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Context-Modernization Of Indian Irrigation System Using A Using A Wireless Network And GSM

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Abstract—

India is country in which agriculture plays one important role in enhancing the country's GDP rate and enriching the country's pride. Hence it is end of the hour of a to emphasize something innovative towards agriculture. Water plays an important role in the world economy. Agriculture consumes more water than any other source and also wastes much of that through inefficiencies. Our proposed system makes efficient use of available water through automatic Water Management system. An Intelligent Irrigation system is the sensor network which senses the information about soil moisture using copper plates and the sensed information is sent to the microcontroller. The microcontroller then compares the sensed soil moisture value with the threshold moisture value. When soil moisture in the field is less than the threshold level, then the motor is turned ON through the registered mobile phone user. When the motor is started, soil moisture is constantly monitored and once the soil moisture reaches the sufficient level then the motor is turned off

by the user and the notification is sent to the user through Global System for Mobile communication network. Thus this system can effectively reduce water wastage compared to the conventional systems. Key words: Embedded System, Copper Plates, Wireless Network, Irrigation System, GSM

1 INTRODUCTION

AGRICULTURE uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements . There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. For instance, in one system plant water status was monitored and irrigation scheduled based on canopy temperature distribution of the plant, which was acquired with thermal imaging . In addition, other systems have been developed to schedule irrigation of crops and optimize water use by means of a crop water stress index (CWSI) . The empirical CWSI was first defined over 30 years ago using measurements of infrared canopy temperatures, ambient air temperatures, and atmospheric vapor pressure deficit values to determine when to irrigate broccoli using drip irrigation . Irrigation systems can also be automated through information on volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, instead of a predetermined irrigation schedule at a particular time of the day and with a specific duration. An irrigation controller is used to open a solenoid valve and apply watering to bedding plants (impatiens, petunia, salvia, and vinca) when the volumetric water content of the substrate drops below a set point . Other authors have reported the use of remote canopy temperature to automate cotton crop irrigation using infrared thermometers. Through a timed temperature threshold, automatic irrigation was triggered once canopy temperatures exceeded the threshold for certain time accumulated per day. Automatic irrigation scheduling consistently has shown to be valuable in optimizing cotton yields and water use efficiency with respect to manual irrigation based on direct soil water measurements An alternative parameter to determine crop irrigation needs is estimating plant evapotranspiration (ET). ET is affected by weather parameters, including solar radiation, temperature, relative humidity, wind speed, and crop factors, such as stage of growth, variety and plant

density, management elements, soil properties, pest, and disease control . Systems based on ET have been developed that allow water savings of up to 42% on time-based irrigation schedule . In Florida, automated switching tensiometers have been used in combination with ET calculated from historic weather data to control automatic irrigation schemes for papaya plants instead of using fixed scheduled ones. Soil water status and ET-based irrigation methods resulted in more sustainable practices compared with set schedule irrigation because of the lower water volumes applied . An electromagnetic sensor to measure soil moisture was the basis for developing an irrigation system at a savings of 53% of water compared with irrigation by sprinklers in an area of 1000 m2 of pasture . A reduction in water use under scheduled systems also have been achieved, using soil sensor and an evaporimeter, which allowed for the adjustment of irrigation to the daily fluctuations in weather or volumetric substrate moisture content

1.1 ORGANIZATION OF THE PROJECT REPORT

The report is organized into six chapters. The present chapter introduces the concept of the project work and the research issues.

The literature survey of the problem is done and the objective of the project work is formulated.

Introduction to Embedded Systems, its Classification, common components, design flow arm7 family,arm7tdmi processor core, LPC2148, microcontroller, features of LPC2148microcontroller,LPC2148,microco ntroller,Pin diagram, architectural overview, interrupt controller, pin connect block, fast general purpose parallel i/o concept deals are also discussed

serial communication, RS 232, MAX 232 standards

Hardware components used like Power supply unit, Zigbee , LCD display, DC Motors, L293D drivers.

Software requirements like, Software design introduction ORCAD design, KEIL C compiler, flash programmer, hardware, software are discussed.

Existing system:

In the existing system, the different irrigation sensors parameters can be monitored continuously and the abnormal conditions information can be intimated to the farmer through GSM technology

Proposed system:

This system is developed to monitor the different parameters of the irrigation field and uninterruptable .the data base can be monitored in the mobile. Analyses of the field condition is easy.

1.2 INTRODUCTION TO EMBEDDED SYSTEMS

Many embedded systems have substantially different design constraints than desktop computing applications. No single characterization applies to the diverse spectrum of embedded systems. However, some combination of cost pressure, long life-cycle, real-time requirements, reliability requirements, and design culture dysfunction can make it difficult to be successful applying traditional computer design methodologies and tools to embedded applications. Embedded systems in many cases must be optimized for life-cycle and business-driven factors rather than for maximum computing throughput. There is currently little *tool* support for expanding embedded computer design to the scope of holistic embedded system design. However, knowing the strengths and weaknesses of current approaches can set expectations appropriately, identify risk areas to tool adopters, and suggest ways in which tool builders can meet industrial needs. If we look around us, today we see numerous appliances which we use daily, be it our refrigerator, the microwave oven, cars, PDAs etc. Most appliances today are powered by something beneath the sheath that makes them do what they do. These are tiny microprocessors, which respond to various keystrokes or inputs. These tiny microprocessors, working on basic assembly languages, are the heart of the appliances. We call them embedded systems. Of all the semiconductor industries, the embedded systems market place is the most conservative, and engineering decisions here usually lean towards established, low risk solutions. Welcome to the world of embedded systems, of computers that will not look like computers and won't function like anything we are familiar with.

