Design and Developments of an Intelligent Irrigation System

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Abstract

This paper introduces an intelligent irrigation system that is utilized in the regions that are suffering water shortage problems. Hence as an advance solution has been cons8idered to have an intelligent irrigation network system. This paper presents an intelligent irrigation system that optimizes the present water level in the water reservoir efficiently, thereby providing the irrigation techniques with even more secure and successful water usability solutions. This proposed system is capable of providing automatically services like starting and stopping of water from the pumps while functioning at the actual irrigation site depending on the present moisture content in the soil, it uses moisture content sensors along with the advance ultrasonic sensors that is used to measure the needed water levels on the irrigation site. For configuring the required control algorithms in the programs for calculating the sensor values that are sent into used Arduino microcontrollers. The system prioritizes the irrigation activities just by deciding the available number of pumps and their respective positions they are operated in any situation. Depending on their differing water needs different crops can be watered in this way. This implemented design, uses an architectural and laboratory level model was built that depicts the farm settings along with the reservoir, control units are connected with pumps running on direct current. The Experimental outcome of model have revealed many aspects from its good performance that makes this system established as an effective supplement tool required for irrigation problems.

Keywords: Moisture sensor, intelligent irrigation system, Soil moisture, available water level, and Water level management.

Introduction

The goal is to build a wireless three-level intelligent irrigation managed system to provide the plants with an automated irrigation system that helps to save water and energy. The main objective is to apply the device through multiple sensors to improve soil health and hence the plant. An appropriate level of soil water is a required prerequisite for optimum plant production. Water is also an important element for the sustenance of life, so there is a need to prevent its excessive use. Irrigation is a key to drinking water sources which calls for the need to control the irrigation water supply. Lands should not be over-irrigated or under watered.

The paper emphasize on the development of a quick, simple-to-install and functioning methodologies for monitoring and indicating the present level of soil moisture in the regions that are suffering from water shortage, continuously monitored so to achieve the maximum level of plant growth along the same time optimize the available irrigation resources on the monitoring software and the sensor data can be viewed on the Internet. The Arduino Uno will be used in this project because it is an inexpensive microcontroller to replace costly controllers in currently available systems. The Arduino Uno can be programmed to interpret certain signals from sensors such as humidity, temperature, rain, etc. Pumping the fertilizer and water into the irrigation system is achieved using a pump [1]. The utilization of the readily present materials that reduces the actual costs of the manufacturing and repairing cost. It makes this proposed model a cost-effective, very low-maintenance and suitable solution especially for the farm needs and applications, this becomes really important for the rural regions and poor farmers [2]. This research work has been expanded to support small-scale farmers, which will increase crop yields and thereby increase the government economy.

The irrigation control based on soil moisture uses Densitometry and the volumetric technique that is fairly easy but linking with these quantities via water soil characteristics related curve that is unique to soil types. It is incorporated with intelligent and automatic system like a plant for irrigation that utilizes the moisture sensors for continuously focus on the watering of respective plants in the fields without and human interference or supervision. Building this intelligent solution for water irrigation problems to save and proper utilization of water sustainability across the regions to keep the field crops environmentally friendly just by simply preventing the soil and the earth regions from severe floods or drought situations, and importantly for saving the farmers and the entire market economic cost of water use [3]. Although many different factors related to environmental plays key role in the agriculture development, the focus of this project is solely on the aspects of agricultural water consumption. The paper is a scaled version of agricultural estates problems encounter by farmers on daily basis, as much in size as in complexity.

Many systems though being introduced to achieve the aim to develop an automated model that can solve these most common issues. Most of already existing systems that use the devices centric to microprocessors. Those available systems provides many technical benefits but are turnout little inexpensive, voluminous, these are also needs high maintenance and are less tolerated specifically in rural scenarios by the technically unskilled workers [4]. India runs the most square measure of the irrigation systems manually. Square calculation of these antique techniques replaced with semi-automated and automatic techniques. The square measurement of ancient techniques on the market such as ditch irrigation, terraced irrigation, irrigation by drip, method. The global irrigation situation is characterized by a doubling of demand for higher agricultural production, low output and reduced water accessibility for farming. These problems are corrected if we are inclined to use a machine-controlled irrigation method.

