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Review on Variables Influencing the Appropriation of Smart Agriculture Using IoT

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Abstract:

Agriculture plays an important role in India and also worldwide. The sudden rise in global population is dragging towards a smart agriculture practices(1). Internet-of-Things (IoT) based technologies moderated almost each industry including "smart agriculture" which moved the industry from analytical to computable approaches. Such radical changes are shaking the prevailing agriculture methods and creating new opportunities along a variety of challenges(2). IoT devices and communication techniques combined with wireless sensors encountered in agriculture applications are analysed in detail. Agri-IoT improved the ways to find the weather conditions, soil quality, crop's growth progress or cattle health. A collaboration of hardware and software that uses data communication-based wireless local area network (Wi-Fi) allows tracking elements of agricultural data visually and precisely, making it easier for farmers to act when something events that need rapid handling.

Keywords **—Agriculture, internet of things, connectivity, sensors, challenges.**

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I. INTRODUCTION

The application of IoT technology to agriculture has the potential to rework farming practices, making them more productive, precise and sustainable. However it's predominantly larger farms in developed countries that have implemented IoT with many smaller farms yet to try so. Two of the main obstacles to mass deployment of IoT in agriculture are high device cost and limited device power. With long range coverage, low power consumption and ultra-low cost devices, Low Power Wide Area (LPWA) communication technologies are particularly compatible for agriculture and supply variety of opportunities. Development and rollout of LPWA technology is happening at a rapid pace round the world and recently work has started on such networks in Ireland. With the potential of such technologies to profoundly impact how agriculture industry operates, this paper is motivated by a requirement to seem at IoT adoption factors from the first farmer's perspective and aims to know the forces involved. This article's best part is to know about the challenges expected to be faced when incorporating this technology with the traditional farming practices. The primary obstacles for adoption were found to be initial investment cost and difficulty to maintain.

The Internet of Things (IoT) concept has been present in the literature in various forms from the late 1980's (Weiser 1991) but was popularised by MIT's Auto-ID centre in the early 2000s with the first public reference to it in a November 2001 MIT white paper (Brock 2001). It was initially associated with Radio Frequency Identification

(RFID) tags for Supply Chain Management but has since expanded into market segments such as connected home, infrastructure & utilities, manufacturing, healthcare, transportation, retail, wearable's and drones.

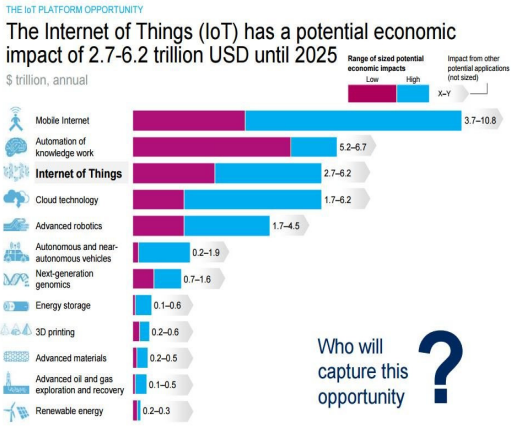
II. LITERATURE SURVEY

The aim of the literature review is to spot previous research conducted on this subject to supply insight on the way to best answer the research question. It begins with a general review of the IoT paradigm, its impact on the world's economy and developments in connectivity options that are of particular interest to the agricultural industry. It then introduces the precise sub-topic of IoT in agriculture, Agri-IoT, outlining sensors and applications utilized in that field. The drivers for appropriating Agri-IoT are then given followed by identified barriers. to know how technology is adopted by people a review of adoption theory was undertaken. Finally the literature was reviewed for previous studies that attempted to spot the factors in agricultural technology adoption.

A. Impacts of iot

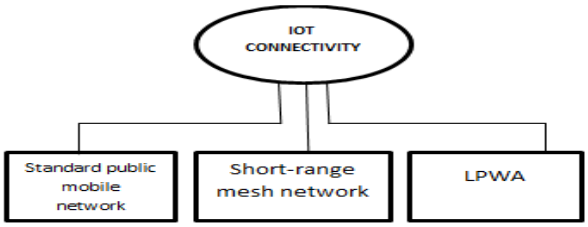
In 2015 there were 15.4 billion IoT devices in the world and there are predicted to be 30.7billion in 2020 and 75.4 billion in 2025. The expected economic impact of IoT technologies by 2025 is estimated to be between a conservative $2.7 trillion and an optimistic $6.2 trillion per year. This will change though, and it's not just things on the web , but an entire raft of technologies from robotics to AI to machine learning, combined with IoT which will make it happen. The idea is that you simply can place a chip inside anything and make it smart. Smart roads, smart buildings, smart cities, smarter people.within the next decade of the web , variety of key developments will inherit play to start out building the semantic web or web 5.0.