1.2.1 CLASSIFICATION

Embedded systems are divided into autonomous, realtime, networked & mobile categories.

Autonomous systems

They function in standalone mode. Many embedded systems used for process control in manufacturing units& automobiles fall under this category.

Real-time embedded systems

These are required to carry out specific tasks in a specified amount of time. These systems are extensively used to carry out time critical tasks in process control.

Networked embedded systems

They monitor plant parameters such as temperature, pressure and humidity and send the data over the network to a centralized system for on line monitoring.

Mobile gadgets

Mobile gadgets need to store databases locally in their memory. These gadgets imbibe powerful computing &

communication capabilities to perform real time as well as non real time tasks and handle multimedia applications. The embedded system is a combination of computer hardware, software, firmware and perhaps additional mechanical parts, designed to perform a specific function. A good example is an automatic washing machine or a microwave oven. Such a system is in direct contrast to a personal computer, which is not designed to do only a specific task. But an embedded system is designed to do a specific task with in a given timeframe, repeatedly, endlessly, with or without human interaction.

Hardware

Good software design in embedded systems stems from a good understanding of the hardware behind it. All embedded systems need a microprocessor, and the kinds of microprocessors used in them are quite varied. A list of some of the common microprocessors families are: ARM family, The Zilog Z8 family, Intel 8051/X86 family, Motorola 68K family and the power PC family. For processing of information and execution of programs, embedded system incorporates microprocessor or micro-controller. In an embedded system the microprocessor is a part of final product and is not available for reprogramming to the end user. An embedded system also needs memory for two purposes, to store its program and to store its data. Unlike normal desktops in which data and programs are stored at the same place, embedded systems store data and programs in different memories. This is simply because the embedded system does not have a hard drive and the program must be stored in memory even when the power is turned off. This type of memory is called ROM. Embedded applications commonly employ a special type of ROM that can be programmed or reprogrammed with the help of special devices.

1.2.2 OTHER COMMON PARTS FOUND ON MANY EMBEDDED SYSTEMS

- UART& RS232

- PLD
- ASIC's& FPGA's
- Watch dog timer etc.

1.2.3 DESIGN PROCESS

Embedded system design is a quantitative job. The pillars of the system design methodology are the separation between function and architecture, is an essential step from conception to implementation. In recent past, the search and industrial community has paid significant attention to the topic of hardware-software (HW/SW) codesign and has tackled the problem of coordinating the design of the parts to be implemented as software and the parts to be implemented as hardware avoiding the HW/SW integration problem marred the electronics system industry so long. In any large scale embedded systems design methodology, concurrency must be considered as a first class citizen at all levels of abstraction and in both hardware and software. Formal models & transformations in system design are used so that verification and synthesis can be applied to advantage in the design methodology. Simulation tools are used for exploring the design space for validating the functional and timing behaviors of embedded systems. Hardware can be simulated at different levels such as electrical circuits, logic gates, RTL e.t.c. using VHDL description. In some environments software development tools can be coupled with hardware simulators, while in others the software is executed on the simulated hardware. The later approach is feasible only for small parts of embedded systems. Design of an embedded system using Intel's 80C188EB chip is shown in the figure. Inorder to reduce complexity, the design process is divided in four major steps: specification, system synthesis, implementation synthesis and performance evaluation of the prototype.

Specification

During this part of the design process, the informal requirements of the analysis are transformed to formal specification using SDL.

System-Synthesis

For performing an automatic HW/SW partitioning, the system synthesis step translates the SDL specification to an internal system model switch contains problem graph& architecture graph. After system synthesis, the resulting system model is translated back to SDL.

Implementation-Synthesis

SDL specification is then translated

into conventional implementation languages such as VHDL for hardware modules and C for software parts of the system.

Prototyping

On a prototyping platform, the implementation of the system under development is executed with the software parts running on multiprocessor unit and the hardware part running on a FPGA board known as phoenix, prototype hardware for Embedded Network Interconnect Accelerators.

Applications

Embedded systems are finding their way into robotic toys and electronic pets, intelligent cars and remote controllable home appliances. All the major toy makers across the world have been coming out with advanced interactive toys that can become our friends for life. 'Furby' and 'AIBO' are good examples at this kind. Furbies have a distinct life cycle just like human beings, starting from being a baby and growing to an adult one. In AIBO first two letters stands for Artificial Intelligence. Next two letters represents robot. The AIBO is robotic dog. Embedded systems in cars also known as Telematic Systems are used to provide navigational security communication & entertainment services using GPS, satellite. Home appliances are going the embedded way. LG electronics digital DIOS refrigerator can be used for surfing the net, checking e-mail, making video phone calls and watching TV.IBM is developing an air conditioner that we can control over the net. Embedded systems cover such a broad range of products that generalization is difficult. Here are some broad categories.

