TEKTELIC
communications

LoRaWAN® for Smart Agriculture

Utilizing IoT for Smart Agriculture

Throughout human history, no industry has been as heavily influenced by technological advancements as the Agriculture industry. The occurrence of several key inventions, ideas, and milestones re-shaped the way humans approached the subject and has had a significant impact on human life as we know it today. From the inventions of the cotton gin and steam engine to the adoption of crop rotation techniques, and the introduction of GMO technologies, the Agriculture industry has been in a state of consistent innovation and this trend does not appear to be slowing down anytime soon.

There are several societal and environmental factors that are influencing the world today which are accelerating the need for smart Agricultural solutions. These factors include accelerated population growth in the developing world, the societal trend of humans migrating from rural areas to cities at an increased rate reducing the labor force in the Agriculture industry, and environmental factors decreasing the amount of adequate land available for farming.

In an attempt to mitigate many of these challenges, the next major breakthrough in the Agricultural space appears to be the introduction of technologies using the Internet of Things (IoT). The concept of using IoT for Smart Agriculture practices is beginning to take off as farmers now have the ability to more easily visualize, analyze and make smart decisions about their crops, livestock, infrastructure, environment, or any other components they are required to monitor and manage.

IoT provides technologies for automation, data collection and analysis, security and preventative maintenance amongst others which in turn contributes to increased yields, improved operational efficiencies, mitigated risks, reduced waste and spoilage all while driving down operational costs. Some of the key areas of the Agriculture space that are being positively impacted by the introduction of IoT technologies that will be addressed in this paper include Precision Farming, Livestock Management and Smart Greenhouses.

Precision Farming
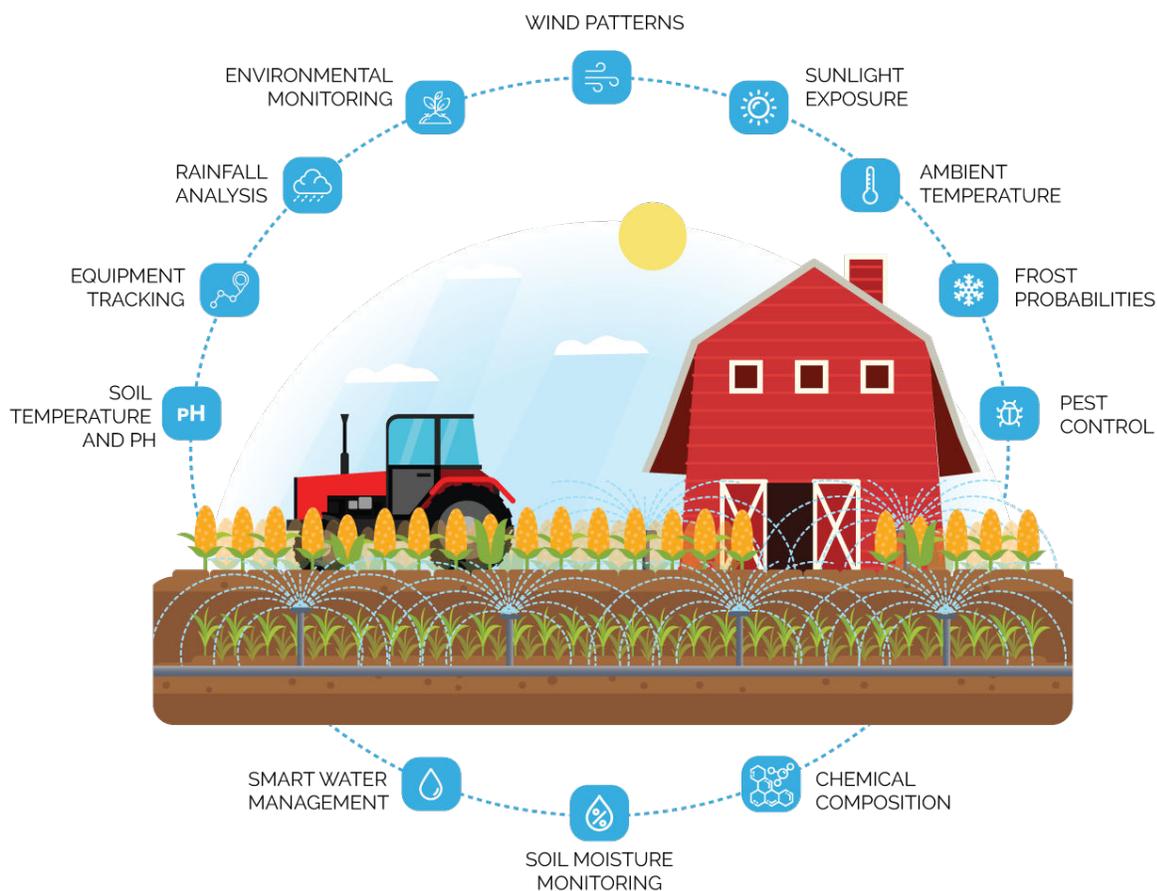
IoT technologies can provide farmers with key metrics about their crops. A network of IoT sensors can collect information about soil metrics including moisture levels, pH and chemical composition. This information can be visualized in real-time by the farmer using an online or mobile-based application. The farmer can then utilize this knowledge to make a smart decision about the management of the crop, with the intention of increasing yields. Visualization into the soil metrics can accommodate more efficient irrigation practices by allowing farmers to better understand what areas of their crops need water and when reducing unnecessary water usage and decreasing the costs associated with this. IoT sensors can be deployed to collect data about sunlight exposure, which can be used to make better decisions about crop placement and help determine if solar integration is a viable option for the farm. Essential weather-related data including ambient temperature and humidity, rainfall analysis, wind patterns and frost

