1. INTRODUCTION:

As we all know that Agriculture is the main backbone of India's Economical Growth, the most important barrier that arises in traditional farming is climatic change. The number of effects of climatic change includes heavy rainfall, most intense storm, heat waves, less rainfall and many more…So, Due to these, the productivity decreases to major extent. Climatic Change also raises the environment consequences such as seasonal changes in life cycle of plants. So, to boost the productivity and minimize the barriers in agricultural field, there is need to use innovative technology and techniques called "Internet of Things". Today, the internet of things is transforming towards agriculture industry and enabling farmers to compete with enormous challenges they face.

2. WHAT IS IOT?

IOT evolve from different building blocks which includes lots of sensors, software's, network components and other electronic devices. Also it makes the data more effective. IOT allows exchanging the data over the network without human to human involvement. In Internet of Things, we can represent things with natural way, just like normal human being like sensor, car driver etc., and this thing is assigned an IP address so that it can transfer data over a network.

The Internet of things (IOT) is the most efficient and important techniques for development of solutions to the problems. (Or) According to Wikipedia…The Internet of things describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

IOT technology is more efficient due to following reasons:

- Global Connectivity through any devices.
- Minimum human efforts.
- Faster Access.

- Time Efficiency.
- Efficient Communication.

3. WHY IOT FOR AGRICULTURE?

- IOT techniques enhance the quantity of production and quality with reduced cost and précised results.
- IOT based methods provide improved irrigation techniques and help decide the right quantity and right time for water
- IOT gives a major improvement to this with direct benefit of technology and information.
- IOT drives automation to next level with sophisticated decision making by use of connectivity and data.
- A great IOT solution must be able to operate at three levels, like :
- Allowing real-time collection & data presentation.
- Offering a solution that is accessible on global level, and not limited to operator or the local networks.
- Providing a solution that is easy to install, cost-effective, and low-powered.

4. CONCEPT OF SMART FARMING:

What is a Smart Farm??

"Smart farming" is an emerging concept that refers to managing farms using technologies like IOT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production

Basically, Smart Agriculture Technology enables the farmers to have better control over process of growing crops and rearing live stock. This way it brings the farmers to reduce the waste and increase the productivity that ranges from quantity of fertilizer utilized to number of journeys made by farm vehicles.

Let us know what exactly is smart farming… Smart farming is a system that enables to grow food, cleanly and sustainably for masses. Mainly, it is an application of the modern Information and Communication Technologies (ICT) into the agriculture. In the scenario of IOT-based farming a system is built to monitor crop field with use of sensors and to automate irrigation system. This way, farmers will be able to monitor field conditions from just anywhere regardless of their current location. So, As compared to conventional farming, IOT-based smart farming is way ahead and is highly efficient. With the applications of IOT-based smart farming, it will be possible to target conventional and large farming operations as well as there would be new levers to elevate other growing trends in the agriculture, such as, family farming, organic farming.

Fig 1: Smart Farming

5. ROLE OF IOT IN AGRICULTURE:

Smart Agriculture will help in monitoring live stock productivity and health as well. IOT sensors are capable of providing farmers with information about crop yields, rainfall, pest infestation and soil nutrition. IOT in agriculture uses robots, drones, remote sensors and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying and mapping the fields and provides data to farmers for rational farm management plans to save both time and money. Let us discuss about the roles of IOT in Agriculture...

Fig 2: Role of IOT in Agriculture

5.1 Water Management:

Water management can be efficiently done using IOT with no wastage of water by using sensors. IOT sensors that are used for water management applications are programmed to collect data virtually from any environment component. Water management sensors may collect information that are related to an individual plant's water usage, total water usage, soil moisture, air humidity, climatic conditions, weather forecasting and many more.. These data points will then be processed to compose a report with automated actions, which will optimize the entire water system. Accurate management of irrigation of water, results in overall savings in water consumption by farm. The intense use of technologies offers a means for providing the exact amount of water needed by plants.

Fig 3: Water Management.