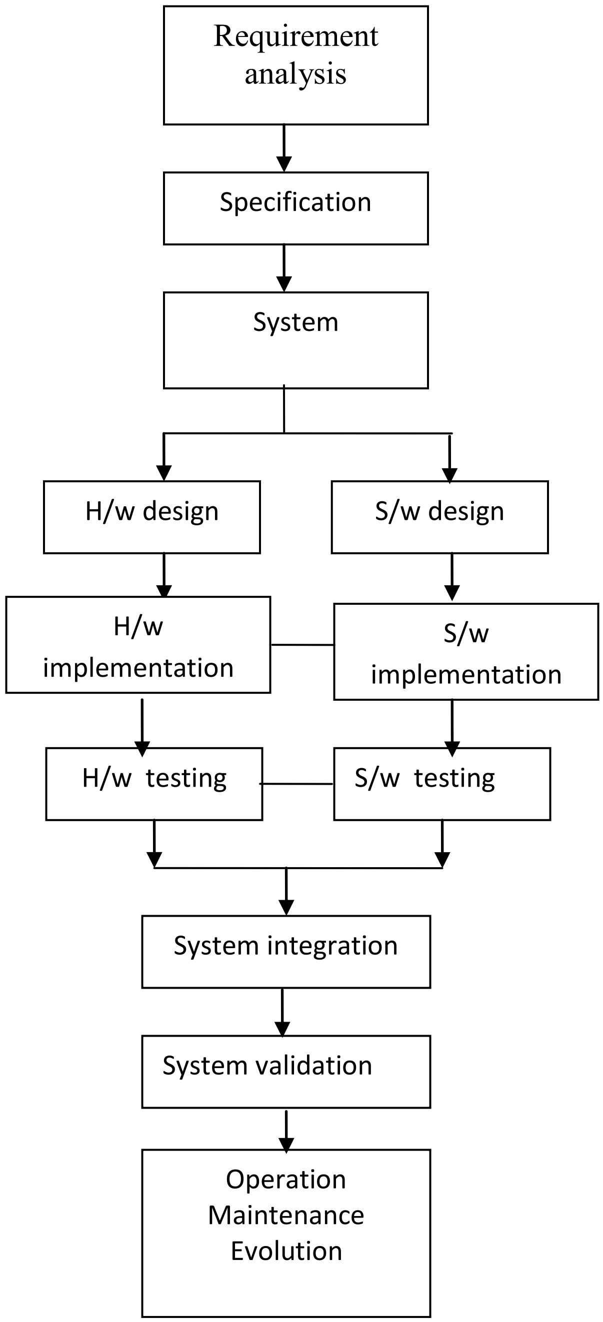

Fig 1.1: Embedded Development Life Cycle

- **Aerospace and defense electronics**: Fire control, radar, robotics/sensors, sonar.
- **Automotive**: Auto body electronics, auto power train, auto safety, car information systems.
- **Broadcast & entertainment**: Analog and digital sound products, cameras, DVDs, Set top boxes, virtual reality systems, graphic products.
- **Consumer/internet appliances**: Business handheld computers, business network computers/terminals, electronic books, internet smart handheld devices, PDAs.
- **Data communications:** Analog modems, ATM switches, cable modems, XDSL modems, Ethernet switches, concentrators.
- **Digital imaging**: Copiers, digital still cameras, Fax machines, printers, scanners.
- **Industrial measurement and control:** Hydro electric utility research & management traffic management systems, train marine vessel management systems.
- **Medical electronics:** Diagnostic devices, real time medical imaging systems, surgical devices, critical care systems.

- **Server I/O:** Embedded servers, enterprise PC servers, PCI LAN/NIC controllers, RAID devices, SCSI devices.
- **Telecommunications**: ATM communication products, base stations, networking switches, SONET/SDH cross connect, multiplexer.
- **Mobile data infrastructures**: Mobile data terminals, pagers, VSATs, Wireless LANs, Wireless phones.

2 LITERATURE SURVEY

Many of the paper have explained about the requirement of the embedded system in industrial system as it reduces the presence of human near the system. A system is proposed on obtaining the data from the industrial system to the embedded system through the use of sensors.

The system in is for real time monitoring of industrial system using RTOS and the use of interfaces for monitoring the system. LCD display interface is for displaying the data through which the system can be monitored.

The system in uses wireless communication for acquiring the data from the system and transmitting the data to the microcontroller

This project will be a reference material to the future student or consumer in order to understand usage of a microcontroller and make use of its features. Reprogramming function of the microcontroller is enabled in order to allow user to explore and experience how to program a microcontroller. Output and input device are presented in such interactive way to actually show how microcontroller does the controlling part of the project

3 BLOCK DIAGRAM

Block diagram consists of power supply ,temperature sensor ,soil sensor ,water level sensor ,humidity sensor ,PIR sensor .all these inputs are connected to LPC2148 micro controller and the results are analyzed through LCD display .which can be shown in the

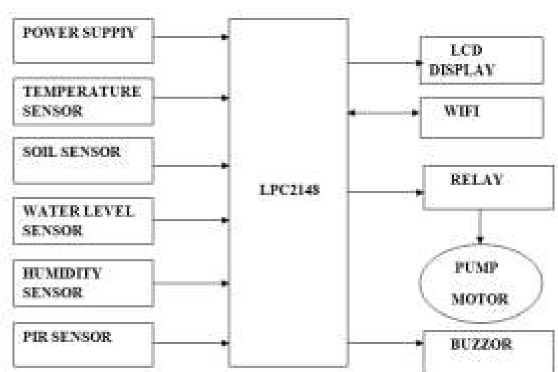

FIG.3.1.block diagram

POWER SUPPLY:

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

TEMPERATURE SENSOR:

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. 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.

