

ASSIGNMENT:01

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Course: IoT (CS7401)

Write case study on IoT in agriculture.

The Internet of Things (IoT) is about making “dumb” things “smart” by connecting them to each other and to the internet. It enables physical objects to be sensed and controlled remotely, creating opportunities for more direct integration between the physical world and computer-based systems.

IoT enables devices embedded with sensors to connect to and interact with each other via the internet. Devices can be remotely monitored and controlled in real time, and can include anything from pumps, sheds and tractors to weather stations and computers.

1. Objective of IoT in agriculture:

Smart farming is a hi-tech and effective system of doing agriculture and growing food in a sustainable way. Smart farming majorly depends on IoT thus eliminating the need of physical work of farmers and growers and thus increasing the productivity in every possible manner.

With the recent agriculture trends dependent on agriculture, Internet of Things has brought huge benefits like efficient use of water, optimization of inputs and many more. What made difference were the huge benefits and which has become a revolutionized agriculture in the recent days.

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. It keeps various factors like humidity, temperature, soil etc. under check and gives a crystal-clear real-time observation.

Benefits of Adopting IOT in agriculture:

Technologies and IoT have the potential to transform agriculture in many aspects. Namely, there are **5 ways IoT can improve agriculture**:

- **Data, tons of data, collected by smart agriculture sensors**, e.g. weather conditions, soil quality, crop's growth progress or cattle's health. This data can be used to track the state of your business in general as well as staff performance, equipment efficiency, etc.
- **Better control over the internal processes and, as a result, lower production risks**. The ability to foresee the output of your production allows you to plan for better product distribution. If you know exactly how much crops you are going to harvest, you can make sure your product won't lie around unsold.
- **Cost management and waste reduction thanks to the increased control over the production**. Being able to see any anomalies in the crop growth or livestock health, you will be able to mitigate the risks of losing your yield.
- **Increased business efficiency through process automation**. By using smart devices, you can automate multiple processes across your production cycle, e.g. irrigation, fertilizing, or pest control.
- **Enhanced product quality and volumes**. Achieve better control over the production process and maintain higher standards of crop quality and growth capacity through automation.

As a result, all of these factors can eventually lead to **higher revenue**.

Challenges faced in smart farming:

- **Lack of Infrastructure** – Even though the farmers embrace IoT technology, due to weak communication infrastructure they would not be able to take advantage of this technology. Farms are situated in rural areas and away from internet access. A farmer needs to have secure access to crop data from any place at any time, so link problems will make an advanced monitoring system in vain.
- **High Cost** – In agriculture the equipment required to implement the IoT program is costly. Sensors are the least expensive part, but it would cost more than a thousand dollars to equip all the farmers' fields to be with them.
- **Lack of Security**– IoT devices communicate with older devices that have access to the internet network, so there is no assurance that they will be able to obtain data readings from drone mapping by using public connections. IoT agricultural systems gather large quantities of data that are difficult to secure.

These are some of the major challenges faced before starting Smart Farming.

Advantages of IoT in agriculture:

- The Internet of Things allows problems to be avoided and all issues which may occur during farming processes to be eliminated. Therefore the product quality is increasing and customers are having a strong high-quality product.
- Water treatment can be carried out effectively using the IoT system without the use of sensors for wasting water.
- The IoT device helps to track the land constantly so that steps can be taken early. It increases efficiency, decreases manual labor, decreases time and allows productive farming.
- The monitoring of the crop can be done easily by using IoT to track crop production.
- Soil control such as pH level and humidity content etc. can be easily identified so farmers can sow seeds according to the soil level.
- The amount of time saved may be very high because of the IoT program. And we can all use more energy in everyday life today.

Disadvantages of IoT in agriculture:

- IoT – smart farming continually requires internet connectivity. The developing countries 'rural portion did not follow those criteria and the internet is slower.
- The IoT related equipment allows the farmer to understand the use of technology and to learn. It is the biggest challenge for the large-scale implementation of smart agricultural farming across the continents.
- Given any security measures, the system offers little power and can lead to various kinds of network attacks.
- It is very complicated to plan, build, manage and allow the broad technology to IoT framework.

2. Architecture/Design of IoT:

There are total 5 layers Architecture of Internet of Things. 5 Layer model can be considered as an extension to the basic architecture of IoT because it has two additional layers to the basic model.

