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RESEARCH ARTICLE

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SMART IRRIGATION USING WIRELESS SENSOR NETWORK, ZIGBEE TECHNOLOGY AND GSM MODULE

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ABSTRACT

An automated irrigation system was developed to optimize water use for agricultural crops. It has different wireless sensors such as soil-moisture sensor, temperature sensor, water level sensor, humidity sensor and current sensor. Due to its energy autonomy and low cost, the embedded system has the potential to be useful in water limited geographically isolated region. In addition current theft can be identified with the help of current sensor in case of free power supply from government as in India. Solar panels are used to drive the motor in case of power shortages. The main theme of this project is to optimize the water usage and increase the crop production.

Keywords— Irrigation, Zigbee Technology, GSM, Automation, Current theft, Sensors.

I. INTRODUCTION

In irrigation the use of fresh water resources is so high but their presence is very less on Earth compared to salt water. The percentage of water usage will continue to be dominant in fields because of population growth and increased food demand. Hence there needs to be a solution for this based on science and technology for sustainable use of water, including technical, agronomic and institutional improvements. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. This can be done by automating the irrigation process [1].

Irrigation systems can be automated through information on volumetric water content of soil using dielectric soil moisture sensors, sensors to measure humidity and temperature of surrounding atmosphere, water level 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 [2]. In addition to these sensors it consists of current sensor to detect the current theft and a light dependent resistor to protect the farm during night time by producing sounds that keeps animals away from farm. If electricity is being misused, the total supply for the farmers through a tripping circuit will be shut down. This also helps the farmers to find their soil fertility. Farmer can monitor all the conditions with the help of the mobile and thus makes it smart irrigation.

ARM7 architecture based LPC2148 microcontroller from Atmel is used to implement

this project. Microcontroller acts as the heart of the project, which controls the whole system. It contains 64k Flash, 2 UART, 48 GPIO's, ISP programming support etc. KEIL IDE is used to program the microcontroller and the coding will be done using Embedded C.