probabilities can be visualized using IoT technologies helping farmers to better understand the environment around them. An IoT network deployment can also be used for the visualization and presence notification of harmful pests which can be utilized for early detection and effective, targeted pest control. Most commercial farming operations utilize expensively, but essential pieces of equipment in their activities. This equipment can be tracked, located, and monitored using IoT technologies to understand their location and operation status, for security purposes including theft or vandalism prevention, predictive maintenance and automation through remote management capabilities.

The time and costs savings associated with the implementation of an IoT precision farming system combined with the increased yield potential increase ROI and improves farming efficiencies.

Livestock Management
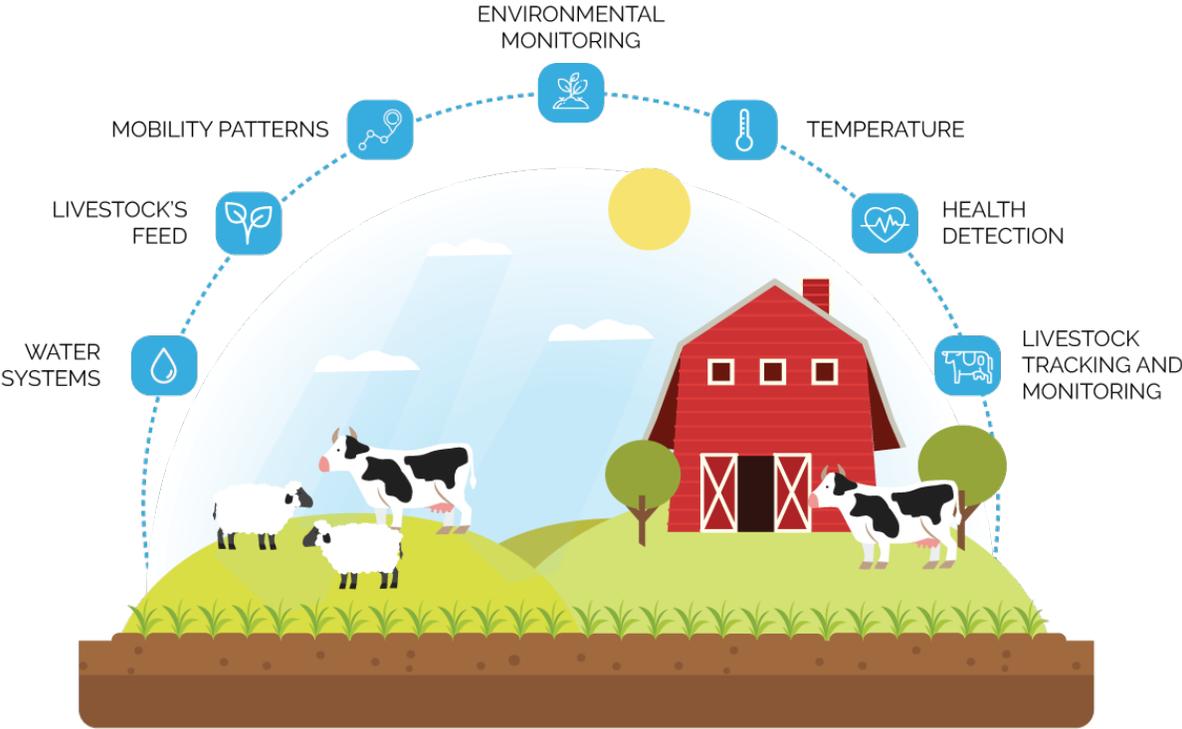
The monitoring of livestock is an essential component of a typical ranch operation. Livestock is some of the most precious and valuable assets in the Agriculture industry and it is a priority for

