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A SMART IRRIGATION SYSTEM USING ARDUINO UNO

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ABSTRACT

The smart irrigation system is an automatic irrigation system which is being widely used in the field of agriculture. Irrigation is practiced in farms where there is a scarcity of water. This smart irrigation system is a farmer-friendly irrigation system, which is completely automated. This system runs without intervention of humans. This smart irrigation system, using Arduino-Uno, checks the moisture level in the soil. If the moisture level in the soil is low, it automatically sends an alert message and turns on the water motor to flow water to the soil. If the moisture level in the soil is sufficient, it switches off the motor. This system helps in agricultural crop growth and soil maintenance. The smart irrigation system reduces the effect caused by insufficient rainfall. This irrigation system prevents excess of water flowing into the soil which causes wastage of water, electricity and damage to the soil, effectively.

Keywords: Smart Irrigation, Arduino Uno, Automatic, Soil moisture sensor, Water motor.

1. INTRODUCTION

Each day, our lives become more dependent on 'embedded systems', digital information technology that is embedded in our environment. More than 98% of processors applied today are in embedded systems, and are no longer visible to the customer as 'computers' in the ordinary sense. An Embedded System is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass- produced, benefiting from economies of scale.

The increasing use of PC hardware is one of the most important developments in high-end embedded systems in recent years. Hardware costs of high-end systems have dropped dramatically as a result of this trend, making feasible some projects which previously would not have been done because of the high cost of non-PC-based embedded hardware. But software choices for the embedded PC platform are not nearly as attractive as the hardware.

Typically, an embedded system is housed on a single microprocessor board with the programs stored in ROM. Virtually all appliances that have a digital interface watches, microwaves, VCRs, cars utilize embedded systems. Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program. 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. The applications software on such processors is sometimes referred to as firmware. The simplest devices consist of a single microprocessor (often called a "chip"), which may itself be packaged with other chips in a hybrid system or Application Specific Integrated Circuit (ASIC). Its input comes from a detector or sensor and its output goes to a switch or activator which (for example) may start or stop the operation of a machine or, by operating a valve, may control the flow of fuel to an engine. As the embedded system is the combination of both software and hardware.

Agriculture stands as one of the cornerstones of human civilization, providing sustenance and indispensable products to communities worldwide. Nevertheless, this vital sector faces a critical challenge due to its substantial dependence on water resources. With water scarcity becoming an increasingly prevalent issue across various regions, the quest for sustainable water management in agriculture has grown more urgent than ever before. Automatic irrigation systems are becoming increasingly popular as a way to conserve water and improve crop yields. These systems use sensors to monitor soil moisture levels and weather conditions, and they can automatically turn on or off irrigation water supplies as needed. This can help to ensure that crops receive the right amount of water at the right time, which can lead to increased productivity and profitability[1]. In this context, the implementation of an automatic irrigation system emerges as a promising solution to address the pressing concerns of water conservation and labor optimization in agriculture. By adopting such innovative technology, farmers can revolutionize their irrigation practices, significantly improving water efficiency and crop yield. The focal point of this research presentation revolves around an automatic irrigation system utilizing the Arduino Uno microcontroller—a cutting-edge development in the realm of agricultural automation. By harnessing the capabilities of the Arduino Uno, this system showcases a proficient means to monitor and manage crop hydration with precision and intelligence. The overarching goal of this study is to explore how the automatic irrigation system, based on the Arduino Uno, can facilitate resource-efficient farming practices. By integrating technology into agriculture, the system aims to curtail water consumption while simultaneously reducing the labor-intensive efforts traditionally associated with manual irrigation. Through this presentation, we delve into the multifaceted benefits of embracing an automatic irrigation system in modern agriculture. As we uncover the potential advantages of water savings, labor optimization, and sustainable farming, we emphasize the transformative impact that this technology can have on the agriculture sector, paving the way towards a more resilient and ecologically responsible future.

2. LITERATURE SURVEY

In Veena Divya,k, Ayush Akhouri “A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methology”deal GSM based Irrigation Control System, which could give the facilities of maintaining uniform environmental conditions. For this, a software stack called Android is used for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. This system covered lower range of agriculture land and not economically [1]

In Mansour ”Impact The Automatic Control Of Closed Circuits Rain gun Irrigation System On Yellow Corn Growth And Yield” this research paper deals of automatic control of closed circuits drip irrigation system as a modified irrigation system on yellow corn crop vegetative and yield parameters under (KSA) Saudi Arabia conditions at Al-Hasa region. The field experiment carried out under automatic irrigation system for three irrigation lateral lines 40, 60, 80 m under the following three Drip Irrigation Circuits (DIC) of: a) one manifold for lateral lines or closed Circuits with one Manifold Of Drip Irrigation System (CM1DIS); b) closed circuits with two manifolds for lateral lines (CM2DIS), order to compensate for ETc and salt leaching requirement. and take more power [2].

