
ISSN: 2321-2152
IJMECE
International Journal of modern
electronics and communication engineering
E-Mail
editor.ijmece@gmail.com
editor@ijmece.com
www.ijmece.com

ISSN2321-2152

www.ijmece .com

Vol 12, Issue.2 April 2024

IoT Enabled Drip Irrigation System with Weather Forecasting

Oduri Ramesh [1], Daravath Rajesh [2],
Prem Kumar Kannuri [3], Akumarthi Bharath[4],
Dr. Md. Shahbaz Khan[5]
[1,2,3,4] UG Student, Department of ECE, CMR Institute of Technology, Hyderabad
[5] Associate Professor, Department of ECE, CMR Institute of Technology, Hyderabad

Abstract

Agriculture, or farming, is the science of cultivating the soil, growing crops, and raising livestock. Ever since the days of the first plow from sticks over ten thousand years ago, agriculture has always depended on technology. As technology and science improved, so did the scale at which farming was possible. With the popularity and growth of the Internet of Things (IoT) in recent years, there are even more avenues for technology to make agriculture more efficient and help farmers in every nation. In this paper, we designed a smart IoT-enabled drip irrigation system using ESP32 to automate the irrigation process, and we tested it. The ESP32 communicates with the Blynk app, which is used to collect irrigation data, manually water the plants, switch off the automatic watering function, and plot graphs based on the readings of the sensors. We connected the ESP32 to a soil moisture sensor, temperature sensor, air humidity sensor, and water flow sensor. The ESP32 regularly checks if the soil is dry. If the soil is dry and the soil temperature is appropriate for watering, the ESP32 opens a solenoid valve and waters the plants. The amount of time to run the drip irrigation system is determined based on the flow rate measured by the water flow sensor. The ESP32 reads the humidity sensor values and notifies the user when the humidity is too high or too low. The user can switch off the automatic watering system according to the humidity value. In both primary and field tests, we found that the system ran well and was able to grow green onions.

Introduction

Agriculture, which involves the cultivation of crops and animals, is one of the most essential practices for maintaining and

growing the human population. Not only does it provide nourishment to human beings, but it is also helpful in eliminating extreme poverty and boosting the economy of a country. Agriculture accounts for 4% of the global gross domestic product (GDP) and is projected to feed about 9.7 billion people by 2050 [1]. Agriculture has always depended on technology in one way or another. People used extremely simple tools for farming more than 12,000 years ago. The farm tools were often made of wood or animal bones [2]. As time went on, humans developed better tools for farming. By the second agricultural revolution in the U.S., tractors were a common sight in farmlands [3]. Water is essential for plant growth and the distribution of mineral nutrients. Irrigation involves the application of water to the soil through a system of pumps, tubes, and sprays. It is commonly used in areas where rainfall is low [4]. There are many different types of irrigation systems. For sustainable agriculture in desert countries, where efficient water use is necessary, drip irrigation systems are a great fit [5]. With drip irrigation, water is directly applied to the soil (close to the roots of the plants) in the form of droplets over time. The most significant advantage of drip irrigation systems compared to other systems is the amount of water saved [6,7].

Literature survey

Agriculture Overview: Development News, Research, Data | World Bank. Available online: https://www.worldbank.org/en/topic/agriculture/overview#1 (accessed on 12 December 2022).

Smart farming is a development that has emphasized information and communication technology used in machinery, equipment, and sensors in network-based hi-tech farm supervision cycles. Innovative technologies, the Internet of Things (IoT), and cloud computing are anticipated to inspire growth and initiate the use of robots and artificial intelligence in farming. Such ground-breaking deviations are unsettling current agriculture approaches, while also presenting a range of challenges. This paper investigates the tools and equipment used in applications of wireless sensors in IoT agriculture, and the anticipated challenges faced when merging technology with conventional farming activities. Furthermore, this technical

knowledge is helpful to growers during crop periods from sowing to harvest; and applications in both packing and transport are also investigated. Sustainable agriculture is a measure of the endurance and sustenance of food grains produced in an eco-friendly manner [1]. Sustainable agriculture helps in the encouragement of farming practices and approaches to help sustain farmers and resources. It is economically feasible and maintains soil quality, reduces soil degradation, saves water resources, improves land biodiversity, and ensures a natural and healthy environment [2]. Sustainable agriculture plays a significant role in preserving natural resources, halting biodiversity loss, and reducing greenhouse gas emissions [3].

Ranjan, S.; Sow, S. Drip Irrigation System for Sustainable Agriculture. Agric. Food 2020, 2, 67–69.