SOIL SENSOR:

In this sensor it measures the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilizes the moderator properties of water for neutrons. Cheaper sensors -often for home use- are based on two electrodes measuring the resistance of the soil. Sometimes this simply consists of two bare (galvanized) wires, but there are also probes with wires embedded in gypsum. Time domain transmission (TDT) and time domain reflectometry (TDR) is also used to measure moisture content;

HUMIDITY SENSOR:

Humidity is the presence of water in air. The amount o f water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical, and biological processes.

BUZZOR:

A **buzzer** or **beeper** is an audio signaling device, which may be mechanical, electromechanical, or electronic. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke.

GSM:

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

MOTOR:

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. Let's start by looking at a simple 2-pole DC electric motor. Every DC motor has six basic parts -- axle, rotor (or armature), stator, commutator, field magnet(s), and brushes.

LCD DISPLAY:

Liquid crystal display is very important device in embedded system. It offers high flexibility to user as he can display the required data on1 it. But due to lack of proper approach to LCD interfacing many of them fail. Many people consider LCD interfacing a complex job but according to me LCD interfacing is very easy task, you just need to have a logical approach. This page is to help the enthusiast who wants to interface LCD with through understanding.

Circuit description

The circuit consists of different components which are above block diagram components when the crop is wet position through sensors water is poured in the field through which the water is in the well. Water level is observed and the motor is on through which water is supplied into the field .

Through another sensors humidity level, temperature level are calculated through the usage of GSM the messages are sent to the farmer such that immediate actions are taken by the farmer. Firstly when the field is wet the sensors are activated and check the water level if the water is available then automatically the water is pumped through the motor to the field and message is sent to the farmer through the GSM usage farmer can get the information. Through another sensors same as above the information is sent to the farmer.

4 ARM PROCESSOR

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI low power consumption, small size, and the thumb instruction set while also incorporating ARM's latest DSP extensions and enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM and x scale architectures. This gives designers a choice of software-compatible processors with strong price-performance points. Support for the ARM architecture today includes:

- Operating systems such as Windows CE, Linux, palm and SYMBIAN OS.
- More than 40 real-time operating systems, including qnx, Wind River's vxworks and mentor graphics' vrtx.
- Co simulation tools from leading eda vendors
- A variety of software development tools.

Figure 2.2 shows the ARM7TDMI Core Diagram. The ARM7TDMI core is based on the Von- Neumann architecture with a 32-bit data bus that carries both instructions and data. Load, store, and swap instructions can access data from memory. Data can be 8-bit, 16-bit, and 32-bit.

Instruction pipeline

The ARM7TDMI core uses a three-stage pipeline to increase the flow of instructions to the processor. This allows multiple simultaneous operations to take place and continuous operation of the processing and memory systems. The instructions are executed in three stages: fetch, decode and execute.

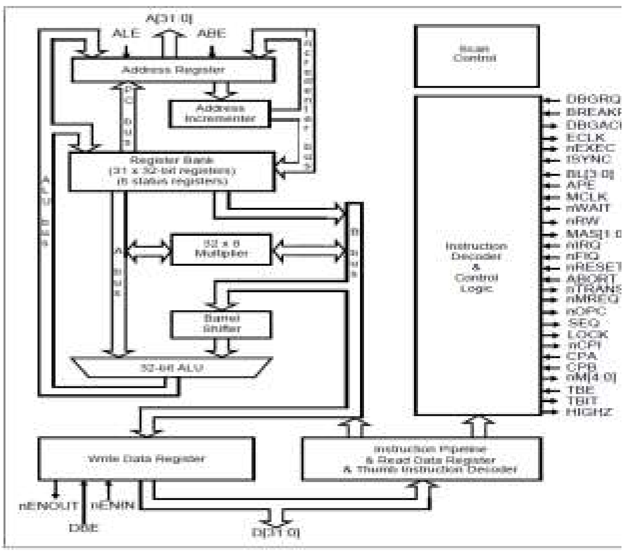

Fig 4.1: ARM7TDMI Core Diagram.

Memory interface

The ARM7TDMI memory interface is designed to allow optimum performance potential and minimize memory usage. Speed critical control signals are pipelined to allow system control functions to exploit the fast-burst access modes supported by many memory technologies. The ARM7TDMI has four basic types of memory cycle: Internal, Non sequential, Sequential, Coprocessor registers transfer. There is also the option to use either a single bidirectional data bus or two separate unidirectional data input and output buses

Memory formats

The ARM7TDMI can be configured to treat stored words in either big-endian or little-endian format.

Performance, code density and operating states

The ARM7TDMI core supports two operating states and instruction set

- ARM state for 32-bit, word-aligned instructions
- Thumb state for 16-bit, half word-aligned instructions.

The ARM instruction set allows a program to achieve maximum performance with the minimum number of instructions. The simpler thumb instruction set offers much increased code density reducing memory requirement. Code can switch between the ARM and thumb instruction sets on any procedure call.

Operating modes

The ARM7TDMI core has seven modes of operation:

- User mode is the usual program execution state

- allow very fast interrupt processing and to preserve values across
- interrupt calls
- System mode is a privileged user mode for the operating system
- Undefined mode is entered when an undefined instruction is executed.

Coprocessors

Up to 16 coprocessors can be connected to an ARM7TDMI system.

Debug features

Internal state of the ARM core can be examined using a JTAG interface to allow the insertion of instructions into core pipeline and avoid using external data bus. ARM7TDMI core includes an internal functional unit known as the Embedded ICE logic.

