



**IOT ENABLED SMART FARMING APPLICATION
NALAIYA THIRAN PROJECT BASED LEARNING
ON
PROFESSIONAL READINESS FOR INNOVATION,
EMPLOYABILITY AND ENTREPRENEURSHIP**

PROJECT REPORT

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1. Introduction

Project Overview

IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors. Farmers can monitor all the sensor parameters by using a web or mobile application even if the farmer is not near his field. Watering the crop is one of the important tasks for the farmers. They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and controlling the motor pumps from the mobile application itself.

Purpose

Increasing control over production leads to better cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for instance, helps eliminate the risk of losing yields. Additionally, automation boosts efficiency. Smart farming reduces the ecological footprint of farming. Minimized or site-specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases.

2. Literature Survey

Existing Problem

IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity. Climate plays a very critical role for farming. And having improper knowledge about climate heavily deteriorates the quantity and quality of the crop production. Precision Agriculture/Precision Farming is one of the most famous applications of IoT in Agriculture. It makes the farming practice more precise and controlled by realizing smart farming applications such as livestock monitoring, vehicle tracking, field observation, and inventory monitoring. To make our greenhouses smart, IoT has enabled weather stations to automatically adjust the climate conditions according to a particular set of instructions. Adoption of IoT in Greenhouses has eliminated the human intervention, thus making entire process cost-effective and increasing accuracy at the same time.

References

1, Sustainable agriculture by the Internet of Things – A practitioner's approach to monitor sustainability progress. 2022, Computers and Electronics in Agriculture.

2, The Interplay between the Internet of Things and agriculture: A metric analysis and research agenda. 2022, International Journal of Intelligent Networks.

3, Agriculture 4.0 and its Barriers in the Agricultural Production Chain Development in Southern Brazil. 2022, SSRN

4, IoT based Agriculture (IoTA): Architecture, Cyber Attack, Cyber Crime and Digital Forensics Challenges. 2022, Research Square.

