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Survey of Iot in Agriculture

Balaji.G
Dr.Vijaykumar
Associate professor & Head,
Department of Computer Applications
Sri Jayendra Saraswathi college of arts and science,coimbatore
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ABSTRACT - Internet of Things (IoT) is a new era of computing technology. Machine to machine, machine to infrastructure, machine to environment, the Internet of Everything, the Internet of Intelligent Things, intelligent systems—call it what you want, but it's happening, and its potential is huge. We see the IoT as billions of smart, connected "things" that will include every aspect of our lives, and its foundation is the intelligence that embedded processing provides. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. As a result, huge volumes of data are being generated, and that data is being processed into useful actions that can "command and control" things to make our lives much easier and safer and to reduce our impact on the environment. The creativity of this new era is boundless. The following thesis is an extensive reference to the possibilities, utility, applications and the evolution of the Internet of Things and more concentrating the IoT in agriculture.
KEYWORDS-IoT, Evolution of IoT, sensors, agriculture, internet.

I. INTRODUCTION

The Internet of Things (IoT) is the network of physical objects devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit; when IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. The research and development companies of IoT are Google, CISCO are the most targeting companies and are the remaining are Intel, IBM, Apple, Microsoft,Samsung, Hawaii. By the prediction of CISCO ,experts estimate that the IoT will consist of almost 50 billion objects by 2020.[1]

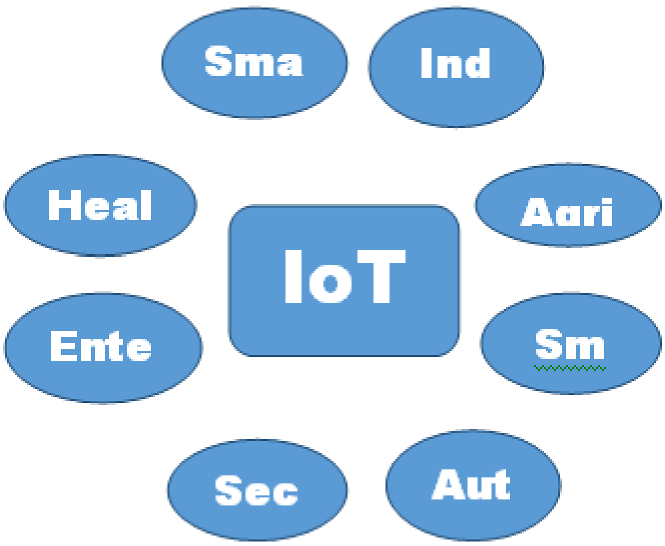

Figure 1.1 Applications of IoT

II. EVOLUTION OF IoT

The term Internet of Things is 16 years old. But the actual idea of connected devices had been around longer, at least since the 70s. Back then, the idea was often called “embedded internet” or “pervasive computing”. But the actual term “Internet of Things” was coined by Kevin Ashton in 1999 during his work at Procter& Gamble.

Ashton who was working in supply chain optimization, wanted to attract senior management’s attention to a new exciting technology called RFID. Because the internet was the hottest new trend in 1999 and because it somehow made sense, he called his presentation “Internet of Things”.

Even though Kevin grabbed the interest of some P&G executives, the term Internet of Things did not get widespread attention for the next 10 years.[2]

III. ARCHITECTURE OF IoT

There is no single consensus on architecture for IoT, which is agreed universally. Different architectures have been proposed by different researchers. [3]

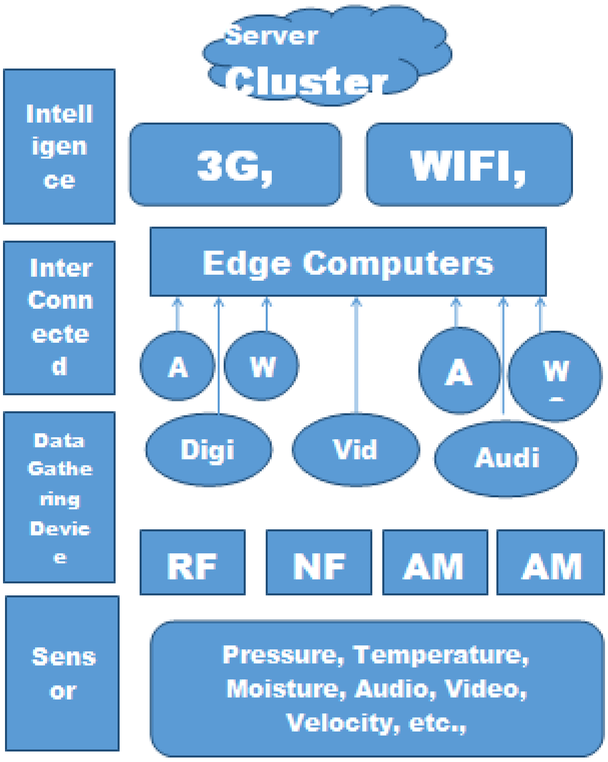

Figure 3.1 Architecture of IoT

3.1Three and five layer architecture:

