Efficient Automatic Plant Irrigation System using ATMEGA Microcontroller

Mr.Sundar Ganesh C S

Abstract: **In this paper an automatic plant irrigation system using ATMEGA microcontroller is discussed. Irrigation is the main part of agriculture. Labor-saving and water-saving technology is a key issue in irrigation. Microcontroller based automatic plant irrigation system allows a simple and low cost method for irrigating the crops automatically.**

I. INTRODUCTION

Irrigation is the most important cultural practice and most labour intensive task in daily agriculture sector. Knowing when and how much to water are two important aspects of irrigation. To do this automatically, sensors and methods are available to determine when plants may need water.

The main objective of this paper is to develop a microcontroller based system to irrigate the plant automatically. This system also supports water management decision, which determines the controlling time for the process. Another objective of the project is to send a short message service(SMS) to farmer regarding motor ON and OFF condition.

II. BLOCK DIAGRAM

Block diagram shows the various components is shown in Fig.1. Moisture Sensor are copper clad of certain length, thickness and separated from each other at a fixed distance[1]. These sensors are used to measure the moisture content of soil in terms of voltage and then given to Operational Amplifier.

The Op-Amp used in this project used in non inverting mode obtained the voltage from sensor is amplified, since they are of very low voltage and then given to Analog to Digital converter.The analog parameters measured by the sensors are then converted to corresponding digital values by the ADC.

[2]The microcontroller is the heart of the proposed embedded system. It constantly monitors the digitized parameters of sensor and verifies them with the predefined threshold values and checks the condition for dry and wet, and correspondingly the relay is made ON or OFF. Another purpose of the microcontroller is to check whether the real-time clock is equal to the ON/OFF time stored previously in EEPROM by the user and for user interface also, when the required condition is met, relay is made ON/OFF.

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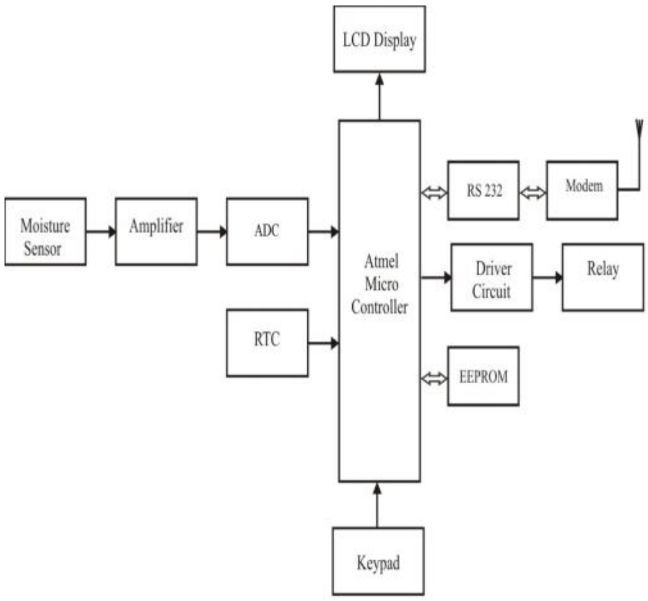


Fig.1 Block Diagram

Liquid crystal display model is used to indicate the output of ADC in decimal, present date, month, year, hour, minutes, seconds and the state of relay whether MOTOR ON or MOTOR OFF. SIM300 modem is used to connect to a GSM network and send text messages regarding on/off status of motor to farmer's mobile.

III. SOIL MOISTURE SENSOR

Soil moisture sensor is used to detect the moisture content of the soil. Moisture sensor circuit gives a high voltage when it is dry and a low voltage when the soil is wet. The voltage obtained from sensor is fed to the OP-AMP

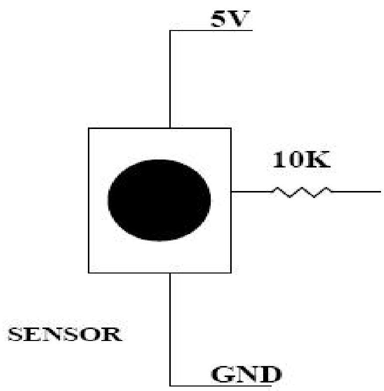


Fig.2 Moisture Sensor

The circuit designed uses a 5 V supply and a copper clad as sensor. It gives a voltage output corresponding to the conductivity of the soil. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil. Fig.2 shows the sensor circuit used in this work[3].

