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Article

A Review on Smart Farming

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I N F O

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A B S T R A C T

Smart cultivating includes the joining of data and correspondence advances into apparatus, hardware, and sensors for use in farming creation frameworks. New advances, for example, the web of things and cloud calculation are required to propel this turn of events, presenting more robots and man-made brainpower into cultivating. Accordingly, the points of this paper are to portray the logical information about keen cultivating that is accessible in the overall logical writing dependent on the fundamental variables of improvement by country and over the long haul Another restricting element is the instruction, capacity , and abilities of ranchers to comprehend and deal with brilliant cultivating apparatuses. These impediments uncovered a market opportunity for endeavours to investigate and help tackle these issue, and science can add to this interaction. Nations that put more in R&D produce the most distributions; this could show which nations will be pioneers in shrewd cultivating. The utilization of both examination strategies in a corresponding way permitted to see how science outline the brilliant cultivating and the mains boundaries to embrace.

Keywords: Smart Farming, IoT, Arduino, Hydroponics Conceptual Framework

Introduction

These restrictions uncovered a market opportunity for endeavors to investigate and help take care of these issue, and science can add to this cycle. Nations that put more in R&D create the most distributions; this could show which nations will be pioneers in brilliant cultivating. The utilization of both exploration techniques in a correlative way permitted to see how science outline the keen cultivating and the mains hindrances to embrace. Agribusiness has seen numerous insurgency, regardless of whether the taming of animals and plants a couple thousand years back, the precise utilization of harvest turns and different enhancements in cultivating practice two or three hundred years prior, or the "green transformation" with methodical rearing and the far reaching utilization of man-made composts and pesticides years and years prior. We recommend that agribusiness is going through a fourth unrest set off by the dramatically expanding utilization of data and Correspondence Innovation (ICT) in farming. Self-sufficient, automated vehicles have been created for cultivating purposes, for example, mechanical weeding , utilization of manure, or reaping of natural products. The improvement of automated elevated vehicles with self-sufficient flight control along with the advancement of lightweight and amazing hyperspectral preview cameras that can be utilized to ascertain biomass advancement and preparation status of yields opens the field for complex ranch the board counsel. In addition, choice tree models are accessible now that permit ranchers to separate between plant sicknesses dependent on optical data. Virtual fence innovations permit cows crowd the board dependent on far off detecting signs and sensors or actuators joined to the domesticated animals.[1] Mechanical turn of events, for example, the utilization of electronic frameworks and

information transmission, has acquainted extremist changes with the horticultural work space lately. These progressions request refreshed data from creation frameworks and from business sectors and specialists associated with creation to give dynamic data to creation just as for the key and administrative issues included.[2]

Big Data in Smart Farming

Brilliant Farming is an advancement that stresses the utilization of data and correspondence innovation in the digital actual homestead the board cycle. New advances, for example, the Internet of Things and Cloud Computing are expected to use this turn of events and present more robots and computerized reasoning in cultivating. This is enveloped by the marvel of Big Data, huge volumes of information with a wide assortment that can be caught, broke down and utilized for dynamic. This survey expects to acquire knowledge into the best in class of Big Data applications in Smart Farming and recognize the related financial difficulties to be tended to. Following an organized methodology, an applied structure for investigation was built up that can likewise be utilized for future examinations on this subject. The survey shows that the extent of Big Data applications in Smart Farming goes past essential creation; it is affecting the whole food production network. Huge information are being utilized to give prescient bits of knowledge in cultivating activities, drive ongoing operational choices, and upgrade business measures for game-changing plans of action. A few creators consequently propose that Big Data will cause significant movements in jobs and force relations among various parts in current food production network organizations. The scene of partners shows a fascinating game between amazing tech organizations, financial speculators and regularly little new companies and new participants. Simultaneously there are a few public establishments that distribute open information, under the condition that the protection of people should be ensured. The eventual fate of Smart Farming may unwind in a continuum of two outrageous situations: 1) shut, restrictive frameworks in which the rancher is essential for an exceptionally coordinated food production network or 2) open, shared frameworks in which the rancher and all other stakeholders in the chain network is adaptable in picking colleagues also for the innovation concerning the food creation side. The further improvement of information and application foundations (stages and guidelines) and their institutional insertion will assume a urgent part in the fight between these situations. From a financial viewpoint, the creators propose to give research need to hierarchical issues concerning administration issues and appropriate plans of action for information partaking in various inventory network situations.[4]

