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Artificial Intelligence Supported Instinctive Irrigation System (IIS) Using Arduino and Zigbee in Wireless sensor Network

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Abstract: An artificial intelligence-supported instinctive irrigation system using Arduino and Zigbee in a wireless sensor network is an innovative application of technology in agriculture. This system utilizes sensors, microcontrollers, wireless communication, and AI algorithms to optimize the irrigation process in real-time.An open-source microcontroller platform that acts as the brain of the system, collecting data from sensors and controlling irrigation devices.A wireless communication module that enables communication between the Arduino and the sensor nodes.In order to detect things like soil moisture, air temperature, relative humidity, and light intensity, several different kinds of sensors are placed out in the field. These sensors provide input for the AI algorithm to make intelligent decisions regarding irrigation.These are devices used to control irrigation, such as solenoid valves or pumps, which can be triggered by the Arduino.When developing wireless sensor networks, preserving energy is one of the most important concerns that must be addressed. The technology known as ZigBee is the solution to this conundrum. Utilising wireless sensor networks and monitoring systems is the key strategy for accomplishing the fundamental objective of this research, which is to advance our understanding of data transmission through wireless media. The purpose of this research is to find a way to automate the irrigation process so that it may be utilised in PA (precision agriculture). This will be accomplished by controlling the three primary parameters of temperature, soil moisture, and air humidity.

Keywords: Artificial intelligence, Soil moisture sensor, precision agriculture, Temperature Sensor, , Light intensity, automated irrigation system, Humidity sensor.

I. INTRODUCTION

In India, there has been an increase in industrialization along with deforestation and other forms of industrial growth. This is part of an endeavour to make India a more developed nation. A lot of power is needed to introduce certain technologies and further development in order to make India developed. Since the farmer suffers greatly as a result, it is challenging for the farmer to learn whether the soil is suitable for growing crops or not[1]. These have a significant impact on power waste, and “ZigBee technology” is utilized to address this problem. The automated irrigation system that is being suggested makes use of Zigbee to assist determine the soil’s requirements for watering. There is a sensor that provides data on the soil’s temperature, humidity, and moisture content. If the sensor’s value matches the threshold values necessary for good crop production, irrigation will begin automatically. Intelligent farming is strongly reliant on effective resource management, which is crucial for irrigation[2]. The World Bank's predictions indicate that over the next several decades, agriculture will require more than 70 percent of the freshwater supply. As a consequence of this, when conducting their investigations, researchers need to keep in mind the significance of water efficiency and the optimisation of agricultural water use. The idea of the intelligent system is becoming increasingly applicable to

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the effective management of resources in a wide variety of contexts. A few examples of the numerous ways in which the smart system contributes to agriculture are the irrigation system, decision-making, disease prediction, control system, and energy efficiency [3]. A smart system is one that incorporates multiple automated operations, such as sensing, controlling, activating, analysing, and making decisions, into a single cohesive whole. For the automated operations to run smoothly, it is necessary to have access to a number of cutting-edge methods, networking capacities, sensing capacities, and intelligence calculations[4]. Make efficient use of the water, and boost your output by employing one of the many ingenious methods available. A smaller amount of potable water is needed for modern irrigation techniques and sustainable farming practises. The Internet of Things and the principles of machine learning make it possible to perform centralised data processing, analysis, and decision making from a large number of ubiquitous sensors [5]. In agriculture, the use of an irrigation system is necessary whenever there is a requirement for the artificial distribution of resources such as water. In parts of the world where rainfall is less frequent, one of the most prevalent uses of this form of irrigation is to keep the soil at the same temperature and moisture level. Farmers that utilise artificial irrigation are better able to keep their fields free of weeds and other forms of plant growth that are undesirable. [6] proposed a secure hash message authentication code. A secure hash message authentication code to avoid certificate revocation list checking is proposed for vehicular ad hoc networks (VANETs). The group signature scheme is widely used in VANETs for secure communication, the existing systems based on group signature scheme provides verification delay in certificate revocation list checking. In order to overcome this delay this paper uses a Hash message authentication code (HMAC). It is used to avoid time consuming CRL checking and it also ensures the integrity of messages. The Hash message authentication code and digital signature algorithm are used to make it more secure . In this scheme the group private keys are distributed by the roadside units (RSUs) and it also manages the vehicles in a localized manner. Finally, cooperative message authentication is used among entities, in which each vehicle only needs to verify a small number of messages, thus greatly alleviating the authentication burden.The two primary groups that can be broken down further are traditional irrigation systems and modern irrigation systems. The traditional method includes the use of a variety of watering tools, such as irrigation channels, watering cans, and buckets. The utilisation of a basin, furrow, strip, or basin does not necessitate any specific practical expertise on the part of the user in order to carry out the most common of the ancient irrigation methods. It would be impossible for us to afford to use the traditional method of watering[7]. The traditional method of watering crops is the foundation of today's modern irrigation system, which was developed with the assistance of recently developed technologies. The three types of irrigation systems that are utilised most frequently today are sprinkler irrigation systems, drip irrigation systems, and pot irrigation systems. There are several different subsets that can be utilised within the contemporary irrigation system [8]. There is a wide range of diversity in the types of weather evapotranspiration controllers, including the signal-based controller, the historic controller, the irrigation system of an on-site weather measurement controller, and many others. The soil moisture sensor controller will determine if the irrigation system is a suspended cycle irrigation system or a water on demand irrigation system, and then classify the systems accordingly. The roles of constituent parts and the attributes they possess are the basis for the formation of some of the most important categories.[9] proposed a novel method for secure transportation of railway systems has been proposed in this project. In existing methods, most of the methods are manual resulting in a lot of human errors. This project proposes a system which can be controlled automatically without any outside help. This project has a model concerning two train sections and a gate section. The railway sections are used to show the movement of trains and a gate section is used to show the happenings in the railway crossings. The scope of this project is to monitor the train sections to prevent collisions between two trains or between humans and trains and to avoid accidents in the railway crossings. Also an additional approach towards effective power utilization has been discussed. Five topics are discussed in this project : 1) Detection of obstacles in front of the train;2) Detection of cracks and movements in the tracks;3) Detection of human presence inside the train and controlling the electrical devices accordingly 4) Updating the location of train and sharing it with other trains automatically 5) Controlling the gate section during railway crossing. This project can be used to avoid accidents in the railway tracks.