Automating farm or nursery irrigation helps farmers to use the appropriate amount of water at the right time, irrespective of labor being given to switch valves both on and off. In addition, farmers' mistreatment automation instrumentation is able to scale back from the overwatering and saturated fields, preventing the irrigation accomplishment at the inappropriate time of the day, which will increase the production by simply making certain enough requirement of water and nutrients at the needed time. Those valves are often essentially controlled by controllers for maltreatment. Automating field or nursery irrigation helps farmers to utilize the water right time and in right amount, no matter how much labor is needed to turn valves both on and off [5]. They lack an extremely designed mobile application built for users with a user interface that is appropriate to them. It just helps the user to track and keep the amount of wetness remotely within no time. The built microcontroller primarily based irrigation system will operate indefinitely for indefinite fundamental measurements, even in such abnormal circumstances, from the intent of reading and performing at remote places.

Objective:

Improving and stabilizing smallholder olive farmers' crop yields by introducing integrated irrigation systems. Encouraging water management activities that maximize water delivery volume and timing [6]. To create a positive economic impact on farmers and their families. Minimize the yield fluctuations from year to year, resulting in higher and more stable farm profits.

METHODOLOGY

Recent advancements in the field of microelectronics technology and wireless technology have produced very minimum cost and less operated power devices that are especially quite important issues for these present systems. This problem with Power control is tried to tackled with new computer architectures and operating strategies in both the hardware and software. In power-conscious design the selection of a microprocessor becomes critical. The system block diagram consists of two sections: transmitter (as shown in Figure 1) and receiver (as shown in Figure 2) sections, that effectively tests the parameter by utilizing the various sensor such as humidity, temperature sensor, soil moisture sensor, and system also consists of 328P microcontroller, GSM module, LCD, and ZigBee module [7].

The sensor for moisture content tests the amount of water in the soil transforms the content of present soil moistures in an electrical signals and then sends these signals as input to the microcontrollers. The used ultrasonic sensors in the model are employed mounted onto the reservoirs. This acts like transducers, translating the water depths into the main reservoirs (water surface distance is measured from the sensors) converted into electronic signals which are sent further into the microcontroller. This should be remembered as it is analog signals are similarly like the electronic signals occurring from these three attached sensors.

