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GSM Based Automated Remote Irrigation System for Efficient Use of Crop Planning

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Abstract:
In India, agriculture is one of the influential sectors which affects the masses and has direct consequences towards the growth of our country. Farmers in our country, have to go through a lot of hardships to meet the demands of high yield. Conventional ways of watering have led to loss of soil nutrient, leaching, under/over irrigation, severely affecting the crop yield. Further, due to numerous issues such as resource management, availability of electricity, changes in environmental conditions, etc., a need for efficiently managed irrigation system is created.

Thence, to address these issues, through this endeavor we present a design for automated irrigation setup which operates on GSM network and hence can be remotely controlled. To implement this, information is collected from the field through sensors and the inputs of the controller. To save the effort of the farmer just to check electricity status a status check feature is also added. The design provides a user friendly and reliable system which automatically intimates the user if any change of electricity or soil moisture transpires. Lastly, an attempt is made to streamline the system to in an economical way.

I. INTRODUCTION

Drip irrigation is artificial method of supplying water to the roots of the plant. It is also called micro irrigation [1]. In past few years there is a rapid growth in this system. The user communicates with the centralized unit through SMS.

The centralized unit communicates with the system through SMS which will be received by the GSM with the help of the SIM card. The GSM sends this data to ARM7which is also continuously receives the data from sensors in some form of codes. After processing, this data is displayed on the LCD [2] Thus in short whenever the system receives the activation command from the subscriber it checks all the field conditions and gives a detailed feedback to the user and waits for another activation command to start the motor. The motor is controlled by a simple manipulation in the internal structure of the starter [3].

The starter coil is indirectly activated by means of a transistorized relay circuit. When the motor is started, a constant monitoring on soil moisture and water level is done & once the soil moisture is reached to sufficient level the motor is automatically turned off & a massage is send to subscriber that the motor is turned off. The water level indicator indicates three levels low, medium, high and also empty tank. Micro irrigation or Drip irrigation is a technique used to artificially water the crops. In this method, pipes are laid down along the crops and water is directly supplied to the root region of the crops using an emitter [4]. Drop by drop water slowly seeps into the soil, saving wastage of water due to surface runoff or evaporation.

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This way nutrients present in the soil also stay back, and soil particles get to absorb and hold water for health crop growth. Since drip irrigation provides water directly to the root of the crop, no water is wasted on weeds. The soil surface between the crops also remains drier, which discourages weed seeds from sprouting [5]. Crops grown in this approach tend to grow quickly and are more productive, as they don't get affected by water stress. Studies have shown that well designed micro irrigation systems consume 30 to 50 percent less water in comparison with other irrigation techniques.

Hence, due to the aforementioned merits we have used this technique for our design. The GSM based irrigation system [Fig.1] may offer users the flexibility to regulate and control the operations of their irrigation systems with little intervention to reduce runoff from over watering for improvement in crop yield [6]. This enables users to take advantage of the globally deployed GSM networks with its low SMS service cost to use mobile phones and simple SMS commands to manage their irrigation system. It will be possible for users to use SMS to monitor directly the conditions of their farmland, schedule the water needs of crops, automatically control watering, and set control operational conditions in accordance with the water needs of crops [7].

This will help minimize overwatering and crop production cost. Although the development of technology in water saving irrigation and automatic irrigation is gaining popularity in India, most of the available technology is still too expensive to put to use by the farmers [8]. Further, it is always difficult for the farmers to adapt when it comes to new technology. Expensive technology and devices are often used in farms for experiment or demonstration but not readily accepted by farmers. Thenceforth, our design aims at providing a cost effective and simple operating system for easy adoption by the Indian farmers.

II. LITERATURE SURVEY

Shen etc. al (2007) introduced a GSM-SMS remote measurement and control system for greenhouse based on PC-based database system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the central station receives and sends messages through GSM module [9]. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity. Indu etc. al (2013) mainly focuses on reviews in the field of remote monitoring and control, the technology used and their potential advantages.

The paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending on the temperature and humidity reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designed system via SMS on GSM network. A Bluetooth module is also interfaced with the main microcontroller chip which eliminates the SMS charges when the user is within the limited range of few meters to the designated system. The system informs users about many conditions like status of electricity, dry running motor, increased temperature, water content in soil and smoke via SMS on GSM network or by Bluetooth.

In "Automatic Irrigation System Based on Wireless Networks" by Genghuang Yang, Yuliang Liu, Li Zhao, Shigang Cui, Qingguo Meng and Hongda Chena system is established that has basically three parts: a PC control platform/cell phone, controller and an action (valve & pump actuator) unit. It uses short wave radio communication between the controllers and the action units. Logging of data such as temperature, soil moisture and air humidity, is done which is facilitates optimization of the irrigation process. Next,it uses Solar batteries to power the controller and action units.

