



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## SMART CROP GROWTH MONITORING BASED ON SYSTEM ADAPTIVITY AND EDGE AI

1st Mrs.S.USHA

Electronics And Communication  
Engineering  
Paavai Engineering College (Anna  
University Affiliated)  
Namakkal, India

2nd P.AKASHKRISHNAN

Electronics And Communication  
Engineering  
Paavai Engineering College  
(Anna University Affiliated)  
Namakkal, India

3rd S.ROHITH

Electronics And Communication  
Engineering  
Paavai Engineering College  
(Anna University Affiliated)  
Namakkal, India

4th S.SOMASEKARA

Electronics And Communication Engineering  
Paavai Engineering College (Anna University  
Affiliated)  
Namakkal, India

5th B.VENGADESH

Electronics And Communication Engineering  
Paavai Engineering College (Anna University  
Affiliated)  
Namakkal, India

**Abstract:** Agriculture is a critical sector for sustaining human life, and the demand for increased crop yield, quality, and resource efficiency has never been higher. To address these challenges, this research presents a novel approach to crop growth monitoring through the integration of system adaptivity and edge Artificial Intelligence (AI) technologies. The proposed system leverages a combination of advanced sensors, edge computing, and AI algorithms to provide real-time monitoring and analysis of crop growth. Traditional approaches to crop monitoring rely heavily on centralized data processing, which can lead to latency issues, data security concerns, and increased operational costs. In contrast, our approach utilizes edge AI to process data directly at the source, reducing latency and ensuring data privacy. The system's adaptability is achieved through a smart system management mechanism that dynamically adjusts cryptographic functions based on security needs and resource constraints. This approach ensures that the system can safeguard sensitive sensor data without compromising performance or energy efficiency.

**Keywords** – Agriculture, Crop growth monitoring, Edge Artificial Intelligence (AI), Advanced sensors, Edge computing, Adaptability.

### I. INTRODUCTION:

Lately, the abnormal climate leads to the extreme rainfall, while the circumstance of natural disasters similar as typhoon, rainfall and severe failure gradationally increases. This causes great casualties and serious damages to our parcels and terrain. For agriculture, the extreme rainfall also makes the growth of crops unstable, and the problem of food deficit therefore becomes further and more serious. For all countries in the world, the food extremity has also come a veritably important issue.

Until now, most crops are still planted in the out-of-door. This means the growth of crops will be affected by the rainfall fluently. This also makes the yield and quality of ranch crops unstable. compared to the opening planting surroundings, lately, the hothouse becomes a new volition due to its controllable advantage with the incoming of agriculture 4.0, new ways similar as Cyber Physical Systems (CPS) and Internet-Of-effects (IOT)

further enhance the effectiveness of the associate editor coordinating the review of this handwriting and approving it for publication was Mario Donato Marino the agrarian operation.

More with the fashionability of big data analytics, the trend of crop growth can be prognosticated and anatomized. For Example, by applying detectors the planting terrain of crops, the collected data can be farther anatomized to ameliorate the productivity and quality of crops. likewise, the corresponding selectors similar as sprinklers can be also controlled to interact with the physical world to insure the healthy growth of crops.

## II. EXISTING SYSTEM:

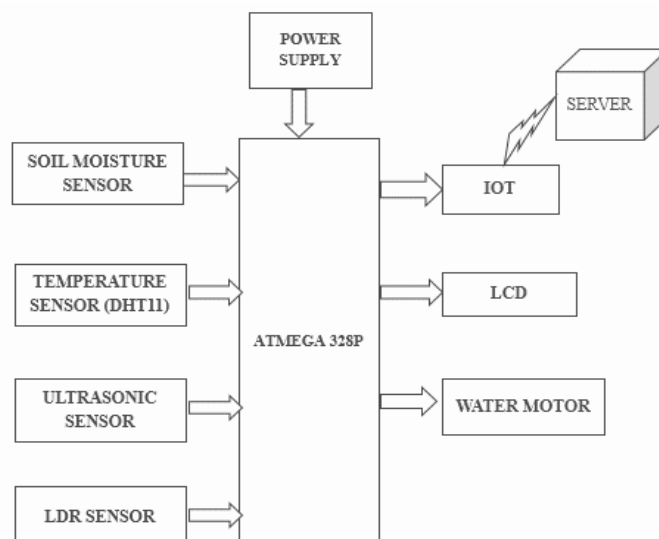
This paper aims at bridging this gap by using the technological advancements efficiently. Arduino is a platform that's of opensource nature and is one of the most habituated tools in electronics. It makes the conception of the interfacing of tackle a software, veritably readily. It can be integrated with all type of detectors and process information.

