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FUZZY BASED IRRIGATION SYSTEM

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ABSTRACT

Agriculture is important in every country directly or indirectly. One of the main factors in agriculture is water. In some cases, the water is excessively used or inadequate to the crop. So, in this scenario for saving the water and its effective usage, we propose an approach using fuzzy logic. Here we use soil moisture and temperature as the base parameter for the fuzzy logic were obtained for water pump operating time. This technique is handled by the Arduino. We also include water level detection to monitor the water level in the field. During the rainy day when the water level increases at a higher level, then an intimation is given to the concerned person via SMS using the GSM module. In this way, crop damage can be reduced during rainy days.

Keywords: Arduino, Soil moisture, Temperature, Water level, GSM module, Fuzzy logic.

I. INTRODUCTION

Agriculture is the mainstay of India's economy. It accounts for a fair amount of gross domestic product (GDP) and it ensures the food security of the country. Agriculture is the backbone of India. Every country around the world mainly depends on agriculture directly or indirectly. Water is one of the important factors for every living thing on Earth. Nowadays, water is needed to be used effectively to reduce wastage of water. This paper is proposing one of the methods to use water effectively for agriculture by using fuzzy logic. The fuzzy logic is mainly used in household appliances. So, fuzzy logic is used to obtain the operating time of the water pump. We use Arduino Uno board which is a microcontroller-based interfacing board. We use GSM communication which has a very higher range of communication

II. METHODOLOGY

The block diagram as shown in figure 1 consists of temperature sensor, soil moisture sensor and water level detector as inputs to the microcontroller. The microcontroller contains fuzzy logic which is programmed into it. The solid state relay controlled water pump, GSM module and LCD as outputs from the microcontroller. The 12V adapter act as the power supply to this system. Fuzzy logic conditions are programmed into the microcontroller with the help of Arduino IDE software. In the proposed system soil moisture and temperature sensors are used as the main inputs and considered as variables for the fuzzy logic. The microcontroller is programmed based on fuzzy logic which is obtained as a user defined and designed using MATLAB software and designed a rule table shown in table 1. When the readings of soil moisture and temperature are checked with the conditions, the operating time of the water pump is decided. The conditions framed are shown below,

1. If the environment temperature is less than 35oc and the soil moisture sensor value is greater than 60, then the water pump operating time is 3 seconds.
2. If the environment temperature is less than 35oc and the soil moisture sensor value is greater than 30, then the water pump operating time is 4 seconds.
3. If the environment temperature is less than 35oc and the soil moisture sensor value is greater than 2, then the water pump operating time is 5 seconds.
4. If the environment temperature is greater than 35oc and the soil moisture sensor value is greater than 60, then the water pump operating time is 6 seconds.
5. If the environment temperature is greater than 35oc and the soil moisture sensor value is greater than 30, then the water pump operating time is 7 seconds.
6. If the environment temperature is greater than 35oc and the soil moisture sensor value is greater than 2, then the water pump operating time is 8 seconds.

So, the water supply is based on conditions from fuzzy logic which makes a more optimized technique. The value of temperature, soil moisture, motor operating time, and high water level indication details are displayed

in the LCD for user reference. During rainy days to protect the crops from damage the water level sensor is used to monitor the water level in the agricultural field and when the water level exceeds the threshold level then a message intimation is sent to a concerned person via the GSM module as an SMS. The concerned person will take action for the high water level in the field and prevents crop damage. The rule table is designed based on fuzzy logic to represent conditions about the system operations based on the membership functions. The linguistic variables for temperature are low and high and for soil moisture are low, medium, and high.

