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AUTOMATIC AGRICULTURE IRRIGATION WITH PERIODIC CAMERA TRAPPED PICTURES AND LAND MONITORING USING WIRELESS SENSOR NETWORK

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ABSTRACT

In last few decades, remotely monitored embedded system for irrigation purposes have become a new necessity for farmer to save his energy, time and money. This paper is proposing a agricultural solution for the farmer based on Wireless Sensor Networks, zigbee and GSM technology. The data acquired about environmental factors of the land and periodic growth of crops captured via camera traps is transmitted to the farmer enabling him to control the actuators in the field. Zigbee based low power handheld devices are employed to enable cost saving, and the valves and sprinklers are employed to save the water usage for irrigation. The proposed system is simple and easy to implement and the parameters recorded helps a great way to farmer to enable the "Smart farms" theory work for him. The microcontroller is used for controlling the above environment.

KEYWORDS: Climatologically Sensors, Camera Trap, GSM, Irrigation Control, PIC 32, Zigbee

INTRODUCTION

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growth in grain fields and preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or farming. Irrigation systems are also used for dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area which makes the proposed system more advantageous to the farmer in the future.

CLASSIFICATION OF CONTROL AND MONITORING SYSTEMS

Technology Used

A Wireless Sensor Network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an

internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding. They concluded that Zigbee technology can be applied for wireless applications in agriculture sector.

GSM technology is used to send camera trapped pictures as MMS to the land owner. GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation digital cellular networks used by mobile phones. It is the de facto global standard for mobile communications with over 90% market share, and is available in over 219 countries and territories.

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power usage allows longer life with smaller batteries

Processors Embedded

Automizing the irrigation system for social welfare of Indian agricultural system and also to provide adequate irrigation in particular area. The set up consists of ARM7TDMI core. In the system, temperature signals are captured by digital multipoint thermometers, and transmitted to the advanced RISC microprocessor (ARM) by using WiFi technology. The microprocessor controls the information stored in SD card. The software design of data acquisition and the progress of transplanting Linux operating system to the ARM hardware platform is described. The sensing hardware consists of CCD camera, which is the inexpensive camera trap. The transmission hardware uses a BlueTooth RS232 300 m slave module for visual data transmission. The sensing nodes act as a node in a medium range Blue Tooth measurement network. This system has simpler features designed with the objective of low cost and effective with less power consumption using sensors for remote monitoring and controlling devices which are controlled via SMS and MMS and using a GSM module. Then the snapshot sent and received by the Zigbee transmitter and receiver.

Sensors Incorporated

The sensors used here is Climatologically Sensor. Sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing. Climatologically sensor is used to monitor the climate of land environment and the moisturizing sensor is used to monitor the moisture of the crops in the land field.

Crop Fields Monitored

Automatic irrigation based on soil moisture for vegetable crops studied the water conservation and new irrigation

technology. They surveyed on the various types of sensors used. They focused on ways to minimize environmental effects caused by excess water supply. They also studied the effect of volumetric sensors that are suitable for irrigation by measuring Dielectric Constant in the field. They concluded that as water supplies become scarce and polluted, there is a need to irrigate more efficiently in order to minimize water use and chemical leaching. Recent advances in soil water sensoring make the commercial use of the technology possible to automate irrigation management for vegetable production.

However, research indicates that different sensors types may not perform alike under all conditions. Reductions in water use range as high as 70% compared to farmer practices with no negative impact on crop yields In this paper they surveyed different applications of zigbee based wireless sensor network in agriculture such as monitoring of environmental conditions like weather, soil moisture content, soil temperature, soil fertility, weed-disease detection, monitoring leaf temperature/moisture content and monitoring growth of the crop, precision agriculture, automated irrigation facility, storage of agricultural products etc. This paper also provides the possible research issues existing in Physical layer of ZigBee.

ANALYSIS OF EXISTING SYSTEMS

PC based systems are generally can easily be controlled from remote places via internet access but it makes the system costlier and difficult to access. It is difficult to monitor and control the status of different sensors and devices in case of power failure unless you have a battery backup which is an additional cost. Low power consumption and high reliability makes zigbee based system as the most suitable wireless technology for agriculture applications like irrigation monitoring. Zigbee can also work on different networks like star, cluster tree, and mesh. However, in each of these cases, Zigbee will provide data exchange when nodes are down because the signaling information can be re-routed to other nodes easily. Zigbee support maximum of 65,000 nodes.

GSM based systems offer various advantages of being controlled from remote places and commands used in GSM are very simple. GSM based system which is proposed here exchanging information between the remote place and designed system via SMS on GSM network. SMS charges are reduced with the help of bluetooth module interface along with GSM if the user is within the range of few meters to the designated system.