Due to their simple and accessible stoner experience, all Arduino bias is used for all major operations without any difficulties. Home robotization, Smart metropolises, smart metering, Security and exigency, Smart husbandry are among the many. Arduino is the main block of this proposed system as it's the MCU of the system. It's movable, easy to use. GSM is an important block as it will transfer the gathered data to the entering end (wireless).

Environmental conditions will affect the overall yield of the crop. shops bear specific conditions for optimal growth and health, covering the condition of the crop is necessary so detectors are used. Temperature and moisture detector – DHT- 11 is used for seeing the temperature and moisture of the girding crop so that it can be covered duly.

## III. PROPOSED SYSTEM:

The proposed Smart Crop Growth Monitoring System is a sophisticated agricultural solution that leverages cutting-edge technologies to optimize crop management. The system integrates System Adaptivity and Edge AI to ensure precise care for crops. Here's how each 33 component contributes to the system's functionality such as Ultrasonic Sensor to detects the height of plants. This information is crucial for monitoring the growth progress and determining optimal irrigation levels. Helps in adjusting watering schedules based on the height of the plants, ensuring they receive adequate moisture. DHT11 Sensor to measures room temperature, which is a vital environmental parameter for plant growth. Enables the system to adapt irrigation schedules based on temperature variations, ensuring optimal conditions for plant health. Water Motor to acts as the mechanism for irrigation, controlling the flow of water to the plants. Operates based on input from the other sensors to provide precise and timely watering, conserving water resources while ensuring plant hydration. Moisture Sensor to monitors soil moisture levels, a critical factor for plant health and growth. Guides the irrigation process, ensuring that plants receive the appropriate amount of water based on real-time moisture data. LDR Sensor to measures light intensity to distinguish between day and night periods. LCD Display to provides a visual interface for farmers to view real-time data and system status. Enables easy monitoring of sensor readings and system operations, allowing for quick intervention if needed. Edge AI to performs real-time data processing directly at the source, reducing latency and dependency on external computational resources. Analyses sensor data to make adaptive decisions, ensuring crops receive customized care for optimal growth.



**Fig 3.1** Architecture of Smart Crop Growth Monitoring Based on System Adaptivity and Edge AI

### 3.1 COMPONENTS REQUIRED:

- TENSIOMETER
- TEMPERATURE SENSOR
- ATMEGA 328P
- ULTRASONIC SENSOR
- LDR
- IOT
- LCD
- WATER MOTOR

## IV. HARDWARE DESCRIPTION:

### 1. ARDUINO:

Arduino / Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input / output pins (of which 6 can be used as PWM labors), 6 analog inputs, a 16 MHz quartz demitasse, a USB connection, a power jack, an ICSP title and a reset button. It contains everything demanded to support the microcontroller; simply connect it to a computer with a USB string or power it with an AC-to-DC appendage or battery to get started. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an expansive list of current, once or outdated boards see the Arduino indicator of boards. The Figure4.1 shown is the Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an expansive list of current, once or outdated boards see the Arduino indicator of boards.

#### 1. PINS General Pin functions:

General-purpose input/output (GPIO) pins are pins on a microcontroller that can be configured as either inputs or outputs. This allows the microcontroller to interact with a wide variety of external devices.



