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SECTION 5

GROUP 9

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Introduction

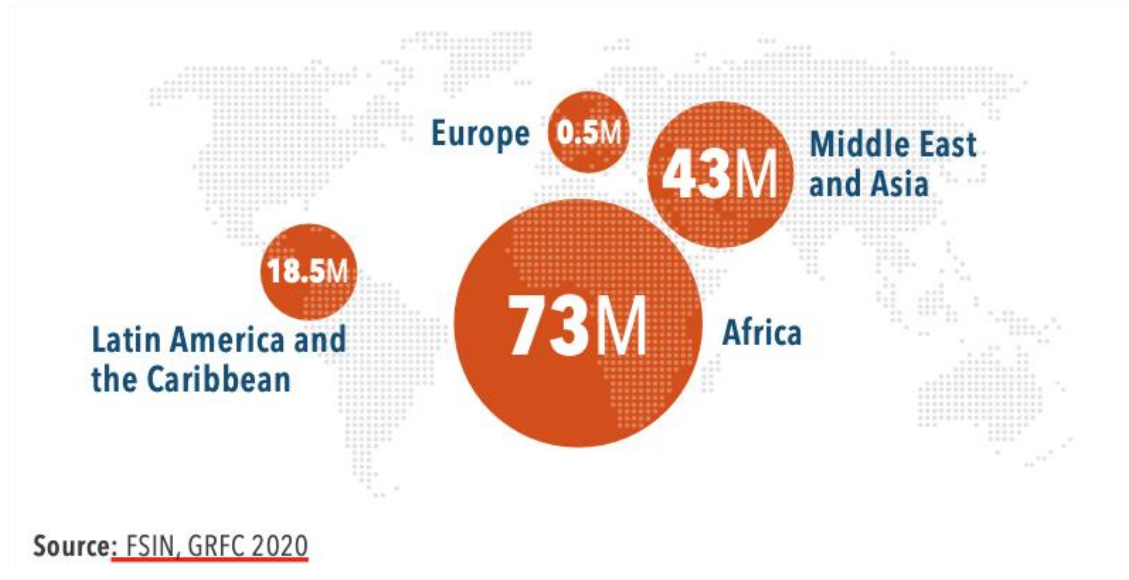
When we return home after a long and exhausting day, the first thing we usually do is eat to refill our energy. We need to consume a certain amount of calories every day to stay healthy. As we all know, food is one of the most important aspects of human life. Food provides nutrients to our bodies to help us grow, be healthy and active. In other words, it supplies energy for all of the body's processes that we can think of, including activity, growing, breathing, etc. Have you ever thought and considered what agriculture is and how it relates to the concept of food that I've been discussing?

Agriculture is the process of growing plants and raising livestock. Agriculture is such a crucial part in human life that everyone is fascinated with it and cannot imagine life without it. All of the things we humans consume, such as milk, meat, vegetables, and fruit, are mostly derived from agriculture. Other items, such as corn, wheat, and rice, are produced from agriculture as well. Agriculture is the production of food and products for human consumption, and it provides the majority of the world's food. [1]More than 500 million family farms manage between 70 and 80 percent of the world's agricultural land, the U.N.'s "The State of Food and Agriculture 2014" reported.

Agriculture is experiencing its "darkest days" unfortunately, since all good things must come to an end or at least can't last forever. What I mean by "darkest days" is food insecurity or a shortage of food sources in a country. [2]The predictions for food insecurity in 2020 were created before COVID-19 became a pandemic and do not take into consideration as it was mentioned in the Global report on food crises 2020. Agriculture is sometimes misunderstood

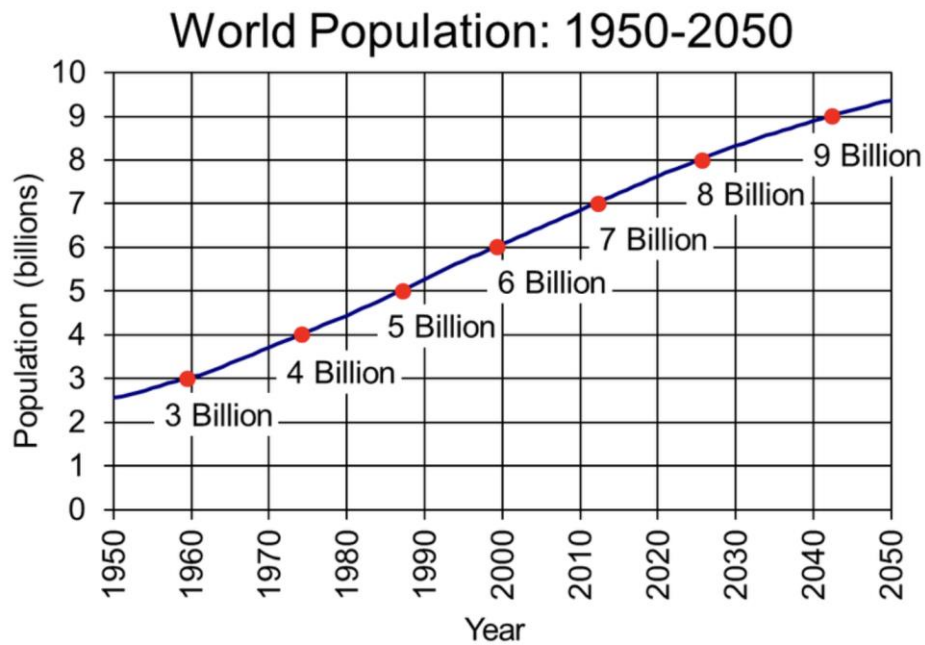
by humans in terms of its value and importance. As can be clearly seen in Figure [1] below, more than half of the affected population were in Africa.

