A Prototype: Sensing and Predicting Weather Forecast for Smart Farming

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***Abstract*— Agrometeorology plays an important role in Precision Agriculture for resource management and affects both the quality and quantity of agriculture products. The existing solutions for monitoring weather parameters in agrometeorology are highly global and costly. These solutions are most of the time inaccessible to the common man or farmers and require frequent physical visits to the field for obtaining information. But in agriculture monitoring highly localized weather conditions is required because the weather conditions applicable to farmland of one city may not be as such for a farmer of a small rural area. Weather conditions such as wind speed, wind direction, rainfall, solar radiation, atmospheric pressure, air particle level humidity and temperature measurement plays an important role in different fields like Agriculture, Science, Engineering and Technology.**

Smart agriculture with the Internet of Things makes it possible for farmers to better collect weather condition data, which holds a wealth of benefits. Better weather data allows farmers to prevent over or under-watering, crop disease, and unnecessary time spent in the fields. Sensors can collect data for years without maintenance or battery replacement and data is accessible immediately via any connected device 24/7.

Index Terms - Agrometeorology, IOT.

I. INTRODUCTION

The Automated Weather Station System was initially used to measure and continuously monitor the changes in various weather parameters without human efforts or interference to prevent the hazardous and irreparable situations caused due to improper planning and guidance for cropland in various agricultural zones. Previously, the measured parameters were stored in a specially designed database and were sent to far-off locations over a wired communication medium. If the data was stored in a database, every time the farmer needed information, stored data had to physically download to a computer late on when it was needed for further mechanisms. Hence, the communication medium was the utmost necessary element in an automated weather system. A weather station provides equipment that run on certain mechanisms to check, monitor and observe the weather conditions. The obtained weather parameters are used to make weather forecast reports and to study the weather and climate. In this system the weather parameters that will be studied are temperature and humidity. The measurements are taken through the weather sensors placed in the agriculture zone. The system is aimed at designing a wireless weather monitoring system with embedded sensors which enables to analyze and keep a check on the weather parameters in an agriculture zone. It will provide proper framed reports based on the analyzed parameters with to the point conclusions to the farmers. It will contain all necessary information that will help the farmers to make proper decisions regarding crop selection, agriculture mechanisms etc. This will help to reduce the impact of hazards that may be caused due to weather on a farmer’s life.

II. PURPOSE

This project serves the purpose of specifying and explaining in detail the features and requirements used in Sensing and Predicting Weather Forecast for Smart Farming.

The idea of building a weather forecasting solution for agriculture looks more than promising. Such a solution should mitigate the effects of climate change by predicting uncommon weather that harms crops. Predicting weather changes will empower agribusinesses to optimize resources, save crops, and automate decision-making on growing and harvesting periods as well as contribute to the concept of climate smart agriculture. The purpose of this project is to provide an optimal solution for monitoring the weather conditions at an extremely local level with low cost, compact Internet of Things (IoT) based system and also to provide an accurate prediction of what the weather would be like in the near future.

II. EXISTING SYSTEM:

TRADITIONAL METHODS

In traditional methods, we use traditional equipments like mercury thermometer, barometer, campbell-Stokes sunshine recorder, pan evaporation method, rain gauge, etc. From these equipments, they get parameters which are used for calculating the final result(weather data).

Figure. (1.1). Traditional Thermometers

WEATHER SATELLITE

A weather satellite is a type of satellite that is primarily used to monitor the weather and climate of the Earth. Satellites can be polar orbiting (covering the entire Earth asynchronously), or geostationary (hovering over the same spot on the equator). While primarily used to detect the development and movement of storm systems and other cloud patterns, meteorological satellites can also detect other phenomena such as city lights, fires, effects of pollution, auroras, sand and dust storms, snow cover, ice mapping, boundaries of ocean currents, and energy flows. Other types of environmental information are collected using weather satellites.