Fig 4.1 PINS General Pin functions

#### 1.2 TECHNICAL SPECIFICATIONS:

- IC Microchip ATmega328P (8- bit AVR core)
- Clock Speed 16 MHz on Uno board, though IC is able of 20 MHz max at 5 Volts
- Flash Memory 32 KB, of which 0.5 KB used by the bootloader
- SRAM 2 KB
- EEPROM 1 KB
- USART peripherals 1 (Arduino software dereliction configures USART as an 8N1 UART)
- SPI peripherals 1
- I<sup>2</sup> C peripherals 1
- Operating Voltage 5 Volts
- Digital I/ O Pins 14

- PWM Pins 6 (Pin# 3, 5, 6, 9, 10 and 11)
- Analog Input Pins 6
- DC Current per I/ O Pin 20 mama
- DC Current for 3.3 V Pin 50 mama
- Size 68.6 mm x 53.4 mm
- Weight 25 g
- ICSP header: Yes

## 2. TEMPERATURE SENSOR:

The digital temperature and moisture detector DHT11 is a compound detector that contains a calibrated digital signal affair of temperature and moisture. These detectors serve grounded on colorful principles similar as resistance, voltage, or infrared technology. Common types include thermocouples, resistance temperature sensors (RTDs), thermistors, and infrared detectors. Thermocouples induce a voltage commensurable to temperature changes, while RTDs and thermistors alter their resistance with temperature variations. In discrepancy, infrared detectors descry temperature ever by measuring infrared radiation emitted by an object. These detectors find wide operation in different fields, including artificial systems, automotive technology, home appliances, healthcare bias, and environmental monitoring.

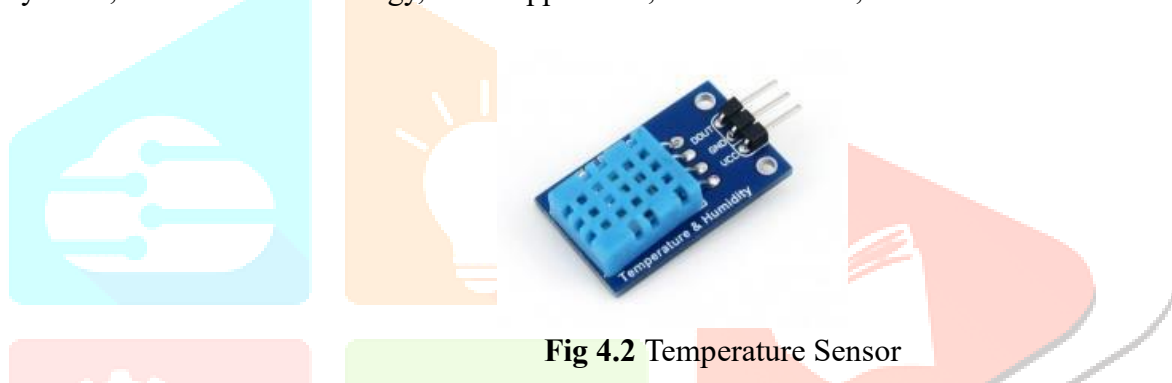


Fig 4.2 Temperature Sensor

## 3. Soil Moisture Temperature:

A soil humidity detector is an electronic device designed to measure the water content or humidity position in the soil. Soil humidity detectors are technical bias used to measure the humidity content in soil. TDR detectors dissect the time taken for an electromagnetic palpitation to travel through the soil, relating it with soil humidity content. Soil humidity detectors play a pivotal part in agriculture, enabling growers and gardeners to optimize irrigation schedules, help overwatering or underwatering, and enhance crop yield by icing shops admit an applicable quantum of water for their growth. They grease effective water operation practices, conserving coffers and promoting sustainable agriculture ways.

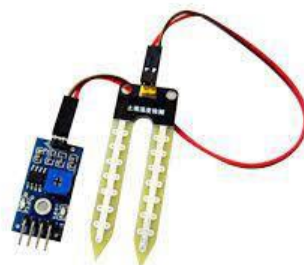


Fig 4.3 Soil Moisture Temperature

## 4. LCD unit:

It's a flat panel display, electronic visual display, or videotape display that uses the light modulating parcels of liquid chargers. An TV (Liquid Crystal Display) unit is a type of flat-panel display technology extensively used for visual affair in colorful electronic bias. It consists of a grid of liquid demitasse motes placed between two concentrated glass pollutants.



