iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35019

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Smart Agriculture using IoT

Roshan Kolte[1], Ritu Lilhare[2], Peeyush Chukekar[3]
[1] *Assistant Professor,* [2, 3] *Students, Department of Information Technology, K.D.K College of Engineering, Nagpur, India*

Abstract: ***Internet of Things (IoT) technology has brought revolution to each and every field of common man's life by making everything smart and intelligent. Smart agriculture is an emerging concept, because IoT sensors are capable of providing information about agriculture fields and act upon based on the user input. The feature of this paper includes development of system which can monitor temperature, level of water moisture through sensors using Arduino Board.***
Keywords: IoT, Smart Agriculture, Soil Moisture Sensor, Temperature Sensor, Water Level Sensor

I. INTRODUCTION

Agriculture, farming or husbandry is a vital occupation since the history of mankind is maintained. The name agriculture represents all entities that came under the linear sequence of links of food chain for human beings. As humans are the smartest living species on this planet, so their smartness always provokes them to change and to innovate. This provoking has led to invention of wheel, advancements in living standards and styles, languages, life spending methodologies and countless more achievements.

The restless attitude of mankind towards innovations has given birth to major inventions, which have not only provided the ease to human beings, but also improvements in efficiency which further leads to better productivity on the cost of less skills. The advancements in agriculture are necessary to balance the demand and supply as population is increasing day by day. As compare to the last fifty years and earlier, the demand of food has accelerated. To overcome the requirements, the deployment of modern technology over this vital source for humans is intolerable. With the use of modern and advanced technologies, efficiency of the agricultural industry can be improved, where it not only includes better productivity, but also lessens intra-field and inter-field losses present in conventional methods. From the beginning, agriculture is crucial part of human society due to the reality that man and agriculture are directly related to each other. This fact leads towards the advancement and enhancement of the typical, inappropriate and time-consuming methodologies, used for agriculture. The fast-moving world, new trends and technological advancement has changed the life style of people. Emerging new technologies are becoming an important part of routine. Smart homes and grid, smart cities [1] smart campus, and smart farming are some of the whole advanced and upgraded, information and communication technologies that are helping humans to save time and get faster and accurate outcomes.

Multiple technologies like ubiquitous computing, wireless networks, RFID tags, after having advanced in other fields of life, due to their tremendous efficiency, are now also imposing the agriculture industry [2]. Moreover, the coming era of IT equipped world will replace traditional methodology with smart, efficient and sustainable agriculture regime [3].

The advanced highly efficient, cost effective, sustainable, fast and aureate results have been the main factors which have invoked researchers to contribute towards smart agriculture. E-farming, smart mobilized fertilization, RFID tags for cattle monitoring, GPS field monitoring, sensor networks in farming, moisture and humidity detection, context aware computing, precious farming, web of things and livestock and ware house management applications, etc.; are some of the technological projects related to the smart farming regime.

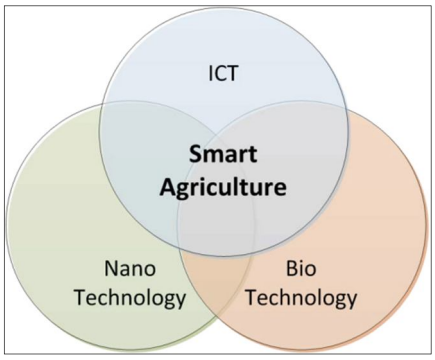
II. TRENDS AND CONVENTIONS

Trends and research conventions are mainly focused on precise agriculture, database integration system and network information, virtual agriculture, expert systems, the connotation and extension, development stage and the impact of agricultural modernization for economic growth and improved life style of rural areas. Due to the direct impact on human life, agriculture is stepping towards modernization steadily. New trends are being introduced often, in order to meet the technological advancements. Comparing the past and continuing technological implementations it can be understood easily how most of the communication and information technologies are playing an effective role in modern agriculture. An increase in the demand for agriculture as a consequence of an abruptly growing population will enhance the need of efficient and actuate infrastructure support, in-order to fulfill the agricultural requirements of the modern society, without any interruption in its production.

Wireless sensor networks and RFID tags are the most standardized technologies playing an active role in the smart agriculture. Many countries like China, India, Korea, Brazil, Australia, several European countries and different American estates, are introducing agricultural technologies in order to strengthen their economy by using information and communication technologies for the improvement in agricultural and rural development.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Hybrid architecture for localized agricultural information dissemination is the client server architecture, in conjunction with the mobile applications on smart-phones, which can be used to deliver the precise agricultural information to the farmers. Geographical data of mobile phones can further localize the required information needs of the farmers [5]. The cattle and farm management, by using RFID tags and the recognition of cattle with the help of image processing, can lead to a decrease in the probability of viral spread [6].