ARM7TDMI processor core

The ARM7TDMI processor core implements the ARMv4T Instruction Set Architecture (ISA).This is a superset of the ARMv4 ISA which adds support for the 16-bit Thumb instruction set. Software using the Thumb instruction set is compatible with all members of the ARM Thumb family, including ARM9, ARM9E, and ARM10 families.

Registers

The ARM7TDMI core consists of a 32-bit data path and associated control logic. This data path contains 31 general-purpose 32-bit registers, 7 dedicated 32-bit registers coupled to a barrel-shifter, Arithmetic Logic Unit, and multiplier.

5 SERIAL COMMUNICATIONS

5.1 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 disk; 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 at 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.

5.2 RS232 STANDARDS:

To allow compatibility among data communication equipment made by various manufacturers, an interfacing standard called RS232 was set by the Electronics Industries Association (EIA) in 1960. Today, RS232 is the most widely used serial I/O interfacing standard. However, since the standard was set long before the advent of TTL logic family, its input and output voltage levels are not TTL compatible. In RS232, a 1 is represented by -3 to -25V, while a 0 bit is +3 to +25V, making -3 to +3 undefined. For this reason, to connect any RS232 to a microcontroller system we must use voltage converters such as MAX232 to convert the TTL logic levels to the RS232 voltage levels, and vice versa. MAX232 IC chips are commonly referred to as line drivers.

5.2.1 DB-9 CONNECTOR:

Since not all the pins are used in PC cables, IBM introduced the DB-9 version of the serial I/O standard, which uses 9 pins only, as shown in the following table:

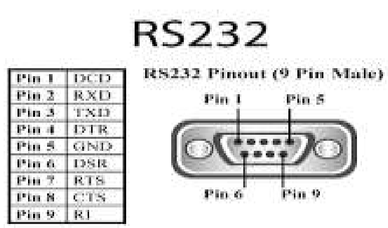

Fig 5.1: RS232 pin configura

PIN	DESCRIPTION
1	Data carrier detect (DCD)
2	Received data (RxD)
3	Transmitted data (TxD)
4	Data terminal ready (DTR)
5	Signal ground (GND)
6	Data set ready (DSR)
7	Request to send (RTS)
8	Clear to send (CTS)
9	Ring indicator (RI)

Table 5.1: Pin Description of DB-9 Connector

The D-subminiature or D-sub is a common type of electrical connector used particularly in computers. At the time of introduction they were some of the smaller connectors used on computer systems. A D-sub contains two or more parallel rows of pins or sockets usually surrounded by a D-shaped metal shield that provides mechanical support, some screening against electromagnetic interference, and ensures correct orientation.

5.3 MAX232:

The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

5.3.1 PIN DIAGRAM OF MAX232:

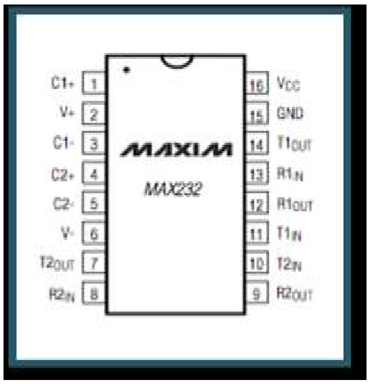

Fig 5.2: Pin Diagram of MAX232

RS232 interfaced toMAX232:

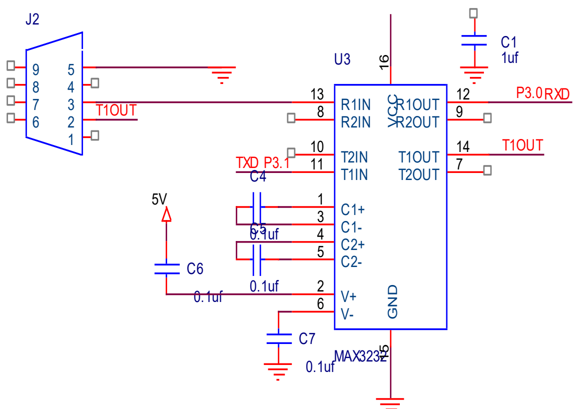

Fig 5.3: RS232 Interfaced to MAX232

RS232 is 9 pin db connector, only three pins of this are used ie 2,3,5 the transmit pin of RS232 is connected to Rx pin of MAX232.

5.3.2 VOLTAGE LEVELS:

It is helpful to understand what occurs to the voltage levels. When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15V, and changes TTL Logic 1 to between -3 to -15V, and vice versa for converting from RS232 to TTL. This can be confusing when you realize that the RS232 Data Transmission voltages at a certain logic state are opposite from the RS232 Control Line voltages at the same logic state. To clarify the matter, see the table below.

RS232 Line Type & Logic Level	**RS232 Voltage**	**TTL Voltage to/from MAX232**
Data Transmission (Rx/Tx) Logic 0	+3V to +15V	0V
Data Transmission (Rx/Tx) Logic 1	-3V to -15V	5V
Control Signals (RTS/CTS/DTR/DSR) Logic 0	-3V to -15V	5V
Control Signals (RTS/CTS/DTR/DSR) Logic 1	+3V to +15V	0V

Table 5.2: TTL Logic Levels

5.4 SERIAL COMMUNICATION IN LPC2148:

UART uses TxD(Transmit) Pin for sending Data and RxD(Receive) Pin to get data. UART sends & receives data in form of chunks or packets. These chunks or packets are also referred to as 'transmission characters'. The structure of a UART data packet is as shown below:

Fig 5.4: Single UART packet/Transmission Character

LPC214x has 2 UART blocks which are UART0 and UART1. For UART0 the TxD pin is P0.0 and RxD pin is P0.1 and similarly for UART 1 the TxD pin is P0.8 and RxD pin is P0.9 as shown in the table below:

Pins:	TxD	RxD
UART0	P0.0	P0.1
UART1	P0.8	P0.9

Table 5.3:UART pins

Data related registers:

1) U0RBR – Receiver Buffer Register (READ ONLY!)