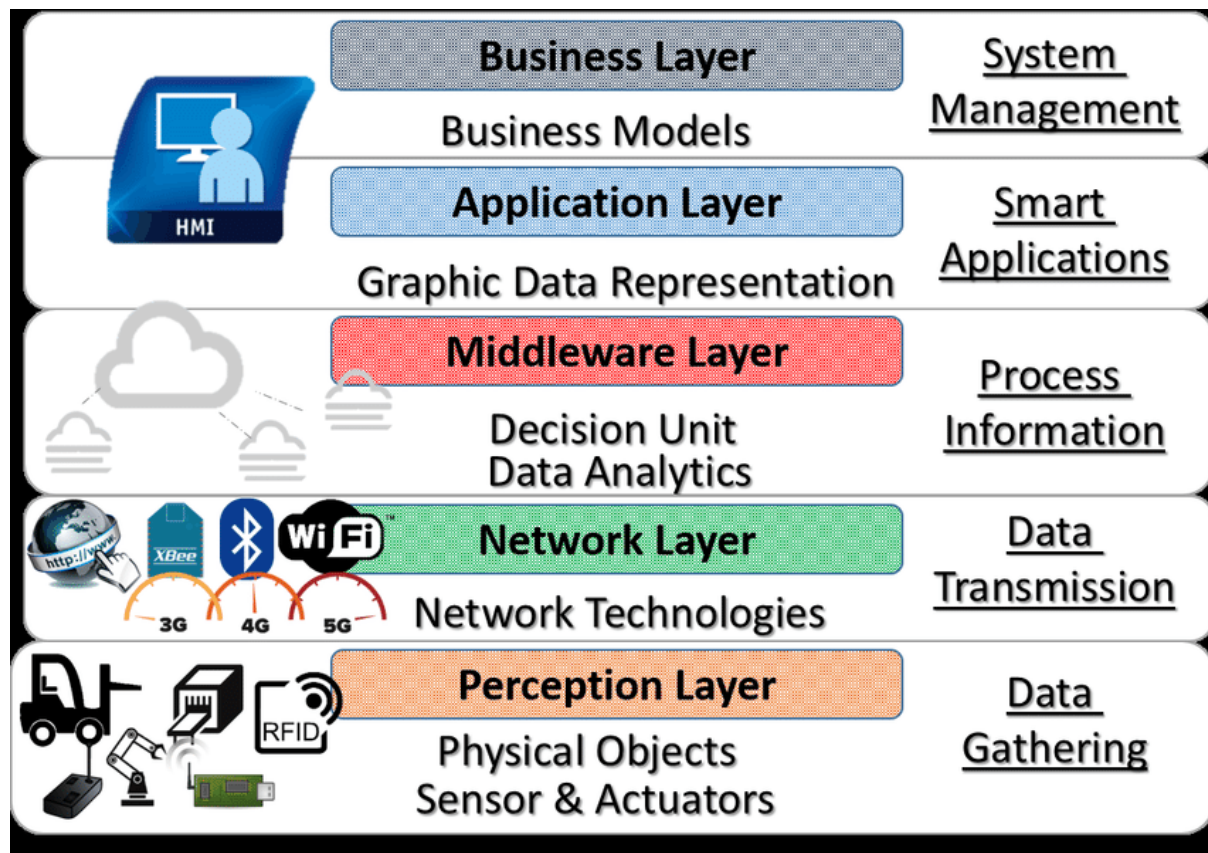


Fig: Architecture/Design of IOT

a.) Perception layer:

This is the first layer of IoT architecture. In the perception layer, number of sensors and actuators are used to gather useful information like temperature, moisture content, intruder detection, sounds, etc. The main function of this layer is to get information from surroundings and to pass data to another layer so that some actions can be done based on that information

b.) Network Layer:

As the name suggests, it is the connecting layer between perception and middleware layer. It gets data from perception layer and passes data to middleware layer using networking technologies like 3G, 4G, UTMS, WiFi, infrared, etc. This is also called communication layer because it is responsible for communication between perception and middleware layer. All the transfer of data done securely keeping the obtained data confidential.

c.) Middleware Layer/ Processing layer:

Middleware Layer has some advanced features like storage, computation,

processing, action taking capabilities. It stores all data-set and based on the device address and name it gives appropriate data to that device. It can also take decisions based on calculations done on data-set obtained from sensors.

d.) Application Layer:

The application layer manages all application process based on information obtained from middleware layer. This application involves sending emails, activating alarm, security system, turn on or off a device, smartwatch, smart agriculture, etc.

e.) Business Layer:

The success of any device does not depend only on technologies used in it but also how it is being delivered to its consumers. Business layer does these tasks for the device. It involves making flowcharts, graphs, analysis of results, and how device can be improved, etc.

