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Automated AVR Based Irrigation System

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Abstract: In crop production a healthy water balance is essential for high quality yields. Under-watered crops suffer from nutrient deficiencies while over-watered plants are more susceptible to diseases pressure and can in some cases lead to root death through suffocation. Also over-watered plants are not able to withstand dry spells during dry season. Water content in the soil means to be Soil moisture is being major factor in implementing the Drip irrigation for small to huge farms. Water resources are draining day to day and technologies are trying to consume water. One of such technology is Drip irrigation. By using soil moisture sensor which is operated on resistance based connected to ADC peripheral of a Microcontroller and pre-scaled. The pre-scaled values are displayed for visualizing in farms and basing on same values microcontroller is programmed when to turn on relay or actuator of ac motor and before turning this motor water level of sump is to be measured by using water level sensor. And this entire system can be treated as node. Number of nodes can be implemented all over the farms. The Nodes data is sent to a main controlling unit which is operating at high speed. The data will be sent from controlling unit to a server and message alert will be given to a farmer. Basing the alerts farmers can take a decision for better yields.
Keywords: AVR, LPC2148, GPRS, Soil moisture sensor, Ultrasonic sensor.

I. INTRODUCTION

Drip Irrigation farming describes a bundle of new information technologies applied to the management of small scale, large scale and commercial agriculture. Using different sensors it promises higher yields and lower input costs by real-time and automatic monitoring of site specific environmental and soil conditions and thereby improving crop management, reducing waste and labor costs. The increasing world population has lead to exponential increase in food demand. This event has necessitated the need for more land to be cultivated. Due to global warming the change of weather patterns has brought and irrigation remains as the only reliable method of crops production. With more and more land now being under irrigation there is a need for optimal use of water. Present day challenges have been used to solve by the knowledge in electronics and computation from past few years. In the forefront of the electronics revolution has been the microcontroller. To measure and control physical quantities like temperature, humidity, heat and light the microcontroller has been used together with various sensors. Automatic systems have been implemented by controlling this physical quantity using the microcontroller. Irrigation systems in crop production can also be automated. This system solves the challenge brought about by the unreliability of climate changes thus need for less water usage. Drip irrigation systems is one of the most convenient, efficient and effective method of water utilization. This system is used in saving water and thus more land can be brought under irrigation. Crops grown under controlled conditions tend to be healthier and thus give more yields. Controlled watering system results in reduction of fertilizer use and thus fertilizer costs go down.

A. *This project report is organized into five chapters:*

1) Chapter one gives the introduction to the project.
2) Chapter Two is the literature review for the project
3) Chapter Three gives a complete technical aspect of the design.
4) Chapter Four gives the pseudo code of the project.
5) Chapter Five gives the result of the project. This chapter also includes the conclusion and references used.

II. LITERATURE SURVEY

A. *Existing System*

In existing drip irrigation system in order to control the system farmer has to work physically. In traditional instrumentation there are many difficulties based on wired and discrete solutions over the large geographical areas. Every time excess of water is given to the fields if conventional irrigation system is used [1].

B. Limitations of existing system:

1) Physical work of farmer to control drip irrigation

2) Wastage of water
3) Wastage of time

B. Classification of Generic Remote Control Systems

Weather related information is flourishing with the use of latest technologies for the idea of remotely monitoring and controlling of irrigation system. [1] In market there are many types of remote control and monitoring systems available. The new generation agriculture system prime objectives are:

C. YL-69 Moisture Sensor

This is an Electrical resistance Sensor. The sensor is made up of two electrodes. The moisture content around the two electrodes is read by soil moisture sensor. The resistance to the current in the soil determines the soil moisture when a current is passed across the electrodes through the soil. More current will pass through the sensor if the soil contains more water, resistance will be low. When the soil moisture is low, the sensor module outputs a high level of resistance. [3]This sensor has both digital and analogue outputs. Analogue output is more accurate than the digital output but digital output is simple to use.

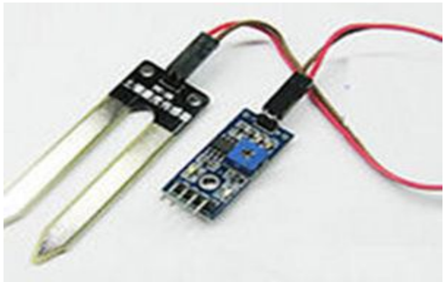

Figure 2.1 YL-69 Sensor

Soil moisture sensor YL-69 has the following specifications: [4]