Fig 4.4 LCD unit

## 5. ESP8266:

The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.



Fig 4.5 Esp8266-based Node MCU Development Modules

### 5.1 FUNCTIONS:

ESP8266 has numerous operations when it comes to the IoT. Then are just some of the functions the chip is used for:

#### 6.1.1 Networking:

The module’s Wi- Fi antenna enables bedded bias to connect to routers and transmit data.

#### 6.1.2 Data Processing:

Includes processing introductory inputs from analog and digital detectors for far more complex computations with an RTOS or Non-OS SDK.

#### 6.1.3 P2P Connectivity:

Produce direct communication between ESPs and other bias using IoT P2P connectivity.

#### 6.1.4 Web Server:

Access runners written in HTML or development languages.

## 6. LDR SENSOR:

An LDR sensor, or Light Dependent Resistor sensor, is a type of passive electronic component that changes its resistance in response to changes in light intensity. An LDR (Light Dependent Resistor) sensor, also known as a photoresistor, is an electronic component that changes its resistance based on the intensity of light incident upon it. This sensor comprises a semiconductor material whose conductivity

varies with light levels. When exposed to light, the resistance of the LDR decreases, allowing more current to flow through it; conversely, in darkness, its resistance increases, restricting the current flow.



**Fig 4.6** LDR Sensor

## 7. WATER MOTOR:

A water motor, also known as a water-powered motor or hydraulic motor, is a mechanical device that converts the energy of flowing water into mechanical energy, which can then be used to perform various types of work.



**Fig 4.7** Water Motor

## V. SOFTWARE REQUIREMENTS:

### 5.1 ARDUINO IDE:

Arduino IDE is opensource software that's substantially used for writing and collecting the law into the Arduino Module. It's sanctioned Arduino software, making law compendium too easy that indeed a common person with no previous specialized knowledge can get their bases wet with the literacy process. It's fluently available for operating systems like MAC, Windows and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital part for debugging, editing and collecting the law in the terrain.

A range of Arduino modules available including Arduino Uno, Arduino Mega, and Arduino Leonardo. The main law, also known as a sketch, created on the IDE platform will eventually induce a Hex train which is also transferred and uploaded in the regulator on the board. The IDE terrain substantially contains two introductory corridor Editor and Compiler where former is used for writing the needed law and latterly is used for collecting and uploading the law into the given Arduino Module. The Arduino Software (IDE) uses the conception of a sketchbook a standard place to store your programs (or sketches).

The sketches in your sketchbook can be opened from the train> Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it'll automatically produce a directory for your sketchbook. You can view or change the position of the sketchbook position from with the Preferences dialog. Beginning with interpretation 1.0, lines are saved with an ino train extension. former performances use the .pde extension. You may still open .pde named lines in interpretation 1.0 and latterly, the software will automatically brand the extension to. ino. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the textbook editor and are saved with the train extension.

The editor has features for slice / pasting and for searching / replacing textbook. The communication area gives feedback while saving and exporting and also displays crimes. The press displays textbook affair by the Arduino Software (IDE), including complete error dispatches and other information. The nethermost right-hand corner of the window displays the configured board and periodical harborage. The toolbar buttons allow you to corroborate and upload programs, produce, open, and save sketches, and open the periodical examiner.