While agriculture isn't expected to be as impacted by IoT because the top three sectors it's still expected to make $100 billion in value per annum by 2025 by helping to optimise farm resource usage and therefore the early detection of pest and disease outbreaks.



B. IOTCONNECTIVITY:

One of the most critical elements of the IoT system is the ability of the device to communicate remotely. There are three main connectivity options for IoT.



B.1) STANDARD PUBLIC MOBILE NETWORK:

A number of public mobile network variations are currently operational like the 2G, GPRS, 3G, 4G and LTE-A standards. All provide the power for remote devices to attach with the cloud. None of those systems were designed specifically with IoT requirements in mind however and don't efficiently transport many of the IoT use cases. And 5G is probably going to also prove beneficial for IoT, and transformative generally.

cellular has historically been a nasty fit many IoT applications because it consumes tons of power and may be costly on a per-unit basis. This has limited cellular connectivity to applications that have an immediate power source, got to send

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B.3) SHORT-RANGE MESH NETWORK:

These involve connecting the remote device locally, between 10cm and a few of 100 metres, and need an in depth proximity between the sensor and therefore the network. Ideal for manufacturing plants and logistics in warehouses but often not suitable for the massive coverage footprints involved in agricultural use-cases. Low range technologies include WiFi, RFID, ZigBee, Bluetooth Low Energy (BLE) and ZWave.

C. LOW POWER WIDE AREA NETWORK:

Low Power Wide Area Networks are wireless technologies with features like more coverage areas, less bandwidth, efficiently minimised packet size and application-layer data sizes, and better battery life operation.

D. Agri-IoT introduction:

There are many terms currently used to describe IoT in agriculture, some overlap in meaning and some describe specific use cases. Examples are smart farming, precision agriculture, precision livestock farming or the Internet of Farming Things describe a common agricultural IoT framework called Agri-IoT that incorporates all the components of the above terms, namely ground, animal, drone or satellite sensor data, social network information, weather forecast data and government alerts in one system.

E. AGRI-IOT SENSORS:

area	measurement
soil	moisture, temperature, nitrogen, pH, matric potential, salinity
liquids	Level, quantity, Temperature, Pressure, water quality, mineral/salt content, dissolved oxygen, pH, Ammonia, Nitrate, Chloride
environment	Temperature, Rainfall, Humidity, Solar Radiation, Atmospheric pressure, wind speed, direction
plant	Photosynthesis, chlorophyll, leaf wetness
animal	Machine vision camera's, microphone acoustic monitoring, calving & fertility
location	Asset tracking, GPS or Real-Time Kinematic (RTK) precision agriculture
security	Passive Infrared (PIR) motion detectors, perimeter security

III. METHODOLGY:

E. INTERNET OF THINGS:

The Internet of Things is the method of connecting any device to the Internet and to other connected devices. The IoT is a massive network of connected things and people – all of which used to collect and share data about the environment around them.

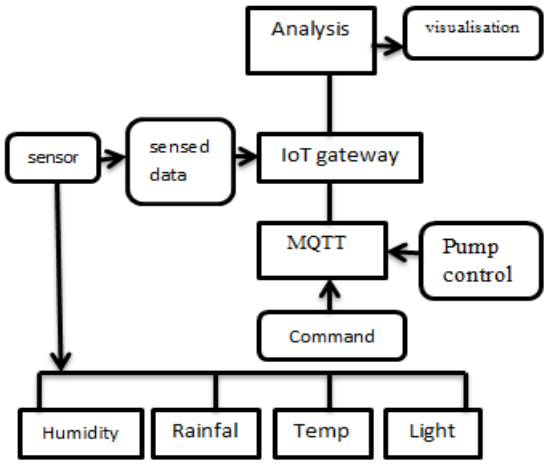
The IoT architecture is usually divided into four layers: perception layer, network layer, processing layer and application layer. Among them, within the perception layer, sensors are mainly used for information recognition, like RFID for obtaining electronic tags, so on obtain the specified front-end data. The network layer refers to the background server that transmits information through the telecommunication network and therefore the Internet. within the processing layer, some early warning, intelligent control and related prediction supported known data are implemented. the appliance layer is to process the knowledge obtained by the perception layer, and to understand the merchandise application through cloud computing, network services, etc.

