Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 1, Issue 10, January 2018
Proceedings of National Conference on Emerging Trends in VLSI, Embedded and Networking (NC-EVEN 17), May 2017

Real Time Autonomous Irrigation Module Design

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Abstract: Agriculture is the back bone of Indian economy. Timely and sufficient supply of water is the most important requirement for agriculture. There is a continuous need of monitoring the moisture level at agriculture lands. This paper introduces an automatic module to supply appropriate amount of water to the field by sensing the crop humidity requirement. This system will be economical in terms of hardware cost and power consumption. It proposes a humidity level sensor at field where sprinkling has to be done w.r.t. the quantity of water needed. The circuit monitors the water level of the tank, to prevent dry run and damage to pump.

Keywords: Crop; water need; Humidity Sensor; Motor Driver

I. INTRODUCTION

India is the country of agriculture. With the increase in demand, the agricultural sector is gaining importance and to manage it, we require optimal utilization of available resources like water and electricity with modified system. Productivity of agriculture depends on matching water supply with crop demand and by irrigating the field accordingly. To determine the crop water demand, it is essential to estimate the soil humidity. One of the major problems in irrigation is the downfall of ground water level [1] which is due to unawareness among framers about irrigation methods and techniques. Although many irrigation techniques were presented earlier still the problem is not solved. In order to achieve this goal, better performance of irrigation system is required. An adequate amount of water is required to grow a crop, which is effected by various factors. The climate changes, per day requirement of water by the crop according to daily weather, type of crop and its growth. Farmers, most of them being uneducated, need a simple and highly advanced system which deals with every possibility of the field. The proposed system will add wings to the running model and will contribute towards the better economic growth. The project includes, advance pumping system which is controlled by the software depending upon the level of the water along with humidity present in the field. It is efficient, cost-effective and compatible to the environmental changes.

II. LITERATURE SURVEY

This paper is based on wireless sensors with GSM-Bluetooth for irrigation system controller and remote monitoring system. This system has simpler features designed with the objective of low cost and effective with less power consumption using sensors for remote monitoring and controlling devices which are controlled via SMS using a GSM module. A Bluetooth module is also interfaced with the main microcontroller chip. This Bluetooth module eliminates the usage charges by communicating with the appliances via Bluetooth when the application is in a limited range of few meters. The system informs user about any abnormal conditions like less moisture content and temperature rise, even concentration of CO2 via SMS from the GSM module or by Bluetooth module to the farmer's mobile and actions are taken accordingly by the farmer. In future, the farmer will be able to monitor and control the parameter by GSM and Bluetooth technologies [2].

The paper presents a low cost, organic, microcontroller driven control system which maintains relative humidity level of a chamber as per the level set by the user along with maintenance of ambient temperature. It can be viewed as an integrated agricultural solution which takes care of the crop yield and post harvested storage by regulating the temperature and humidity factors which are most critical. Unlike other techniques, this approach uses the energy liberated by the stored products in store houses, green-houses to drive humidifiers and dehumidifiers. Along with use of biodegradable materials as the humidity controlling agents, this system presents a robust electronic design for humidity sensor (H20-G) to interact with the microcontroller and an intelligent electronic valve assembly to regulate the flow of air as per the need [3].

This project an attempt has been made to automate farm or nursery irrigation that allows farmers to apply the right amount of water at the right time, regardless of the availability of labor to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed. The Microcontroller based automated irrigation system consists of moisture sensors, analog to digital converter, microcontroller, relay driver, solenoid valve, solar panel and a battery. This system can be used in the areas where electrical power is difficult to obtain [4].

This paper introduces an automatic module to supply appropriate amount of water to the field by sensing the crop humidity requirement. It even reduces probability of

soil erosion and protects the crop rotting due to over irrigation during heavy rainfall with advanced rainfall unit. This system will be economical in terms of hardware cost and power consumption. It proposes a humidity level sensor at field where sprinkling has to be done w.r.t. the quantity of water needed. The circuit monitors the water level of the tank, to prevent dry run and damage to pump [5].