In M. Guerbaoui, elafou,a.ed-dahhak ” GSM based automated drip irrigation system ” we proposed a system contribution to the development of greenhouse production in Morocco. The proposed solution involves the development of an integrated system for automate the drip fertilizing irrigation in green house. The solution adopted involves a data acquisition card PCL-812PG controlled by PC. The irrigation is provided by a hydraulic circuit based on an electric pump. Water needs are evaluated by measuring soil water status by soil humidity sensor [3].

In Purnima, S.R.N Reddy, “Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth” ,proposed artificially supplying water to land where crops are cultivated. Traditionally hand pumps, canal water and rainfall were a major source of water supply for irrigation. This method has led to severe drawbacks like under irrigation, over-irrigation which in turn causes leaching and loss of nutrient content of soil. Changing environmental conditions and shortage of water have led to the need for a system which efficiently manages irrigation of fields. Automated irrigation system is a machine based system, which automates the irrigation of land by combining various software and hardware approaches together for field irrigation. This paper deals with a detailed survey of various GSM based automated farm irrigation systems. GSM serves as an important part since it is responsible for controlling the irrigation facility and sends them to receiver through coded signal. Our study is concentrated on comparison of various GSM approaches [4].

Jin Li, “Filter Design and Optimizing based on a Neural Network” To improve irrigation water use efficiency, reduce cost of irrigation water, this paper discussed the design of wireless sensor network and Internet technology of farmland automatic irrigation control method. Emphasis on an analysis of the routing protocol of sensor network nodes to achieve the system hardware and software design, middleware, and applications such as mobile phone or wireless PDA of internet of things, will constitute a variety of sensors intelligent network, thus enhancing the overall automation system and monitoring levels. The final analysis of the network in the Internet based on the agricultural plants of farmland water-saving irrigation system integrated approach. User use mobile phones or wireless PDA can easily soil moisture content of online monitoring and control to realize the irrigation automation. As a new internet of things information network , for most types of agricultural materials, agricultural products through the Internet of Things will be fresh growth state, response to environmental changes, storage preservation, distribution and quality and safety of equipment, machinery, With the development of internet of things, its technology has been widely applied to all aspects of agricultural production, water-saving irrigation involves engineering, agriculture, biology, automation, communications, and many other technologies. water-saving irrigation automatic control system based on wireless sensor using the sensor and set the conditions and the receiver communication, control irrigation systems, valves open, close, so as to achieve the purpose of automatic water-saving irrigation [5].

3. SYSTEM CONSTRUCTION

The Arduino-based plant irrigation system is a simple yet effective project designed to automate the watering process of plants using a microcontroller and sensor technology. This system uses an Arduino Uno as the central controller, a soil moisture sensor to monitor the water content in the soil, a motor driver to control the power to the pump, and a pump motor to deliver water to the plant. The soil sensor continuously checks the moisture level, and when it drops below a predefined threshold, the Arduino activates the motor driver, which turns on the pump to irrigate the plant. Once the soil reaches an adequate moisture level, the pump automatically shuts off, preventing overwatering. This project is ideal for home gardens, greenhouses, or educational purposes, promoting efficient water use and reducing the need for manual intervention in plant care.

In the existing plant irrigation methods, watering is typically done manually or through basic automatic systems such as timers. These systems do not take into account the actual moisture level of the soil, which often results in either overwatering or underwatering. Even in basic automated systems using an Arduino, the process is relatively simple: a soil moisture sensor checks the soil condition, and if it's dry, the Arduino Uno activates a motor driver that powers a pump motor to water the plant. Once the soil moisture reaches a set level, the system shuts off the pump. However, this basic system often lacks real-time adaptability, data logging, and advanced control features like weather prediction or multiple plant zone management, which limits its efficiency and scalability[6].