Considering these facts, the green houses are increasing in their popularity, every day. According to recent trends and technological development in Wireless Sensor Networks, it has been made possible to use WSN in the monitoring and control of the greenhouse parameter, in precision agriculture.

Actuated sensor networks are being deployed for the management of green houses. Using wireless sensor networks will reduce the chances of human errors that can occur while investigating the facts, about the ideal method of irrigation suitable for all weather conditions, types of soils and different crop cultures [7].

The usage of advanced technologies and automated machines, which is making the world soar to greater heights, experiences a lag when it comes to the farming either due to the lack of awareness or because of the unavailability of advanced facilities in the market, leading towards poverty in farming. In order to make the market more accessible to the farmers, the concept of e-farming is introduced. E-farming is the web application that will help the farmers to perform the agro-marketing leading to achieve success and increase in their standard of living [8].

Smart agriculture is composed of many different technological implementations. These applications are replacing the tough, unreliable and time-consuming traditional farming techniques with efficient, reliable and sustainable smart agriculture [9]. Water irrigation context aware farming, pesticide control, remote monitoring, security control, environmental monitoring, precious agriculture, machine and process control, vehicle guidance, animal feeding facilities, traceability system, food packaging and inspection etc. are a few examples [5].

In compliance with smart technologies, robotics is also being introduced so as to make more room for technological advancements in agriculture. Internet of Things (IoT),

Bio technology

1) Nanotechnology
2) Information and Communication Technology (ICT)

The summation of these three distinct technological aspects leads the ideology of smart agriculture. Bio, Nano and informatics are counter parts of this technological reform, and are somewhere inter-related. Agricultural biotechnology, biosensors directly related to Bio technology as impact of enhanced innovations to communicate the development and desired attributes to meet the changing demands of consumers closer innovations for on- farm and post-harvest operations due to increased demands of product lines, material testing and Bio-control. Agricultural biotechnology is used for implanting RFID tags inside plants and animals for enhancing productivity, available resource utilization and product monitoring. 'Smart' machines are used as a helpful tool for achieving higher quality and accuracy, capacity and can save time. Use of smart micro-machines has partial impacts on agriculture, environment and ecosystems [11].

Table 1

Trends	Reforms	Impact
Agriculture e - marketing	• Web portals • Direct consumer and retailer interaction • Online availability • Improved social approach • E-store	Improved economic condition, direct interaction between two parties, discarded communication gap, & marketing of surplus products
Farmers	• Controlled and automated farm fields. • Hot line support • On time pesticide and other fault detection by using different sensors. • Always connected to the farm by smart phones. • Alarm support and monitoring	Reduced labor, Reduced human errors, accurse, time saving, and resource availability.
Farming	• Smart irrigation system • Weather and humidity detection • Tracking system • GPS and satellite enabled monitoring • Smart application for pesticide and fertilizer applications • Smart security for field • Smart automated machinery • Actuated nodes for farms • Smart harvesting • Soil monitoring	Improved hand tools, advanced irrigation practices, improved storage, better productivity, development in machines mechanically e.g., power, tractors, and equipment, mechanical harvesters, Irrigation system, reclamation, development in the tools and equipment for different Product testing. Improved quality.
Food safety and food security	• Climate-smart farming • Eco friendly farming	Larger growth, economic stability
Food labeling	• Bar code • 2D visual tags • Ware house management • Tag base identification technology	Well organized fields, Time saving

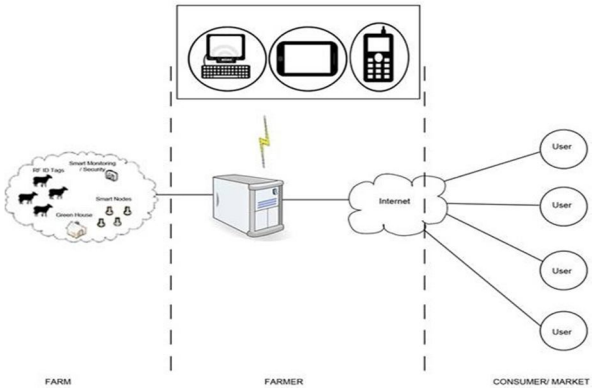
Table 1: The trend in smart agriculture paradigm

III. THE CONCEPT OF SMART

Generally speaking, if a machine/artifact or any system does something that we think an intelligent person can do, we consider the machine to be smart. Any system, process and domain are said to be smart if follows 6 different levels of intelligence.