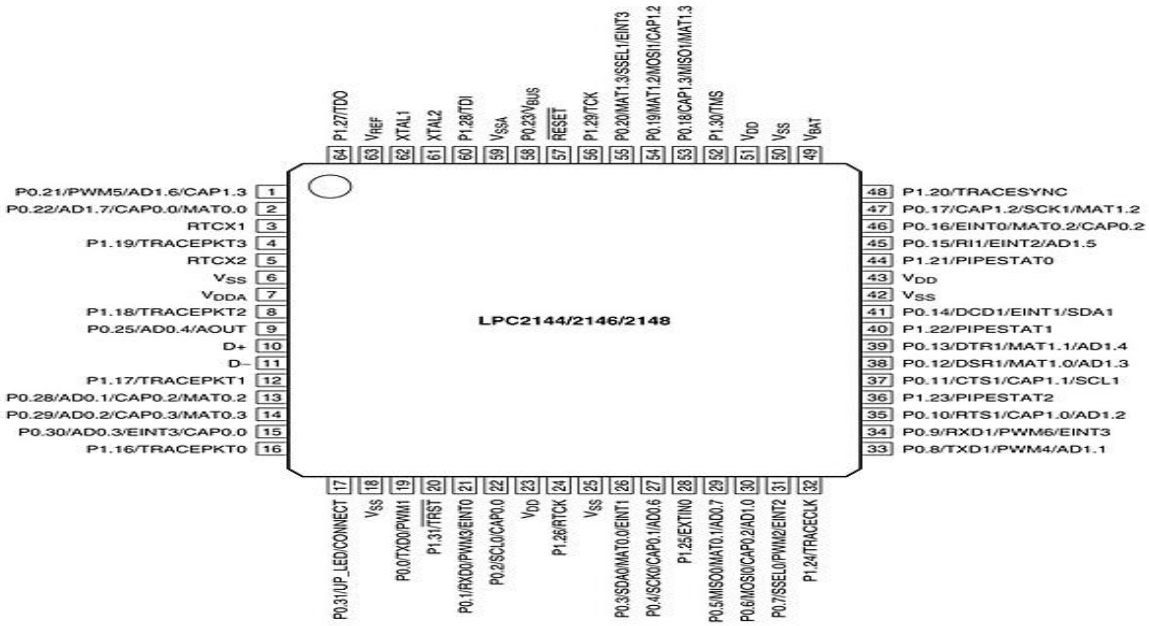


Fig.1: ARM7 (LPC2148) micro controller

SENSORS

Water level indicator model consists of a series of levels arranged one below the other namely level0, level1 and level2. Water flows from the top level through outlets at the bottom. When the water flow reaches level2 the pump will be in ON mode automatically which is displayed on an LCD screen.

Fig.2: Water level Sensor

A current sensor is a device that detects electric current in a wire, and generates a signal proportional to it that could be analog voltage or current or even digital output. In this project current sensor is used to detect the current theft i.e., when the farmers misuse it for household purposes. Whenever the current limit exceeds GSM will automatically send a message to electricity department [3].

Fig.3: Current Sensor

The temperature sensor used is a precision integrated-circuit, whose output voltage is linearly proportional to the temperature. It does not require any external calibration or to provide typical accuracies of temperature at normal conditions. Due to its low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

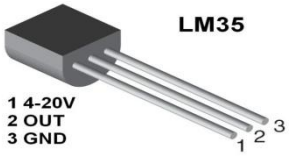


Fig.4: Temperature sensor

Soil moisture sensors measure the volumetric water content indirectly by using properties of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. Depending upon the moisture

content in the soil, pump will be automatically ON/OFF [4].

Fig.5: Soil moisture sensor

A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold [5]. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

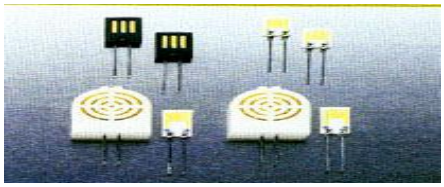


Fig.6: Humidity Sensor

A photo resistor or light-dependent resistor (LDR) is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. It is used in this project to protect the field from animals at night by producing sound.

Fig.7: LDR sensor

BLOCK DIAGRAM

In this different sensors are present. They collect the information and sends to ARM7 microcontroller. Then the microcontroller sends this information to the receiver section through ZigBee transceiver.

It receives the information from sensing node via ZigBee technology and all this will be monitored by the farmer through his mobile. The range can be increased by using mesh networks.

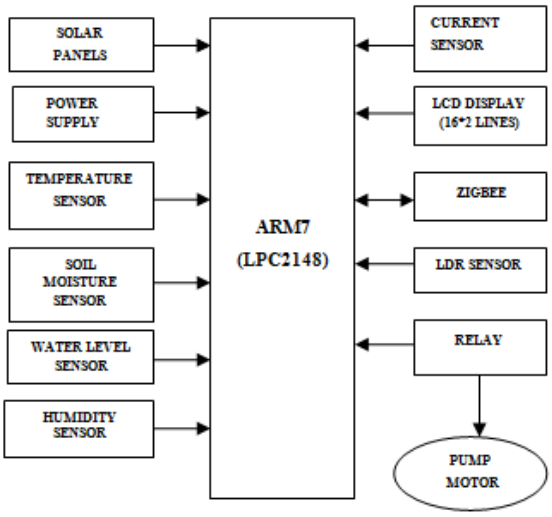


Fig.8: Block diagram of Sensor node

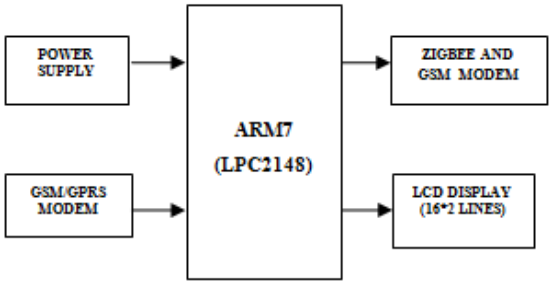


Fig.9: Block diagram of monitoring section

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. In this project it is used as a way of communication between transmitter and receiver.

