Real Time Automation of Agricultural Environment

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Abstract- The paper, "Real time automation of agricultural environment", using PIC16F877A and GSM SIM300 modem is focused on automating the irrigation system for social welfare of Indian agricultural system. This system will be useful for monitoring the soil moisture condition of the farm as well as controlling the soil moisture by monitoring the level of water in the water source and accordingly switching the motor ON/OFF for irrigation purposes. The system proposes a soil moisture sensor at each place where the moisture has to be monitored. Once the moisture reaches a particular level, the system takes appropriate steps to regulate or even stop the water flow. The circuit also monitors the water in the water source so that if the water level becomes very low, it switches off the motor to prevent damage to the motor due to dry run. The system also consists of a GSM modem through which the farmer can easily be notified about the critical conditions occurring during irrigation process.

Keywords- Agriculture, GSM, Soil Moisture Sensor

I. INTRODUCTION

Appropriate environmental conditions are necessary for optimum plant growth, improved crop yields, efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected at high frequency with less labour requirements.[1] In agriculture lands, there is a continuous need for monitoring the water level.[2] The other problems faced by farmers are physical effort ,inconvenience, wastage of electricity, erratic and highly un-reliable power, long distance travel to fields at odd hours, risk to life from electric shocks, labour problem, running of motor during absence of water in the source, soil erosion and fertilizer run-off due to excess water.[3] According to the food and agricultural organization (FAO), average crop yield for irrigated areas is 2.3 times higher than those from rain fed areas[4]. The project consists of a high speed microcontroller (PIC16F877A) and sensors at different field locations and inside the well. These sensors are interfaced to the microcontroller and control actions are taken by switching the motor ON/OFF depending upon the farm conditions. Turning ON the motor starts the sprinkler irrigation.

Sprinkler Irrigation is a method of providing irrigation water which is similar to rainfall. Water is distributed through a system of pipes usually by pumping. Sprinklers provide efficient coverage for small or large areas. It is also adaptable to almost all irrigable soils since sprinklers are available in a wide range of discharge capacity. The system is more suitable for Red and Black soil which has high moisture retention level.

II. WORKING OF THE PROPOSED SYSTEM

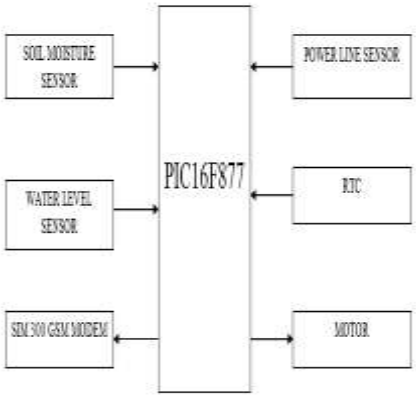

Fig.1 Block diagram

The farm would be regularly irrigated automatically at particular time intervals (typically 2-3 hours per day).

1. The microcontroller (PIC16F877A) will check for three conditions:
   i. Availability of adequate water level in the water source.
   ii. Availability of continuous power supply.
   iii. Moisture level in the soil.

2. In between the fixed time intervals, if the moisture level in the soil falls to the lowest level then the microcontroller will check the above mentioned 1st two condition & will turn ON the motor for irrigation of the farm.
3. The motor will be turned OFF by the microcontroller as soon as the soil moisture sensor indicates adequate availability of moisture in the soil. Turning OFF the motor will stop the irrigation of the farm.
4. The farmer will be informed via an SMS if the following conditions occur:
   i. When the moisture level of the soil is the least.
   ii. The water level in the water source has reached the minimum level.
   iii. When there is no power supply available at the farm.

III. HARDWARE IMPLEMENTATION OF THE PROPOSED SYSTEM

The project consists of the following hardware components:
Power Supply: The circuit mainly consists of transformer, bridge rectifier, filter, regulating IC 7805 and it provides a regulated supply approximately 5V.

RTC: Real time clock (RTCs) are the clock modules. The main advantage of RTC is that they have an arrangement of battery backup which keeps the clock/calendar running even if there is power failure.
Advantages of DS1307 RTCs are:

- Real-time clock (RTC) counts seconds, minutes, hours, date of the month, month, day of the week, and year with leap-year compensation valid up to 2100
- 56-byte non-volatile RAM for data storage

GSM modem SIM 300: A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. A GSM Modem can be used to build the following applications:

- SMS Gateway i.e. to send and receive SMS
- Telemetric i.e. to collect data from remote terminals
- Highly Reliable for 24x7 operation with Matched Antenna

Relay: The basis for relays is the simple electromagnet. If we take an electromagnet, it will interact with metals in its vicinity. If we were to place a piece of metal, near the electromagnet and connect some contacts, so that when the electromagnet is energized, the contacts close.