The main motto of this paper is to save time, money and power of farmer with an automatic irrigation system. Manual intervention is required for the traditional farmland techniques. Human intervention can be minimized with the automated technology of irrigation. By using soil moisture sensor levels of soil moisture/humidity can be checked. Whenever there is a change in humidity/moisture in the soil this sensor senses the change and an interrupt signal is passed to the microcontroller and depending on this the irrigation system works. The automated irrigation system provides a web interface to the user so that the user can monitor and control the system remotely i.e., can make the irrigation system ON and OFF remotely [6].

III. METHODOLOGY

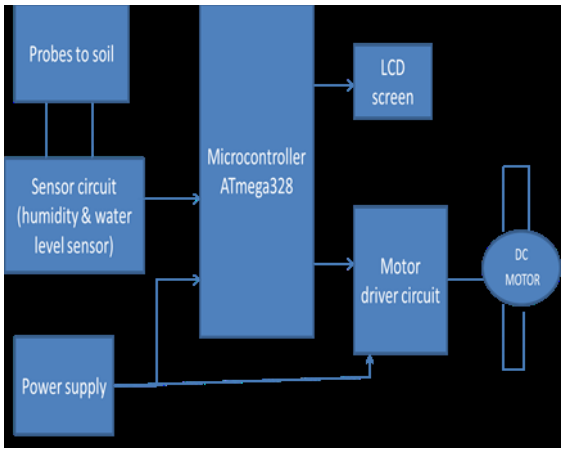


Fig 1. Block Diagram

In order to turn on the designed module, power supply unit/module of +12V is required. Potentiometer shall be interfaced to the controller board for setting the moisture level. Humidity sensor senses the water content of the soil and provides the analog voltage output. The sensor used is soil moisture sensor dc 5V, which measures humidity. The microcontroller reads the analog signal from the humidity sensor through built-in ADC channel and converts the data appropriately microcontroller monitors the water level(digital input) and analyze/compare the humidity data with the configured set value by the user and controls the AC motor operation accordingly.

Float level sensor shall be used for the detection of water level in the tank/well.

Motor drive circuit drives AC motor through relay. Suitable relay shall be selected depending on the motor power rating. The motor will be used for pumping the water.

LCD display shall be interfaced to the microcontroller. LCD display is used for displaying measured humidity and for setting the preset value.

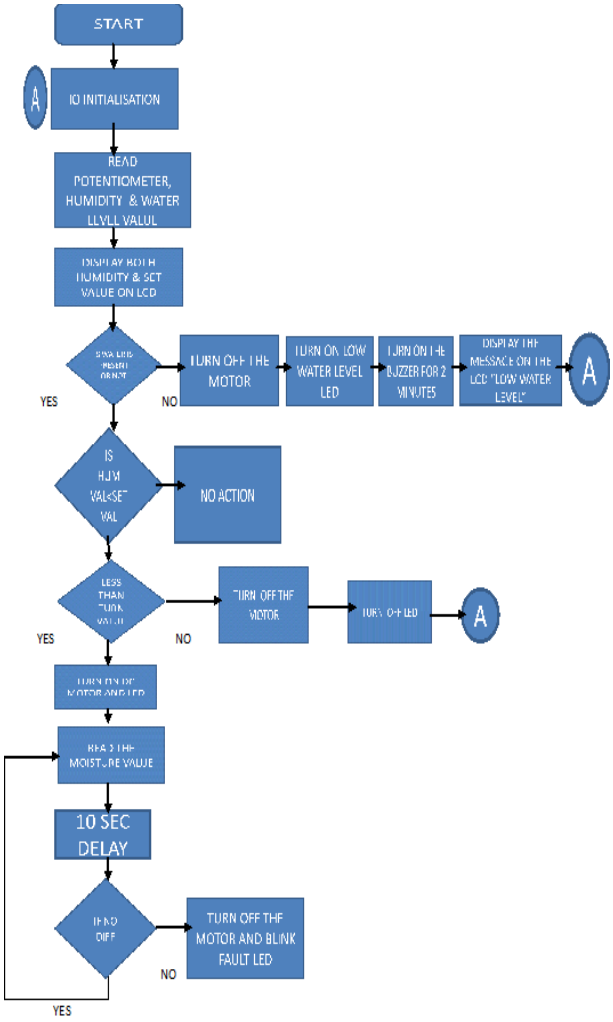
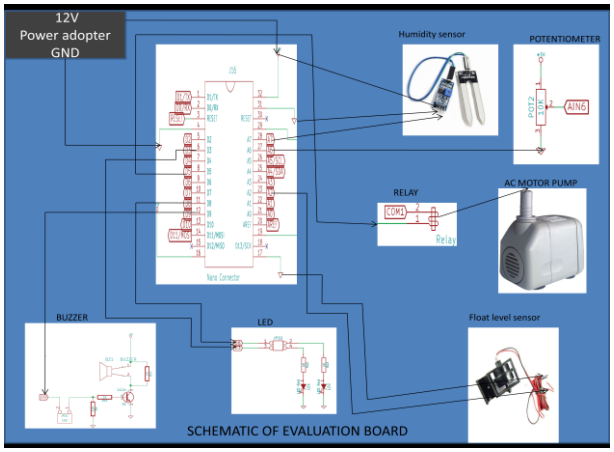