3.Implementation of IoT in agriculture:

There are many benefits of implementing new technology – Internet of things in agriculture:

(i) Agricultural drones:



Technological advancements has almost revolutionized the agricultural operations and the introduction of agricultural drones is the trending disruption.

The Ground and Aerial drones are used for assessment of crop health, crop monitoring, planting, crop spraying, and field analysis. With proper strategy and planning based on real-time data, drone technology has given a high rise and makeover to the agriculture industry. Drones with thermal or multispectral sensors identify the areas that require changes in irrigation. Once the crops start growing, sensors indicate their health and calculate their vegetation index. Eventually smart drones have reduced the environmental impact. The results have been such that there has been a massive reduction and much lower chemical reaching the groundwater. Perhaps one of the most promising agritech advancements is the use of agricultural drones in smart farming. Also known as UAVs (unmanned aerial vehicles), drones are better equipped than airplanes and satellites to collect agricultural data.

(ii) Monitoring of climatic conditions:



Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity (i.e. precision farming). The whole IoT ecosystem is made up of sensors that can detect real-time weather conditions like humidity, rainfall, temperature and more very accurately. There are numerous no. of sensors available to detect all these parameters and configure accordingly to suit your smart farming requirements.

These sensors monitor the condition of the crops and the weather surrounding them. If any disturbing weather conditions are found, then an alert is send.

(iii) Precision farming/Precision agriculture:



Also known as precision agriculture, precision farming is all about efficiency and making accurate data-driven decisions. It's also one of the most widespread and effective applications of IoT in agriculture.

By using IoT sensors, farmers can collect a vast array of metrics on every facet of the field microclimate and ecosystem: lighting, temperature, soil condition, humidity, CO2 levels, and pest infections. This data enables farmers to estimate optimal amounts of water, fertilizers, and pesticides that their crops need, reduce expenses, and raise better and healthier crops.

(iv) Cattle Monitoring and Management:



Good health and wellbeing are essential to dairy cow farms and sustainable production of milk. Unfortunately, day-to-day monitoring of animals condition is difficult, especially in large farms where employees do not have enough time to observe animals and detect first symptoms of diseases. IoT-based monitoring system designed to monitor the health of dairy cows and animals. The system is composed of hardware devices, a cloud system, an end user application and innovative techniques of data measurement and analysis algorithms. The system was tested in a real life scenario and has proved it can effectively monitor animal welfare and the estrous cycle.

(v) IoT based Smart Greenhouse Automation:



Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.

In addition to sourcing environmental data, weather stations can automatically adjust the conditions to match the given parameters. Specifically, greenhouse automation systems use a similar principle.

(vi) Data Analytics:



The conventional database system does not have enough storage for the data collected from the IoT sensors. Cloud based data storage and an end-to-end IoT Platform plays an important role in the smart agriculture system. These systems are estimated to play an important role such that better activities can be performed. In the IoT world, sensors are the primary source of collecting data on a large scale. The data is analysed and transformed to meaningful information using analytics tools. The data analytics helps in the analysis of weather conditions, livestock conditions, and crop conditions. The data collected leverages the technological innovations and thus making better decisions. With the help of the IoT devices, you can know the real-time status of the crops by capturing the data from sensors. Using predictive analytics, you can get an insight to make better decisions related to harvesting. The trend analysis helps the farmers to know upcoming weather conditions and harvesting of crops. IoT in the Agriculture Industry has helped the farmers to maintain the quality of crops and fertility of the land, thus enhancing the product volume and quality.

4. Conclusions/Results:

IoT enabled agriculture has helped implement modern technological solutions to time tested knowledge. This has helped bridge the gap between production and quality and quantity yield. Data Ingested by obtaining and importing information from the multiple sensors for real time use or storage in a database ensures swift action and less damage to the crops. With seamless end to end intelligent operations and improved business process execution, produce gets processed faster and reaches supermarkets in fastest time possible. Yes, there are many challenges that we can face before adopting IoT in agriculture, there are many disadvantages too but if IoT is 100% efficiently adopted for agriculture in world, it can change the future of our farmers and land for sure