

## Abstract

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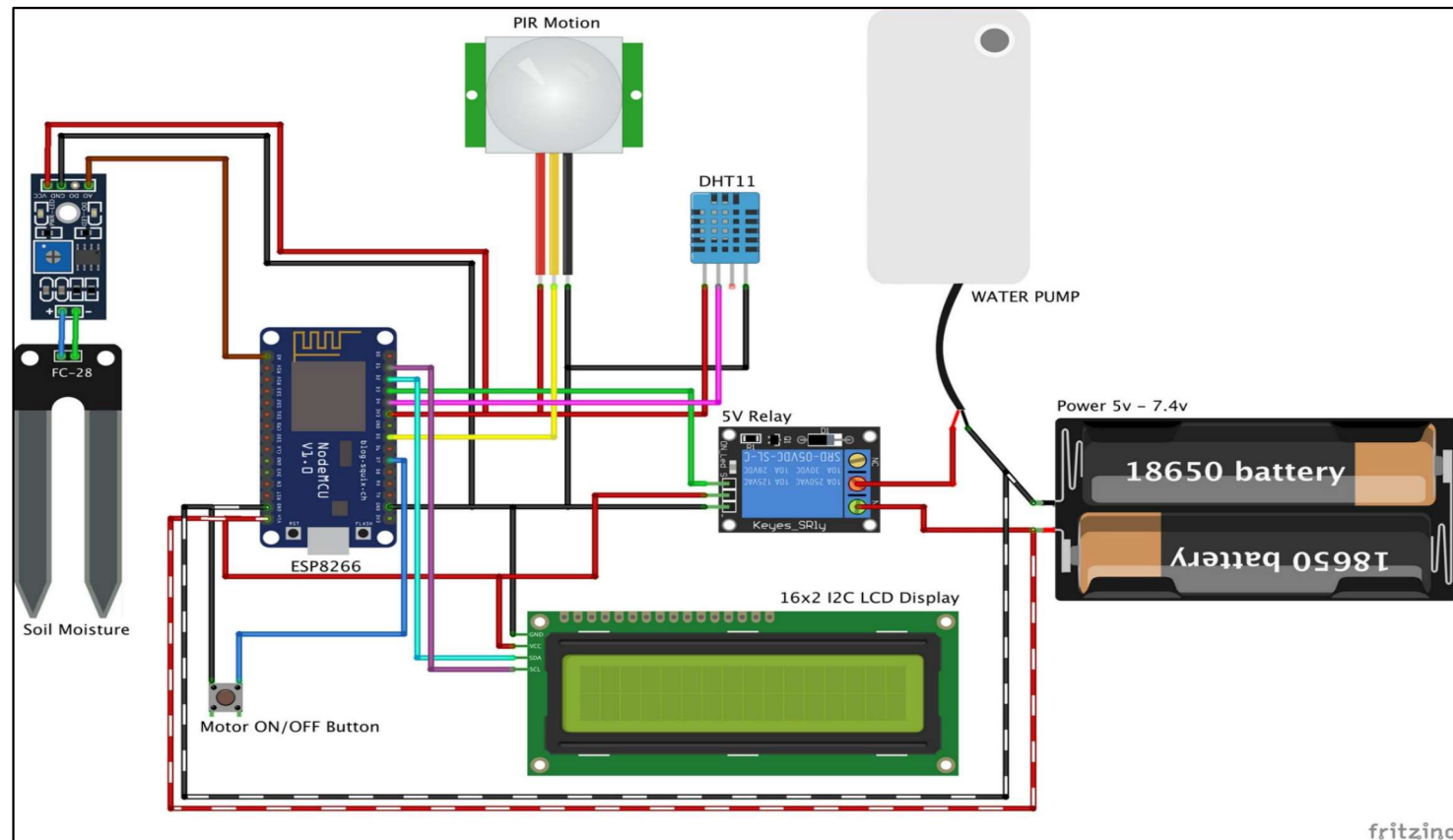
This project presents a Smart Agriculture Monitoring System that employs ESP32 WiFi Module to wirelessly transmit sensor data. The system continuously collects data from soil moisture, Motion, temperature, and humidity sensors, providing real-time insights to farmers for informed decision-making.

