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Real Time Automation of Irrigation Systems using Mobile Based Applications

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Abstract- Water is the basic requirement of the world, with irrigation being the topmost field to utilize it. Hence, it has become necessary to adopt smart ways for irrigation as the present system is irrational, tedious, time consuming and very wasteful in terms of water usage. This prototype discussed in this study focuses on the effective irrigation and prevention of water wastage encountered in uncontrolled irrigation. The study focuses on avoiding wastage of water and increasing irrigation efficiency by using a cross platform app based irrigation system with the help of soil moisture sensor, water level sensor, temperature sensor, GSM controller, microcontroller (Arduino) and an app. This application precisely controls water system for fields by using a sensor microcontroller system. It is achieved by installing sensors in the field to monitor the soil temperature and soil moisture which then transmit data to the microcontroller for estimation of water demands of field. The GSM controller installed with the microcontroller transmits sensed data over the network to the app. App having the built-in standards does the comparison and displays it to the user who can interactively use the app to put forward commands to control the water supply in the field. With this project, remote fields can be efficiently linked and controlled with a touch of an app.

Keywords- Arduino, GSM Technology, Irrigation System, Moisture Sensor, Smartphone

1. Introduction

Agriculture being one of the most important occupation of India contributes about 16% of total GDP and 10% of the total exports [1]. It is the second largest country in terms of total arable land with 60% area being arable [2]. Even then, full use of resources is not being made due to reasons like lack of rains and scarcity of land reservoir system. Another major reason being unplanned usage of water.

Traditionally irrigation is done manually but it has lots of problems such as increase in workload of farm labour, leaching of soil, lesser yield of crop and wastage of water. These outmoded techniques need to be replaced with semi-automated and automated techniques for water deployment system to sustain use of water and provide water to the farms according to their moisture, temperature and soil type. Automatic irrigation would save energy and resources enabling farmers to smear the right amount of water at the right time by automating farm.

This study focuses primarily on reducing the wastage of water and minimizing the manual labour on field for irrigation. It provides an alternative to a primitive method of irrigation in which an alarm intimates the farmer when water reaches a certain level in the tank. The farmer then shuts off the alarm manually and closes the water inlet to stop the supply. Leakage of water from the tank or a damaged alarm can result in wastage of the valuable resource. The proposed system will allow farmers to continuously monitor the water levels inside the water tank and moisture level in the field, remotely controlling the supply over the GSM network in connection with a smartphone application. In addition to this, if desired, the irrigation system can be remotely and manually started or stopped regardless of measured sensor with a touch on the mobile application. In this study, irrigation automation with few sensors has been carried out. Additionally, remote control of the irrigation system has also been executed with smartphones.

2. Literature Review

After relevant research in the field of agriculture, researchers observed that the yield of agriculture goes on decreasing day-by-day. Use of technology in the field of agriculture plays an important role in increasing the production as well as in reducing the extra manpower efforts. Few of the researches tried for betterment of farmers and provided systems that use technologies which are helpful for increasing the agricultural yield [3]. Some of such researches carried out in field of agriculture are summarized here. The tank overflow control model is a primitive method in which a wire is installed at a desired water level inside the tank. When water

reaches this level, it touches the open wire and completes a circuit resulting in excitation of an alarm to notify the farmer. The farmer then shuts off the alarm manually. In case of water leakage, the alarm will never go off and the motor may keep running for a longer duration, causing wastage of water and electricity. In GSM Based Automated Irrigation Control using Rain Gun Irrigation System, Suresh et al. mentioned about using automatic microcontroller based rain gun irrigation system in which the irrigation will take place only when there will be intense requirement of water that will save a large quantity of water [5]. These system brings a change in management of field resources where they developed a software. In GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile, Pavithra and Srinath, supported water management decision monitoring the whole system with GSM (RS-232) module. In Irrigation Control System Using Android and GSM for Efficient Use of Water and Power, Shabadi at al. automated irrigation system using valves to turn motor ON and OFF [7]. These valves may be easily automated by using controllers. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from overwatering saturated soils, avoid irrigating at the wrong time of day which improves crop performance by ensuring adequate water and nutrients when needed. Innovative GSM Bluetooth Based Remote Controlled Embedded System for Irrigation proposed a system where GSM/Bluetooth based remote controlled embedded system is used for irrigation. The system sets the irrigation time depending on the environmental factors and can automatically irrigate the field [8]. Information, regarding the status of power supply, is exchanged between the system using SMSs on GSM network. Integration of Wireless Technologies for Sustainable Agriculture proposed a system that eliminates the use of wired technology and improves the old method of collecting data and allowing the farmer to control their sprinklers remotely. It utilizes wireless sensor networks to collect real time status of agricultural field and uses mobile phone to control the watering of the field using sprinklers [9].

