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IOT Based Automated Irrigation System for Arecanut Plantation -A Review

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Abstract

India is an agricultural nation where agriculture supports roughly 70% of the people. Farmers can choose from a vast variety of fruits and vegetable crops. It takes a lot of technical skill to grow these crops for the best yield and production, though. With the use of technology, it can be enhanced. Using an automatic watering system will improve irrigation management. a system that enables farmers to monitor their fields from anywhere in the world, including their homes. For the agricultural fields, it suggests a system of automatic watering. One of the essential functions in human existence today is automation. Along with comfort, it also improves productivity, saves time, and uses less energy. Automation and control equipment are now used in industry, but they are costly and inappropriate for use on farms. Therefore, we have created a smart irrigation system that is affordable and can be used by Indian farmers.

Keywords: *Smart farming, Arduino, Soil moisture sensor, temperature sensor, Internet of things.*

INTRODUCTION

Enhancing irrigation effectiveness can significantly lower production costs, increasing industry sustainability and competitiveness. Average crop yields can be maintained (or even enhanced) while reducing environmental effects from excess applied water and subsequent agrichemical leaching with effective irrigation. Soil moisture sensors are now

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available thanks to recent technology advancements, enabling the effective and autonomous operation of irrigation systems. IOT is a reflecting system for tying up physical items that can be accessed online. Sensors are used to gather data, and since each device has its own IP address, it may access and transfer resources over the Internet without the need for manual operation. It is a framework for architecturally integrating and transferring data between computational devices. Smart homes, wearable technology, automated vehicles, industrial internet, smart cities, smart agriculture, smart retail, energy engagement, poultry farming, and smart cities are just a few of its many application areas. The main objectives of this research are to manage the development of intelligent agriculture and to improve harvest output.

LITERATURE REVIEW

Raza et.al (2020): A study was conducted on 25-year-old Kinnow mandarin trees grafted into Rough lemon (Citrus jambhiri Lush) between the years 2011 to 2015, taking into account Pakistan's limited water resources, low average yield of citrus fruits, and haphazard irrigation system. Drizzle irrigation (DI), full cover sprinklers (FCS), strip cover sprinklers (SCS), and conventional flood irrigation (TFI) were the four irrigation methods used in this study. We assessed the yield, quality, and water usage efficiency (WUE). The Citrus Research Institute (CRI), located in Sargodha, Pakistan, was the site of this investigation. Tensiometers were positioned in each block's root zone at depths of 30, 60, and 90 cm to measure the soil's moisture content. The entire volume of water applied under the flood irrigation system was measured using a flume metre. The fruit yield of the Kinnow plants grown under the TFI system was 26.12 t ha-1 (687 fruits tree-1 and 104.55 kg tree-1), and the WUE was only 2.29 kg m-3. In contrast, plants grown under the DI system produced a fruit yield that was 40.46 percent higher (1288 fruits tree-1 and 181 kg tree-1), and the WUE was 4.85 kg m-3. When compared to TFI, DI was able to save 55% more water. When compared to TFI, FCS and SCS considerably increased yield by 28.45 percent (1029 fruit trees-1 and 151 kgtree-1) and 27.19 percent (1045 fruit trees-1 and 147.92 kgtree-1), respectively. WUE in the FCS and SCS systems was 3.03 kg m-3 and 3.35 kg m-3, respectively. It has been determined that DI is preferable in terms of increased output and WUE; as a result, Kinnow growers are advised to use DI to increase yield and improve WUE.

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Arindam et al. (2020): This study has made an effort to demonstrate how integrating the farming system with a high-end IT environment would be a viable long-term solution. A number of transformations have led to the development of information technology. The Internet of Things (IoT) and blockchain technology are now mainstream. By 2030, 500,000 million gadgets are expected to be connected to the Internet, according to a CISCO research. Smart devices, such as sensors and cameras, produce data that the Internet of Things analyses, aggregates, and provides insights for decision-making. The Internet of Things (IoT) will serve as the focal point for all connected devices that collect environmental data and exchange network communications. According to a recent study, it is estimated that 50% of all food produced in the US is wasted. In essence, this study has investigated a number of current and emerging uses.