The most basic architecture is a three-layer architecture. It was introduced in the early stages of research in this area. It has three layers, namely, the perception, network, and application layers.(i)The perception layer is the physical layer, which has sensors for sensing and gathering information about the environment. It senses some physical parameters or identifies other smart objects in the environment.(ii)The network layer is responsible for connecting to other smart things, network devices, and servers. Its features are also used for transmitting and processing sensor data.(iii)The application layer is responsible for delivering application specific services to the user. It defines various applications in which the Internet of Things can be deployed, for example, smart homes, smart cities, and smart health.

The three-layer architecture defines the main idea of the Internet of Things, but it is not sufficient for research on IoT because research often focuses on finer aspects of the Internet of Things. That is why, we have many more layered architectures proposed in the literature. One is the five-layer architecture, which additionally includes the processing and business layers. The five layers are perception, transport, processing, application, and business layers. The role of the perception and application layers is the same as the architecture with three layers. We outline the function of the remaining three layers.(i)The transport layer transfers the sensor data from the perception layer to the processing layer and vice versa through networks such as wireless, 3G, LAN, Bluetooth, RFID, and NFC.(ii)The processing layer is also known as the middleware layer. It stores, analyses, and processes huge amounts of data that comes from the transport layer. It can manage and provide a diverse set of services to the lower layers. It employs many technologies such as databases, cloud computing, and big data processing modules.(iii)The business layer manages the whole IoT system, including applications, business and profit models, and users' privacy. The business layer is out of the scope of this paper. Hence, we do not discuss it further.

Another architecture proposed by Ning and Wang is inspired by the layers of processing in the human brain. It is inspired by the intelligence and ability of human beings to think, feel, remember, make decisions, and react to the physical environment. It is constituted of three parts. First is the human brain, which is analogous to the processing and data management unit or the data centre. Second is the spinal cord, which is analogous to the distributed network of data processing nodes and smart gateways. Third is the network of nerves, which corresponds to the networking components and sensors.

3.2 Cloud and fog based architecture

Let us now discuss two kinds of systems architectures: cloud and fog computing . Note that this classification is different from the classification, which was done on the basis of protocols.

In particular, we have been slightly vague about the nature of data generated by IoT devices, and the nature of data processing. In some system architectures the data processing is done in a large centralized fashion by cloud computers. Such a cloud centric architecture keeps the cloud at the centre, applications above it, and the network of smart things below it. Cloud computing is given primacy because it provides great flexibility and scalability. It offers services such as the core infrastructure, platform, software, and storage. Developers can provide their storage tools, software tools, data mining, and machine learning tools, and visualization tools through the cloud.

Lately, there is a move towards another system architecture, namely, fog computing, where the sensors and network gateways do a part of the data processing and analytics. A fog architecture presents a layered approach, which inserts monitoring, pre-processing, storage, and security layers between the physical and transport layers. The monitoring layer monitors power, resources, responses, and services. The pre-processing layer performs filtering, processing, and analytics of sensor data. The temporary storage layer provides storage functionalities such as data replication, distribution, and storage. Finally, the security layer performs encryption/decryption and ensures data integrity and privacy. Monitoring and pre-processing are done on the edge of the network before sending data to the cloud.

Often the terms "fog computing" and "edge computing" are used interchangeably. The latter term predates the former and is construed to be more generic. Fog computing originally termed by Cisco refers to smart gateways and smart sensors, whereas edge computing is slightly more penetrative in nature. This paradigm envisions adding smart data pre-processing capabilities to physical devices such as motors, pumps, or lights. The aim is to do as much of pre-processing of data as possible in these devices, which are termed to be at the edge of the network. In terms of the system architecture, the architectural diagram is not appreciably different . As a result, we do not describe edge computing separately.

Finally, the distinction between protocol architectures and system architectures is not very crisp. Often the protocols and the system are codesigned. We shall use the generic 5-layer IoT protocol stack for both the fog and cloud architectures.

3.3 Social IoT

Let us now discuss a new paradigm: social IoT (SIoT). Here, we consider social relationships between objects the same way as humans form social relationships. Here are the three main facets of an SIoTsystem :(i)TheSIoT is navigable. We can start with one device and navigate through all the devices that are connected to it. It is easy to discover new devices and services using such a social network of IoT devices.(ii)A need of trustworthiness (strength of the relationship) is present between devices (similar to friends on Facebook).(iii)We can use models similar to studying human social networks to also study the social networks of IoT devices.