This register contains the top most byte(8-bit data chunk) in the Rx FIFO i.e the oldest received data in FIFO. To properly read data from U0RBR , the DLAB(Divisor Latch Access) bit in U0LCR register must be first set to 0.

2) U0THR – Transmit Holding Register (WRITE ONLY!)

U0THR contains the top most byte in Tx FIFO and in this case it's the newest (latest) transmitted data. As in the case with U0RBR, we must set DLAB=0 to access U0THR for write operation.

Baud Rate Setup related registers:

1) U0DLL and U0DLM – Divisor Latch registers

Both of them hold 8-bit values. These register together form a 16-bit divisor value which is used in baud rate generation which we will see in later section. U0DLM holds the upper 8-bits and U0DLL holds the lower 8-bits and the formation is "[U0DLM:U0DLL]". Since these form a divisor value and division by zero is invalid, the starting value for U0DLL is 0×01 (and not 0×00) i.e the starting value in combined formation is “[0x00:0x01]” i.e 0×0001.

2) U0FDR – Fractional Divider Register

This register is used to set the prescale value for baud rate generation. The input clock is the peripheral clock and output is the desired clock defined by this register. This register actually holds to different 4-bit values (a divisor and a multiplier) for prescaling which are:

Control status registers:

1) U0FCR – FIFO Control Register

Used to control Rx/Tx FIFO operations.

1. **Bit 0 – FIFO Enable** 1 to enable both Rx and Tx FIFOs and 0 to disable.
2. **Bit 1 – Rx FIFO Reset** Writing a 1 will clear and reset Rx FIFO.
3. **Bit 2 – Tx FIFO Reset** Writing a 1 will clear and reset Tx FIFO.
4. **Bits [7 to 6]** Used to determine that how many UART0 Rx FIFO characters must be written before an interrupt is activated. [00] (i.e trigger level 0) for 1 character.

   [01] (i.e trigger level 1) for 4 characters.

   [10] (i.e trigger level 2) for 8 characters.

   [11] (i.e trigger level 3) for 14 characters.
5. Others bits are reserved.

2) U0LCR – Line Control Register

Used to configure the UART block (i.e the data format used in transmission).

1. **Bit [1 to 0] – Word Length Select:** Used to select the length of an individual data chunk. [00] for 5 bit character length. Similarly [01] , [10] , [11] for 6 , 7 , 8 bit character lengths respectively.
2. **Bit 2 – Stop bit select:** 0 for using 1 stop bit and 1 for using 2 stop bits.
3. **Bit 3 – Parity Enable:** 0 to disabled Partiy generation & checking and 1 to enable it.
4. **Bit [5 to 4] – Parity Select:** [00] to Odd-parity, [01] for Even-parity, [10] for forced “1″ (Mark) parity and [11] for forced “0″ (Space) parity.
5. **Bit 6 – Break Control:** 0 to disable break transmission and 1 to enable it. TxD pin will be forced to logic 0 when this bit is 1!

6. **Bit 7 – Divisior Latch Access bit:** 0 to disable access to divisor latches and 1 to enable access.

5.5 WIFI MODULE(ZG2100M):

The ZG2100 single-chip 802.11b transceiver includes MAC, baseband, RF and power amplifier, and built in hardware support for AES, and TKIP (WEP, WPA,WPA2 security). The device has an API targeted for embedded markets so an operating system is not required for operation. There is a fully integrated radio ideal for 1 & 2Mbps operation with optional support for external PA and antenna switch operation.

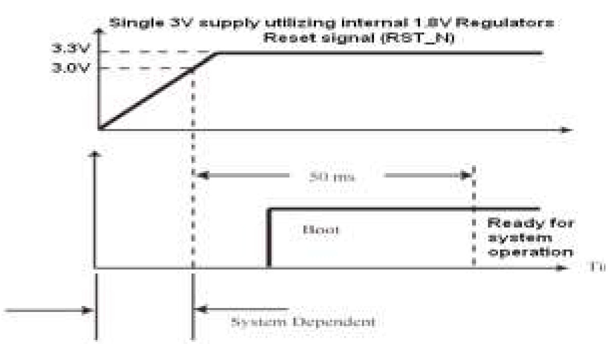

Fig 5.5:ZG2100M/ZG2101M ROM Boot Sequence Timing

5.5.1 ZG2100 POWER STATES:

Please refer to "Application Note 101 - Power-Up Reset Characteristics" for more information. The power state definitions are as follows:

	VDD33	VDD18	CE_N	Circuitry
OFF	0V	0V	0V	Power disconnected to ZG2100
HIBERNATE	3.3V		3.3V	All internal circuitries are OFF
SLEEP	3.3V		0V	Reference clock and internal bias circuitry are ON
RX ON	3.3V		0V	Receive circuits are ON
TX ON	3.3V		0V	Transmit circuits are ON
STANDBY				Transition State Only

Fig 5.6:ZG2100 power states

5.5.2 SPI INTERFACE:

SPI Slave Interface with Interrupt for Host:

Operation:

The slave Serial Peripheral Interface Bus (SPI) is used to interface with the HOST. The slave SPI interface works with ZG2100M/ZG2101M Interrupt line (INT_NX). When data is available for the HOST during operation, the INT_NX line is asserted low by ZG2100. The INT_NX line is de-asserted high, by ZG2100M/ZG2101M, after the data is transferred to the HOST SPI buffer. The SPI CLK Speed can be up to 25MHz.