Water is important for optimum production of crops both in terms of quality and quantity. Increasing population is leading to increase in demand of food and as we know that agriculture uses a considerable portion of the water. So, we can say that the demand of water is increasing with the demand of food. About 70% of the global freshwater is used in agriculture. In many developed countries this use has been decreased because of increase in the use of irrigation practices with higher water use efficiency like drip irrigation. Farmers are aware of the current and the upcoming competition for water so they know that the adoption of efficient irrigation systems is beneficial for them. Drip irrigation is an efficient irrigation method that delivers water slowly and directly to the plant root systems when network of pipes. It reduces the loss of water due to evaporation which is very common in other type of irrigation methods like flooding. It is also called as micro irrigation. Management of the drip irrigation system requires proper knowledge of the system, climate and environmental conditions for the growing crop. The impact of climate variables for plant growth and production in different season should be properly understood so that management practices for optimum production can be achieved. In drip irrigation system, water is supplied to the crop drop by drop at very low rate from a system of small diameter plastic pipes fitted with outlets called emitters for drippers. It is also called as trickle irrigation.

It does not wet the whole soil profile like surface or sprinkler method of irrigation, it only gets a part of soil in which roots grow. In other words, it delivers water and nutrients directly to the plant roots on in the right amount at the right time so that each plant can achieve its proper growth and development.

Mangi, N. Performance and evaluation of drip irrigation system, and its future advantages. Sch. Rep. 2020, 4, 27–41

The drip irrigation system is a kind of micro-irrigation system that has the potential to salvage the water and other nutrients by entrance water to drip gradually to the main roots of plants and other plant parts, which is from on the soil surface or buried inside the soil surface. The main aim of drip irrigation is to place water directly into the main root zone and decrease the water vapor. The system Drip irrigation spreads water through a schematic shape of different tubes, emitters, pipes, and valves. Its depending on the designed how well it make, maintained, installed, and operated it is, a system drip irrigation can be more useful than other various types of drip irrigation systems, like as sprinkler irrigation or surface irrigation. The system drip irrigation is firstly introduced mainly to save water and step-up the water use efficiency in agriculture field. More ever, it also presents various other social and economic benefits to the society. In drip irrigation system water is utalized micro jet or by drop by drop, on the surface of soil or under the soil, at a lower rate than the infiltration of the soil. In our this research, deeply research works heed water management for system drip irrigation and its upcoming advantages has been discussed and reviewed so that a precise perception may be existence for the farmers and for futures. Agriculture is actually responsible for seventy % of aver all world's water use, growing for food and fiber crops, fodder for livestock, bio-fuel, and fiber for clothes which is used in our daily life (i.e. cotton). Kang and Nishigama (1996) introduced a simple method for designing laterals used in drip irrigation systems. In this method, given the average discharge required in emitters, the uniformity needed in water application. Among twenty % of the agricultural sector irrigates its crops, and yet that segment is responsible for fourty % of the food from planet's. Irrigation is main key, Barak argues, to improving or advancements of crop production. The system Drip irrigation passes the water to plants through a schematic system of emitters and pipes, and supply controlled and slow method

of water. It is also high capital deeply than traditional irrigation systems, but apportions a very small quantity volume of water per unit of time with higher precision

Sathyapriya, E.; Naveenkumar, M.R.; Dhivya, V. An Empirical Study on Drip Irrigation. In Proceedings of the National Conference on Micro Irrigation, TNAU, Coimbatore, India, 1–3 March 2017.

Land and water are the basic needs for agriculture and economic development of the country. According to International Water Management Institute (IWMI), one-third of the world's population will face absolute water scarcity by the year 2025. Agriculture which consumes more than 80% of the country's exploitable water resources. The overall development of the agriculture sector and the intended growth rate in GDP is largely dependent on the judicious use of the available water resources. Hence, this Scheme on Micro Irrigation (MI), which aims at increasing the area under efficient methods of irrigation viz. drip irrigation. Drip irrigation is an efficient method of providing irrigation water directly into soil at the root zone of plants and thus, minimizes conventional losses such as deep percolation, runoff and soil erosion. It also permits the utilization of fertilizers, pesticides and other water-soluble chemicals along with irrigation water resulting in higher yields and better quality produce. Drip irrigation system is regarded as solution for many of the problems in dry land agriculture and improving the efficiency in irrigated agriculture. Keeping all these in view, the present study was designed to study the extent of benefits derived from drip irrigation in horticultural crops and to identify the constraints encountered by farmers in adopting the drip irrigation for horticultural crops. The results revealed that majority of drip irrigation farmers had expressed the advantages like saving of water, saving in labour cost for irrigation, increased yield, water saving, labour saving, increased quality of produce, reduced weed growth, extended self-life of produce and uniform application of water. The constraints encountered by the farmers had, problem of non-availability of quality material, no follow up services by drip agencies, high initial investment cost, lack of capital to cover maximum holding under drip irrigation, delay in sanction of loan, leakage in the present drip system. Hence, it

is clear from the study, drip irrigation agencies, financing institutions and others to supply adequate standard spare parts and other appropriate measures to ensure the satisfactory situation for proper adoption of drip irrigation method.