farmers to keep tabs on these assets. An IoT network can be deployed to monitor livestock location and an asset tracking device can be configured to instantly notify the farmer when one of their assets has left a predefined space. The IoT network gives ranchers important insight about common behaviors and patterns of their livestock including mobility patterns, grazing habits, reactions to environmental changes and can even help to detect potential health concerns that may not be outwardly visible. Vital statistics such as weight, temperature, and heartrate can be consistently monitored and reacted upon in the event of an anomaly or concern. The livestock's feed and water systems can be automated utilizing an IoT network to ensure the animals are being fed the appropriate amount, at the correct time and give the farmer visibility into feed storage and water reservoir fill levels for proactive and efficient re-ordering or re-stocking practices.
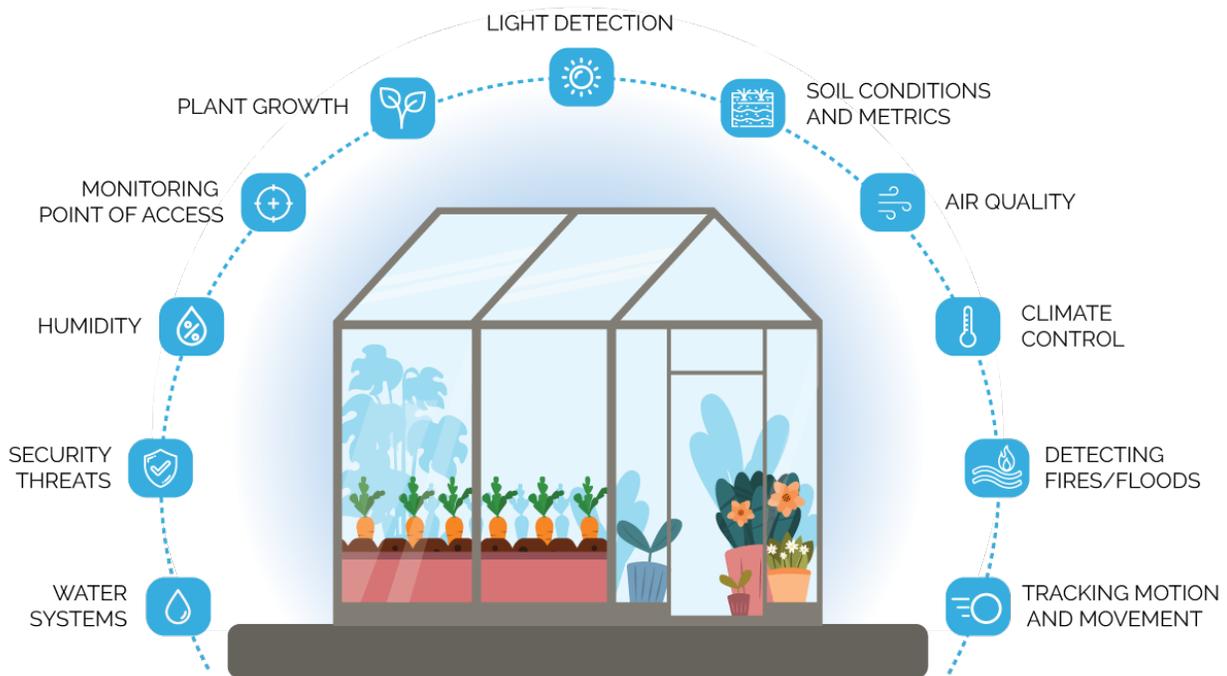
Smart Greenhouses

