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A Literature Review: Agriculture & IoT Technology and Land Analysis in our College Campus through LoRaWAN Line-Up

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Abstract:- With gaining high Acceptance , quick expansion and increase in the Internet of Things (IoT) application have expanded too many fields. One of the trending fields for IoT growth is agriculture. In newest years, a new agricultural information and communication Technology (ICT), called intelligent agriculture , which meets the needs of farmers for information collection , signal processing, data analysis, and equipment control, has been developed. This work proposes an intelligent agricultural service platform that is based on a wireless sensor network and LoRa communication technology . This work uses LoRa as a network transmission interface to solve the problem of communication failure and save energy . An agricultural intelligent agriculture service platform is developed to support environmental monitoring and improve agricultural management efficiency. This paper presents a organized literature review of IoT technologies and their current utilization in different application domains of the agriculture sector. There will be a small analysis of the land of our college campus using LoRa Technology in terms of agriculture perspective as just a trial before working on a large scale.

Keywords:- *Lora-based, Agriculture, Internet of Things, Wireless Sensor, Low Power Wide Area Network (LPWAN),*

I. INTRODUCTION

IoT is a new and forthcoming trend in technology that finds its employment in nearly every field. Things, when connected to the internet and each other, make the entire system smart. We've used IoT in every way of life Smart Metropolises, Smart homes, smart retail, and numerous further. Using IoT in farming and agriculture practices is the requirements of the hour as the global population will hit a peak of 9.6 billion by 2050, to meet that kind of demand the husbandry assiduity needs to supply at an indeed briskly rate. This is made possible by using ultramodern technology and substantially IoT. IoT makes labour-free granges a possibility.

The Internet of Things(IoT) is the network of physical objects or" effects" lodged with electronics, software, detectors, and connectivity to enable it to achieve higher value and service by swapping data with the manufacturer, driver or other connected devices. Each thing is uniquely identifiable through its embedded computing system but can interoperate within the being Internet architecture.

LPWAN aims to provide long-range communications , connecting devices which are distributed over a large geographical area. It is an alternative option to M2M (Machine-to-Machine) communication using cellular mobile technologies. Most of the LPWAN operates in the ISM (Industrial , Scientific and Medical), unlicensed frequency band. The different frequencies are 169 MHz, 433MHz, 868/915 MHz, and 2.4 GHz which depend on the operating region. Its latency is high, therefore, it is not suitable for the application in which delays are not tolerated or a high rate of data transfer is required.

LoRa stands for “Long Range”, is a long-range wireless communication system that features low power operation i.e. around 10 years of battery lifetime , low data rate i.e. 27 kb/s, and long communication range (2-5 km in urban areas and 15 km in rural areas). Its spreading factor is 7. It is promoted by LoRa Alliance.

LoRa features include- Long Range, robustness, multipath resistance, Doppler resistance, low power consumption, and forward error correction (FEC). LoRa can have two distinct layers-

- Physical Layer
- MAC layer protocol (LoRaWAN)

- **Physical layer:** LoRa is a physical layer radio modulation technique that is based on CSS (Chirp Spread Spectrum). It uses frequency chirps which vary linearly with time to encode data.
- **MAC (Medium Access Control) Layer Protocol:** LoRa-based communication protocol, since 2015 is called LoRaWAN (Long Range Wide Area Network) MAC protocol. It is standardized by the LoRa Alliance, which is an open-source protocol. It is placed after LoRa physical layer. LoRa defines the link-layer layer whereas LoRaWAN defines network architecture and communication protocol.

This paper discusses all about IoT technology in Agriculture field i.e. its advantages, disadvantages, protocols, its alternative option, etc. We will also discuss small work on land analysis in our college campus. Rest of the paper is organised as follows – Section I briefs introduction about Agriculture & IoT Technology. Section II talks about how Literature Review. Section III discussed about IoT agricultural Sensor and its working protocol. In Section IV we discuss about interference between LoRa, IoT Technology and agriculture. In Section V we discuss about advantages of Smart Agriculture. Section VI discussed about Open issues and challenges. In Section VII explains our work in our college campus. Section VIII is followed by conclusion.