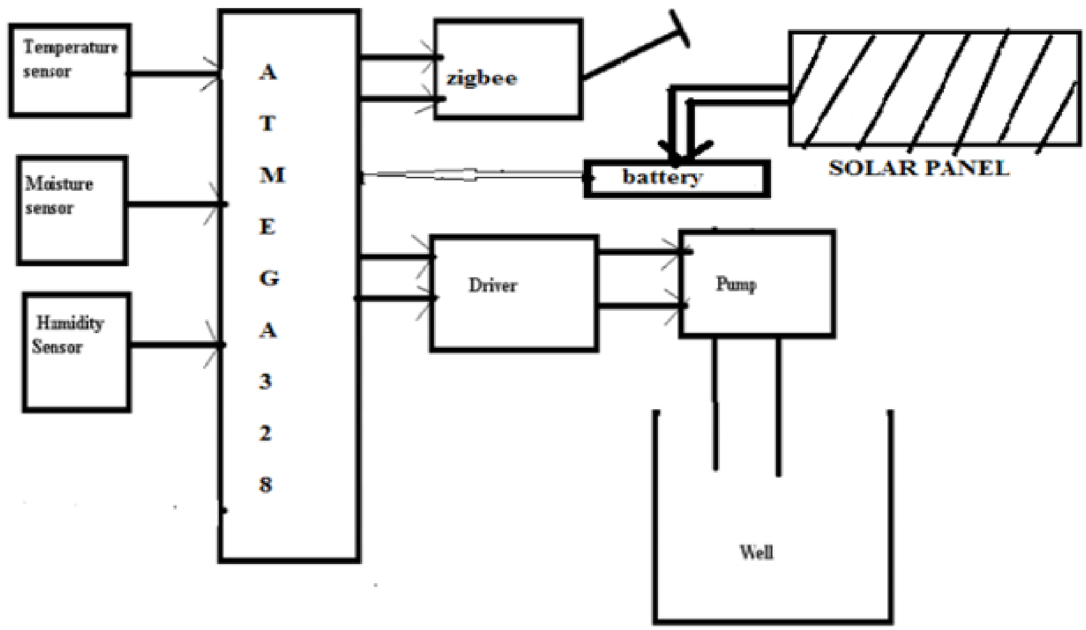

Figure 1: Transmitter Section

The 3 sensors utilized in this proposed system are:

a. First is Temperature segment,

b. Second is Moisture to the surface, and

c. Third is Dampness.

Integrated-circuit temperature sensors with LM35 accuracy, its output voltages are linearly directly proportional to present temperature at degree Celsius (Centigrade). Therefore, this LM35 has a special benefit over the Kelvin-calibrated with linear temperature sensor, because this consumers are not needed for the removal of a significant constant value of voltage, its output is to achieve a very convenient Centigrade scaling. The LM35 is a temperature sensor that is used for temperature sensing. This is an integrated circuit that can be used to calculate temperature with electrical output. It is more precise and ranges from -55 to 150 degrees C in operating temperature. A sensor measuring humidity detects relative humidity. This means it tests both humidity and air temperature. Relative humidity, measured as a percentage, is the ratio of real humidity in the air to the average amount of moisture air that can maintain that particular temperature. The colder the air is, the more humidity it can bear so that the relative humidity varies with the temperature variation. It is used for humidity sensing. Humidity is basically a percentage indicator of the air vapor.

Sensors for soil moisture calculate the level of water in the soil. Several soil moisture sensors form a considered soil moisture probes. One of the common type of these commercially used sensor for soil moisture is of Frequency domains like capacitance sensors. This use two samples in this sensor to dip into the soil.