II. THE RELATED WORK

Research and development in the agricultural sector have been expanding at a breakneck pace recently. Recently, the temperature of the soil, the pH of the soil, and other variables have become the principal focus of research as a direct result of the pressing need to boost yields.

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Irrigation was applied to the area after it was determined using electromagnetic sensors how much moisture was already present in the soil [10]. The findings of these experiments indicate a reduction in water waste of 53 percent.Drip irrigation has been demonstrated to be beneficial due to the fact that it prevents the loss of usable water and delivers nutrients and water directly to the root zone. Microcontroller. The use of sensor-controlled drip irrigation has made a significant impact in agricultural practises [11]. When calculating the rate of evapotranspiration, irrigation is an additional important aspect that must be taken into consideration. The rate at which a plant loses water through transpiration is referred to as the evapotranspiration (ET) rate. This rate is strongly affected by a variety of elements, including the type of plant, the wind speed, the humidity, the temperature, the body mass index, and others [12].The "WSN" will provide assistance to farmers so that they can raise their investments and their revenues, which will ultimately result in a larger agricultural footprint. Wireless sensor network (WSN) field sensors are used in agriculture to monitor factors such as moisture and temperature that are vital to the fertility of the soil. The data that is collected by a wireless hybrid sensor network will ultimately be shared with the environment that it is monitoring [13]. ZigBee is a wireless communication system that employs the same frequency for transmitting and receiving data from and to sensing components as well as comparing the results of these activities[14].The IEEE 80215.4/ZigBee wireless sensor network is managed by the PAN coordinator, who also guarantees that the most efficient use of power is made. Both the management of energy and the utilisation of WSN for monitoring soil health require MAC criteria as an essential component. Real-time monitoring of agricultural energy consumption is now possible thanks to the development of beacon-based wireless sensor networks [15-16]. It is possible that the cost of computationally heavy software and hardware might be greatly decreased by making use of sensor networks, which are not only small but also very accurate. Wireless mobile sensor networks (WSNs) can increase the amount of time that passes between battery changes for the sensors in the network by relocating sensors that are no longer in use to other places. The uptime of the network as well as its power consumption can be enhanced by the modelling and optimisation of the gearbox system. An Arduino microprocessor, grove moisture sensors, and water flow sensors were utilised in the construction of an autonomous watering system for the sake of this research [17]. ZigBee is a protocol that is used by Arduino microcontrollers for wireless data transmission, and this protocol is used to monitor soil moisture. When the relative humidity reaches a specified threshold, the water flow through the pipe is modified such that it is proportional to the change. An up-to-date database that includes flow, water pressure, moisture content, and operating time allows users to observe the motor's moisture level and running duration on displays and GSM-enabled mobile devices[18]. This is possible thanks to the database. This article discusses how to construct a large autonomous irrigation system that makes the most use of both people and water by utilising wireless ZigBee technology. The system will be able to do this in the most effective manner possible[19]. All aspects of the ZigBee system, including the protocol, network, controller, and coordinator, as well as the software algorithm, are thoroughly explained. In this study, a variety of soil characteristics, such as moisture, water flow, electrical conductivity, and others, were investigated. ZigBee was used as the wireless sensor network (WSN) component of a multi-hop ad hoc network to facilitate large field deployment of MFPz. A radio chip compliant with the IEEE 802.15.4 standard was used to power the MFPz's wireless microcontroller[20]. The design and instrumentation of a site-specific precision linear move irrigation system, as well as a wireless sensor network and software for real-time in-field sensing and control, are discussed in detail in this study [21]. The author of this work built a fully automated irrigation system to assist farmers in making the most efficient use of the water that they have available. As part of a decentralised wireless sensor network, temperature and moisture sensors are positioned in close proximity to the plant's roots. The delivery of water is controlled by a gateway device that is based on a microcontroller [22]. The findings of this study provide a workable strategy for regulating irrigation for crops that are produced in containers. Real-time data can be gathered about the surrounding environment and the soil if a wireless sensor network is utilised. A notification via text message is sent to the farmer whenever there is a scarcity of water in a given region [23]. This study introduced an automated system that makes use of GSM and ZigBee technologies to monitor the growth of crops and determine the appropriate amount of irrigation. In order to improve the efficiency of the drip irrigation system and consequently cut down on the amount of water that is wasted, several sensors are utilised[24]. These sensors communicate their findings to the irrigation control centre (ICC) using a microcontroller. The ICC then receives the information using ZigBee.