# Objectives

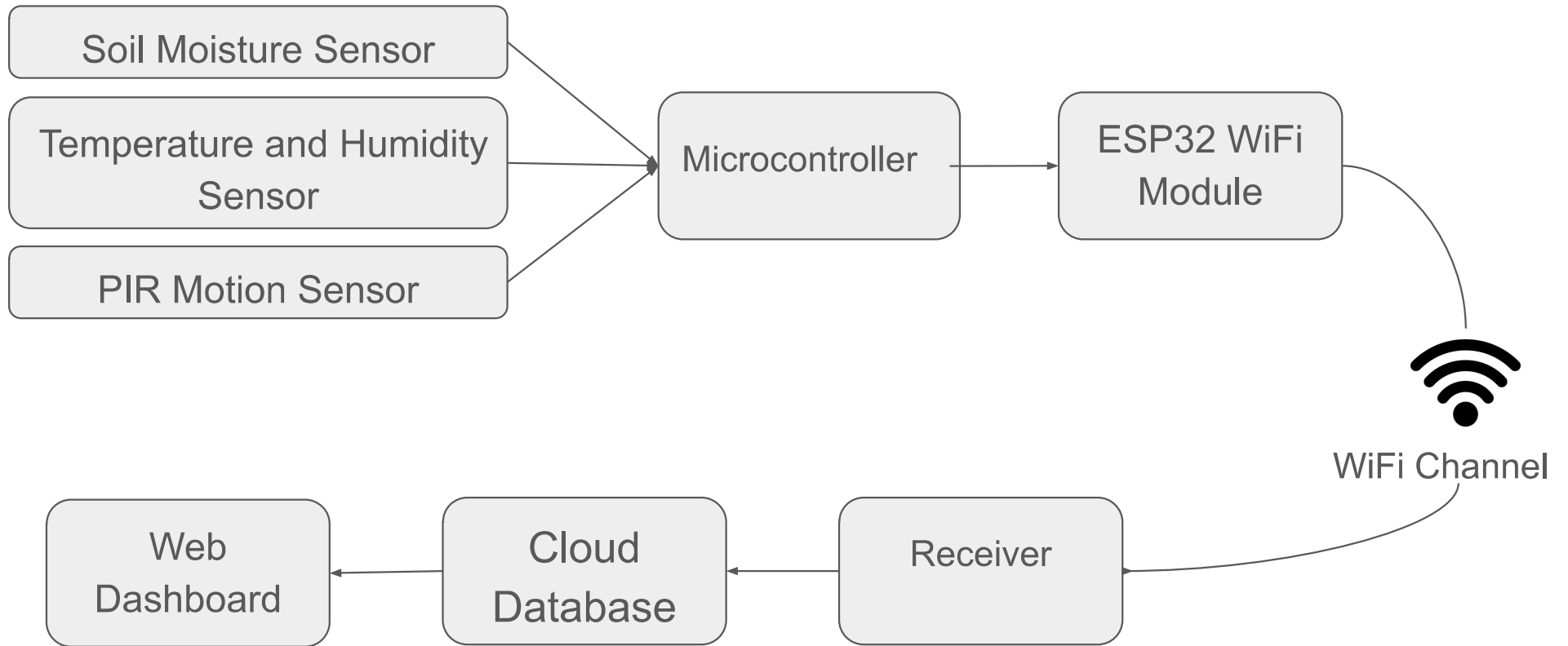
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- Automated Alerts: Notify users about critical conditions affecting crop health.
- **Implement Digital Communication: Utilize OFDM with QAM and PSK is primarily used in the ESP32 for Wi-Fi communication.**
- **While BPSK, QPSK & QAM via WiFi is used to transmit environmental sensor data.**
- Real-Time Monitoring: Continuously gather and transmit data from agricultural fields.
- Data Visualization: Create a user-friendly dashboard for displaying sensor readings.