3. Proposed System

The proposed system allows users to continuously monitor the water level in the field, remotely on a mobile application through GSM network. The mobile application can be used to shut the water supply automatically and irrespective of the physical location of the user. Thus, the task of switching off the motor manually has been automated. The smart irrigation system can be installed in farms to monitor the moisture content of the soil continuously. It would turn on the motor automatically when water content of the soil goes below a certain level. The user can check if the farm is well irrigated remotely on the mobile application, without visiting the farm. These systems would improve the livelihood of farmers extensively.

A GSM based farm irrigation system has two major technologies behind it, primary being the "GSM" and secondary one is the controller or processor. GSM (Global System for Mobile Communication) is a standard set used to describe protocols for digital cellular networks. This GSM facility serves as an important part for controlling the irrigation on field and sending the results to the farmers using coded signals to a mobile device which indirectly controls the entire farm's irrigation system. The processor or the controller works as a central core for functioning of the automated process after it has been initiated by the GSM based device and finally presents the output to the device.

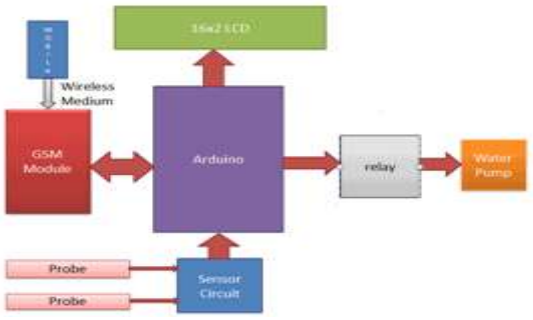

Figure 1: Layout of the System

The system which is remotely controlled, proposes a low cost information exchange via GSM network. The soil moisture, humidity and various other environmental factors influencing growth of crops are periodically sensed using high quality accurate sensor and those values are passed on to the processor/controller to calculate required amount of water and fertilizers and various other inputs during irrigation [10]. The functionality of GSM increases the efficiency of the automated irrigation system by providing a more user-friendly interface using GSM coupled with a cross-platform application that can operate on any mobile's operating system.

4. Methods & Materials

4.1 Hardware

In the developed irrigation system, Arduino Uno as microcontroller, SIM900 as GSM module, a soil moisture sensor, LM35 as temperature sensor, L293D as motor driving chip were used.

a) Arduino

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simple connection to a computer with a USB cable or power it with a AC-to-DC adapter or battery is required to get it started.

Figure 2: Arduino Uno

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Table 1: Arduino Uno Specification Table

Features	Arduino Uno
Flash memory	32K
RAM	2K
EEPROM	1K
UART (Serial ports)	1
Digital Pins	14
Analog Inputs	6
ADC Resolution (bits)	8
MircoSD memory card socket	0
Solar Lipo battery charger	No
RealTimeClock (RTC)	No
Bee socket (WiFi/Xbee/Cellular)	No
Processor	ATmega328P

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter or battery. The adapter can be connected by plugging a 2.1mm centre-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the power connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

b) GSM Module

SIM900 GSM module is used in the model, operated at frequencies of 850, 900, 1800, and 1900 MHz. The irrigation system is always connected to network with this GSM module using AT commands. 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.

Figure 3: GSM Sim900

An RS-232 port was once a standard feature of a personal computer for connections to modems, printers, mice, data storage, un-interruptible power supplies, and other peripheral devices. However, the limited transmission speed, relatively large voltage swing and large standard connectors motivated the development of the universal serial bus which has displaced RS-232 from most of its peripheral interface roles. Many modern personal computers have no RS-232 ports and must use an external converter to connect to older peripherals. Some RS-232 devices are still found especially in industrial machines or scientific instruments.

c) Moisture Sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. In this particular project, moisture sensors which can be inserted in the soil in order to measure the moisture content of the soil are used.