Fig 2. Flow Diagram

A. Schematic Of Design Module



Sl no	Signal description	Nano board Pin/port number	ATmega 328 MC Pin /port number	Type of Input/output
1.	RESERVED	A0	PC0	
2.	RESERVED	A1	PC1	
3.	HUMIDITY SENSOR	A7	ADC7	ANALOG INPUT
4.	RELAY	D5	PD5	DIGITAL OUTPUT
5.	SDA	A4	PC4	SERIAL COMMUNICATION(bidirectional)
6.	SCL	A5	PC5	CLOCK OUTPUT
7.	POTENTIOMETER	A6	ADC6	ANALOG INPUT
8.	RESERVED(LDR)	A7	ADC7	
9.	FAULT LED	D3	PD3	DIGITAL OUTPUT
10.	BUZZER	D9	PB1	DIGITAL OUTPUT
11.	WATER LEVEL SENSOR	A2	PC2	DIGITAL INPUT
12.	LOW LEVEL LED	D8	PB0	DIGITAL OUTPUT

Table3.1 –pin configuration

Fig 3. Pin Configuration

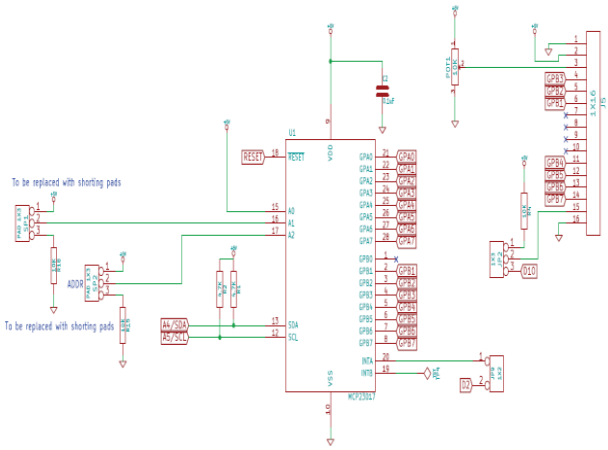


Fig 4. Schematic Of Evaluation Board

IV. Hardware And Software Requirements

A. Software

- Embedded C language will be used for developing the firmware which is finally programmed/burned into the flash memory of the Microcontroller ATmega328.
- For embedded project, C language programming is fairly efficient and supports access to I/O Controls [7].
- The Microcontroller reads the analog signal from the humidity sensor through built in ADC channel and converts the data appropriately.
- Microcontroller monitors the water level (digital input) and analyze/compare the humidity data with the configured set value by the user and controls the DC motor operation accordingly.
- Both the set value & the real time humidity sensor values will be displayed on the LCD.
- When the sensors are activated motors turn ON and field gets auto irrigated. Once the humidity sensor reaches the particular level the system takes steps to regulate or even stop the water flow.