# Circuit Diagram



## Block Diagram



# Tools and Technologies

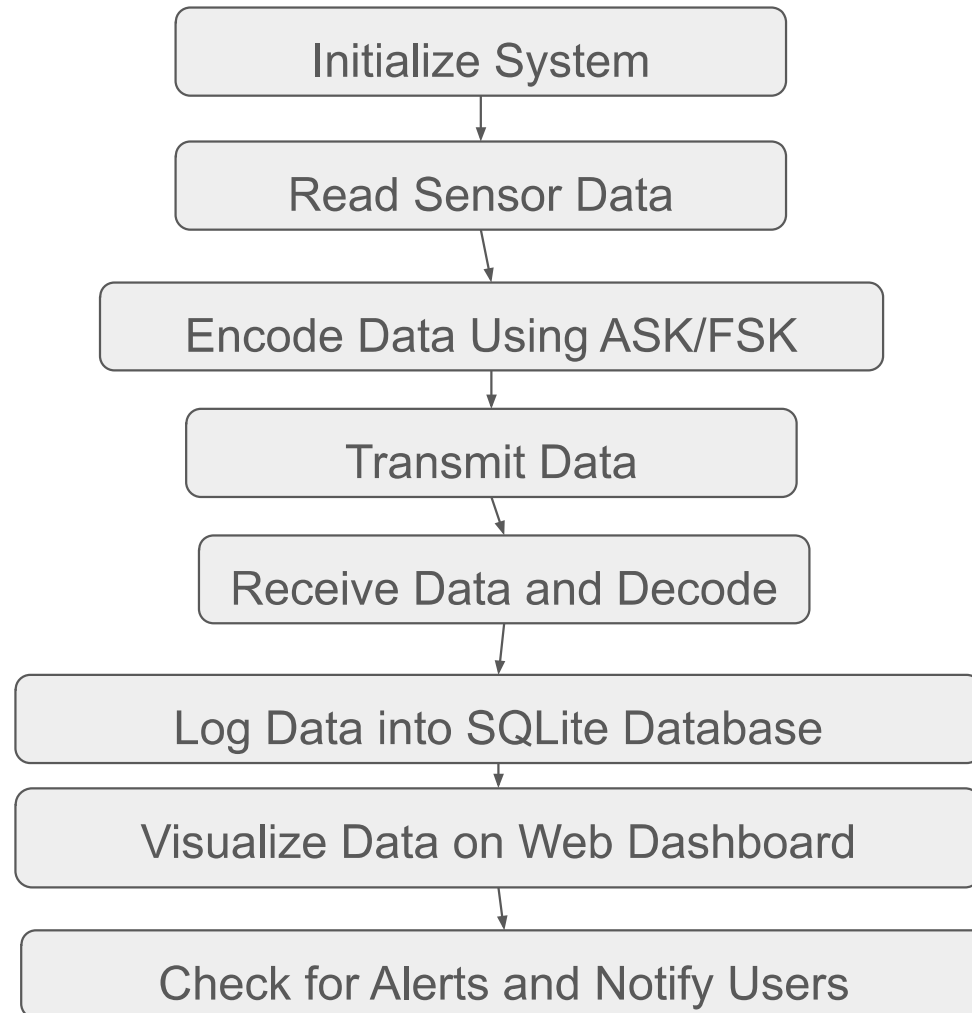
## Hardware:

- Microcontroller: ESP-32, Arduino
- Sensors: Soil moisture sensor, DHT11 (temperature and humidity sensor), PIR Motion Sensor.
- Relay module & Water Pump
- 7.4V external power supply

## Software:

- Programming Languages: C++ (Arduino framework and ESP-32 libraries) Python (for MQTT and Flask)
- Libraries: Digital Humidity and Temperature Sensor, PIR Library, DevKit

# Flowchart



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# Detailed Digital Communication Concepts

## Overview of Digital Communication Techniques:

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Digital communication involves transmitting data using digital signals, making it less susceptible to noise and interference compared to analog signals. In our project, we utilize two primary modulation techniques: Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), and higher-order QAM.



## Modulation Techniques

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- OFDM (Orthogonal Frequency Division Multiplexing)
- QAM (Quadrature Amplitude Modulation)
- PSK (Phase key Shifting)

# Communication Protocol

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- Data Acquisition: Sensors monitor environmental conditions continuously.
- Data Encoding: Sensor data is formatted into a binary string, possibly including checksums for error detection.
- Data Transmission: Encoded data is sent wirelessly using WiFi.
- Data Reception and Decoding: The receiver demodulates the signal to retrieve the original data, ensuring accurate communication.
- Error Handling: The system employs error-checking mechanisms to maintain data integrity.

## Data Logging and Visualization

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The data collected from the sensors is logged into a SQLite database, allowing for historical analysis. The system visualizes this data through a web dashboard, providing real-time insights.

## Alerts and Notifications

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Automated alerts notify users of critical conditions. For instance, if soil moisture drops below a threshold, the system sends a notification, enhancing decision-making.