Figure [1]



This situation is less important for us as we are currently located in Malaysia or elsewhere.

Even if the source of the food insecurity problem is not in our current location, we should begin to consider strategies to avoid it and create a barrier in its path. It is not here today, but tomorrow we may be worse than those countries, and finding a solution might be too late. We should be wise enough to recognize a solution before it arises so that we may solve and overcome it in plenty of time. As well because of the growing global population, we should be able to utilise more land for agriculture. [3]The world's population is expected to reach 9.7 billion in 2050 and around 11 billion by 2100, assuming a slower pace of increase.



There are several of technological limitations, so the world's agricultural land is not being harnessed to its maximum potential.

[4] Agricultural workers in Malaysia are enormously enhanced – rising from US\$6,294 in 1980 to US\$19,231 in 2016 (in constant 2010 U.S. dollars), a 206 percent increase. Malaysia is rapidly improving; but, with the help of Internet of Things (IOT) technologies, we can improve it even further.

Agriculture in the world, especially in Malaysia, will really change for all reasons with the help of new technological equipment. It will be possible to utilise new technologies and the most up-to-date information to track, monitor, automate, and assess management concept functionings in farming industries.

[5] IoT analysts Beecham Research believes that smart farming could transform not just large farms, but small and medium-sized ones too. The Internet of Things or IoT is frequently used to save costs, time, and waste. We can easily monitor climate conditions, greenhouse automation, crop management, cattle monitoring and management, precision farming, agricultural drones, predictive analytics for smart farming, end-to-end farm management systems simply by having IoT technology.

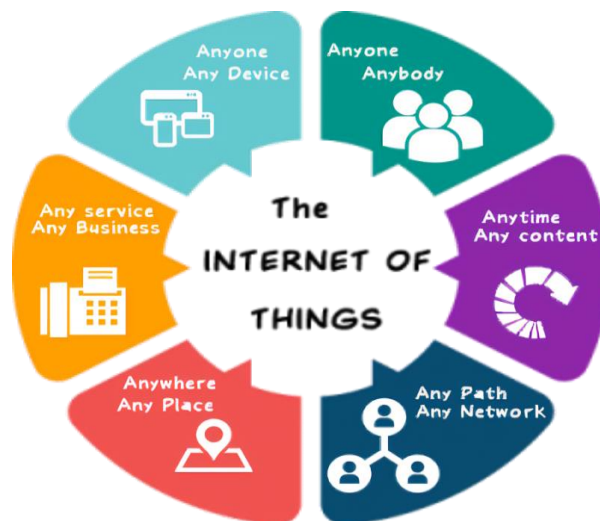
These technologies can also support other areas in agriculture, such as safety and nutrition, health, and sustainability. “Small farmers and large landowners need help to approach and understand the potential of the IoT market by installing smart technologies to increase sustainability and competitiveness in their productions.” said Alicia Asín, Libelium CEO. In summary, IOT technology will provide us with numerous benefits in the field of agriculture worldwide, particularly in Malaysia.

Suggest 4th IR technologies: IoT

What is IoT ?

Internet of Things (referred to as IoT) technology establishes a connection between everything and the Internet through sensing devices to realise intelligent identification and management.

- Connect each other's devices through cloud applications, enabling network devices to transmit information
- Collect information through automated systems, analyze it and create actions



IoT in Agriculture

Agricultural activities often use sensors for a long time. Due to the shortcomings of sensors collecting real-time data, traditional technical methods cannot be used. The data is stored in the memory by the sensor for easy access in the future. Modern sensors have made great strides. They can connect to the cloud via a satellite network. This way we can view real-time data and make better choices.

With the advancement of IoT technology in agricultural operations, sensors can be applied to every stage of the agricultural process, even the complete growth process and progress of seeds.

The existence of IoT agriculture also ushered in the second wave of green revolution. This also makes good use of the advantages of IoT agriculture. For example, reliable data can help farmers make better decisions while reducing expenses and increasing yields.