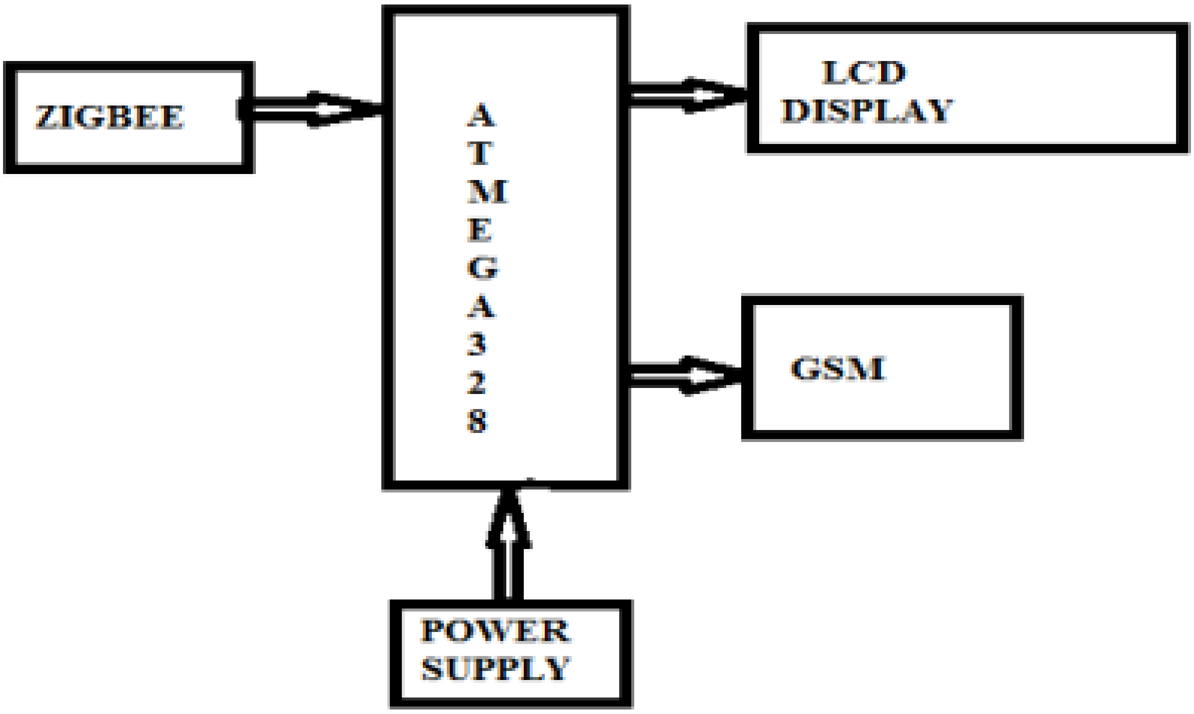

Figure 2: Receiver Section

Microcontroller:

This is a computing display physically positioned that is available as open-source built onto a simple boards with microcontroller that includes an ATmega328 microcontroller and software development environment. The Arduino, it could be utilized for constructing the interacting object, to take the inputs from series of attached switches or maybe sensors and based on them it tracks a choices of motors, lights and other outputs from physical devices. Arduino functions may be performed on their own or link to programs running on people's systems (e.g. Flash, Encoding, Proteus, and MaxMSP). Arduino Uno is a kind of microcontroller board that is basically based onto the Atmel AT mega 328 microcontroller. 'Uno' means one in Italian and the most recent board in the Arduino Uno series is fitted with a 16 MHz ceramic resonator, a USB connection, an ICSP header, 0.5 KB, and 2 KB of SRAM, 1 KB of EEPROM, and 16 MHz clock's speed are used by the boot-loader. The Arduino Uno is shown in Figure 3.

The job is to organize all intelligent irrigation system activities. The micro-controller collects and digitizes the calculated values in the form of analog voltages from the two sensors. The controller output is sent through the relay to the irrigation pumps as digital control. The device status including moisture content, water levels and the pumps enabled for the irrigation is displayed onto the microcontroller-connected device called LCD, Liquid Crystal Display. Its controllers are draws the power from the sources of DC of about 12 Volts. The algorithm was developed using the Arduino script programming language in the Arduino Integrated Development Environment (IDE) and uploaded to the microcontroller. This algorithm allows system for automatic start and stopping pumps at present levels when the moisture content reaches; decide the number of pumps to be triggered at any moment and prioritize the position to be irrigated depending on the water level in the reservoir.

International Journal of Modern Agriculture, Volume 10, No.1, 2021
ISSN: 2305-7246

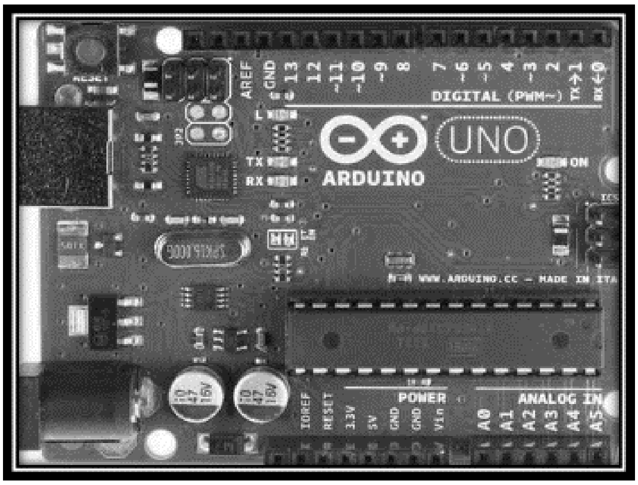

Figure 3: Microcontroller

The GSM Modules:

The SIMs 900 could be utilized integrated into with many applications because this is like a complete solution of the Quad-bands like GSM or it advancement GPRS into the SMT package. The SIM900 has the potential to provide the GSM or GPRS versions with 850 or 900 or1800 or1900 MHz outputs for the audio, important data, SMS and small form factor Fax and requires low power consumption for an industry-standard interface. GSM900 has a small size of the twenty four mm x twenty four mm x three mm, and could fit in almost any requirement of the space in the M2 M specification, as the slim and compact design specifications are present [8].