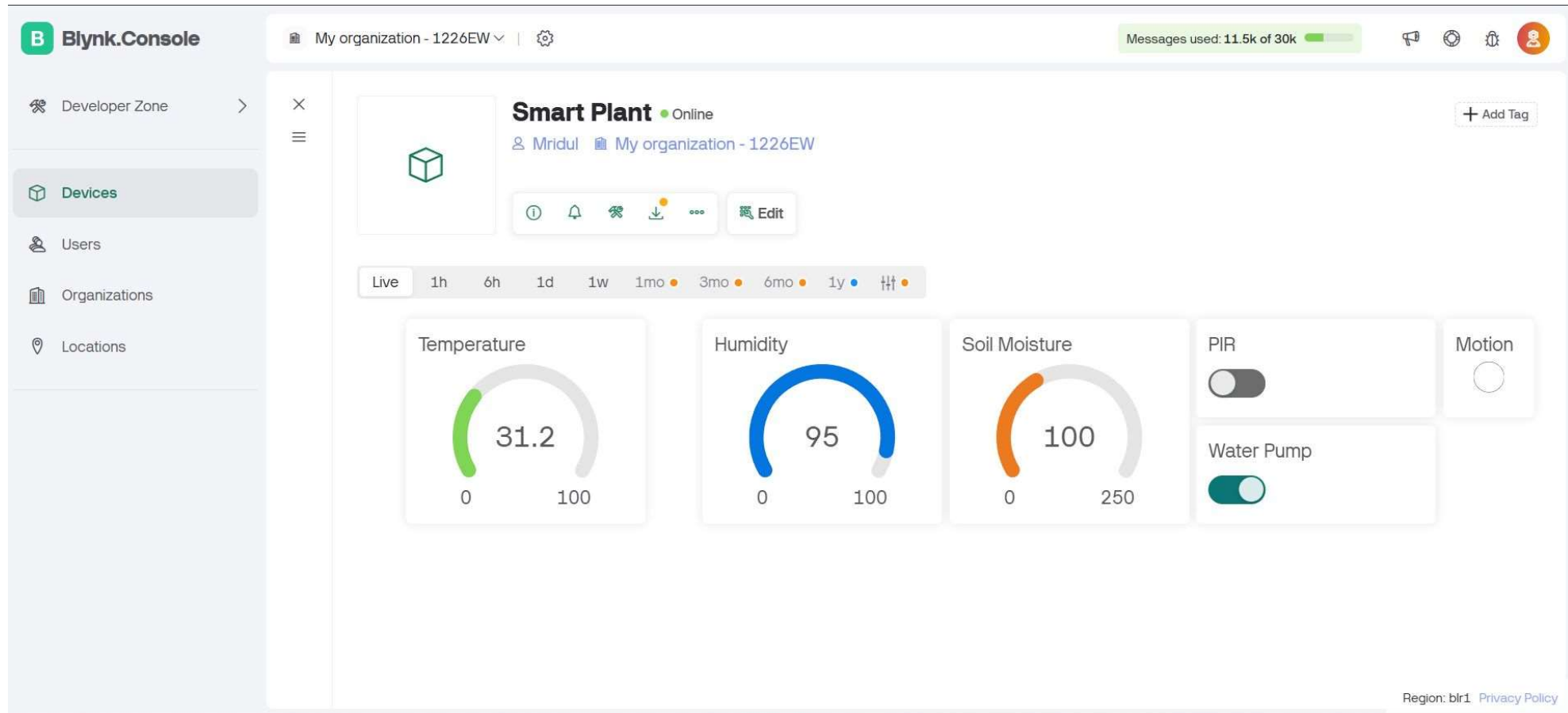
## Future Considerations in Digital Communication

- Adaptive Modulation: Future iterations could explore adaptive modulation techniques to enhance reliability.
- Advanced Error Correction: Implementing error correction codes could improve data integrity.
- IoT Integration: Expanding the project to include IoT platforms for enhanced data analytics.

## Summary of Modulation Techniques by Wi-Fi Standard

Wi-Fi Standard	Frequency Band	Modulation Techniques	Data Rate Range
802.11b	2.4 GHz	DSSS with BPSK, QPSK, CCK	Up to 11 Mbps
802.11g	2.4 GHz	OFDM with BPSK, QPSK, 16-QAM, 64-QAM	Up to 54 Mbps
802.11n	2.4 GHz	OFDM with BPSK, QPSK, 16-QAM, 64-QAM	Up to 150 Mbps

# Result on Website



## Conclusion

This project demonstrates the integration of digital communication techniques in a smart agriculture monitoring system. By employing BPSK, QPSK & QAM via WiFi the system provides robust and efficient data transmission, helping farmers make informed decisions based on real-time environmental data.



## Future Works

Explore additional sensors (e.g., pH, light intensity).

Improve communication range and robustness.

Implement machine learning algorithms for predictive analytics.