System Components

- Arduino Uno: The central controller of the system. It processes data from the soil moisture sensor and controls the irrigation pump accordingly.
- Soil Moisture Sensor: Measures the moisture content of the soil. It provides an analog output that the Arduino reads to determine whether the soil is dry or wet.
- I2C LCD Display: An LCD screen with I2C communication that displays the status of the soil moisture and irrigation system. This makes it easy to monitor the system's functioning.
- Motor Driver (e.g., L298N): This component is used to control the pump motor. The motor driver receives the control signals from the Arduino and switches the pump on or off.
- Pump Motor: A small 12V water pump used to water the plant when the soil moisture is below a set threshold. The motor pumps water from a reservoir to the plant.
- Power Supply: A 12V DC adapter or battery to power the pump motor and the motor driver and 5V supply for the Arduino (can be from a USB cable or a separate adapter).
- Relay Module: One of the most common uses for relay modules is to control high-power devices from a low-power microcontroller.

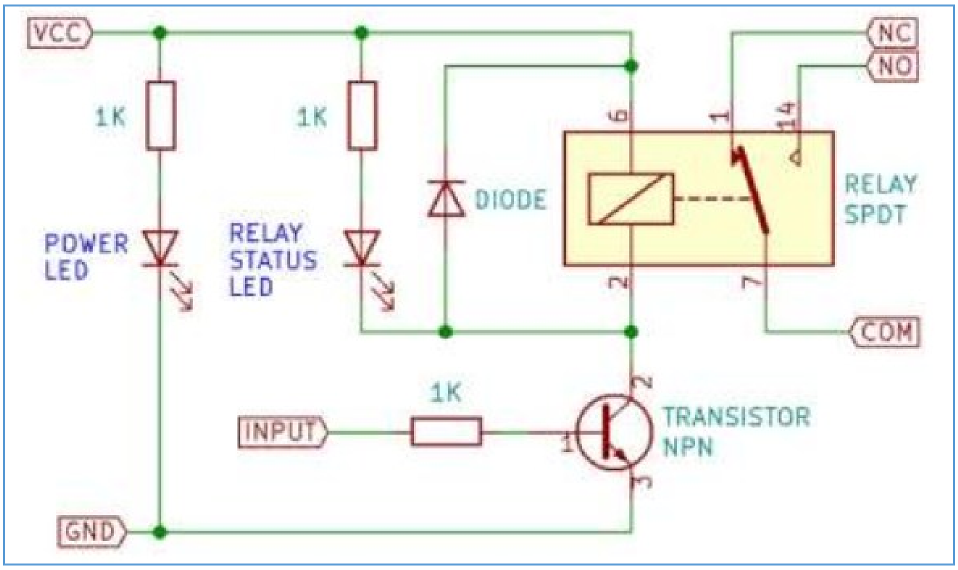

Figure 1: Relay module Circuit diagram.

For example, you could use a relay module to control a light bulb from an Arduino. The relay module would take the low-power signal from the Arduino and use it to switch on or off a high-power circuit that controls the light bulb[7]. The relay module acts as a crucial safety feature, separating the low-voltage Arduino Uno from the higher voltage requirements of the water pump. By functioning as a control interface, the relay module enables the Arduino Uno to safely manage the water pump's activation and deactivation. This isolation ensures that the microcontroller remains protected and extends its lifespan while effectively controlling the water pump.

System Work Flow

- Soil Moisture Sensing: The soil moisture sensor detects the moisture level in the soil. The analog signal it sends to the Arduino will vary depending on the soil's moisture content. A higher signal indicates more moisture, and a lower signal means the soil is dry.
- Threshold Comparison: The Arduino compares the moisture level to a preset threshold value. If the moisture is below the threshold (indicating dry soil), the system activates the pump to water the plant. If the moisture level is above the threshold (indicating wet soil), the pump stays off.
- Motor Control: The motor driver controls the pump motor. When the Arduino sends a signal to turn the motor on, the motor driver powers the pump, allowing water to be pumped from the reservoir to the plant.
- Display Feedback: The LCD display shows the current moisture level and updates in real time. It also displays messages like "Watering..." or "Moisture OK" to inform the user of the system's status.