1) *Adapting:* The term adapting refers to the change to meet any particular requirements in terms of smart agriculture the changes would be referred to as environmental.
2) *Sensing:* The ability to sense the changes in surrounding or to observe any change.
3) *Inferring:* It basically refers to conclusion which is based on results and observations.
4) *Learning:* After getting conclusions and observed results the learning can be used to improve the methodologies used previously. It involves different type of information.
5) *Anticipating:* It relates to thinking of something new and innovative which going to be happened or we can say it as the next level of anything.
6) *Self-Organizing:* The processes referred to any intelligent system which can be composed of these main paradigms;

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com



Smart Consumer has ability to sense and monitor and then change its parameters according to the need.

1) Jotting all the 6 initials, smart agriculture,
2) Smart Farmer
3) Smart farms

Smart consumer tends to the online access, for any end user to get information related to the productivity, particularly the consumer electronics [12] in which one can be able to buy and sell the productions directly from the farm. This involves internet applications, web application, data base and online stores etc. The other end of smart consumer is the smart farmer side. It is the main node from where the farmer can directly interact with open market, without any extra expenses and involvement of third party. Any farm management system can be used to manage these outside activities. This node is then connected with the smart farm, which implies sensor nodes for humidity, moisture, weather, irrigation system, ware house management, cattle, pesticide detection and monitoring [2]. Figure 2

IV. RELEVANT TECHNOLOGIES

In the present era, there are various and constantly evolving technologies available. Many of them are suitable, in various locations and scenarios. These technologies are fairly equal to use and fine in their output regardless of their deployment in either rural or urban areas. While we are discussing agriculture and relevant technologies, there are two major groups to discuss; the sensors available and the communication platforms.

A. Sensors

The Sensors available for remote deployments are not for a single measurement or coordinate collections. They are especially designed for gathering a bunch of information from concerned entity. The main composite sensors are available for climate, soil and plants. For better understanding a chart is given below in which the sensors and their sensing abilities have been mentioned.

S. No	Sensors	Sensitivity
1.	Weather	• Temperature • Humidity • Atmospheric Pressure • Wind • Speed • Direction
2.	Soil	• Temperature • Moisture • Conductivity • Salinity
3.	Plants	• Temperature • Moisture • Carbon die Oxide • Hydrogen • Photosynthesis

Table 2: Sensors Available

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

B. Communication Technologies

Deployments of sensors are in remote areas so as to collect their gathered information or data and wireless is the best fit medium. Moving towards wireless three constrains other than cost must be considered before selection of node or sensors communication technique, Range of Communication, battery life and data Integrity/Security. Till date there are four standards available and suitable for wireless nodes in agriculture-based areas.

1) ZigBee
2) Bluetooth
3) Wibree
4) Wi-Fi

All above are for ISM band. The considerable specifications will be their transmission range, power consumption, cost and data security. As we can extract easily from the Table 2 [13] that ZigBee is undeniably the winner for maximum applications, since 250Kbps is an acceptable data rate for frequent transmission of data, and no transmission in agriculture field will be in stream or in real time. It has low power consumption, high transmission range, as along with 128-bit security key processing power. The reason behind 250Kbps is the 128bit encryption key and due to its low power consumption, its processing is also slow but still there is no better option than ZigBee.

V. ISSUES AND PROPOSED SOLUTIONS

According to the International Assessment of Agricultural Science and Technology for Development (IAASTD) [14].
The widespread realization is that despite significant scientific and technological achievements in our ability to increase agricultural productivity, we have been less attentive to some of the unintended social and environmental consequences of our achievements. We are now in a good position to reflect on these consequences and to outline various policy options to meet the challenges ahead, perhaps best characterized as the need for food and livelihood security under increasingly constrained environmental conditions from within and outside the realm of agriculture and globalized economic systems.
The synthesis proposed some of the factors like equitable environment and sustainability which can be used to improve the rural livelihoods and can be useful in reducing hunger and poverty.
In compliance with these factors, biological diversity and services for ecosystem rapid changes in climate and availability of water are some of the major concerns which are addressed.
To fulfill the diverse needs of human life, there is a need for sustainability which requires the concern of the international collaboration. Apart from the technological advancement making its way towards smart agriculture, in order to benefit this industry which, the humans directly associated with, along with its long-lasting benefits also has some issues related to the agricultural advancement.

