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Design and Implementation of Smart Irrigation System with Uninterrupted Power Supply

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Abstract: Irrigation is need of farmer to save water resource and need to use in minimum quantity because it is not a conversational resource. Agricultural sector uses maximum water in world. Due to its immense use water is vanishing day by day. Irrigation is one solution to this problem as it saves large amount of water. In traditional irrigation method water is sometimes over supplied or less supplied to the crop. So it is hard to take a decision to save water and get maximum profit from the field. This traditional method requires manual intervention. It creates a need of more labor work and maintenance. Thus maintaining a good irrigation system is a necessity in today's water scarcity environment. Hence a new system which makes the irrigation fully automated is being proposed. In our proposed automated system the temperature of irrigation field is being measured by a temperature sensor and based on the sensed value the crops is being watered. This whole system works all the time without any interruption in the working of our proposed system using uninterruptable power supply.

I. INTRODUCTION

Agriculture is considered as the main source of income in India. This is an important factor in human society to growing demand in food production. But agricultural areas are getting reduced due to laziness in mankind. In past farmers depend on monsoon for cultivation. Thus they suffered a lot due to lack irrigation. Irrigation is defined as the science of artificial application of water to the crops. But the irrigation system which is of current technology is time consuming one and also requires high maintenance. Today farmers face the problem of unavailability of sufficient water for irrigation. Thus we can say efficient management of water resources plays a crucial role in agricultural sector. In our country most of the irrigation systems are operated manually. This unmanned system adversely affects the growth of crops.

Our system comprises some changes in usual irrigation system. The proposed automated irrigation system, contrary to a traditional irrigation method regulates supplied water automatically to the field based on the temperature in the irrigation field. We use sensors to acquire the corresponding data.

The requirement of multiple sensors spread out over the field means the presence of many wires in it. This will create a lot of problems in ploughing, harvesting etc. Wireless connectivity to the sensor is a best idea in this context. Thus the sensor data is sent through Xbee; a low cost wireless communication modules to microcontroller which then regulates the water supply. The whole system efficiently operates with UPS which protects our sophisticated devices from sudden power supply failure and supply variations.

Automating irrigation allows farmers to apply right amount of water at the right time, regardless of availability of the labors. If the plants get water at the proper time then its production can be increased up to 30%. Thus through this system we are modernizing agriculture sector, thereby conserving water resources, increasing production, save energy of the farmer.

Many features can be further be added to this like a system to identify the insects in crops and pesticides is sprayed only in that portion using a stream video camera through image processing.

II. TRADITIONAL METHODS OF IRRIGATION

The water available in wells, lakes and canals is lifted up by different methods in different regions, for taking it to the fields. Cattle and human labor is used in these methods. So these methods are cheaper, but less efficient. The various traditional ways are

Moat (Pulley system): A moat or pulley system of irrigation is one that involves pulling water up from a well

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or other water source in order to water plants and other crops. It is not often in use as it can be time consuming and may not always be as efficient as other methods of irrigation. On the other hand, it does not cost a lot of money to install a moat or pulley irrigation system as it does not require vast technology or machinery invested in it

Fig. 1: Moat (pulley system)

Chain pump: These ancient Chinese irrigation systems use round metal discs and a long loop of metal chain to water soil and plants. Each metal disc runs through a pool of liquid, and each disc collects some water during this process. When the chain is pulled, the metal disc rises up to the top, and the water held inside pours out, hydrating the earth and flora. This low-cost method of traditional irrigation has been practiced for centuries.