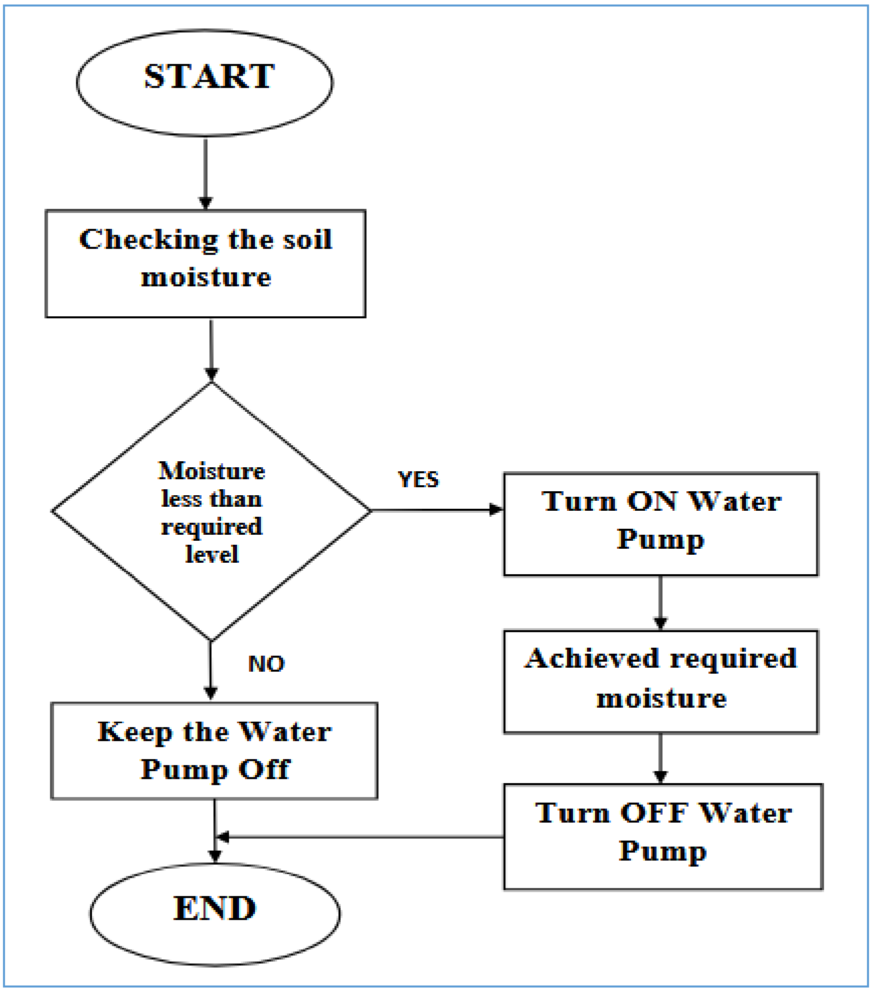

Figure 2: Flow Chat of Irrigation System

The automatic irrigation system using Arduino Uno represents a significant advancement in agricultural practices, particularly concerning water management and sustainability. The system's functionality initiates with the moisture sensor, which diligently measures the soil's moisture level. This sensor continuously provides real-time data to the Arduino Uno, the central control unit of the system. Leveraging its versatile programming capabilities, the Arduino Uno processes the moisture data and compares it to a pre-set threshold value that can be customized to suit various plant species and environmental conditions. Upon detecting that the soil's moisture level has fallen below the

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threshold, signaling the need for irrigation, the Arduino Uno promptly takes action. It activates the water pump connected through a relay module, enabling water to flow to the plants. The water pump ensures the plants receive the optimal hydration required for healthy growth. The intelligent irrigation process continues until the soil moisture level reaches the desired threshold, prompting the Arduino Uno to deactivate the water pump. This water-saving mechanism efficiently conserves water resources, prevents over-irrigation, and reduces unnecessary water consumption. The automatic irrigation system's brilliance lies in its continuous loop operation, tirelessly monitoring the soil's moisture level to deliver the appropriate amount of water to the plants based on their immediate needs. This iterative cycle optimizes water usage, minimizes irrigation costs, and fosters resource-efficient agriculture[8].

The system's user-friendly assembly and maintenance further enhance its appeal, making it a practical and accessible solution for farmers and gardeners alike. By embracing the automatic irrigation system with Arduino Uno, agriculture takes a significant stride towards sustainability. Its ability to enhance crop yields, improve soil health, and conserve water resources underscores its indispensable value in modern farming practices. This innovative technology empowers farmers to adopt responsible water management practices, safeguard the environment, and pave the way for a more resilient and prosperous agricultural future. The complete work flow of the system is represented in the fig (2). The process starts with giving the supply to the system. When the system gets started then the soil moisture sensor checks the moisture

content in the soil. If the moisture level of the soil is less than the required level then the water pump gets into the one state. Once the moisture level is achieved the required level then the water pump turns off and the process ends. If the soil moisture level is not less than the required level then the water pump remains off and the process ends[9].