II. LITERATURE REVIEW

Recent researches shows that then frequencys off pproaches relateds too Agriculture IoT increases overs times. There are multiples research approaches in the fields of IoT agricultures. Some of the approaches are investigated. in this following sections.

- **Proposedt system or result:** Theres may be singles or many systems andt results have been suggested to probe the phenomenon within its factual environment.
- **Reviews:** A system that collects quantitatives data applicable to IoT farming. Authorss presenteds a review on multiples IoT agrarian operations and communications protocolst[1]. In[2], a review has been presented on IoT-grounded perfection sowing and irrigation.
- **Platforms:** Differents IoT- grounded platformss haved beens developedt unders then controlledd terrain to examine its effect on husbandry.
- **Architectures:** Multiples IoT agriculturals frameworks designedd to collects then datas from devices/sensors and keep the collected data for correct analysist[3].
- **Application:** Mobile apps give a connection for numerous IoT bias and grease the cultivator having better control over different agrarian operations. Several operations have been evolved to cover the crop productivity and complaint findings at early stages[4]. In[5], a cloud- based IoT operation has been evolved to measure the farm variables such as light, moisture, water, and fungicides.

Different Research Approaches in IoT Agriculture is shown in Fig. 1.

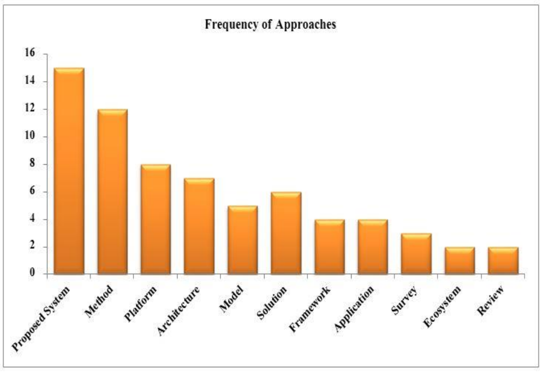

Fig. 1: Different Research Approaches in IoT Agriculture

IoT farming results correspond of multiples monitorings, checking, and trackings that measures severals typess of variabless such as air monitorings, temperatures monitorings, moisture monitorings, soil monitoring, water monitoring, fertilization, pest controller, clarification control, and position tracking.

Application Domain of IoT agriculture is shown in Fig.2. The major domain or primary focus of IoT Application is shown in the Fig.3.

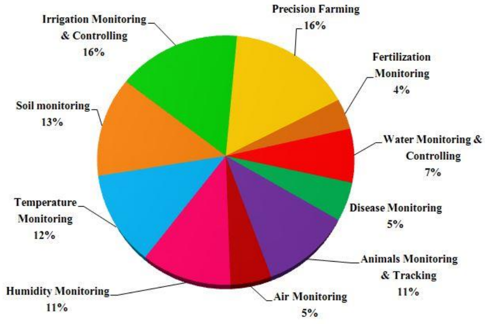

Fig. 2: Application Domain of IoT agriculture

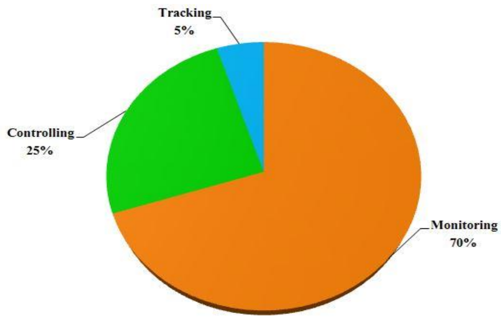

Fig. 2: Major domain or primary focus of IoT Application

III. IOT-BASED DEVICES/SENSORS IN AGRICULTURE AND IOT COMMUNICATION PROTOCOLS AND STANDARDS IN AGRICULTURE

The most essential device used for IoT is Sensors. Sensors are devices that re-collect meaningful data which is employed to pick up the required analysis. For farming, sensors are substantially used to get readings used to measure temperature, discover conditions & humidity content in the soil. Generally used sensors are temperature detectors, moisture detector, soil pattern covering detector, tailwind detector, a position detector, CO_2 detector, pressure detector and humidity detector. The significant characteristics of IoT devices/ sensors that make them suitable for farming are their(1) portability;(2) dependability;(3) memory;(4) continuity;(5) power and computational effectiveness; and(6) coverage.Some of the IoT-based Sensors in Agriculture with operation are shown in Table I.