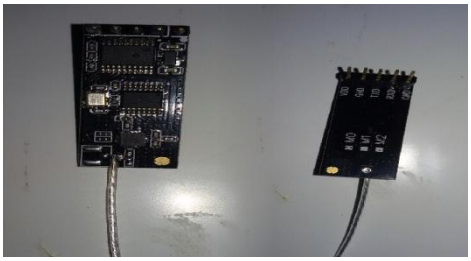


Fig.10: ZigBee Transceiver

A GSM module assembles a GSM modem with standard communication interfaces like RS-232,

USB etc., so that it can be easily interfaced with a microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands.

Fig.11: GSM Modem

Automatic Valves

Generally valves are used to maintain proper water level in the farm. These are used when there are continuous rains. When water is above a certain value, then these valves get opened automatically and a message will be sent to the farmer's mobile using Zigbee and GSM module.

Fig.12: Automatic valves

Simulation in Keil

The output is verified in Keil after checking all the errors in Proteus.

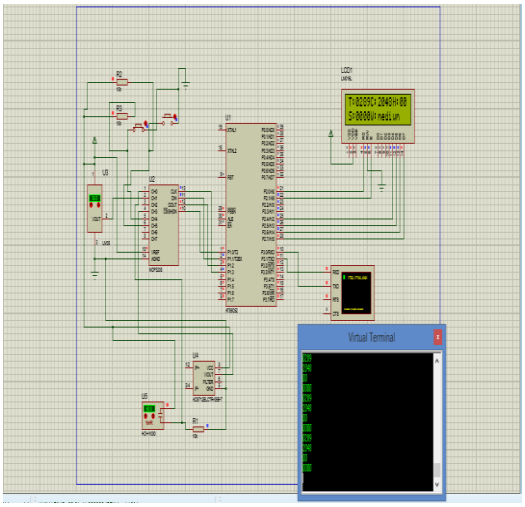
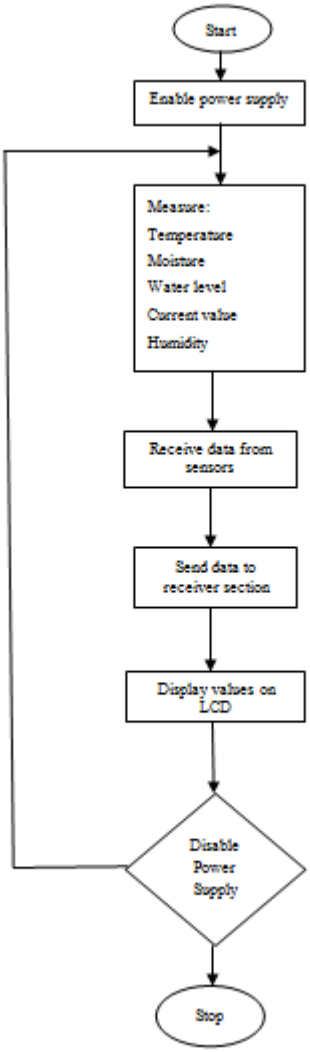


Fig.13: Output Verification

The steps that are present in this project are as shown in the below figure



CONCLUSION

In proposed irrigation process the soil moisture, temperature, humidity, water level are sensed by the sensors and the information is processed by the controller and transmitted over the ZigBee module. In addition there is a current sensor which is used to monitor the current theft. LDR is used to protect the farm at night. At the base station the data is received by the ZigBee module and transferred to GSM through RS232 interface and then it can be transmitted to farmer's mobile phone using GPRS module by using AT commands which are the instructions used to control a modem. This system was found to be feasible and cost effective

for optimizing water resource for agriculture production. In this system solar panels are used to produce power in case of power shortages and valves are used to maintain the required amount of water level in the farm. This system can be adjusted to a variety of crops and we can improve the maintenance by the use of sensors and hence reducing the human effort.

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