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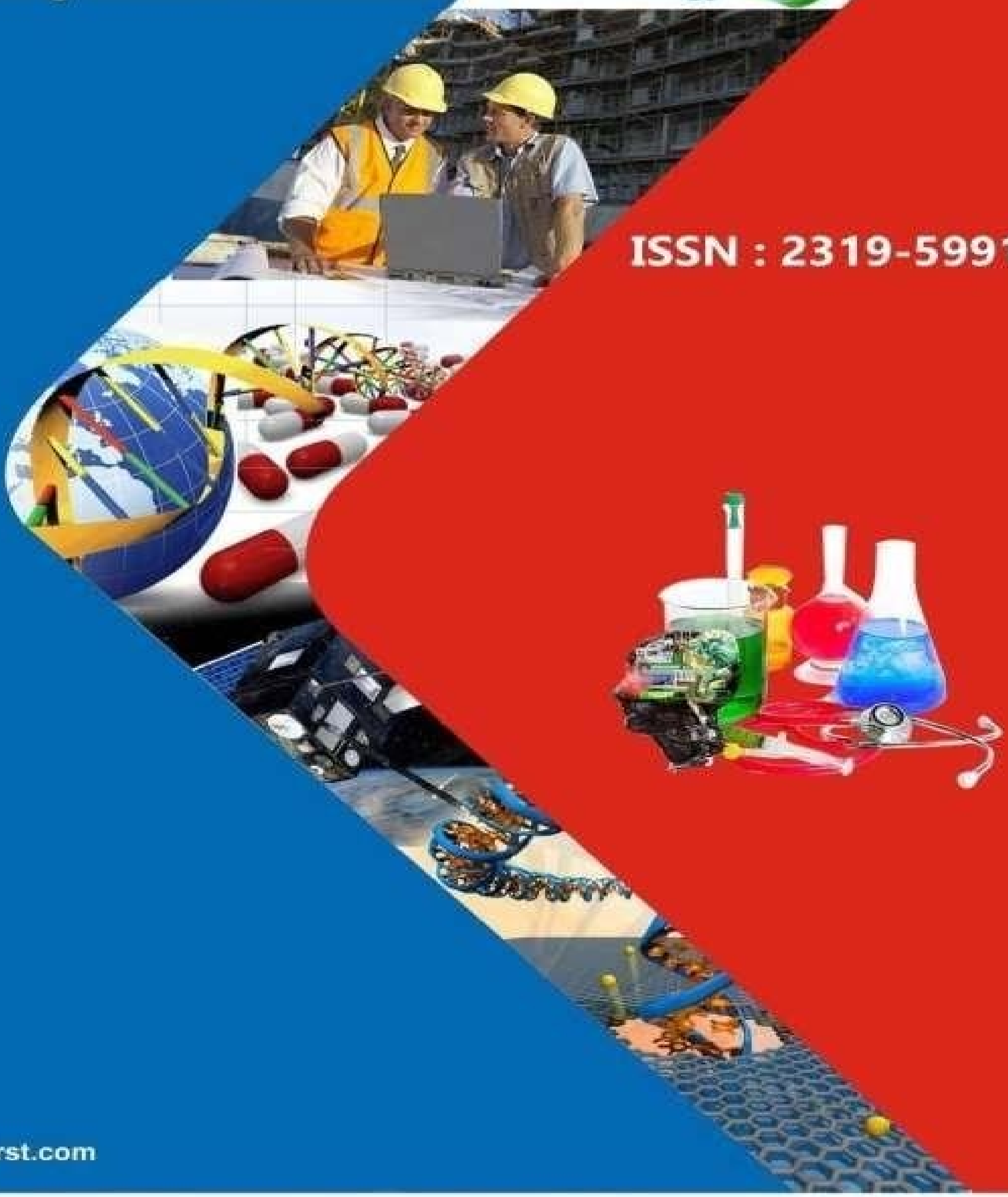

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IOT AND MACHINE LEARNING BASED SMART SOIL IRRIGATION FARMING SYSTEMS