As brilliant machines and sensors crop up on ranches and homestead information fill in amount and extension, cultivating cycles will turn out to be progressively information driven and information empowered. Fast improvements in the Internet of Things and Cloud Computing are moving the wonder of what is called Smart Farming. While Precision Agriculture is simply considering in field fluctuation, Smart Farming goes past that by putting together administration assignments with respect to area as well as on information, improved by setting and circumstance mindfulness, set off by continuous occasions. Real-time assisting reconfiguration features are required to carry out agile actions, especially in cases of suddenly changed operational conditions or other circumstances (e.g .weather or disease alert). These features typically include intelligent assistance in implementation, maintenance and use of the technology. Summarizes the concept of Smart Farming along the management cycle as a cyber-physical system, which means that smart devices - connected to the Internet - are controlling the farm system. Smart devices extend conventional tools (e.g. rain gauge, tractor, notebook) by adding autonomous context-awareness by all kind of sensors, built-in intelligence, capable to execute autonomous actions or doing this remotely. In this picture it is already suggested that robots can play an important role in control, but it can be expected that the role of humans in analysis and planning is increasingly assisted by machines so that the cyber- physical cycle becomes almost autonomous. Humans will always be involved in the whole process but increasingly at a much higher intelligence level, leaving most operational activities to machines. Big Data technologies are playing an essential, reciprocal role in this development: machines are equipped with all kind of sensors that measure data in their environment that is used for the machines' behaviour.[4]

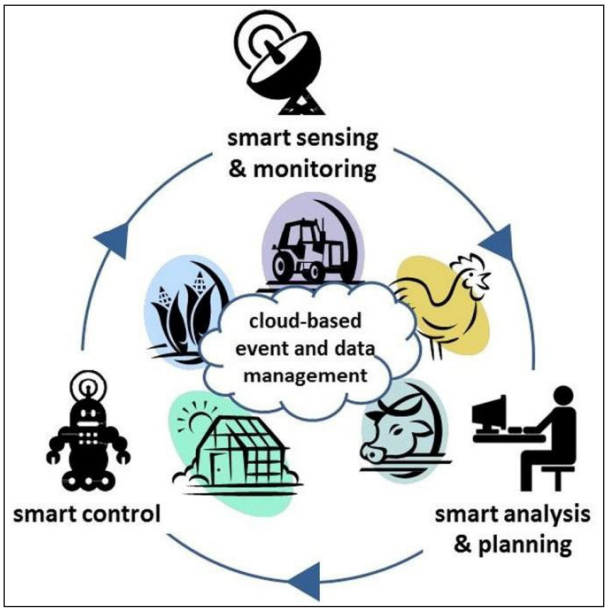

Figure 1.Big Data in smart farming[4]

Big Data advances are playing a fundamental, equal job in this turn of events: machines are outfitted with all sort of sensors that measure information in their current circumstance that is utilized for the machines' conduct. This fluctuates from generally straightforward input systems (for example an indoor regulator managing temperature) to profound learning calculations (for example to execute the correct harvest assurance technique). This is utilized by joining with other, outside Big Data sources, for example, climate or market information or benchmarks with different homesteads. Due to rapid developments in this area, a unifying definition of Big Data is difficult to give, but generally it is a term for data sets that are so large or complex that traditional data processing applications are inadequate. Big data requires a set of techniques and technologies with new forms of integration to reveal insights from datasets that are diverse, complex and of a massive scale. Big Data represents the information assets characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value. The Data FAIR port initiative emphasizes the more operational dimension of Big Data by providing the FAIR principle meaning that data should be Findable, Accessible, Interoperable and Re-usable. This also implies the importance of metadata i.e. 'data about the data' (e.g. time, location, standards used, etc.).

