

Internet of Things (IOT) in Smart Agriculture

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Abstract: The Internet of Things (IOT) is the scheme of getting real-world objects connected with each other, will change the way users organize, obtain and consume information completely. Internet of Things (IOT) enables various applications such as crop growth monitoring and selection, irrigation decision support, etc. in Digital Agriculture domain. Agriculture can be connected to the IOT through sensor networks that allows us to create connections among agronomists, farmers and crops regardless of their geographical differences. This approach is helpful in providing real-time information about the lands and crops that will help farmers make right decisions. The main objective of this paper to introduce various technologies used in Smart Agriculture.

Keywords: Internet-of-Things, Sensor Networks, Agriculture

INTRODUCTION

The Internet of Things (IOT) is transforming the agriculture industry and enabling farmers to contend with the enormous challenges they face. The industry must overcome increasing water shortages, limited availability of lands, difficult to manage costs, while meeting the increasing consumption needs of a global population that is expected to grow by 70% by 2050.

New innovative IOT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production.

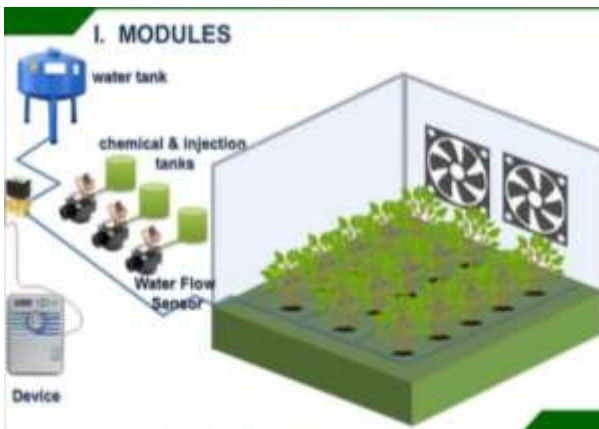
For farmers and growers, the Internet of Things has opened up extremely productive ways to cultivate soil and raise livestock with the use of cheap, easy-to-install sensors and an abundance of

insightful data they offer. Prospering on this prolific build-up of the Internet of Things in agriculture, smart farming applications are gaining ground with the promise to deliver 24/7 visibility into soil and crop health, machinery in use, storage conditions, animal behavior, and energy consumption level.

Some interesting internet of things (IOT) project in agriculture

A. **Cold chain management.** Tracking produce temperature at the point of harvest to local flash cooling facilities to mobile or fixed cooling facilities to improve shelf life, etc. Using sensors and wireless connectivity. 2/3rds of all produce in India spoils before it ever gets to market.

- B. **Smarter irrigation** through better temperature, humidity, and other sensors networked wirelessly.
- C. **Condition based, rather than scheduled, maintenance** of agricultural machinery and tools based on the use of sensors, wireless, and wireless location.
- D. **Animal tracking.** The number of cows in the USA is ~90 million. Optimize feeding, breeding, animal health, etc.
- E. **Product recall/security.** Track with precision the source of say, some E. coli outbreak to minimize the cost of executing a recall.
- F. **Remotely piloted equipment. Tractor drones.** We might as well also invent scarecrow drones as well while we are at it.



Application areas of smart farming:

The set of technologies used in smart farming is complex, to reflect the complexity of activities run by farmers, growers, and other sector stake holder. For the purposes of this report, smart farming is structured in the following application areas:

1. **Weather Monitoring** - IOT based weather station is nothing different from the earlier station just that, now data is available in real time on a web-app using GPRS communication instead of SATCOMM. We are running one of Citizen weather network in Bangalore.
2. **Greenhouse/Agriculture warehouse / Cold-chain monitoring** - With IOT, we can drop battery powered low power wireless sensor nodes communicating to each other using RF or BLE, form a mesh network, show data locally or push it to cloud using any back-end connectivity.
3. **Farm monitoring / livestock** – A company who was doing RFID tagging for livestock monitoring - Roxan ID with the help of IOT they were able to track position, counting and other variables of cattle's.
4. **Milk Farm monitoring** - Real time monitoring of milk levels in a diary, if chilling temperature is properly maintained or not. Final Stellapps Home Company in India which was doing the same.
5. **Home gardening** - *Groove Ecosystem* - A complete grow bed which provide you an indoor garden coupled with LED grow lights and an aquarium, connected via WIFI to a cloud server which provide you, your garden data in real time on a app. Remote Control of farm irrigation system -

Remotely controlling motors irrigating fields either with an Android application or DTMF.

6. NDVI based imaging using Drones - Agricultural Intelligence. Drone Enabled.. Not exactly IOT but must be counted in smart agriculture.
7. GPS based navigation for Tractors in order to cover most of the field in a timed and efficient manner.
8. Automatic tractors and drones taking care of orchards and fields.

Technology used in smart agriculture:

KaaIoT platform:

The **Kaa open-source IOT Platform** is a crucial middleware technology that allows walking safely into the agriculture IOT field. By tying together different sensors, connected devices, and farming facilities, Kaa streamlines the development of smart farming systems to the maximum degree possible. Kaa is perfectly applicable for single-purpose smart farming products - such as smart metering devices, livestock trackers, or failure prediction systems - as well as for multi-device solutions, among which are resource mapping and farming produce analytics solutions.

