ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Web Based Automatic Irrigation System Using Wireless Sensor Network and Embedded Linux Board

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Abstract:

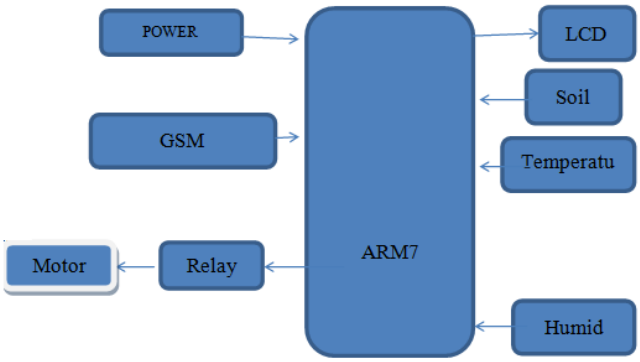
This paper presents an automation of farm irrigation system using a wireless sensor network (WSN) and embedded Linux board. The system provides a web interface to the user so that the user can control and monitor the system remotely. In this paper, Raspberry Pi is used as an embedded Linux board which is designed based on the arm 11 microcontroller architecture. Embedded Linux board makes the communication with all distributed sensor nodes placed in the farm through ZigBee protocol and itself act as a coordinated node in the wireless sensor network. The goal of coordinator node is to collect the parameters like soil moisture and soil temperature wirelessly. Each sensor node consists of soil moisture and soil temperature sensor and one ZigBee Antenna device for communication with the coordinator node. Raspberry Pi stores collected data in the database and analyzes the stored data. The system will work according to the algorithm developed for watering the crop. The board has an Ethernet interface and runs the simple data web server. Hence coordinator collects the data over ZigBee wireless communication protocol and allow user to monitor the data from a web browser. User can make the irrigation system ON or OFF remotely. The system will reduce the water consumption and giving uniform water to the crop results in increasing yield.

Introduction to Embedded Systems:

Embedded systems are electronic devices that incorporate microprocessors with in There implementations. The main purposes of the microprocessors are to simplify the system design and provide flexibility.

Having a microprocessor in the device means that removing the bugs, making modifications, or adding new features are only matters of rewriting the software that controls the device. Or in other words embedded computer systems are electronic systems that include a microcomputer to perform a specific dedicated application. The computer is Hidden inside these products. Embedded systems are ubiquitous. Every week millions of tiny computer chips come pouring out of factories finding their way into our everyday products. Embedded systems are self-contained programs that are embedded within a piece of hardware. Whereas a regular computer has many different applications and software that can be applied to various tasks, embedded systems are usually set to a specific task that cannot be altered without physically manipulating the circuitry. Another way to think of an embedded system is as a computer system that is created with optimal efficiency, thereby allowing it to complete specific functions as quickly as possible..

BLOCK DIAGRAM:



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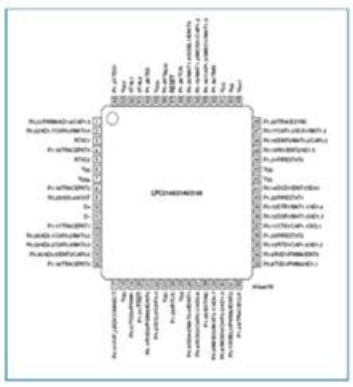
ARM Microcontroller: LPC2148:

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8kB up to 40kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.The application program may also erase and/or program the flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc.



ARM7TDMI-S processor has two instruction sets:

The standard 32-bit ARM set.

• A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code.Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system. The particular flash implementation in the LPC2141/42/44/46/48 allows for full speed execution also in ARM mode. It is recommended to program performance critical and short code sections (such as interrupt service routines and DSP algorithms) in ARM mode. The impact on the overall code size will be minimal but the speed can be increased by 30% over Thumb mode.

POWEW SUPPLY

In this project we have power supplies with +5V & -5V option normally +5V is enough for total circuit. Another (-5V) supply is used in case of OP amp circuit .Transformer primary side has 230/50HZ AC voltage whereas at the secondary winding the voltage is step downed to 12/50hz and this voltage is rectified using two full wave rectifiers .the rectified output is given to a filter circuit to fiter the unwanted ac in the signal After that the output is again applied to a regulator LM7805(to provide +5v) regulator.

Whereas LM7905 is for providing –5V regulation (+12V circuit is used for stepper motors, Fan and Relay by using LM7812 regulator same process like above supplies.)Do not use the word "essentially" to mean "approximately" or "effectively".In your paper title, if the words "that uses" can accurately replace the word "using", capitalize the "u"; if not, keep using lower-cased..

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GSM

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in Europe and other parts of the world for transmitting mobile voice and data services. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band.GSM was first introduced in 1991. As of the end of 1997, GSM service was available in more than 100 countries and has become the de facto standard in Europe and Asia.

