



SmartAgri

Preliminary Report V1

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Overview

This preliminary report aims at defining an architecture for SmartAgri systems. The goals of this report are mentioned below

Goals

1. The system should reduce the time required for a person to be in the field.
2. The system should notify the sensors' parameters and allow control of different valves and actuators etc via web app.

Specifications

The system is divided into 3 different layers which should communicate with each other in real-time.

Layers

- Hardware - Sensor Nodes
- Processing Layer - Server {Ubuntu Server 18.04}
- Application Layer - Mobile and Web Apps

Components Required

- ESP32 Dev Module
 - https://www.amazon.com/ESP32-WROOM-32-Development-ESP-32S-Bluetooth-Arduino/dp/B084KWNMM4/ref=sr_1_10?dchild=1&keywords=esp32+dev+module&qid=1631286335&sr=8-10
- Atmospheric Temperature and Humidity Sensor (DHT22)
 - https://www.amazon.com/HiLetgo-Temperature-Humidity-Electronic-Practice/dp/B0795F19W6/ref=sr_1_2?dchild=1&keywords=dht22&qid=1631286498&sr=8-2
- Atmospheric Pressure Sensor
 - https://www.amazon.com/Gikfun-Barometric-Pressure-Temperature-EK1214x3/dp/B07Q3PQ81R/ref=sr_1_1?dchild=1&keywords=atmospheric+pressure+sensor+arduino&qid=1631286562&sr=8-1
- Soil Moisture Sensor
 - https://www.amazon.com/lcstation-Resistive-Soil-Moisture-Sensor/dp/B076DDWDJK/ref=sr_1_7?dchild=1&keywords=soil+moisture+sensor&qid=1631286644&sr=8-7
- NPK Sensor
 - https://www.amazon.com/Neufday-Precision-Nutrient-Intelligent-Fertilizer/dp/B0836WYNJ1/ref=sr_1_2?dchild=1&keywords=soil+nPK+sensor&qid=1631286692&sr=8-2
- RS485 Converter for NPK Sensor
 - https://www.amazon.com/Max485-Chip-RS-485-Module-Raspberry/dp/B00N1OLNAG/ref=sr_1_2?dchild=1&keywords=MAX485&qid=1631286785&sr=8-2
- Soil pH Sensor
 - https://www.amazon.com/Taidacent-Detector-Agricultural-Phosphorus-Potassium/dp/B08MXVSKG9/ref=sr_1_1?dchild=1&keywords=soil%2Bph%2Bsensor&qid=1631286952&sr=8-1&th=1
- Soil EC Sensor
 - https://www.amazon.com/Taidacent-Detector-Agricultural-Phosphorus-Potassium/dp/B08MXVSKG9/ref=sr_1_1?dchild=1&keywords=soil%2Bph%2Bsensor&qid=1631286952&sr=8-1&th=1
- 9V 5A Adapter
 - https://www.amazon.com/Supply-Adapter-Converter-Regulator-Monitor/dp/B0888DQ343/ref=sr_1_4?dchild=1&keywords=9v+5a+dc+adapter&qid=1631287139&sr=8-4

- 9V to 5V Buck Converter
 - https://www.amazon.com/UCTRONICS-Converter-Transformer-Voltage-Regulator/dp/B07XXWQ49N/ref=sr_1_1?dchild=1&keywords=9v+to+5v+step+down+converter&qid=1631287177&sr=8-1