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ABSTRACT

Agriculture plays vital role in development of social and economic condition of the all countries in the world. Water is the source of life and also a precious source for agriculture. Emerging trends in agriculture aims at ensuring more productivity, less damage to the land and helpful for the concept of Sustainable Agriculture (12). Crop productivity is mainly dependent on soil moisture level, less moisture result in loss of yield and plants dying. Excess water causes water wastage and root diseases. To maximize crop production the adequate water quantity at right time is required. In the proposed study IOT and Machine Learning based automated irrigation system developed. The system is divided in to three stages, first is circuit building and sensors installation, the second stage is of reading sensor data and checks the present soil moisture level and in third stage motor ON and OFF decisions is taken by considering the crop type. On server the sensor data is get stored, system gives real time data from the sensors. IOT (Internet of Thing) helps to implement Wireless Sensor Network and Machine Learning can manage optimum water utilization for precious farming by analyzing available data. Finally, the experiments are conducted on the samples collected from the farmland of wheat crops. Additionally, two different scenarios are considered to collect the water requirement samples. Based on the experimental and theoretical analysis of water requirements the proposed irrigation system can reduce the water demand by up to 25% as compared to traditional ways of irrigation. Moreover, in comparison of popular valve automation system the proposed multiple value based system reduces the amount of water wastage up-to 22%. Therefore by utilizing the advance computational techniques (IOT and ML), we can reduce the cost of irrigation system and planning.

Keywords: Microcontroller, LCD, IOT, MQ-3 Sensor, Buzzer, Fire Sensor, MQ-2 sensor, Power Source, Relay, Water Motor.

I. INTRODUCTION

1.1 INTRODUCTION

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Microcontroller are widely used in Embedded Systems products. An Embedded product uses the microprocessor (or microcontroller) to do one task & one task only. A printer is an example of Embedded system since the processor inside it perform one task only namely getting the data and printing it. Although microcontroller is preferred choice for many Embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in recent years many manufactures of general-purpose microprocessors such as INTEL, Motorola, AMD & Cyrix have targeted their microprocessors for the high end of Embedded market. One of the most critical needs of the embedded system is to decrease power consumptions and space. This can be achieved by integrating more functions into the CPU chips. All the embedded processors have low power consumptions in additions to some forms of I/O, ROM all on a single chip. In higher performance Embedded system, the trend is to integrate more & more function on the CPU chip & let the designer decide which feature he/she wants to use.

1.2 EMBEDDED SYSTEM

Physically, embedded systems range from portable devices such as digital watches and MP3 players to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected. Embedded systems span all aspects of modern life and there are many examples of their use. Telecommunications systems employ numerous embedded systems from telephone switches for the network to mobile phones at the end-user. Computer networking uses dedicated routers and network bridges to route data.

EXAMPLES OF EMBEDDED SYSTEM:

Automated teller. machines (ATMS). Integrated system in aircraft and missile. Cellular telephones and telephonic switches. Computer network equipment, including routers timeservers and firewalls. Computer printers, Copiers. Disk drives (floppy disk drive and hard disk drive). Engine controllers and antilock brake controllers for automobiles. Home automation products like thermostat, air conditioners sprinkles and security monitoring system. House hold appliances including

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microwave ovens, washing machines, TV sets DVD layers/recorders. Medical equipment. Measurement equipment such as digital storage oscilloscopes, logic analysers and spectrum analysers. Multimedia appliances: internet radio receivers, TV set top boxes.Small hand-held computer with P1M5 and other applications. Programmable logic controllers (PLC's) for industrial automation and monitoring. Stationary video game controllers.

1.3 CHARACTERISTICS:

Embedded systems are designed to do some specific tasks, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. Embedded systems are not always standalone devices. Many embedded systems consist of small, computerized parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.

The software written for embedded systems is often called firmware, and is usually stored in read- only memory or Flash memory chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen, and little memory.

1.4 MICROPROCESSOR (MP):

A microprocessor is a general-purpose digital computer central processing unit (CPU). Although popularly known as a "computer on a chip" is in no sense a complete digital computer. The block diagram of a microprocessor CPU is shown, which contains an arithmetic and logical unit (ALU), a program counter (PC), a stack pointer (SP), some working registers, a clock timing circuit, and interrupt circuits.

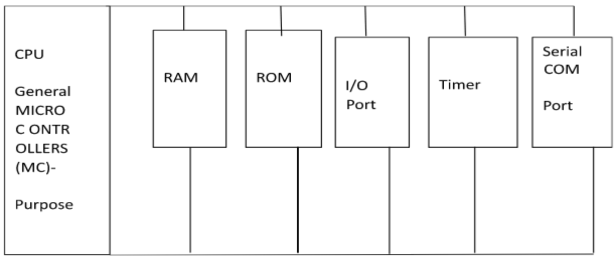

Fig 1.1 Block diagram of microprocessor

1.5 MICROCONTROLLER (MC):

Figure shows the block diagram of a typical microcontroller. The design incorporates all of the features found in micro-processor CPU: ALU, PC, SP, and registers. It also added the other features needed to make a complete computer: ROM, RAM, parallel I/O, serial I/O, counters, and clock circuit.