Both Big Data and Smart Farming are generally new ideas, so it is normal that information about their applications and their suggestions for innovative work isn't broadly spread. A few creators allude to the approach of Big Data and related innovation as another innovation publicity that may neglect to appear, others consider Big Data applications may have passed the 'pinnacle of swelled assumptions' in Gartner's Hype Cycle. This survey expects to give knowledge into the cutting edge of Big Data applications comparable to Smart Farming and to distinguish the main innovative work difficulties to be tended to later on. In looking into the writing, consideration is paid to both specialized and financial viewpoints. Nonetheless, innovation is changing quickly around there and a cutting edge of that will most likely be obsolete not long after this paper is distributed. Thusly the examination essentially centers around the financial effect Big Data will have on homestead the board and the entire organization around it since it is normal that this will have a more extended enduring effect.[3]

Conceptual Framework

For this survey a theoretical structure was created to give a methodical arrangement of issues and ideas for the examination of Big Data applications in Smart Farming from a financial viewpoint. A significant intricacy of such applications is that they require joint effort between various partners having various jobs in the information esteem chain. Thus, the structure draws upon writing on chain network the board and information driven methodologies. Chain networks are viewed as made of the entertainers which vertically and evenly cooperate to increase the value of clients. An important foundation of chain networks is the concept 'value chain', which is a system of interlinked measures, each enhancing the result of administration. In large information applications, the worth chain alludes to the arrangement of exercises from information catch to dynamic and information advertising. The regularly refered to theoretical system on organization the executives contains three firmly interrelated components: the organization structure, the business measures, and the administration segments. The organization structure comprises of the part firms and the connections between these organizations. Business measures are the exercises that produce a particular yield of significant worth to the client. The administration parts are the administrative factors by which the business measures are coordinated and overseen across the organization. The organization the executive's part is additionally partitioned into an innovation and association segment. For our purpose the framework was tailored to networks for Big Data products in Smart Farming as submitted.

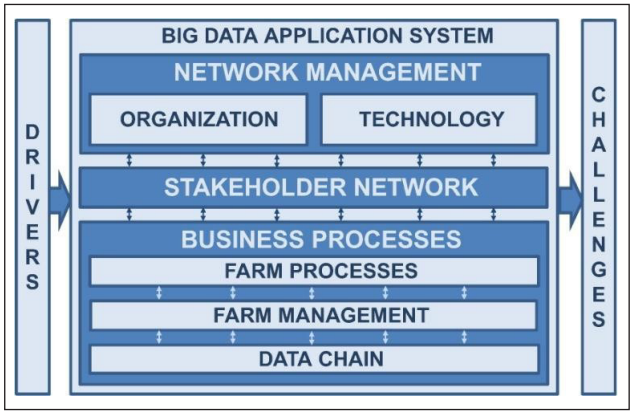

Figure 2.Conceptual Framework[3]

Farm Processes

A business interaction is a bunch of sensibly related assignments performed to accomplish a characterized business result Business cycles can be partitioned into essential and supporting business measures. Essential Business Processes are those engaged with the formation of the item, its showcasing and conveyance to the purchaser. Supporting Business Processes encourage the turn of events, sending and upkeep of assets needed in essential cycles. The business cycles of cultivating altogether vary between various sorts of creation, for example domesticated animals cultivating, arable cultivating and nursery development. A typical component is that rural creation is relying upon normal conditions, for example, environment (day length and temperature), soil, bugs, infections and climate.

Farm Management

Management or control processes ensure that the business process objectives are achieved, even if disturbances occur. The basic idea of control is the introduction of a controller that measures system behaviour and corrects if measurements are not compliant with system objectives. Basically, this implies that they must have a feedback loop in which a norm, sensor, discriminator, decision maker, and effectors are present. As a consequence, the basic management functions are *Sensing and monitoring*: Estimation of the real exhibition of the ranch measures. This should be possible physically by a human onlooker or mechanized by utilizing detecting advancements, for example, sensors or satellites. Also, outer information can be gained to supplement direct perceptions.

Analysis and decision Making: Contrasts estimations and the standards that determine the ideal exhibition (framework targets concerning for example amount, quality and lead time perspectives), signals deviations and settles on the proper mediation to eliminate the flagged unsettling influences.

Intervention: Plans and executes the chosen mediation to correct the farm processes' performance.

Data Chain

The data chain refers to the sequence of activities from data capture to decision making and data marketing. It comprises all events that are necessary to control data for farm management.