A. Human Behavior

The main barrier in the development of agriculture is the human behavior towards adapting new technology. It has always been hard for a common man to adopt something different from the traditional method.
Most people from the ruler areas are associated with the farming and are not much educated and independent in technological advancement. This factor has widened the gap between the modern and ruler areas. It is evident that the electronic media can be a great means of reducing the hesitation of adapting new technologies by commercials and on-air campaigns.

B. Agriculture

There are many issues directly associated with agriculture like grid, croup and soil monitoring, irrigation, pesticide and fertilization applications, and cattle farming [15]. Information and communication technology can be a practical tool for overcoming these technical issues.

C. Climate Changes

The climatic change is biggest issue in agricultural paradigm, which directly affects each and every factor associated with farming. This natural conflict directly influences productivity and quality, leaving lasting and long-term impacts on food security.
Quick solutions are needed for this issue. Pre-weather detection, temperature monitoring, climate changes, moisture levels, air flow and pressure, rain and extreme weather prediction are few of the many solutions.

D. Market/Vendors

Due to the long geographical distances between the open market and the actual farm the field cost of the production is increased and will directly benefit the brokers or the third person involved, leaving the farmers inadequately paid for their efforts. When it comes to venders of agriculture equipment's equal opportunities should be given to the manufacturing industries. Monopoly should be discouraged. This will improve the quality and cost reduction. Online services and applications can be used to provide direct interaction between farmers and consumers; e-store can be a better option. Standardization in equipment manufacturing can improve the productivity and compatibility between different vendors.

E. Regulations

Reforms are needed on national and international level. Government policies and regulations are needed. The formation of regulating authority and its up gradation for technologically advanced agriculture is needed in order to provide an accessible and open market [14].

VI. SOCIO ECONOMIC CHALLENGES

Whenever there is a new invention or anything out of the regular practice it is hard to implement and to convince the society and users to adapt the change. Most of the people related to the occupation of farming are under privileged and are not much familiar with the rapidly changing technologies due to which they lay emphasis on continuing practice with the traditional methods which are not only time consuming but also require greater man power resulting in limited outcomes. Distance learning call center for customer care and guidance and awareness campaigns in this regard are needed. Another major challenge is the dramatic increase in the world population. According to Food and Agriculture Organization (FAO). The future is daunting too: food needs are projected to increase by 70% by 2050 when the global population reaches 9 billion, while climate change is projected to reduce global average yields [16]. The use of advanced production techniques and new researches can contribute to overcome this problem.

Decline in economy is one of the biggest problems, which agriculture industry is facing presently. The unstable inflation in the rates is of major concern. A remarkable investment is becoming the need in modern agriculture and the poor image of farming should be changed among the new farmers [11] [16].

VII. ADVANTAGES

Technology is improving the efficiency of agriculture, in terms of production and economic growth. This directly creates an impact on employment and labor opportunities, environmental sustainability, small holder income, good security and the price of food.

The spread of smart technologies in the field of farming has been impressive and is particularly contributing towards improved varieties in the production of grains. Advances in farm management technology have also become popular, in terms of providing accuracy and ease of management and security. Development of supporting infrastructure, high-tech irrigation, increased employment opportunities, increased production and decreased food price, nutrition and food utilization, access to land and other resources and the utilization of all available resources are some of the plus points of technology in agriculture [17]. These all result in the transformed reformed economic growth for common man. Following is the table summarizing benefits provided by CSIRO documentation Smart Farming: leveraging the impact of broadband and the digital economy. Table 3

In terms of:	Advantages
On-farm benefits	• soil fertility monitoring • Improved pasture production • Monitoring • Animal weight and body condition • Animal disease monitoring • Early detection of pesticides
Broader economic opportunities	• New financial opportunities and development • Provide ways to add values for farming produce. • Use of smart sensor systems which help to improved quality. • Helping enable such claims for premium products and prices. • Pro-poor reduction

Agribusiness Service Sector	• Development of an agribusiness services sector. • Supporting the agricultural and food industries • Use of digital services • Enabled broadband connectivity.
Environmental Management	• Sensor data for weather • Sensors for water quality and flow • Use of Satellite for data collection. • Greater capacity. • Enhanced environmental management.
Broader Social Benefits	• Improvements to the quality of life. • Provide access to health • Improve education • Income sources for government • business services and • Improved life style for rural communities. • Fill the gap between rural and urban.