Mahalakshmi et.al (2020): The goal is to introduce new approaches for the smart agricultural system, including tracking and monitoring, crop production, import and export procedures, sales information, etc. Utilizing IoT-based smart sensors for crop management allows one to effectively combat the effects of a challenging and changing climate, geographic limitations, natural disasters, pestilences, and crop illnesses. This study suggests an IOT-based wireless sensor network cloud platform for smart agriculture data. Intelligent production data is safely saved in the cloud and made accessible to authorised users. This application service in cloud computing enables the encryption and transmission of multimedia data across an open transmission medium. The performance findings show that this security service performs better for crop encryption with a shorter encryption time of about 2.986 ms and resistance to statistical attacks. Space complexity is a significant problem in cloud computing; it is practically eliminated with the second storage space reduction goal by transforming the data to binary bits. After proper verification, the data that has been safely kept in this private cloud can be retrieved and used for smart agriculture management. The simulated annealing solver simulation environment from MATLAB R2013a is used for the implementation. [4] Nipun and Jaganatha (2020): The purpose of the study is to roughly compare standard farming practises versus innovative farming practises. The first experiment compares how much water each approach uses, with

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the proposed method using a neural network while the conventional method relies on humans to control the irrigation process. Based on the type of crop, this information is compared to the soil moisture at that time to determine whether or not to water the crops. In the second experiment, power usage for both traditional and modern farming is measured. The system is designed to have a grid of sensors that are each connected to the control room via the internet. We have a soil moisture sensor, a temperature sensor, and a humidity sensor at each grid point. The control room will get data from these sensors in real time. The percentage of precipitation, abbreviated as POP, is the primary factor that the control room uses to determine the weather forecast. The gathering of the data set constitutes the first phase of the research, and testing constitutes the second phase. Utilizing a MySQL database, which may be created using the idea of big data, an app is used to track data from the field. With the aid of the given sensor data sheets and the Arduino forum, the microcontroller unit is connected. The effectiveness of conventional farming techniques depends on the farmer's ability to assess whether crops need water, whether the soil needs manure because the top layer's composition has changed, or whether the soil is unsuitable for the desired crop. While water may be effectively conserved and extra information about the land and changing weather conditions can be obtained through smart farming.

Prem Jose (2020): This work presents an economic analysis of the risks and opportunities associated with arecanut farming in Karnataka. The sample farmers from the specified taluks, namely Thirthahalli, Kadur, Puttur, Vittla, Tumkur, and Hollakere, served as the study's main source of data. The consumer and trader data were gathered from the three districts that were chosen: Shimoga, Mangalore, and Bangalore. A regression study was done to look at the variables affecting the arecanut's gross returns. First, several functional form types were looked at using the Akaike Information Criterion, adjusted R2, and co-efficient of determination (R2). Last but not least, the linear form was determined to be a superior fit based on explanatory power, which is the co-efficient of determination (R2) and the significance of regression co-efficient. Gross arecanut returns served as the dependent variable in the model. To examine how farmers perceived threats based on productivity, market, and policy, Garret ranking was utilised. A logit analysis was done on consumers'

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willingness to consume nutritional arecanut products. The returns from alternative/potential uses of arecanut were examined using secondary data on such usage. The economy of arecanuts is currently in peril on multiple fronts. One threat that has the potential to significantly reduce demand is legal intervention to forbid some value-added goods, such as ghutka. With these factors in mind, the current study has made an effort to investigate the cost of cultivation, significant threats, alternate applications for arecanut, as well as consumer and trader knowledge.

Srabanti (2020): This study highlights the important role of IOT and demonstrates how, thanks to its applications across a range of industries, it is gradually integrating into our daily lives. This study will highlight the various spheres of daily life where IOT applications are thriving. This study will outline the main ideas and applications of IOT in daily life and will show how they affect every aspect of our lives, including health, education, agriculture, transportation, smart cities, retail, and the environment.

Sudipta et.al (2020): In order to manage agriculture as efficiently as possible, this research attempted to design an IOT-based agricultural system employing data mining and a communication protocol/network. IOT-based technology creates constant communication between objects, things, and humans. Data mining and communication protocols will be utilised to optimally transport data with security and recovery, as well as to anticipate or infer information from concealed data. Different data mining methods, classification, various sensor nodes and their functionalities, and how the use of sensor nodes in agricultural fields have all been covered in this study. It may be used by the majority of agricultural systems to prepare the cultivation process and crop monitoring system. The current farming system has to adopt a new paradigm that integrates IOT-enabled fields.

