Case Study on Farm Monitoring
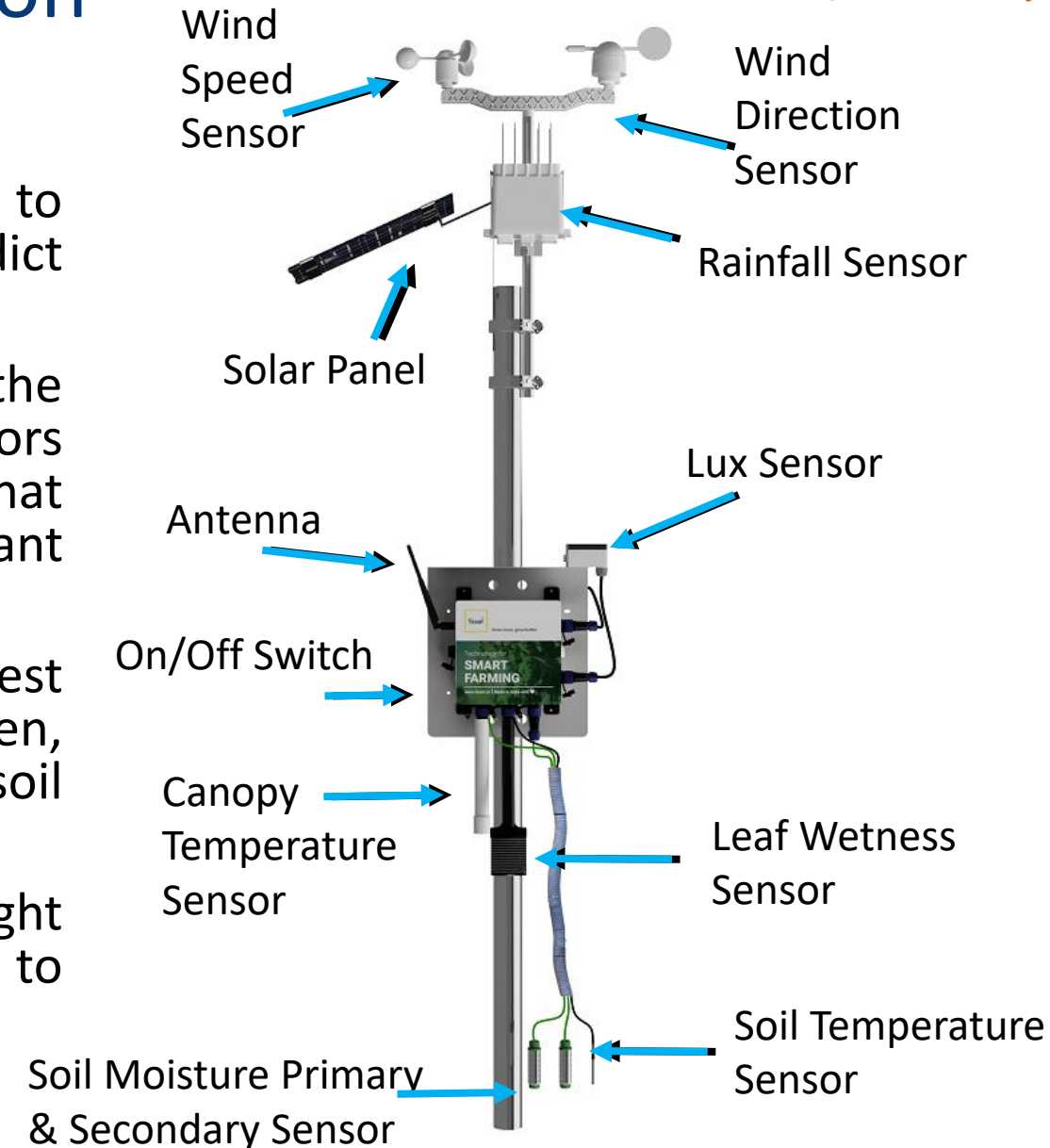# Meteorological Weather Station

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Elements of Farm Weather Station

1. Sensors:

- The data gathered by the sensors can be used to make machine learning models to accurately predict weather forecast, diseases, etc.

- Leaf wetness sensors are used to detect the presence of surface moisture. Leaf wetness sensors can also be used to monitor the conditions that result in fungal development and growth on plant surfaces.

- Other sensors are used to determine the best planting time for crops. Sensors like NPK (Nitrogen, Phosphorous, Potassium) are used to check the soil fertility.

- Soil Moisture Sensor is used to decide the right amount of water that should be given to plant to avoid stresses in plants and soil.