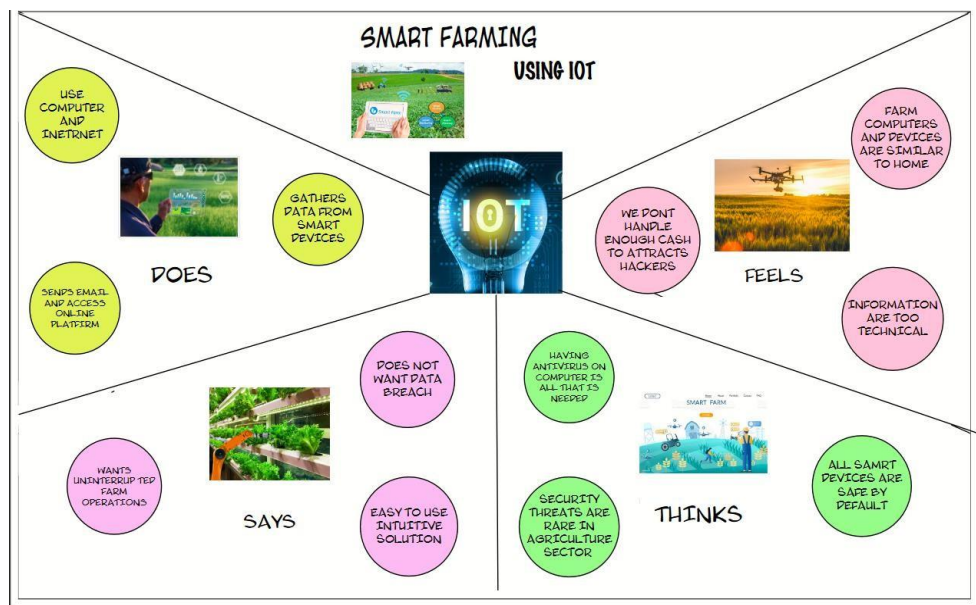
Problem Statement Solution

The traditional agriculture and allied sector cannot meet the requirements of modern agriculture which requires high-yield, high quality and efficient output. Thus, it is very important to turn towards modernization of existing methods and using the information technology and data over a certain period to predict the best possible productivity and crop suitable on the very particular land. The adoptions of access to high-speed internet, mobile devices, and reliable, low-cost satellites (for imagery and positioning) are few key technologies characterizing the precision agriculture trend. Precision agriculture is one of the most famous applications of IoT in the agricultural sector and numerous organizations are leveraging this technique around the world. Some products and services in use are VRI optimization, soil moisture probes, virtual optimizer PRO, and so on. VRI (Variable Rate Irrigation) optimization maximizes profitability on irrigated

crop fields with topography or soil variability, improve yields, and increases water use efficiency. IoT has been making deep inroads into sectors such as manufacturing, health-care and automotive. When it comes to food production, transport and storage, it offers a breadth of options that can improve India's per capita food availability. Sensors that offer information on soil nutrient status, pest infestation, moisture conditions etc. which can be used to improve crop yields over time. Some of the sample problem statements related to Agriculture & allied sectors where IoT application will be beneficial are given below.

3.IDEATION &PROPOSED SYSTEM

Prepare Empathy Map



Ideation

6.	Scalability of the Solution	Image recognition-based prediction of crops health Ai based automated irrigation using temperature, pressure, humidity, and soil moisture sensors
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Proposed Solution Fit

Problem-Solution fit canvas 2.0		Purpose / Vision	
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS <i>The customers of this product are the farmers who cultivate crops. Our aim is to assist, aid and help them to monitor the field parameters remotely and to keep track of the parameters. This product saves the agriculture from extinction.</i>	6. CUSTOMER CONSTRAINTS CC <i>Deployment of huge number of sensors is difficult. It requires an unlimited or continuous internet connection to be successful.</i>	5. AVAILABLE SOLUTIONS AS <i>The irrigation process is automated using IoT. weather data and field parameters were obtained and processed to automate the process of irrigation. The drawbacks are high cost of installation, efficient only for short distance, difficulty in storing the data.</i>
	Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P <i>The objective of this product is to obtain the different field parameters using sensor and process it using a central processing system. Cloud is used to store and transmit the data by using IoT. Weather APIs are employed to assist the farmer in making decision. The farmer could take decision through a mobile application.</i>	9. PROBLEM ROOT CAUSE RC <i>The frequent change or unpredictable weather and climate, made it difficult for the farmers to do agriculture. These factors play a major role in making decision whether to water the plant or not. The monitoring of the field is hard when the farmer is out of station, thus leading to crop damage.</i>
Identify strong TR & EM		3. TRIGGERS TR <i>Farmers facing issues in providing proper irrigation. No proper supply of water leads to reduced production which affects the profit level of the farmer. Farmer's struggle to predict the weather.</i>	10. YOUR SOLUTION SL <i>Our product collects the data from different types of sensors and it sends the value to the main server. It also collects the weather data from the weather API. The ultimate decision, whether to water the crop or not is taken by the farmer using mobile application.</i>
	4. EMOTIONS: BEFORE / AFTER EM <u>BEFORE:</u> Lack of knowledge in weather forecasting → Random decisions → low yield. <u>AFTER:</u> Data from reliable source → correct decision → high yield		

4.Requirement Analysis

Functional Requirement

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	End users can monitor and control their connected farm using IOT applications on their smartphones or tablets
NFR-2	Security	The software keeps the user's information more securely.
NFR-3	Reliability	The smart farm, embedded with IOT systems, could be called a connected farm, which can support a wide range of devices from diverse agricultural device manufactures.
NFR-4	Performance	It is a user-friendly software and have high performance.
NFR-5	Availability	Available for every user, visible for all users and farmer.