Table 1: Classification of Existing Remote Monitoring and Control Systems

References	Technology	Processor	Monitoring station	Tools	Programming code	Modules interfaced
[3]	GSM	MSP430F149	PC	C430 IDE	C	Siemens TC 35
[4]	GSM, Zigbee		Mobile, PC	Kiel IDE		
[6]	Wireless, GPS	AT89S52	7 segment display	Kiel IDE	Assembly	
[7] –[8]	GSM	AT89S52	Mobile	Kiel IDE	Embedded in C	Granular Matrix Sensors
[15]	GPRS, Zigbee	MSP430F2274	PC	C430 IDE	C	Chipcon CC2420
[18]	GPRS, Zigbee	8051 family, Open source database	Mobile, PC	Kiel IDE	Embedded in C	
[19]	Bluetooth, RF Modules	8051 family	Mobile, PC	Kiel IDE		PIR sensors 325

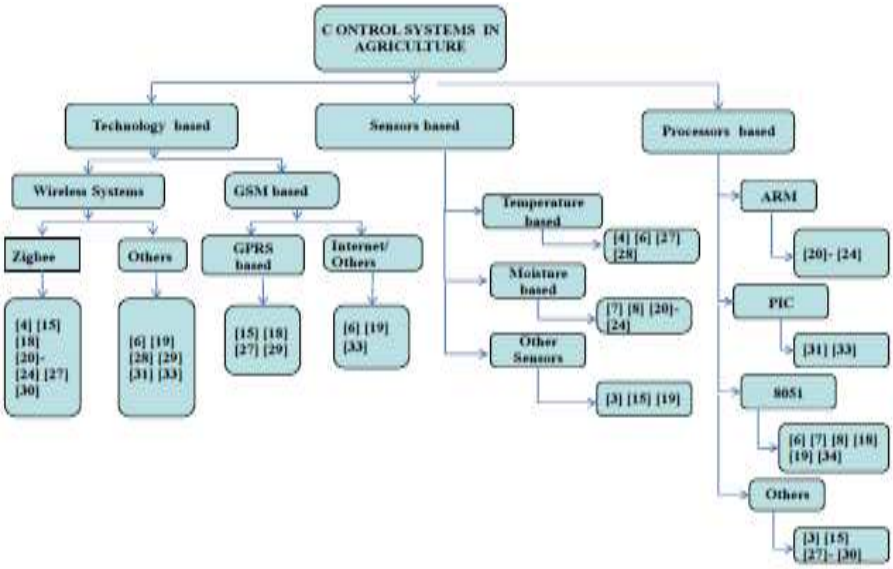

Figure 1: Classification of Existing Agricultural Control Systems

PROPOSED SYSTEM

Climatologically Sensors are placed in the field for irrigation monitoring. The sensors are connected to the microcontroller where microcontroller is operated at crystal oscillator generated frequency. The sensed information are periodically captured and then transmitted to the remote controller with the help of Zigbee transmitter. The remote controller receives the information through the Zigbee receiver and the camera trapped land monitored pictures are displayed to the LCD of receiver side.

BLOCK DIAGRAM

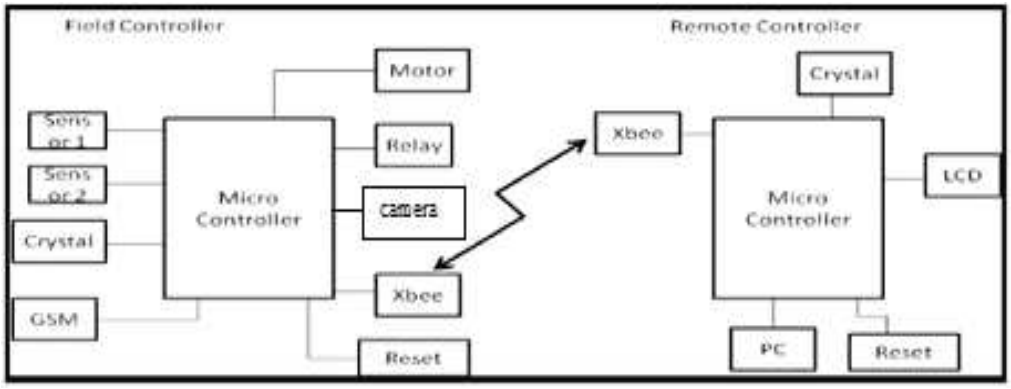

Figure 2

CONCLUSIONS AND FUTURE WORK

Camera trap was added at the end of the proposed system. Camera trap is a hand held device used to take pictures of crop field and periodic camera trapped pictures are sent over GSM to the land owners. The proposed system can be enhanced in the future with the help of cloud computing based agricultural irrigation to adjust the quantity of water based on sensor data. This system enables users who don't have expertise in agriculture to irrigate properly.

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