5.2 Crop Monitoring:

IOT helps to monitor the land continuously, so that precautions can be taken at the early stage. It increases productivity, reduces manual work and time and makes farming more efficient. Crop monitoring can be easily done to observe the growth of crop. The platform for the crop monitoring system implements two types of platforms and accomplishes the system networking.

→ The first one is the Environmental parameter platform that collects meteorological and soil information such as temperature, humidity, wind, air, rainfall, soil PH etc.,

→ The second one is the Image capture platform that obtains crop growth images. The growth of crops and growing conditions can be observed directly by distributing instructions. This increases the productivity and makes farming more efficient.

Fig 4: Crop Monitoring

5.3 Soil Management:

Soil Monitoring with IOT uses technology to empower farmers and producers to maximize yield, reduce disease and optimize resources. IOT sensors can measure soil temperature, NPK (Nitrogen, Phosphorous, and Potassium), volumetric water content, Photosynthetic radiation, soil water potential and soil oxygen levels. Data from the IOT sensors are then transmitted back to a central point for analysis and visualization. The

resultant data can then be used to optimize farming operations, and make subtle adjustments to conditions to maximize crop yields and quality.

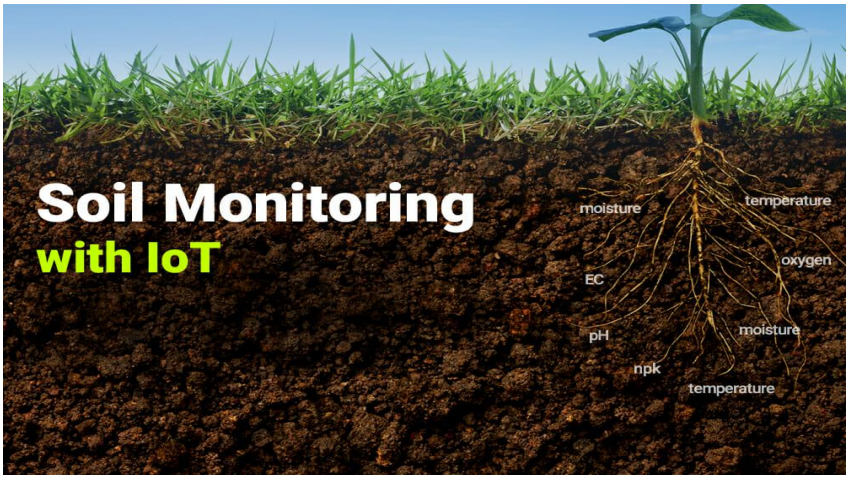


Fig 5: Soil Management

5.4 Control of Insecticides and Pesticides:

Insects have always been a nuisance for farmers. So, Pesticides and Insecticides have played a major role in preventing infestations. But, Extreme use of Pesticides can result in severe water and soil contamination and can also intoxicate plants with harmful chemicals. So, Sensors are used to detect the pesticides percentage and indicates the pesticides present in fresh fruits and vegetables and the detected information will be displayed in the LCD (Liquid Crystal Display). We also have sensor that are used for pest detection like low-power cameras and sensors, high-power thermal sensors, fluorescence image sensing etc., A farm owner can use different sensors to monitor the growth of pests and take further counter measures to manage them.