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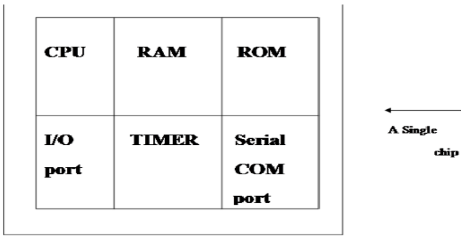

Fig 1.2 Microcontroller

1.6 COMPARISION BETWEEN MICROPROCESSOR AND MICROCONTROLLER

The microprocessor must have many additional parts to be operational as a computer whereas microcontroller requires no additional external digital parts. The prime use of microprocessor is to read data, perform extensive calculations on that data and store them in the mass storage device or display it. The prime functions of microcontroller is to read data, perform limited calculations on it, control its environment based on these data. Thus the microprocessor is said to be general-purpose digital computers whereas the microcontroller are intend to be special purpose digital controller. Microprocessor need many opcodes for moving data from the external memory to the CPU, microcontroller may require just one or two, also microprocessor may have one or two types of bit handling instructions whereas microcontrollers have many.

II. LITERATURE SURVEY

2.1 INTRODUCTION

In India, where agriculture accounts for 60-70 percent of the GDP, there is a pressing need to modernize traditional agricultural techniques in order to increase output. The groundwater table is lowering day by day as a result of uncontrolled water usage; lack of rainfall and shortage of land water also contribute to a decrease in the amount of water on the planet. Water scarcity is currently one of the world's most pressing issues. Water is required in every sector. Water is also necessary in our daily lives.Agriculture is one of the industries that need a lot of water. Water wastage is a serious issue in agriculture. Every time there is a surplus of water, it is distributed to the fields.Climate change and its consequences are widely explored in academic studies on water resources and agriculture. Because of the potential repercussions of global warming, water adaptation methods are being considered to assure water availability for food and human production as well as ecosystem sustainability. Additionally, the safety of water for human consumption and return to the environment must be maintained. Increased water shortages, poor quality of water, higher water and soil salinity, loss of biodiversity, increased irrigation needs, and the expense of emergency and corrective action are all possible risks from climate change. As a result of these factors, a rising number of researches are focusing on creating creative water utilization in irrigation. The Internet of Things (IOT) has now progressed from a concept to

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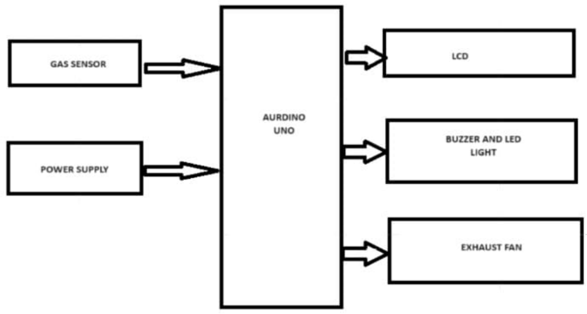
being implemented in real world applications. Since then, the technological and application hurdles have been considerable.IoT platforms enable complex real-time control systems by layering communication infrastructure, hardware, software, analytical approaches, and application knowledge. Recognizing the expected IOT consequences on systems is one of the most difficult technological issues, because IOT allows systems to become service mashups, combining items as services. System development will become dynamic plugand-play interoperable service composition, and system logic will become service orchestration as a result.An IOT-based smart irrigation system with an effective machine learning algorithm is developed to assist farmers in overcoming the uncertainty of rainfall and increasing production. This model provides a superior irrigation decision-making model. This research presents a Machine Learning (ML) strategy for successfully regulating irrigation and enhancing agricultural yield as a result..

III. PROBLEM STATEMENT

In general, there is no automated irrigation method that is being used all over the world. However, some study has been done in the topic of automating the watering process. In most existing studies, the following is the basic method for Automated Irrigation: To begin, data is collected from several sensors to determine the moisture content of the soil and the temperature of the surrounding environment. They're attached to a breadboard that's wired up to the Arduino board. The Arduino IDE receives the data from the board. The programming language employed executes instructions that extract data and reflect it, i.e., a decision is made whether to turn the water pump "On" or "Not" based on the extracted data.