Wind Speed Sensor

Wind Direction Sensor

Rainfall Sensor

Solar Panel

Lux Sensor

Antenna

On/Off Switch

Canopy Temperature Sensor

Leaf Wetness Sensor

Soil Temperature Sensor

Soil Moisture Primary & Secondary Sensor

1. Sensors

1. Wind Speed Sensor
   Price: 8k

2. Wind Direction Sensor
   Price: 8k

3. Rainfall Measurement Sensor
   Price: 5-8k

4. pH Sensor
   Price: 2k

AIO unit speed, direction, rainfall measurement
Price: 6-7k

1. Sensors

6. Lux Sensor
Price: 350-1.5k

7. Soil Temp Moisture Sensor
Price: 2-5k

5. Temp, Humidity, pressure and altitude Sensor
Price: 500-1k

SOIL NPK SENSOR
Power Supply: ☐12-24V
Output: ☐0-5V   ☐0-10V
        ☐4-20mA ☐485
Measurement Type: ☐N ☐P ☐K

9. NPK Sensor
Price: 3-6k

8. Leaf Wetness Sensor
Price: 2-5k

Elements of Farm Weather Station contd.

- ## Technology Insight

- Different companies use different technologies as per their convenience, one of them is LoRa, and other being Hologram International IoT sim card, etc.

- It depends on the card, but many (including Hologram's Global SIM card and Hyper card) are capable of multi-network connectivity. That means your devices can connect to the best networks available locally, no matter where they roam in the world.

Industrial Sim

Embedded Sim
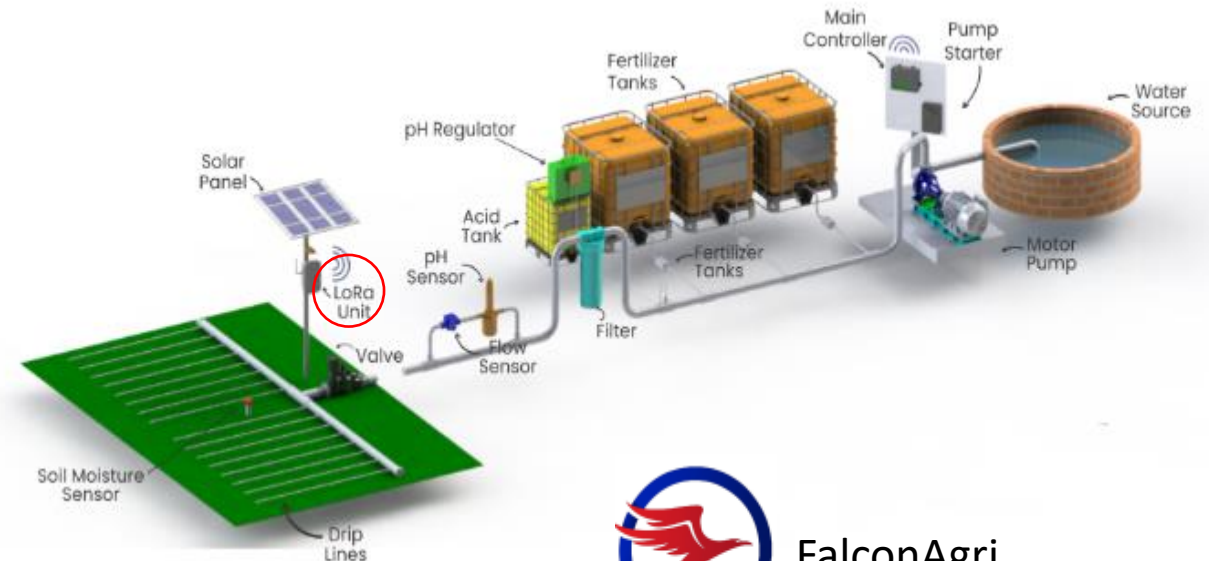
FalconAgri

Elements of Farm Weather Station contd.

2. LoRa (Long Range):

- LoRa is a radio communication technique that collects data from the sensor & transfers it to the internet using a device called as "GateWay".

- GateWay has a simcard (GSM) inside it that enables it to access internet.

- The data collected now can be sent to the server using a network called as "THE THINGS NETWORK".

- Advantages of LoRa is, it consumes very less power.

