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Automated Precision Irrigation

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Research

On

Automated Precision Irrigation

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ABSTRACT

Agriculture needs 85% of the available freshwater and its requirement may increase in future. Hence, a system is needed to utilize water efficiently in agriculture. The modern drip irrigation system lessens a significant amount of water usage compared to the traditional methods. And some crops need variable amounts of water as grow.

This seminar proposes an automation of drip irrigation in which the various mechatronics sensors calculates soil's wetness level and transmits the data onto the microcontroller. The microcontroller decides the irrigation and sends the status of the field to the Farmers.

Agriculture plays vital role in the development of agricultural country like India. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture

CONTENTS

ABSTRACT 4

1. INTRODUCTION 6

2. OBJECTIVE 7

3. LITERATURE REVIEW 8

3.1 What Is Drip Irrigation? 8
3.2 Why Should I Use Drip Irrigation? 8
3.3 Methods Of Irrigation 8
3.4 Developmental Stages Of Drip Irrigation 8

4. MY PROPOSED IDEA 9

4.1 Construction 10
4.1.1 Temperature sensor 10
4.1.2 Rain sensor 11
4.1.3 Automatic water control valves 11
4.1.4 Water level sensor 12
4.1.5 Humidity sensor 12
4.1.6 Soil moisture sensor 13
4.1.7 pH sensor 13
4.1.8 Microcontroller Control 14

5. WORKING 15

6. BENEFITS IN THIS FIELD 15

7. DEMERITS TO OVERCOME 16

8. APPLICATIONS 17

9. FUTURE SCOPE 18

10. RECENT TRENDS IN TOPIC 19

11. CONCLUSION 20

REFERENCES 21

1. INTRODUCTION

In India 60-70 % economy depends on the agriculture. With the different landforms, different atmospheric conditions, and unplanned use of waters natural resources which causes the shortage of water forces us to think in different way. Best solution to this problem is Drip irrigation system and Sprinkler irrigation. With the help of drip irrigation system we can also provide the fertilizers to crop. This process is called as Fertigation.

Fertigation allows us to apply the nutrients in right amount and uniformly at wetted root where the active roots of plants are present. Fertigation has the potential to ensure that the right combination of water and nutrients is available at the root zone, satisfying the plants total requirement of water and nutrient.

An interactive computer program was developed for estimation of irrigation water requirement, required amount of fertilizers, and capacity of fertilizer tank, capacity of drip system, injection duration and injection rates at different levels of Fertigation. The right combination of water and nutrients is the key for high yield and the quality of product.

2. OBJECTIVE

As agriculture is the largest employment source in India but due to unplanned use of water the ground water level is decreasing day by day, lack of rains and scarcity of land water also results in decrement in volume of water on earth, farmers are suffering from the unavailability of water problem.

One major reason of insufficient water for irrigation is that an unnecessary wastage of water due to traditional irrigation system. Most of the crops are very sensitive to water levels and available nutrients for proper growth. If water level with sufficient amount of nutrients are not maintained then the crops results in improper growth.

Hence, there should be a system which will help to provide precise level of water with nutrients to crops. Automated Irrigation is an artificial application of water to the soil using wireless system. An irrigation system is a system that delivers water to an area where water, nutrients, fertilizers are needed when required.

3. LITERATURE REVIEW

Drip irrigation, also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters. It is done through narrow tubes that deliver water directly to the base of the plant.

Drip irrigation saves water because little is lost to runoff or evaporation. This watering method also promotes healthy plant growth, controls weed growth, and reduces pest problems.

3.1 Synopsis

1. **R. Nageswara Rao, B.Sridhar, researched on 'Iot based smart crop-field monitoring and automation irrigation system', published on IEEE Xplore, 2018**

The proposed system developed on the information sent from the sensors and estimate the quantity of water needed. A two sensors are used to get the data to the base station the humidity and the temperature of the soil, the humidity, the temperature, and the duration of sunshine per day. The proposed systems based on these values and calculate the water quantity for irrigation is required. The major advantage the system is implementing of Precision Agriculture (PA) with cloud computing, that will optimize the usage of water fertilizers while maximizing the yield of the crops and also will help in analyzing the weather conditions of the field

2. **T. Rajasekaran and S. Anandamurugan, researched on 'Challenges and Applications of Wireless Sensor Networks in Smart Farming', published by 'Springer Nature Singapore Pte Ltd. in 2019**

Human survival is a huge task of their lives in the society. Agriculture is the most important role played by the survival of human civilization. The technological advancement in wireless communication and reduction in size of sensor is innovatively projects in the various fields such as environmental monitoring, precision farming, health care, military, smart home, etc.

This paper provides an insight into various needs of wireless sensor technologies, and challenges involved in deployment of Wireless Sensor Network (WSN). Smart Farming (SF) has been played a major role to enhance more production in the field of agriculture. This article not only focuses on smart farming but also compared with traditional methods in agriculture.