Ajanta et al. (2019): The initiative intends to eliminate the manual system, which involves personal liability problems and the ignorance of the field employees, by autonomously monitoring the irrigation system in both large- and small-scale plantation estates. Even knowledgeable individuals occasionally struggle to predict how much water or fertiliser should be used to achieve the highest output. Our system will therefore keep track of the temperature, humidity, soil moisture level, and other physical parameters like the

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presence of significant air pollutants like PM2.5, PM10, CO, and NOx. To determine if irrigation is required or not, the variables and crop production are compared to datasets from previous surveys. Using this data, a microcontroller system that monitors and manages the entire irrigation system determines the pace at which water is released from pumps. Additionally, it is possible to track the growth of plants both longitudinally and horizontally.

Neha et al.(2019): A farm monitoring and automatic irrigation system is shown in this study. It consists of three modules: I a unified sensor pole (USP), (ii) an irrigation unit (IU), and (iii) a sensor information unit (SIU). In order to grant users access, USP first spends some time in admin mode, gathering crop, plantation date, and soil data for use in one-time setup mode to calculate evapotranspiration and irrigation schedules. Finally, it enters a continuous monitoring mode in which it senses the data, processes it using NN, and then delivers the decision to the IU while also sending the sensor data to the SIU. The IU is in charge of processing receiving data from the USP, writing it to the appropriate port, and turning on or off the water for the necessary zone. It continuously checks for new clients and acts accordingly. By routing the incoming data stream on the Mosquitto broker to log files, the SIU archives the sensor data. The HTTP server operating on the same system then uses these log files to enable remote sensor data monitoring. The paper for an example test bed includes comprehensive results for each module. USP (the system's brain) costs between $800 and $1,000 ($12 to $15). The technique results in overall water savings of 67 percent when compared to standard methods. Therefore, smart solutions for people who live far from their farms and in water-scarce places are provided by effective water use and visit-free monitoring.

Amana et.al (2018): This project benefits those who are new to farming. The method makes recommendations for the best plants to grow in a person's soil type. The aspect of human contact in plant watering is fully eliminated when the weather system predicts and adjusts the plant watering cycle according to the weather. The only thing left to do is to plant the seeds. With the development of water soluble fertilisers, farmers are no longer required to fertilise their crops. The water tank could simply be filled with fertiliser, and the irrigation system would take care of the rest.

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Mona et.al (2018): In this paper the proposed method shows how the rain water is used efficiently without wastage. Sensor technology is used to reduce the wastage of water, labor and efficiently spread the water evenly as per requirement of the area and the type of crop. Soil moisture sensors & temperature sensors are used in the system. The system architecture in this project uses microcontroller and Arduino which consumes very less amount of power and have a very good life for providing its functionality. In this study, when the temperature exceeds 35°C and moisture content of the soil goes below 40% the motor will turn on and water is supplied to the farm.

Venkatesh et.al (2018): The present study's goals are to reduce energy use and evaluate how producing arecanuts affects the environment. The information was gathered from 70 arecanut growers in the Indian state of Goa. The production, consumption, and supply of inputs to the farm are impacted by the environment. The functional units taken into account were one hectare and one tonne of arecanut production (based on mass) (land-based). The average technical efficiency of arecanut farms, as determined by the data envelopment analysis, was 0.89, suggesting the possibility to save resources to the tune of 11 percent with a mean economic saving of 413 $ ha-1 year-1 without lowering the arecanut production. The primary energy consumers in the system were irrigation, manures, and chemical fertilisers. The production of arecanuts has the greatest detrimental effect on human health, followed by ecological quality. The production of arecanuts has a 959.87 kg CO2 eq per tonne and 2399.25 kg CO2 eq per hectare basis global warming potential, respectively. Finally, to reduce the environmental impact of arecanut production in the area, advanced irrigation techniques, efficient machinery use, and efficient input utilisation must be implemented.

Nandhini et al. (2017): It has been suggested to use an automated irrigation system with an intruder detection system for effective water management. Measured soil parameters include soil moisture, pH, and humidity, and the pressure sensor's sensed values are shown on an LCD. The PIR sensor used in the intruder detection system keeps birds out of the field by repelling them. A communication channel was created between the farmer and the field using the GSM module. The farmer will be informed of the current field state

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by SMS, and the webpage will also be updated. The farmer can access the server regarding the state of the field from anywhere at any time, saving time and labour.

Srishti (2017): This research suggests an automated irrigation system that automatically waters plants while monitoring and preserving the desired soil moisture content. The control unit is implemented using the ATMEGA 328P microcontroller on the Arduino Uno platform.