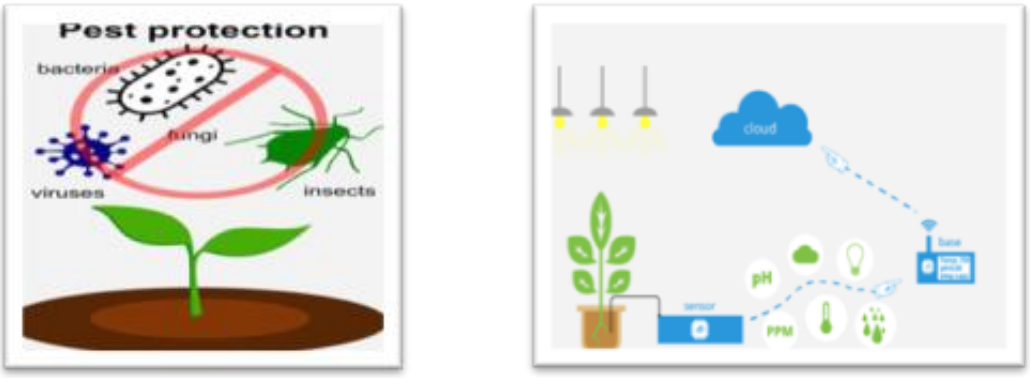


Fig 6: Control of Insecticides and Pesticides

6. WAYS IOT CAN TRANSFORM AGRICULTURE:

We have five ways in which IOT can transform agriculture, they are:

Fig 7: Ways IOT can transform agriculture

6.1 Efficient Scaling: Efficient scaling is made possible through the process of automation. Multiple processes around production cycle, such as fertilization, pest control or irrigation can be automated with the use of smart devices.

6.2 Better Quality: With an effective IOT solution it is possible to have increased control over production process as well as maintain high standards of growth capacity and crop quality through automation. This way, farmers can expect higher revenues eventually.

6.3 Be in Control: IOT Technology allows maintaining control over internal process and by this way production risks can be decreased.

6.4 Data Collection: The data which is collected by the smart sensors would be able to track things like crop's growth process, soil quality, weather condition, as well as cattle's health also. Farmers can use this data for tracking state of operation and other factors like equipment efficiency and staff performance.

6.5 Manage the Costs: Control over the production will lead in reducing the waste levels and also allows to effectively managing the costs.

7. FARMING ANALYSIS AND MAJOR FUNCTIONALITY:

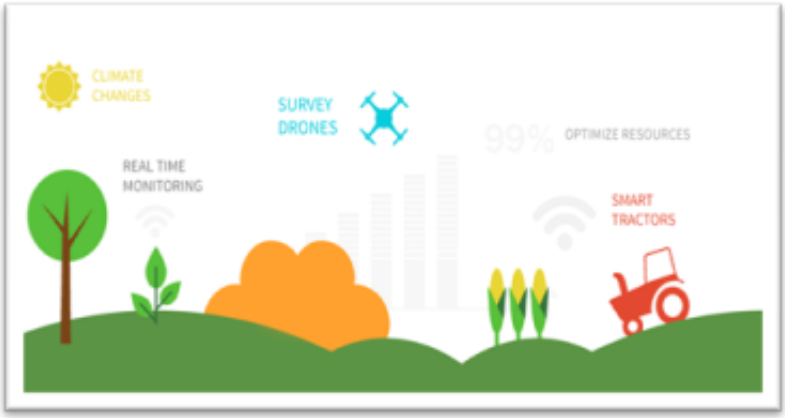


Fig 8: Farming analysis and major functionality

7.1 Real-time Data: Agriculture field such as temperature, humidity, light, soil moisture, data network is passed to the data processing system for intelligence analysis and processing.

7.2 Real-time Surveillance: Users can watch the actual images of agriculture field and remote monitoring of crop growth process through mobile or laptop anytime and anywhere.

7.3 Data Storage: Data can be stored in the form of a knowledge base at any time in processing and query.

7.4 Data Analysis: Cloud based big data analysis is used to analyze the data, then the prediction is performed based on data mining technique, which reaches the farmer through mobile.

7.5 Remote Control: User can use the internet terminal that is an electronic communication hardware device that handles the input and display the data. Those can be implemented to the agricultural fields.

7.6 Intelligent Decision: According to expert system, the platform system has self learning ability to control the farm equipment wisely.

8. CHALLENGES OF IOT IN AGRICULTURE:

Let us discuss some of the challenges of IOT in Agriculture:

8.1 The Brain: Data analytics need to be at the core of every smart agriculture. The enormous information itself is enough for the chaos. Thus, we need to have effective facts of analytics capabilities, practice predictive algorithms and device studying in order to reap actionable insights based on the collective data.