The copper clad acts as the sensor. It is immersed into the soil, whose moisture content is under test. The soil is examined under two conditions, namely dry and wet condition.

Under dry condition, the probes are placed in the soil under dry conditions and are inserted up to a fair depth of the soil. As there is no conduction path between the copper clad, the sensor circuit remains open. Under excess water condition the conductivity of the soil increases drastically and a steady conduction path is established.

IV.ANALOG TO DIGITAL CONVERTER

MCP3208 devices are successive approximation 12-bit ADC with on-board sample and hold circuitry. The MCP3204/3208 devices operate over a broad voltage range (2.7 V - 5.5 V). Low current design permits operation with typical standby and active currents of only 500 nA and 320 µA, respectively.Fig.3 shows the functional block diagram of MCP3208 ADC.

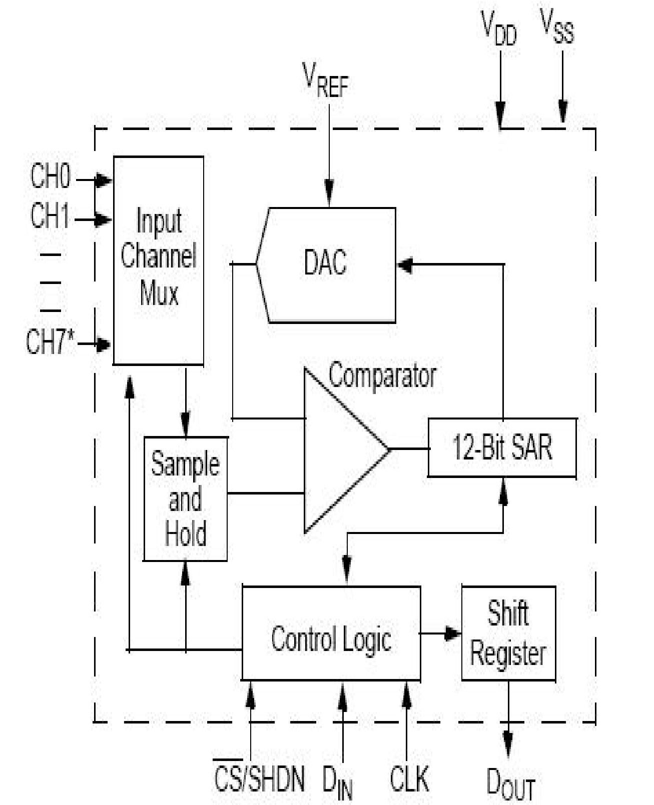


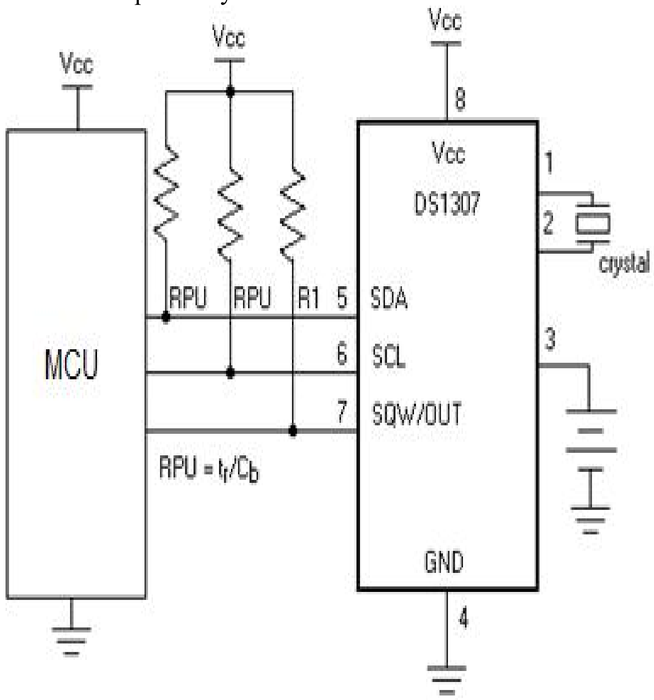
Fig.3 Functional Block Diagram of MCP3208 ADC

The MCP3208 A/D converters employ a conventional SAR architecture. With this architecture, a sample is acquired on an internal sample/hold capacitor for 1.5 clock cycles starting on the fourth rising edge of the serial clock after the start bit has been received.

V.REAL TIME CLOCK

The DS1307 serial real-time clock (RTC) is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV-SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply.