Kaa is feature-rich and, as an open-source platform, grants full access to its modules for any necessary modifications, extensions, or integrations. Out of the box, Kaa already provides a set of ready-to-use components for a quick start with smart farming applications. After all, farming is all about

connecting with nature - leave everything else to Kaa.

SMART FARM NET:

Smart Farm Net can integrate virtually any IOT device, including commercially available sensors, cameras, weather stations, etc., and store their data in the cloud for performance analysis and recommendations. An evaluation of the Smart Farm Net platform and our experiences and lessons learnt in developing this system concludes the paper. Smart Farm Net is the first and currently largest system in the world (in terms of the number of sensors attached, crops assessed, and users it supports) that provides crop performance analysis and recommendations.



Phenonet

Phenonet is an agricultural phenotyping field laboratory, involving a variety of crop studies that are being conducted using state-of-the-art IOT technologies, including sensor networks, IP cameras, mobile smartphones, and related data analytics.



Phenonet is helping plant biologist and growers achieve the following:

- (1) Identify the influence of different conditions on a variety of crops in real-world outdoor farm environments.
- (2) Understand water resource consumption in order to manage it effectively;
- (3) Study the impact of various fertilizers.
- (4) Get real-time data to forecast crop performance.
- (5) Share data and results.

AGRITECH

With the proliferation of smart devices, Internet can be extended into the physical realm of Internet-of-Things (IOT) by deploying them into a communicating actuating network. In Ion, sensors and actuators blend seamlessly with the environment; collaborate globally with each other through internet to accomplish a specific task. Wireless Sensor Network (WSN) can be integrated into Ion to meet the challenges of seamless communication between any things (e.g., humans or objects).

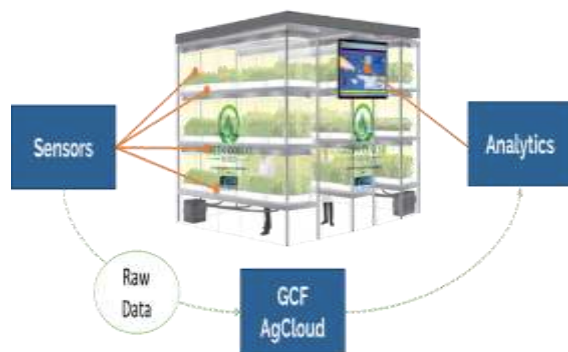
The potentialities of IOT can be brought to the benefit of society by developing novel applications in transportation and logistics, healthcare, agriculture, smart environment (home, office or plant). This research gives a framework of optimizing resources (water, fertilizers, insecticides and manual labour) in agriculture through the use of IOT. The issues involved in the implementation of applications are also investigated in the paper. This frame work is named as AgriTech.



FREIGHT FARMS

Freight Farms is a ***Boston-based agriculture technology*** company that provides the tools and services to enable fresh food production in any environment. The company grew out of the desire to eliminate the negative effects of food production and distribution, and has grown into a platform that empowers anyone to grow food anywhere. Freight Farms' flagship product, the Leafy Green Machine, is a complete hydroponic growing facility built entirely inside a shipping container, with environmental controls and indoor

growing technology. The “LGM” allows for immediate growing of a variety of crops regardless of weather conditions resulting in access to year-round local, fresh produce that is always in season. Farmhand Connect, Freight Farms’ App, provides farmers with access to real-time data from sensors inside the farm, giving them the ability to monitor all the key components of the farm: air, water, nutrients, and plant growth. Users check temperature, humidity and CO2 levels in the air, nutrient/pH levels of the water, and receive notifications of any changes to the environment.



SOLUTION

Freight Farms turned to Xively by LogMeIn for its connected product expertise and Xively Internet of Things (IOT) Platform. Security, scalability and expertise were important deciding factors and Freight Farms wanted to work with a company who could take on the entire connectivity stack, had a deployment ready platform with everything they needed, while providing the best guidance and advice from Xively Professional Services. By providing a secure, dependable, fast connection, Xively is allowing the Freight Farms

development team to improve on other areas of the farm and overall business.

TEMPUTECH

Temputech have come up with a Hazard & Grain Management cloud-based apps which are powered by GE equipment insight platform. This wireless sensor monitor device acts as a safety measure against hazards like fire, overloading etc. in Grain elevators by way of slowing down or stopping the operation of conveyor belts in situation of overloading or overheating to avoid any possible damage.



In addition, farmers can set alarms for various factors or situations related to temperature, humidity & vibration and so on that can be monitored by the sensor.

CONCLUSION

It is forecasted that internet of things in 2050 will increase the food productivity by 70% and would be feeding to 9.6 billion of people globally by the year 2050.

The demand for food has to be set against the challenges of rising climate change and more extreme weather

conditions, along with the environmental impact resulting from intensive farming practices.

The IOT will be the complete solution to field activities, irrigation problems, and storage problems using remote controlled robot, smart irrigation system and a smart warehouse management system respectively. Implementation of such a system in the field can definitely help to improve the yield of the crops and overall production.

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