Non- Functional Requirements

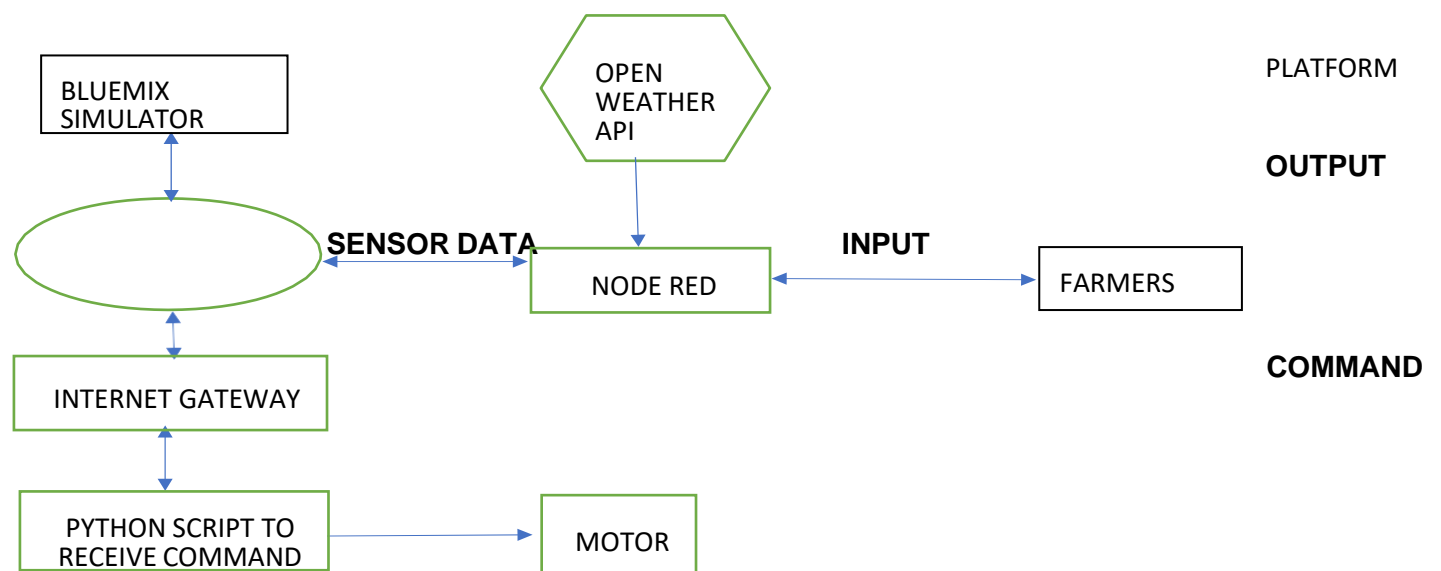
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Application.
FR-2	User Confirmation	Confirmation of registered user.
FR-3	User Profile	Log in Access the Profile
FR-4	Analyse	Data from smart sensors can be analysed for predictive analysis and automated decision making.