3.1 What does GSM offer

GSM supports voice calls and data transfer speeds of up to 9.6 kbit/s, together with the transmission of SMS (Short Message Service). GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3G in Australia, Canada and many South American countries. By having harmonized spectrum across most of the globe, GSM's international roaming capability allows users to access the same services when travelling abroad as at home. This gives consumers seamless and same number connectivity in more than 218 countries. Terrestrial GSM networks now cover more than 80% of the world's population. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

HISTORY

In 1982, the European Conference of Postal and Telecommunications Administrations (CEPT) created the Group Special Mobile (GSM) to develop a standard for a mobile telephone system that could be used across Europe. In 1987, a memorandum of understanding was signed by 13 countries to develop a common cellular telephone system across Europe. Finally the system created by SINTEF lead by Torleiv Maseng was selected.

In 1989, GSM responsibility was transferred to the European Telecommunications Standards Institute (ETSI) and phase I of the GSM specifications were published in 1990. The first GSM network was launched in 1991 by Radiolinja in Finland with joint technical infrastructure maintenance from Ericsson. By the end of 1993, over a million subscribers were using GSM phone networks being operated by 70 carriers across 48 countries.

3.3 GSM Frequencies

GSM networks operate in a number of different frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G). Most 2G GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas (including Canada and the United States) use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated. Most 3G GSM networks in Europe operate in the 2100 MHz frequency band. The rarer 400 and 450 MHz frequency bands are assigned in some countries where these frequencies were previously used for first-generation systems.GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used.

In some countries the GSM-900 band has been extended to cover a larger frequency range. This 'extended GSM', E-GSM, uses 880–915 MHz (uplink) and 925–960 MHz (downlink), adding 50 channels (channel numbers 975 to 1023 and 0) to the original GSM-900 band.Time division multiplexing is used to allow eight full-rate or sixteen half-rate speech channels per radio frequency channel. There are eight radio timeslots (giving eight burst periods) grouped into what is called a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 Kbit/s, and the frame duration is 4.615 ms.

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The transmission power in the handset is limited to a maximum of 2 watts in GSM850/900 and 1 watt in GSM1800/1900.

3.4 GSM ARCHITECTURE

The GSM network consists mainly of the following functional parts:

MSC

The mobile service switching centre (MSC) is the core switching entity in the network. The MSC is connected to the radio access network (RAN); the RAN is formed by the BSCs and BTSs within the Public Land Mobile Network (PLMN). Users of the GSM network are registered with an MSC; all calls to and from the user are controlled by the MSC. A GSM network has one or more MSCs, geographically distributed.

TYPES OF MOTORS

Industrial motors come in a variety of basic types. These variations are suitable for many different applications. Naturally, some types of motors are more suited for certain applications than other motor types are. This document will hopefully give some guidance in selecting these motors.

AC Motors

The most common and simple industrial motor is the three phase AC induction motor, sometimes known as the "squirrel cage" motor. Substantial information can be found about any motor by checking its (nameplate).

Advantages

- Simple Design
- Low Cost
- Reliable Operation
- Easily Found Replacements
- Variety of Mounting Styles
- Many Different Environmental Enclosures

Simple Design

The simple design of the AC motor -- simply a series of three windings in the exterior (stator) section with a simple rotating section (rotor). The changing field caused by the 50 or 60 Hertz AC line voltage causes the rotor to rotate around the axis of the motor.

16 * 2 Alphanumeric LCD

Liquid crystal display is very important device in embedded system. It offers high flexibility to user as he can display the required data on it. A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. LCDs therefore need a light source and are classified as "passive" displays. Here the lcd has different memories to display data, those are discussed below.

Display data RAM (DDRAM) stores display data represented in 8-bit character codes. Its extended capacity is 80 X 8 bits, or 80 characters. The area in display data RAM (DDRAM) that is not used for display can be used as general data RAM. So whatever you send on the DDRAM is actually displayed on the LCD. For LCDs like 1x16, only 16 characters are visible, so whatever you write after 16 chars is written in DDRAM but is not visible to the user.

Figure below will show you the DDRAM addresses of 2 Line LCD.

SERIALCOMMUNICATION

INTRODUCTION

Computers transfer data in two ways: parallel and serial. In parallel data transfers, often 8 or more lines (wire conductors) are used to transfer data to a device that is only a few feet away. Examples of parallel transfers are printers and hard disks; each uses cables with many wire strips. Although in such cases a lot of data can be transferred in a short amount of time by using many wires in parallel, the distance cannot be great. To transfer to a device located many meters away, the serial method is used. In serial communication, the data is sent one bit at a time, in contrast to parallel communication, in which the data is sent a byte or more at a time. The 8051 has serial communication capability built into it, thereby making possible fast data transfer using only a few wires.

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When a microprocessor communicates with the outside world, it provides the data in byte-sized chunks. In some cases, such as printers, the information is simply grabbed from the 8-bit data bus of the printer. This can work only if the cable is not too long, since long cables diminish and even distort signals. Furthermore, an 8-bit data path is expensive. For these reasons, serial communication is used for transferring data between two systems located at distances of hundreds of feet to millions of miles apart. The Figures shows serial versus parallel data transfers.

Motors

Motor is a device that creates motion, not an engine; it usually refers to either an electrical motor or an internal combustion engine.