With the societal shift of the population migrating to urban areas, and the decrease in the availability of land available to be farmed, indoor agriculture has emerged as an essential practice for food and plant production, as it allows for growth in geographic regions that may not be able

to accommodate certain crops naturally. IoT enhances the effectiveness and efficiency of a greenhouse by providing key metrics about environmental conditions and key events requiring attention or action. Some of the most common metrics measures by IoT networks include climate control, visualization into the indoor environmental conditions such as temperature, humidity and air quality, soil conditions and metrics, light detection and control and plant growth. An IoT network can also be utilized as a security system in greenhouses by detecting fires and floods, monitoring point of access open/close status in secure areas, tracking motion and movement, and notifying greenhouse managers of unauthorized access and other security threats including structural damage to the greenhouse itself.

LoRaWAN® for Smart Agriculture

One of the primary challenges on integrating IoT into the agriculture industry is determining which technologies are best suited to solve the unique challenges in the market. Given that smart agriculture deployments are often located in rural areas with often limited access to power, or traditional communication networks, one technology has emerged as a market leader. LoRaWAN® or Long Range Wide Area Network has proven to be an ideal technology for many of the smart agriculture applications outlined in this paper. LoRaWAN® is a globally standardized, bi-directional communication protocol that operates in the unlicensed ISM (Industrial, Scientific, Medical) spectrum, which reduces operating expenses associated with having licensed wireless connectivity like 4G or LTE at each of the end devices in your network. LoRaWAN® is capable of transmitting over very long distances with the proven range in typical rural outdoor environments of over 20 km and deep indoor penetration capabilities ideal for smart greenhouses.

One of the primary benefits of the LoRaWAN® technology is its extremely low power optimization capabilities that are often tested to be at least 10 times more efficient than competitive M2M technologies. It is not uncommon for a battery-operated LoRaWAN® device such as a soil metric sensor or cattle tracker tag to have a battery life of over ten years. Not only is LoRaWAN® ideal for long-range and low power deployments, but its multi-usage capabilities also accommodate high device capacity in a single network. A carrier-grade LoRaWAN® collection hub, known as a

gateway can have the capacity to simultaneously send and receive hundreds of messages every second from the devices deployed in its vicinity. The bi-directional communication capabilities of the LoRaWAN® technology allows users to not only collect data from deployed devices but also send messages from their application down to the device as well. This is particularly useful in the agriculture space as it accommodates remote control over assets like electronic gates and fences, automated feed troughs, and even industrial equipment like generators or cooling fans.

Long Range	Maximum Battery Life	Multi Usage	Low Cost
• Greater than cellular • Deep indoor coverage • Star topology	• Low power optimized • 10-20yr lifetime • >10x vs cellular M2M	• High capacity • Multi-tenant • Public/Private network	• Minimal infrastructure • Low cost end-node • Open Software • Growing Eco-system

Geolocalization	Bi-Directional (FDD)	Global Standard	Secure
• In/out door • Accurate • No Battery Impact	• Acknowledge • Scalable Capacity • Broadcast	• Global Standard • True Mobility • Seamless • Roaming	• Unique ID • Application • Network

LoRaWAN® Features, Differentiators and Benefits

Conclusion

In conclusion, the Internet of Things has emerged as the latest innovation which is helping the agricultural industry adapt to many of the environmental and logistical challenges facing our planet's growing population today. Some of the key areas being impacted by IoT include Precision Farming, Livestock Management and Smart Greenhouses. The LoRaWAN® technology has been proven to be an ideal solution for many of the Smart Agriculture applications that are being deployed in the market. A LoRaWAN® Smart Agriculture network can provide farmers and stakeholders with invaluable data and information to visualize and analyze key metrics, providing a platform to make intelligent decisions resulting in reduced costs and improved efficiencies.

TEKTELIC has developed a complete End-to-End Smart Agriculture comprised of sensors, gateways and backend software allowing users to better understand their assets. Contact TEKTELIC to learn more about our End-to-End Smart Agriculture IoT solution and how we are providing solutions for various other industries today.

About TEKTELIC

TEKTELIC Communications is a premier supplier of complete End-to-End IoT solutions. With a focus on providing 'total solutions' TEKTELIC leverages its world-class IoT gateways, sensors and software to create enhanced value for its clients. With a strong commitment to quality, engineering, and service excellence, clients are assured TEKTELIC's IoT solutions will meet the current and future needs of their business.

Visit www.tektelic.com for more information.