III. PROPOSED WORK

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The system design procedure that has been suggested can be carried out in a couple of different ways. The top-down method is one strategy, and the bottom-up method is another. You can see how the approach that is advised to be used for system design is separated into five distinct phases by looking at figure 1 below.

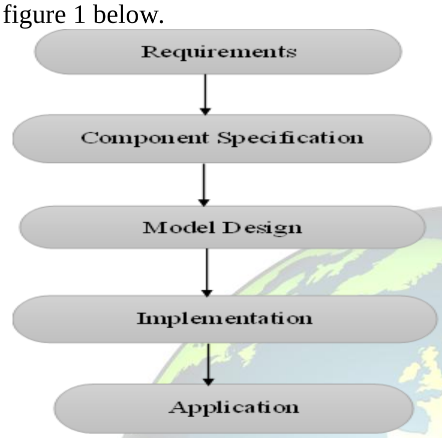

Figure 1: Proposed system design process

Requirements

It is the initial stage of the proposed automatic irrigation system's design process, and it isseparated into two types and they are listed below.

Functional Requirements

Technical information, data processing, sensing, and indication are all functional needs. The suggested method employs a sensor tool to measure humidity, temperature, and soil moisture. It employs an automated indicator to find automatic operations like a motor pump, a fan that is on or off, or a buzzer that blows.

Non-Functional Requirements

Functional demand and it cannot coexist. The suggested system entails monitoring and Managing the humidity, temperature, and water content of the soil. The functioning of the Pump, Fan, Buzzer are all initiated automatically when this factor exceeds the threshold value for certain crops.

Component Specification

In an artificial intelligence-supported automatic irrigation system using Arduino and Zigbee in a wireless sensor network, the components play a crucial role in collecting data, processing it, and controlling the irrigation process. Here are the specifications of the key components:

IV. ZigBee Module

Zigbee transceiver module: Such as XBee or NRF24L01, which provides wireless communication capabilities. Ensure the module can be easily connected to the Arduino board. Adequate range and low power consumption is Required for reliable and efficient communication between the sensor nodes and the central Arduino unit. The IEEE 802.15.4 standard served as the foundation for the development of the ZigBee protocol. There are three distinct ways in which computer networks can be organised: in the form of a star, a tree, or a mesh. Star topology can be useful for applications that are on a smaller scale. The process of recreating routes in a tree topology can be both time-consuming and expensive. Mesh networks enable more reliable multi-hop communication and are more adaptable than other network architectures. The topology of a network may be chosen by its architects based on which application it will serve most effectively. Peer-to-peer broadcasts, as described by IEEE 802.15.4, are the only means through which devices participating in a mesh network are able to communicate with one another. The protocols for LRWPANs, also known as low-rate wireless personal area networks, are defined by IEEE Standard 802.15.4. These low-priced gadgets have a restricted communication range and only provide the bare necessities in terms of functionality. However, given that these devices can function for extended amounts of time, it is essential that the designers take into consideration how efficiently they use energy. Star and mesh are the two basic categories that can be used to classify the network topologies supported by IEEE 802.15.4. There are two distinct categories of technological devices: ones with less functions and ones with more. Maintaining the functionality of all of the other devices falls within the purview of the PAN coordinator. A FFD has the option of either associating themselves with an existing PAN coordinator or taking on the role of PAN coordinator themselves. A neighbouring PAN coordinator has the capability of sending data to or receiving data from an RFD. The goal of the IEEE 802.15.4 standard is to make it easier for devices that are within radio range of one another to communicate with one another.This is illustrated in Figure 2.

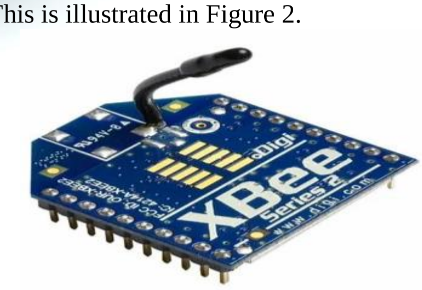

Figure. 2. ZigBee Module

Arduino Microcontroller:

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Arduino Uno or Arduino Mega: These are commonly used microcontroller boards suitable for handling multiple sensors and actuators. Analog and digital input/output (I/O) pins are Required to interface with the sensors and actuators. The Serial communication ports: Used for communication with the Zigbee module. Sufficient memory and processing power to handle the AI algorithms and control logic. The most important piece of hardware is the microcontroller, which is most commonly referred to as the Arduino Uno. After receiving data from the soil moisture sensor, it processes that data in accordance with the programmed instructions for the microcontroller. The open-source Arduino board may be of service to those individuals who are interested in dabbling with electronics. Your efforts will allow for the creation of a programming that can be utilized by the Arduino programmable circuit board. The IDE (Integrated Development Environment) software, which is utilized to write code and transfer it to the hardware board of the Arduino, will be employed to upload the Arduino programming. Simple C and C++ functions that may be called from various programming languages make up the Arduino programming language. The general diagram for Arduino uno is illustrated in Figure 3.