Fig 9: Brain

8.2 The Hardware: To create an internet of things for agriculture, the sensors should be perfect and efficient. The desire will depend on the kind of particulars we want to obtain. So, the sensors should be significant to the achievement of the product and that is also going depend on the accuracy of the collected data and its consistency. The tools that are required for the IOT in agriculture should be efficient and significant to the achievement of the product.

Fig 10: Hardware

8.3 The Maintenance: Maintenance of the hardware is very important because the sensors are usually used in the subject and may be effortlessly broken also. Thus, we need to make sure that the hardware is durable and clean to keep.

Fig 11: Maintenance

8.4 The Mobility: Smart farming applications should be well fitted for use in the field and also each connected device should be autonomous and have enough wireless range to communicate with the other devices and to send data to the central server. Smart farming applications should be tailored for use in the field. A business owner or farm manager should be able to access the information on site or remotely via a smart phone or desktop computer.

Fig 12: Mobility

8.5 The Infrastructure: To ensure that the smart farming application performs well and to make sure that it can handle the data load, we need a solid internal infrastructure and that should be secure.

Fig 13: Infrastructure

8.6 The Connectivity: Connection to the internet is a base necessity of proper IOT device operation. The need to transmit data between many agricultural facilities still poses a challenge for the adoption of the smart farming. The connection between these facilities should be reliable enough to withstand bad weather conditions and to ensure non-disruptive operations. Farmers can overcome this by using ultrahigh frequency and very high frequency broadcast bands.

Fig 14: Internet Connections

9. CASE STUDIES OF IOT IN AGRICULTURE:

Let us discuss few case studies of IOT in Agriculture:

9.1 Monitoring of Climatic Conditions: Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors, located throughout the sector, they acquire numerous information from the environment and ship it to the cloud. The provided measurements can be used to map the climatic conditions and choose the appropriate crops that improve their capacity. Using sensors in our fields allow more precise with their weather data collection. This makes water usage, planting, and maintenance more accurate, thus using less resources. This can help us save time, labor and money.Examples of such agriculture IOT devices are allMETEO, Smart elements and Pycno.

Fig 15: Monitoring of Climatic Conditions

9.2 Greenhouse Automation: Greenhouse automation can automatically modify the situations to fit the given parameters. A greenhouse farming technique complements the production of vegetation by controlling the environmental parameters. Farmers can also 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. Sensors will collect the amount of specific parameters with the plant requirement and ship it to the cloud. It then methods the statistics and applies a manipulate motion and the details will be displayed in the panel. For instance, Farmapp and Grow link are also IOT agriculture products offering such capabilities among others. Green IQ is likewise an interesting product that makes use of smart agriculture sensors. It is a smart sprinkler controller that allows us to manage the irrigation and lighting systems remotely.