The DS1307 is a low-power clock/calendar with 56 bytes of battery-backed SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The DS1307 operates as a slave device on the I^2C bus. Access is obtained by implementing a START condition and providing a device identification code followed by a register address. Subsequent registers can be accessed sequentially until a STOP condition is executed.



. Fig.4 Connection Diagram of Real Time Clock

When V_{cc} falls below 1.25 times V_{BAT}, the device terminates an access in progress and resets the device address counter. Inputs to the device will not be recognized at this time to prevent erroneous data from being written to the device from an out-of-tolerance system. When V_{cc} falls below V_{BAT}, the device switches into a low-current battery-backup mode. Upon power-up, the device switches from battery to V_{cc} when V_{cc} is greater than V_{BAT} +0.2 V and recognizes inputs when Vcc is greater than 1.25 x V_{BAT}.

VI.MODEM

It is a compact and portable 60 pin terminal and can be connected to a computer with the help of a standard RS232 serial port. SIM300 is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a **SIM (Subscriber Identity Module)** card just like mobile phones to activate communication with the network. The SIM300 is integrated with the TCP/IP protocol. Extended AT commands are developed which is very useful for those data transfer applications.

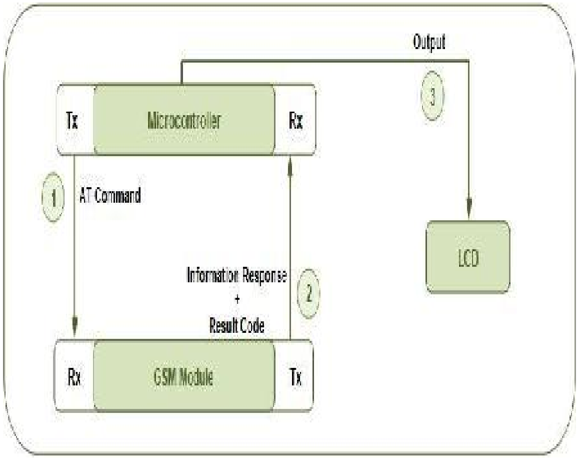


Fig.5 Interface between modem and microcontroller

Since AT commands are the interface between GSM modem and controller, these commands can be sent to the GSM modem by the microcontroller itself. In this case, the receive (Rx) and transmit (Tx) pin of the GSM module are connected to the transmit and receive pin of AT89S52's serial port, respectively. The controller is programmed to send a fixed command 'AT' to the module. So this involves serial data communication. Fig. 3.27 shows the interfacing of microcontroller with GSM modem along with flow of AT commands, information response and result codes.

VI.RESULTS

When the soil is dry, the sensor output voltage is about 2.85 V which is the input to op-amp. The voltage is amplified in the op-amp and the output of 4.72 V is given to microcontroller. This voltage is enough to drive and turn on the relay. Also, the message "MOTOR ON" is sent to the mobile number of the farmer, that is stored in the system.

Similarly when the soil is wet, the sensor output voltage is about 29.5 mV which is the input to op-amp. The voltage is amplified in the op-amp and the output of 33.4 mV is given to microcontroller. This voltage is not enough to drive the relay and hence the relay is turned off. Also, the message "MOTOR OFF" is sent to the same mobile number. Table 1 shows the reading obtained from sensor, OP-AMP output and relay condition.

Table 1 : Results

SOIL CONDITION	SENSOR OUTPUT	OP-AMP OUTPUT	RELAY STATUS
Dry	2.85 V	4.72 V	ON
Wet	29.5 mV	33.4 mV	OFF

VII.CONCLUSION

Efficient irrigation management is a major concern in many planting systems. In this project, we presented technology which allowed farmers to maximize their productivity while saving labour. This report shows in detail, the design of the hardware architecture, the software algorithm applied for the field irrigation system. The performance of the whole system proved its high reliability. Efficient scheduling of irrigation gives the highest return for the least amount of water.

Potential applications of this system can be extended to environmental monitoring, precision agriculture, and facility automation by little modifications. The value of this technology can be best realized when integrated with agronomic knowledge, using the information gathered in the improvement of decision support systems. Also, improving operations by providing early warning of equipment failure and a predictive maintenance tool, improving energy management, providing automatic record-keeping for regulatory compliance, eliminating personnel training costs or reducing insurance costs.

People can also link several such star irrigation networks through adding wireless routers to achieve large-scale remote irrigation application.

VIII.FUTURE WORK

The performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the microcontroller by using other controllers such as AVRs and PICs. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of Microcontrollers.

The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time.

This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

IX REFERENCES

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