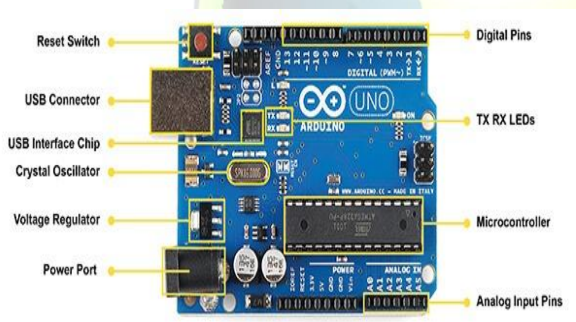

Figure. 3. Arduino UNO

GSM Module

Installing a GSM/GPRS module is required in order for the ARM7 microprocessor to be able to communicate with other electronic devices (such as desktop computers, laptops, mobile phones, and so on). This mobile communication architecture is utilised by applications to a significant degree. The Global System for Mobile Communications (GSM), which is already capable of a rapid data transfer rate, is taken to an entirely new level by GPRS. A GSM/GPRS module is a type of modem that may connect to a wide variety of communication interfaces, including USB, RS-232, and others. It will first retrieve data from the controller, and then it will update a server or database that is hosted online. The GSM module is illustrated in Figure 4.

Figure. 4. GSM Module

LCD Display

The reading that was taken from the humidity sensor by the Arduino can be seen shown on the LCD. The information that is gathered at the same time is transmitted to a relay module, which makes use of it to determine whether or not to activate the water pump. Once the necessary condition for turning on the water pump has been satisfied, water will start to be sucked up from the water source and pushed down the opposite end of the pipe in order to keep watering the soil. This process will continue until the water pump is turned off. It is shown in Figure 5.

Figure. 5. LCD Display

Soil Moisture Sensor

The amount of water that is now contained within the earth is referred to as the "soil moisture." Sensors that detect soil moisture are frequently utilised in the process of determining the hydration levels of the soil. Tensiometers are an additional type of sensor that can measure the water potential property of soil moisture. Gypsum blocks also perform this measurement. These gadgets also go by the moniker of soil water potential sensors in some circles. In order to assess the quantity of moisture present in the soil, moisture sensors are utilised. Since the removal, drying, and coefficient of a sample is required for the direct hydrometric measurement of free-soil wetness, soil wetness sensors calculate water content by substituting another feature of the soil, such as the soil's electrical phenomena, non-conductor constant, or interaction with neutrons. This is because the direct hydrometric measurement of free-soil wetness requires these steps.The corresponding diagram is illustrated in figure 6.

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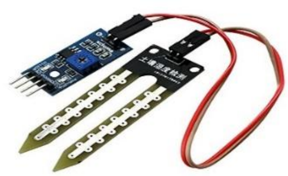

Figure 6. Soil Moisture Sensor

Humidity Sensor

The air that we breathe in our everyday life has a certain level of humidity. The amount of water vapour that is present in the air is expressed as a percentage of its maximum value when referring to relative humidity. Absolute humidity, in contrast to relative humidity, takes into consideration the total number of water molecules present in a given volume of air. Relative humidity, on the other hand, simply takes into account the level of saturation present in the air. According to Dalton's law, the total air pressure is equivalent to the sum of the partial vapour pressures of the numerous gases that make up air, including water vapour. This includes the pressure exerted by water vapour. The amount of moisture that may be contained within an atmosphere is determined by the saturation water vapour pressure. The temperature dependence diagram is depicted in figure 7, which corresponds to this diagram.

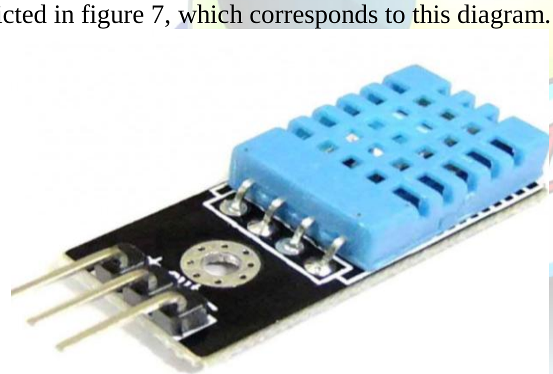

Figure. 7. Humidity Sensor

Temperature Sensor

In addition to the temperature sensor, the packaging also includes the circuitry that is required for in-depth signal processing. The temperature sensor ICs can be used in their current form without the need for any additional corrective circuitry to be installed. It has three different connectors and requires a power supply of approximately 5.5 volts. This kind of temperature sensor is made out of a substance that has a very noticeable reaction to any change in temperature. When there is a change in temperature, there will also be a change in the resistance value. This change in resistance is detected by the circuit, which then applies it to the task of determining the temperature. Since the temperature sensors are attached directly to the central processing unit, there is no requirement for an expensive A/D converter to be installed. In this instance, we make use of the LM35 temperature sensor, the readings of which are linear with regard to the temperature expressed in Celsius. The diagram for temperature sensor is illustrated in Figure 8.