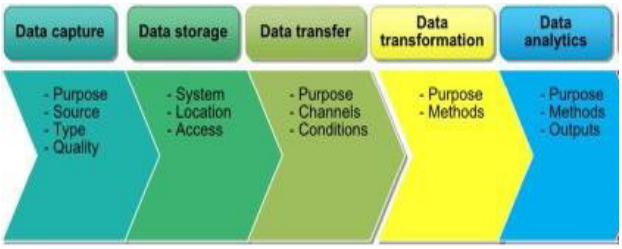

Figure 3.The data chain of Big Data applications[3]

Being an indispensable piece of business measures, the information chain comprises essentially of a specialized layer that catches crude information and converts it into data and a business layer that settles on choices and gets an incentive from gave information administrations and business insight. The two layers can be entwined in each stage and together they structure the premise of what has come to be known as the 'information esteem chain'.

Shrewd Farming is an advancement that underscores the utilization of data and correspondence innovation in the digital actual ranch the board cycle. New advances, for example, the Internet of Things and Cloud Computing are required to use this turn of events and present more robots and man-made consciousness in cultivating. This is included by the wonder of Big Data, huge volumes of information with a wide assortment that can be caught, broke down and utilized for dynamic. This survey plans to acquire understanding into the best in class of Big Data applications in Smart Farming and recognize the related financial difficulties to be tended to. Following an organized methodology, an applied structure for investigation was built up that can likewise be utilized for future examinations on this subject. The audit shows that the extent of Big Data applications in Smart Farming goes past essential creation; it is affecting the whole food inventory network. Huge information are being utilized to give prescient experiences in cultivating tasks, drive ongoing operational choices, and upgrade business measures for game-changing plans of action. A few creators in this way recommend that Big Data will cause significant movements in jobs and force relations among various parts in current food store network organizations. The scene of partners displays a fascinating game between incredible tech organizations, investors and regularly little new businesses and new contestants. Simultaneously there are a few public organizations that distribute open information, under the condition that the security of people should be ensured. The eventual fate of Smart Farming may disentangle in a continuum of two extraordinary situations: 1) shut, exclusive frameworks in which the rancher is important for a profoundly incorporated food store network or 2) open, shared frameworks in which the rancher and all other stakeholders in the chain network is adaptable in picking colleagues also for the innovation concerning the food creation side. The further advancement of information and application foundations (stages and guidelines) and their institutional insertion will assume an essential part in the fight between these situations. From a financial viewpoint, the creators propose to give research need to hierarchical issues concerning administration issues and appropriate plans of action for information partaking in various production network situations.

Smart Farming using Internet of Things (IoT)

The biggest problem faced during production of crops, leading to wastage or below par production is non-timely watering in the field or inaccurate amount of water being poured in the field. At times, due to the human tendency, either greater or lesser amount of water is allowed to enter the field thereby destroying the crop. This marks the first major problem. Also water-level in the source tank sometimes goes low or sometimes get over-drained. Thus information regarding scarcity or abundance of water in the reservoir is the second major problem. Over sprinkling of pesticides and chemicals for large production of products lowers the life-span of field. Many times the farmer is far away from the field and is therefore unable to get the current status of the field. Hence his periodic visit is

must on the field to take care of the water requirement, chemical requirement and other production related issues. Thus for timely observation, automatic control over such parameters would ease the burden of any individual. Traditional methods of cultivation like manual ploughing, two crop pattern and old system of irrigation are mainly responsible for low productivity of agriculture. Due to the use of these old implements agriculture is backward. Lack of proper understanding of the need to grow crop sustainability will push farmers in to vicious circle of debts, heavy use of chemical (fertilizers), water mismanagement, and low productivity and thus more debts for the new cycle. This problem is avoided by making the control of water automatic with the help of digital pins of any microcontroller. Basically any pump (automatic) can be controlled with the help of a microcontroller and a current amplifying device. In this project arduino is being used as a microcontroller and bc147 as a current amplifier and as a switching device. In order to read the information of all these activities on the field, GSM sim900 was implemented on the field. This GSM was a dual band module with features of message oriented (mo) and message terminated (mt). Finally, all these data was received and transmitted via ausb cable and enc28j60 to the thing speak platform for future purposes.[5]

