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I-Farm: Intelligent farm

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ABSTRACT

Irrigation is the most important agricultural input in a tropical monsoon country like India where rainfall is uncertain, unreliable and erratic India cannot achieve sustained progress in agriculture unless and until more than half of the cropped area is brought under assured irrigation. Irrigation which consumes more than 80% of the total water use in the country needs a proper overhaul if the country has to improve agricultural output and boost the overall economy. The system aims to overcome with the problem of irrigation by developing the application intelligently, that will help farmer to control irrigation system with less efforts. This system consists of sensors and farming devices where, sensors senses farming related parameters like soil moisture, temperature, humidity, water level etc., and farming devices like motor pump acts according to data generated by sensors and gathered and provided by admin PC. Admin PC will be interfaced with microcontroller, System operates in three modes manual mode(touch mode), auto mode(condition based mode) and prediction mode(intelligent mode). System uses cloud server to store logs. Admin Pc and Android Client can communicate with cloud server using WIFI(IEEE802.11b) to view logs or update some information.

Keywords— Automation, WSN, Sensors, Cloud Server, Android Phone, WI-FI.

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I. INTRODUCTION

Irrigation is one of the fundamental problems of agriculture in developing countries. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains and scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. Traditional field irrigation is usually manned and needs massive manpower and material resources, this led to deficiency of real-time and accuracy and went against the development trend of long-time agricultural production and sustainable utilization of water resources. Managing water is a crucial task in the agriculture field because its availability for agriculture is a global challenge for the upcoming years. Also, farmers have to maintain their land manually.

II. LITERATURE SURVEY

The authors of [1], proposed a system with a distributed wireless network of soil moisture and temperature sensors placed in the root zone of the plants. The implementation is a photovoltaic powered automated irrigation system that consists of a distributed wireless network of soil moisture and temperature sensors deployed in plant root zones. Each sensor node involved a soil-moisture probe, a temperature probe, a microcontroller for data acquisition, and a radio transceiver; the sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture and temperature are reached. Communication between the sensor nodes and the data receiver is via the Zigbee protocol, under the IEEE 802.15.4WPAN. This receiver unit also has a duplex communication link based on a cellular-Internet interface, using general packet radio service (GPRS) protocol, which is a packet-oriented mobile data service used in 2G and 3G cellular global system for mobile communications (GSM). The Internet connection allows the data inspection in real time on a website, where the soil-moisture and temperature levels are graphically displayed through an application interface and stored in a database server. This access also enables direct programming of scheduled irrigation schemes and trigger values in the receiver according the crop growth and season management. The aim of the implementation was to demonstrate that the automatic irrigation can be used to reduce water use.

The MobiCrop [2], is a project that is aimed at supporting crop farmers to make decisions on how to apply pesticides, when to apply the pesticides, which ones to apply, and so on. The application was designed as a distributed system where a middleware is proposed. The main purpose of the middleware is to shield the database server from the mobile participants. Furthermore, the caching technique was put forward to support offline accessibility of the pesticide information in the event of network loss. However, caching can lead to situations of stale data especially when there is no connectivity for a long time. In this paper [2] the authors, proposed the dual caching technique as a measure of pushing updates to the mobile in real time. A proxy layer is introduced that keeps mirrored copies of the information on the database server. Furthermore, the farmers are able to store device specific caches and later share the cache data.

In the paper [3], a practical, low-cost and environmental friendly Intelligent Greenhouse Monitoring System (IGMS) is designed based on WSN technology. In this particular application, IGMS is used to monitor key environmental parameters such as the temperature, humidity and soil moisture. Data collected from sensors will be sent to a remote server for monitoring and analysis. When the threshold value of a particular data (e.g. moisture) is reached, pumps, valves and related devices will be triggered to initiate the automatic irrigation operation.

In [5], using PIC16F877A and GSM SIM300 modem is focused on automating the irrigation system for social welfare of Indian agricultural system. This system will be useful for monitoring the soil moisture condition of the farm as well as controlling the soil moisture by monitoring the level of water in the water source and accordingly switching the motor ON/OFF for irrigation purposes. The system consists of a GSM modem through which the farmer can easily be notified about the critical conditions occurring during irrigation process. They have used RS232 and MAX232 for serial communication. In [5] the authors have used microcontroller (PIC16F877A) which is based on RISC for checking the three conditions:

- Availability of adequate water level in the water source,
- Availability of continuous power Supply,
- Moisture level in the soil.