Verdouw, C.; Wolfert, S.; Tekinerdogan, B. Internet of Things in Agriculture. In CABI Reviews; CABI International: Wallingford, UK, 2016; pp. 1–12

This literature review on Internet of Things (IoT) in agriculture and food, provides an overview of existing applications, enabling technologies and main challenges ahead. The results of the review show that this subject received attention by the scientific community from 2010 on and the number of papers has increased since then. The literature on IoT in agriculture and food is very much dominated by Asian scientists, especially from China. In other continents, the concept of IoT was up to recently mainly adopted by non-agricultural scientists. The application area of food supply chains is addressed most frequently, followed by arable farming. Most papers report the results of explorative studies or they present IoT systems that are designed or implemented in prototypes and pilots. The literature reviewed focuses on sensing and monitoring, while actuation and remote control is much less addressed. The findings indicate that IoT is still in its infancy in the agriculture and food domains. Applications are often fragmentary, lack seamless integration and especially more advanced solutions are in an experimental stage of development

Verma, D.K.; Mishra, A.; Mishra, K. Role of IOT in Introducing Smart Agriculture. Int. Res. J. Eng. Tech. 2022, 9, 883–887.

Internet of Things (IoT) refers to the implementable Machine-to-Machine (M2M) communications which is a crucial component of recent growth in the digital market. In this paper, important agricultural applications are highlighted, and applicability of IoT towards improved performance and productivity are discussed. Characteristics of IoT are presented. Usable hard ware platforms, wireless communication technology standards, and IoT cloud services for agricultural applications are analyzed. Various sensor based IoT systems also listed in this paper. Author also reviewed and studied the

existing IoT deployments in multiple domains. IoT sensors may provide information about agriculture fields and then act on it based on user input. The development of a system that can monitor temperature, level of water, wetness, and even movement if any occurs in the field that may kill the crops in an agricultural field using sensors utilizing the Arduino UNO board is termed as smart agriculture. The goal is to integrate developing technologies, such as the Internet of Things (IoT) and smart agriculture with automation. After the hardware has been built to meet changing needs and technologies, the software must be updated

Existing system

The IoT-enabled drip irrigation system with weather forecasting is an innovative agricultural technology designed to optimize water usage and enhance crop yield. This system integrates Internet of Things (IoT) capabilities to enable remote monitoring and control of irrigation processes. Through a network of sensors placed in the soil, the system collects real-time data on soil moisture levels, temperature, and other relevant environmental factors. This data is then transmitted to a central hub, where it is analyzed to determine the precise irrigation needs of the crops.

One key feature of this system is its integration with weather forecasting technology. By accessing up-to-date weather forecasts, the system can anticipate changes in weather patterns, such as rainfall or temperature fluctuations. This information allows the system to adjust the irrigation schedule accordingly, ensuring that crops receive the optimal amount of water. The ability to adapt irrigation practices based on weather predictions not only conserves water but also helps prevent over-irrigation, which can lead to soil erosion and nutrient leaching.

Farmers can conveniently monitor and control the irrigation system through a user-friendly interface, often accessible via a mobile application or web portal. This remote accessibility provides farmers with the flexibility to manage irrigation operations from anywhere, saving time and resources. Additionally, the system may send real-time alerts and notifications to farmers in case of abnormal conditions or emergencies, enabling swift responses to potential issues.

Overall, the IoT-enabled drip irrigation system with weather forecasting represents a sustainable and technologically advanced approach to precision agriculture. By leveraging data-driven insights and predictive analytics, this system contributes to efficient resource utilization, improved crop yields, and environmentally responsible farming practices.