- Disadvantage is, its initial cost is high, only the price of GateWay costs around 20-25k.
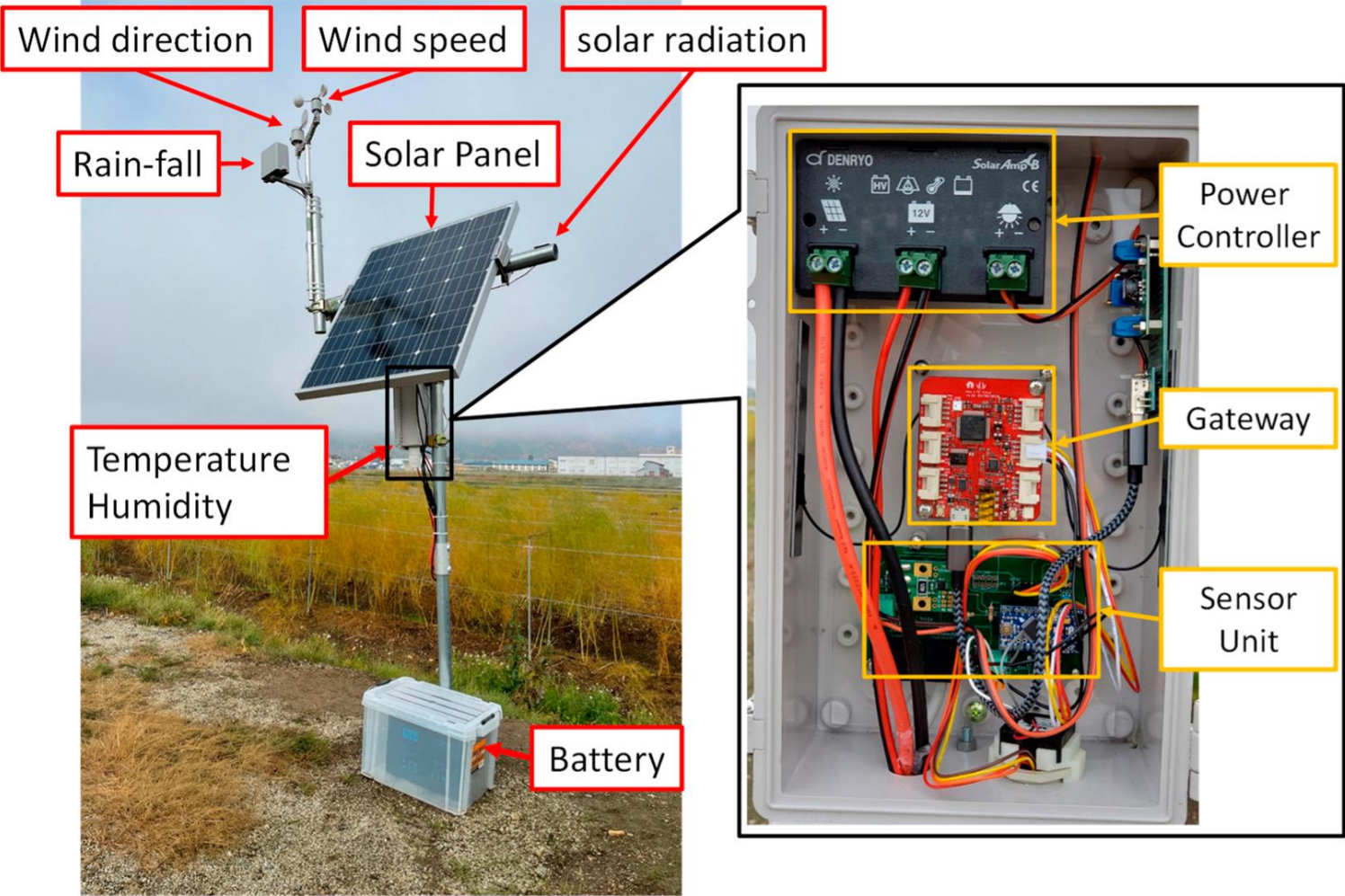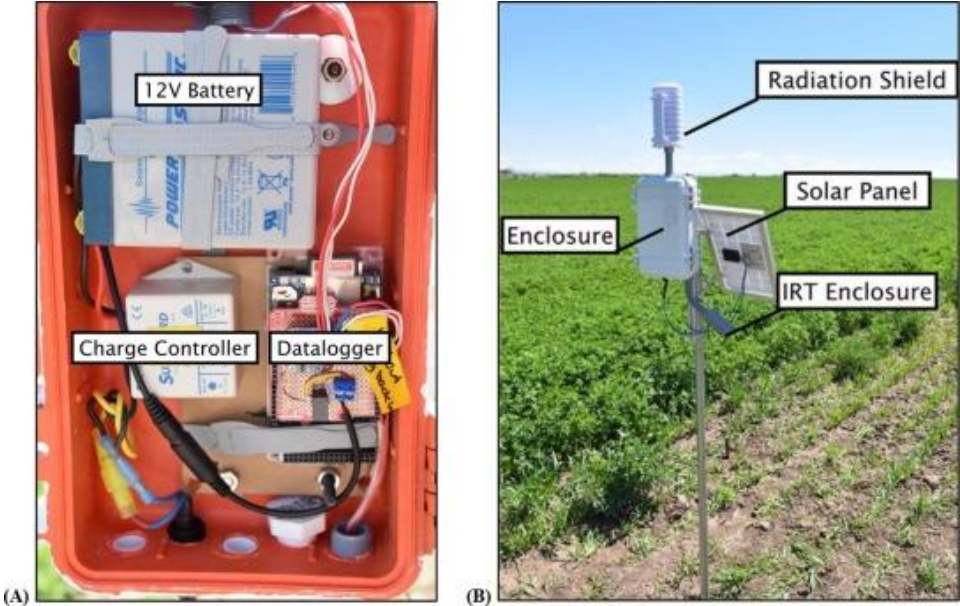