- Output current to 500 mA
- Output voltage to 50 V

RS232 Connector & MAX 232 (Serial Communication): The serial port sends and receives bytes of information one bit at a time. The important serial characteristics are baud rate, data bits, stop bits and parity. It operates up to 120 kbit/s.

Microcontroller (PIC16F877A): PIC is based on RISC architecture and which executes more number of instructions per given time compared to CISC architecture. PIC is a low power device with many on chip peripherals like SPI, ADC, I2C, USART, Analog comparator. It is of low cost.[5] Its crystal frequency is 8Mhz.

Sensors
Soil moisture sensor: Digital soil moisture sensor is used to check whether the soil is dry or wet. There are various soil moisture sensors available in the market. Some of them are VG 400, Hydra probe soil moisture sensor, SM 150, Grove, Trime-pico 64, Theta probe etc. The main problem of using these sensors is their cost is too high. Thus cost of the system rises. In the proposed system a simple circuit using 2N2222A transistor is used for soil moisture sensing.

Water level sensor: Water level sensor is used to detect water level in water source such as well, tank. Basically the unit is made up of sensors acting as a switch. In proposed system we make use of IC CD4066 for water level sensing. It works on the principle of conductivity of water.

IV. FLOW CHART OF THE PROPOSED SYSTEM

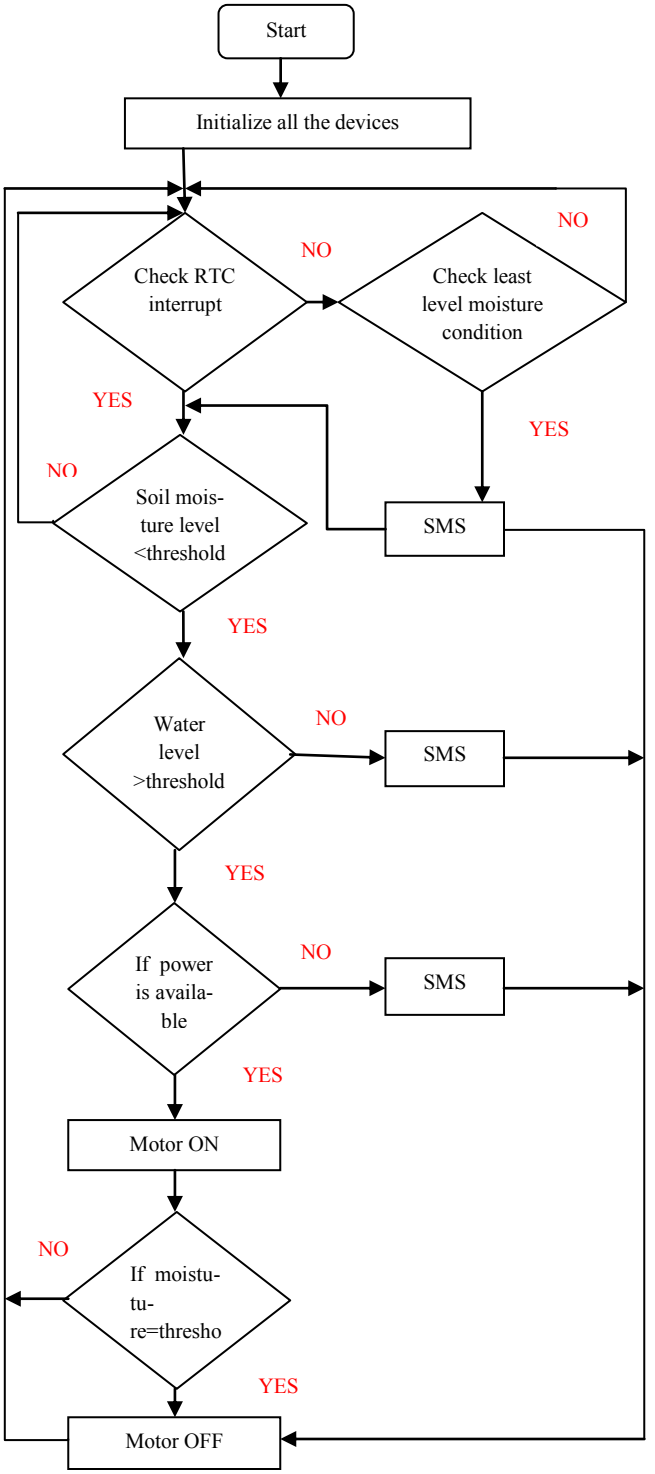

Fig.2 Flow chart of proposed system

V. RESULTS

The simulation of both water level sensor and soil moisture sensor was done using proteus. Breadboard implementation of both the circuits was successfully done. The GSM SIM 300 module was interfaced with PIC16F877A and serial transmission of data was successful.