ISSN2321-2152

www.ijmece .com

Vol 12, Issue.2 April 2024

Proposed system

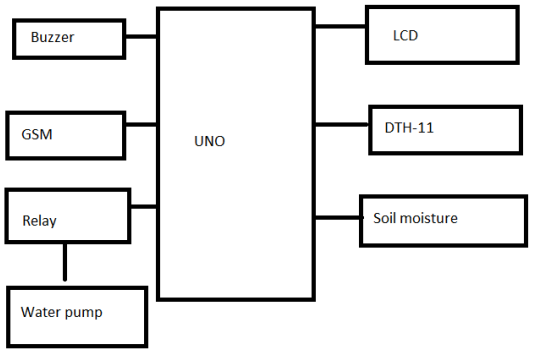
The proposed IoT-enabled drip irrigation system with weather forecasting aims to revolutionize traditional agricultural practices by integrating cutting-edge technology. This system leverages the Internet of Things (IoT) to create a smart and efficient irrigation solution. Sensors placed in the soil continuously monitor moisture levels, ensuring that crops receive the optimal amount of water. The IoT connectivity allows real-time data transmission to a central control unit, which can be accessed remotely by farmers through a user-friendly interface.

One of the key features of this system is its integration with weather forecasting. By incorporating weather data, the system can anticipate upcoming weather conditions and adjust the irrigation schedule accordingly. For instance, if rain is predicted, the system can temporarily halt irrigation to prevent overwatering and conserve resources. Additionally, it can proactively increase watering in anticipation of dry spells or high temperatures. This predictive capability enhances water efficiency and ensures that crops receive precisely tailored irrigation, leading to improved yields and resource utilization.

The user interface provides farmers with a comprehensive overview of the entire irrigation process, including real-time soil moisture levels, historical data, and upcoming weather forecasts. This empowers farmers to make informed decisions, optimize resource usage, and respond promptly to changing environmental conditions. The system also incorporates alerts and notifications, enabling farmers to receive instant updates on critical parameters or anomalies in the irrigation process.

In summary, the proposed IoT-enabled drip irrigation system with weather forecasting represents a significant advancement in precision agriculture. By seamlessly combining soil monitoring, IoT connectivity, and weather forecasting, this system offers a sustainable and intelligent approach to irrigation, contributing to enhanced crop productivity, water conservation, and overall farm management efficiency.

Block diagram



HARDWARE COMPONENTS

LCD (Liquid Cristal Display)

ISSN2321-2152

www.ijmece .com

Vol 12, Issue.2 April 2024

Introduction:

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

BUZZERS

In common parlance a Buzzer is a signaling device that is not a loudspeaker. It can be mechanical, electromechanical, or electronic (a piezo transducer). BeStar produces Buzzers in every available configuration for a wide variety of applications. A Piezo transducer can produce the sound for panel mount buzzers, household goods, medical devices and even very loud sirens. When a lower frequency is required an electromagnetic buzzer can fill the need. These are very common in automotive chimes and higher end clinical diagnostic devices. The BeStar buzzer range includes self drive units with their own drive circuitry (indicators), or external drive units, which allow the designer the flexibility to create their own sound patterns.

BeStar buzzers, whether a piezo buzzer, or an electro-magnetic buzzer, self (indicator) or non-self (transducer) drive are available with a variety of mounting methods, such as surface mount, thru hole, flange, wire leads or panel mounting. Sealed, high temp, very loud, weather resistant; whatever your application requirement is, BeStar has a

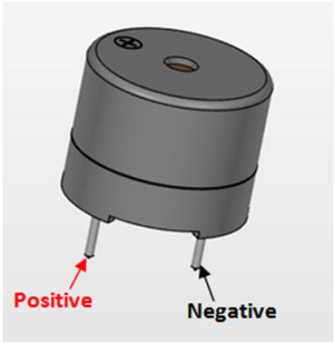
ISSN2321-2152

www.ijmece .com

Vol 12, Issue.2 April 2024

piezo buzzer that will meet your design criteria.

ACTIVE PASSIVE BUZZER



Active Passive Buzzer

Active Passive Buzzer Pinout

GSM (Global System for Mobile communications)

Introduction:

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

The rarer 400 and 450 MHz frequency bands are assigned in some countries, where these frequencies were previously used for first-generation systems.

RELAY MODULE

Relay modules are simply circuit boards that house one or more relays. They come in a variety of shapes and sizes, but are most commonly rectangular with 2, 4, or 8 relays mounted on them, sometimes even up to a 16 relays.

Relay modules contain other components than the relay unit. These include indicator LEDs, protection diodes, transistors, resistors, and other parts. But what is the module relay, which makes the bulk of the

device? You may ask. Here are facts to note about it:

- A relay is an electrical switch that can be used to control devices and systems that use higher voltages. In the case of module relay, the mechanism is typically an electromagnet.
- The relay module input voltage is usually DC. However, the electrical load that a relay will control can be either AC or DC, but essentially within the limit levels that the relay is designed for.
- A relay module is available in an array of input voltage ratings: It can be a 3.2V or 5V relay module for low power switching, or it can be a 12 or 24V relay module for heavy-duty systems.
- The relay module information is normally printed on the surface of the device for ready reference. This includes the input voltage rating, switch voltage, and current limit.