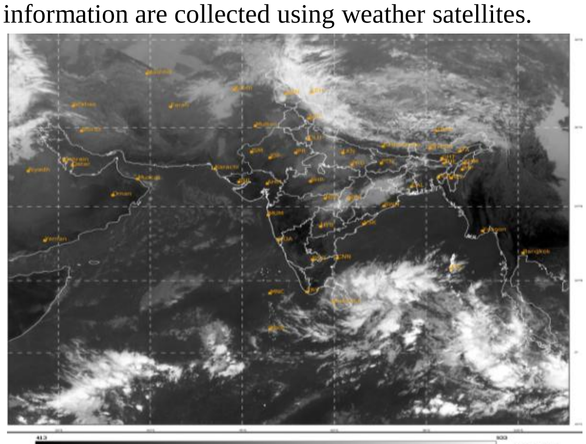

Figure. (1.2). Weather Satellite

DATA LOGGER

A data logger (also data logger or data recorder) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer), and called digital data loggers (DDL).They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer, and use software to activate the data logger and view and analyse the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device. One of the primary benefits of using data loggers is the ability to automatically collect data on a 24-hour basis. Upon activation, data loggers are typically deployed and left unattended to measure and record information for the duration of the monitoring period. This allows for a comprehensive, accurate picture of the environmental conditions being monitored, such as air temperature and relative humidity.

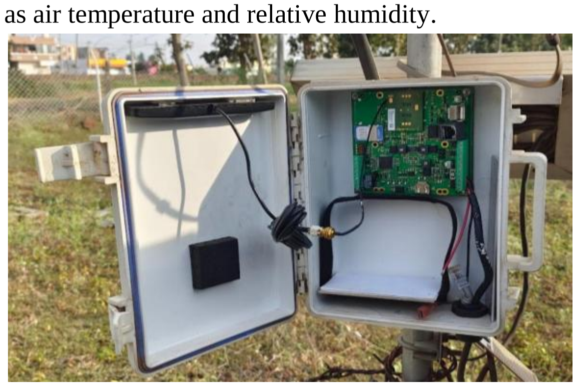

Figure. (1.3). Data Logger System

IV. PROPOSED SYSTEM

The proposed work provides an optimal solution for monitoring the weather conditions at extremely local level with low cost, compact Internet of Things (IoT) based system. In SENSING AND PREDICTING WEATHER FORECAST FOR SMART FARMING, we are going to monitor a few most important environmental parameters like temperature, humidity, UV index,wind speed,wind direction,atmospheric pressure and rainfall. It transmits real-time data through wireless communication protocol to a cloud platform. The data from the device is accessible on a dashboard that visualizes and analyzes the data in the desired formats. In terms of power consumption and cost, it is not a good idea to connect every sensor node individually to the cloud. Rather it is a good idea to collect data from all the sensor nodes of a small area and publish all the data to the cloud from a single gateway.

V. LITERATURE SURVEY

MEASUREMENTS TECHNIQUES

Tipping Bucket Rain Gauge

The most common rain detector used in electronic weather stations is the "tipping bucket" type of rain sensor. This interesting technology uses two small "buckets" mounted on a fulcrum (balanced like a see-saw). The tiny buckets are manufactured with tight tolerances to ensure that they hold an exact amount of precipitation, typically .01 inch. The tipping bucket assembly is located underneath the rain collector, which funnels the precipitation to the buckets. As rainfall fills the tiny bucket, it becomes overbalanced and tips down, emptying itself as the other bucket pivots into place for the next reading. The action of each tipping event triggers a small switch that activates the electronic circuitry to transmit the count to the indoor console, recording the event as .01 inch of rainfall. On a wireless rain gage, that count is transmitted via a radio signal.

For detailed information about weather station set up, please review that section elsewhere in our education center. Be aware that the accuracy of a tipping bucket rain gauge degrades significantly if it is installed on a non-level plane, so it is critical that it be mounted on a level surface (a bubble level can be used to make sure of it). The surface should also be free of vibration. Follow the manufacturers instructions when installing your tipping bucket rain gauge and be sure to verify that the path for water runoff from the drain screens is unobstructed.

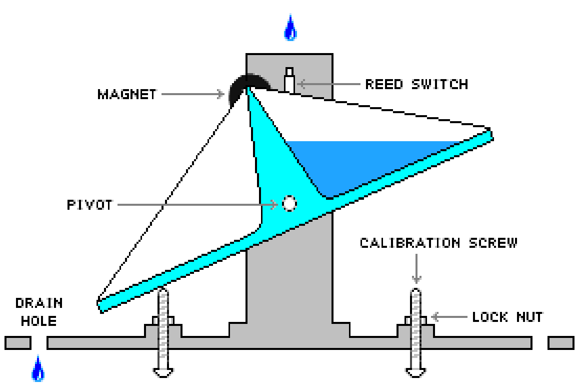

Figure. (1.4). Rain Fall Measurement Using Tipping Bucket

Once the rain detector has been installed, you will need to check to see if the bucket assembly has been secured from movement during shipment. Often manufacturers use some type of fastener (like a cable tie) to hold the assembly steady until it's been installed. If you find that there is a fastener, carefully remove it.