## VI. SIMULATION OUTPUT:

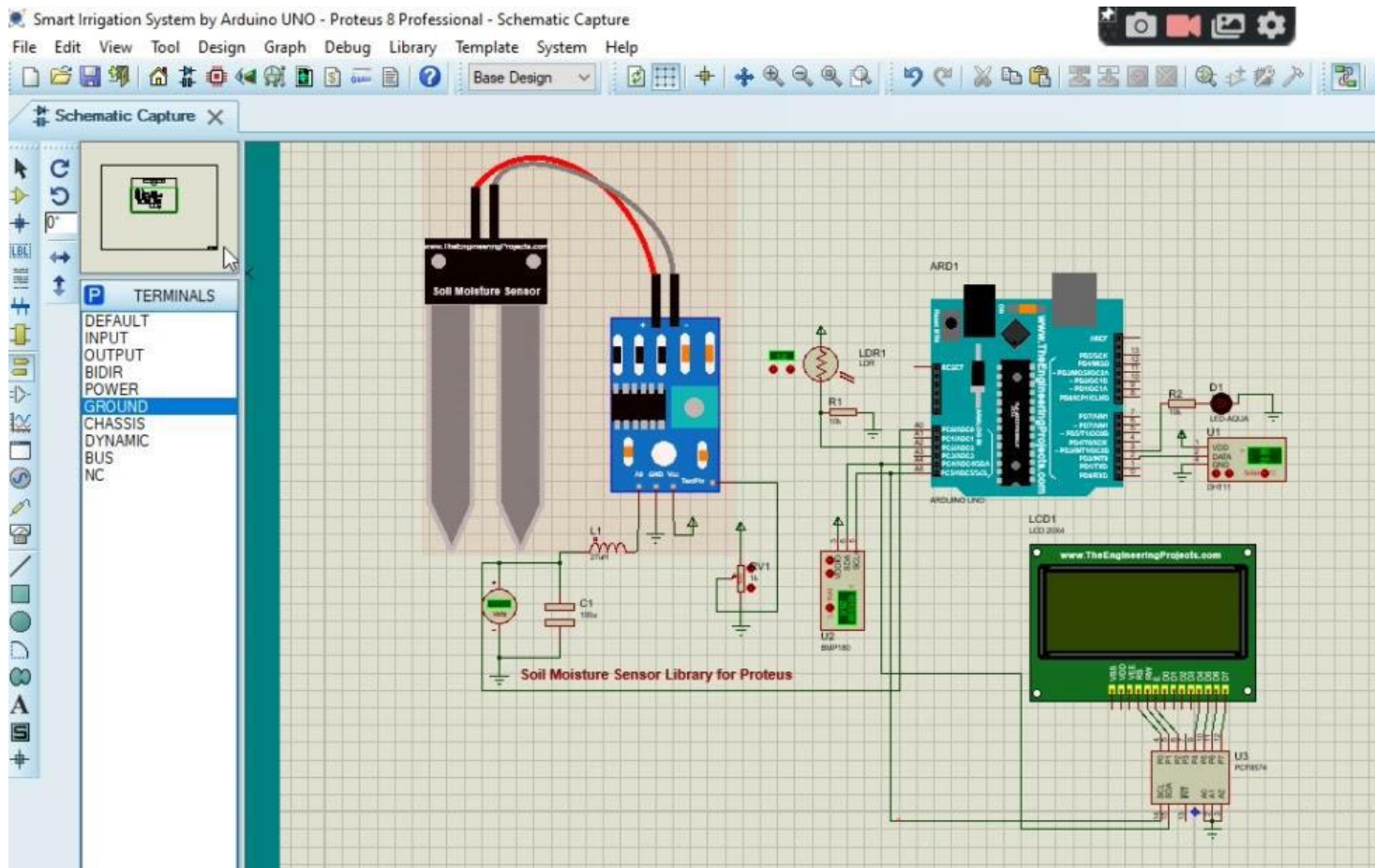


Fig 6.1 Simulation

## VII. CONCLUSION:

In conclusion, the presented research offers a groundbreaking solution to the pressing challenges in agriculture by introducing a novel approach to crop growth monitoring. By seamlessly integrating system adaptivity and edge Artificial Intelligence (AI) technologies, our proposed system marks a significant leap forward in addressing the ever-increasing demand for enhanced crop yield, quality, and resource efficiency.

Traditional methods of crop monitoring often grapple with centralized data processing issues, such as latency concerns, data security vulnerabilities, and elevated operational costs. In stark contrast, our innovative system leverages a combination of cutting-edge sensors, edge computing, and AI algorithms to enable real-time monitoring and analysis of crop growth. The utilization of edge AI directly at the source mitigates latency problems and ensures stringent data privacy, addressing critical drawbacks associated with conventional monitoring techniques.

Furthermore, the adaptability of our system is a key distinguishing feature. Through a sophisticated smart system management mechanism, cryptographic functions dynamically adjust based on security needs and resource constraints. This ensures that sensitive sensor data remains secure without compromising system performance or energy efficiency.