SPI Timing Characteristics

Single VCC =3.3V (+/-10%)

Characteristic	Min	Max
SPI, Data setup to falling clock	1 ns	
SPI, Data hold from falling clock	1 ns	
SPI SLAVE CLK		25 MHz
SPI MASTER CLK		25 MHz

Figure 5.7: ZG2100M/ZG2101M SPI Timing Characteristics

SPI Timing:

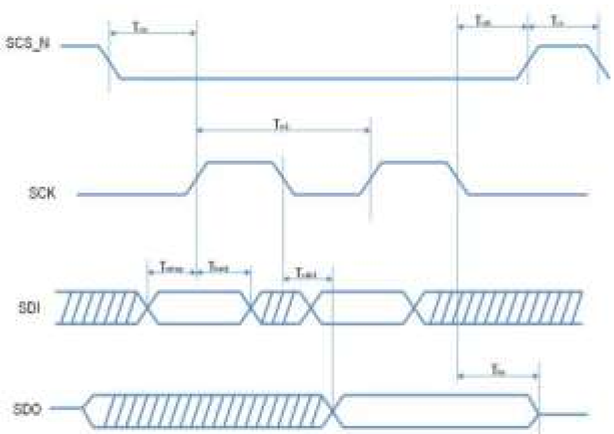

Fig 5.8: ZG2100M/ZG2101M SPI Timing Waveform

Single VCC = 3.3V (+/-10%)

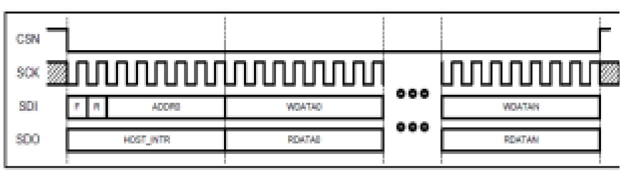

Fig 5.9:ZG2100M/ZG2101M SPI Register Timing

5.5.3 FIFO INTERFACE:

HOST FIFO Basic Commands

FCMD[2:0]

0x0 – RFIFO_CMD

0x1 – WCONT (Continue Previous Packet)

0x2 – WSTART0 (Start Packet, head/continue)

0x3 – WSTART1 (Start Packet, head0/continue)

0x4 – WEND CMD

0x5 – REND CMD

FIFO Read:

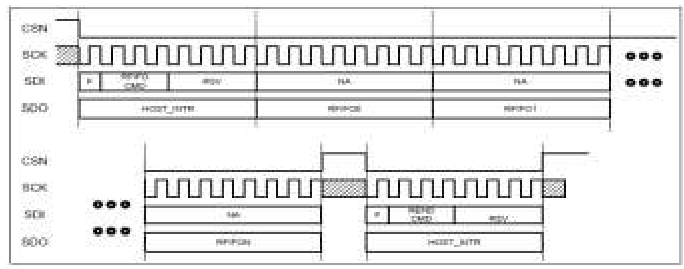

Fig .5.10:ZG2100M/ZG2101M FIFO Read Timing FIFO Write:

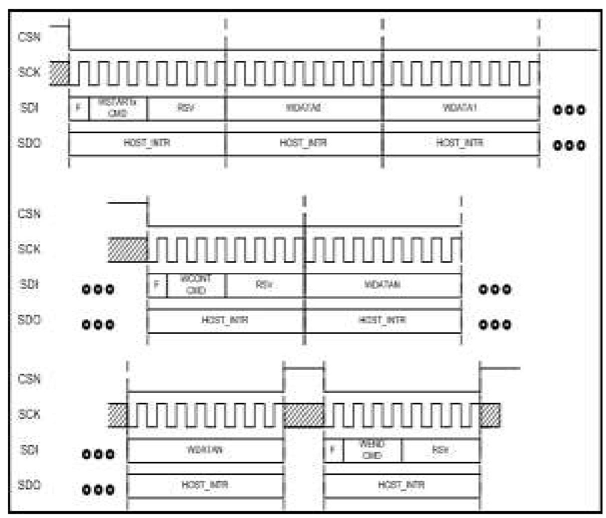

Fig 5.11:ZG2100M/ZG2101M FIFO Write Timing

5.5.4 PACKAGE INFORMATION:

Module Drawing:

The antenna will need a reasonable ground plane area on the mother board area to be efficient. Do not use a metallic or metalized plastic for the enclosure. Plastic enclosure keep away dimension, from the antenna in any orientation, will be provided after module antenna characterizations. To maintain the efficiency and impedance for ZG2100M PCB antenna, designer should keep conductors and dielectrics, which are more than 0.5 mm thick, 15 mm from the antenna in all directions.