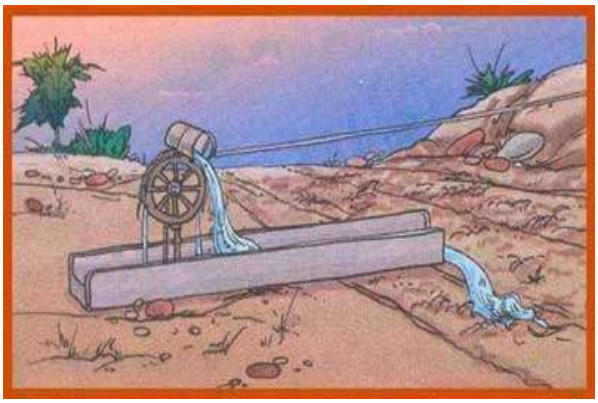

Fig. 2: Chain pump

III. MODERN METHODS OF IRRIGATION

Sprinkler System: This system is more useful on the uneven land where water is available in smaller quantity. The perpendicular pipes, having rotating nozzles on the top, are joined to the main pipeline at regular intervals. When the water is allowed to flow through the main pipe with the help of a pump, it escapes from the rotating nozzles. It is sprinkled on the crop as if it is raining. Sprinkler is very useful for the sandy soil

Fig. 3: Sprinkler system

Drip System: In this system, the water falls drop by drop just at the position of the roots. So it is called drip system. It is the best technique of watering fruit plants, gardens and trees. This system consists of a main pipe to which lateral pipes are joined. The specially prepared nozzles are attached to these lateral pipes to water plants drop by drop. Water is not wasted at all. So, it is a boon in regions where availability of water is poor.

Fig. 4: Drip irrigation system

IV. METHODOLOGY

The outmoded irrigation technique has been replaced with automated technique. Many smart irrigation systems have been devised. A smart irrigation system, contrary to a traditional irrigation method, regulates supplied water according to the needs of the fields and crops. The feedback mechanism of a smart irrigation system is a temperature sensor. This temperature sensor is placed at a specific location on the irrigation field. Based on its value the water is being pumped to corresponding area up to a predetermined time. Wireless communication technology will make the communication possible between transmitter section and receiver section. This will avoid the presence of many wires in the field. Otherwise it may create a lot of problems to ploughing, harvesting, etc.

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V.PROPOSED BLOCK DIAGRAM

The proposed block diagram of our system mainly consist of Arduino, Temperature sensor, XBEE, Relay, Valve, Pump and UPS. The temperature from the atmosphere is measured. The temperature sensor used is LM35. The LM35 is precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 is operates at -55˚ to +120˚

LM35 has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature.

Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost direct and reliable communication with microprocessors. The temperature sensor unit can communicate effectively with low-cost processors without the need of A/D converters.

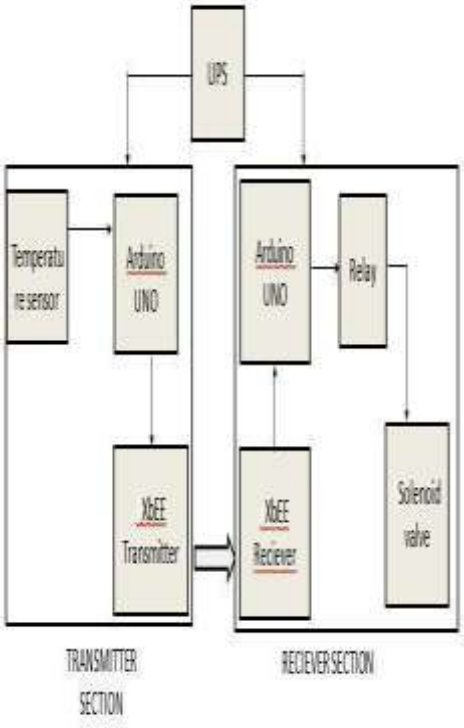

Fig. Block diagram

The output is then given to XBEE module for wireless transmission to base station. The XBEE RF modules were engineered to meet IEEE 802.15.4 standards and support the unique needs of low cost, low power wireless sensor networks, the module require minimal power and provide reliable delivery of data between devices. The module operates within 2.4MHz frequency band with a data transfer rate of 250kbps and it allows point to point, point to multipoint and mesh networking methods.

