

Automatic Irrigation Control System Using Embedded Ethernet Communication

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Abstract

Efficient water management is major concern in many cropping systems in semi arid and arid areas. Distributed in field sensor based irrigation systems offer a potential solution to support site specific irrigation management that allows produces to maximize their productivity while saving water. This paper describes details of a wireless sensor network & controller & using ASP.NET for real time in field sensing. Here I am monitoring and controlling the moisture of the soil. It consists of sensor unit which provides the details of the moisture present in the soil at time. The microcontroller has an on chip analog to digital converter (ADC) which converts the signal into digital and taken for further processing. It communicates with the Ethernet controller through serial peripheral interface protocol (SPI). Now from the Ethernet controller the moisture data are uploaded to a web server. That can be accessed from any location by entering the IP address of the Ethernet controller. This project also provides low cost automation. It also requires minimum cost for the operation and maintenance of the overall system.

Keywords: Sensors, Automation, Control systems, ASP.NET, Ethernet Controller, Water resources.

1. Introduction

IRRIGATION is an essential practice in many agricultural cropping systems in semi arid and arid areas, efficient water application and management is major concerns .IRRIGATION SYSTEMS generally apply water quite uniformly; however Substantial variations in soil properties and water availability exist across most fields. In these cases, the ability to apply site – specific irrigation management to match spatially and temporally variable conditions can increase application efficiencies, reduce environmental impacts, and even improve yields. The development of a distributed in-field sensor based site specific irrigation system offers the potential to increase yield and quality while saving water but irrigation control, data interface, software design and communication can be challenging. [5],[6] Software design for microcontroller is MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip’s PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools. Software used for web application is ASP.NET which is very popular Microsoft product developed by Microsoft

Corporation with Ms SQL as backend. Microsoft’s ASP.NET is the quickest and easiest way to create applications.ASP.NET is very popular Microsoft product developed by Microsoft Corporation. This front-end tool is mainly used for developing both client server applications and desktop applications. This software works under windows XP platforms. This is one of the improved languages that are efficient than ASP language.

ASP.NET includes a variety of open active controls for user interface to design application form.

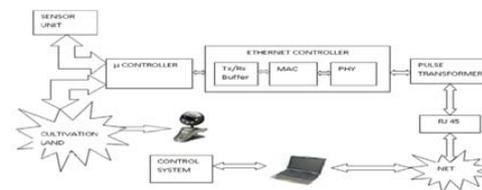


Fig.1 system layout for infield wireless sensor network for site specific irrigation system

2. Materials And Methods

A conceptual system layout of distributed in-field WSN is illustrated in fig.1.The system consists of two distributed in field sensors across the field,microcontroller, Ethernet controller and control system.The in-field sensors monitor the field conditions of soil moisture,soil temperature.All in-field sensory data are wirelessly transmitted to the microcontroller.It processes the in-field sensory data through a user friendly decision making program and sends control commands to control system.Microcontroller updates and sends current information of sensors from the sensor unit for real time monitoring and control of the irrigation system.

A. Site-Specific Field Configuration

A Spatial variation of study site was examined in this paper so that minimum number of in-field sensors could be placed with optimal impact for characterizing the scope of the field information. In this case the optimal distribution of the in-field sensors was determined on the basis of the spatial soil variability [12].

B. System Components

Wireless Data Communication: [4], [11] Most wireless communication follow standard protocols such as the IEEE 802.11, Bluetooth, or Zigbee, which all use spread spectrum radio technology. Bluetooth is an international standards of short-range wireless communication. The key features of Bluetooth technology are robustness, low power, and low cost.

PIC (16F887) various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877.

Ethernet controller: The ENC28J60 is a stand-alone Ethernet controller with an industry standard serial peripheral interface (SPI). The ENC28J60 meets all of the IEEE 802.3 specifications. It incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module for fast data throughput and hardware assisted checksum calculation, which is used in various network protocols.