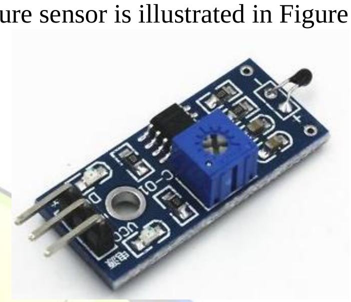

Figure8. Temperature Sensor

Soil pH sensor

With the assistance of an instrument known as a soil pH sensor, one is able to ascertain the pH level of the soil at the present time. Two probes made of stainless steel are inserted in a vertical position into the soil so that the pH level may be determined. The soil pH sensor is illustrated in Figure 9.

Figure 9: Soil pH Sensor

Acoustic Sensor

Acoustic sensors are utilized in the process of determining variations in soil depth (top soil depth and hardpan depth), soil bulk density (compaction), and soil bulk texture (sand, silt, and clay).The diagram corresponding to this acoustic sensor is illustrated in figure 10.

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Figure 10: Acoustic Sensor

Relay

Switches that are operated electrically are known as relays. There are many various kinds of relays, the most majority of which use magnets to automatically activate switches. However, there are also relays that use solid state technology, which operate in a different way. Relays are utilised both for controlling a single circuit with several low-power signals as well as for managing many circuits with a single signal. In the communication circuits used for long-distance transmissions, the important relays were responsible for amplifying the signal that was sent back from one circuit and then re-sending it on another circuit. The illustration of Relay is shown in figure 11.

Figure 11: Relay

Actuators:

Solenoid Valves or Pumps: Used to control the flow of water for irrigation. Compatibility and control capability: Ensure the actuators can be controlled by the Arduino board, either directly or through appropriate interfaces.
Water flow capacity: Select actuators based on the irrigation requirements of the field.

Power Supply:

Arduino Power Supply: The microcontroller board requires a stable power supply to operate reliably.Sensor and Actuator Power Supply:
Provide appropriate power sources for the sensors and actuators used in the system.
Battery or Solar Power: Consider using batteries or solar panels to power the system if mains power is not available in the field.

AI Algorithm:

Machine Learning Libraries: Utilize machine learning libraries like TensorFlow, scikit-learn, or PyTorch to implement the AI algorithms for decision-making.
Algorithm Training and Deployment: Train the AI algorithm using historical data and deploy it on the Arduino for real-time decision-making.
The overall process of the work flow specified in the proposed system is shown below.

The sensors deployed in the field continuously monitor environmental parameters. They measure soil moisture levels, temperature, humidity, and light intensity at regular intervals.The sensor nodes transmit the collected data wirelessly to the central Arduino unit using Zigbee communication. Zigbee offers low-power and long-range communication capabilities, making it suitable for this application.The Arduino receives the sensor data and passes it through an AI algorithm for analysis. The AI algorithm uses machine learning techniques to make decisions based on the collected data and predefined rules.The AI algorithm analyzes the sensor data to determine whether irrigation is required. It considers factors such as soil moisture levels, weather conditions, crop type, and specific irrigation requirements. Based on the decisions made by the AI algorithm, the Arduino activates the appropriate irrigation devices (actuators) to water the crops. It triggers solenoid valves or pumps to release the required amount of water to the field.The system continues to monitor the environmental conditions and adjusts the irrigation process in real-time. The sensors continuously collect data, and the AI algorithm keeps making decisions to optimize irrigation efficiency.The diagram for the proposed system is illustrated in figure 12.