It may also refer to:

 Electric motor, a machine that converts electricity into a mechanical motion

 AC motor, an electric motor that is driven by alternating current

 Synchronous motor, an alternating current motor distinguished by a rotor spinning with coils passing magnets at the same rate as the alternating current and resulting magnetic field which drives it

 Induction motor, also called a squirrel-cage motor, a type of asynchronous alternating current motor where power is supplied to the rotating device by means of electromagnetic induction.

RELAY

A relay is used to isolate one electrical circuit from another. It allows a low current control circuit to make or break an electrically isolated high current circuit path. The basic relay consists of a coil and a set of contacts. The most common relay coil is a length of magnet wire wrapped around a metal core. When voltage is applied to the coil, current passes through the wire and creates a magnetic field. This magnetic field pulls the contacts together and holds them there until the current flow in the coil has stopped. The diagram below shows the parts of a simple relay.

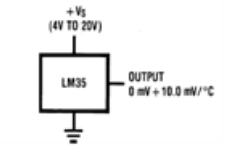

Figure: Relay

Operation:

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current is switched off, the armature is usually returned by a spring to its resting position shown in figure 6.6(b). Latching relays exist that require operation of a second coil to reset the contact position.

TEMPERATURE SENSOR

Temperature Sensor which converts temperature value into electrical signals. We used IC called LM 35 as a temperature sensor. LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.

LM35

 LM35 is precision integrated circuit temperature sensor. Its output voltage is linearly proportional to temperature (in celsius).

 The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over full −55 to +150°C temperature range.

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a) Soil temperature sensor

The temperature sensor used here is DS1822 digital

thermometer with ± 2°c accuracy over a -10°c to +85°c range.

Data is read over a 1 wire serial bus in 2´s complement format

with 9 to 12 bits of resolution. The DS1822 requires only one

data line (and ground) for communication with a central

microprocessor. It has an operating temperature range of –55°Cto +125°C. In addition, the DS1822 can derive power directly from the data line, eliminating the need for an external power supply. Each DS1822 has a unique 64-bit serial code, which allows multiple DS1822s to function on the 1-Wirebus; thus, it is simple to use one microprocessor to control many DS1822sdistributed over a large area. Applications that can benefit from this feature include temperature monitoring systems inside buildings, equipment or machinery, and process monitoring and control.

b) Soil moisture sensor

The module consists of, detection probe, and sensor board. It is having triple output mode, digital, analog, and serial with exact readings. The sensor will detect the moisture of the soil surrounding it, i.e. shortage of water content of the soil. If the contents are low the module output will be high otherwise the output will remain in neutral conditions.

This moisture sensor has two probes used to pass the current into the soil, and then itreads that resistance between two probes to get the moisture level. More water present in the soil makes the soil conduct electricity more easily indicate less resistance, while dry soil having less water conducts electricity poorly indicate more resistance.

What's New in µVision4?

µVision3 adds many new features to the Editor like Text Templates, Quick Function Navigation, and Syntax Coloring with brace high lighting Configuration Wizard for dialog based startup and debugger setup. µVision3 is fully compatible to µVision4 and can be used in parallel with µVision4.

What is µVision4?

µVision3 is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. It encapsulates the following components:

•A project manager.

•A make facility.

•Tool configuration.

•Editor.

•A powerful debugger.

To help you get started, several example programs (located in the \C51\Examples, \C251\Examples, \C166\Examples, and \ARM\...\Examples) are provided.

•HELLO is a simple program that prints the string "Hello World" using the Serial Interface.

•MEASURE is a data acquisition system for analog and digital systems.

•TRAFFIC is a traffic light controller with the RTX Tiny operating system.

•SIEVE is the SIEVE Benchmark.

•DHRY is the Dhrystone Benchmark.

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•WHETS is the Single-Precision Whetstone Benchmark.

Additional example programs not listed here are provided for each device architecture.

Building an Application in µVision4

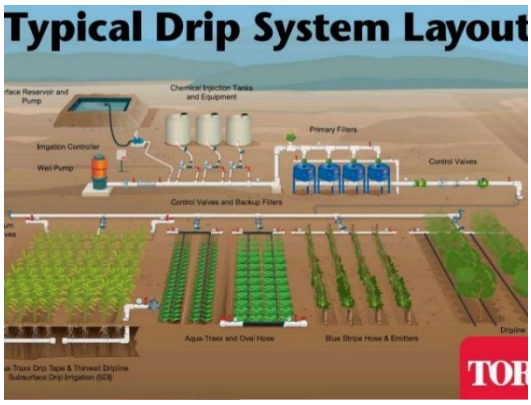
To build (compile, assemble, and link) an application in µVision4, you must:

1.Select Project –

(forexample,166\EXAMPLES\HELLO\HELLO.UV4).

2.Select Project - Rebuild all target files or Build target.

µVision4 compiles, assembles, and links the files in your project.



CONCLUSION:

The project "WEB BASED AUTOMATIC IRRIGATION SYSTEM USING WIRELESS SENSOR NETWORK AND EMBEDDED LINUX BOARD "has been successfully designed and tested Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

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