LoRa GateWay
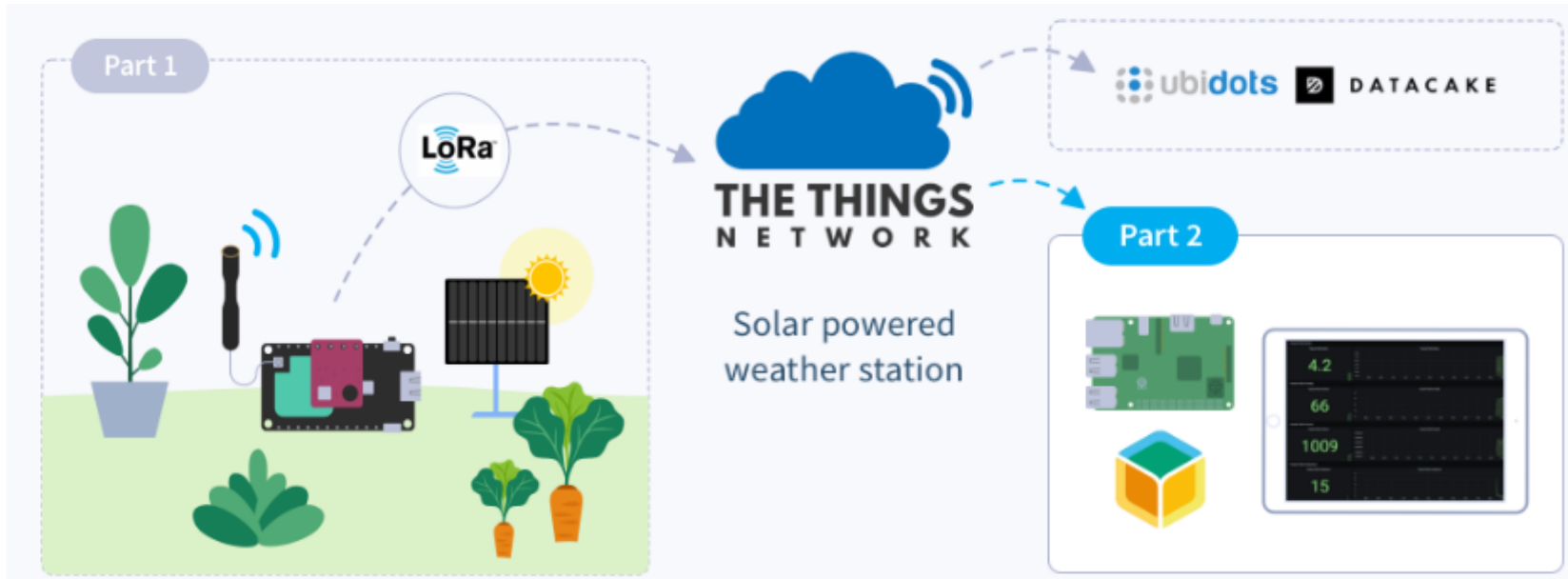
LoRa Chip

Internet Chip

Gateway's

3. Server and Mobile Application:

- A sensor node that connects with an array of sensors records data at every configured interval, creates a data frame, and pushes it to the backend server on a 4G/3G/GPRS network.

- Function of server is to enable the user to store the data, along with storage it has m/c learning models that predict conditions based on data acquired.

- The AI Code continuously trains the machine learning model. The data gathered is segregated into 80-20, 80% is used to train and 20% used for testing.

- An app has backend and frontend. The app backend talks to the storage server to pull data and run algorithms. The app frontend presents data to users on the Web, iOS, and Android. A single codebase should be developed for web-app and all mobile apps.