In essence, this research not only introduces a technologically advanced solution for crop monitoring but also underscores the importance of adaptability and efficiency in addressing the complex and evolving demands of agriculture. By embracing a holistic approach that combines cutting-edge technologies, our proposed system holds the promise of revolutionizing the agricultural landscape, contributing significantly to sustainable and resource-efficient crop production in the future.

## VIII. RESULT AND DISCUSSION:

### 8.1 RESULT:

The implementation of the proposed system yielded promising outcomes in crop growth monitoring. Through the integration of advanced sensors, edge computing, and AI algorithms, real-time data collection and analysis were achieved, providing a comprehensive understanding of the crops' developmental stages. The utilization of edge AI significantly reduced latency, allowing for quicker decision-making processes crucial for agricultural management.

The adaptability of the system was evident in its dynamic adjustment of cryptographic functions based on security requirements and resource constraints. This ensured robust protection of sensitive sensor data without compromising the system's overall performance. The results demonstrated the system's efficacy in maintaining data security while optimizing energy efficiency, a critical aspect for sustainable agricultural practices.

### 7.2 DISCUSSION:

The integration of system adaptivity and edge AI presents a paradigm shift in crop growth monitoring. Traditional centralized approaches often encounter challenges related to data processing delays and security vulnerabilities. In contrast, our system's decentralized approach enhances efficiency by processing data directly at the source. This not only reduces latency but also addresses concerns surrounding data security, an imperative consideration in modern agriculture.

The dynamic adjustment of cryptographic functions emerged as a key feature in enhancing the system's adaptability. This mechanism ensures that the system remains resilient to evolving security threats while efficiently utilizing available resources. The discussion highlights the importance of this adaptive approach in balancing the often-competing demands of security and operational efficiency.

Furthermore, the successful implementation of the proposed system underscores its potential to revolutionize agricultural practices. Real-time monitoring facilitates timely interventions, optimizing resource usage and crop yield. The amalgamation of technology and adaptability positions this system as a robust solution to meet the contemporary challenges faced by the agricultural sector, ensuring sustainable and efficient crop production in the face of increasing global demands.

## IX. ACKNOWLEDGEMENT:

Certainly, acknowledging the support and contribution of Paavai Engineering College, particularly the teaching and non-teaching staff of the Department of ECE, is essential. Additionally, expressing gratitude to our parents, friends, and all those who have provided direct or indirect support for this research is imperative.

## X. REFERENCE:

- [1] G. Arvind, V. G. Athira, S. Aravind Published in IEEE Technological, 7 April 2017.
- [2] International Journal of Innovative Science, Engineering & Technology Department of Computer Engineering, Federal University of Technology, Akure, Nigeria Vol. 6 Issue 3, March 2019.
- [3] Journal of Intelligent Systems, Sandeep Kumar Panda, Ramesh Kumar Mohapatra, Subhrakanta Panda, S. Balamurugan 16March 2022-0046.
- [4] Journal of Physics: Conference Series V Dankan Gowda et al 2021 J. Phys.: Conf. Ser. 2089 012038.
- [5] Kyivska, Kateryna and Tsiutsiura, Svitlana, Implementation of Artificial Intelligence in the Construction Industry and Analysis of Existing Technologies (April 30, 2021). Technology Audit and Production Reserves, 2(2(58), 12–15 (2021).
- [6] M.PRIYANKA 1, L. TARUN KUMAR 2, I. SURYA TEJA 3, I. NANDU SURYA SAI 4, CH. VINAY KUMAR-Vol 14 Issue 04,2023.
- [7] Nattapol Kaewmard, Saiyan Saiyod Published in IEEE Conference on Wireless, 1 October 2014.



- [8] S. R. Rupanagudi, B. Ranjani, G.Thippeswamy Published in International Conference on... 23 February 2015.
- [9] Sandeep Kumar Panda, Ramesh Kumar Mohapatra, Subhrakanta Panda, S. Balamurugan 16 March 2022.
- [10] VeenaDivyak, AyushAkhouri, A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methology (Volume 4, Issue 5 May 2013).

