Intelligent Low Cost mobile phone based Irrigation System using ARM

P.Sathyanarayana A. Gopalakrushana J. Archana

Abstract — This paper describes the development of Intelligent Low Cost mobile phone based Irrigation System using UC/OS-II RTOS an ARM. The major occupation of rural India is agriculture. Insufficient rains at various stages of growth are one of major causes of losses to farmers. Many farmers use induction motor pumps to irrigate their farms from wells, rivers and streams nearby. However, shortage of electric power in many states has resulted in unplanned load shedding of long durations in rural areas. So there is a need to ensure that water is distributed to field whenever normal conditions exist. So a remote monitoring is required. Due to the drastic reduction in call and messaging rates makes cellular networks best choice for this. Moreover, simple cell phones having just messaging facility are available at throwaway prices due to migration of population towards higher end models. Such simple models can be easily adapted for remote control applications. The system isbased on ARM controller and includes GSM Modem ,Water level Sensor, Humidity Sensor ,Real time clock.

Keywords- ARM micro-controller, GSM Modem, Water level Sensor, Humidity Sensor ,Real time clock Keil UVision, FlashMagic

I. INTRODUCTION

Remote monitoring of processes, machines, etc is popular due to advances in technology and reduction in hardware cost. Internet based monitoring is one of common approaches of remote monitoring.

This approach requires additional devices like modems, buffers, etc. with TCP/IP protocols support and Internet connection. The cost of such system varies greatly depending on speed and bandwidth requirements and hence is justified normally for bio-medical and industrial applications where intensive data transfer of parameters and images are required. Cellular networks provide Short Messaging Service (SMS) and Multimedia Messaging Service (MMS), which have been utilized by many researchers for telemetry applications especially in medical field. This approach offers simple interface with only destination cell phone address and message requirement without any header / protocol overhead.

This method is suitable for remote monitoring of systems with moderate complexity. Wireless sensor networks (WSN) also offer attractive opportunity for remote monitoring. This consists of wireless network of sensor nodes connected to adjacent nodes and base station. Each node consists of micro-controller, radio-transceiver and set of sensors. Base station acts as gateway for Internet connectivity. However, this technology is still in nascent stage and deployment entails substantial investments in infrastructure. Major applications of WSN are in field of environment monitoring, defense, etc.

Technological advances can be used to alleviate some of the problems of rural population. Relative omnipresence and drastic reduction in call and messaging rates makes cellular networks best choice for communication.

II. SYSTEM DESCRIPTION

The architecture of the project consists of the following modules

GSM Modem: To send and receive SMS to and from user

Humidity Sensor: To measure the relative humidity in the field

Rainfall sensor: To measure and detect rainfall

Water level sensor: To detect the level of water existing in the water field

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Water Pumps: To Pump in and pump out water from the tank to the field

A. GSM MODEM

Global System for Mobile Communications GSM is a digital wireless network standard designed by standardization committees from major European telecommunications operators and manufacturers. The GSM standard provides a common set of compatible services and capabilities to all mobile users across Europe and several million customers worldwide. The basic requirements of GSM have been described in five aspects.

Services: The system shall provide service portability, i.e., mobile stations or mobile phones can be used in all participating countries. The system shall offer services that exist in the wire line network as well as services specific to mobile communications. In addition to vehicle-mounted stations, the system shall provide service to Mss used by pedestrians and /or on board ships.

Quality of Services and Security: The quality for voice telephony of GSM shall beat least as good as the previous analog systems over the practical operating range. The system shall be capable of offering information encryption without significantly affecting the costs to users who do not require such facility.

Radio Frequency Utilization: The system shall permit a high level of spectrum efficiency and state-of-the-art subscriber facilities. The system shall be capable of operating in the entire allocated frequency band, and co-exist with the earlier systems in the same frequency band.

Network: The identification and numbering plans shall be based on relevant ITU recommendations. An international standardized signaling system shall be used for switching and mobility management. The existing fixed public networks should not be significantly modified.

Cost: The system parameters shall be chosen with a view to limiting the cost of the complete system, in particular the Mss.

B.GSM ARCHITECTURE

In this architecture, a mobile station (MS) communicates with a base station system (BSS) through the radio interface. The BSS is connected to the network and switching subsystem (NSS) by communicating with a mobile switching center (MSC) using the A interface.

C. MOBILE STATION

The (MS) consists of two parts: the subscriber identity module (SIM) and the mobile equipment (ME). In a border definition, the MS also includes a third part called terminal equipment (TE), which can be a PDA or Pc connected to the ME. In this case, the first two parts i.e., ME and SIM are called the mobile terminal (MT). A SIM can be a smart card that usually has the size of a credit card, a smaller sized “plug-in SIM". The SIM is protected by a personal identity number (PIN) of length between four to eight digits. The PIN is loaded by the network operator at the subscription time. This PIN can be deactivated or changed by the user. To use the MS, the user is asked to enter the PIN. If the number is not correctly entered in three consecutive times, the SIM is blocked and therefore the MS cannot be used. To unblock the SIM, the user is asked to enter the 8-digit PIN Unblocking Key (PUK).