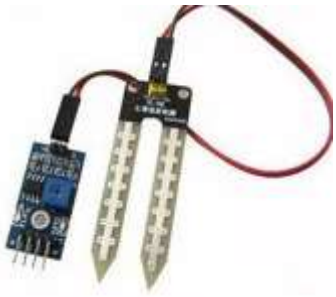

Figure 4: Moisture Sensor

Soil electrical conductivity is simply measured using two metal conductors spaced apart in the soil except that dissolved salts greatly alter the water conductivity and can confound the measurements. An inexpensive fix is to embed conductors in a porous gypsum block which releases calcium and sulphate ions to swamp the soil background level of ions. The water absorbed by the block is correlated with soil water potential over the range -60 to -600 kPa providing a tertiary indicator for use in medium to heavy soils. Soil humidity sensor shown in Fig. 3 is used probing into the soil to detect the moisture content of the soil. This sensor uses two probes to pass current through the soil and then it reads the resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance). Its sensitivity can be adjusted by trimmer potentiometer.

d) Temperature sensor (LM35)

Temperature sensor (LM35) within 0.5 degrees of the actual temperature is used.

Figure 5: Temperature sensor (LM35)

Table 2: Sensors used and their features

Parameter	Temp. sensor	Humidity sensor	Soil moisture sensor
Type	LM 35	SY-HS-220	SMS using rods
Functions	Sense the temp.	Convert humidity to voltage	Measure soil moisture content
Operating temp.	-55°C to 150°C	-30°C to -85°C	-40°C to 60°C
Features	1) Ext. calibration not required	1) Humidity range: 30-90 % RH	1) Range: 0 to 150%
	2) Low cost	2) Accuracy= ±5 %	2) Accuracy= ±4 %
	3) Low impedance output	3) Less Current consumption	3)Power: 3mA@5VDC
	4) Operates from 4V to 30V	4) Rated voltage: DC 5.0V	4) Resolution: 0.05 to 0.4%

e) DC Motor

A DC motor for converting rotary direct current electrical energy into mechanical energy is used in the model for working as per the commands issued by the Arduino and accordingly switch ON/OFF the water supply to the field.

Figure 6: DC Motor

4.2 Software

a) Arduino IDE

The open-source Arduino environment makes it easy to write code and upload it to the i/o board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software. The ATmega328 on the Arduino Uno comes pre-burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files)

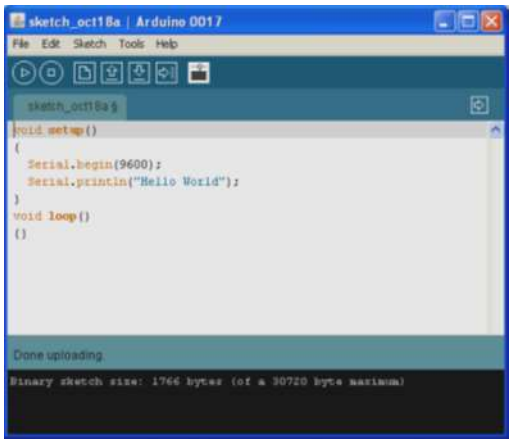

Figure 7: Sketch on Arduino IDE

b) Apache Cardova Platform

Apache Cordova is an open-source mobile development framework. It allows users to use standard web technologies - HTML5, CSS3, and JavaScript for cross-platform development. Applications execute within wrappers targeted to each platform, and rely on standards-compliant API bindings to access each device's capabilities such as sensors, data, network status, etc.

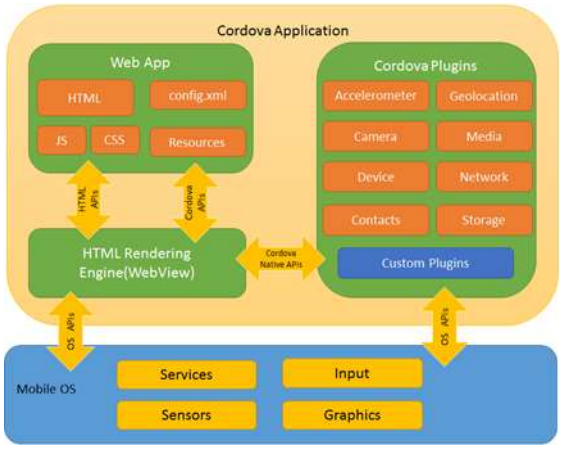

Figure 8: Cardova App architecture

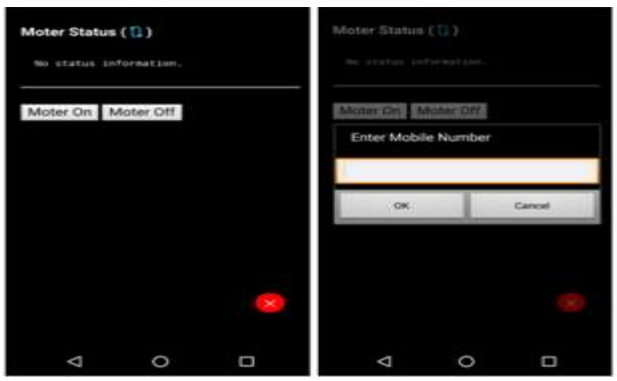

Figure 9: Screenshots from the app

5. Algorithm

Below stated are the steps that the proposed system undergoes.