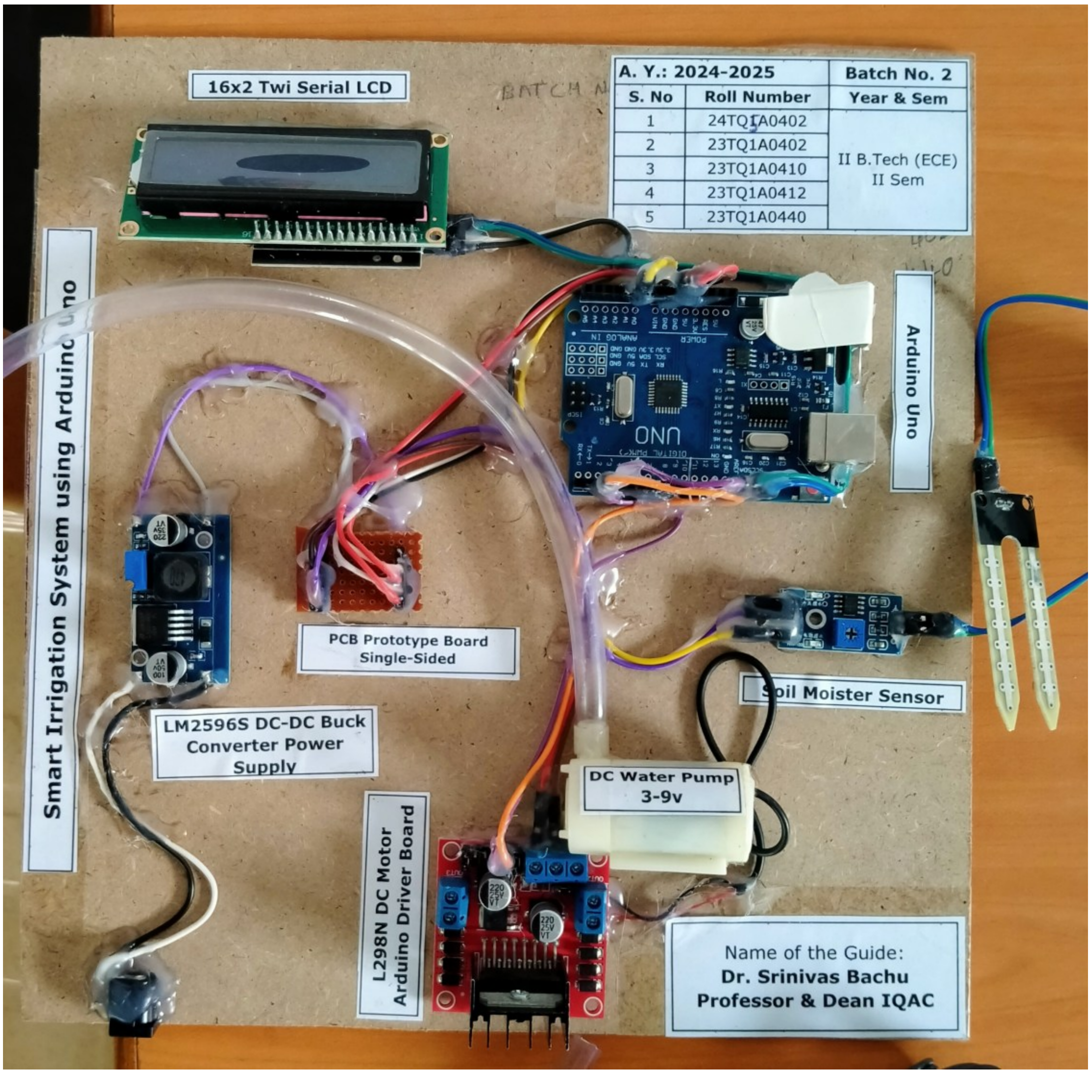

Figure 3 . Connection of the Automatic Watering System.

4. CONCLUSION

The Irrigation System Using Arduino project successfully demonstrates how automation can be integrated into agriculture to enhance water efficiency and reduce manual labor. By utilizing sensors to monitor soil moisture and an

Arduino microcontroller to control a water pump, the system ensures plants receive adequate water only when necessary. This not only conserves water but also promotes healthier plant growth. The project is cost-effective, scalable, and adaptable, making it a practical solution for both small gardens and larger agricultural fields. Future improvements can include integrating wireless connectivity for remote monitoring and solar power for energy efficiency.

5. REFERENCES

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