The system makes use of soil moisture sensors to determine the precise moisture content of the soil. This value enables the system to avoid over- or under-irrigation by using the proper amount of water. IOT is utilised to inform farmers on the condition of their sprinklers. A GSM-GPRS SIM900A modem is used to update a webpage with data from the sensors so that a farmer may check whether the water sprinklers are ON or OFF at any particular moment. Additionally, graphs are produced from the sensor readings via a Thing Talk channel for study. Setting a threshold value at which irrigation should start allowed for sprinkler control. Until the soil is completely moist, the sprinklers are activated when the sensors detect moisture content below the threshold. Moisture sensors, an Arduino Uno, and a GSMGPRS SIM900A modem make up the hardware. The data obtained from Arduino is primarily transmitted to inter via the GSM modem. The sprinklers can be turned on and off by the system using the values collected by the sensors. The farm's irrigation system can be observed remotely by a farmer. The irrigation process, one of the most time-consuming tasks in farming, can be automated by using the proposed method to turn on and off the water sprinkler in accordance with soil moisture levels. One of the activities that uses the most water is agriculture.

The system uses data from soil moisture sensors to irrigate the soil, helping to avoid crop damage by preventing over- or under-irrigation of the soil. Through a website, the farm owner can follow the procedure online. This experiment has shown that the use of automation and the Internet of Things may significantly advance farming. Thus, by permitting optimal use of water resources, the system provides a viable remedy for the issues encountered in the current manual and laborious irrigation procedure.

Bhojaraja et.al (2015): In this study, arecanut crops' ages were determined

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using Hyperion photos using well-known supervised classification methods. The arecanut plantations chosen for the study are situated in the Davanagere region of Karnataka state, India's Channagiri Taluk. Spectral reflectance of arecanut crops with ages ranging from 1 to 50 years is measured using a handheld spectroradiometer with a 1 nm spectral precision, together with I GPS coordinates of chosen plots. These spectral measurements were taken just before the Hyperion imagery was purchased in order to create an age-based spectral library.

The investigation revealed that crops with ages between 3 and 7, 8 to 15, and over 15 years displayed distinctive spectral activity. Support vector machines using linear kernel functions outperformed all other adopted classification methods in terms of accuracy, with an overall accuracy of 72% for within-class separability. The accuracy of each producer's age group classification ranged from a low of 12.5% for the 3–7 year age group to a maximum of 86.25 percent for the over 15 year age group. It may be inferred that it is possible to construct an age-based spectral library for plantation crops like arecanut in addition to age-based arecanut crop classification.

Mohanraj et.al (2016): The study suggests an e-agriculture application built on a framework made up of monitoring and KM-Knowledge base modules. Farmers require information throughout the whole farming cycle in order to make effective decisions. The necessary data is dispersed across many locations and comprises primary agricultural knowledge as well as real-time data on market prices and output levels.

An information flow model linking diverse dispersed sources to the crop structures is created. With the development of technology, manual processes are being replaced with automated ones that use less manpower and less energy. The article outlines the benefits of ICT in the Indian agriculture sector and outlines a route for farmers in rural areas to replace some of the traditional methods. Using a variety of sensors and knowledge base inputs, monitoring modules are demonstrated. TI CC3200 Launch pad linked sensor modules and other relevant electronic components are used to create a prototype of the mechanism. Between the developed system and the current systems, a comparison is done. The approach gets beyond the drawbacks of conventional farming methods by making efficient use of water resources and cutting labour

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costs. The knowledge base is organised with different crop specifics that discuss information acquisition, flow, and different inputs like market accessibility, geographical data, and weather forecasting. Modules including remaining, monitoring plant growth at different stages, irrigation planner, crop profit calculator, calamity check, and trouble identifier are all included in the monitoring system.

The water requirement of a plant per day is determined using the evapotranspiration method and a developed algorithm. A comparison between numerous applications and the currently constructed system was done, taking various factors like knowledge base and monitoring into consideration.

Srisruthi et al.(2016): The article offers effective automated farm monitoring and irrigation techniques that use a variety of sensors to remotely sense and monitor different soil parameters like temperature, moisture, and fertility and to control the amount of water and fertiliser applied to the land in accordance with the need.