REVIEW OF LITERATURE

There is a large number of tutorials, surveys and research studies in the area of IoT. Significant surveys consider IoT concepts and technologies as a whole, including the architectures, technologies and principal applications of IoT. Further works focus on evolution, architecture, IoT in agriculture, challenges and the future scope, these include works comparing IoT architectures.

IV. IoT IN AGRICULTURE

IoT in Agriculture is based on smart farming, crop monitoring with help of sensors to observe light, temperature, moisture, soil, etc., the farmers can monitor the field from anywhere and anytime.[5]

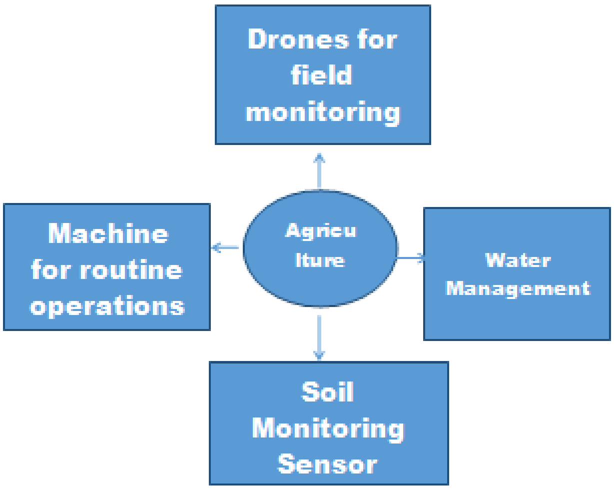

Figure 4.1 IoT in Agriculture

4.1. Precision Farming

Also known as precision agriculture, precision farming can be thought of as anything that makes the farming practice more controlled and accurate when it comes to raising livestock and growing of crops. In this approach of farm management, a key component is the use of IT and various items like sensors, control systems, robotics, autonomous vehicles, automated hardware, variable rate technology, and so on.The adoption of access to high-speed internet, mobile devices, and reliable, low-cost satellites (for imagery and positioning) by the manufacturer 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. CropMetrics is a precision agriculture organization focused on ultra-modern agronomic solutions while specializing in the management of precision irrigation.The products and services of CropMetrics include VRI optimization, soil moisture probes, and 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.The soil moisture probe technology provides complete in-season local agronomy support, and recommendations to optimize water use efficiency. The virtual optimizer PRO combines various technologies for water management into one central, cloud based, and powerful location designed for consultants and growers to take advantage of the benefits in precision irrigation via a simplified interface.

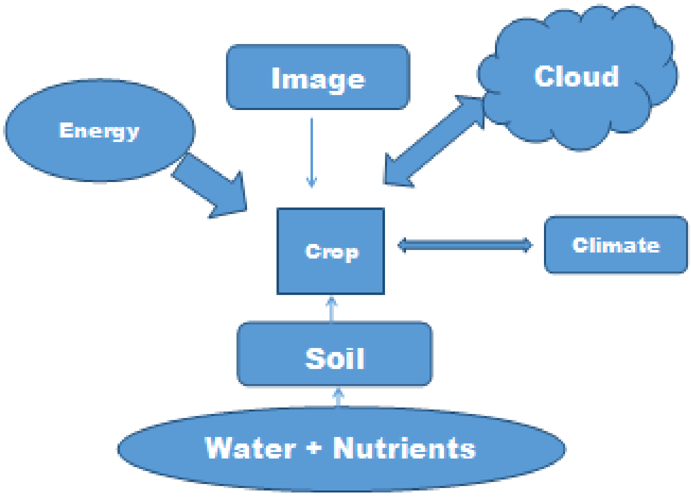

Figure 4.1 Precision Farming

4.2 Agricultural Drones

Technology has changed over time and agricultural drones are a very good example of this. Today, agriculture is one of the major industries to incorporate drones. Drones are being used in agriculture in order to enhance various agricultural practices. The ways ground-based and aerial based drones are being used in agriculture are crop health assessment, irrigation, crop monitoring, crop spraying, planting, and soil and field analysis.The major benefits of using drones include crop health imaging, integrated GIS mapping, ease of use, saves time, and the potential to increase yields. With strategy and planning based on real-time data collection and processing, the drone technology will give a high-tech makeover to the agriculture industry.This Box You Agree to our

Precision Hawk is an organization that uses drones for gathering valuable data via a series of sensors that are used for imaging, mapping, and surveying of agricultural land. These drones perform in-flight monitoring and observations. The farmers enter the details of what field to survey, and select an altitude or ground resolution.From the drone data, we can draw insights regarding plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, field water mapping, scouting reports, stockpile measuring, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping, and so on.The drone collects multispectral, thermal, and visual imagery during the flight and then lands in the same location it took off.