I. Start the process.

II. Initialize power supplied to GSM.

III. Check the moisture level (less than or more than) of the irrigation field with help of a moisture sensor employed.

IV. If the level is more than a fixed threshold criterion, then there is no need for irrigation and the motor pump is switched off.

V. If moisture level is less than a fixed criterion, the gsm and app interacts (SMS plugin built-in feature of app fetches the SMS sent from authorized mobile number) and a pop-up notification is raised stating the need for action.

VI. On receiving pop-up on the mobile app, user with a touch on "Motor on" button turns on the motor to supply water in the field.

VII. A water level indicator placed in the field keeps a check on the level of water in field and if the level exceeds the standardized limit, controller automatically turns off the motor and pops up a notification on user's app to notify him/her.

VIII. At any time if the user intends to power off the supply, the action is performed by touch on "Motor off" button.

IX. The app shows the duration for which electricity to the motor pump is supplied and field is irrigated and also the real time moisture and temperature of field assisting the user to take necessary actions.

6. Conclusion

Irrigation has been the backbone of human civilization since humans started agriculture. As the generation evolved, man developed many methods of irrigation to supply water to the land. In the present scenario, conservation of water is of high importance. Present study attempts to save the natural resources available to human kind. By continuously monitoring the status of the soil, we can control the flow of water and thereby reduce the water wastage. By knowing the status of moisture and temperature through GSM with the use of moisture and temperature sensors, water flow can be controlled by just sending a message with the touch on an app. This helps in conservation of both water and labour and provides operational flexibility. If water is stored in tanks at irrigation lands, one can remotely monitor the status of the water level, temperature value and

moisture content in soil through the mobile app from the farfetched fields at any time which avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water. This system is also secure because only through authorized login on the app, the state of the field is seen. As the developed mobile app is cross platform, it can be run on any smartphone without the restriction of operating system. A number of fields can be reviewed using the same app as it has the feature of replacing mobile no. stored for fetching data from. This saves the valuable time of the farmers and free them from worrying about the state of the field. The feature of giving real time of motor running duration gives the feedback of electricity supply and knowledge of motor run time. It will also increase the productivity of the field as definite amount of water is supplied. Thus, this system is cheaper and efficient when compared to other type of automation systems.

REFERENCES

[1] Elumalai Kannan, Sujata Sundaram, "Analysis of Trends in India's Agricultural Growth", on ISEC, Banglore

[2] Knox, J. W.; Kay, M. G.; Weatherhead, E. K. Water regulation, crop production, and agricultural water Management-Understanding farmer perspectives on irrigation efficiency. Agric. Water Manag. 2012, 108, 3–8.

[3] Hedley, C. B.; Knox, J. W.; Raine, S. R.; Smith, R. Water: Advanced Irrigation Technologies. Encycl. Agric. Food Syst. 2014, 5, 378–406.

[4] Turral, H.; Svendsen, M.; Faures, J. M. Investing in irrigation: Reviewing the past and looking to the future. Agric. Water Manag. 2010, 97, 551–560.

[5] Gold Pan, "with modern facilities to enhance agriculture of things", agricultural market, Volume 3 pp.27-28, 2010

[6] R. Suresh, S. Gopinath, K. Govindaraju, T.Devika, N. Suthanthira Vanitha, "GSM based Automated Irrigation Control using Rain Gun Irrigation System", International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 2, February

[7] Pavithra D. S., M. S. Srinath, "GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Vol 11, Issue I, Jul-Aug 2014, pp. 49-55.

[8] Laxmi Shabadi, Nandini Patil, Nikita. M, Shruti. J, Smitha. P & Swati. C, "Irrigation Control System Using Android and GSM for Efficient Use of Water and Power", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 7, July 2014.

[9] Indu Gautam, S.R.N. Reddy, "Innovative GSM Bluetooth Based Remote Controlled Embedded System for Irrigation", on IJCA, June 2012

[10] Kalyan Mohan Goli, Karthik Madidipatla, Thentu Sravani, "Integration of Wireless Technologies for Sustainable Agriculture", on IJCST,2011.

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