The microcontroller is programmed with an algorithm based on the threshold values of sensor outputs, and it executes the necessary operations by using relays up until the strayed-out parameter has been returned to its ideal level. Real-time data logging of environmental indicators is made possible by the cloud's user-friendly interface, which also supports the examination of historical data for potential future expansion. The project also intends to maximise the utilisation of land and labour, conserve water, boost crop output, prevent energy waste, provide maximum automation, and benefit society by implementing more advanced, environmentally friendly agricultural practises.

Bhojaraja et.al (2015): The study is conducted in a section of the Karnataka district of Davanagere's Channageri Taluk. Arecanut plantations of all ages make up the vast majority of the study area. One of the key determinants of crop water need (CWR), which in turn affects irrigation planning and scheduling, is growth stage. To estimate CWR, it is crucial to make accurate estimates of the crop area, the area occupied by various age groups, and the region under stress.

Traditional area estimation techniques are expensive and time-consuming. Within-crop differences can be distinguished with greater accuracy and dependability

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because to advancements in hyper spectral remote sensing. The spectral signatures of various age groups and stressed arecanut crops are gathered to create a spectral library using the ASD FieldSpec Pro® handheld spectroradiometer. Arecanut crops of diverse age groups and under stress (crown choke disease) are mapped using the Spectral Angle Mapper (SAM) method with 73.68 percent accuracy using the spectral library and Hyperion data.

Crop coefficients are determined using an NDVI-based method, and CWR is evaluated using reference crop evapotranspiration calculated using the Hargreaves and Samani equation. In the research region, 784.80 hectares of land are used for the production of arecanuts, with a daily irrigation need of 28056.09 m3.

According to the investigation, the average CWR for arecanut crops, from young to mature, ranges from 19 to 23 litres per day. The fact that crown choking disease has stressed 16.9% of the cropland now in existence while using the same amount of water as healthy crops is an additional intriguing finding. An immediate solution to this problem will improve plant health and, in turn, yield.

Chetan et al (2015): In this study, we provide a novel approach to smart farming that involves wirelessly connecting a smart sensing system and a smart irrigation system. Our method focuses on the assessment of physical characteristics that are essential to farming operations, such as soil moisture content, nutrient content, and pH. A smart irrigator installed on a mobile overhead crane system sprays the crops with the necessary amount of green manure, compost, and water based on the determined soil's critical physical and chemical parameters. This research illustrates the intricate modelling and control tactics of a smart irrigation system and smart farming system.

Ravi et.al (2007): In this study, fertigation levels (25, 50, 75, and 100% of the recommended fertiliser dose, 100:18:117 g N:P:K palm1 year1), fertigation frequencies (10, 20, and 30 days), and two controls (control 1, drip irrigation without fertiliser application, and control 2, drip with 100% NPK soil application) were all examined for their effects on productivity and r The 2-year-old Arecanut plantation was the site of the experiment, which was designed using RBD and a factorial component.

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A combined study of 4-year data revealed a strong relationship between fertiliser dose and fertigation frequency and arecanut kernel yield. The significance of applying nutrients effectively at the proper time and amount is shown by the association between biomass accumulation in various regions and fertigation levels. The 11-year study found that fertigation adoption not only boosts output but also provides improved efficiency of the two most important inputs, namely water and nutrients in crop production, as it results in higher Water Use Efficiency (WUE) and Agronomic Nutrient Use Efficiency (ANUE). The significant yield response of arecanut to drip fertigation suggests that enough fertiliser and water availability is required to overcome soil and climatic limitations in laterite soils. The study unequivocally demonstrates that adopting drip fertigation with 75 percent NPK at a frequency of 10 days can provide arecanut farmers with advantages such as greater yields, resource usage efficiency, and profitability.

Therefore, fertigation technology has several benefits as a result of the growing shortage of water and arable land as well as the rising cost of fertiliser. Additionally, this method offers the potential to reduce environmental pollution by using fewer fuel and fertiliser resources.

CONCLUSIONS

1. Despite the fact that water availability is a problem, the only way to use the limited water supply efficiently is through smart farming.

2. Smart farming can offer more details about the land and the varying weather conditions and can best conserve water.

3. With the right authentication, data that has been saved safely on the cloud or on another secure platform can be retrieved and used for smart agriculture management.

4. The technology uses data from sensors that measure soil moisture to irrigate the soil, which helps to prevent over- or under-irrigating the soil and reducing crop damage.

5. The suggested technology can be utilised to automate irrigation by turning on and off water sprinklers based on soil moisture levels.

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6. This analysis has led to the conclusion that IOT and automation have the potential to significantly advance farming.

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