Working

The field was divided into 4 patches, each was used for different crop cultivation. Different crops have different water requirement. This can be determined by analyzing standard water requirement table globally used. The problem of over-supply of water to the farm patch is avoided by making use of digital pins of ARDUINO and a voltage switching device BC547.[5]

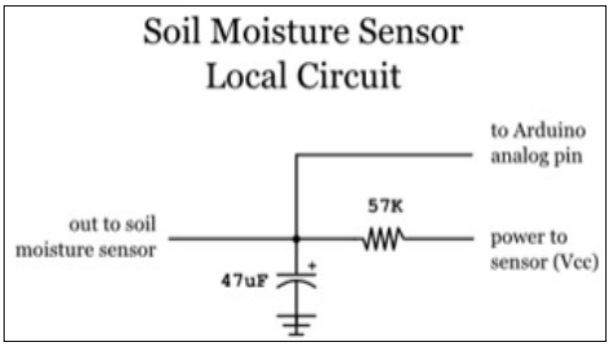

Figure 4.Soil Moisture Sensor using local circuit[5]

Observation

The starting perusing proposes that the two soils are required to give a similar perusing (yield esteem) on the arduino yet RED soil gives the higher scope of perusing on same measure of water content. Hence for developing a specific sort of harvest it is fundamental to decide the kind of yield and as needs be the edge esteem must be altered.

The readings in the above table demonstrate that immersion of earthy colored soil arrives at later when contrasted with the red soil, henceforth water holding limit of earthy colored soil is more.

Because of low water holding limit of the red soil, the water infiltration level of red soil is more than earthy colored soil , subsequently red soil is more great for profound attached yields when contrasted with the harvests whose root profundity is only couple of centimeters.[5]

Using Arduino and Data Mining

The current scenario in India depicts a steady decrease of agriculture contribution to the Indian GDP. The reasons for this condition are mainly - the current erratic weather condition and crop loss. New technologies and advanced fertilizers have not penetrated through the corners of India where majority of the farmers reside. Through this paper, we introduce a concept for smart farming which utilizes wireless sensor web technology for moisture detection in the soil in conjunction with a smart phone application which plays a vital role in helping farmers. We introduce Arduino based automatic plant watering system and android application which will help to control Arduino via internet. Also, this android application provides farmers with agricultural related information such as costs of seeds, moisture level required, type of soil needed, weather forecast, fertilizers and pesticides to be used.[6]

Smart Farming and Sustainable Agriculture Drones

The utilization of robots in horticulture is getting increasingly mainstream. The paper presents a novel way to deal with recognize diverse field's furrowing methods by methods for a RGB-D sensor. The introduced framework can be effortlessly incorporated in economically accessible Unmanned Aerial Vehicles (UAVs). To effectively group the furrowing methods, two diverse estimation calculations have been created. Exploratory tests show that the proposed strategy can give a decent order of the field's furrowing profundities.

The persistent development of the total populace along with the bringing down of assets at removal represent the issue of savvy use of assets. This is especially significant particularly in the field of food creation and soil abuse. The normal strategies utilized in horticulture to break down and survey the right creation and utilization of assets utilizes optical and multispectral methods applied to photographs caught from satellites. These procedures permit to survey the wellbeing condition of cultivating; for example the light ingestion from the leafs shows the presence of chlorophyll. This is a basic and significant stage since the consequences of these stage will influence the choices of intercessions on the taking care of the dirts, the insurance from creepy crawlies/ organisms or if different countermeasures ought

to be taken. The more habitually this sort of investigation is done, the more responsive and consequently exact the countermeasure will result. Then again this movement is tedious whenever held by hand and satellite-time subordinate whenever done by this sort of innovation.[7]