Table 3: Benefits of Smart Agriculture

A. Required Advancements

In the agriculture Industry especially in under-developed countries the technological advancements are necessary. Although, it may not be very economic and may have financial constraints at the time of planning and deployment but if we talk about broader scope or of the fore vision of these advancements it will not only increase the net income of agriculture but also improve the quality of the production. As we know that the precise and time to time collection is not an easy task done by humans. Therefore, technology will keep the farmers aware of each and every instance and the drift of the coordinates in some underneath areas which humans might miss to check and are able to take prompt action to relevant issues. These issues may be related to rain, parasites, condition of soil or humidity/dryness factors.

VIII. SUMMARY

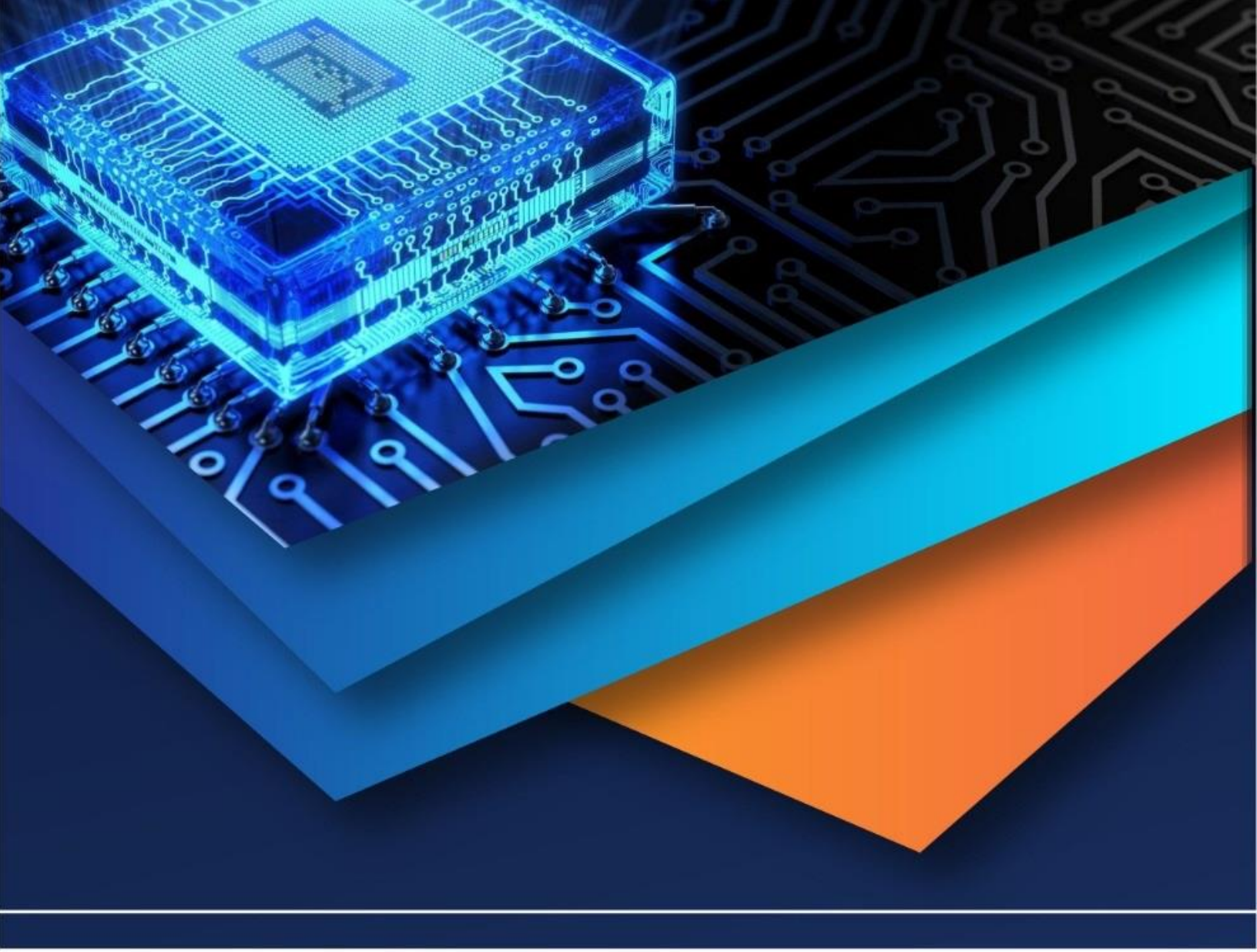
In this chapter we have discussed the importance of agriculture, it's conventional as well as adopted methods and trends in the light of productivity and requirement of market. As all us can understand that production in every field must equal the demand and supply ends, which is certainly not possible without integration of technology in the field. Moving further we have disused the available technologies and platforms in wireless communication field, according to their data rates and most useful areas. Continuing with the wireless technologies we have also elaborated the concept of SMART and its relevance in the future for overcoming the necessity human engagement or appointment. As the chapter goes on the discussion continues on the available sensors for agriculture field as well as the wireless communication technologies those can be utilized in the field of agriculture. Moving on we have disused the issues and some of the proposed solutions in the light of Human behavior, agriculture, climate changes, market and the proper regulation.