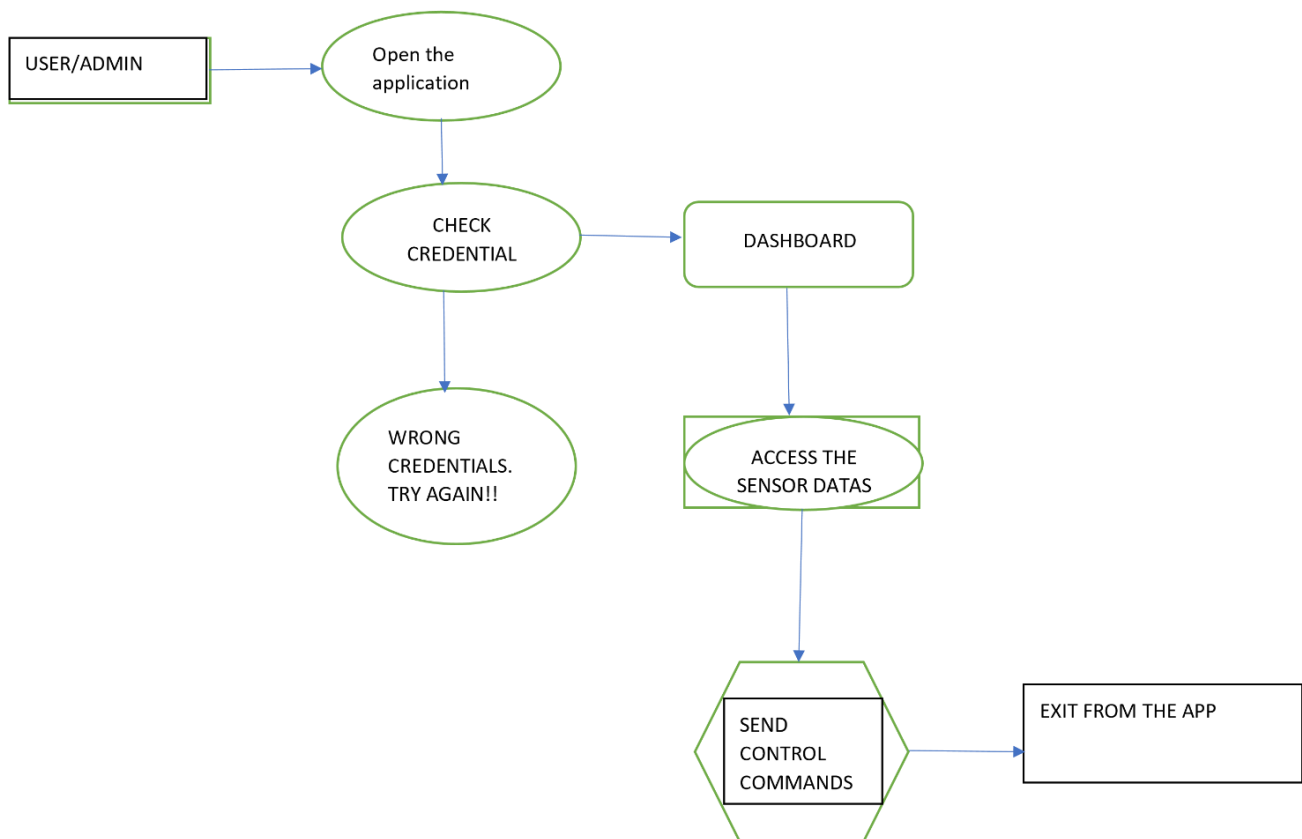
FR-5	Recommend	Based on the farming the software recommends the automated irrigation practices.
NFR-6	Scalability	The proposed precision farming structure allows the implementation of a flexible methodology that can be adopted to different types of crops.

Data Flow Diagrams

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.





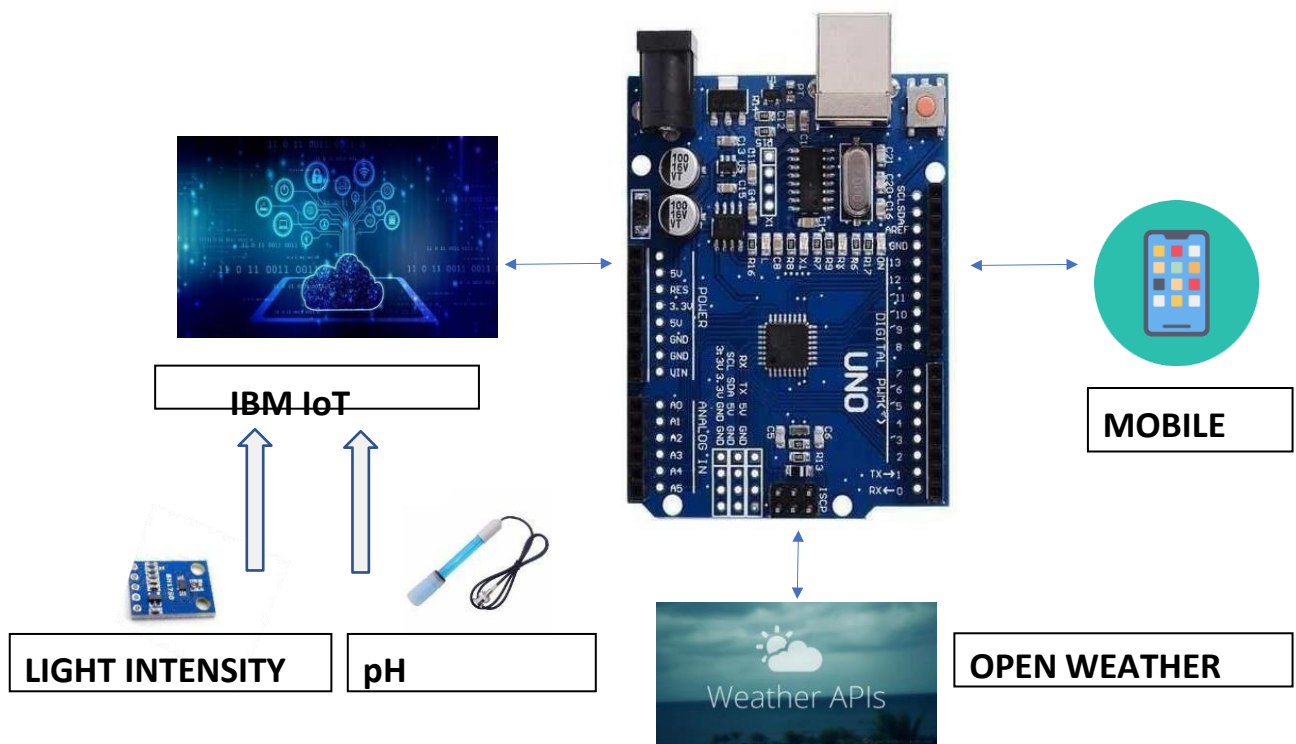
- The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the ibm cloud.
- Aurdino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weather API.
- NODE-RED is used as a programming tool to write the hardware, software and APIs. The MQTT protocol is followed for the communication.
- All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could make a decision through an app, weather to water the crop or not depending upon the sensor values. By using the app they can remotely operate to the motor switch.

Solution & Technical Architecture

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.



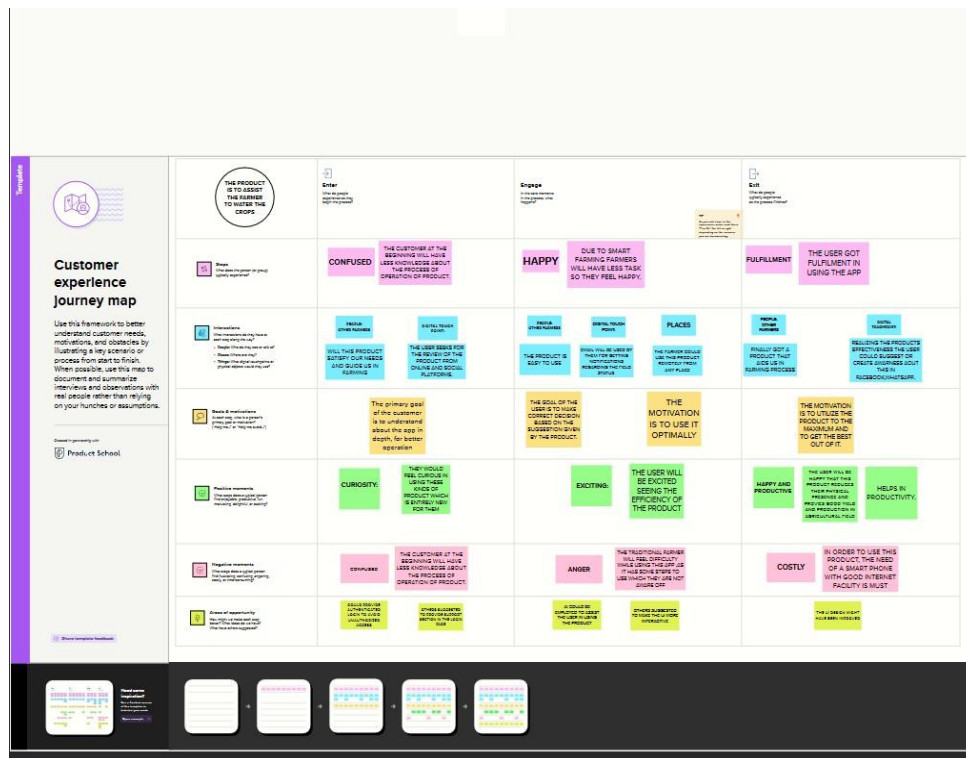
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Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson IOT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM Cloud
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	Sensitive and private data must be protected from their production until the decision-making and storage stages.	e.g. Node-Red, Open weather App API, MIT App Inventor , etc
3.	Scalable Architecture	scalability is a major concern for IoT platforms. It has been shown that different architectural choices of IoT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.	Technology used
4.	Availability	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.	Technology used
5.	Performance	The idea of implementing integrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.	Technology used

User Stories

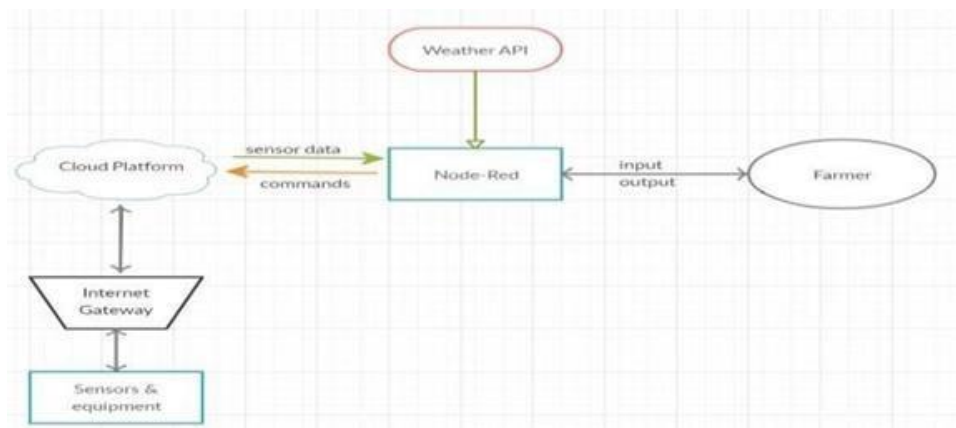


6. PROJECT PLANNING & SCHEDULING

Sprint Delivery planning & Estimation

SPRINT DELIVERY OVERVIEW :

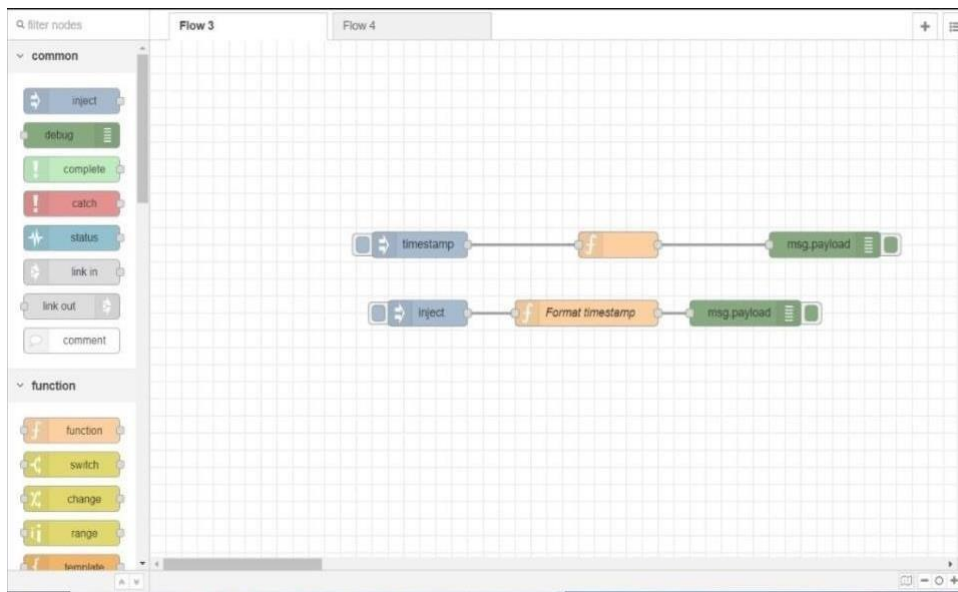
In order to implement the solution , the following approach as shown in the block diagram is used



1.Required Software Installation

A Node-Red

Node-RED is a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things. NodeRED provides a web browser-based flow editor, which can be used to create JavaScript functions.