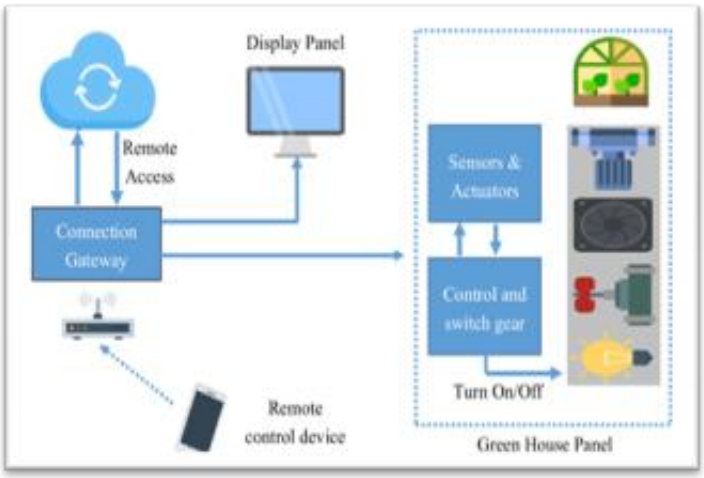


Fig 16: Greenhouse Automation

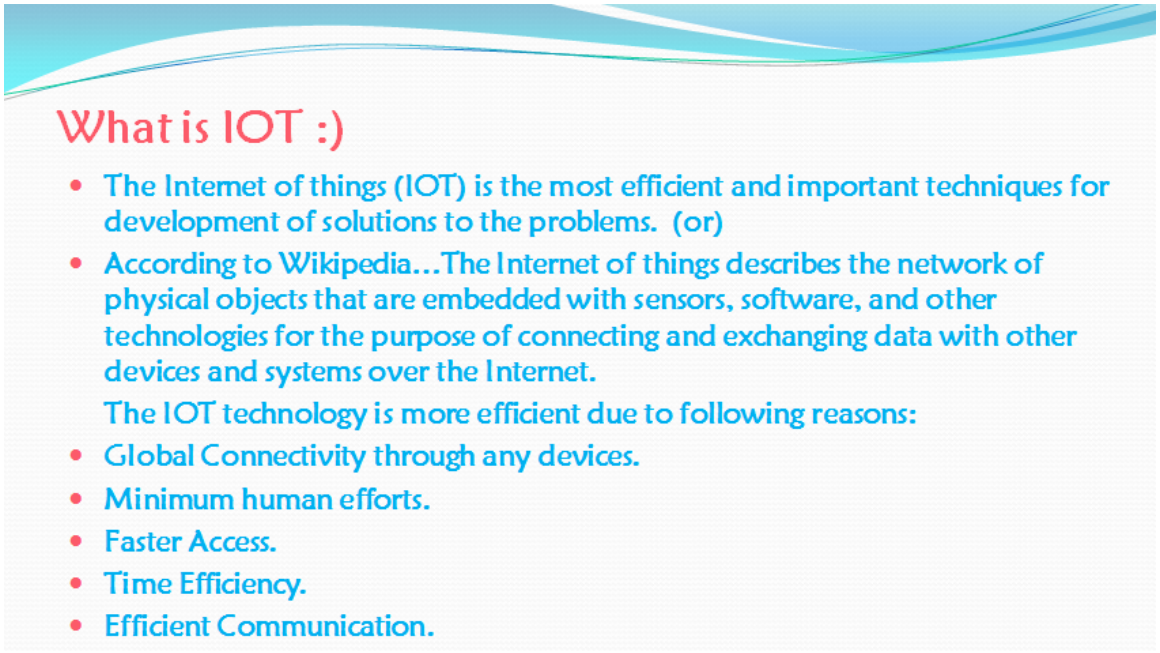
9.3 Cattle monitoring and Management: Just like crop monitoring, there are IOT agriculture sensors that can be connected to the animals on a farm to reveal their fitness and log overall performance. This works similarly to IOT gadgets for pet care. Sensors can identify sick animals so that farmers can separate them from the herd and avoid contamination. Using drones for real-time cattle tracking also helps farmers reduce staffing expenses. For example, SCR by Allflex and Cowlar- It is a fit bit for cows that helps to improve milk yield, better health and early disease detection of the cattle.

Fig 17: Cattle monitoring and Management

10. PPT SLIDES:

Slide - 1

Slide - 2



Slide - 3

Why IOT for Agriculture :)

- IOT techniques enhance the quantity of production and quality with reduced cost and précised results.
- IOT based methods provide improved irrigation techniques and help decide the right quantity and right time for water
- IOT gives a major improvement to this with direct benefit of technology and information.
- IOT drives automation to next level with sophisticated decision making by use of connectivity and data.
- A great IOT solution must be able to operate at three levels, like :
- Allowing real-time collection & data presentation.
- Offering a solution that is accessible on global level, and not limited to operator or the local networks.
- Providing a solution that is easy to install, cost-effective, and low-powered.

