REAL TIME AUTO-IRRIGATION USING WSN

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Abstract

Agricultural sector is playing vital role in Indian economy, in which irrigation mechanism is of key concern. In dry areas or in case of inadequate rainfall, irrigation becomes difficult. So, it needs to be automated for proper yield. Increasing energy costs and decreasing water supplies point out the need for better water management. Irrigation management is a complex decision- making process to determine when and how much water to apply to a growing crop to meet specific management objectives. If the farmer is far from the agricultural land he will not be noticed of current conditions. So, efficient water management plays an important role in the irrigated agricultural cropping systems. Our project aims to find the exact field condition and to control the wastage of water in the field. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers irrigation motors. An algorithm is developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. GSM technology is used to inform the end user about the exact field condition and status of the motors.

Index Terms—automated irrigation, GSM, moisture sensor, temperature sensor.

I. INTRODUCTION

India is the agriculture based country. Our ancient people completely depended on the agricultural harvesting. Agriculture is a source of livelihood of majority Indians and has great impact on the economy of the country. In dry areas or in case of inadequate rainfall, irrigation becomes difficult. So, it needs to be automated for proper yield.

In present scenario, irrigation techniques in India are through the manual control in which the farmers irrigate the land at regular intervals. Manual operation of the routine practices in agriculture requires lot of attention and care. Also it is difficult to perform desired jobs efficiently and precisely. Ultimately this may result in lower crop production, non-uniform growth and poor quality. The introduction of automation in irrigation system will result in increased application efficiency and drastically reduce labour requirement. The proposed system helps to monitor and control the irrigation system using a simple mobile phone.

II. BLOCK DIAGRAM OF AUTO-IRRIGATION SYSTEM

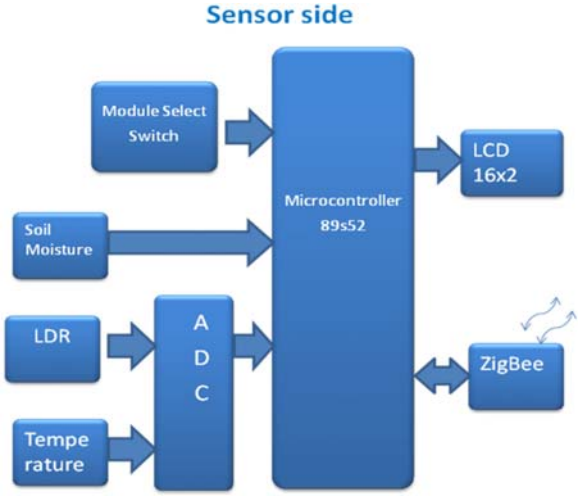

Fig1(a) Sensing node

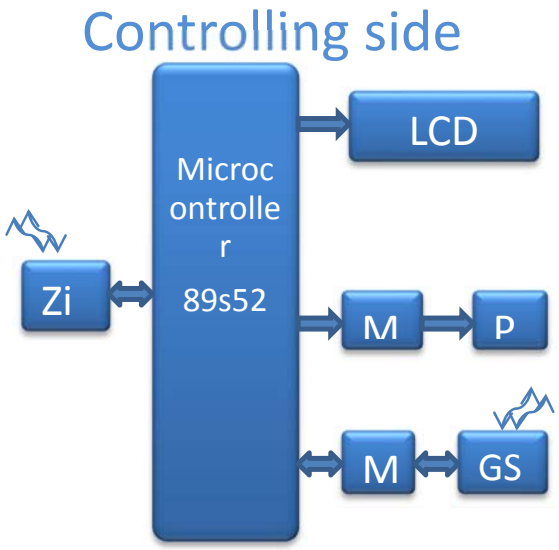

Fig1(b) Controlling Terminal

The System consists of two parts:a) sensing node b) controlling terminal.

The sensors will give analog output but our processor will accept only the digital data. So we require a ADC, by connecting the sensors to the ADC channel pins we get the required form of output. The total arrangement is shown in the above Fig1(a).

Here we are using total three sensors to monitor the field condition. Those are Temperature, Soil moisture,Light sensor(LDR).

The sensed parameters are then displayed on the LCD and sent to the controlling side continuously via ZigBee. LCD is for the field display purpose.

On the Controlling side, an algorithm is developed with threshold values of sensors that is programmed into a microcontroller**.**Depending on data received from the sensors, action is taken whether to switch ON/OFF water pumps .

As the sensed parameters are continuously being sent to the controlling side, as soon as the sensed parameters are within acceptable levels the microcontroller will switch OFF the water pump.

Moreover, when a certain command is sent to the system by the end user , the sensors sends the information it recorded so far (which are also displayed on the LCD panel of the system fixed in the field) to the mobile phone of the end user (through which the commands are been initiated) in the form of a text message.