Challenges & Problems in Agriculture

- ❖ Weather and temperature change
 - Changes in weather and temperature can cause product deterioration. The cause may be overheating, which requires a lot of moisture.
- ❖ Labour shortage, scarcity of manpower
 - Insufficient manpower leads to less labour and less products, because there are many things that need to be managed, such as planting, watering, checking product quality, and so on.
- ❖ Lack of proper monitoring, requires a lot of manual intervention and long monitoring time
 - Due to the small amount of labour, insufficient monitoring, and imperfect infrastructure monitoring, the error rate is high and it takes a long time.
- ❖ The challenge of analysing large-scale unstructured data is inefficient
 - Due to the lack of adequate infrastructure, the company cannot store the ever-increasing data. The wrong decisions made by the company are costly. Due to the data is inaccurate because a lot of information has not been verified.
- ❖ Large amounts of stored data lead to large costs
 - The large amount of stored data leads to insufficient data centre capacity. Therefore, clients need to invest in building a new data centre to store more data. Clients also need to maintain the data centre every month, which requires a lot of cost.

Solutions & Applications IoT in Agriculture

IoT technology:

ZigBee

Standard wireless technology can reduce costs and reduce the consumption of wireless machines on machines and IoT networks.

It offers substantial benefits in terms of low-power operation, high security, resilience, and high-complexity systems, and is well suited for use in IoT applications leveraging wireless control and sensor networks.

Zigbee is an open standard that is appropriate for low data rate and low power consumption applications. Zigbee is different from Wifi because zigbee uses a mesh network structure. For example, connecting other network nodes through the interconnection of a series of devices. Data is typically sent across a medium distance of ten to one hundred metres, however ZigBee's mesh network substantially enhances that distance.

Furthermore, when compared to Wi-Fi networks, to avoid hub devices and construct a self-healing architecture, Zigbee uses mesh networking protocols and allows for much lower data rates.

Smart Farming/Agriculture:

Focus on providing infrastructure for agriculture, using advanced technology and modern information to track, monitor, automate and analyse the operation of management concepts and communication technologies to manage farms. This is also called precision agriculture, which is managed by software and monitored by sensors. As the global population continues to grow, the need to increase crop yields while optimising the manpower required is also increasing.

Available smart agriculture technologies include:

Sensors: management of soil, water, light, humidity, and temperature

Software: expert solutions for specific farm types of software or standalone IoT platforms

Hardware: automatic tractor, processing equipment

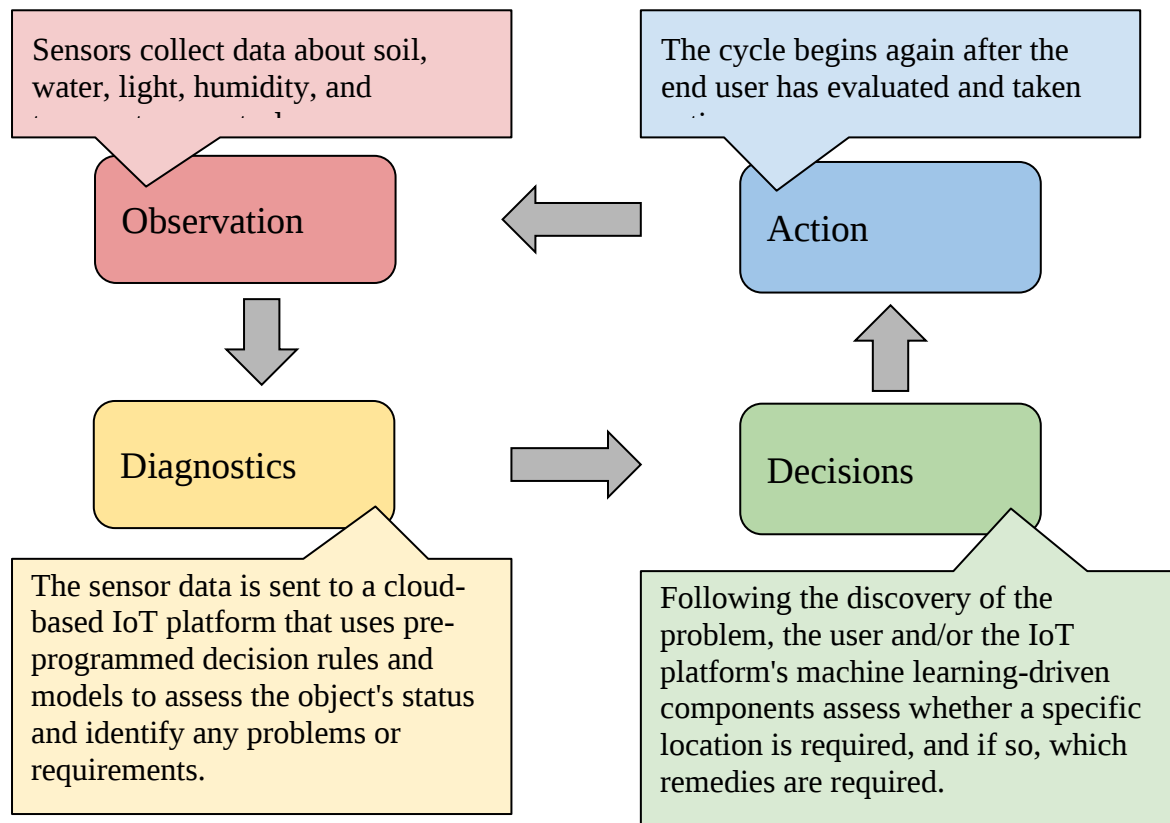
Telecommunications technology: GPS, advanced network