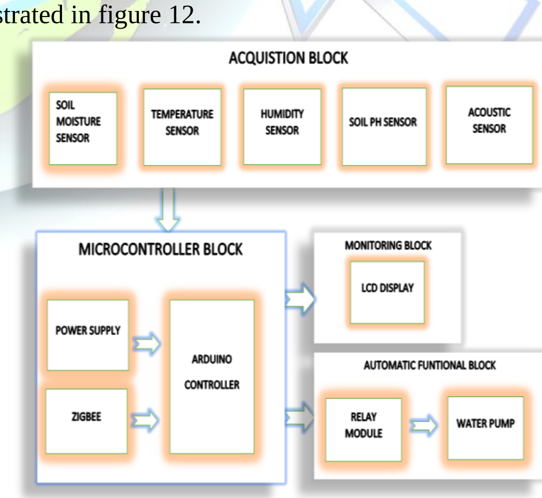

Figure 12:Architecture of the proposed system

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It includes the partition for the given hardware device, performance, and trouble shooting has three nodes in it. Nodes 1 and 2 are referred to as sensing nodes, whereas node 3 is referred to as a receiving node. In an automated watering system, the receiver node is crucial. Although Nodes 1 and 2 operate in the same way, the destination's address differs. The receiving node has the destination's address configured. Utilising sensors, Node 1 and Node 2 detected the data, which was then sent to the ADC. It is converted from analogue to digital by an ADC before being sent to a UART for serial transmission. The PIC Microcontroller 18F458 has this built in. For wireless data transfer, ZigBee is utilised. The information collected at Nodes 1 and 2 is transmitted to the ZigBee node that is responsible for accepting data. Through the use of a PIC 18F458 microcontroller, the information that has been acquired by this receiver node is presented on both an LCD and a PC. Following the selection of the suitable crop type and the crop that is wanted, the LCD and the PC will display the threshold value for the chosen crop and compare it to the value that is currently being displayed. If the current value is higher than the setpoint, then the action will be taken without further intervention automatically.

Implementation of the proposed system

Implementation entails joining all the parts together and creating a suitable framework. As well include troubleshooting chores to keep the system operating efficiently.It is a challenging step becausewe need to determine why the system is malfunctioning.The sensor in the suggested system sends a signal tothe microcontroller.The soil moisture sensor, humidity sensor, and temperature sensor each have three channels.With the aid of the ADC, sensory data is transformed to digital form and sent to the LCD for display.Following that, this data is sent via UART to ZigBee.Additionally, ZigBee outputs to the driver after comparing the sensor output with the predetermined values.UART is used transport the data to the master node for ZigBee.Information is gathered from nodes 1 and 2.There are four ways to choose a group of values for aspecific crop.Switches use resisters as interfaces to Port E. For the buzzer, fan, and pump motor,three relays are employed.This relay connects to Pins RA0, RA1, and RA2, and BC547 is used to manage the additional power generated by the relay's coil, which amplifies the signal from the PIC 17F458 microcontroller.The information is shown on the PC and 16*4 LCD of the Master Node. The suggested system uses temperature, humidity, and moisture sensors to monitor agricultural fields, which would enhance the both the quality and volume of agricultural outputs. The information from the sensors may be monitored by the farmer at home; it is shown on the LCD of the master node and on a computer. A farmer can choose a certain crop, Within the master node are wheat, rice, jowar, and bajara. The microcontroller is programmed with a threshold value that corresponds to the moisture temperature, and humidity values needed for a particular crop. Actual values are sensed by infield sensors that soil moisture, temperature, and humidity. These numbers are contrasted with the cutoff numbers.

V. RESULTS AND DISCUSSION:

Because the master node has a computer and an LCD screen, the farmer may monitor the readings from the sensors without having to leave the convenience of his own house. A farmer has the option of growing a variety of crops, including wheat, rice, jowar, and bajara, all of which are featured in the master node from which the farmer can select. The microcontroller is programmed to a particular threshold that is determined by the properties of moisture, temperature, and humidity that are required for a particular crop. Real-time information on a variety of environmental parameters, including temperature, humidity, and soil moisture, is gathered via sensors located in the field. The data are analysed in relation to the threshold values. An external event, such as a pump, fan, or alarm, is activated whenever the value reaches a threshold that has been previously established. The farmer selected rice as his crop, and then used Terminal version 1.9b to visualise the actual rice's moisture, temperature, and humidity on both the master node and the personal computer, as well as to make comparisons and automate the process. The remaining crop varieties, which include wheat, jawar, and bajara, will be cultivated using this manner. When the irrigation for the crop is turned off, it results in a loss of revenue. Both the humidity and the moisture content of the soil are normal. When the irrigation system was turned on, the crop's temperature, humidity, and soil moisture levels had all already surpassed the point that had been established for them. The farmer will receive an alert on the LCD and PC that is connected to the master node if the relative humidity of the crop rises above the threshold value in table 1.

Table 1: Humidity Vs Time

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Time(In Hour)	Humidity
800	37
1000	38
1200	40
1400	30
1600	32
1800	36

The graphical representation of the humidity value with respect to time is illustrated in figure 13.

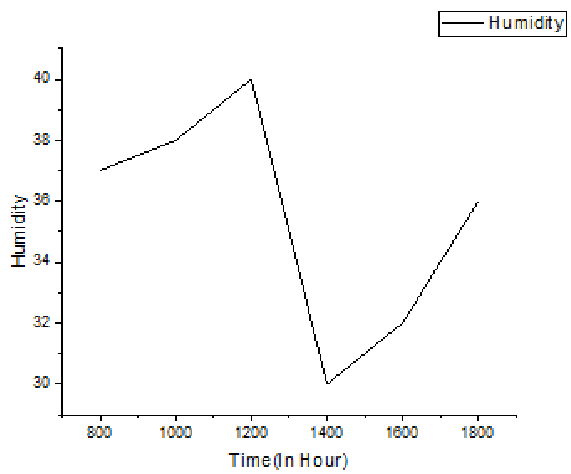

Figure 13: Humidity Vs Time

When the temperature of the crop reaches the predetermined threshold, the fan begins to rotate, and the relevant data is shown on the LCD and personal computer of the master node. The values corresponding to the temperature and time is shown in table 2.