- Data usage of server has recurring cost 8-10k yearly, based on how many sensors are used and time interval of data.
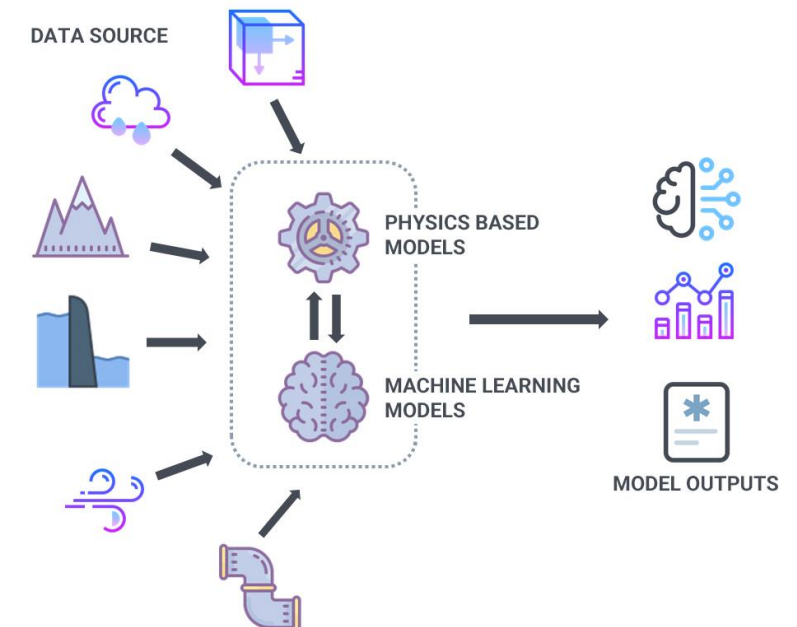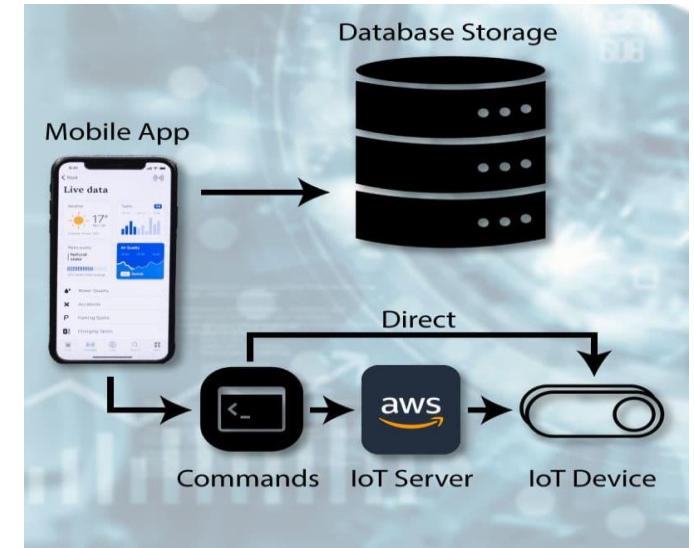
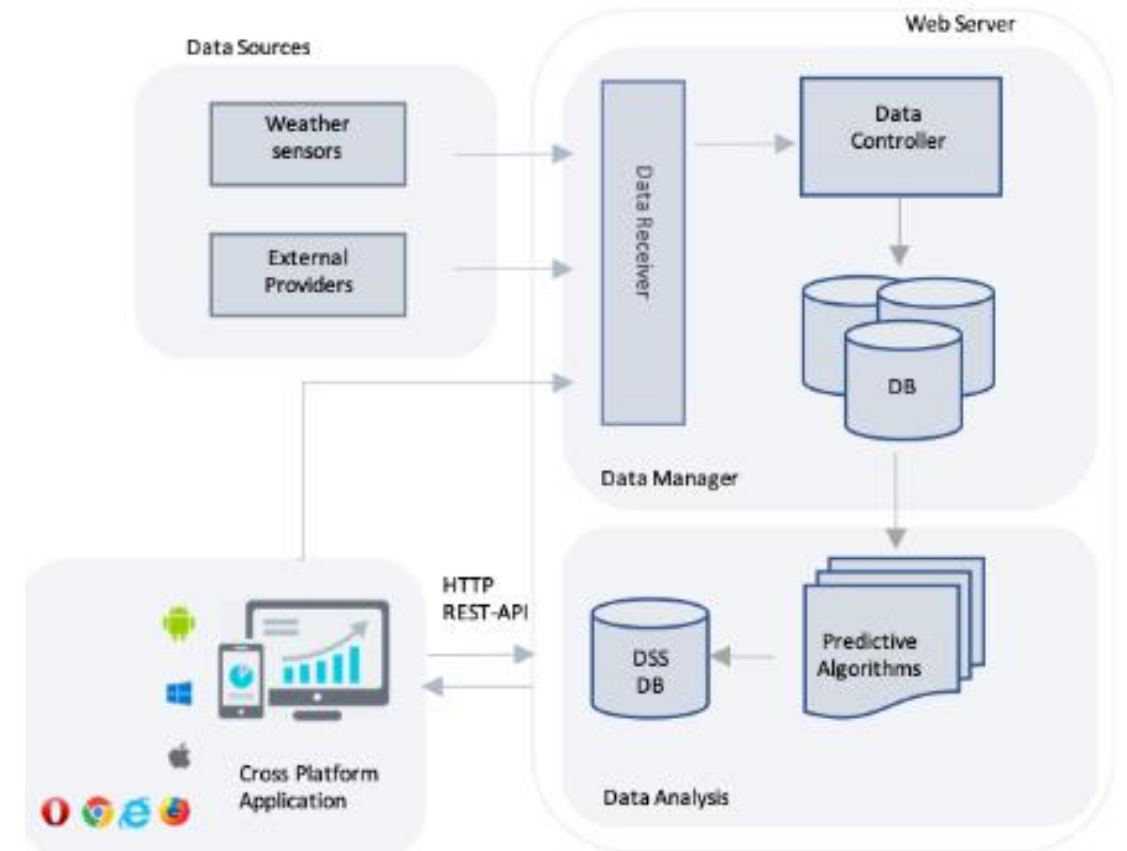# Architecture of ML Model and Server