B. Hardware

- MICROCONTROLLER ATMEGA328: The Microcontroller used in the implementation of hardware is a low-power, high performance CMOS ATmega328 microcontroller [8].
- Humidity sensor senses the water content of the soil& provides the analog voltage output. The sensor used is Soil Moisture Sensor DC 5V, which measures humidity.
- Float level sensor shall be used for the detection of water level.
- Power supply unit/module used for obtaining the +5V DC supply required for the controller board.

V. Simulation Result

a) Initial dry condition:

Preset value is adjusted using potentiometer. Initially preset value is considered to be 30% with an hysteresis of 33%. When the humidity is below 30% then the AC motor pump should pump the water to the field until the humidity reaches upto 63%. When the humidity value reaches above 63% motor should turn off automatically.

Fig 5. Display of humidity value and preset value

b) Low water level condition:

When there is low water level in well/tank. Even though the humidity value is below 30% the AC motor pump should not turn on. And maintenance of alerts is provided by blinking “LOW WATER LEVEL” LED, beeping the

buzzer at regular instant and by displaying "LOW WATER LEVEL" message on the LCD.

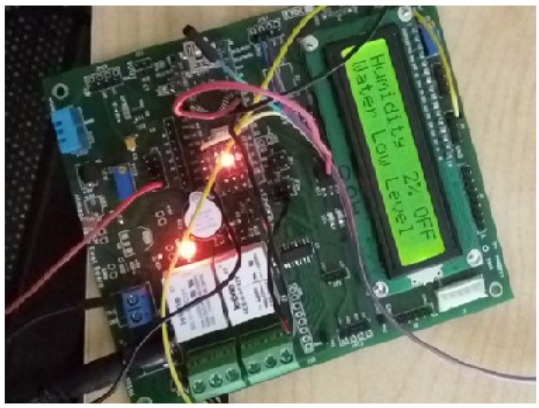


Fig 6. Low water level condition

c) Leakage/System Fault condition:

Even though the humidity value is less and water level is high in tank/well, the AC motor pump will not turn on. This is due to the fault in pipes or any other parts in the system. Maintenance is provided by blinking the "SYSTEM FAULT" LED and displaying the "SYSTEM FAULT" message onto the LCD.

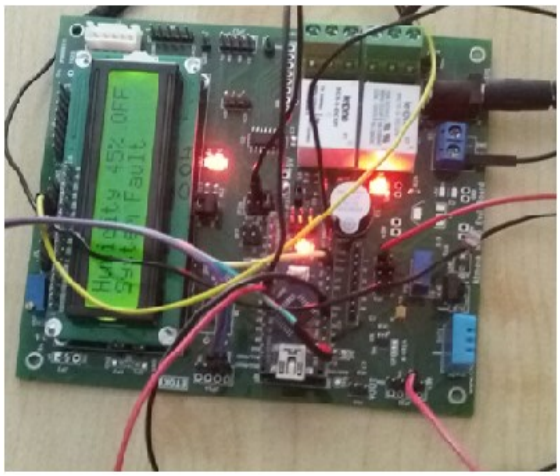


Fig 7. System fault condition

VI. ADVANTAGES

- Automatically irrigates the farm field by sensing moisture content in the soil and water level in tank/well.
- Less human involvement is required.
- Provides maintenance alerts when required.

VII. CONCLUSION

The implementation of automatic system is easy, feasible, economical and eco-friendly for the proper and efficient crop cultivation. This project is miniature version of the actual system with the implementation of all the features explained in the abstract. This system requires less maintenance. This module can be used for real time irrigation controlling. Even uneducated and untrained farmers can easily use this machine as it is portable and reliable.

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