Slide – 4

Concept of Smart Farming :)

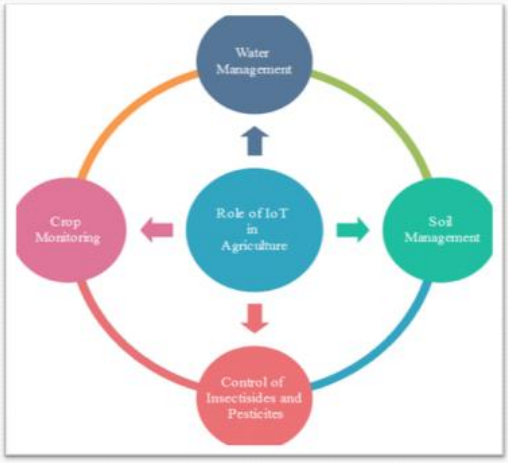
- What is a Smart Farm ??

"Smart farming" is an emerging concept that refers to managing farms using technologies like IOT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production.

Slide – 5

Role of IOT in Agriculture :)

- IOT in agriculture uses robots, drones, remote sensors and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying and mapping the fields and provide data to farmers for rational farm management plans to save both time and money.



Slide – 6

Water management :)

- The intense use of techno--logies offers a means for providing the exact amount of water needed by plants.

Slide - 7

Crop monitoring :)

- The growth of crops and growing conditions of crops can be observed directly by distributing instructions .

Slide – 8

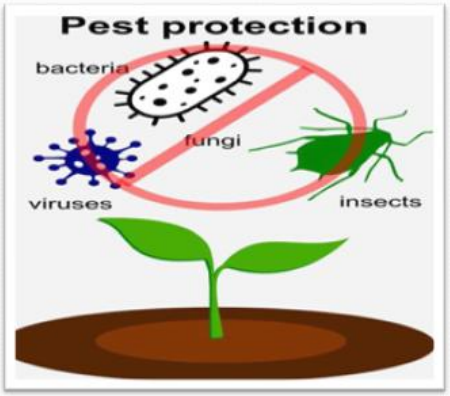
Soil management :)

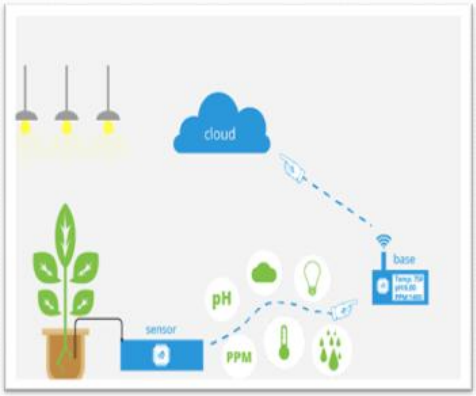
- Soil Monitoring with IOT uses technology to empower farmers and producers to maximize yield, reduce disease and optimize resources.

Slide – 9

Control of insecticides and pesticides :)

- A farm owner can use different sensors to monitor the growth of pests and take further counter measures to manage them.





Slide – 10

Ways IOT can transform Agriculture :)

- Efficient Scaling
- Better quality
- Be in control
- Data collection
- Manage the costs

Slide – 11

Farming analysis & major functionality :)

- Real – time data
- Real – time Surveillance
- Data Storage
- Data Analysis
- Remote Control
- Intelligent decision

Slide – 12

Challenges of IOT for Agriculture :)

The Brain :)

- Facts analytics capabilities, practice predictive algorithms and device studying is needed .

Slide – 13

The Hardware :)

- The tools that are required for the IOT in agriculture should be efficient and significant to the achievement of the product.

Slide – 14

The Maintenance :)

- Maintenance of the hardware is a project that is of number one importance for Internet of Things products in agriculture.

Slide -15

The Mobility :)

- Smart farming applications should be tailored for use in the field.
- A business owner or farm manager should be able to access the information on site or remotely via a smart phone or desktop computer.

Slide – 16

The Infrastructure :)

- To ensure that the smart farming application performs well , we need a solid internal infrastructure.

Slide – 17

Internet Connections :)

- Poor Internet connectivity in farms.
- Disrupted connectivity to the cloud.
- Farmers can overcome this challenge by making use of UHF and VHF broad-cast bands that have the capability of multiplying the strength of Wi-Fi signals, making them stronger.