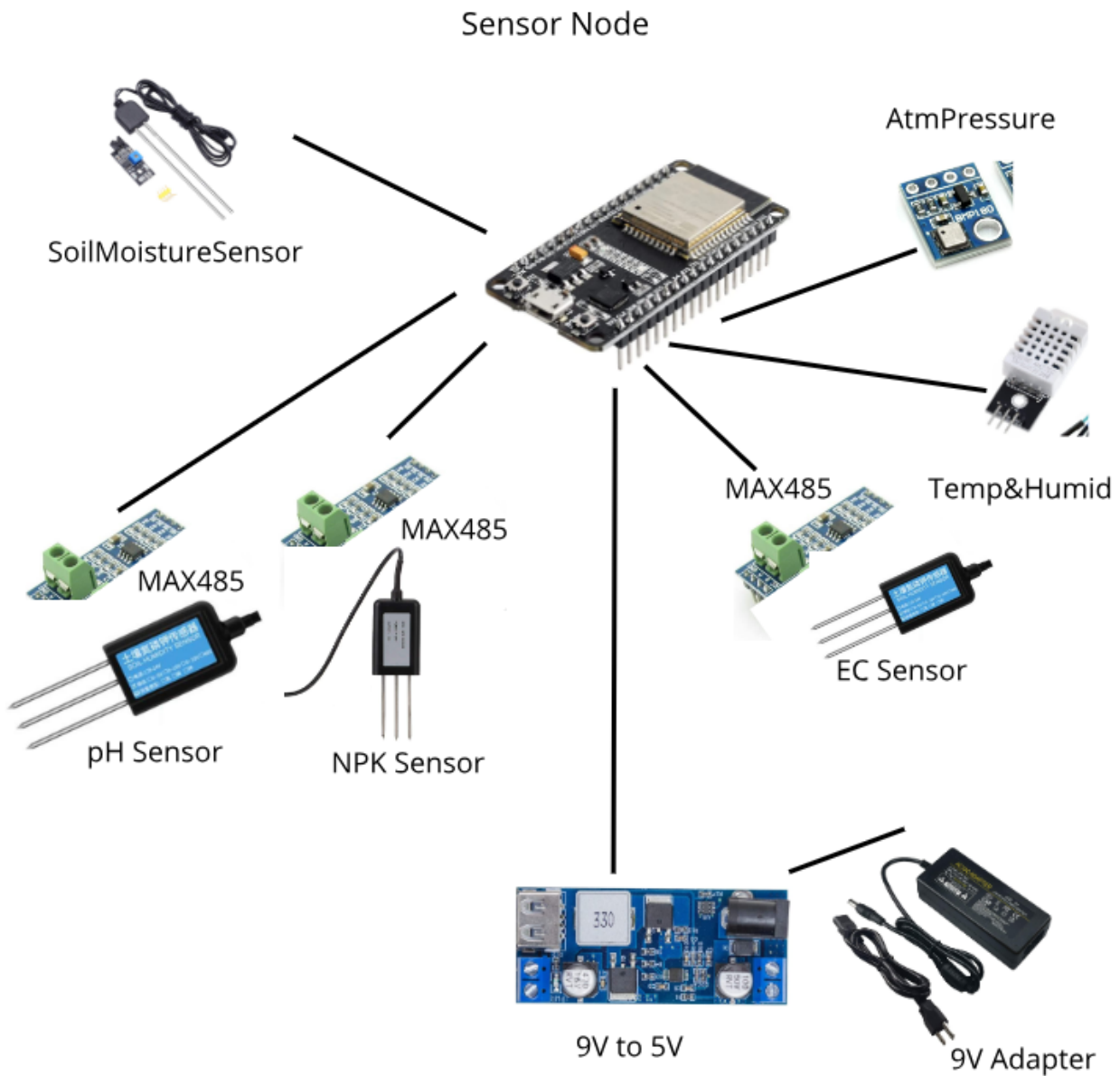
Architecture

The complete project has multiple components

- Sensor Nodes
- IoT Server

Sensor Nodes are small boxes containing esp32, Modubus to Serial adapters, and a connector for the sensors. While for the power a 9v 5A adapter is required.