Keeping in the vision that deployment is not as easy, as it is not accepted very easily by the consumer due to its pre-benefit cost, we have also a convincing discussion under the Socio-economic challenges. At the end of it we have not only disused the advantages but also listed them in tabular form. The chapter is concluded on a short discussion on areas where advancements are required.

REFERENCES

[1] Pu Liu, Zheng Hong Peng (2013) Smart Cities in China, Computer. IEEE computer Society Digital Library. IEEE Computer Society 47: 72-81.
[2] Carlos Cunha R, Emanuel Peres, Raul Morais, Ana Oliveira A, Samuel Matos G, et al (2010) The use of mobile devices with multi-tag technologies for an overall contextualized vineyard management. Computers and Electronics in Agriculture 73: 154-164.
[3] Sidney Cox (2002) Information technology: the global key to precision agriculture and sustainability. Computers and Electronics in Agriculture 36: 93-111.
[4] Shouyi Liu, Dongling Wei, Jiajun Liu (2011) Agricultural Information Engineering Research. Computer Science and Service System (CSSS), 2011 International Conference, Nanjing.
[5] Wang Ning, Naiqian Zhang, Maohua Wang (2006) Wireless sensors in agriculture and food industry Recent development and future perspective. Computers and Electronics in Agriculture 50: 1-14.
[6] Cheng Chi, Jianqiao Li, Yangling Shaanxi (2013) Cattle Face Recognition Using Local Binary Pattern Descriptor. Signal and Information Processing Association Annual Summit and Conference (APSIPA), Asia- Pacific, Kaohsiung.

[7] Chaudhary DD, Nayse SP, Waghmare LM (2011) application of wireless sensor networks for greenhouse parameter control in precision agriculture. International Journal of Wireless & Mobile Networks (IJWMN) 3: 140-149.
[8] Sindhu MR, Aditya Pabshettiwar, Ketan Ghumatkar K, Pravin Budhehalkar H, Paresh Jaju V et al.(2012) E-FARMING/ (IJCSIT) International Journal of Computer Science and Information Technologies v: 3 .
[9] Esfahani , Latifeh, Asadiyeh, Zahra (2009) The Role of Information and Communication Technology in Agriculture. The 1st International Conference on Information Science and Engineering (ICISE2009).
[10] Charith Perera, Arkady Zaslavsky, Peter Christen, Dimitrios Georgakopoulos. Context Aware Computing for The Internet of Things: A Survey. IEEE Communications Surveys & Tutorials, Canberra, Australia.
[11] Linus Opara (2004) Emerging technological innovation triad for smart agriculture in the 21st centurity Part-I prospects and impacts of nanotechnology in agriculture. Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. Invited Overview Paper v: VI.
[12] Yukikazu Murakami, Slamet Utomo, Keita Hosono, Kazuhiro Shigeta (2012) Proposed of Cultivation Management System with Informatics and Communication Technology. 1st IEEE Global Conference on Consumer Electronics p: 175 - 176.
[13] Aqeel-ur-rehman, Abu Zafar Abbasi, Noman Islam, Zubair Shaikh (2014) A review of wireless sensors and networks' applications in agriculture. Computer Standards & Interfaces 36: 263–270.
[14] IAASTD (2008) Agriculture on a Cross road. Executive Summary of the Synthesis Report. IAASTD Intergovernmental Plenary in Johannesburg South Africa.
[15] Aqeel-ur-rehman, Zubair Shaikh(2009) Applications of Modern High Performance Networks: Smart Agriculture. Bentham Science publishers.
[16] Climate Works Foundation, World Bank Group. Climate-Smart Development, 2014 International Bank for Reconstruction and Development/the World Bank and Climate Works Foundation.
[17] Department for International Development (DFID) (2004) Technology and Its Contribution to Pro-Poor Agricultural Development, DFID



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY