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IoT Based Smart Agriculture System

Prof. M.T. Dangat[1], Ms. Shruti Baravkar[2], Mr. Dinesh Rakshe[3], Mr. Tejraj Walavalkar[4], Mr. Nikhil Jagtap[5]
[1]*Professor, Department of Electronics and Telecommunications, AISSMS Polytechnic, Pune, Maharashtra, India*
[2, 3, 4, 5]*Student, Department of Electronics and Telecommunications, AISSMS Polytechnic, Pune ,Maharashtra ,India*

Abstract: ***Agriculture is the driving force of the Indian economy, but the traditional method of agricultural irrigation faces issues like inefficient irrigation, water wastage, and a lack of real-time monitoring. This paper introduces the design for the Internet of Things-Based Smart Agriculture System, where the irrigation process is performed based on real-time environmental inputs, and the need for water conservation is emphasized. The Internet of Things-Based Smart Agriculture System is designed with the use of sensors, a micro controller, and the GSM communication module.***
This is an auto-controlled system based on the measurement of moisture levels in the soil and the environment. The SMS notifications are sent automatically to the farmer when there is critical activity, such as when the irrigation pump is turned on or when there is irregular activity in the field. The whole system is solar-powered, which is not only economical but also eco-friendly. This technology increases agricultural productivity, and it is a move towards smart farming.

I. INTRODUCTION

Agriculture sits right at the heart of any economy. It feeds people, creates jobs, and drives national growth. In countries like India, you'll find a huge chunk of the population relying on farming, either directly or indirectly, to make a living. But here's the thing most farmers still stick to old-school methods: lots of manual labor, fixed watering routines, and just trusting their gut or past experience.

The result? Water gets wasted, people work harder than they need to, and harvests don't reach their full potential. Water scarcity only makes things tougher, so using every drop wisely is a big deal.

Traditional irrigation really doesn't help much. It doesn't tell farmers what's happening in the soil or the air, so they usually water their fields by habit or guesswork. Sometimes they use too much water, which drains nutrients from the soil and racks up the electricity bill. Other times, they don't use enough, and crops suffer. Keeping an eye on huge fields all day isn't realistic either, especially for folks farming in faroff rural areas.

Now, with technology racing ahead, the Internet of Things IoT for short steps in game changer.IoT bring stronger sensors, microcontrollers, and wireless tech that gather real-time info straight from the field. These smart systems let farmers constantly track soil moisture, temperature, and humidity, all with precision. With this data, irrigation can run automatically, giving crops just the water they need, exactly when they need it.

This kind of smart agriculture isn't just about gadgets; it's about making life easier and farming smarter. The system uses moisture sensors to check water levels in the soil, and other sensors to keep tabs on the weather. A microcontroller crunches all that data and switches the irrigation pump on or off without anyone having to watch over it. Plus, with a GSM module onboard, farmers get text updates about their fields and irrigation status even if there's no internet around.

At the end of the day, using IoT in agriculture means better water management, less back breaking labor, bigger harvests, and a push towards smarter, more sustainable farming. This project shows how tech, when done right, can tackle real world farming problems and pave the way for the future of precision agriculture.

II. PROBLEM STATEMENT

Most farmers still use old school irrigation methods turning things on and off by hand, sticking to the same schedule no matter what. The problem? They end up wasting a lot of water, working harder than they need to, and sometimes their crops don't get what they need. Without upto the minute info about the soil or the weather, it's tough for them to make smart choices about when and how much to irrigate. On top of that, unreliable electricity and high energy bills in many rural areas make things even trickier. That's why farmers need a smarter, more affordable system that can keep an eye on the field, adjust watering as needed, save energy, cut down on manual work, and let them check in from anywhere.

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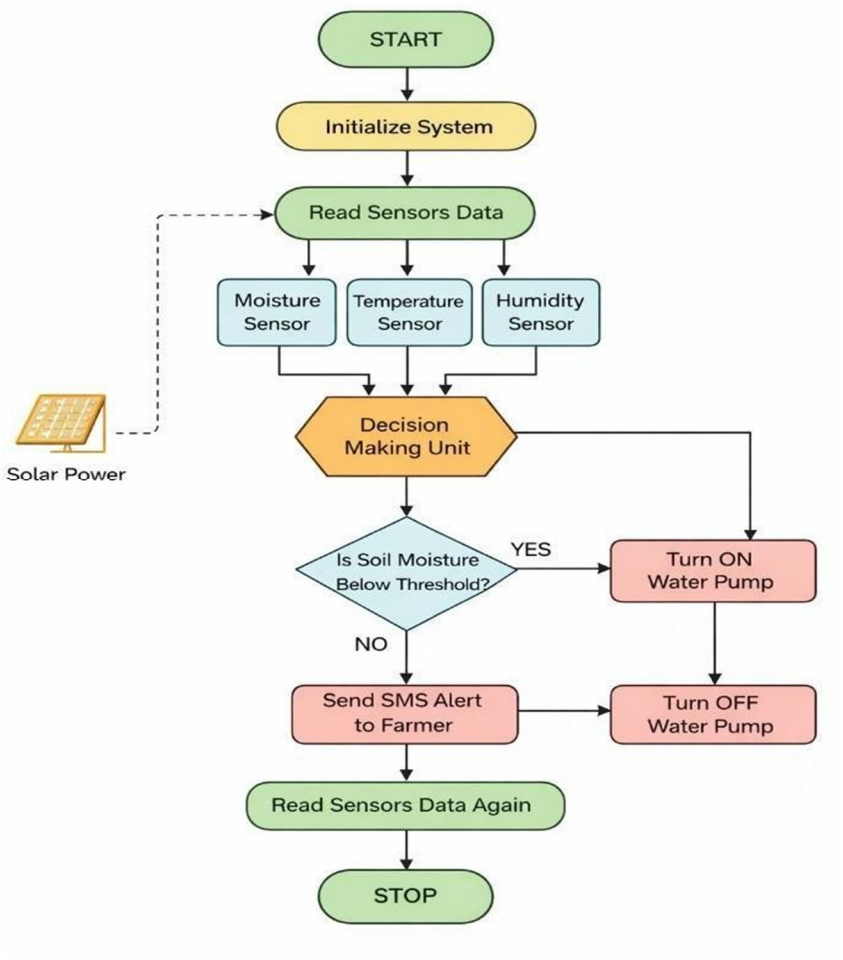
Flowchart



III. COMPONENTS USED

A. Arduino Nano

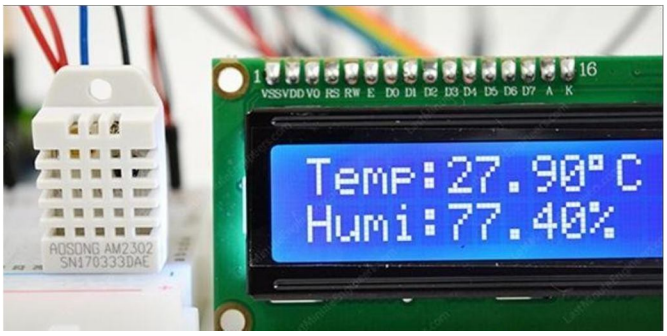
The Arduino Nano is a small and compact microcontroller board based on the **ATmega328P**, commonly used in embedded and IoT projects. It can read data from sensors and control devices like motors, relays, and LEDs. Due to its small size and low power consumption, it is ideal for projects such as smart agriculture systems.

B. Soil Moisture Sensor

The soil moisture sensor is used to measure the amount of moisture present in the soil. It helps determine whether the soil is dry or wet by sending data to the microcontroller. In smart agriculture systems, it is mainly used to automate irrigation and ensure plants receive the right amount of water.

C. Temperature and Humidity Sensor (DHT11/DHT22)

The DHT11/DHT22 sensor is used to measure the temperature and humidity of the surrounding environment. It senses these physical conditions and converts them into digital signals that can be read by a microcontroller such as an Arduino. This sensor helps in monitoring environmental conditions and is widely used in applications like weather monitoring and smart agriculture systems.



D. GSM Module (SIM900/GSM 900A)

The GSM module enables the system to communicate over the cellular network using a SIM card. It can send SMS alerts or transmit data from the field to the farmer's mobile phone. In a smart agriculture system, it helps farmers receive real-time updates about soil and environmental conditions

E. Relay Module

A relay module is an electronic switch used to control high-power devices using a low-power signal from a microcontroller. It allows the Arduino to turn devices like water pumps or motors ON and OFF safely. In a smart agriculture system, it is commonly used to automate irrigation based on sensor data

F. DC Water Pump/ Motor

A DC water pump is used to move water from a source to the plants for irrigation. It operates using direct current power and can be controlled through a relay module connected to the microcontroller. In a smart agriculture system, the pump automatically turns ON or OFF based on the soil moisture level.

IV. OUTCOME

The system keeps an eye on soil moisture, temperature, and humidity around the clock. When the soil gets too dry, it kicks on the irrigation automatically no need for anyone to step in. The water pump turns itself on and off, and the farmer gets a text whenever the pump starts or stops or when irrigation happens.Water use drops a lot compared to oldschool methods. Since the whole thing runs smoothly on solar power, it works great even in remote, rural spots.

V. FUTURESCOPE

Let's take the IoT Smart Agriculture System up a notch. Imagine plugging it into a cloud platform now you're storing and analyzing data in real time, nomore waiting. Pair that with a mobile app, and suddenly you're sensors and tap into weather fore casts ,and your irrigation decisions get a whole lot smarter. ,using AI and machine learning means the system can spot crop health issues early and even predict yields. And if you've got more than one field or you're juggling different crops, you can scale the whole setup to handle the mall .It's efficient, flexible, and ready to grow with you

VI. CONCLUSION

The IoT Smart Agriculture System takes the hassle out of irrigation. It uses sensors, a microcontroller, GSM communication, and solar power to make watering crops automatic and precise. No more wasted water, and farmers don't have to keep checking fields all the time. Crops get the right amount of water, right when they need it. This project really shows how IoT can make farming smarter, more affordable, and better for the environment especially for small and medium-sized farm.

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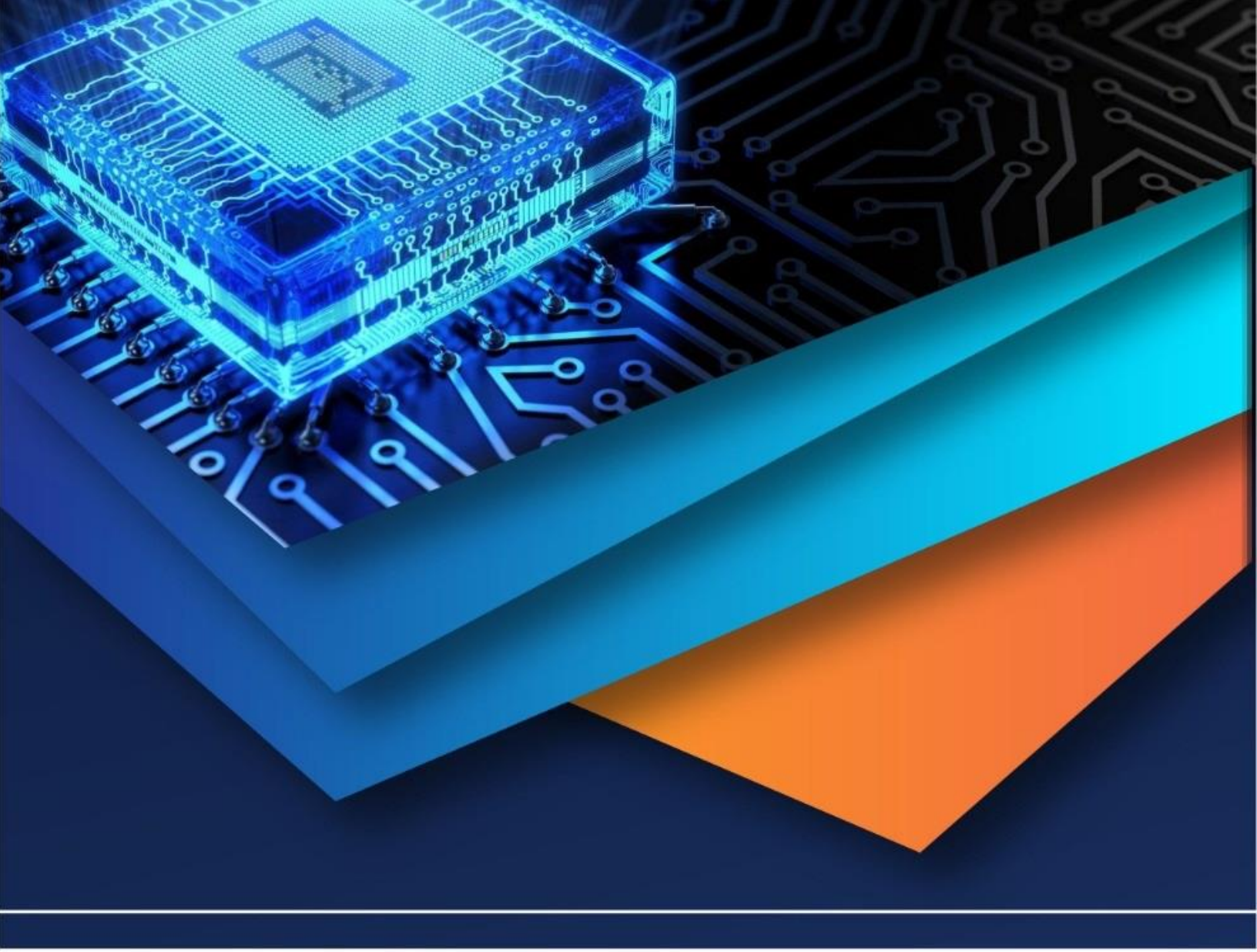

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