III.PROPOSED ARCHITECTURE

I-Farm is basically based on main four modules Admin PC, Android Application, Cloud server and hardware. Interaction of all modules is given below in block diagram. All sensors, ADC, Microcontroller, signal conditioner and MAX 232 come under hardware module. Working of system is as follows:

- When sensors senses changes in parameters like soil moisture, temperature, water level etc., they send their signal to signal conditioner. Signal conditioner is used to convert a signal that may be difficult to read by conventional instrumentation into a more easily read format.
- From Signal conditioner all of the data is given to Analog to digital converter. An analog-to-digital converter is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude.
- All data obtained by ADC is then given to Microcontroller and from Microcontroller to Admin PC through MAX 232.A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripheral. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.
- According to gathered data at admin PC user can take decision whether to set farm device on/off or set threshold value of sensor or to test hardware or to monitor hardware status etc. If user set farm device like water pump on then this change in device state is given to microcontroller and then from microcontroller to actual device through device driver.
- Admin PC keeps updating all logs to cloud server by using WIFI connection. Android clients can access server through android application developed for them by using WIFI connection.
- Through this application user can monitor, control, set threshold for farm hardware's remotely using cloud server.

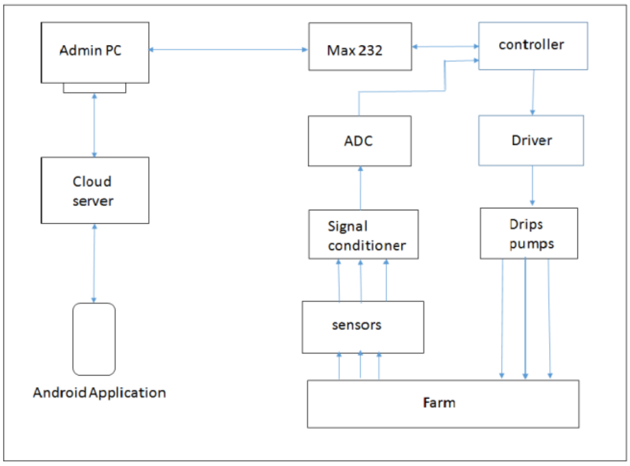

Fig 1: Proposed System Architecture

IV. HARDWARE REQUIREMENTS

1. MAX232 :

The MAX232 IC is used to convert the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide TIA-232 voltage level outputs (approx. ± 7.5 volts) from a single five volt supply via on-chip charge pumps and external capacitors. This makes it useful for implementing TIA-232 in devices that otherwise do not need any other voltages. The receivers reduce TIA-232 inputs, which may be as high as ± 25 volts, to standard five volt TTL levels. These receivers have a typical threshold of 1.3 volts and a typical hysteresis of 0.5 volts.

2. ATmega32 :

The ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. Because of these features we are using ATmega32 microcontroller.

3. ULN2803 :

A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads. In English, the chip takes low level signals (TLL, CMOS, PMOS, NMOS - which operate at low voltages and low currents) and acts as a relay of sorts itself, switching on or off a higher level signal on the opposite side. The ULN2803 comes in an 18-pin IC configuration and includes eight (8) transistors. Pins 1-8 receive the low level signals; pin 9 is grounded (for the low level signal reference). Pin 10 is the common on the high side and would generally be connected to the positive of the voltage you are applying to the relay coil. Pins 11-18 are the outputs (Pin 1 drives Pin 18, Pin 2 drives 17, etc.).

V. MATHEMATICAL MODEL

Let S= {U, S, D, Sval, Sth, Uname, Pwd, Cmd, Hstatus, n, con_obj, F, S}

Where,

U is finite set of users

U = $\{U_1$, U2, U3…….$U_N\}$

S is finite set of sensors

S = $\{S_1$, S2, S3…….$S_N\}$

D is finite set of devices

D = $\{D_1$, D2, D3…….$D_N\}$

Sval is finite set of sensor values

Sval = $\{SV_1$, SV2, SV3…….$SV_N\}$

Sth is threshold set of each sensor

Sth =$\{ST_1,ST_2,ST_3…….ST_N\}$

Uname is Username for login

Pwd is Password

cmd is Android client commands

Hstatus is Status of h/w sensors and devices

n is Hardware nodes

S (Success) = $\{S_1, S_2\}$

S_1 = All Sensors will be able to capture all the values related to agricultural field.

S_2 =All the values from sensors are successfully received by computer system.

F(Failure) = $\{F_1, F_2\}$

F_1 = Sensors fails to capture all the values.

F_2 =All the values from field are received by sensors but unable to send to computer system.

VI. CONCLUSION

We are developing a system named I-Farm is an automatic water irrigation system. I-Farm totally operates on outputs from sensors and immediate action of farming devices on that outputs. Main components are :

- Admin PC and Java based application.
- Hardware.
- Android Application.
- Cloud server.

I-Farm is low cost, scalable, reliable system. This system is useful to farmer to reduce workload and helps in water conservation and proper utilization. If we deploy I-Farm on large scale, initial cost will be high but it will be beneficial to Indian farming.

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