3.1 BLOCK DIAGRAM OF EXISTING SYSTEM

shows block diagram of existing system



Block diagram of Existing System

3.1 Disadvantages of Existing System:

High Initial Cost: Installing a comprehensive IOT and machine learning-based irrigation system can be expensive due to the cost of sensors, actuators, data processing infrastructure, and necessary software.

Technical Complexity: Understanding and managing the complex technology behind these systems can be challenging for farmers with limited technical expertise.

Data Accuracy Dependence: The effectiveness of the system heavily relies on accurate data from sensors, which can be

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affected by environmental factors like weather fluctuations and soil variations.

Weather Dependency: While the system can adapt to weather changes, extreme weather events can still significantly impact irrigation needs, potentially requiring manual adjustments.

Sensor Malfunction Issues: Sensor failures can lead to inaccurate data, resulting in improper irrigation practices and potential crop damage.

IV. PROPOSED SYSTEM

Irrigation can be automated utilizing sensors, microcontrollers, Wi-Fi modules, and the Thing Speak platform. A controller is necessary to maintain all of the sensors and to drive the motor as needed. We utilized Arduino UNO to accomplish this. The Arduino UNO can output a maximum voltage of 5 volts. The moisture sensors module and DTH11 sensor can both be powered by 5 volts, but not the motor. We need at least 7 volts to run a motor. To solve this issue, we utilized a 9v battery to power the motor. We'll need a switch to regulate the motor whenever it's needed. We utilized a relay module to accomplish this. It's a switch in the electrical system. We must deliver a strong pulse to the module in order to close the switch. The field is constantly monitored by the soil moisture sensor. Arduino UNO is attached to the sensors. The sensor data is sent to the user via wireless transmission so that he can manage irrigation

4.1 BLOCK DIAGRAM OF PROPOSED SYSTEM

the block diagram of proposed system. The proposed system contains different modules consisting of both hardware and software components

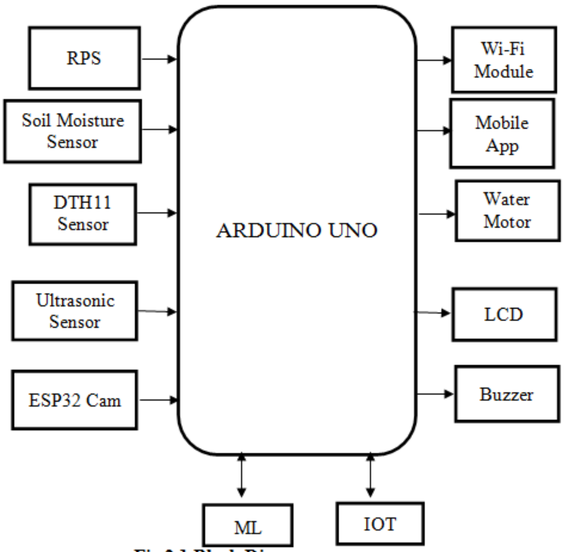

Fig 2.1 Block Diagram

V. BLOCK DIAGRAM OF PROPOSED SYSTEM

HARDWARE COMPONENTS

Power Supply, Arduino UNO, Soil Moisture Sensor, DTH11 Sensor, Ultrasonic Sensor, ESP32 Cam, Wi-Fi Module, Water Motor, LCD, Buzzer