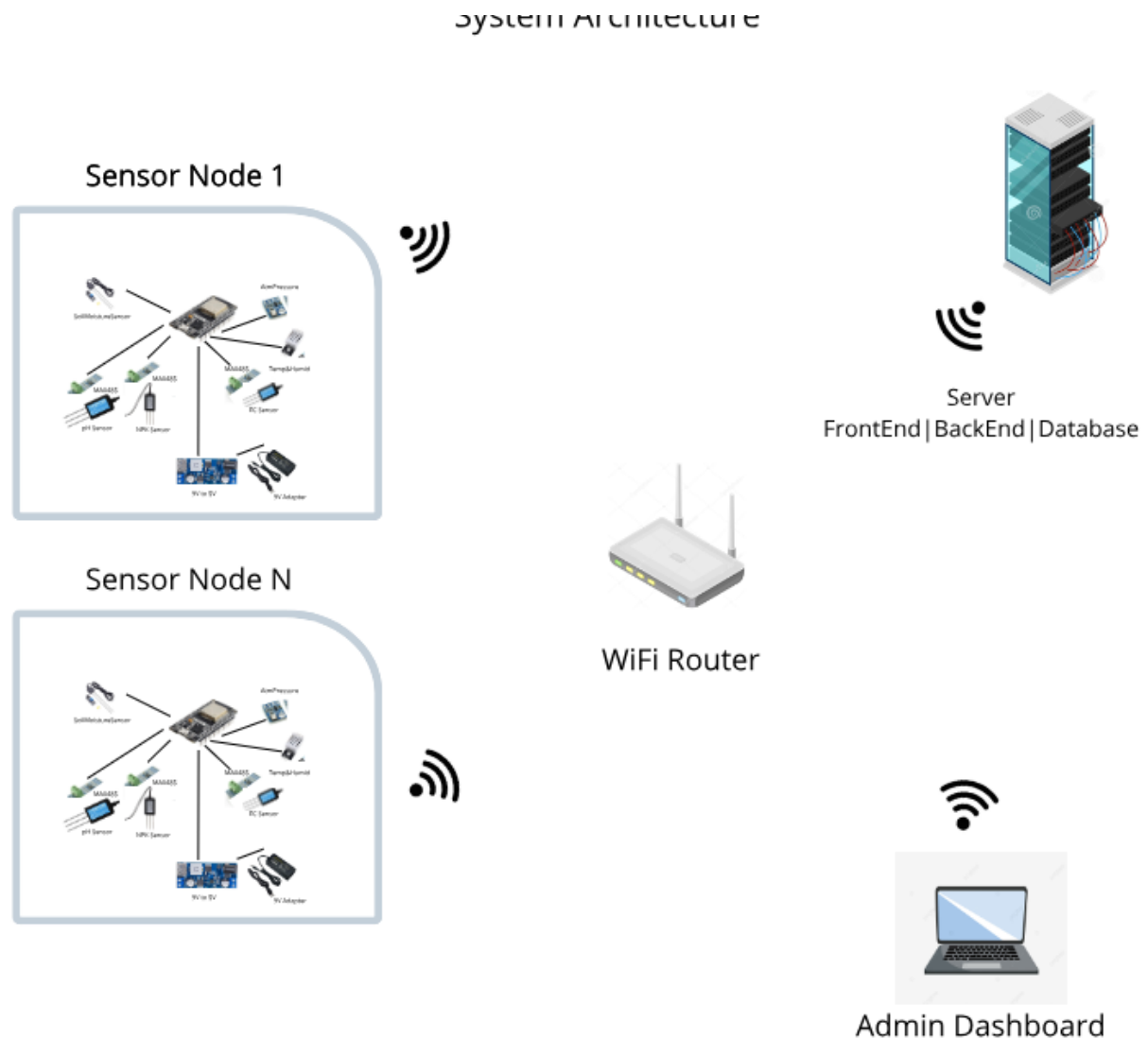
Sensor Nodes Architecture



Above is the Sensor Nodes architecture. Each box contains a single sensors along with ESP32.

The whole assembly with sensors along with a Master(ESP32) is referred to as a sensor node.

System Architecture



Above shown is the complete system architecture. Each Sensor Node can communicate with the server via MQTT(it is best to use MQTT for data communication because it is low-powered) and the IoT server exposes an OTA API as well. The web app can get the live data from the IoT Server.

Software Architecture

Multiple Nodes management

The nodes should have unique identifiers which are the MAC address numbers of ESP32 which will be used to uniquely identify each Node.

SensorNodeID:[DataString]

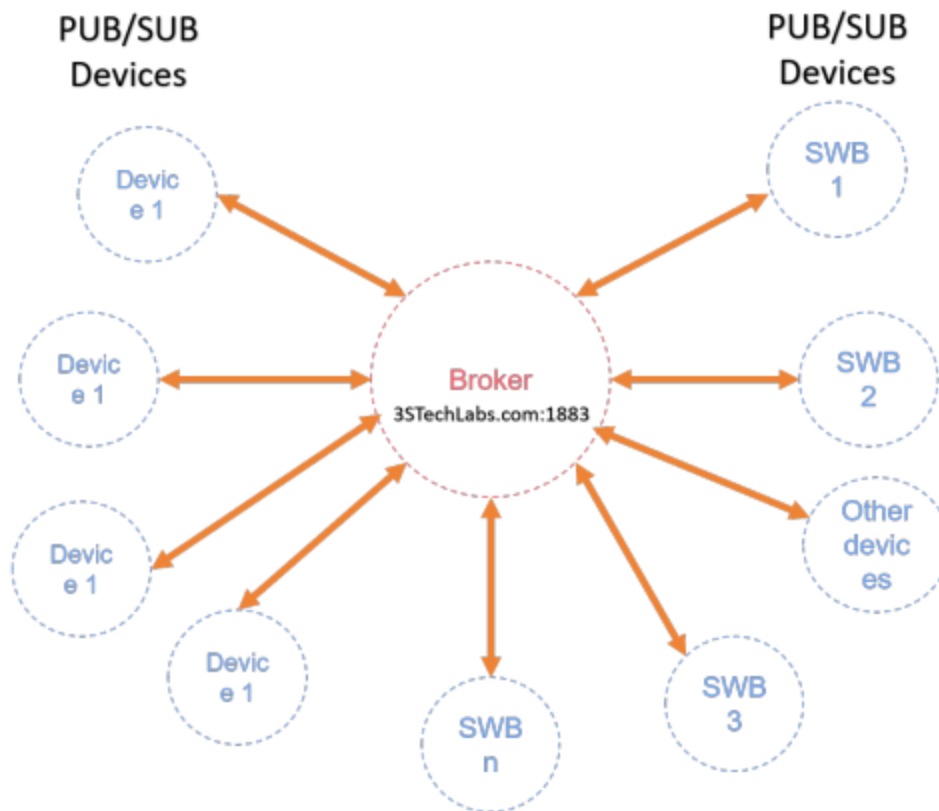
- SensorNodeID is a unique ID of Sensor Node
- [DataString] contains the sensor value(Status)