The data from XBEE router is received at the receiver side by the XBEE coordinator and this data is transferred to Arduino board.

The ARDUINO UNO is one of the most common and widely used Arduino processor boards. This is a microcontroller based on ATmega328P. It has digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, USB connection, a power jack and a reset button.

It contains everything needed to support the microcontroller; simply connect it to a battery to get started.

If the temperature is above threshold value, then the Arduino pass information to the relay for the opening of the solenoid valve and the water is pumped to the field through pump to the agriculture field.

If the temperature reaches below threshold value, then the Arduino provide information hence relay control the closing of the solenoid valve. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet.

The relay is used to connect and disconnect the load from the main power. An Uninterrupted Power Supply is employed along with the system to provide adequate power for the working of the entire system.

Power supply system

An UPS is the central component of any well-designed power protection architecture. A static UPS is designed to be the prime source of power to a every critical load. A UPS not only provides uninterruptible power to a critical load, but also isolation from the utility fine and the associated fine voltage variations as well as various forms of voltage transients present on the utility line. The method in which one or more UPS units are utilized will dictate the cost of the system and the degree of load protection provided by the system.

In this system, 230V supply is stepped down to 12V AC. This is then converted into 12V DC with the help of rectifiers, capacitors and regulators. This 12V DC is used to charge a battery and output of the battery is given to our smart irrigation system. Thus our system becomes independent of power supply variations and supply failures. The experimental setup of following is given below.

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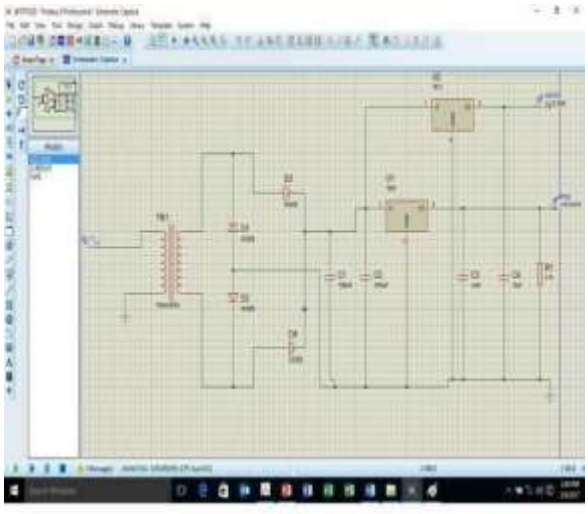

Fig. Power supply simulated in proteus 7

VI. CONCLUSION AND FUTURE SCOPE

Our proposed automated irrigation system requires less man power for operation. The water is been supplied by the field only when the soil humidity goes below the reference level. The system helps minimizing the overall watering and crops production cost. This system is considered to be cost effective and cultivation of agricultural products and plants in the area where there is water scarcity. It requires very less maintenance and is adjustable according to the changing environment. Through this system we can step in to an unmanned irrigation, which is highly efficient. Automated irrigation system has huge demand and future scope too. This system can also supply fertilizer and other agricultural chemicals like calcium, sodium, ammonium, and zinc to the field by adding new sensors and valves.

Many features can further be added to this system which definitely includes web-based communication, mobile alerts and weather adaptive systems. This type of system is a good solution for condition monitoring of agricultural setups as it is very low in cost. This idea should be implemented to large scale farms in the form of sensor grids in which each sensor will be treated as a Zig Bee node.

Additional feature to identify the insects in crops and pesticides sprayed only in that portion using the stream video camera through image processing can also be included. Proposed system can also be modified and used in such a way that it can sense the water level of the tank and whenever this water level is too low then the system can immediately provide a sound alarm, then it automatically switch on the motor. When the water level reaches 90% of the tank then the motor can be switched off through remote system. This automated system can be used in cricket stadium, golf stadium.

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