Zig-Bee Module:

ZigBee 802.15.4 RF modules belonging to the X-Bee family is looking for the excellent tools for high wireless performance, this is the very first option for the OEMs and also a small solution as well as a very cost-efficient technology. The X-Bee modules come in a huge ranges of two which could be of normal or long size. Only with exceptions of about few differing Input Output features, pin-for-pin compatibility are found in all X-Bee devices, a common OEM footprint is given to various applications [9-10]. The X-Bee Series 1 is free-scale silicone based on ZigBee 802.15.4. Since the firmware feature 802.15.4 it is suitable for topologies like point-to other multipoint, point-to-very point. ZigBee model 802.15.4 RF modules belonging to the X-Bee family are looking for the excellent wireless performances, this is both for the first choice for OEMs. Module Can X-Bee comes into a choices of like two which can be regularly or long used. Though with exception of a few different Input output features, pin-for-pin compatibility is found in all X-Bee devices, various applications are given a similar OEM footprint (Figure 4).

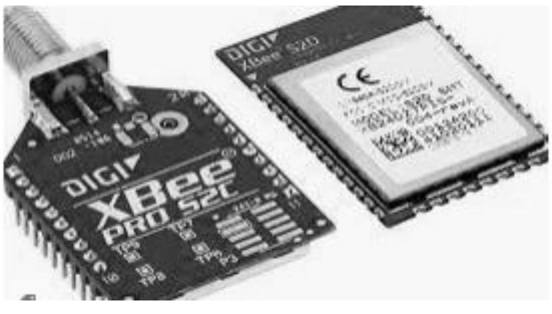

Figure 4: Zig-Bee Module

It is essentially recommended for the effective automated and intelligent irrigation systems; this technology can give a very valuable tool for the conservation of water's planning and based on it irrigation scheduling that can be applied onto the other related crops of agriculture. Maximum plant water absorptions are ensured by the uniform distribution of the water using a servo motor. So, there's low water wastage. This device also allows regulating the amount of water supplied to the plants as required by measuring soil moisture and temperature based on plant types [11]. It can be utilized in the large agricultural sectors that requires the human intervention required to reduce. Many elements of this device could be adapted for finely tuning. On a garden plant the intelligent irrigation system was tested. The water requirement for the plant is 600-800 mm per day and the soil temperature level varies from 50ºC-100ºC. The range of humidity and temperature was set in the Arduino code as 300-700 and 450-800 respectively. However, this model proves really cost-effective in many ways and also efficient for water management techniques and waste reduction.

CONCLUSION

An intelligent irrigation system is developed which optimizes water use. This device ensures the durability of these irrigation pumps; avoids the water wastage by recycling the used water, by prioritizing the pump operations on the basis of water levels present in the reservoirs. It helps in ensuring that different plants get irrigated successfully so that growth of crops can occur properly as it is relative to the present and varying water requirements of the crops. This will be useful in areas where irrigation practice is threatened by water scarcity. An intelligent irrigation system built proves that water usage could be minimized for the given quantity of the output of fresh fuel, biomass. Utilizing solar power is important especially in irrigation systems as it play a significant role for the organic crop growth and other geographically isolated agricultural items where investment in the electricity turns out really expensive. The developed real time irrigation system is completely dependent on the module GSM technique and ZigBee technologies. The programs are extremely flexible and is cost-efficient. This is so simple and effective that it doesn't even requires the individuals for supervision.

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