The communication is done over WiFi and data is shared to the IOT Server(and the webapp) over MQTT.

Web Server Integration

The communication should ideally be done using MQTT because of its smaller data packets and fast response. Your webapp or smartphone app will communicate with the IOT Server instead of communicating directly with the Sensor Nodes. This can save power and can make the communication and OTA fast.

What is MQTT?



Take an example of a system in which there are hundreds of people having smart bands that can display information of a person's surroundings. And then there are Android, iOS and Windows devices that can be used to monitor smart bands to define set of parameters for bands.

So in a scenario where there are mixed types of devices including hardware platforms, the best communication protocol is MQTT.

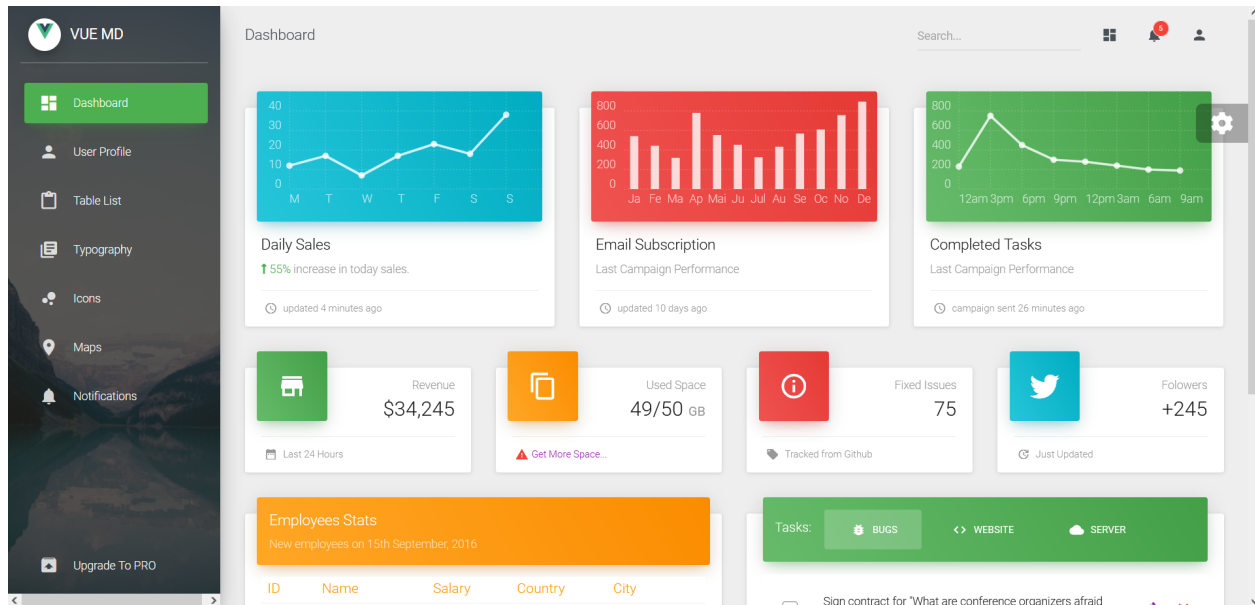
It can handle two-way and parallel communication and the number of devices that can be connected and communicate via MQTT are limitless, the only limit is server resources. MQTT is also known as pub/sub protocol.

