Furthermore, two antennas were incorporated to establish a point-to-point communication link. This configuration enables communication with another weather station, allowing coverage over a wider area. The system provides direct communication between two devices with a range of up to 30 km. Through this setup, data can be transmitted remotely, and both nodes can share network access.

All of this was carried out with the aim of obtaining accurate weather conditions for the area, enabling subsequent analysis and informed decision-making. This helps prevent risks and optimize resources, particularly in hard-to-reach areas, while supporting environmental analysis in applications such as agriculture and disaster management.