D. SPECIFICATIONS OF GSM MODEM

Designed for global market, SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz SIM300 features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.With a tiny configuration of 40mm x 33mm x 2.85mm , SIM300 can fit almost all the space requirements in our applications, such as smart phone, PDA phone and other mobile devices. In this hardware SIM300 is only interfaced with RS232, Regulated power Supply 4.0V SIM Tray Antenna with LED indications.

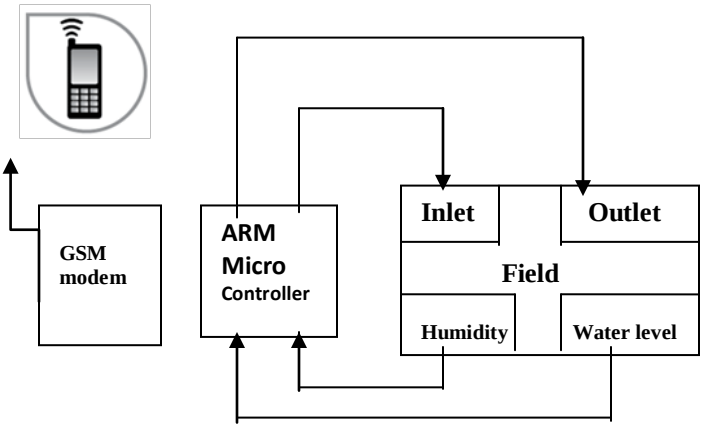

Figure 1 BLOCK DIAGRAM OF PROJECT

III. MICROCONTROLLER SYSTEM

A microprocessor system consists of a microprocessor with memory, input ports and output ports connected to it externally. A microcontroller is a single chip containing a microprocessor, memory, input ports and output ports. Since all four blocks reside on the one chip, a microcontroller is much faster than a microprocessor system.

We have several other basic microcontroller families such as PIC, M68HCXX, and AVR etc. All these basic microcontrollers are useful for implementing basic interfacing and control mechanisms for simple applications. There are several applications which require lot of computation and high speed data processing. In such applications advanced microcontrollers and

microprocessors are used. One such advanced architecture is **ARM.**

The LPC2148 microcontrollers are based on a 32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory of 512 kB. For critical code size applications, the alternative 16-bit Thumb mode reduces the code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 microcontrollers are ideal for the applications where miniaturization is a key requirement, such as access control and point-of-sale. 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 particularly suitable for industrial control and medical systems.

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A command line is a string of characters sent from a DTE to the modem (DCE) while the modem is in a command state.

A command line has a prefix, a body and a terminator. Each command line (with the exception of the A/ command) must begin with the character sequence AT and must be terminated by a carriage return. Commands entered in upper case or lower case is accepted, but both the A and T must be of the same case, i.e., "AT or "at. The default terminator is the ENTER key <CR> character. Characters that precede the AT prefix are ignored. The command line interpretation begins upon receipt of the ENTER key character. Characters within the command line are parsed as commands with associated parameter values. The basic commands consist of single ASCII characters, or single characters proceeded by a prefix character (e.g., "&" or "+"), followed by a decimal parameter. Missing decimal parameters are evaluated as 0.

