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Smart Irrigation using Sensor Network

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Abstract: ***An automated irrigation system monitors and maintains the desired soil moisture content via automatic watering. AtMega328 microcontroller is used to implement the control unit. The setup uses temperature and soil moisture sensors which measures the exact internal temperature and moisture level in the soil. Every crop has its own requirements of temperature and water for its growth. The sensor values are utilized to control the water supply to avoid over/under irrigation. Information from the sensors is regularly updated on a web page as well as stored in a database using ESP8266 module. Based on the statistical values the flow of water is regulated using flow meter and solenoid valve. IOT enables the farmers to have a constant update about the status of valve via an android application and also turn them ON/OFF at any time.***

Keywords: ***Micro-controller, AtMega328, ESP8266, IOT, Flow meter, Solenoid Valve, Irrigation***

I. INTRODUCTION

Agriculture plays a vital role in the growth of a country's economy. Farming is a laborious task in most developing and underdeveloped countries. This results in problems such as waste of water resources in agricultural production. With the strides in electronics, this can be mitigated. One of the main challenges confronting water management in agriculture is to improve its efficiency & sustainability. This can be achieved with an Automated Irrigation System. An automatic irrigation system refers to the operation of the system with no or minimum manual intervention besides surveillance. The water distribution to the fields becomes effortless. Many farmers still prefer traditional methods of farming which results in low yield. However these methods can be replaced with automation to effectively increase the yield as well as reduce human intervention. Continuous Monitoring of environmental factors is necessary to improve the yield of crops.

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II. EXISTING SYSTEM

[5]. The existing system is implemented with the help of micro-controller called PIC18F2550 and it is used for serial USB features. The sensor used is HSM 20G for humidity and temperature sensing. The communication is done with the help of Bluetooth module called Cytron blue bee Bluetooth. There are two types of connections used i.e. primary and secondary connections. After the smart phone's Bluetooth is connected to the personal computer the window GUI will act as a server to forward data to and from the smart phone to the main control. The main disadvantage of this system is the effective area under control. The range of a Bluetooth module is 100 meters in diameter. Moreover the limitations of 7 devices in a piconet are far less than what is to be implemented practically.

III. PROPOSED SYSTEM

The important parameters that influence a plant growth include moisture content in the soil & temperature. These are monitored using temperature sensor (LM35) and moisture sensor(SEN0114).The input from these sensors is taken and the data is processed using a micro-controller and can be transmitted to any device with the help of ESP8266(WI-FI)module, connected to the same LAN network. Data levels thus acquired are used to set multilevel threshold for the assessment of water requirements of various crops. This data is uploaded to the database & the same can be retrieved using another remote device through an android application. A rule based algorithm is used to determine the water requirement and provide appropriate decision to operate the solenoid valve. Figure 1 depicts the proposed model.

Hardware

1) *Moisture Sensor (SEN0114):* The soil moisture sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil dielectric permittivity is a function of water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore water content of the soil is measured.

2) *Temperature Sensor (LM35):* An increase in voltage results in rise in temperature. The LM35 series are precision integrated circuit temperature sensors whose output voltage is linearly proportional to Celsius temperature. The sensor measures the relative humidity in the range of 0 to 100 percentage.IC−741 Op-Amp is used as a differential amplifier which is the combination of both inverting and non-inverting

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amplifier. The output of the amplifier is in the terms of mV. The degree Celsius that is measured from temperature sensor is converted to mV that is one degree is equal to 10 mV.

3) *Solenoid Valve:* A solenoid valve is an electro mechanically operated valve. The valve is controlled by an electric current through the solenoid. In case of a two port valve the valve is switched on and off. In case of a three port valve the output is switched between the two outlets.

4) *Water Flow Meter (YF-S201):* Water flow sensor consists of a plastic valve body, a water rotor and a Hall Effect sensor. When water flows through the rotor, the rotor rolls. Its speed changes with different water flow.

5) *Atmega328:*ATmega328 is an 8bit micro-controller with Harvard architecture. It can handle the data size of up-to 8 bits. It is an AVR based micro-controller. Its built in internal memory is around 32KB, has a SRAM of 2KB data memory. It has an operating range from 3.3V to 5V. It has an ability to store the data even when the electrical supply is removed from its bits biasing terminals.

6) *Wi-Fi Module (ESP8266):* ESP8266 is an impressive low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing micro-controller via the UART serial connection. The module can even be programmed to act as a standalone Wi-Fi connected device by just adding power. The ESP8266 requires 3.3V power Supply.