4.3 Livestock Monitoring

Large farm owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their cattle. This information helps them in identifying animals that are sick so they can be separated from the herd, thereby preventing the spread of disease. It also lowers labour costs as ranchers can locate their cattle with the help of IoT based sensors.

JMB North America is an organization that offers cow monitoring solutions to cattle producers. One of the solutions helps the cattle owners observe cows that are pregnant and about to give birth. From the heifer, a sensor powered by battery is expelled when its water breaks. This sends an information to the herd manager or the rancher. In the time that is spent with heifers that are giving birth, the sensor enables farmers to be more focused.

4.4 Smart Greenhouses

Greenhouse farming is a methodology that helps in enhancing the yield of vegetables, fruits, crops etc. Greenhouses control the environmental parameters through manual intervention or a proportional control mechanism. As manual intervention results in production loss, energy loss, and labour cost, these methods are less effective. A smart greenhouse can be designed with the help of IoT; this design intelligently monitors as well as controls the climate, eliminating the need for manual intervention.For controlling the environment in a smart greenhouse, different sensors that measure the environmental parameters according to the plant requirement are used. We can create a cloud server for remotely accessing the system when it is connected using IoT.

This eliminates the need for constant manual monitoring. Inside the greenhouse, the cloud server also enables data processing and applies a control action. This design provides cost-effective and optimal solutions to the farmers with minimal manual intervention.Aluminium greenhouse is a drip installation and Agri-Tech greenhouse organization and uses new modern technologies for providing services. It builds modern and affordable greenhouses by using solar powered IoT sensors. With these sensors, the greenhouse state and water consumption can be monitored via SMS alerts to the farmer with an online portal. Automatic Irrigation is carried out in these greenhouses.The IoT sensors in the greenhouse provide information on the light levels, pressure, humidity, and temperature. These sensors can control the actuators automatically to open a window, turn on lights, control a heater, turn on a mister or turn on a fan, all controlled through a Wi-Fi signal.

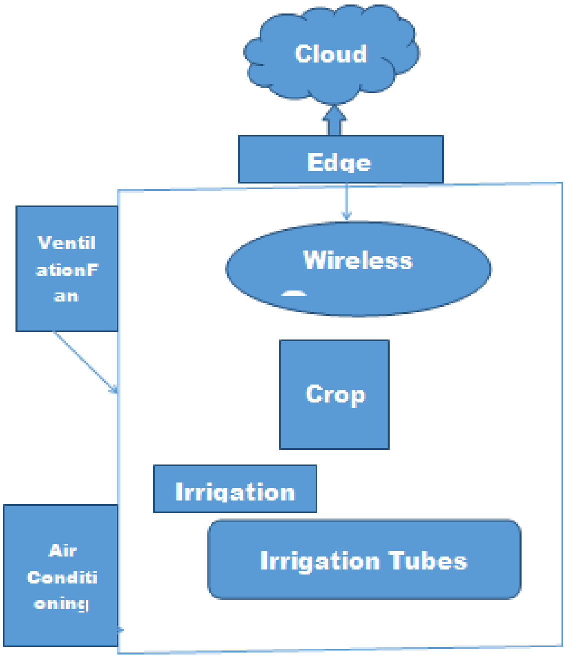

Figure 4.4.1 Smart Greenhouses

V. NEW CHANGES THAT CAN BE MADE:

The sensors placed can be damaged because of any disorders so it should be made strong.

- Low power consuming sensor devices must be used.
- Agriculture not includes the irrigation, it includes livehood, transport, and marketing.
- Nowadays IoT is used in tracking the live hoodin that field, the sensors track them if any health issues occurs for the livehood. But we can improve it by diagnosing the disease automatically and make an easy way of medication for it.
- Then IoT can be used to measure the amount (weight) of grains that is collected while threshing.
- Using the IoT devices we can make able to collect the recent updates of agri products marketing.
- Already there are sensors to intimate the farmer if the plats are infected, but we can make the sensors able to diagnose the disease andautomatically search for the required pesticides and insecticides.
- Vehicles which are sent for marketing purpose can be tracked by the farmers. Selling of their products can be made known as a database by the farmers by using IoT devices

VI. MAJOR DISADVANTAGES:

- Complexity
- Loss of privacy and security
- Power consumption
- Average error occurrence is high.

VII. CONCLUSION

Thus, the IoT agricultural applications are making it possible for ranchers and farmers to collect meaningful data. Large landowners and small farmers must understand the potential of IoT market for agriculture by installing smart technologies to increase competitiveness and sustainability in their productions. The demand for growing population can be successfully met if the ranchers as well as small farmers implement agricultural IoT solutions in a successful manner.

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