

Design of Smart Irrigation System Using Raspberry Pi for Agriculture

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ABSTRACT: Agriculture is the worldwide prime occupation of human being, 64% of total available land is occupied by the agriculture, and it consumes 85 % of fresh water. This figure of water consumption increases every year due to globalization and population growth. There is a challenge in front of every country to sustain the fresh food requirement and reducing the farm water consumption. From last decade, few existing system working for reducing the agriculture water consumption, but these systems have some limitations. So, the modern technology is necessary to resolve this problem and support better irrigation management. In this paper, Raspberry Pi is used as an embedded Linux board which is designed based on the ARM V8 microcontroller architecture. The board has an Ethernet interface and runs the simple data web server. The present work focus on automatic control of water motor, monitor the plant growth using webcam and can also watch live streaming of farm on PC by using Wi-Fi.

KEYWORDS: Raspberry Pi, PC, Wi-Fi, Irrigation.

I. INTRODUCTION

India is the largest freshwater user in the world, and our country's total water use is greater than any other continent. The agricultural sector is the biggest user of water, followed by the domestic sector and the industrial sector. Groundwater contributes to around 65% of the country's total water demand. Today water has become one of the most precious resources on the Earth and one of the most important factors in agriculture is water availability.

The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. [1]

The system using remote access and wireless communication is discussed in this paper. The system explained here is a network of wireless sensors and a wireless base station to process the sensor data to automate the irrigation system. The sensors are soil moisture sensor and soil temperature sensor. The Base station microcontroller is programmed such that if the either soil moisture or temperature parameters cross a predefined threshold level, the irrigation system is automated, i.e. the motor relay that is connected to water pump, switches to ON otherwise OFF. [2]

An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. [3]

This paper presents a smart irrigation system for an agriculture farm with the use of devices like Raspberry Pi. Python programming language is used for automation purpose. This paper contributes an efficient and fairly cheap automation irrigation system. System once installed has less maintenance cost and is easy to use. This paper focuses on online monitoring of agriculture field with the help of Wi-Fi on PC and parameters such as temperature and soil moisture. It is more advantageous than the traditional agriculture techniques.

The remaining of this paper is organized as follows. In Section 2 consists of literature review. Design and Implementation of the paper as explained in Section 3. Results are presented and discussed in Section 4. Conclusion and future enhancements are discussed in Section 5.

II. DESIGN AND IMPLEMENTATION

The block diagram of the proposed system as shown in Fig. 1 and Fig. 2. The main components of this diagram are sensors, Raspberry Pi module, Wi-Fi connection, LDR, relay's, motor, and lamp.

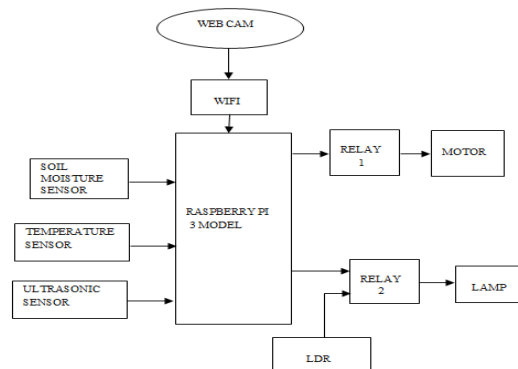


Fig 1: Irrigation Control System (Transmitting section).

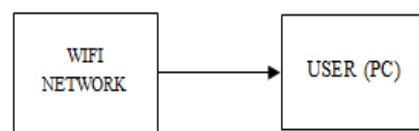


Fig 2: Monitoring Unit (Receiving Section).

A. SENSORS

Sensors are the device which converts the physical parameter into the electric signal. The system which shown in fig 1 consists of

- Soil moisture sensor- used to measure the moisture content of the soil.
- Temperature sensor - used to detect the temperature of the soil.
- Ultrasonic sensor - used to measure the water level in the water tank.

B. RASPBERRY PI 3

The Raspberry Pi 3 is a wonderful platform that can be used to build home automation system. Raspberry Pi is a small sized single board computer which is capable of doing the entire job that an average desktop computer does like spread sheets, word processing, Internet, Programming, Games etc. It consist of 1GB RAM, ARM V8 Processor, 2 USB and an Ethernet port, HDMI & RCA ports for display, 3.5mm Audio jack, SD card slot (bootable), General purpose I/O pins, runs on 5v.