A considerable number of IoT communication technologies are being employed within IoT operations due to their low cost, wide content range, and low energy conditions as compared to other long- range communication technologies. All the communication technologies that have been linked are shown in Fig. 4.

IV. IoT, AGRICULTURE AND LORA TECHNOLOGY

A. IoT smart farming framework

An IoT smart agriculture agrarian framework has been suggested are consists of five main factors, which are data accession, common platform, data processing, data visualization, and system management. The flow chart of smart IoT farming Framework is shown in Fig. 5.

Sensors	Operations
pH Sensor	To monitor the exact amount of nutrients in soil, PH sensors are used, which is efficient for the healthy growth of plants and crops
Gas Sensor	Through the observation of infrared radiations this sensor measures the exact amount of toxic gases in livestock and greenhouses
Motion Detector Sensor	The sensor is used to track/trace the location of animals and field, moreover it also detect the motion of an unwanted object in the field or farm and generate alerts to farmer for timely action and preventing crop loss.
Ultra Violet Sensor and Passive Infrared (PIR) Sensors	An ultra violet sensor monitors the UV rays for the effective growth of crops. In the PIR sensor, a motion detector is fixed that traces the range of a person's movement in the field.
Soil Moisture Sensor	The soil sensor measures the quantity of water and level of moisture all over the field
Temperature Sensor	Changes in the soil temperature affect the absorption soil nutrients and moisture.
Humidity Sensor	Humidity leaves a negative impact on the growth of plant leaves, photosynthesis, and pollination. Therefore, to sense the level of humidity in air, this sensor directly measures the temperature and moisture content in the air.

Table 1: IoT-based Sensors in Agriculture with operation

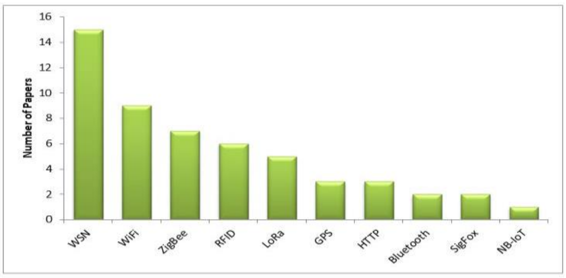

Fig. 4: Communication technologies in IoT

B. Agriculture and LoRa Technology –

This network consists of client(node), master, and end user monitoring network. Each client consists of microcontroller and module transceiver LoRa. The client gathers data from detector and transfers them via LoRa network. After data is entered in master, also it's promoted to the internet via Wi-Fi network. So, principally the conception of this network is using allocated detector and integration between master and nodes. The end of the cloud- based IoT system is to assay and integrate the data that's approaching from the real world into IoT things. Smart Agricultural platform with LoRa is shown in Fig. 6.

C. Advantages of Smart Agriculture

- Smart Agriculture enhances the productivity of farming.
- It prevents soil degradation and also minimizes the risk of groundwater degradation.
- It allows efficient use of water and fertilisers.
- It increases the opportunities for skilled employment.