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Lastly, use of short wave radio communication which has a range 1-4 KM (on low power mode), reduces the wire footprint.

In Veena Divya,k, AyushAkhouri "A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methology"deal GSM based Irrigation Control System, which could give the facilities of maintaining uniform environmental conditions [10]. For this, a software stack called Android is used for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system.

In Purnima, S.R.N Reddy, "Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth" ,proposed artificially supplying water to land where crops are cultivated. Traditionally hand pumps, canal water and rainfall were a major source of water supply for irrigation [11]. This method has led to severe drawbacks like under irrigation, over-irrigation which in turn causes leaching and loss of nutrient content of soil. Changing environmental conditions and shortage of water have led to the need for a system which efficiently manages irrigation of fields. Automated irrigation system is a machine based system, which automates the irrigation of land by combining various software and hardware approaches together for field irrigation. This paper deals with a detailed survey of various GSM based automated farm irrigation systems. GSM serves as an important part since it is responsible for controlling the irrigation facility and sends them to receiver through coded signal. Our study is concentrated on comparison of various GSM approaches [12].

III. SYSTEM ARCHITECTURE

The system includes an Arduino Mega2560 board which the controller. To communicate with the GSM module, Attention (AT) commands have beused in the algorithm. A SIM900A GSM module is used to interact with the user. Four Channel Relay, and an AC to DC adapter is included to check the electricity status. To check the soil moisture, sensors are used which measure the volumetric water content of soil. A water tank level measurement circuit is made, whose output is given to the controller and it is further intimated to the user through the GSM module by a SMS. The data collected is processed in the controller and required actions are taken on the basis of the algorithm. On field indication led for each component (pump and valves) has been provided to visually check the status.

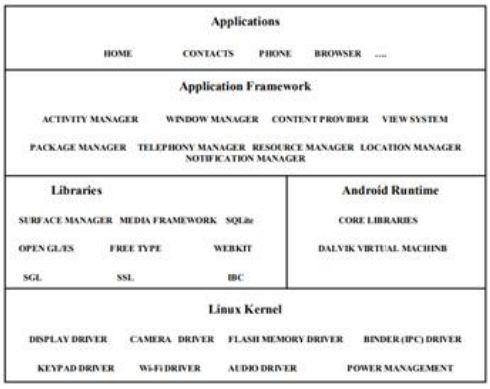

Fig.1: Android Architecture

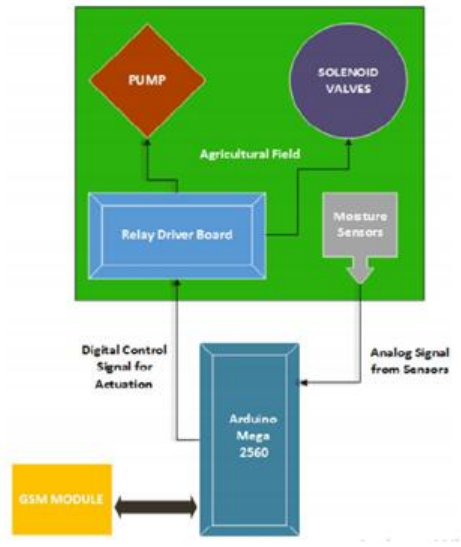

Fig.2. Block Diagram of the Setup

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The user communicates with the controller unit through SMS using the GSM network. A sim card is installed in the GSM module which is on the field and connected to the controller. The GSM module sends the data received, to Arduino Mega (controller) which also continuously receives the data from the sensors. Input pins have been used on Arduino for electricity status and water level of tank. Whenever the system receives the activation command from the user it checks the electricity status and reverts back with the actual status of the system. Further, when the user sends in activation code for initiating the pump and energizing the solenoid valves, the system does the same and again gives the user a feedback intimating the status of the pump and the valves. The pump is controlled by a simple transistorized relay circuit. When the pump starts, a constant monitoring on soil moisture is done and once the present soil moisture set point is reached the system is automatically turned off and a message is send to user that the pump and valves are turned off.