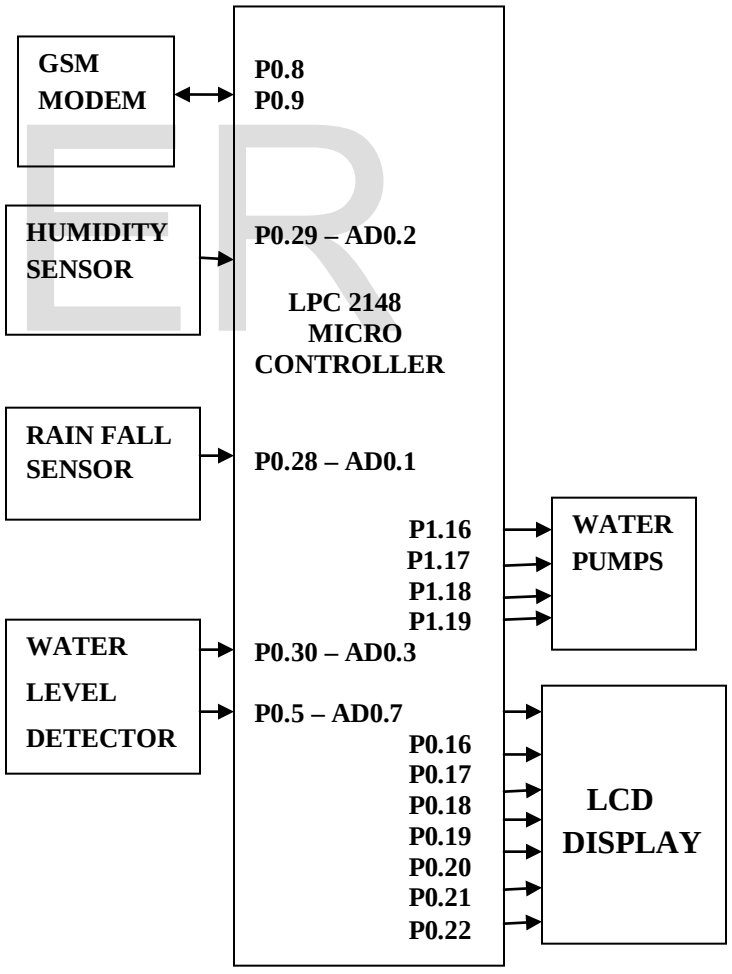


Figure 2. LPC2148 INTERFACING

B.RAINFALL SENSOR

A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers.

C. WATER LEVEL DETECTOR

This water level sensor is conducive for liquids that have a conductivity of equal to or more than 25m Siemens. It is your best choice for a water level switch. The system is economical to install as no special cable is required for signal transmission. The level probe and the evaluation unit can be connected using a long cable. The AC is provided on the probe for preventing electrode deterioration.A low AC voltage is applied between the probe electrode and the tank wall When the water/liquid comes in contact with the electrode tip, a conductive path is established between the sense electrode and the tank wall/reference electrode. This current is sensed, amplified and made to operate a relay whose contacts in turn can be used for annunciation/control.

D.WATER PUMPS

Water Pumps are used to pump out water as per the desired water temperature set and to pump in water into the tank A pump is a device used to move fluids, such as liquids, gases or slurries. A pump displaces a volume by physical or mechanical action. Pumps fall into three major groups: direct lift, displacement, and gravity pumps. Their names describe the method for moving a fluid. Liquid pumps: These pumps feature excellent suction performance (3mAq) and forcing performance (40mAq).

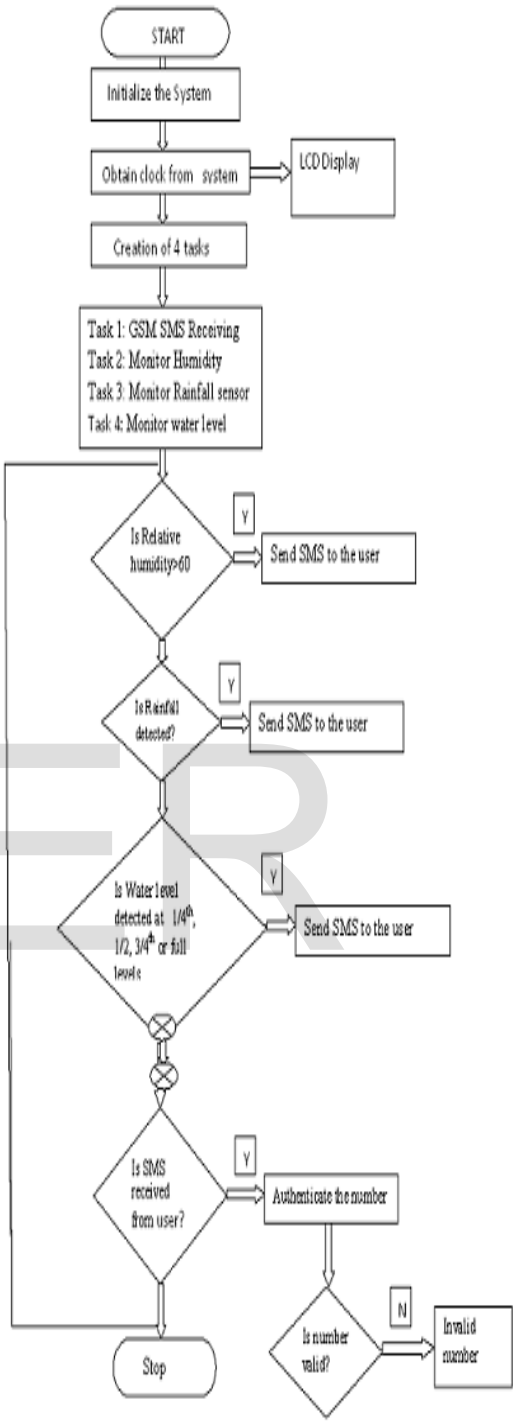
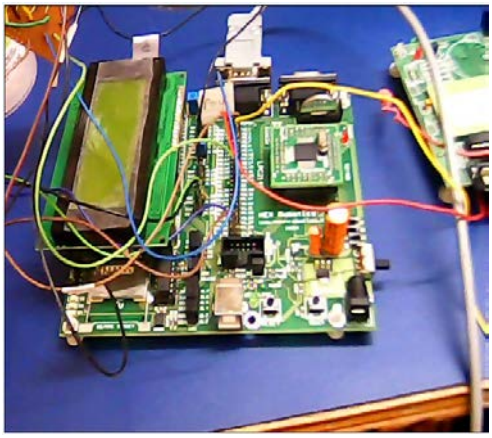
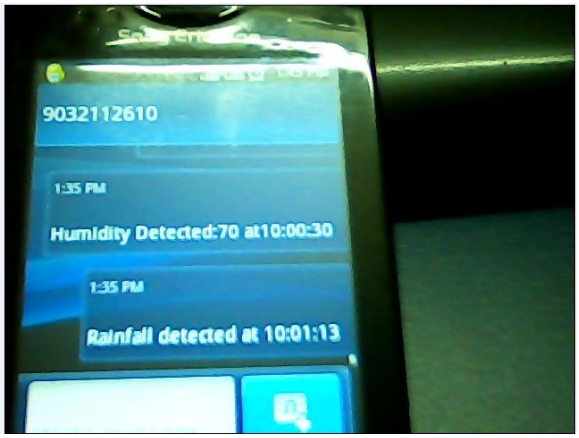