Satellite: 24/7 data collection from the entire field (around the clock)

Data analysis: independent analysis solutions, data pipelines for downstream solutions

Data collection: crop yield, soil mapping, climate change, fertilisation, weather data, mechanical conditions, animal health values

Smart Farming Cycle based on IoT



IoT solutions for agricultural problems

Management of livestock

Agriculture relies largely on manual labour as a business. The gap between supply and demand has increased as the global economic landscape has changed. Smart agriculture technology, like precision agriculture, allows farmers to keep a closer eye on the demands of particular animals. and alter their feed as needed, reducing infections and improving herd health.

Farmers can use IoT-based intelligent tracking to send inventory information straight to their smart devices. It allows farmers to detect flu epidemics sooner and distinguish between infected and uninfected kinds through inventory management.

Wireless IoT applications can be used by large farmers to track the location, health, and the well-being of their animals. They can use this data to detect sick animals and remove them from the rest of the herd to prevent disease transmission.

Agricultural Drones

In smart agriculture, industrial drones can be used in a variety of ways. Drones are used to check the quality of air, soil, and moisture on the one hand, and they can also assist with physical operations like automatic fertiliser spraying and preventing physical breakthroughs in the farm on the other.

Drones fly around collecting multispectral, thermal, and visual images., providing farmers with information on a variety of indicators, including plant health index, plant count and forecasting production, reconnaissance reports, inventory counts, chlorophyll counts, drainage mapping, and so on.

Smart Greenhouse Automation

Greenhouses are commonly used to maintain the proper environment for plants, and this process necessitates constant monitoring and manual intervention. In conjunction with industrial IoT solutions, this procedure can be automated. Data acquired by smart sensors may be automatically processed, and deep learning systems can be used to make judgments and build a specific environment. Climate variables and water use can be monitored via SMS or Wi-Fi-based systems with the help of these smart sensors.

The Internet of Things-powered smart greenhouse can intelligently monitor and manage the environment without the requirement for human involvement. Depending on the needs of the crops, several sensors are utilised to assess environmental factors. With minimum user intervention, processing and control, these data are stored on a platform that is hosted in the cloud (cloud-based).

Zigbee in Smart Farming

Multiple sensors are installed across a huge farm, and the data from each sensor should reach a central gateway. To communicate all sensor data from all sensor nodes to a primary gateway system, a Zigbee mesh network is employed. Zigbee is a wireless M2M protocol designed for low-cost, low-power networks. The Zigbee protocol provides point-to-point and point-to-multipoint communication, allowing mesh networks to be built. A network of Zigbee mesh nodes may hold up to 65000 nodes.

Benefits of IoT in Agriculture

- A vast amount of data is collected by smart agricultural sensors.
 - ◆ Weather patterns, soil quality, crop growth progress, and livestock health are examples of information acquired by smart agricultural sensors. These numbers can be used to keep the label of your company's overall health, as well as personnel performance and equipment efficiency.

- Process automation can help run your firm more efficiently.
 - ◆ Can automate several operations throughout the production cycle, including irrigation, fertilisation, and pest control, by employing smart devices.

- Improve the output and quality of your products.
 - ◆ Using automation, having more control over the manufacturing process and uphold higher crop quality and growth capacity criteria.

- By enhancing manufacturing control, it may cut expenses and waste.
 - ◆ Being able to recognise any anomalies in crop development or livestock health reduces the risk of losing produce.

- Internal process control is improved, lowering production risks.
 - ◆ Can better arrange product distribution if it can predict production output. Can be sure that items will not go unsold if the client knows exactly how many crops the client wants to harvest.

Potential Client

Farmers

The implementation of IoT into agriculture can help farmers to increase their harvest. IoT enables growers and farmers to reduce waste and enhance productivity. Implementation of IoT allows farmers to minimise the cost and improve the quality and quantity of production. For example with the sensors and monitors, farmers can monitor the field conditions of the crops. The data saved in the system can be analysed by the farmers and take necessary action based on this data.

Sensors help farmers to obtain the data of the soil acidity, the temperature of the soil, determine which crops are suitable and also monitor the condition of the crops. They can also access climate forecasts to predict weather patterns in the coming days and weeks.

Farmers can also use their smartphone to remotely monitor their equipment, crops, and livestock, as well as obtain statistics on their livestock feeding and produce. They can even run statistical predictions for their crops and livestock with this technology. Drones as a tool for farmers to survey their lands, perform real time data, generate real time data and weather forecasting.

BI Intelligence survey expects that the adoption of IoT devices in the agriculture industry will reach 75 million in 2020, growing 20% annually. At the same time, the global smart agriculture market size is expected to triple by 2025, reaching \$15.3 billion (compared to being slightly over \$5 billion back in 2016).

Manufacturing sector

Manufacturing sector can execute the process by using autonomous machines. IoT in the manufacturing sector can help to carry out repetitive work with more efficiency. Less workers are needed to carry out the process line. IoT used in the manufacturing sector helps the factory to monitor efficiency and quality. IoT can make sure all the quality of the crops being processed is the same and fulfil the quality to export. Machines are more capable to work on repetitive jobs as it makes sure the speed and quality of the process. Workers needed only to monitor the machines work well.

Data can also be collected to monitor the quality of the crops being sent. The condition of the crops can be collected and stored in cloud data. The condition of the crops can also be sent back as a feedback to farmers to ensure that the quality of the crops will not decrease. Food security can also be ensured by the factory as they can carry out laboratory tests by using IoT to ensure people are consuming safe and healthy food. This will ensure the quality of crops reach the requirements to export and more and more this gain trust from the investor to invest. Food security is ensured by IoT as it carries more detail and precise data, people are more reassured to consume.

The result of laboratory tests can also be stored in the cloud to use as a reference in the future. This can help to ensure if bad rumours about the crops, the result can be taken out as evidence. Besides, laboratory tests can also be carried out to improve the quality of the crops by adding more nutrition into the crops.

Companies

Implementation of IoT into agriculture, companies enjoy benefits like better crop productivity and improved worker safety. They can use less fertiliser, water and pesticides. Because farmers can decrease the fertilisers and pesticides they use, there is less runoff into groundwater and rivers. This results in a lower impact on the ecosystem.

Data analysts can analyse the production and also the import and export of the crops. The trade and market can be analysed by using these data to give a reference to the companies which crops are easier to plant and also which crops are more needed to import or export. The prices and amount of the crops are easier to control to prevent wasting as real time data are being collected.

Investments into the sector of agriculture are more stable for those companies as farmers are using sensors to monitor all the conditions and predict the situation faced by the crops and prevent it from happening. For example, in the old times, floods, drought, locust disaster were not able to be predicted and most of the farmers were facing crop failure and pasture losses. This causes more and more indirect effects on society. Economic crisis might happen as the prices of the crops increase and fewer can afford to consume. People will face famine, protests, disease, starvation, malnutrition, high death and war will happen.

The technology now is being implemented in this sector and these natural disasters can be prevented as weather is forecast day by day. Farmers can easily predict the weather coming and prevention is done. This helps the companies wouldn't face a loss and minimise the loss.

Architecture Planning and Design

The problem of current architecture/infrastructure

1. Climate and Weather Change

Natural disasters, droughts, floods, pest attacks, plant diseases, and changes in crop cycle timing have all had a negative impact on Malaysian agriculture and its productivity and profitability. Considering climate change is universal and will continue to exist indefinitely, farmers must adapt to it and discover strategies to lessen its effects in order to maintain agricultural output and achieve food security. Agriculture is largely and strongly reliant on the weather.

Weather and climate have varying effects on different aspects of agricultural production, and they frequently occur at the same time. The different sorts of climate extremes can lead to distinct effects on agricultural productivity. This resulted in the farmer having a say in decision-making. These findings highlight the importance of understanding how farmers employ technology to increase our understanding of how climate affects many aspects of crop production.

Weather plays a major role in determining crops yield. Environmental stressors such as drought, high temperature and air pollution are major limiting factors to crop productivity in the tropics (Ariffin et al., 2003). It's also worth noting that the technology available to farmers is tied to their economic circumstances and influences how they deal with climate risk. Farmers' decisions also have a big impact on which aspects of crop production are affected by the weather.

Example of effect of climate and weather change that affect agriculture in Malaysia

Water Resources and Water Availability

As climate change affects rainfall and causes drought, water shortage is becoming a significant issue. In general, a 10° increase in temperature results in a 3-9 percent increase in potential

evapotranspiration (PET). The climate change will have an impact on the water availability.

Natural catastrophes are likely to become more frequent and severe as a result of climate change. Hydrological extremes include floods and droughts. In Malaysia, the Nahrin study on the Impact of Climate Change on the Hydrologic Regime and Water Resources of Peninsular Malaysia found that water supply issues would arise in the future, particularly in areas with higher risk or vulnerability, such as the Muda watershed in Kedah and small basins like Linggi. Furthermore, a drought or reservoir storage analysis of Bekok Dam based on 15 climate change scenarios or forecasts reveals that there will be numerous critical drawdown times between 2010 and 2100. [6]

2. Labor Shortage, Scarcity of Manpower

Due to a statewide acute shortage of manual harvesters, Malaysia's rubber business has lost RM30 billion in the last three years due to a lack of manpower, while the Malaysian Palm Oil Council (MPOC) has warned that the industry may not produce an additional RM20 billion income this year. Small and medium enterprises (SMEs) in the food and beverage (F&B) manufacturing, furniture, and agriculture sectors, according to SME Association of Malaysia national secretary general Chin Chee Seong, are also experiencing a 300,000-worker shortfall. [7]

This is because most of the workers that work in agriculture sector are foreigner as Malaysia relies heavily on them. Due to the pandemic, this make the foreign workers cannot be immigrate to Malaysia and caused in labour shortage. The other factor is that working in agricultural is low income compare to office workers and poor working environment. Plus, most of the agricultural sector is practice an old-fashion method and still not implement the technology into their work, this also make younger generation lose of their motivation or interest in this sector.

Labor shortage in agricultural sector can cause many shortcoming like decrease the crops yield percentage and income as lack of people to manage the crops condition such as plants' nutrient, moisture, distribute the fertilizers and pesticides.

3. Challenge of Analyzing Large-Scale of Unstructured Data and Requires Large Sum of Costs

The adoption of agricultural technology such as the Internet of Things (IoT) or cloud computing is not widespread among Malaysian farmers. As a result, they continue to function in the agriculture sector using human-resource information, which is a record of human experiences. Even though it was digitalized in this period, these pieces of information were saved in personal computers and social networks.

However, this type of data or information is frequently unstructured and ungoverned. Furthermore, the material is unreliable because much of it has not been validated. The extraction and integration of agricultural data produces raw data.

As the data grew in size, it could no longer be stored solely on a personal computer, and it would turn into large-scale data that would take a long time to analyse. Limited capacity with regard to the collection of relevant social media data and semantic integration of these data from a diversity of sources is considered to be a major challenge (Bennett, 2015).

It will be more difficult to evaluate or extract data in the future if the data was not handled appropriately at the start. In the worst-case scenario, the startup company will have to pick which software services to utilise to accommodate their data, whether they will use cloud services or keep physical data. Agricultural big data storage has an impact on not just data analysis efficiency, but also data storage costs. As a result, selecting to take the next step will have a significant impact on the company's future commercial condition, as digitalization and reorganising all unstructured data will be quite costly.

Suggestions

1. Automated Watering System (using Soil Moisture Sensor)

Automatic watering system can help farmer to manage the water resources more efficiently and appropriate quantities of water. Moreover, it can reduce the suffering in water usage of farmer due to lack of rain and drought.

In automatic watering system, we will install the sensors in the soil in every row of plantations, the more sensors installed, the higher the work efficiency. As a result, they continue to function in the agriculture sector using human-resource information, which is a record of human experiences.

In this machine the basic idea is to rely on the type of soil and the amount of water needed by each type of soil. This process is done by measuring the level of moisture in each type and using the pump to supply water.

The installed sensors will work as data collector and when the soil humidity and moisture meet the dry condition that need to be watered, it will notify the farmer and automatically take an action to water the crops. But if the moisture level of the soil is not meet the condition to be watered, it will not automatically function. The farmer can control this system and see the data analyzing by using user interface on mobile where we will build the application that is friendly user.

2. Implement sensors in every corner of plantations to help in monitoring the crops (Cloud IoT Based Soil Nutrient Content Monitoring System)

Apart from using soil moisture sensor, we will implement Soil NPK Sensor all around the plantations. The Soil NPK Sensor may be used to detect nitrogen, phosphorous, and potassium levels in the soil as to estimate how much more nutrient content should be supplied to soil to promote crop fertility.

It aids in identifying the soil's fertility, allowing for a more methodical assessment of the soil's state. With the features of a high-quality probe, rust resistance, electrolytic resistance, salt & alkali corrosion resistance, the sensor can be buried in the soil for a long time. This will assure the probe part's long-term operation. As a result, it can be used in any type of soil. Alkaline soil, acid soil, substrate soil, seedling bed soil, and coconut bran soil may all be detected with this device.

How do Soil Moisture Sensor and Soil NPK Sensor work?

The sensor node will detect or read the moisture, pH, NPK content of the soil and these data will be transmitted wirelessly to the gateway. In this case, we will use ZigBee to act as central gateway to gather the data from all of the installed sensors.

Zigbee is a wireless M2M protocol designed for low-cost, low-power networks. The Zigbee protocol provides point-to-point and point-to-multipoint communication, allowing mesh networks to be built. The gateway will upload the data to the cloud database which is Amazon RDS. The server will diagnose the data according to the pre-programmed condition and identify the problems or requirements. Then, it will send the results to the user to take the further action.

3. Implement Cloud Computing to Organize the Data and Reduced the Costs

Implement Cloud Computing to Organize the Data and Reduced the Costs

AWS (Amazon Web Services) is a secure cloud platform that provides a diverse range of worldwide cloud-based services. Because these goods are distributed over the internet, access to computing, storage, network, database, and other IT resources is depending on user demand. The AWS environment may be modified and updated on demand, dynamically scaled up or down to fit consumption patterns and save money, or shut down temporarily or permanently. Instead of being a capital investment, invoicing for AWS services becomes an operational expense. AWS services are built to operate together to serve almost any application or workload. Users may quickly assemble sophisticated,

scalable solutions using building blocks and then adapt them as their needs evolve.

a. FreeRTOS

FreeRTOS is an open source, real-time operating system for microcontrollers that makes small, low-power edge devices easy to program, deploy, secure, connect, and manage. Every sensors that installed in the plantations contains microcontrollers that processing the data and control other functions in the sensor. It will generates signal to send to the database as it was securely connect to the cloud or other edge devices. This can make the farmer to easily collect data from IoT applications.

b. Amazon RDS (Relational Database Service)

Amazon RDS is easy to set-up, operate and scale a relational database in the cloud. For web and mobile applications that require a database with high throughput, huge storage scalability, and high availability, Amazon RDS is a good choice. This is because Amazon RDS has no licencing restrictions, it is ideal for these apps' fluctuating consumption patterns. This services is act as main database that can store all the the agronomical data and insights.

c. Amazon S3 (Simple Storage Service)

Amazon S3 will gather the photo from drone and the topography of the land. As the picture was high resolution, it required a vast amount of storage to stored the data. Users can store virtually as many objects as they want in a Amazon S3 bucket, they can write, read, and delete objects in the bucket. Moreover, users may optimise expenses, organise data, and establish fine-tuned access controls to fulfil specific agricultural job requirements using cost-effective storage classes and easy-to-use management tools.

d. Amazon EC2 (Elastic Compute Cloud)

Amazon EC2 can help in store all the data that transmitted from sensors in the plantations. As we know, the crops was planted seasonal which mean that the amount of crops will not maintain in

every season. Some season will have a large amount of crops but some season need to decrease it. Amazon EC2 can assist in storing all of the data collected by sensors in the plants. Amazon EC2 Auto Scaling allows user to scale their Amazon EC2 capacity up or down automatically based on circumstances they specify.

e. AWS IoT Events

AWS IoT Events is a fully managed service that makes detecting and responding to events generated by IoT sensors and applications simple. It's simple to identify events across hundreds of IoT sensors transmitting various telemetry data, such as soil moisture and pH, as well as soil nutrient levels, using IoT Events. Select the required data sources to ingest, specify the logic for each event using simple 'if-then-else' statements, and choose an alert or custom action to be triggered when an event occurs.

IoT Events also will integrates with AWS IoT Analytics, to offer IoT Events responds to events by automatically triggering warnings and actions depending on the logic defined by the user to fix issues quickly, save maintenance costs, and improve operational efficiency. early detection and unique insights into events. IoT Events automatically triggers alerts and actions in response to events based on the logic user define to resolve issues quickly, reduce maintenance costs, and increase operational efficiency.

f. AWS IoT Analytics

AWS IoT Events will analyse all the data that obtained from Amazon S3 and Amazon EC2 to gain the insights of crops condition. It's the simplest approach to analyse IoT data and gain insights on how to make better, more accurate decisions for IoT applications and machine learning use cases.

Before saving IoT data in a time-series data repository for analysis, AWS IoT Analytics filters, converts, and enhances it. AWS IoT Analytics is a fully managed service that automates the operationalization of analyses and scalable up to petabytes of IoT

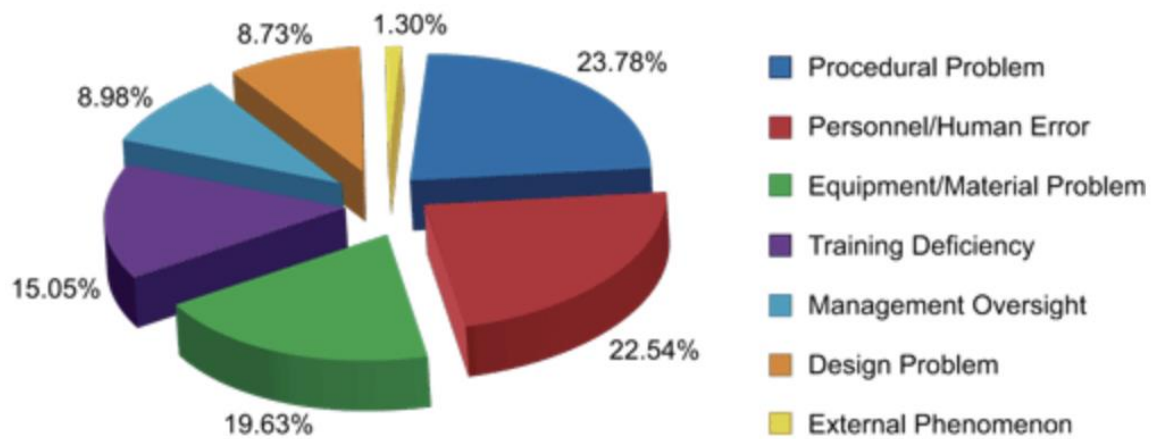
data. You can analyse data from millions of devices and build quick, responsive IoT apps without having to manage hardware or infrastructure with AWS IoT Analytics.

Conclusion

In conclusion, as a solution to all these problems, we have a technical solution(IoT) due to food insecurity, population growth, and technical limitations/constraints. In particular, it was mentioned and highlighted about IoT technology, which has many advantages. The Internet of Things (IoT) makes everything possible and incorporates advanced technology that makes every procedure in agriculture easier.

The Internet of Things (IoT) connects to each device using cloud applications, allowing network devices to send and receive data. There are numerous advantages to employing cloud applications, including enhanced collaboration, superior accessibility, cheap maintenance costs, portability/mobility, data security, and many others. IoT combined with Cloud computing would transform your agribusiness to a whole new level, much beyond anything you ever imagined. It will also be able to collect data through automated methods, analyse it, and take appropriate actions. Using IoT will provide many benefits without hesitation, but it will also present some challenges along the way. Weather and temperature changes, labour scarcity, a lack of effective monitoring, vast amounts of stored data contribute to high expenses, and the complexity of processing big amounts of unstructured data is inefficient in IoT were some of the issues were mentioned. Let's take a quick look at the solutions that smart farming has brought in general. Smart farming is a new concept in agriculture that refers to managing farms using Internet of Things (IoT), robotics, drones, and artificial intelligence (AI) to increase product quantity and quality while minimising the amount of human labour required for production. Its not difficult to eventually recognize that Robots will reduce human employment, but the robotics industry will also generate jobs.

While some of you may be concerned about other people's work as the agricultural industry expands, new robots will create more IoT jobs. Most humans will eventually be able to operate robots and use the Internet of Things all across the planet. Remember, no matter where we are, there is food insecurity worldwide. So simply moving to IoT will benefit the entire planet by making it mandatory for everyone to study IoT.



Using robots also will benefit the results that we reach in agriculture, we will get informed about the exact and the best results. Using robots will also help the outcomes we achieve in agriculture, as we will be notified of the exact and best results of data. Weather, livestock growth, and several accurate data results will be analyzed.[19]According to Department of Defence data or DoD, human error is to blame for 80 to 90 percent of all errors. Can you imagine how reducing such a large number of errors would help agriculture around the world, including Malaysia? For Smart Farming, there are four cycles based on IoT: observation, diagnosis, decision, and action. In order to be more effective in the field, farmers can use IoT-based intelligent tracking to provide inventory information straight to their smart devices. The results of soil, water, light, humidity, and temperature management will be supplied immediately to those devices for diagnosis. If you're wondering how those details will be delivered, the answer is simple: by drones. Drones may take multispectral, thermal, and visual photos while flying overhead, giving farmers with data on a range of variables. Many farmers will be able to precisely observe, diagnose, make decisions, and take the appropriate action as a result of these smart technologies.

Also the smart greenhouse powered by the Internet of Things can intelligently monitor and manage the environment without the need for human assistance. Several sensors are used to assess environmental conditions depending on the needs of the crops. As a result, crop watering, planting, and other vital requirements for growth will be more precise. Due to sensitive measurements taken during field spraying, you will be able to pinpoint the exact timing of the crop's process with the help of IoT. As another solution, we've

come up with Zigbee as the initial alternative. Zigbee is an open standard for low-data-rate and low-power applications. The mesh nature of Zigbee distinguishes it from Wifi. Agriculture communication and operations will be considerably easier and more sophisticated due to Zigbee.

As a summary of all of the factors mentioned, It must be emphasised that there is no better alternative than developing IoT in the agriculture industry for the betterment of everything. Farmers can benefit from the usage of IoT in agriculture by increasing their harvest. Having more harvest will definitely be a greater barrier to global food insecurity around the world. Having a greater harvest and knowing the precise timeline will put you ahead of the rest of the non-IoT farmers in the agribusiness field. Due to the high quality of the crops, you will be able to establish more efficient agreements with firms for longer periods of time. Growers and farmers can use the Internet of Things to minimise waste and increase output. Farmers may reduce costs while improving the quality and quantity of their harvest by adopting IoT. If you want a better harvest, easier working fields, more precise land results of crop fields, lower expenses, and higher quality, you must integrate the Internet of Things in agriculture as soon as possible.

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