Hence the protocol of choice here is MQTT.

WebApp

The web app will be made using VueJS for frontEnd, NodeJS and FastAPI for BackEnd and Mongo DB for the database.

I will use [CreativeTim dashboard template](#) to create a nice-looking management portal. Sample preview of the dashboard is shown below



Features of the WebApp

1. Minimalistic design
2. User login/signup
3. Device addition deletion
4. Real-time devices monitoring
5. Setting up alarms

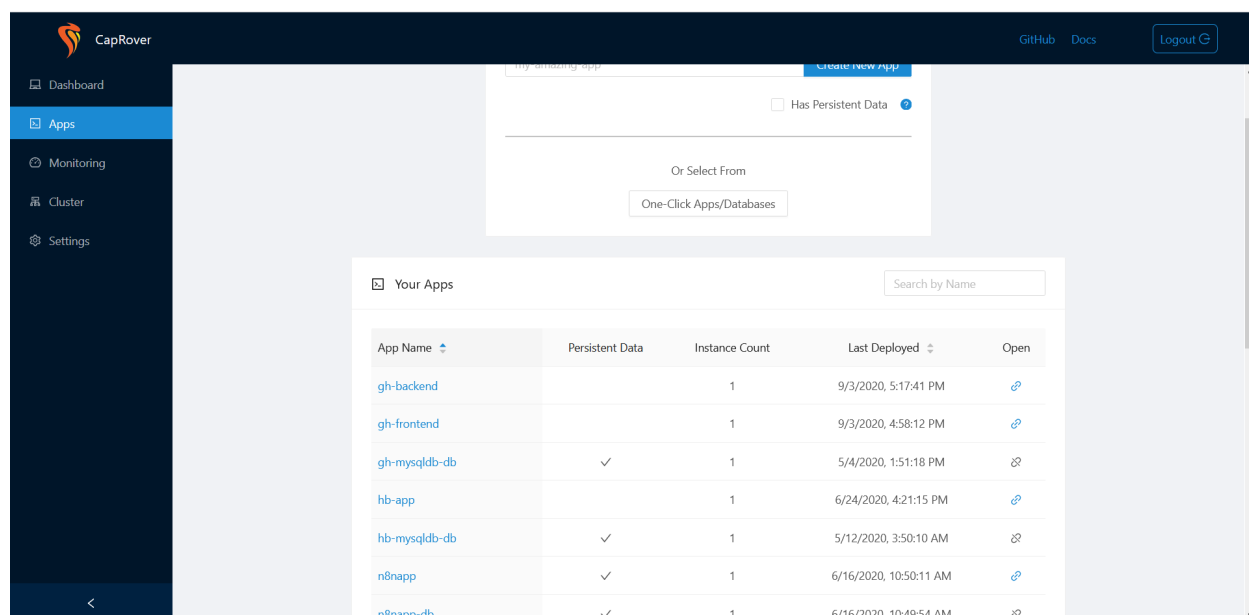
Management and CI/CD Pipeline

We will use Github for delivering the code. The developers from my team will be working on Hardware, Firmware, Backend, Frontend and apps simultaneously and for modularity we will dockerize different components of the app.

For Continuous Integration and Delivery we will be using CapRover running on a bare metal Ubuntu 18.04 instance and each component of the project's github repository will be linked to the respective Containers running in the Caprover. It will allow fully-automated delivery.

We will use our own company's production server running on AWS for testing and delivery during the development time. After that we can transfer the files to your own AWS and details of migration are mentioned in the Terms and Condition section of this report.

My automation engineer will work on this.