Buffer

- 8-Kbyte Transmit/Receive packet Dual port SRAM
- Configurable Transmit/Receive Buffer Size
- Hardware managed Circular Receive FIFO
- Byte-wide Random and Sequential Access with
- Auto-Increment
- Internal DMA for Fast Data Movement
- Hardware Assisted Checksum Calculation for various

Network Protocols

- Medium Access Controller (MAC) Feature
- Supports Unicast, Multicast and Broadcast
- Programmable Receive Packet Filtering and Wake-up
- Host on Logical AND or OR of the Following:
 - Unicast Destination address
 - Multicast address
 - Broadcast address

Physical Layer (PHY) Features

- Two Programmable LED Output for LINK, TX
- RX, collision and Full/Half-duplex status

Pulse transformer: A pulse transformer is a transformer that is optimized for transmitting rectangular electrical pulses (that is, pulses with fast rise and fall times and a relatively constant amplitude). Small versions called *signal* types are used in digital logic and telecommunications circuits, often for matching logic drivers to transmission lines. Medium-sized *power* versions are used in power-control circuits such as camera flash controllers. Larger *power* versions are used in the electrical power distribution industry to interface low-voltage control circuitry to the high-voltage gates of power semiconductors. Special high voltage pulse transformers are also used to generate high power pulses for radar,

particle accelerators, or other high energy pulsed power applications.

To minimise distortion of the pulse shape, a pulse transformer needs to have low values of leakage inductance and distributed capacitance, and a high open-circuit inductance. In power-type pulse transformers, a low coupling capacitance (between the primary and secondary) is important to protect the circuitry on the primary side from high-powered transients created by the load. For the same reason, high insulation resistance and high breakdown voltage are required. A good transient response is necessary to maintain the rectangular pulse shape at the secondary, because a pulse with slow edges would create switching losses in the power semiconductors.

Power supply: The **7805 voltage regulators** employ built-in current limiting, thermal shutdown, and safe-operating area protection which makes them virtually immune to damage from output overloads. 7805 is a three-terminal positive voltage regulator

The 7805 series has several key advantages over many other voltage regulator circuits which have resulted in its popularity: 7805 series ICs do not require any additional components to provide a constant, regulated source of power, making them easy to use, as well as economical, and also efficient uses of circuit board real estate. By contrast, most other voltage regulators require several additional components to set the output voltage level, or to assist in the regulation process. Some other designs (such as a switching power supply) can require not only a large number of components but also substantial engineering expertise to implement correctly as well.

7805 series ICs have built-in protection against a circuit drawing too much power. They also have protection against overheating and short-circuits, making them quite robust in most applications. In some cases, the current-limiting features of the 7805 devices can provide protection not only for the 7805 itself, but also for other parts of the circuit it is used in, preventing other components from being damaged as well.

RJ45: A registered jack connector and wiring pattern used for connection of a high-speed modem to a telephone network using a keyed 8P8C modular connector. An unkeyed 8P8C modular connector, often found on Ethernet cables

Control system: A DC motor is an electric motor that runs on direct current (DC) electricity. DC motors were used to run machinery, often eliminating the need for a local steam engine or internal combustion engine. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Modern DC motors are nearly always operated in conjunction with power electronic devices.

3. Software Tools

3.1 MPLAB IDE How To Program PIC(16F887) Microcontroller In C Using MPLAB IDE

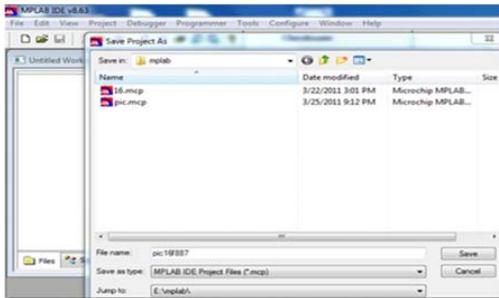


Fig. 2 Create a MPLAB IDE project file

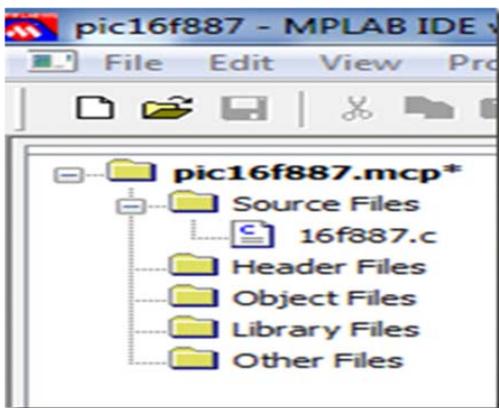


Fig. 3 Connect pic16f887

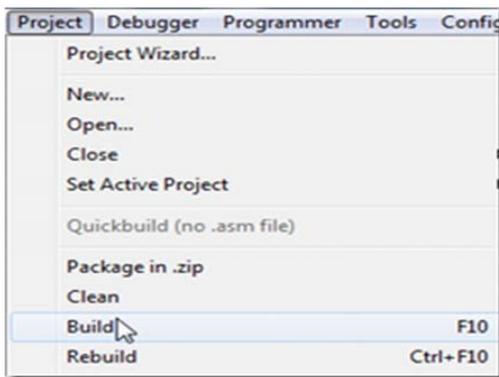


Fig. 4 Build the project using pic16f887

The current version of MPLAB IDE is version 8. It is a 32-bit application on Microsoft Windows and includes several free software components for application development, hardware emulation and debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third-party software and hardware development tools. Both Assembly and C programming languages can be used with MPLAB IDE v8. Others may be supported through the use of third-party programs. Support for MPLAB IDE, along with sample code, tutorials, and drivers can be found on Microchip's website. MPLAB IDE v8 does not support Linux, Unix or Macintosh operating systems.