Wind Vane

A very old, yet reliable, weather instrument for determining wind direction is the wind vane. Most wind vanes consist of a long arrow with a tail, which is allowed to move freely about a vertical post. The arrow always points into the wind and, hence, always gives the wind direction. Wind vanes can be made of almost any material. At airports, a cone-shaped bag opened at both ends so that it extends horizontally as the wind blows through it sits near the runway. This form of wind vane, called a wind sock, enables pilots to tell the surface wind direction when landing.

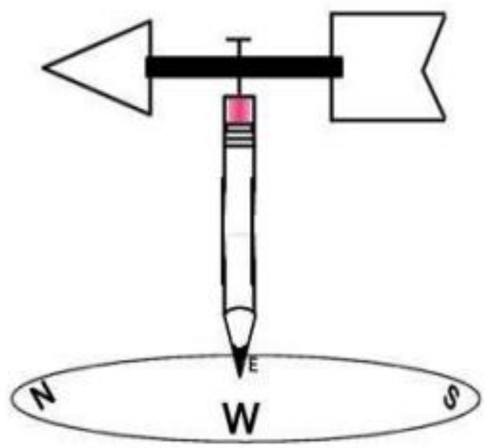

Figure. (1.5). Wind Wane

Anemometer

The instrument that measures wind speed is the anemometer. Most anemometers consist of three (or more) hemispherical cups (cup anemometer) mounted on a vertical shaft. The WIND VANE difference in wind pressure from one side of a cup to the other causes the cups to spin about the shaft. The rate at which they rotate is directly proportional to the speed of the wind. The spinning of the cups is usually translated into wind speed through a system of gears, and may be read from a dial or transmitted to a recorder.

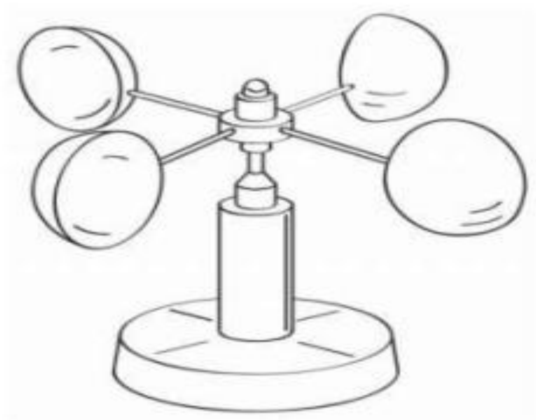

Figure. (1.6). Anemometer

The wind-measuring instruments described thus far are “ground-based” and only give wind speed or direction at a particular fixed location. But the wind is influenced by local conditions, such as buildings, trees, and so on. Also, wind speed normally increases rapidly with height above the ground. Thus, wind instruments should be exposed to freely fl owing air well above the roofs of buildings. In practice, unfortunately, anemometers are placed at various levels; the result, then, is often erratic wind observations.

Calculating Wind Velocity from Your Data:

Anemometers usually carry a meter calibrated in units of speed activated by voltage generated by connecting the vanes to a small electric generator.

In this anemometer you calculate the wind velocity as follows:

Measure the distance from cup center to the center of the shaft. It is about 16 cm.

Count the number of rotations in one minute as the anemometer spins. Use a stopwatch to time the interval and count the number of times the contrast cup passes.

When a cup makes one full revolution, it covers a distance equal to the perimeter of a circle of radius 8 cm. It covers a distance equal to 2πr, which would mean: 2 x 3.1416 x 8 cm, or 50.3 cm.

Your anemometer cup therefore moves through 50.3 cm each time it revolves.

Calculate the speed of your anemometer. Example: you counted 60 revolutions in one minute. Your anemometer speed would be 60 RPM (revolutions per minute). It means a linear distance of 60 x 50.3 cm covered per minute.