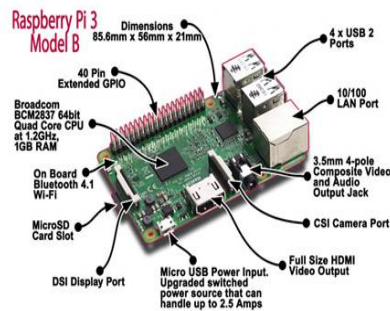


Fig 3: Raspberry Pi 3 model

C. WORKING PRINCIPLE

Raspberry Pi is the heart of the system. In this project, webcam is interfaced to Raspberry Pi via Wi-Fi module. The Raspberry Pi Model B+ incorporates a number of enhancements and new features. Enhanced features are improved power consumption, increased connectivity and greater IO which made this powerful, small and lightweight ARM based computer. The Raspberry Pi cannot directly drive the relay. It has only zero volts or 3.3 V. It needs 12V to drive electromechanical relay. In that case it uses a driver circuit which provides 12V amplitude to drive the relay.

Sensors connected to the Raspberry Pi board give a resistance variation at the output. This signal is applied to the comparator and signal conditioning circuit which has potentiometer to decide the moisture level above which the output of comparator goes high. This output signal is given to the Raspberry Pi board. If the soil moisture value is above the moisture level then the 3 phase induction motor will be OFF, whereas if the moisture level is low motor will be ON through the relay. For monitoring the farm at night LDR is used which controls the light automatically.

D. ALGORITHM

Step 1:Start.

Step 2:Initialize the system on Raspberry Pi.

Step 3: The water level sensor constantly checks for the water level of the motor.

Step 4: The soil moisture sensor checks the soil moisture level constantly.

Step 5: The USB camera installed with the Raspberry Pi gives the complete surveillance of the field and this can be monitored in the internal network system.

Step 6: The DHT11 sensor constantly senses the temperature and humidity of the field and updates the data in the web server.

Step 7: If the water level reduces the permissible level, the relay which is connected to the Raspberry Pi will turn on the motor.

Step 8: Similarly, if the soil becomes dry, the motor which is connected to the relay will be turned on to wet the field.

Step 9: If the step 8 is completed, it will go to the step 4.

Step 10: Similarly, if the step 7 is over, the command will go to the step 3.

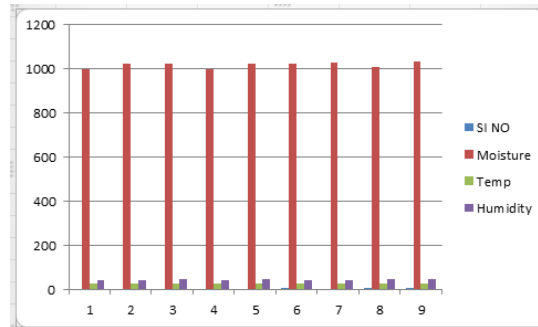


Fig 4: Sensor values Update in Chart

Fig 9 shows temperature and humidity values which is shown on the LCD display. The values can further be seen on PC by using Wi-fi connection. Fig 10 shows system monitoring based on IoT.

Time stamp	Temperature	Humidity
2015-12-13 21:16:06	22	45
2015-12-13 21:11:06	22	40
2015-12-13 21:06:06	22	45
2015-12-13 20:50:32	21	45
2015-12-13 20:45:32	21	45
2015-12-13 20:40:32	20	40
2015-12-13 20:35:32	21	45
2015-12-13 20:30:31	22	45
2015-12-13 20:25:31	21	45

Fig 5: T/H Sensor Data's Update.



Fig 6: Image capture by the webcam

The Readings from different sensors are collected and send to micro controller. It stores collected data in the database and analyzes the stored data. The readings are displayed on PC using WIFI connection. Thus an irrigation system which controls the flow as per the requirement along with automation. With the use of low cost sensors and the simple circuitry makes these instrument a low cost product, which can be bought even by a poor farmer. This work is best suited for places where water is scarce and has to be used in limited quantity.

III. CONCLUSION & FUTURE ENHANCEMENT

The automated irrigation system is feasible and cost effective for optimizing water resources for agricultural production. The system would provide feedback control system which will monitor and control all the activities of plant growth and irrigation system efficiently.

- Rain gun sensor can be added so that when it rains there won't be floods. Rain water harvesting can be done and this harvested water can be used to irrigate fields.
- Hooters can be used so that it gives siren at various occasions such as intrusion detection, floods etc. Using IR sensors any object passing into fields can be detected and alerted. We can include many more water quality sensors that affect the crops.

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