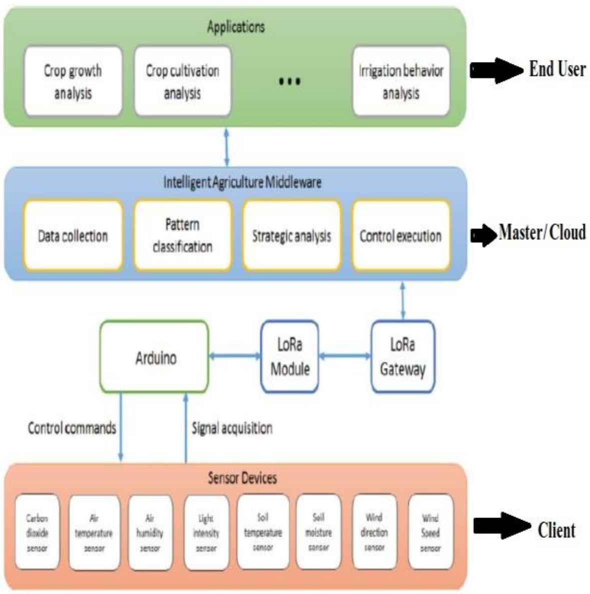

Fig. 6: Smart Agricultural platform with LoRa

V. OPEN ISSUES AND CHALLENGES

1. Security

Security issues arise at a different level of IoT-based agricultural systems, which need to be addressed. Due to low security, users face many difficulties such as loss of data and other on-field parameters. IoT privacy and security issues have been discussed in [11]–[13] broadly. In the agriculture field, IoT devices are at risk due to physical interference such as attack by animals and predators or modification in physical address [13], [14].

2. Cost

While deploying IoT in agriculture, several cost-related issues arise such as setup and running costs. The setup costs consist of hardware costs such as IoT devices/sensors, base station infrastructure, and gateways.

3. Lack Knowledge of Technology

Poor understanding of technology is the main barrier among the farmers who are living in rural areas. This problem is common in developing countries, where most farmers are uneducated[15].

4. Reliability

In the field of agriculture, IoT devices are deployed in an open environment due to which harsh environmental conditions may cause communication failure and the humiliation of deployed sensors.

5. Scalability

A large number of IoT devices and sensors are deployed in the agriculture field, due to which an intelligent IoT management system is required for the identification and controlling of each node.

6. Localization

It is important to select the best placement position so that devices can communicate and exchange information easily without any disturbances.