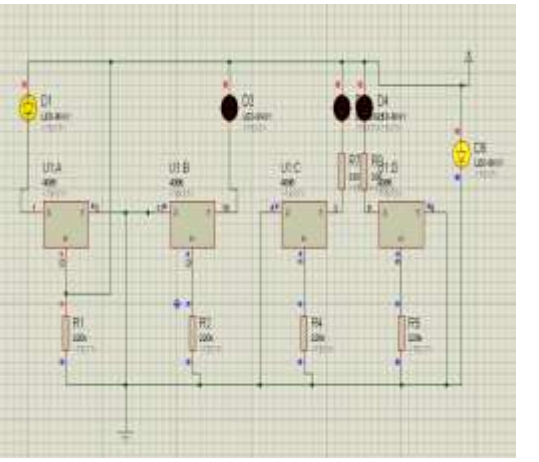

Fig. 3 Simulation of water level sensor

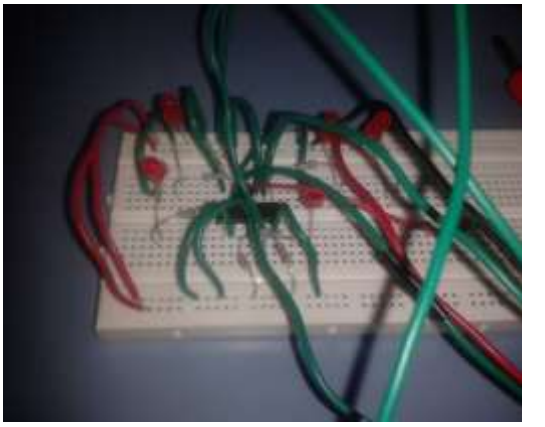

Fig.4 Breadboard implementation of water level sensor

Table.1 Conditions when the LED would glow

L1	L2	L3	L4	Glowing LED
1	0	0	0	LED1 glows
1	1	0	0	LED1,2 glows
1	1	1	0	LED1,2,3 glows
1	1	1	1	LED1,2,3,4 glows

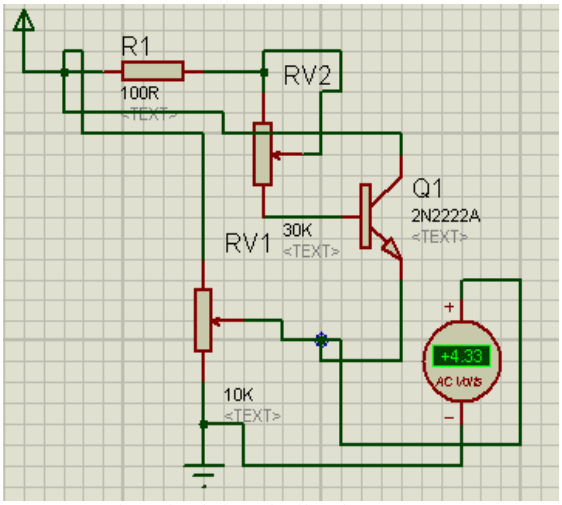

Fig.5 Simulation of soil moisture sensor

Fig.6 Breadboard implementation of soil moisture sensor

Table.2 Soil resistance and corresponding voltage values for soil moisture sensor.

Resistance of soil (KΩ)	Output voltage (Volts)
71.2 (Dry)	0.0013
69.5	0.0019
68.1	0.419
57.6	0.197
42.5	0.199
18.5	0.205
17.6	0.208
15.8	0.211
14.2	0.214
12.5	0.22
11.7(Moist)	0.23

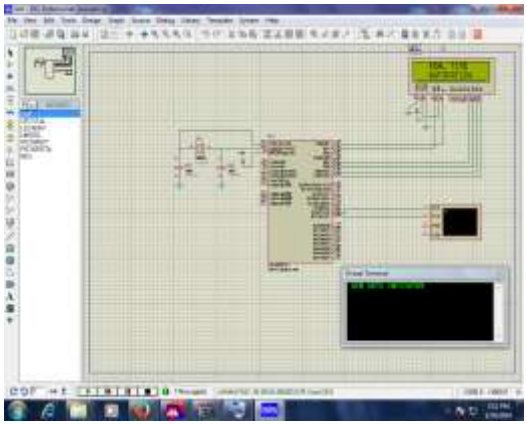

Fig.7 Simulation of Message sent by GSM Modem

VI. FUTURE WORK

- Interfacing of sensors with Microcontroller.
- Development of the microcontroller board using PIC16F877A.
- To calculate the PH value and send it through GSM modem.
- To implement the security system for field into the system.

VII. REFERENCES

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