3. **Durga C, V Ramulu, M Umadevi, K Suresh, researched on 'Effect of sensor based irrigation scheduling practices under drip and furrow method of irrigation on growth parameters,shelling percentage and test weight of Rabi maize', published by 'Journal of Pharmacognasy and Phytochemistry, on 15-12-2018**

A field experiment was conducted for field evaluation of soil moisture sensors for irrigation scheduling in rabbi maize at Water Technology Centre, PJTSAU, Hyderabad. The experiment was laid out in a split plot design replicated thrice with 12 treatment combinations. Maize (Zea mays L.) is known as miracle crop or queen of cereals due to its high productivity among the cereal crops of Graminae family and is a staple food in many regions of the world. To safeguard and sustain the food security in India, it is quite important to increase the productivity of maize under limited water resources. As per the concepts of water foot print and virtual water, 1 kg of maize needs 900 liters of water. Moisture sensors viz.,tensiometer, gypsum block, profile probe, nano sensor (IITB), soil moisture indicator have been installed both under surface and drip irrigation methods.

4. **DR. URIEL OR, researched on 'Technological Development Of Micro-Irrigation And Its Applications In Developing Countries, published by 'Agronomist, NETAFIM, Kibbutz Magal, on 18-04-2018**

Four decades have passed since the introduction of drip irrigation technologies. During the first decade, drip irrigation was viewed as a method for conserving water. Over the second, it was found to increase yield quantities and quality with efficient irrigation, but was used mainly for intensive crops, such as flowers, vegetables and orchards and was considered suitable only for advanced farmers. During the third decade, this technology started to find its way into field crops and all types of fruit orchards. During this decade, this system started penetrating developing countries, mainly India and Israel. During the fourth decade (the 90s), drip irrigation began penetrating countries with rainy climates, as supplementary irrigation, as well as being introduced for use for small traditional farm-holders, as an efficient and easy-tooperate method.

5. **Yair Andrey Rivas-Sánchez, María Fátima Moreno-Pérez and José Roldán-Cañas, researched on 'Environment Control with Low-Cost Microcontrollers and Microprocessors' published by 'Application for Green Walls, MDPI', on 17-12-2018**

This paper proposes the use of low-cost automated irrigation programmers via a freeware called Arduino. The system is based on air and substrate measurements to ensure optimal plant growth and high water-use efficiency. At certain thresholds, the irrigation system is activated. This not only makes irrigation more convenient but also helps to reduce energy consumption, increases irrigation efficiency and saves time.

3.2 Methods Of Irrigation

Irrigation methods are commonly designated according to the manner in which water is applied to the land to be irrigated. Surface Irrigation Methods The water is applied by spreading in it sheets or small streams on the land to be irrigated.These methods are adopted for perennial irrigation system. Sprinkler Irrigation Methods The irrigation water is applied to the land in the form of spray, somewhat as in ordinary rain.It can be used for all the crops except rice and jute and for almost all soils except very heavy soils with very low filtration rates. Sub-Surface Irrigation Methods The water is applied below the ground surface so that it is supplied directly to the root zone of the plants.The main advantages of these methods are that the evaporation losses are considerably reduced and the hindrance caused to cultivation by the presence of borders, pipes and field channels in the other methods of irrigation is eliminated.

3.3 Developmental Stages Of Drip Irrigation

- During the 60s drip irrigation was viewed as an interesting new method, suitable for arid or semi-arid regions, where water is the main element in shortage.
- During the 70s, it was found that this method has certain advantages in high-income intensive crops, such as vegetables, flowers and certain orchards. The use of drip expanded, mainly to greenhouses and to crops grown under plastic mulching.
- During the 80s drip irrigation became more established and found its way into field crops, such as cotton, sugarcane, pineapple, as will as extensively in orchards, mainly vineyards, citrus orchards, deciduous fruit trees, bananas and other subtropical orchards.
- During the 90s certain developments established drip irrigation as a ”legitimate” irrigation method
- Over the last decade, from the accumulation of vast pool of data it is highly reliable irrigation systems.

4. PROPOSED SYSTEM

The proposed method aims at making agriculture smart using automation and IoT technologies. Internet of Things (IoT) enables various applications crop growth monitoring and selection, irrigation decision support, etc. The proposed systems based on values from sensors can calculate the water quantity for irrigation

The major advantage the system is implementing of Precision Agriculture (PA) with cloud computing, that will optimize the usage of water fertilizers while maximizing the yield of the crops and also will help in analyzing the weather conditions of the field.