Hydroponics

This is one of the fast growing farming sector and can govern food production in the future. It provides the right amount and right type of nutrients and saves space. Soil related problems are also eliminated. It has minimal weeding and harvest is made easy. A sensor network can monitor and gather information from the hydroponics farm.[7] A predictive analysis using Bayesian algorithm based on a priori probability shows that the farm can be made autonomous. The algorithm is learning based on the data coming from the different sensors. The greater the number of datasets analysed, the more accurate the BN prediction will be.[1] After processing the data, the algorithm transmits the decisions onto the cloud server wherein it transfers the data onto the web interface to monitor and control the system. The nutrients required for the plant growth is supplied as a solution with a specific mix of components based on the plant's need. The system could also be built in a closed environment so that pest attacks are to the minimum. This will also prevent the algae from forming in the nutrient solution. Often in hydroponics system a single crop is seen cultivated. But diversity in the crop varieties can be achieved by using multichannel system with separate storage tanks and individual sensors. This one time set up helps to plant different varieties of crops. Especially for household use, the hydroponic system of agriculture can be used to grow multiple crops simultaneously. But then it requires independent system monitoring for all the different crops and independent channels to route it on a concurrent basis depending on some priority or scheduling algorithm.[5] In profound water culture the roots are submerged in supplement rich water with pH sensors checking it. Red light was utilized as an upgrading boundary to animate the development of shoot and root. The regulator works the engines dependent on the pH estimations of the supplement arrangement and the level of the blend. Figure shows various plants filling in a similar framework. L293d engine drivers were utilized. pH esteems will be distinctive for all the three harvests. Ex: Mint - 6 to 6.8 Diffenbachia - 5 to 6 Tusli - 6 to 5.[8]

Development of a Smart Moblie Farming Service System

Computerized agribusiness is utilized to digitalize, envision, plan, screen and control the pertinent agrarian items and cultivating measures as indicated by horticultural necessities by utilizing advanced innovation. It is fundamental for accuracy agribusiness to procure the farmland data and afterward settle on cultivating choice progressively. Be that as it may, how to get the cultivating data at a high thickness is a bottleneck in the method of horticultural improvement up to this point. Contrasted and customary horticulture data gathering frameworks, the WSN innovation gives us more favorable circumstances, for example, significantly more comfort and lower cost. Through the WSN base station, the cultivating data from WSN hubs is gathered and communicated to the web, so the biological climate of the farmland can be distantly checked. Moreover, it can upgrade the cropland creation reasonability and improve the intellectualized level.[9] System design:- The portable agrarian data administration framework comprises of the WSNs, altered cultivating PDAs, have PC and the product running on them shows the engineering of the framework.

Figure 5.Integrating different plants on a single hydroponics system[8]

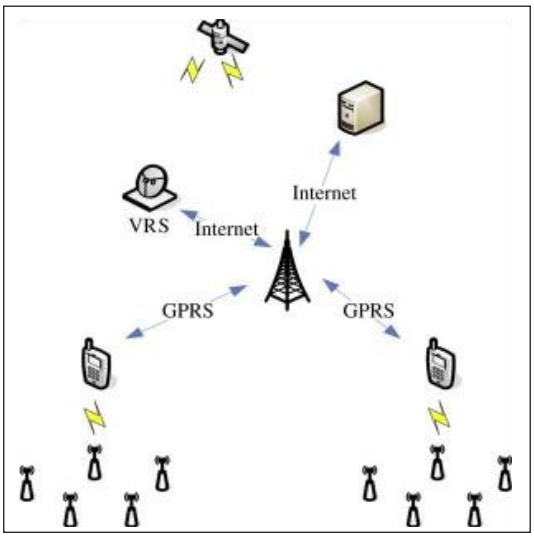

Figure 6.The architecture of the system[10]

Via the embedded GIS system on the PDA, both the farming information from the WSN and the GPS information of each sampling site were recorded by the smart mobile terminal. In the meantime, the embedded GIS system checked the data to make sure if the datum was nonzero and if the completed data had been collected. After the farming information from all sampling sites was acquired

accurately, the data were saved locally or transmitted to the host PC through GPRS. And in the host PC, the remote farming management system received the data from the farming PDA and saved them to the farming database built by the SQL Server. Hence a variety of data processing could be carried out, such as visualizing the farming information, drawing the thematic map for some individual farming parameter, analysing the specific variance of some parameter, making irrigation decisions according to the irrigating model, etc.[10]

Future Enhancement

A continuous circulating supply of water has to be ensured at fixed intervals so that the plants are not rotten and algae formation does not happen. Providing correct nutrient solution which will cater to the plant's requirements is the utmost concern. Also not all plant varieties are suitable for hydroponics. Plants varieties with deep roots are generally considered not suitable. If the trees are pruned in a bonsai fashion and additional support provided for the plant varieties to grow and spread, this can be overcome. If instead of soils some pebbles or loose granites are used and then filled with water, this problem can be overcome. This is especially helpful for fruit bearing plants like tomato. Also slow release of the nutrients was found to increases the yield rate. Potassium acrylate as a substrate promotes bacteria and my corrhizal colonization. This can also be utilised.[8]

Making utilization of non-traditional assets like the breeze power, sun oriented board (12V,15-18W) which can viably control the GSM module and can be utilized as a reinforcement towards the day's end.