Daily Avg Temp
Daily Avg Humidity
Daily Blight Units

Low
Medium
High
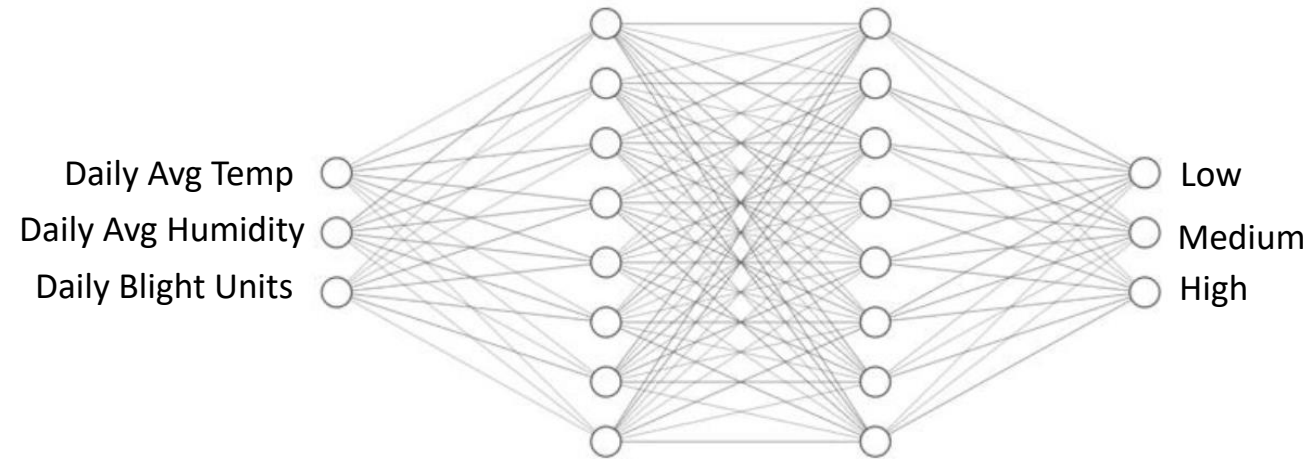
Feed-forward Neural Network developed to predict an index risk of Potato Late Blight Disease
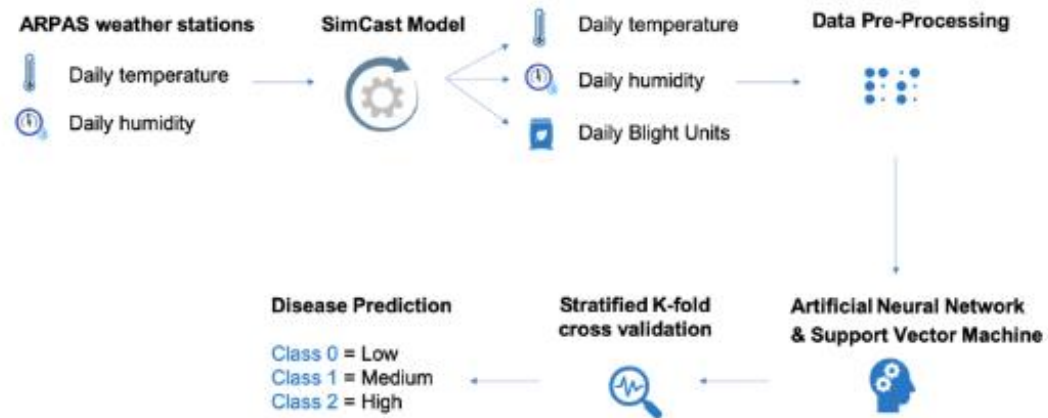
Work Flow of Proposed Method

Architecture of Server

1. Introduction

The variable of leaf wetness is understood as the presence of water on plant tissues [1]. It is measured as leaf water duration (LWD), which is defined as the time the plant surface shows visible water [2]. This measurement is essential for analyzing and preventing crop, forest, and plant diseases because surface wetness affects fungal and bacterial infection processes [3] and influences the deposition of atmospheric pollutants on leaves [4].