Users have to interact with the system through SMS using their registered mobile number. We have added a feature with which commands through SMS would be accepted only by the authorized person's mobile number, thereby curbing unauthorized access. If SMS from an unregistered mobile number is sent to the system, it reverts back with the message 'Unauthorized Access'. Apart from this security feature, the user can know the current electricity status of the field, know the water level of the tank, turn on/off the pump and solenoid valves, check the moisture content of the soil, put the system on auto cut off mode, and change the set point for auto cut off. At present the GSM module is used for Remote Control activities such as Gate Control, Temperature Control etc. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB) for computer. The MODEM is the soul of such modules. They generate, transmit or decode data from a cellular network, for establishing communication between the cellular network and the computer. These are manufactured for specific cellular network (GSM/UMTS/CDMA) or specific cellular data standard (GSM/UMTS/GPRS/ EDGE/HSDPA) or technology (GPS/SIM). They use serial communication to interface with the user and need Hayes compatible AT (Attention) commands for communication with the computer (any microprocessor or microcontroller system). Arduino uno -An exposed source podium which involves of both a physical programming circuit board (Micro controller) and a piece of software (Integrated development Environment). Soil Moisture Sensor - The Soil Moisture Sensor (SMS) is a sensor linked to an irrigation system director that measures soil moisture contented in the energetic root zone previously each planned irrigation event and bypasses the cycle if humidity is above a user defined set point.

Relay - Switches that exposed and close circuits automatically and electro magnetically. Control one electrical circuit by opening and closing contacts in another circuit. Temperature sensor& humidity sensor- This DHT11 Temperature and Humidity Sensor structures a regulated digital signal output with the temperature and humidity sensor difficult. Its knowhow ensures the high consistency and excellent long-term constancy. A high-performance 8-bit microcontroller is linked. This sensor contains a resistive element and a sense of wet NTC temperature measuring devices. It has outstanding feature, fast response, anti interference ability and high cost performance compensations.

V. SOFTWARE IMPLEMENTATIONS

Android software development is the process by which new applications are created for the Android operating system. Applications are usually developed in the Java programming language using the Android Software Development Kit. The Android software development kit (SDK) includes a comprehensive set of development tools. These include a debugger, libraries, a handset emulator based on QEMU, documentation, sample code, and tutorials.

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The SDK also supports older versions of the Android platform in case developers wish to target their applications at older devices. Development tools are downloadable components, so after one has downloaded the latest version and platform, older platforms and tools can also be downloaded for compatibility testing. Android applications are packaged in.apk format and stored under /data/app folder on the Android OS (the folder is accessible only to the root user for security reasons). APK package contains.dex files (compiled byte code files called Dalvik executable), resource files, etc...

VI. RESULTS

In the proposed solution of designing an automated water irrigation system, the goal was successfully achieved. The soil moisture sensors were tested at different moisture levels and field results show that these are very useful to the tune irrigation practices for greater efficiency. Further, this system is low cost and designed to improve irrigation efficiencies and reduce resource wastages. In addition to this, the project checks the electricity status at the field and keeps the farmer informed, saving him from travelling distances to the farm in vain.

Fig.3: GSM based automatic irrigation control system by using mobile

Also, if there is change in state, that is if electricity is available from the state of being not available, automatically a SMS is sent to the farmer informing the same. The project also aims at the problem of water management besides prevention of over-irrigation and under-irrigation. Thus, this can be applied extensively. The designed system is inexpensive and also be used in personal gardens as well.

VII. CONCLUSIONS

The proposed controller eliminates the on-place switching mechanism used by the farmers to ON/OFF the irrigation system. Integrating features of all the hardware components used have been developed in it. Occurrence of each module has been logical out and located prudently, thus donating to the best working of the unit. Next, using highly advanced IC's with the help of rising technology, the project has been really employed. The microcomputer irrigation system applied was found to be feasible and cost actual for changing water resource for agricultural manufacture. This irrigation system permits cultivation in places with aquatic insufficiency thereby cultivating sustainability. The micro irrigation system progressive proves that the use of water can be weakened for a given amount of fresh biomass manufacture.

Thus, this system avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water. The main advantage is that the system's action can be changed according to the situation (crops, weather conditions, soil etc.). By implementing this system, agricultural, horticultural lands, parks, gardens, golf courses can be irrigated. Thus, this system is cheaper and efficient when compared to other type of automation system.In large scale applications, high sensitivity sensors can be implemented for large areas of agricultural lands. A stand by battery or solar cells can be implemented which comes into use in case of power cuts. A secondary pump can be used in case of failure of the pump.

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VIII. FUTURE WORKS

In addition to our setup, we can add temperature, smoke, and wind sensors to increase the number of parameters for improved controller decision. However, that will led to an intricate algorithm and will also increase the cost of system. So depending upon the requirement, two solutions can be developed – Low Cost, Less Features, and High Cost, More Features.

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