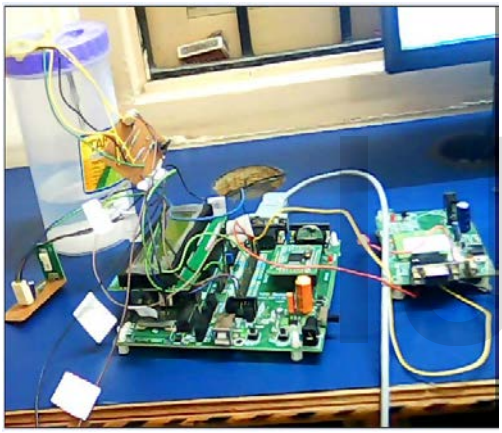
Figure 3. PROJECT OVERVIEW

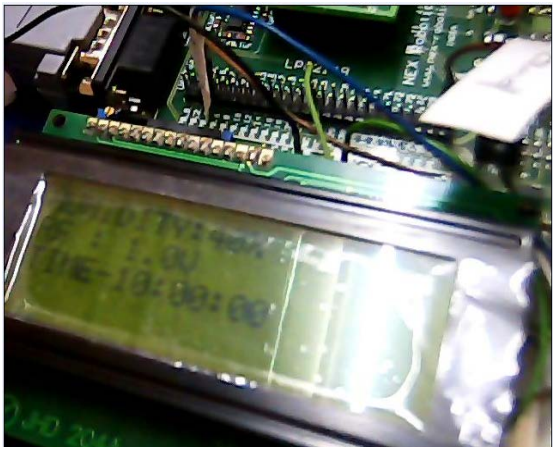
MOBILE PHONE IMAGES

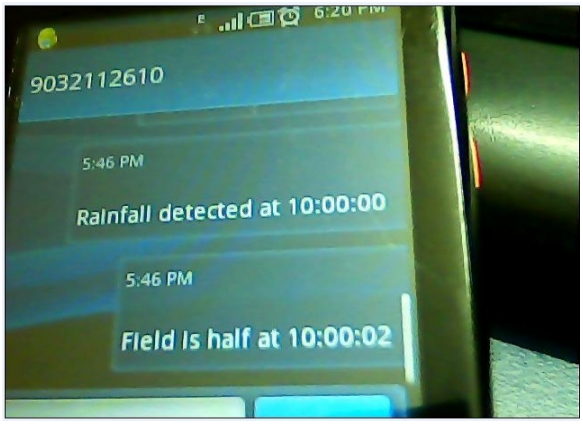
IV. RESULTS











V. CONCLUSION

This system is based on ARM microcontroller and mobile communication, which is developed for optimum water distribution and removes excess water in field due to heavy rain falls.

This is scheme updates the information about climate that is humidity, rainfall, water levels in fields at regular intervals to the farmer through the SMS. This system proves to be great boon to farmers whose agriculture motors are located far away from their houses as they are able to remotely control the operation of motors that is they can switch ON and OFF the motor by sending SMS to this system. This scheme provides great facility to farmers that is they set the time for how much time motor can operate.

This scheme ensures protection of motor against overloads, overheating and provides optional automated restarting if normal conditions are reestablished to complete the specified task. Its major attraction is ultra low cost due to mobile communication and power saving system as ARM microcontroller is used

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