Convert this into km/hr using the following calculation:

$$\frac{60 \times 50.3\text{cm}}{1 \text{ min}} \times \frac{60\text{min}}{1 \text{ hr}} \times \frac{1 \text{ km}}{100000\text{cm}}$$

$$= 60 \times 0.003 \text{ km/hr}$$

$$= 1.8 \text{ km/hr}$$

VI. IMPLEMENTATION

Software Design:

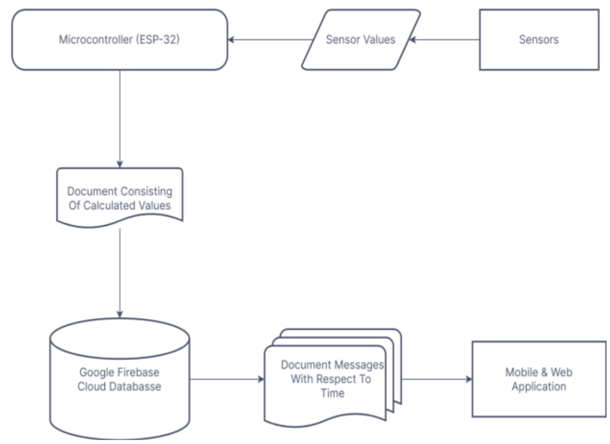

Figure. (1.7). Software Flow Diagram

CAD Design and 3D Printing:

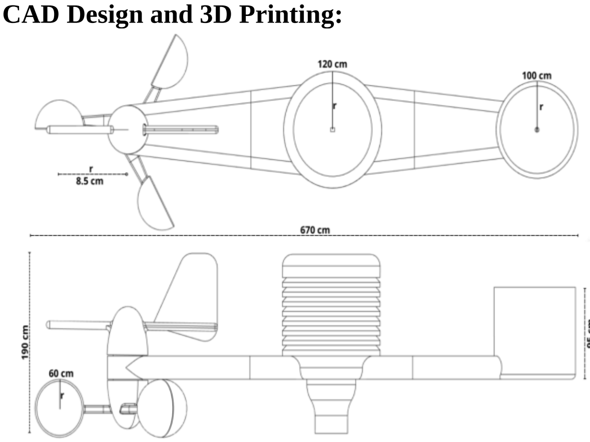

Figure. (1.8). CAD DESIGN and Measurements

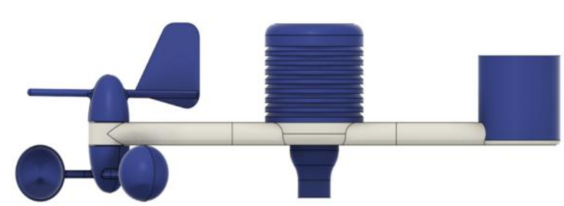

Figure. (1.9). CAD DESIGN MODEL

VII. OUTCOME


Figure. (1.10). End Product

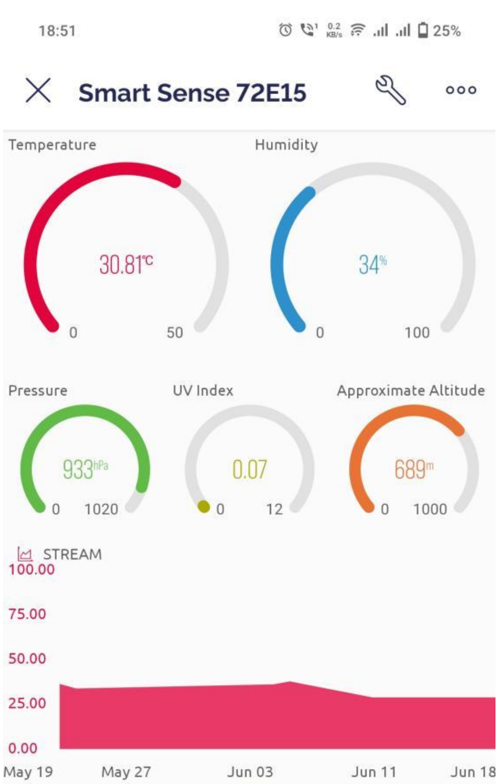

Figure. (1.11). User Interface

VIII. CONCLUSION

This model concludes by using the topics of IoT, Cloud Database, Product Designing and Meteorology, it can help general people, agriculture scientists and specialist to know the real time weather of his/her surrounding environment. The model also helps in recent agricultural trends like greenhouses to collect the data and then can be used for enhanced growth of the plants and crops. Further this model can be enhanced using different algorithms and methodologies for predicting the climatic changes of a local area. This can provide ease use of systems and many other applications.

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