Temperature Vs Time

Time(In Hour)	Temperature (Degree Celsius)
1	35
2	40
3	32
4	48
5	25
6	55

The graphical representation of the temperature value with respect to time is illustrated in figure 14.

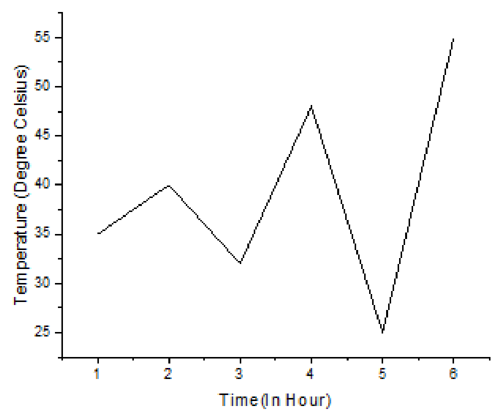

Figure 15: **Temperature Vs Time**

When the soil moisture value exceeds the crop's threshold value, the pump turns on and displays information on the LCD and PC of the master node. The values corresponding to the Soil moisture value is shown in table 2.

Table 2: Time vs Soil moisture value

Time	Soil Moisture
1	70
2	88
3	76
4	92
5	87
6	95

The graphical representation of the soil moisture value with respect to time is illustrated in figure 15.

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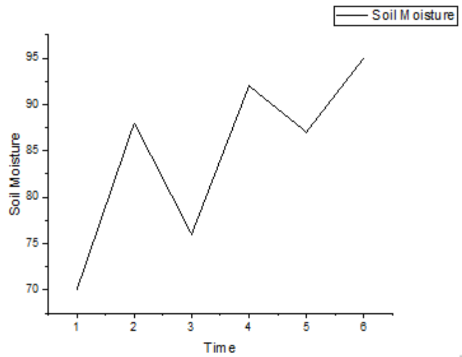

Figure 15: Time vs Soil moisture value

According to the forementioned outcome, we experimentally analysed that it operates automatically without requiring any human labour and also obtains an accurate result for monitoring the soil content, environmental considerations and effective energy utilization. The graph corresponding to the soil sample is illustrated in figure 16.

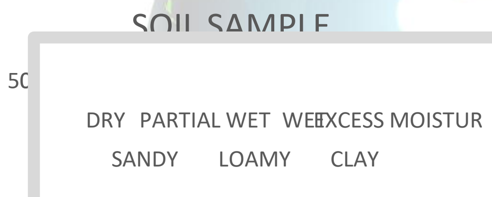

Figure 16:Graph on Soil Sample

VI. CONCLUSION

The Artificial Intelligence-Supported Instinctive Irrigation System (IIS) was created and implemented with a variety of benefits for efficient and effective irrigation management using Arduino and Zigbee in a wireless sensor network. This system utilises AI-driven algorithms, sensor data, and wireless connection to create an intelligent and fully-automated watering setup. First, the IIS incorporates artificial intelligence to assess a variety of environmental parameters, such as temperature, humidity, soil moisture, and weather conditions, to determine the optimal watering requirements for plants. This allows for targeted and accurate irrigation, reducing the risk of plant stress and yield losses associated with either over- or under-watering. Second, the use of Arduino microcontrollers provides a stable and malleable environment for data collection, processing, and control. Thanks to Arduino boards' ability to interface with a wide range of sensors, real-time monitoring of critical parameters is now feasible. The collected information can subsequently be used by the AI systems to draw reasonable judgements on water distribution and irrigation schedules. Thirdly, the Zigbee wireless sensor network allows for streamlined communication between the system's many components, such as sensors, Arduino boards, and actuators. Zigbee's low power consumption and robust mesh networking features make it ideal for widespread deployments, and so facilitate the creation of a decentralised and interconnected irrigation system.

References

[1] Zhai, Zhaoyu, José Fernán Martínez, Victoria Beltran, and Néstor Lucas Martínez. "Decision support systems for agriculture 4.0: Survey and challenges." Computers and Electronics in Agriculture 170 (2020): 105256.

[2] Nandurkar, S. R., V. R. Thool, and R. C. Thool. "Design and development of precisionagriculture system using wireless sensor network." In 2014 First international conference on automation, control, energy and systems (ACES), pp. 1-6. IEEE, 2014.

[3] Priyankha, J. Jeya, and K. Suresh Kumar. "Crop disease identification using a feature extraction HOG algorithm." Asian Journal of Applied Science and Technology 1 (2017): 35-39.

[4] Abdulkareem, Karrar Hameed, Mazin Abed Mohammed, Saraswathy Shamini Gunasekaran, Mohammed Nasser Al-Mhiqani, Ammar Awad Mutlag, Salama A. Mostafa, Nabeel Salih Ali, and Dheyaa Ahmed Ibrahim. "A review of fog computing and machine learning: concepts, applications, challenges, and open issues." Ieee Access 7 (2019): 153123-153140.