Module Use Schematic

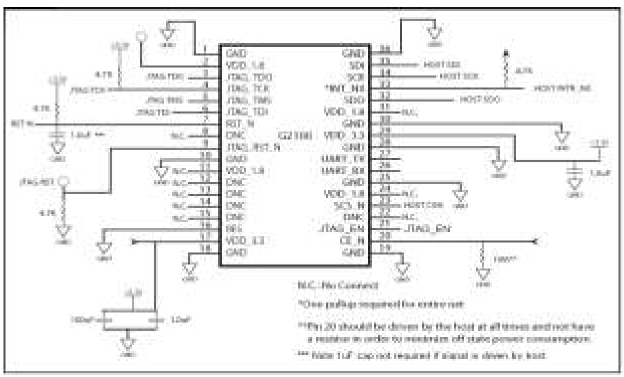

Fig 5.12:ZG2100M/ZG2101M Module Use Schematic

Power Consumption:

Nominal conditions: 25C, 3.3V supply applied to VDD33, commercial parts

Power Conservation Modes	Min	Typ	Max	Unit
Hibernate, CE_N=3.3v		0.1		uA
Sleep		250		uA
Standby (transitional power state)		10		mA
Core Supply	Min	Typ	Max	Unit
Rx On, Receive Irx, -83dBm		85		mA
Tx On, Transmit Itx, +0dBm		165		mA
Tx On, Transmit Itx, +10dBm		230		mA

Fig 5.13:power consumption

Receiver 2.4GHz Band

RX Min Input Level Sensitivity, 2Mbps, 8% PER		-88		dBm
RX Max Input Level (Power), 1Mbps, 8% PER		-4		dBm
RX Max Input Level (Power), 2Mbps,8% PER		-4		dBm

Fig 5.14:Digital Electrical Characteristics

Single VCC =3.3V (+/-10%)

Characteristic	Min	Typ	Max	Unit
V_{IL} (Input Low Voltage)	-0.3		0.8	V
V_{IH} (Input High Voltage)	2		Vcc*1.1	V
V_{OL} (Output Low Voltage)			0.4	V
V_{OH} (Output High Voltage)	2.4			V
I_{OL} (Low Level Output Current @ V_{OL} Max)		8.5		mA
I_{OH} (High Level Output Current @ V_{OH} Min)		15.4		mA

Fig 5.15:Module Reflow Profile

5.6 UART:

The LPC2141/42/44/46/48 each contains two UARTs. Compared to previous LPC2000 microcontrollers, UARTs in LPC2141/42/44/46/48 introduce a fractional baud rate generator for both UARTs, enabling these microcontrollers to achieve standard baud rate such as 115200 with any crystal frequency above 2 MHz In addition, auto-CTS/RTS flow-control functions are fully implemented in hardware (UART1 in LPC2144/46/48 only).

Features:

- 16 byte Receive and Transmit FIFO.
- Register locations conform to ‘550 industry standard.
- Receiver FIFO triggers points at 1, 4, 8, and 14 bytes
- Transmission FIFO control enables implementation of software (XON/XOFF) Flow control on both UARTs.

I2C-bus serial I/O controller:

The LPC2141/42/44/46/48 each contains two I2C-bus controllers. The I2C-bus is bidirectional, for inter-IC control using only two wires: a serial clock line (SCL), and a serial data line (SDA). Each device is recognized by a unique address and can operate as either a receiver-only device (e.g., an LCD driver or a transmitter with the capability to both receive and send information (such as memory)).

Features:

- Compliant with standard I2C-bus interface.
- Bidirectional data transfer between masters and slaves.
- Multi-master bus (no central master).

SSP serial I/O controller:

The LPC2141/42/44/46/48 each contains one SSP. The SSP controller is capable of operation on a SPI, 4-wire SSI, or Micro wire bus. It can interact with multiple masters and slaves on the bus. However, only a single master and a single slave can communicate on the bus during a given data transfer. The SSP supports full duplex transfers, with data frames of 4 bits to 16 bits of data flowing from the master to the slave and from the slave to the master.

Features:

- Synchronous serial communication.
- Master or slave operation.**General purpose timers/external event counters:**

The Timer/Counter is designed to count cycles of the peripheral clock (PCLK) or an externally supplied clock and optionally generate interrupts or perform other actions at specified timer values, based on four match registers

5.6.1 WATCHDOG TIMER:

The purpose of the watchdog is to reset the microcontroller within a reasonable amount of time if it enters an erroneous state. When enabled, the watchdog will generate a system reset if the user program fails to 'feed' (or reload) the watchdog within a predetermined amount of time.

Features:

- Internally resets chip if not periodically reloaded.
- Debug mode.
- Programmable 32-bit timer with internal pre-scalar.

5.6.2 REAL-TIME CLOCK:

The RTC is designed to provide a set of counters to measure time when normal or idle operating mode is selected. The RTC has been designed to use little power, making it suitable for battery powered systems where the CPU is not running continuously

6.Conclusion

The automated irrigation system implemented was found to be feasible and cost effective for optimizing water resources for agricultural production. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. The automated irrigation system developed proves that the use of water can be diminished for a given amount of fresh biomass production. The use of solar power in this irrigation system is pertinent and significantly important for organic crops and other agricultural products that are geographically isolated, where the investment in electric power supply would be expensive. The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance. The modular configuration of the automated irrigation system allows it to be scaled up for larger greenhouses or open fields. In addition, other applications such as temperature monitoring in compost production can be easily implemented

FUTURE SCOPE:

Furthermore, the Internet link allows the supervision through mobile telecommunication devices, such as a smart-phone. Besides the monetary savings in water use, the importance of the preservation of this natural resource justify the use of this kind of irrigation system

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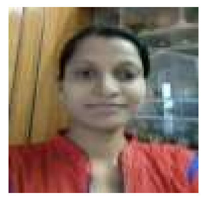

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