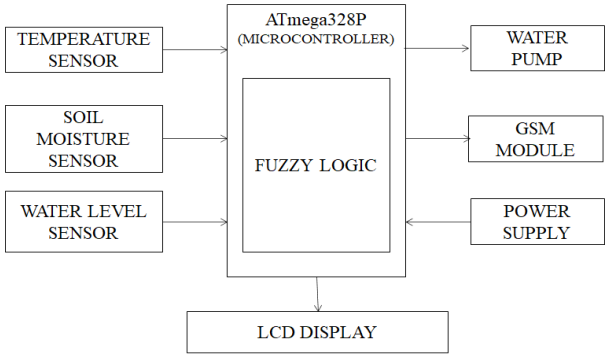

Figure 1: Block Diagram of Proposed System

TEMPERATURE / SOIL MOISTURE	LOW(LESS THAN OR EQUALS 35 DEGREE CELCIUS)	HIGH(GREATER THAN 35 DEGREE CELCIUS
LOW(GREATER THAN 60)	3 SECONDS	6 SECONDS
MEDIUM(GREATER THAN 30)	4 SECONDS	7 SECONDS
HIGH(GREATER THAN 2)	5 SECONDS	8 SECONDS

Table 1: Rule Table

Power supply

The power supply requirements differ for Arduino Uno and GSM module and the rest require a 5V supply, such as sensors and relay. All the component's power supply are taken from Arduino Uno as a 5V whereas Arduino Uno and GSM module are getting power supply from the 12V adapter.

Arduino Uno

Arduino Uno is a small-sized board that has ATmega328P as a microcontroller and all the necessary interfaces which helps the user to make the microcontroller easily interact with the external sensors or other outputs and it is programmed easily using the Arduino IDE software. The Arduino Uno is programmed with fuzzy logic conditions with two inputs such as temperature and soil moisture. The water level detector is also an input fed to Arduino Uno to detect the water level in the field.

GSM Module

The GSM module uses the SIM card for communication and it communicates to the microcontroller through serial communication. In this proposed system, this communication is implemented due to its range and not need internet connectivity. The GSM module helps to send SMS to the farmer or concerned person when the water level is high in the field. Crop damage occurs during rainy days mainly due to an increase in water level in the field and it can be prevented by sending an alert message via SMS.

Temperature Sensor

The temperature sensor is used to measure the ambient temperature which one of the membership functions with linguistic variables high and low. In this proposed we used LM 35 for the temperature measurement and it is fed input to the Arduino Uno. The Arduino Uno will process that input and check with conditions that are programmed within the Arduino Uno.

Soil Moisture Sensor

The soil moisture sensor is used to analyze the moisture in the soil from the earth conductivity between the two electrodes. The soil moisture sensor output is given as input to the Arduino Uno. The Arduino Uno will process the input and check with conditions.

Water Level Detector

The water level detector will sense the water level in the field. The detector will detect the water level with the tapping taken from the resistors connected in series. So when the conduction takes place when the level of water in the field is high.

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Solid State Relay

The solid state relay is used to operate as a switching component to turn on and off the water pump which is operated at different power ratings. When the conditions are satisfied to turn on the water pump, the Arduino Uno will trigger the solid state relay to close the circuit to operate the water pump.

LCD

The LCD is used to display the state of the system which is shown in figure 3, figure 4, and figure 5. It can display the temperature, soil moisture sensors readings, and displays "water lvl high" when the water level is detected from the water level detector. When the solid state relay is triggered to operate the motor, the LCD shows "motor on" to represent the motor is on.

III. MODELING AND ANALYSIS

In normal irrigation methods, the operating state of the water pump is ON and OFF only. On implementing the fuzzy logic for the irrigation system, we can control the operating time of the water pump for the desired value according to the conditions met. This might similar to the normal condition but it will be very effective when there are a greater number of inputs than two inputs. The rule table are designed for the hardware model presentation purpose which have operating time in seconds. But it is depending on type of crop and soil.