Vcc power supply	3.3V or 5V
Current	35mA
Signal output voltage	0-4.2V
Digital Outputs	0 or 1
Analog	Resistance (Ω)
Panel Dimension	3.0cm by 1.6cm
Probe Dimension	6.0cm by 3.0cm
GND	Connected to ground

Table 2.1 YL-69 specifications

D. Water Level Sensor

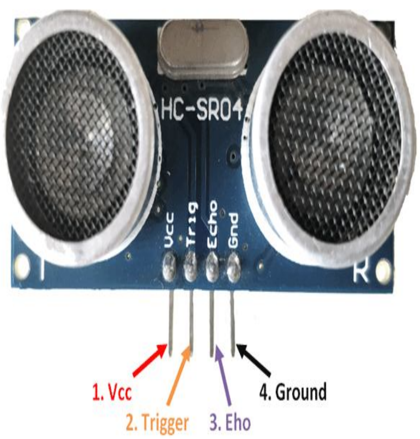

Figure 2.2 Ultrasonic sensor

Ultrasonic Sensor Pin Configuration

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. To initialize measurement by sending US wave this pin has to be kept high for 10us.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Table 2.2 Ultrasonic Sensor Pin Configuration

E. HC-SR04 Ultrasonic Sensor - Working

In many applications where measuring distance or sensing objects are required this sensor is a very popular. In front the sensor module has two eyes like projects which form the Ultrasonic transmitter and Receiver. The formula that sensor works with is given by Distance = Speed × Time An ultrasonic wave is transmitted by the Ultrasonic transmitter, this wave travels in air and when it gets objected by any material it gets reflected back towards the sensor this reflected wave is observed by the Ultrasonic receiver module

III. SYSTEM DESCRIPTION

A. Block Diagram

The system has three major parts; moisture sensing part, control section and the output section. The soil moisture was detected using soil moisture sensor (a resistance type sensor). The control unit was achieved using ATMega328 microcontroller. The control unit was used to control the irrigation system by switching it on and off depending on the soil moisture contents. The output section sends information to end user.

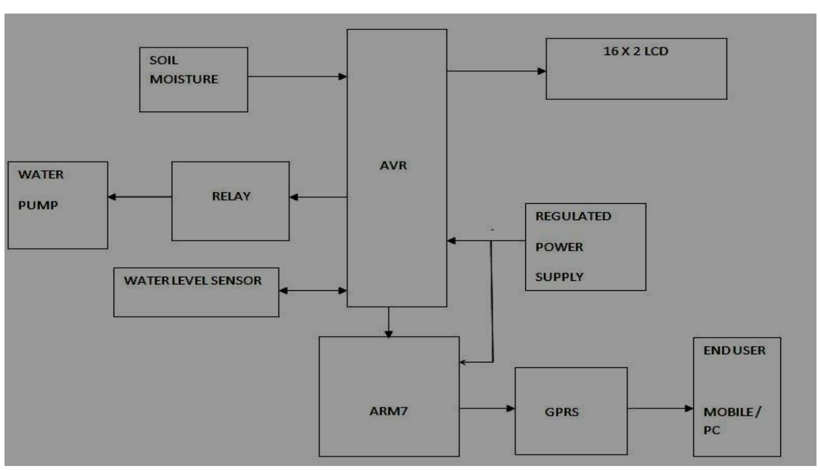

Figure3.1 Block diagram of project

B. Hardware Design

ATMega32 microcontroller was selected the control unit of the microcontroller. ATmega32 was selected from the AVR (Alf and Vegard's RISC processor) family [2]. Atmega32 has a total of 40 pins of which are divided into 4 ports [2]. In which Port A is designed to serves as the analog inputs to the A/D Converter. Port A, Port B, Port C and Port D serves as an 8-bit bi-directional I/O port, the board has a soil moisture sensor, water level sensor, water pump, LCD and RELAY. To interface the ATmega32 and a soil moisture sensor a digital PCB drive is required. The PCB drive has a digital potentiometer and a LM393 comparator. The LM393 comparator is used to compare the voltages across the sensor probes and the set Vcc voltage. When connected in digital mode the digipot is used to alter the sensitivity of the sensor. The out of the PCB drive has four connections pins.. The analogue configuration was selected as its more stable compared to the digital configuration. The PCB drive pin A0 was connected to the ATmega32 analog pin A0. The output of the sensor to the ATmega32 analog pin A0 was resistance. The resistance to flow of current between the sensor probes changes with soil moisture level and soil type. For different soils and different soil moisture levels the current passing through the sensor probes (Iout) was calculated as shown below: Iout = Vcc / {Soil Resistance value (RS)} Equation: Soil moisture sensor Current calculation