[5] Adi, Erwin, Adnan Anwar, Zubair Baig, and Sherali Zeadally. "Machine learning and data analytics for the IoT." Neural computing and applications 32 (2020): 16205-16233.

[6] Christo Ananth, M.Danya Priyadharshini, "A Secure Hash Message Authentication Code to avoid Certificate Revocation list Checking in Vehicular Adhoc networks", International Journal of Applied Engineering Research (IJAER), Volume 10, Special Issue 2, 2015,(1250-1254).

[7] Sundaresan, S., M. Surendar, T. Ananthkumar, K. Sureshkumar, and Jefrin Sharmitha Prabhu. "Impact of wind farms on surveillance radar system: a realistic

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scenario in Palakkad gap region." Journal of Ambient Intelligence and Humanized Computing (2023): 1-8.

[8] Singh, Sushil Kumar, Shailendra Rathore, and Jong Hyuk Park. "Blockiotintelligence: A blockchain-enabled intelligent IoT architecture with artificial intelligence." Future Generation Computer Systems 110 (2020): 721-743.

[9] Christo Ananth, K.Nagarajan, Vinod Kumar.V., "A Smart Approach For Secure Control Of Railway Transportation Systems", International Journal of Pure and Applied Mathematics, Volume 117, Issue 15, 2017, (1215-1221)..

[10] Kumar, K. Suresh, T. Ananth Kumar, S. Sundaresan, and V. Kishore Kumar. "Green IoT for Sustainable Growth and Energy Management in Smart Cities." In Handbook of green engineering technologies for sustainable smart cities, pp. 155-172. CRC Press, 2021.

[11] Chikankar, Pravina B., Deepak Mehetre, and Soumitra Das. "An automatic irrigation system using ZigBee in wireless sensor network." In 2015 International Conference on Pervasive Computing (ICPC), pp. 1-5. IEEE, 2015.

[12] Anisi, Mohammad Hossein, Gaddafi Abdul-Salaam, and Abdul Hanan Abdullah. "A survey of wireless sensor network approaches and their energy consumption for monitoring farm fields in precision agriculture." Precision Agriculture 16 (2015): 216-238.

[13] Akyildiz, Ian F., and Erich P. Stuntebeck. "Wireless underground sensor networks: Research challenges." Ad Hoc Networks 4, no. 6 (2006): 669-686.

[14] Truong, Van-Truong, Anand Nayyar, and S. Ahmad Lone. "System performance of wireless sensor network using LoRa–Zigbee hybrid communication." Computers, Materials & Continua 68, no. 2 (2021): 1615-1635.

[15] Sengeni, D., and K. Suresh Kumar. "A Cloud Based Online Cattle Healthcare and Monitoring System Using Internet of Things (IoT)."

[16] Sushanth, G., and S. Sujatha. "IOT based smart agriculture system." In 2018 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), pp. 1-4. IEEE, 2018.

[17] Shafi, Uferah, Rafia Mumtaz, José García-Nieto, Syed Ali Hassan, Syed Ali Raza Zaidi, and Naveed Iqbal. "Precision agriculture techniques and practices: From considerations to applications." Sensors 19, no. 17 (2019): 3796.

[18] Gunasekaran, P., K. Suresh Kumar, R. Hari Priya, and V. Balaji. "Laser Based Smart Security Monitoring System Using Nodemcu and React. Js with Improved Storage Efficiency." In 2021 International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1-4. IEEE, 2021.

[19] Zahoor, Syed Ahsan, Shakeel Ahmad, Ashfaq Ahmad, Aftab Wajid, Tasneem Khaliq, Muhammad Mubeen, Sajjad Hussain et al. "Improving water use efficiency in agronomic crop production." Agronomic Crops: Volume 2: Management Practices (2019): 13-29.

[20] Ayars, J. E., A. L. A. N. Fulton, and B. Taylor. "Subsurface drip irrigation in California—Here to stay?." Agricultural water management 157 (2015): 39-47.

[21] Soulis, Konstantinos X., Stamatios Elmaloglou, and Nicholas Dercas. "Investigating the effects of soil moisture sensors positioning and accuracy on soil moisture based drip irrigation scheduling systems." Agricultural Water Management 148 (2015): 258-268.

[22] Kannan, S., P. Pugazhendiran, and N. Rishi Keshav. "Energy optimization mechanism using metastable-smart grid (MSSG)." In Journal of Physics: Conference Series, vol. 2466, no. 1, p. 012024. IOP Publishing, 2023.

[23] Soulis, Konstantinos X., Stamatios Elmaloglou, and Nicholas Dercas. "Investigating the effects of soil moisture sensors positioning and accuracy on soil moisture based drip irrigation scheduling systems." Agricultural Water Management 148 (2015): 258-268.

[24] Talaviya, Tanha, Dhara Shah, Nivedita Patel, Hiteshri Yagnik, and Manan Shah. "Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides." Artificial Intelligence in Agriculture 4 (2020): 58-73.

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