III. Components Of Auto-Irrigation System

a. Microcontroller (89s52):

The Atmel AT89 series is an Intel 8051-compatible family of 8 bit microcontrollers (µCs) manufactured by the Atmel Corporation. Based on the Intel 8051 core, the AT89 series remains very popular as general purpose microcontrollers, due to their industry standard instruction set, and low unit cost. This allows a great amount of legacy code to be reused without modification in new applications. While considerably less powerful than the newer AT90 series of AVR RISC microcontrollers, new product development has continued with the AT89 series for the aforementioned advantages.

All four ports in the AT89C51 and AT89C52 are bidirectional .Each consists of a latch (Special Function Registers P0 through P3), an output driver, and an input buffer. The output drivers of Ports 0 and 2, and the input buffers of Port 0, are used in accesses to external memory. In this application, Port 0 outputs the low byte of the external memory address, time-multiplexed with the byte being written or read. Port 2 outputs the high byte of the external memory address when the address is 16 bits wide. Otherwise the Port 2 pins continue to emit the P2 SFR content. All the Port 3 pins, and two Port 1 pins (in the AT89C52)are multifunctional .The alternate functions can only be activated if the corresponding bit latch in the port SFR contains a 1. Otherwise the port pin is stuck at 0. It has less complex feature than other microprocessor.

The 89S52 has 4 different ports, each one having 8 Input/output lines providing a total of 32 I/O lines. Those ports can be used to output DATA and orders do other devices, or to read the state of a sensor, or a switch. Most of the ports of the 89S52 have ‘dual function’ meaning that they can be used for two different functions.

The first one is to perform input/output operations and the second one is used to implement special features of the microcontroller like counting external pulses, interrupting the execution of the program according to external events, performing serial data transfer or connecting the chip to a computer to update the software. Each port has 8 pins, and will be treated from the software point of view as an 8-bit variable called ‘register’, each bit being connected to a different

Input /Output pin.

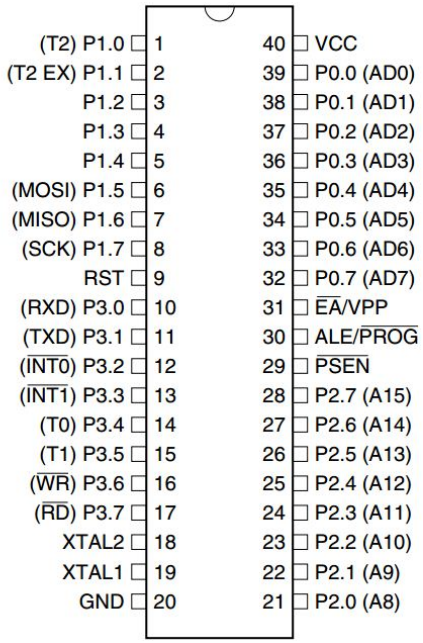

Fig 2. Pin diagram of 89s52

b. Temperature Sensor:

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ºC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 ºC temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ºC rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/ ºC.

c. Soil Moisture Sensor:

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity.

Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages

d. Light Sensor(LDR):

Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices.

A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing throgh the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

e. Max 232:

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels.

These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels.

f. GSM Modem:

GSM 900 modem is a highly flexible plug and play GSM 900 operating frequency modem for direct and easy integration RS232, voltage range for the power supply and audio interface make this device perfect solution for system integrators and single user. Voice, Data/Fax, SMS, GPRS, integrated TCP/IP stack, RTC and other features like the GSM / GPRS. It has Built-in TCP/IP

Protocol Built-in RTC in the module. AT Command based system it has the signaling speed of 85.6 kbps.

g. MCP3208 (ADC):

MCP 3208 devices are successive approximation 12-bit Analogto-Digital (A/D) Converters with on-board sample and hold circuitry. The MCP3204 is programmable to provide two pseudo-differential input pairs or four singleended inputs. The MCP3208 is programmable to provide four pseudo-differential input pairs or eight singleended inputs.

h. Wireless Transreciever / ZigBee (NRF24L01):

The Nrf24L01+(Nrf24L01p) is a single chip 2.4GHz transceiver with an embedded baseband protocol engine suitable for ultra low power wireless applications. The Nrf24L01+ is designed for operation in the world wide ISM frequency band at 2.400 – 2.4835GHz. To design a radio system with the Nrf24L01+, you simply need an MCU (microcontroller) and a few external passive components. The high air data rate combined with two power saving modes make the Nrf24L01+ very suitable for ultra low power designs.

i. LCD(16x2):

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multisegment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix.

This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

IV. ADVANTAGES OF THIS SYSTEM

1. User friendly and cost effective.
2. Highly sensitive
3. Easy to maintain.
4. Saves labor works.
5. No soil erosion, which saves land.
6. Enhances plant growth and yield and better quality of produce.
7. Water is only delivered, when its needed.

V. CONCLUSION

This application of sensor-based irrigation has some advantages such as preventing moisture stress of trees, diminishing of excessive water usage, ensuring of rapid growing weeds, measuring fertility of soil.

Thus the proposed methodology has implemented a wireless sensor network based on the soil moisture level,temperature and light intensity monitoring system to control the water pump.

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