F.SMART AGRICULTURE:

Smart agriculture is an intelligent system of agricultural experts, integrated system of agricultural products and traceability system of organic agricultural products. It links the web platform and cloud computing method, realizes the digitalization of agricultural information, automation of agricultural production and intellectualization of agricultural management, so on construct a contemporary green agricultural system with low carbon, energy saving, and high yield, and alter the normal farming way by means of science and technology.

Traditional agriculture	Traditional Agriculture are often defined as a primitive sort of farming that involves the intensive use of indigenous knowledge, traditional tools, natural resources, organic and cultural beliefs of the farmers. it's noteworthy that it's still employed by about 50% of the planet population
Smart agriculture	Smart agriculture is the progressive stage of agricultural production which incorporates mobile networks, IT platforms, cloud storage, big data, internet of things and internet technology.

BLOCK DIAGRAM OF SMART AGRICULTURE:



IV. AGRI-IOT ADOPTION BARRIER:

There are varieties of issue hindering the adoption of Agri-IoT by farming community.

1. **Cost :**

In an agricultural market where margin of profit and profitability are becoming tighter, farmers are trying to find technologies that reduce cost without decreasing production. Cost are going to be a crucial think about Agri-IoT because the average.

2. **Return on Investment :**

Immature systems haven't yet been proven to supply definite return on investment and difficulty in determining ROI is usually cited by end-users as a key barrier to adoption. Although a big increase in milk revenues was observed after investment in Automatic Milking Systems this was likely thanks to a rise in milking frequency and profit after operating costs didn't increase.

3. **Training :**

Appropriate training is crucial to assist farmers understand the utilization and applicability of Agri-

IoT systems). Consistent with SURVEY 71% of farmers still operate primarily of practical experience giving lack of your time to find out together of the most reasons.

4. Robustness :

Agri-IoT devices are going to be exposed to harsh environmental conditions and wish to figure for extended periods of your time without maintenance. they have to still operate correctly in high radiation , extreme temperatures, rain or high humidity, strong winds, vibrations, tolerate water submersion, dirt and be robust against physical impacts from farm machinery or animals. they have to stay active for extended periods on battery power as mains power or frequent battery replacement isn't an option for open field deployments.

5. Interoperability :

Standards are required to permit interoperability between different device manufactures and to supply confidence to end-users that they won't find you buying into a technology that becomes obsolete by a rival. IoT states that one among the central issues facing IoT is making full interoperability between inter-connected devices possible. Because of the broad nature of the IoT paradigm however there are multiple standardisation bodies involved like the ITU, Machine-to-Machine (M2M) Workgroup of the Telecommunications Standards Institute and therefore the Internet Engineering Task Force (IETF).

6. Privacy & Security :

Agri-IoT devices are likely to be placed in large open areas without supervision for long periods of your time making them vulnerable to theft, damage or physical tampering. there'll got to be adequate security mechanisms put in situ to detect and counter such activities. Because of the connected nature of Agri-IoT devices they're also in danger of hacking or information acquisition threats. Sufficient encryption features are required to affect this while not raising the value or complexity of the remote device.

V. CONCLUSION

All over the world researchers are seeking technological solutions to reinforce the production of agriculture in such a way that improves existing services by adopting IoT technology. In this article, we have presented a compact survey on the state of the art for Agri-IoT. To this end, we address agricultural network architecture, platform, and topology which help to know about IoT backbone and facilitates farmers to boost the crop productivity. In addition, this article delivers an vast overview on current and continuing advances in IoT agricultural applications, devices/sensors, communication protocols and many innovative technologies. This research deals with various IoT agricultural challenges and security requirements for the better understanding of IoT smart farming security. Government has started favoringIoT in agriculture and it is anticipated that soon IoT in agriculture will refurbish the traditional farming method. It is also clear that many big organizations have started exploring and expanding new techniques for farm management system using IoT.

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