Intruder alert or signal can be utilized so any human/ animal gatecrasher can't upset the efficiency of the ranch.

A camera can be introduced to screen the live homestead progressively framework 4. An investigation dependent on expulsion of overabundance downpour water can be executed too[5] Associated cultivating and IoT Ag is causing a move from conventional homestead the board faculty and apparatuses towards a product oversaw activity that is overseen by individuals incompetent in customary cultivating rehearses. The horticulture business will be constrained by organizations that are not ordinary specialists of agribusiness, for example, ranchers and conventional homestead esteem chain, including ranch gear creators, seed providers, and makers and providers of plant nourishments and synthetics.[11]

The change to industrialized social orders has prompted quick declines in cultivating inhabitance rates to estimations of 2% and less of the populace in Europe and North America. Digitalization of agribusiness may impact business openings and occupation profiles of ranchers and cultivating related experts considerably further. Will this improvement persuade or deter capable people from going into the field of farming? Will the likely loss of ranchers' duty to information overseeing robots and ICT frameworks increment or abatement the acknowledgment and the enthusiasm for this calling? Another arising challenge will consolidate the ranchers' information and encounters with these new advances.[1,2] An adjustment in the worldwide maturing segment has set off the reception of computerization in cultivating rehearses. Computerization and control frameworks makers have seen a positive flood in their deals because of this significant change in the cultivating business. In the course of recent years, agrarian robots have additionally been fused into cultivating activities as they treat soil and yields specifically according to their necessities and decrease the requirement for physical work. UAV/drones created the most elevated income among all agrarian robots used in shrewd cultivating. The greater part of robot sending was accomplished for crop the board.[11] The agricultural sector is going to face enormous challenges in order to feed the 9.6 billion people that the FAO predicts are going to inhabit the planet by 2050: food production must increase by 70% by 2050 and this has to be achieved in spite of the limited availability of arable lands, the increasing need for fresh water (agriculture consumes 70 per cent of the world's fresh water supply) and other less predictable factors, such as the impact of climate change, which, according a recent report by the UN could lead, among other things, to changes to seasonal events in the life cycle of plant and animals.[12] One way to address these issues and increase the quality and quantity of agricultural production is using sensing technology to make farms more "intelligent" and more connected through the so-called "precision agriculture" also known as 'smart farming'.[11] It's something that's already happening, as corporations and farm offices collect vast amounts of information from crop yields, soil-mapping, fertiliser applications, weather data, machinery, and animal health. In a subset of smart farming, Precision Livestock Farming (PLF), sensors are used for monitoring and early detection of reproduction events and health disorders in animals.[8] Typical monitored data are the body temperature, the animal activity, tissues resistivity, pulse and the GPS position. SMS alerts can be sent to the breeder based on predefined events, say, if a cow is ready for reproduction.[12]

Conclusion

The data was available for transmission due to the GSM which was sent after we would send a particular encrypted message. The data sent consisted the readings of the moisture, the patch on which the water was ON/OFF, the readings of the water level indicator [5]This system is a reliable communication system without breakdown because of the use of Personal Area Network. All the data can be

read by the smart device without interruption and delay because of the efficient use of communication algorithm in the control node.[13] The smart farming will revolutionized the world of farming and it will increase the productivity as well as improve the quality and can save lives of farmer. There is an urgent need for a system that makes the agricultural process easier and burden free from the farmer side. With the recent advancement of technology is has become necessary to increase the annual crop production output of our country India an entirely ago centric economy. The ability to conserve the natural resources as well as giving a splendid boost to the production of the crops is one of the main aims of incorporating such technology into the agricultural domain of the country. To save farmer's effort, water and time has been the most important consideration.

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