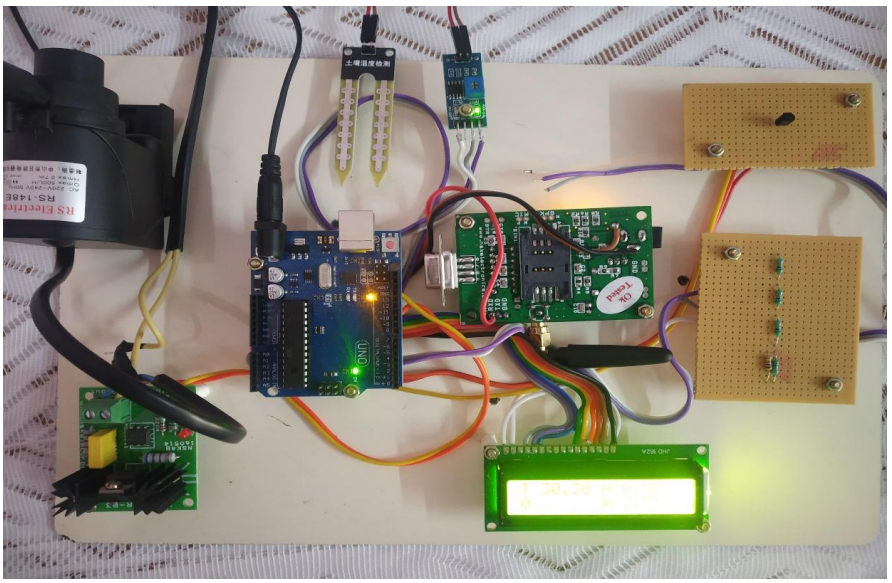

Figure 2: Hardware model of Proposed System.

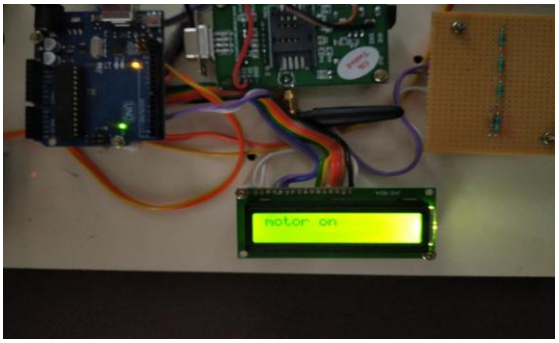

Figure 3: the LCD display that shows motor ON

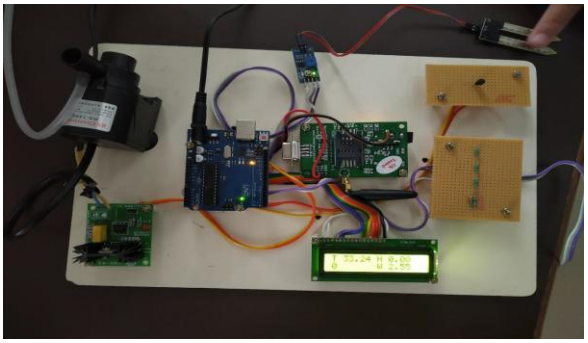

Figure 4: LCD display that indicates sensor values

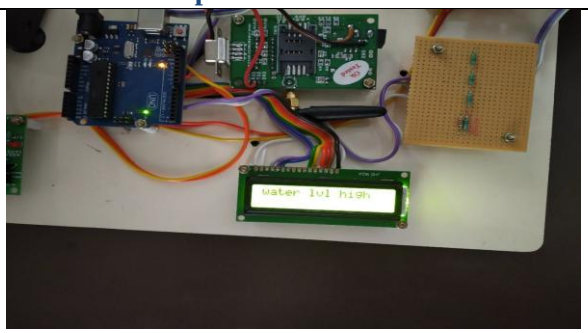

Figure 5: LCD display that shows water level is high in the agricultural field

IV. CONCLUSION

The fuzzy logic implementation of the project is efficient when the irrigation takes place in the field. The condition based on the fuzzy logic is for the general irrigation for the crop in the field or the garden. The fuzzy logic has many conditions according to the expected accuracy of the output value that needs to be implemented for the conditions because many conditions help us to make a better decision. Hence fuzzy logic system will be more efficient than the traditional irrigation system which requires continuous monitoring. Also, the crop damage due to heavy rainfall can be reduced using a water level detector.

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KALPANADEVI.S is currently working as an Associate Professor in the Department of Electrical and Electronics Engineering at Knowledge Institute of Technology, Salem**.**

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