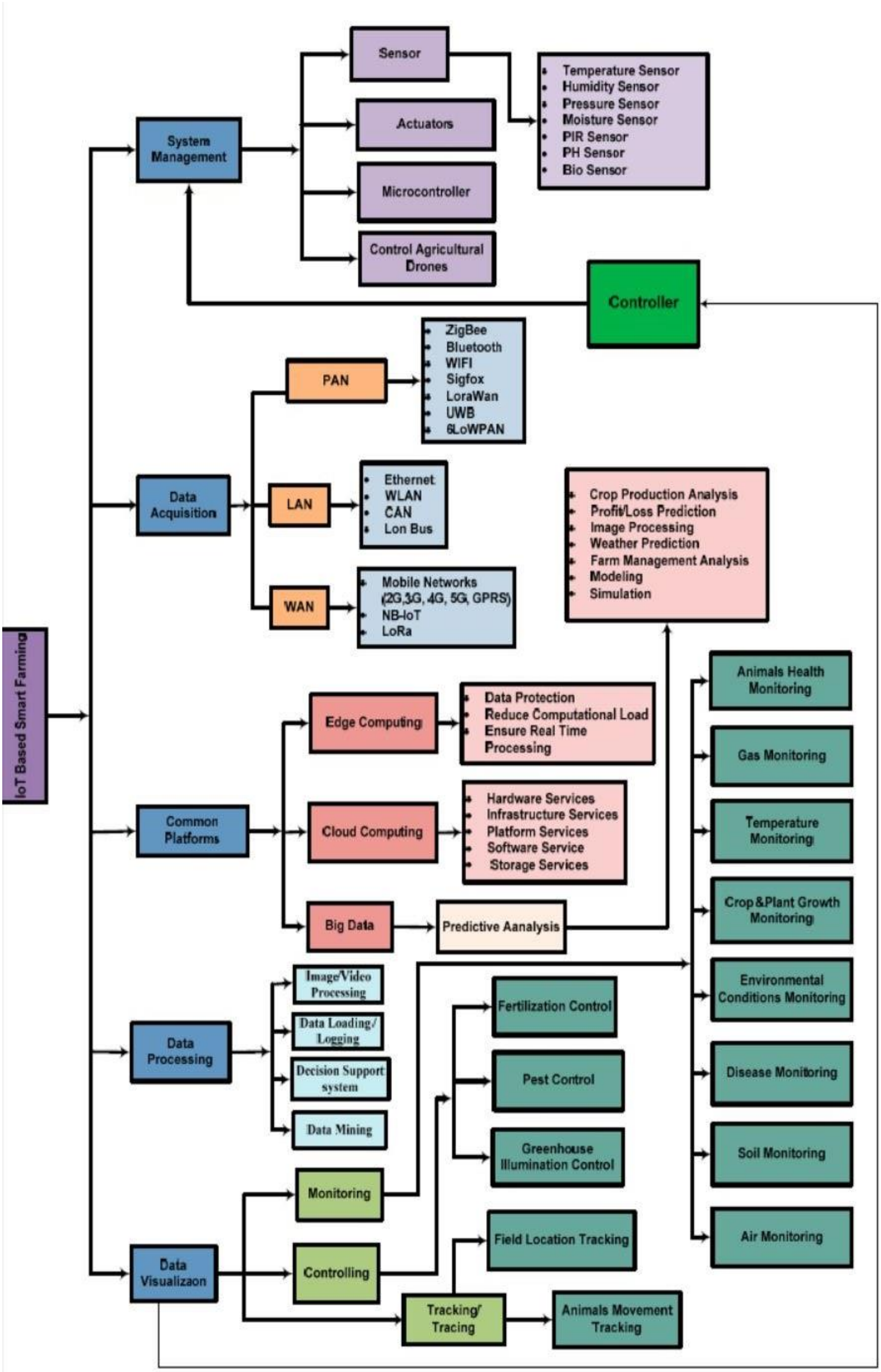

Fig. 5: Flow chart of smart IoT farming Framework

VI. OUR WORK ON LAND ANALYSIS IN OUR COLLEGE CAMPUS THROUGH LORAWAN LINE-UP

This is just the small work or beforehand work in order to work on the large scale.

In this project, we analyses the different land area of the college in terms of land quality such as temperature, humidity, soil moisture in order to check how it is beneficial for crops.

For this we have created one node which consists of agricultural sensor temperature and humidity sensor, soil moisture sensor, whose function is discussed in section 2 of this paper and one gateway via LoRa Technology, whose creation is discussed in[6].

For the land analysis we selected 3 positions of the college campuss and placed node from where we receive maximum and continuous packet and then we compare all this parameter with each other.

	ECE Department	Boys Hostel	Forest Area
Temperature(Mean Value)	36°C	41°C	29°C
Humidity(Mean Value)	39%	42%	66%
Soil Moisture(Mean Value)	568	702	418

Table 2: Different Value Parameter At different Location

Graphical comparison is shown in Fig. 7.

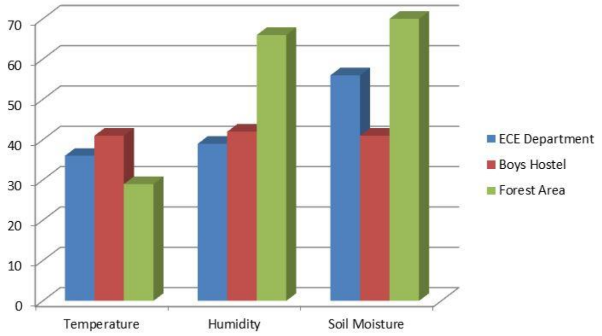

Fig. 7: Different agricultural Parameter at different location

From above all observation we can conclude that-

As we know that natural vegetation is adversely affected by increased temperature, so the land area with high temperature is not good for natural vegetation. Humidity regulates photosynthesis rate or transipirational water loss. Lower humidity, reduces the photosynthesis rate. Similarly, soil moisture also vegetation directly. This is the only prerequisite land analysis which gives complete information for crops which will be most suitable for cultivation. Similarly we can analyse different places before cultivation in order to obtain maximum profit with less investment.

VII. CONCLUSIONS

In this paper, we presented the literature review along with small analysis on LoRaWAN line-up in our campus through Land Analysis. It includes all relevant research paper regarding IoT and LoRa technology. Its all aspects such implementation, limitation, future scope, etc. all things are mentioned in a sequential order. After reading this complete article all of us will get complete clarity and satisfactory information about Agriculture, IoT & LoRa technology. Firstly, detailed discussion on IoT Technology in agriculture field and its protocol. Then it is followed by its implementation. Further we talked about its advantages, limitations, applications , recent works and its future scope. Finally this paper ends with the land Analysis through LoRaWAN line-up.

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