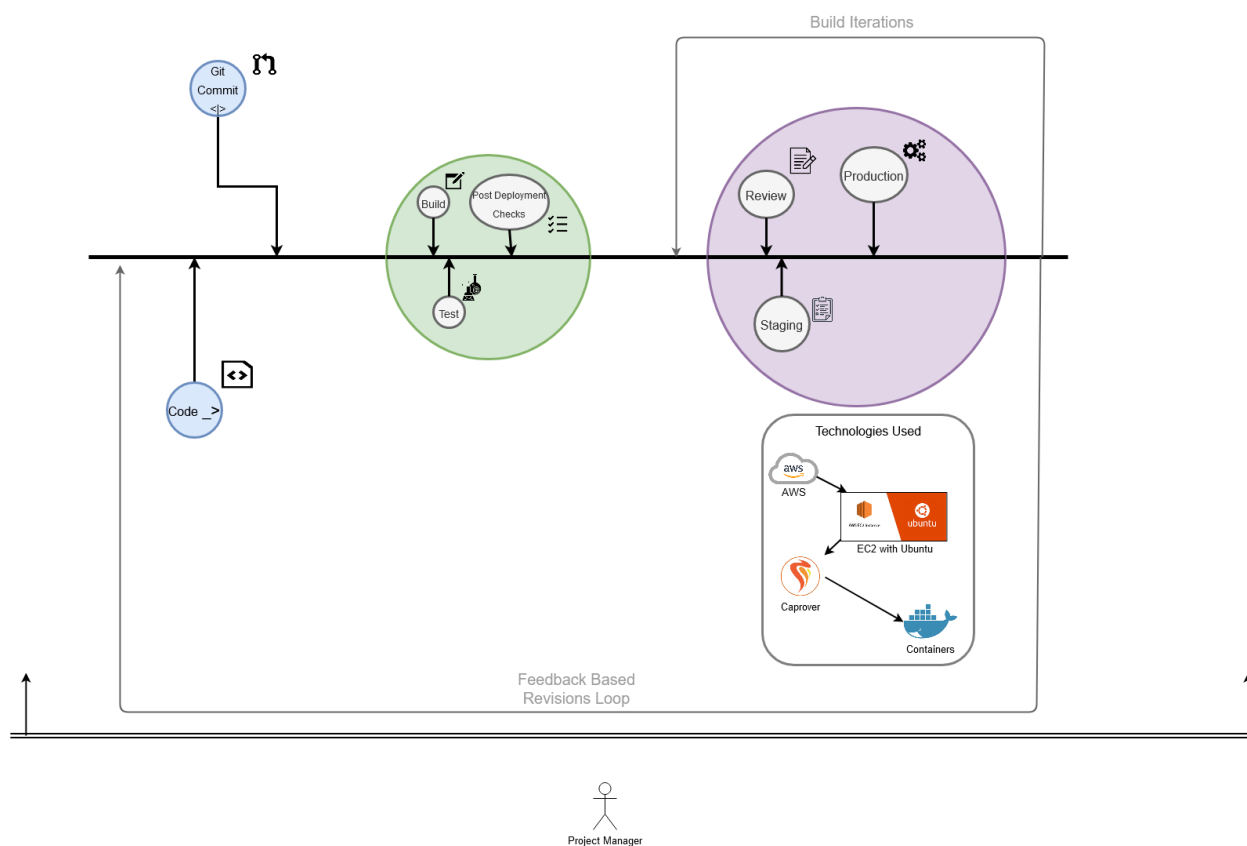


From the picture above you can see that all of the services like backend, frontend and database etc are running in separate containers allowing a smooth delivery pipeline.

3STechLabs' CI/CD Standard Pipeline

Below is our well-tested CI/CD Pipeline for project management and delivery. This has been proven to work for our 10+ Full-Stack IoT Projects and Products.

3STechLabs CI/CD Pipeline



(For a detailed look, please open the image file of above diagram)

Questions and Their Answers

1. Could you develop a prototype for us?

- Do you want me to send you the completed prototype to your address? If yes, unfortunately, I can't do this at this moment and neither can I commit anything like that because of the current Covid-19 situation the flights are delayed eventually delaying the shipments and in some cases even missing the delivery altogether.
- On other hand, I will provide you
 - Complete Code
 - Circuit diagrams
 - A complete report on how to setup and configure things.
- You can use all the delivered files and documentation to assemble. the prototype yourself.

Milestones Breakdown

1. Sensor Nodes Design - **Milestone 1** **\$350**
 - a. Hardware and Firmware with WiFi Manager + Setup Document
 - b. Development Time 15 Days
2. IoT Server Design and Configuration - **Milestone 2** **\$460**
 - a. WebServer backend and other related things + Setup Document
 - b. Development Time 20 Days
3. WebApp Dashboard Design **Milestone 3** **\$0**
 - a. Based on the CreativeTim dashboard
 - b. Development Time 12 days
 - c. *This milestone will be developed for free.

Terms and Conditions

- We will not ship anything physically unless otherwise decided, instead, you will be provided with a setup document with the completion of each milestone which will be easy to follow and will contain all of the necessary information.

In this document, the company refers to 3STechLabs.

If you agree to this report please fill-out the form below.

<https://naumanshakir3s.typeform.com/to/jZlIJP>

Profile

Name: Nauman Shakir

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I'm a Full-Stack IoT Developer and have done more than 150 hardware projects and running an IoT and Hardware Design House

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