Figure 1 depicts relationships among leaf wetness duration (LWD) and air temperatures required for infection of several hosts by three different phytopathogenic fungi. Using these types of relationships, disease-warning systems were developed and are now being used by grower communities for a variety of crops. Examples of disease-warning systems based on LWD are shown in Table 1. As a component of Integrated Pest Management (IPM), disease-warning systems provide growers with information regarding the optimum timing for chemical or biological management practices based on weather variables (rainfall, humidity, LWD, air temperature) most suitable for pathogen dispersal or host infection (21). This approach contrasts with traditional calendar-based systems, which recommend sprays based on fixed calendar dates or phenological stages, rather than on dates determined by measures of environmental variables on infection and the levels of disease risk. Disease-warning systems can reduce the number of recommended sprays during periods when disease risk is low, but may also recommend more sprays than a calendar-based system when conditions are exceptionally disease-conducive (20). Although these systems are robust enough to permit some errors in the estimates or measurements of LWD, the need for highly accurate LWD data remains a priority to achieve the most efficient disease management.

potential yield. Diseases are one of the main factors that cause yield losses, and their development is directly associated with weather conditions that vary from one year to the next. In this context, leaf wetness measurement supports the prevention and control strategies that guarantee a successful coffee production each year.

Criticality of Machine Learning and Artificial Intelligence

- AI and ML is the governing body for this technology.

- Irrigation Model:

- AI systems give you Irrigation advisories (Light Irrigation, Normal Irrigation or Deep Irrigation) based on a combination of live moisture levels along with many other parameters like Evapotranspiration, VPD, RDI, and Micro-climatic conditions.

- Disease Model:

- For a disease like Powdery Mildew, technology works to mitigate the risk of infection during its three stages: primary, pre-secondary, and secondary. During the disease life-cycle, technology monitors rainfall and leaf wetness (as spores require moisture to form), temperature, past disease history, canopy level forecast temperature, and humidity along with an ultra hyper-local macro-climatic forecast for alerting farmers when levels reach optimal conditions for disease development.

- Rainfall and Weather Forecast Model:

- This model takes various factors into consideration like location, min & max temperature, past rainfall history, sunshine, evaporation, humidity, wind gust direction & speed at various time intervals and correlates it with existing data to accurately predict the weather and rainfall at that location.

- Generally these companies acquire such data from IMD (Indian Meteorological Department).

Advantages of this Technology

- The biggest advantage of such technology is Customer Acquisition Cost is reduced greatly.

- Many other businesses can easily be merged using the same app developed for weather station.

- Since, you have access to data, monitoring every farmers field becomes very easy and data can be used for other business.

Parameter Known	Business
Grade of Crop	Export
Nutritional Value	Fertilizers
Diseases	Pesticide, Fungicides
Diseases Alert Time	Drone Spraying

Advantage to Businessman

Grape/Acre	Without fyllo	With fyllo	Improvement
Produce Qty	12 tonnes	15 tonnes	25%
Export	8 tonnes	14.5 tonnes	81.20%

Advantage to Farmer

Challenges Associated with Development of Weather Station


1. **Development of PCB:**
    - Since this application has variety of sensors, there is no market ready PCB.
    - Writing the firmware for this application.
    - Expert team will be required.

2. **Development of Accurate Machine Learning Models:**
    - Gathering Data will take time.
    - Incorporating the gathered data with diseases will be particular for every crop.
    - Expert team will be required.