3.2 ASP.NET

ASP.NET is a Web application framework developed and marketed by Microsoft to allow programmers to build dynamic Web sites, Web applications and Web services. It was first released in January 2002 with version 1.0 of the .NET Framework, and is the successor to Microsoft's Active Server Pages (ASP) technology. ASP.NET is built on the Common Language Runtime (CLR), allowing programmers to write ASP.NET code using any supported.

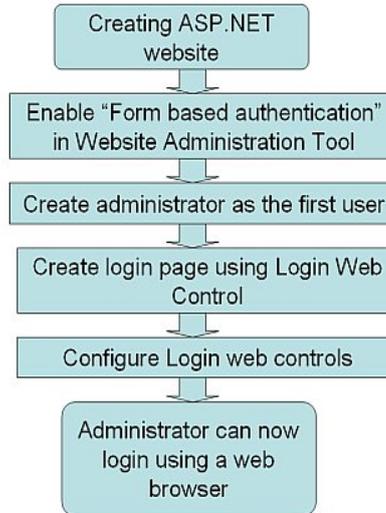


Fig. 5 Flowchart for ASP.NET

3.3 ASP.NET file:

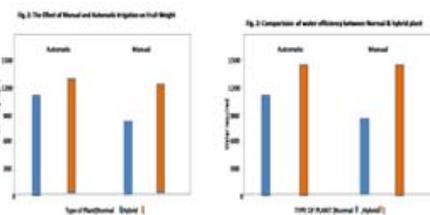
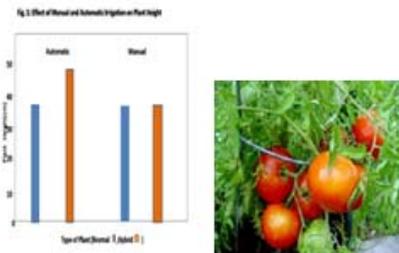
- An ASP.NET file is just the same as an HTML file
- An ASP.NET file can contain HTML, XML, and scripts
- Scripts in an ASP.NET file are executed on the server
- An ASP.NET file has the file extension ".aspx"

3.4 ASP.NET work:

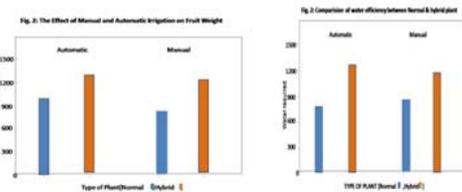
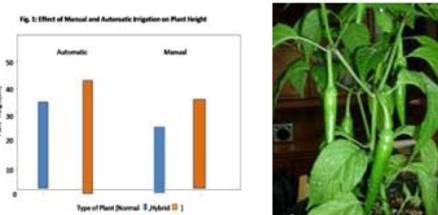
- When a browser requests an HTML file, the server returns the file
- When a browser requests an ASP.NET file, IIS passes the request to the ASP.NET engine on the server
- The ASP.NET engine reads the file, line by line, and executes the scripts in the file
- Finally, the ASP.NET file is returned to the browser as plain HTML

4. Experiments And Results

A. Tomato plant



B. Chili plant



5. Conclusion

Continuing population growth and increased urbanization threaten water availability for agriculture, including greenhouses and nurseries. Thus, efficient water use is increasingly important. More efficient irrigation practices not only reduce water use, but also save energy and reduce leaching and runoff of fertilizer. In addition, better water management may reduce the incidence of root diseases and may be used for growth control. To improve irrigation practices is the use of soil moisture sensor based on the amount of water in the substrate. The objective of this work was to quantify water savings that can be achieved using soil moisture sensor for irrigation control. In this phase moisture and temperature of the soil should be measured and its response time is instantaneous. & Enables measurements to be taken over a large area. In LCD display we can monitor temperature and moisture of the soil.

6. Future Work

In this real time irrigation system we can add wireless video transmission through input, using ASP.NET. So, we can monitor and control the field in online as the type of video format.

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