To affect display a 16x2 Liquid Crystal Display (LCD) was chosen. LCD pins D0, D1, D2, D3, D4, D5, D6 and D7 were used as data lines in a 8 bit mode configuration. These pins were connected to ATmega32 pins 22, 23, 24, 25, 26, 27, 28, and 29 respectively. Pin 15(A) was connected to Vcc and pin 16 (K) was connected to GND. These pins (A and K) are for the LEDs integrated on the LCD circuit board. LCD's pin E (Enable) was connected to digital pin 3 on the ATmega32 board. Pin RS (Register Select) on the LCD was connected to ATmega32 digital pin 1. R/W pin of the LCD was connected to 2. The figure below shows the LCD-microcontroller interface. To implement the final bit of the automated irrigation system an electric motor (240VAC) was selected as the water pump. The first two units of the system i.e. sensing unit and the control unit (microcontroller) are powered by 5VDC. To interface the two units a 5VDC relay (SLT73-5D-1Z) was used as the isolation unit. The microcontroller was connected to the relay via an NPN transistor (2N4123). To protect the transistor; while turning it on, a resistor was used. The resistor limits the current flowing through the transistor. The connection was as shown below.

C. Proposed System Features

1) Low cost drip irrigation system
2) Long range connectivity. It provided everywhere and anywhere connectivity.
3) System productivity increases and water consumption reduces.
4) User friendly handling.

IV. PSUEDO CODE

A. Transmitter Code

PORT initialization
LCD initialization
ADC initialization
TIMER1 initialization
READ sensor value
DISPLAY water level distance and moisture level
COMPARE sensor and water level with set threshold
IF sensor value > maximum set value and water level HIGH
TURN-ON pump, sending data to receiver
DISPLAY condition on LCD
ELSE IF sensor value < maximum set value and water level LOW
TURN-OFF pump, sending data to receiver
DISPLAY condition on LCD
ELSE IF sensor value < maximum set value and water level HIGH
TURN-OFF pump, sending data to receiver
DISPLAY condition on LCD

B. Receiver Code

PORT initialization

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LCD initialization
UART0 initialization
UART1 initialization
WAITING for receiving
IF data is received then data updated

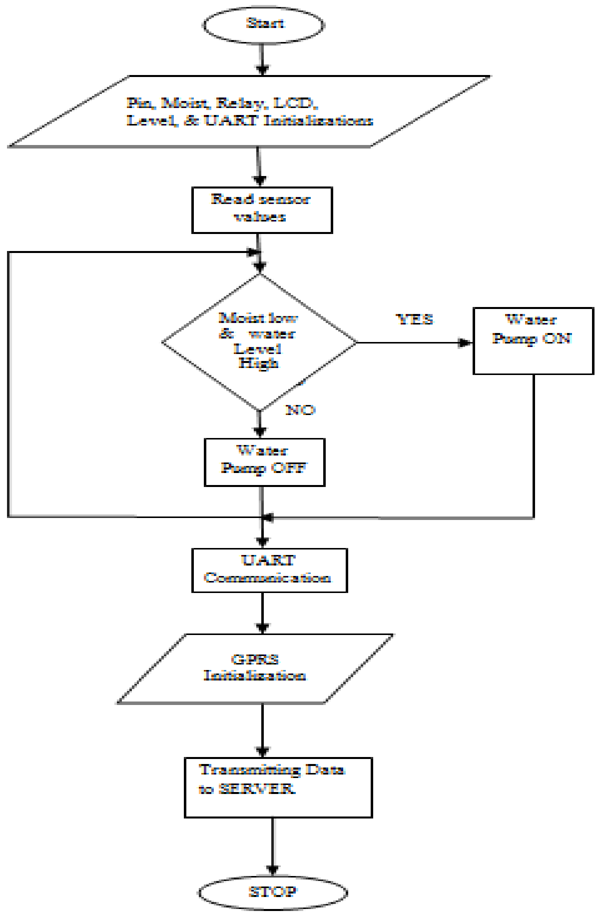

Figure 4.1 The Program Flow Diagram

V. RESULT

The results of the system are as shown below:

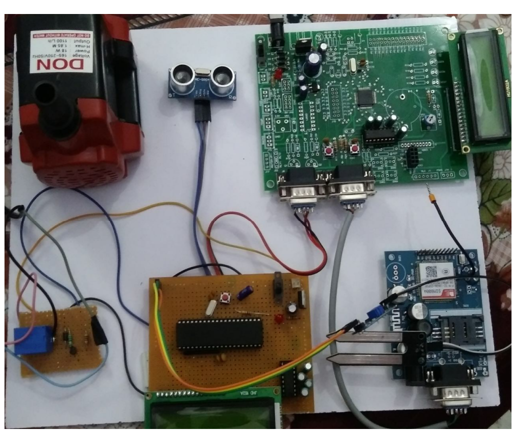

Figure 5.1 The model for the proposed system

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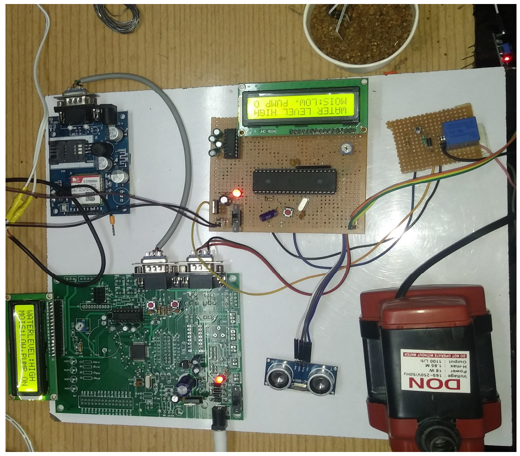

Figure 5.2 System result in dry soil

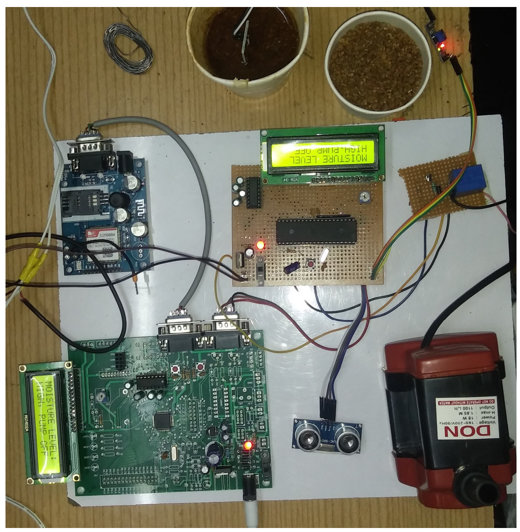

Figure 5.3 System result in wet soil

```
MOIS_LEVEL_HIGH_PUMPOFF
MOIS_HIGH_PUMPOFF
WL_HIGH
WL_HIGH


WL_HIGH
WL_HIGH
WL_HIGH_MOIS_LOW_PUMPON
WATER_LEVEL_LOW_PUMPOFF
MOISTURE_HIGH_PUMP__OFF
WL_HIGH_MOIS_LOW_PUMPONWATER_LEVEL_LOW_PUM
POFF
WL_HIGH_MOIS_LOW_PUMPONWATER_LEVEL_LOW_PUM
POFF
WATER_LEVEL_LOW_PUMPOFFMOISTURE_HIGH_PUMP_
_OFF
WL_HIGH_MOIS_LOW_PUMPONWATER_LEVEL_LOW_PUM
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WL_HIGH_MOIS_LOW_PUMPONWATER_LEVEL_LOW_PUM
POFF

MOISTURE_HIGH_PUMP__OFF
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_OFF
MOISTURE_HIGH_PUMP__OFF
MOISTURE_HIGH_PUMP__OFF
MOISTURE_HIGH_PUMP__OFF
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Figure 5.4 Server Output

In this project, we developed a system that can help in an smart irrigation system by analyzing the moisture level of the soil. The smart irrigation system proves to be a useful system as it automates and regulates the watering without any manual intervention. This project has major applications for farmers and gardeners who do not have enough time to water crops/plants.

The moisture sensors measure the moisture level (water content) and temperature of the different plants. The moisture sensor sends the signal to the AVR board which triggers the Water Pump to turn ON and supply the water to respective plant if the moisture level is found to be below the desired level. The system may be further extended for outdoor utilization.

VI. CONCLUSION

This proposed automated drip irrigation system is a useful system as it regulates and automates the watering without any manual intervention. This system used to monitor moisture levels in the soil. The system was used to switch on/off the watering system/pump according to set soil moisture levels. While the sensing bit was implemented using a soil moisture sensor the control unit prototype was implemented using a microcontroller on ATmega32 platform.

The limitation of this design is that the failure of any particular part or device is not informed and has to be tested manually.

VII. FUTURE SCOPE

This Smart irrigation proves to be the system automates for irrigation system and regulates water for irrigation is done without manual Using this system, solenoid valves and relay board can be controlled remotely which opens the opportunities to control the water flow as well as the electrical flow. Irrigation system is automated with depends on sensor Report the pump is operated by the weather condition by soil, rain and temperature conditions the water pump will work and by wireless the data is communicate and the sensor readings are uploaded into cloud network by Wi-Fi technology.

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