Slide – 18

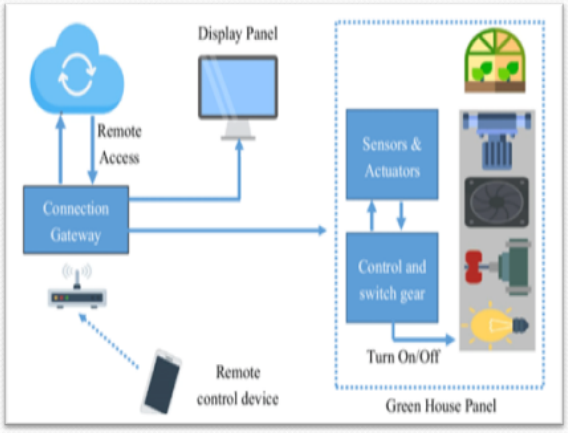
Few case studies of IOT for Agriculture :)

- Monitoring of climate conditions :)
  - Using sensors in our fields allow more precise with their weather data collection.
  - This makes water usage, planting, and maintenance more accurate, thus using less resources.
  - This can help us save time, labor and money.

Slide - 19

Greenhouse automation :)

- Greenhouse automation can automatically modify the situations to fit the given parameters.
- Green IQ is likewise an interesting product that makes use of smart agriculture sensors.
- A greenhouse farming technique complements the production of vegetation by controlling the environmental parameters.



Slide – 20

Cattle monitoring and management :)

- Just like crop monitoring, there are IOT agriculture sensors that can be connected to the animals on a farm to reveal their fitness and log overall performance.
- This works similarly to IOT gadgets for pet care.

Slide - 21

11. CONCLUSION:

- With the population growing rapidly, the demand can be successfully met if the farmers implement agricultural IOT solutions in a prosperous manner…
- The focus on smarter, better, and more efficient crop growing methodologies is required in order to meet the growing food demand of the increasing world population.
- IOT help farmers in decision making and fast reactions to event happening.
- The inclusion of IOT is envisioned to be useful for advancing the agricultural and farming industries by introducing new dimensions.
- Thus, the IOT agricultural applications are making possible for farmers to collect meaningful data.
- As a whole, the underneath descriptions of various aspects of IOT should be used in such a way, that agriculture be smart and ubiquitous.

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13. ANNEXURE - QUERIES INCORPORATED:

- **Name the sensors used in IOT for Agriculture** - Location Sensors, Optical Sensors, Electro-Chemical Sensors, Mechanical Sensors, Dielectric Soil Moisture Sensors and Air Flow Sensors.
- **Devices of IOT in Agriculture-** allMETEO, Pycno, Farmapp, Grow link, Green IQ, SCR by Allflex, Cowlar, Sensors, Actuators, Gadgets, Appliances that are programmed for certain applications and can transmit data over the internet or other networks.
- **Applications of IOT in Agriculture-** Precision Farming, Agricultural Drones, Livestock Monitoring, Smart Greenhouses, Monitor Climate Conditions, Remote Sensing, Computer imaging.
- **How the moisture of the soil is identified-**The controller used here is Arduino, it is chosen as it is widely used for research purposes and different sensors and hardware are easy to interface. The soil moisture/humidity sensor uses 0.4 mA of current so chance of loading effect is very less. The solenoid valve requires 24V of power while the controller can only output 5V. So, the valve is given external power. The LCD is connected to the controller via usual connections with 15th and 16th pins are given +5V and ground connection for backlighting which is useful for viewing in low light. The display shows moisture content is percentage as programmed. The wireless module is connected to Arduino which takes 3.3V-5V as input. The code is written so that it can collect data from a certain server address and send data to it.

Fig 18: Arduino Uno R3

Fig 19: Moisture Sensor

Fig20:Moisture sensor in dry soil

Fig21:Moisture sensor in 100% moist condition