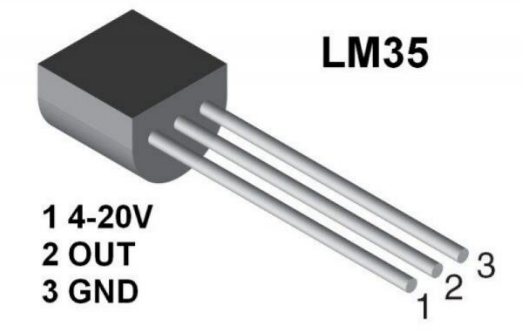
4.1 CONSTRUCTION

The main components in the Automated Precision Irrigation are as follows, for the construction of the system, I have selected an array of 7 mechatronics sensors:

1. Temperature sensor
2. Rain sensor
3. Automatic water control valves
4. Water level sensor
5. Humidity sensor
6. Soil moisture sensor
7. pH sensor
8. Microcontroller Control

4.1.1 Temperature Sensor

Temperature sensor is a device which is designed specifically to measure the hotness or coldness of an object.**LM35** is a precision IC temperature sensor with its output proportional to the temperature (in °C).With LM35, the temperature can be measured more accurately than with a thermistor. It also possess low self-heating and does not cause more than 0.1 °C temperature rise in still air. The operating temperature range is from **-55°C to 150°C**



Source:ELECTROBIST

4.1.2 Rain Sensor

Working Principle of Raindrop Sensor, raindrop sensor is basically a board on which nickel is coated in the form of lines. It works on the principal of resistance. When there is no rain drop on board. Resistance is high so we gets high voltage according to V=IR. When rain drop present it reduces the resistance because water is conductor of electricity and presence of water connects nickel lines in parallel so reduced resistance and reduced voltage drop across it.

Source:Circuits4you.com

4.1.3 Automatic Water Control Valves

Solenoid valves are control units which, when electrically energized or de-energized, either cut off or permit fluid flow. The actuator is an electromagnet. When the valve is energized, a magnetic field builds up which pulls a plunger or pivoted armature against the action of a spring. When de-energized, the plunger or pivoted armature is returned to its original position by the action of the spring.

Source: Shanxi Baite Fluid Machinery Co., Ltd.

4.1.4 Water Level Sensor

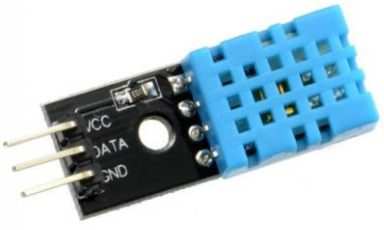
The Water Level Indicator employs a simple mechanism to detect and indicate the water level in an overhead tank or any other water container. The sensing is done by using a set of probes which are placed at different levels on the tank.

When the water-level is below the minimum detectable level (MDL), When the water reaches level1 (but is below level2) the connection between the probes gets completed (through the conducting medium – water) and the base voltage of transistor increases. The similar mechanism applies to the detection of all the other levels. When the tank is full, all inputs to microcontroller become low and all its outputs go high.

Source - ELSEVIER
Title - Smart sensor For
Automatic Drip Irrigation
System For Paddy cultivation

4.1.5 Humidity Sensor

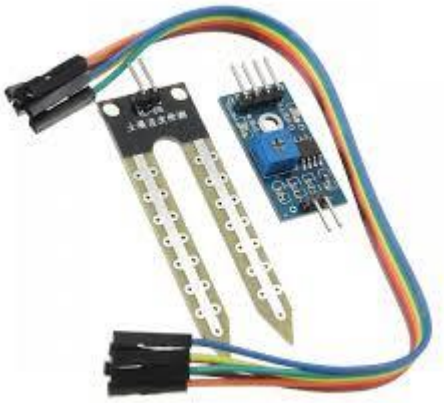
A capacitive humidity sensor measures relative humidity by placing a thin strip of metal oxide between two electrodes. The metal oxide's electrical capacity changes with the atmosphere's relative humidity.



Souce: Core Electronics

4.1.6 Soil Moisture Sensor

Baseline's soil moisture sensors work by sending a high frequency pulse of electricity down an embedded wire path. The high frequency of the pulse causes the sphere of influence of the pulse to move outside the sensor blade and into the soil around it. When the pulse travels through moisture, it slows down. The sensor measures the speed, and then converts this measurement to a moisture content reading.



Soucre:Robosap

4.1.7 pH Sensor

pH probes measure pH by measuring the voltage or potential difference of the solution in which it is dipped. By measuring potential difference, hydrogen ion concentration can be calculated using the *Nernst equation* which gives the relationship between Hydrogen ion concentration and Voltage or Potential.

Hence, a pH probe measures the potential difference generated by the solution by measuring the difference in hydrogen ion concentration using the Nernst equation and displays the pH as output.