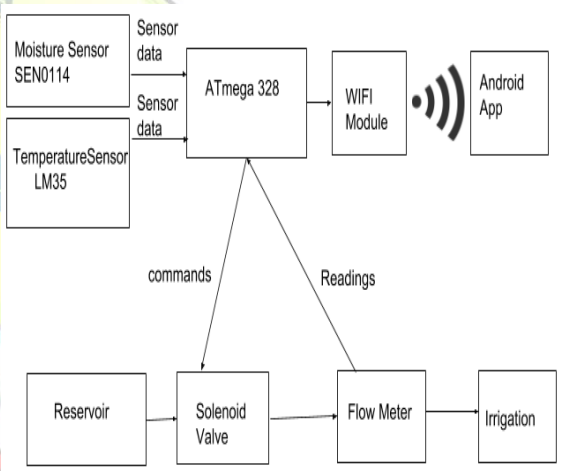

Figure 1

Software

1) *Android Studio:* Android software development is the process by which new applications are created for devices running on the Android operating system. Applications are usually developed in Java programming language using the Android software development kit (SDK). The application is designed to

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receive real-time data from the sensors. These values (temperature and moisture values) are displayed in the application. Apart from the sensor values the user (in our case it is the farm owner) can manually control the electrical state of the valve (ON and OFF). The state of the valve is also displayed in the app. START button starts the operation to receive real time temperature and moisture values and ON/OFF MOTOR button is used switch on and off the valve.

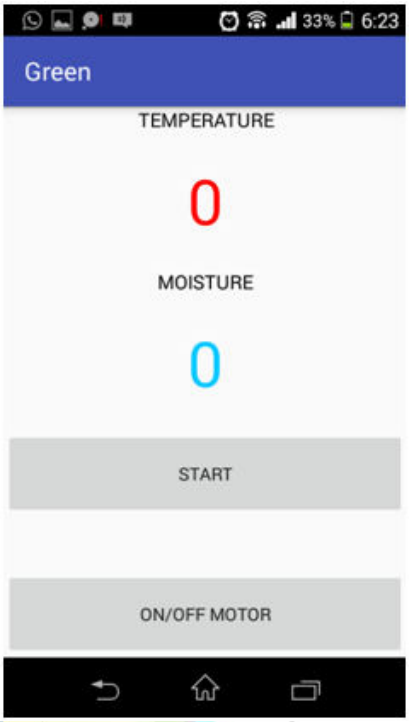

Figure 2

IV. IMPLEMENTATION AND RESULTS

Fire-base real-time database is used to store the sensor data. Decision support is provided based on rules that depend on thresholds governed by the sensor inputs. Google API is used to store and retrieve data from the database. An android application is created for real time monitoring of the soil parameters as shown in Figure 2.

The flow of control and logic is shown in Figure 3 This application uses HTTP (Hypertext transfer protocol) which uses a client-server or a request-response model) the app sends and receives data through HTML codes, using requests and response. Based on the water requirement the irrigation of the crop is automated. A flow meter sensor is employed and the flow of the water is controlled through a valve. An additional feature facilitates the control of the valve through the App.

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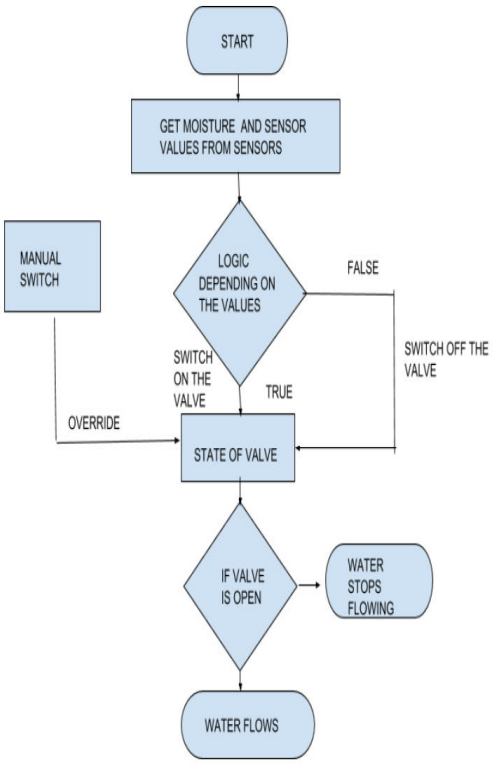

Figure 3

CONCLUSION AND FUTURE WORK

Thus an embedded system is designed to reduce water consumption by interfacing moisture sensor to the controller. Measured sensor values can be set to lower and upper thresholds to maintain optimum soil moisture saturation and minimize plant wilting. This can also contribute to better plant growth. Implementation of the proposed system in the fields can definitely improve the overall production. However, research indicates that different sensor types may not perform alike under all conditions. Due to soil's natural variability & location, integration of number of moisture sensors may be crucial. Therefore future work should include optimization of sensor placement.

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