Installation :

- First install npm/node.js
- Open cmd prompt
- Type => npm install node-red To run the application :
- Open cmd prompt
- Type=> node-red
- Then open <http://localhost:1880/> in browser

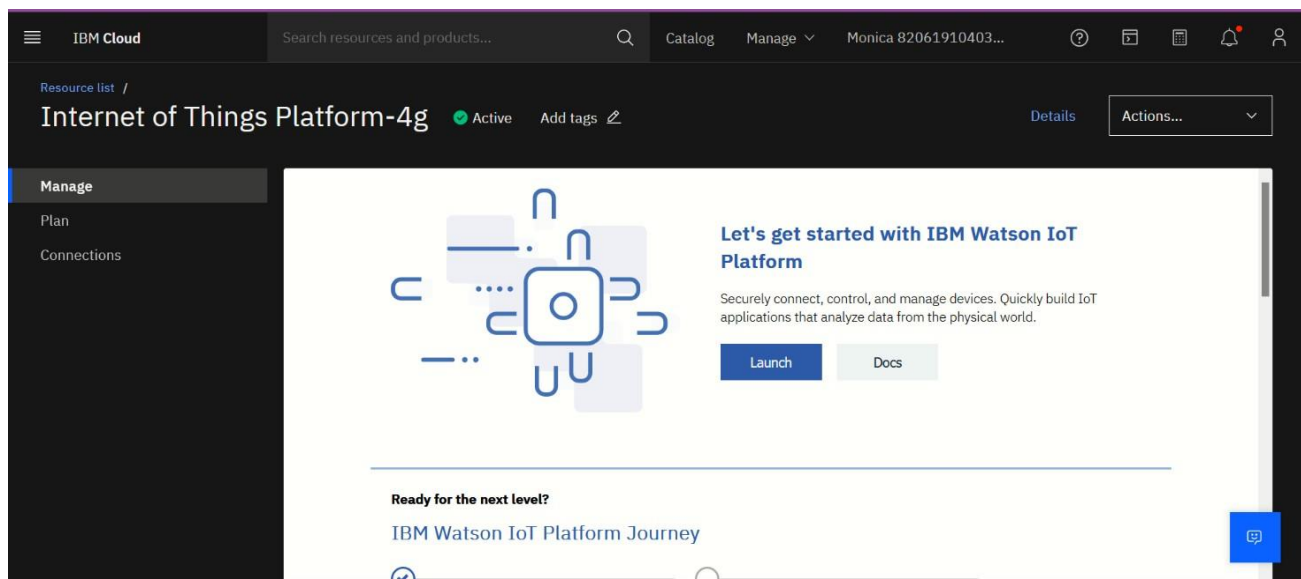
Installation of IBM IoT and Dashboard nodes for Node-Red

In order to connect to IBM Watson IoT platform and create the Web App UI these nodes are required

1. IBM IoT node
2. Dashboard node

1.2.B IBM Watson IoT Platform

A fully managed, cloud-hosted service with capabilities for device registration, connectivity, control, rapid visualization and data storage. IBM Watson IoT Platform is a managed, cloud-hosted service designed to make it simple to derive value from your IoT devices.