Source: Robu.in

4.1.8 Microcontroller

The MCP3208 12-bit Analog-to-Digital Converter (ADC) combines high performance and low power consumption in a small package, making it ideal for embedded control applications. The MCP3208 features a successive approximation register (SAR) architecture and an industry-standard SPI™ serial interface, allowing 12-bit ADC capability to be added to any PICmicro® microcontroller.

The MCP3208 features 100k samples/second, 8 input channels, low power consumption (5nA typical standby, 400 µA max.active), and is available in 16-pin PDIP and SOIC packages. Applications for the MCP3208 include data acquisition, instrumentation and measurement, multi-channel data loggers, industrial PCs, motor control, robotics, industrial automation, smart sensors, portable instrumentation and home medical appliances.

Source:IndiaMART

5. WORKING

PA agriculture irrigation system is developed with low complex circuitry. 7 sensors are used efficiently in the circuit to get the calibrated information to the system. With the help of this approach the irrigation system completely automated also provides real-time information about the lands and crops that will help farmers make right decisions.

Cloud computing is “a new style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet”. Threshold values may be varying depends on the crop and plantation. In future by introduce the machine learning algorithm to be used to process the data and reduce the complexity of the hardware.

All observations and experimental tests proves that proposed is a complete solution to field activities, irrigation problems, Implementation of such a system in the field can definitely help to improve the field of the crops and overall production.

6. BENEFITS IN THIS FIELD

- Saves water resources
- Avoid leaching which occur due to traditional method
- saves large amount of fertilizer during whole crop period
- Sensors used have high sensitivity and are easy to handle
- Labor saving is the advantage of this system
- The system is more compact
- Requires low maintenance cost
- Can be modified with new features easily
- Low cost but providing maximum automation
- Can be use for different plant species
- Provides user-friendly interface

7. DEMERITS TO OVERCOME

- Complete automation in terms of pest and insects detection cannot be achieved
- No self test system to detect malfunction of sensors
- Requires uninterrupted power supply
- Failure of a single part causes whole system collapse

8. APPLICATIONS

- System can be used in gardens and provide proper irrigation to garden plants
- System can installed in Green House where different parameters needs to be monitored and controlled with small changes
- Can also be used in poly houses
- The system can be used for study of crops under different water and pH condition
- The application of nutrients is quantitative and in accurate, therefore is adapted for perennial crops like citrus, fruit trees and crop grown on heavy soil

9. FUTURE SCOPE

- Communication through internet
- Communication through GSM mobile
- Solar power and wireless sensor application
- Centralized database maintenance of crops according to the atmospheric condition throughout the year
- Can control more parameters more precisely

10. RECENT TRENDS IN TOPIC

- A Handheld Co-Robotic Device for Automated Tuning of Emitters to Enable Precision Irrigation.
- Centre pivot irrigation system.
- Drip Irrigation with fertigation.
- Lateral move irrigation system.
- Mobile drip irrigation system.

11. CONCLUSION

- The Mechatronics based automized drip irrigation system technique proves to be real time feedback control system which monitors and controls all the activities of drip irrigation effectively.
- By using this farmers can save..
  - Man power
  - Reduce use of natural recourses
  - Low cost and reliable system
  - Dependency on rainfall can be avoided
  - Improve quality and production efficiently

REFERENCES

1. S.R.Barkunan, V.Bhanumathi, J.Sethuram, researched on 'Smart sensor For Automatic Drip Irrigation System For Paddy cultivation', published by 'ELSEVIER', on 22-11-2018

2. R. Nageswara Rao, B.Sridhar, researched on 'Iot based smart crop-field monitoring and automation irrigation system', published by 'IEEE Xplore', in 2018

3. Yair Andrey Rivas-Sánchez, María Fátima Moreno-Pérez and José Roldán-Cañas, researched on 'Environment Control with Low-Cost Microcontrollers and Microprocessors' published by 'Application for Green Walls, MDPI', on 17-12-2018

4. E.Sathyapriya[1*] M.R.Naveenkumar[2] and V.Dhivya, researched on 'An Empirical Study On Drip Irrigation', published by ' Department of Agricultural Entomology, TNAU, Coimbatore', in 2017

5. DR. URIEL OR, researched on 'Technological Development Of Micro-Irrigation And Its Applications In Developing Countries, published by 'Agronomist, NETAFIM, Kibbutz Magal, on 18-04-2018

6. Durga C, V Ramulu, M Umadevi, K Suresh, researched on 'Effect of sensor based irrigation scheduling practices under drip and furrow method of irrigation on growth parameters,shelling percentage and test weight of Rabi maize', published by 'Journal of Pharmacognasy and Phytochemistry, on 15-12-2018

7. T. Rajasekaran and S. Anandamurugan, researched on 'Challenges and Applications of Wireless Sensor Networks in Smart Farming', published by 'Springer Nature Singapore Pte Ltd. in 2019