Conclusion

We were successful in building an IoT-enabled smart drip irrigation system. It provides an enhanced automation feature, where if the soil is dry, the temperature is in the ideal range for maximum water absorption, the time falls within the designated morning or evening irrigation windows, and the ESP32 will open the solenoid valve and water the plants. We added safety features to prevent scenarios such as over-irrigation, missing the irrigation time, or leaving the plants thirsty. Using the Blynk IoT dashboard, we can also monitor soil moisture, temperature, and air humidity. If the humidity is too low or too high, the admin user receives a notification on the Blynk app. We can use the Blynk dashboard to stop the automation function or manually open the valve based on the monitored data.

References

1. Agriculture Overview: Development News, Research, Data | World Bank. Available online: https://www.worldbank.org/en/topic/agriculture/overview#1 (accessed on 12 December 2022).

2. Woods, M.; Woods, M.B. Ancient Agricultural Technology: From Sickles to Plows; Twenty-First Century Books: Minneapolis, MO, USA, 2011; pp. 98–99. ISBN 978-0-7613-7269-1.

3. Bellis, M. Farm Machinery and Technology Changes from 1776 to 1990. Available online: https://www.thoughtco.com/americanfarm-tech-development-4083328 (accessed on 13 December 2022).

4. Types of Agricultural Water Use | Other Uses of Water | Healthy Water | CDC. Available online: https://www.cdc.gov/ healthywater/other/agricultural/types.html (accessed on 13 December 2022).

5. Ranjan, S.; Sow, S. Drip Irrigation System for Sustainable Agriculture. Agric. Food 2020, 2, 67–69.

6. Mangi, N. Performance and evaluation of drip irrigation system, and its future advantages. Sch. Rep. 2020, 4, 27–41.

7. Sathyapriya, E.; Naveenkumar, M.R.; Dhivya, V. An Empirical Study on Drip Irrigation. In Proceedings of the National Conference on Micro Irrigation, TNAU, Coimbatore, India, 1–3 March 2017.

8. Verdouw, C.; Wolfert, S.; Tekinerdogan, B. Internet of Things in Agriculture. In CABI Reviews; CABI International: Wallingford, UK, 2016; pp. 1–12. [CrossRef]

9. Verma, D.K.; Mishra, A.; Mishra, K. Role of IOT in Introducing Smart Agriculture. Int. Res. J. Eng. Tech. 2022, 9, 883–887.

10. Ghosh, S.; Sayyed, S.; Wani, K.; Mhatre, M.; Hingoliwala, H.A. Smart irrigation: A smart drip irrigation system using cloud, android and data mining. In Proceedings of the 2016 IEEE International Conference on Advances in Electronics, Communication and Computer Technology (ICAECCT), Rajarshi Shahu College of Engineering, Pune, India, 2–3 December 2016.

[11] Reddy, Kallem Niranjan, and Pappu Venkata Yasoda Jayasree. "Low Power Strain and Dimension Aware SRAM Cell Design Using a New Tunnel FET and Domino Independent Logic." International Journal of Intelligent Engineering & Systems 11, no. 4 (2018).

[12] Reddy, K. Niranjan, and P. V. Y. Jayasree. "Design of a Dual Doping Less Double Gate Tfet and Its Material Optimization Analysis on a 6t Sram Cells."

[13] Reddy, K. Niranjan, and P. V. Y. Jayasree. "Low power process, voltage, and

temperature (PVT) variations aware improved tunnel FET on 6T SRAM cells." Sustainable Computing: Informatics and Systems 21 (2019): 143-153.

[14] Reddy, K. Niranjan, and P. V. Y. Jayasree. "Survey on improvement of PVT aware variations in tunnel FET on SRAM cells." In 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), pp. 703-705. IEEE, 2017

[15] Karne, R. K. ., & Sreeja, T. K. . (2023). PMLC- Predictions of Mobility and Transmission in a Lane-Based Cluster VANET Validated on Machine Learning. International Journal on Recent and Innovation Trends in Computing and Communication, 11(5s), 477–483. https://doi.org/10.17762/ijritcc.v11i5s.7109

[16] Radha Krishna Karne and Dr. T. K. Sreeja (2022), A Novel Approach for Dynamic Stable Clustering in VANET Using Deep Learning (LSTM) Model. IJEER 10(4), 1092-1098. DOI: 10.37391/IJEER.100454.