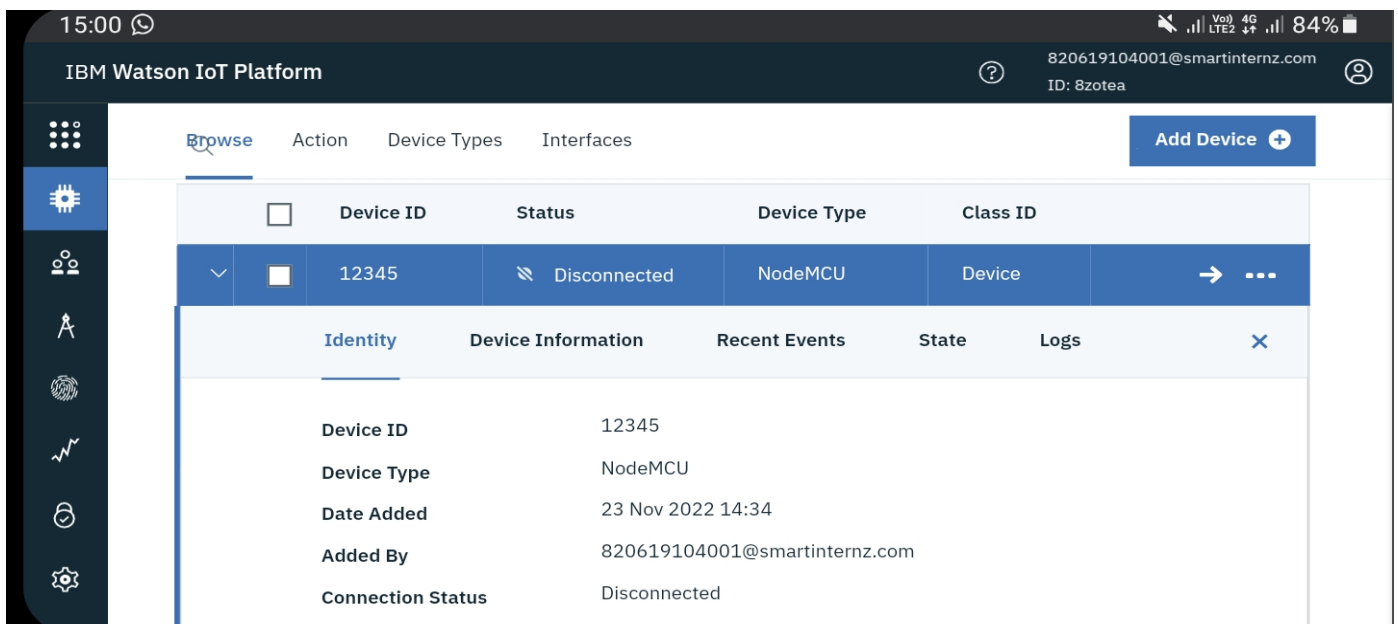


Steps to configure:

- Create an account in IBM cloud using your email ID
- Create IBM Watson Platform in services in your IBM cloud account
- Launch the IBM Watson IoT Platform
- Create a new device
- Give credentials like device type, device ID, Auth. Token • Create API key and store API key and token elsewhere.

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1.2.C Python IDE

- Install Python3 compiler
- Install any python IDE to execute python scripts, in my case I used Spyder to execute the code.

```
Python 3.7 (64-bit)
Python 3.7.5 (tags/v3.7.5:5c82a394b, Oct 15 2019, 00:11:34) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more
>>>
```

IoT Simulator

- In our project in the place of sensors we are going to use IoT sensor simulator which give random readings to the connected cloud.
- The link to simulator: <https://watson-iot-sensor-simulator.mybluemix.net/>
- We need to give the credentials of the created device in IBM Watson IoT Platform to connect cloud to simulator.

OpenWeather API

OpenWeatherMap is an online service that provides weather data. It provides current weather data, forecasts and historical data to more than 2 million customer.

Website link: <https://openweathermap.org/guide>

Steps to configure:

o Create account in OpenWeather
o Find the name of your city by searching
o Create API key to your account
o Replace "city name" and "your api key" with your city and API key in below red text
api.openweathermap.org/data/2.5/weather?q={city name}&appid={your api key} Link I used in my project:
<http://api.openweathermap.org/data/2.5/weather?q=Gudur,in&appid=62354068e45f41ffa6a5b164714145fe>