SOFTWARE COMPONENTS

The following software tools used in the proposed system

Arduino IDE, Proteus Design Tool

VI. RESULT AND DISCUSSION

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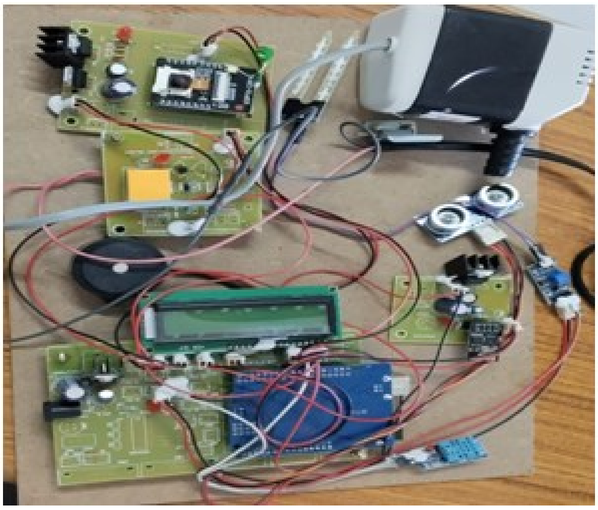
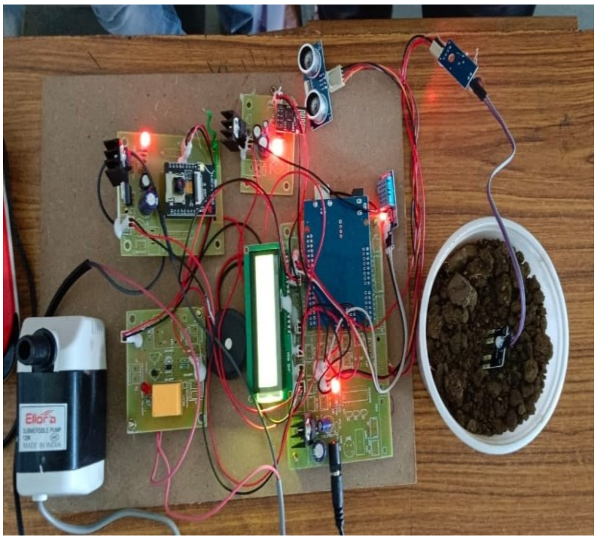
6.1 PROTOTYPE (THROUGH KIT)

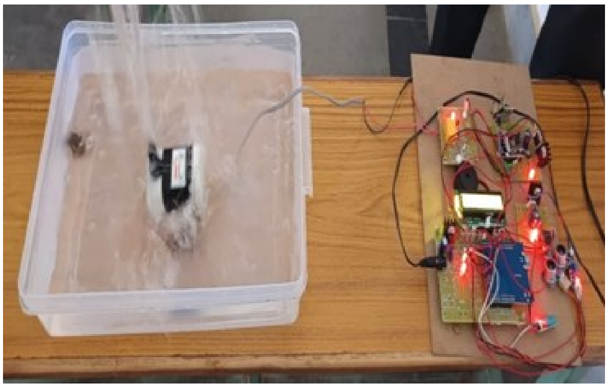
shows the prototype of the project



EXPERIMENTAL RESULTS

shows the displaying the gas on LCD





VII. CONCLUSION

Regular crop updates, such as moisture, humidity, and temperature, are critical in agriculture. Climate forecasting data accuracy has increased dramatically as a result of technological advancements, and weather forecasting data may now be utilised to estimate rainfall in a specific location. To estimate rainfall possibilities, this study suggests an Automated Irrigation System that uses the Internet of Things and Ensemble Learning techniques. The suggested technique predicts rainfall in the near future by combining sensor data from the recent past with weather projected data. We utilised the Ensemble learning approach to forecast the likelihood of rain on that particular day. Rather than constructing separate specialised models and calculating classification metrices for each of them, the main purpose of this technique is to develop a single model that trains numerous models and classifies the output based on their aggregate majority of votes for each output class. Forecasted rainfall possibilities are superior in terms of accuracy and mistake rate. A solo system prototype can also use the prediction method. The system prototype is low-cost because it is based on open-source technologies. We'd like to perform a water-saving study based on the suggested technique in the future, with more nodes and a lower system cost. The irrigation system automation we provided as part of our strategy performed wonderfully. It's also

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costeffective. Using this technique, we can reduce the number of people needed in the fields for upkeep. This approach will not only irrigate the ground automatically based on the moisture level in the soil and the possibility of rain, but it will also send the data to the Thingspeak server, allowing the farmer to keep track of the land's status..

VIII. FUTURE SCOPE

A solo system prototype can also use the prediction method. The system prototype is low-cost because it is based on open-source technologies. We'd like to perform a wa-ter-saving study based on the suggested technique in the future, with more nodes and a lower system cost. The irrigation system automation we provided as part of our strategy performed won-derfully. It's also cost effective. Using this technique, we can reduce the number of people needed in the fields for upkeep.This approach will not only irrigate the ground automatically based on the moisture level in the soil and the possibility of rain, but it will also send the data to the Thing speak server, allowing the farmer to keep track of the land's status

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