3. **Development of server:**
    - Continuous management of data and rolling upgrade.
    - Maintaining System Performance with increasing scalability (linear scalable server Container), Over to air (OTA) upgrade and zero downtime.
    - Expert team will be required.
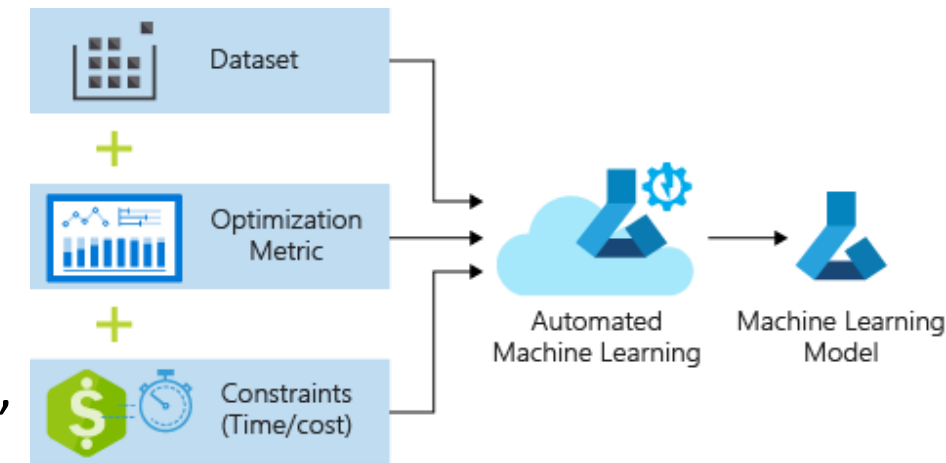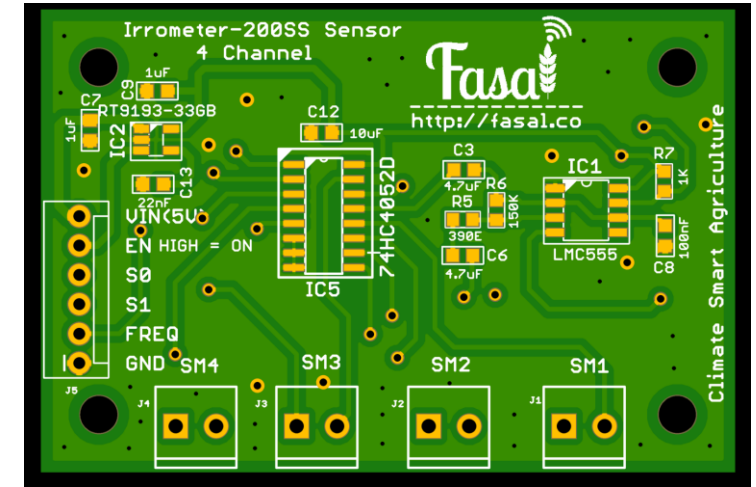
Suppliers of Weather Station

1. Fasal:

Price : 55,000 /-

- Wind Speed and Wind Direction
- Rainfall Measurement
- Lux Sensor (Light Intensity)
- Soil Temperature Sensor
- First and Second Layer Soil Moisture Sensor
- Leaf Wetness Sensor
- Canopy Temperature Measurement
- Weather Temp, Barometric pressure and humidity

2. Fyllo:

- Wind Speed and Wind Direction
- Rainfall Measurement
- Lux Sensor (Light Intensity)
- Soil Temperature Sensor
- First and Second Layer Soil Moisture Sensor
- Leaf Wetness Sensor
- Canopy Temperature Measurement
- Solar Radiation
- Weather Temp, Barometric pressure and
  humidity

Price : 57,000 /-
(for additional irrigation unit / plot) : 25k /-

3. Hydro flow tech :

Price : 75,000 /-

- Wind Speed and Wind Direction
- Rainfall Measurement
- Lux Sensor (Light Intensity)
- Soil Temperature Sensor
- First and Second Layer Soil Moisture Sensor
- Leaf Wetness Sensor
- Canopy Temperature Measurement
- Weather Temp, Barometric pressure and humidity

4. GRAMWORKX AGROTECH :

Gramworkx
FARMING ● FUTURE ● TECHNOLOGY

Hexagon Dynamics
Optimize with Reliability

Price : 100,300 /-

QUOTATION

Items	Rate	Quantity	Amount
Automatic Weather Monitoring Station **Advance Model- Data logger** **Make: -** Quick Engineering Solutions **General Specification:-** • PC interface • Recording & display • 12 volt Lithium- ion batteries.6Ah • Micro controller based system. • 16 characters X 2 lines display.. • With Pendrive data • Weather proof enclosure • Tripod tower 6 feet • Real time clock provided. • Logging interval 1 minute to 24 hour. • Easy to use.	20,000	01	20,000/-
• **Wind speed,** • **wind direction,**		20,000/-	
• **Temperature,** • **Relative humidity**		5,000/-	
• **Rain Fall**		20,000/-	
• **Soil Moisture**		8,000/-	
• **Soil Temperature**		8,000/-	

Wind Speed Sensor
Solar Panel
Temperature, Humidity, Pressure Sensor
Rain Bucket
LuX (Light Intensity) Sensor
Controller & Antenna
Leaf Wetness Sensor
Soil Moisture Sensors

5. Changsha Zoko Link Technology: NiuBoL

Price : 146,000 /-

- Wind Speed and Wind Direction
- Rainfall Measurement
- Solar Radiation Sensor
- Soil Temperature, Sensor
- Soil Moisture Sensor, npk sensor
- Leaf Wetness Sensor
- Canopy Temperature Measurement
- Weather Temp, Barometric pressure and
   humidity
- Water PH level sensor

Thank You