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Vegetable Crop Surveillance Using Precision Management

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Abstract—This paper presents our field experience in agriculture using sensors. By, monitoring the sensors connected we can collect data from those sensors to our central database. Although, several improvisation have been made in monitoring vegetable crops such as brinjal and lady's finger they need to be cultivated as disease prone varieties. The main objective of this paper is to present a complete system which monitors the plant at regular intervals and collect data for further manipulation. Depending on the changes that may affect the plant (brinjal and lady's finer) farmers are alerted through text message or voice message.The software, which we have used for this research is Arduinoand LabVIEW which is much simpler embedded software than any other software. The project is done under an agricultural scenario
Keywords—Sensors, Arduino, LabVIEW, embedded

I. INTRODUCTION

Agricultural researchers and farmers deploy sensors at their remote agricultural-fields to obtain the data of temperature, humidity, soil moisture and so on. Automatic collection of those data greatly helps their analytical works. Currently the transmission of the data is not automatic and farmer must look after the plants every now and then.

We have explored an automatic surveillance of the changes that occur on the plants and by carrying those data's through GSM to the farmer for easy and improved farming which is called precision farming. It is now widely acknowledged as a framework that can be applied to village communications ([10], [13].

Focusing on the application to sensor networks, we contribute to the research community by showing our implementation-based experiment. Several approaches exist for collecting data from sensors. However, we must keep in mind that all the sensors placed on the plants needs to be monitored constantly and report the changes in a period of time. Not all the sensors will notify a change every now and then. Thus the sensors are programmed to report if a change occurs and also to provide data at regular intervals. These two conditions are applied to all the sensors.The data once received from the sensors needs to be taken to the server and are constantly collected and stored in the server this is done by the help of transmitters and receivers.

The data once collected needs to be analyzed using formulas/iterations and fixed thresholds. This paper presents our field experience on sensor data gathering conducted in the M.S.Swaminathan Research Foundation assuming such an agricultural scenario.We placed five sensors on the plants and collected data from them to our central data server. This paper is organized as follows. Section II shows a brief of the vegetable crops. Section III the system overview for Arduino based data gathering from the vegetable crops. Section IV presents mechanism for displaying collected data in LabVIEW interfaced to Arduino. Section V provides discussion and related works. Finally, we conclude this paper in Section VI.

II. DESCRIPTION OF PLANTS

A) Brinjal

The brinjal plant is a delicate, tropical perennial often cultivated as a tender or half-hardy annual in temperate climates. It grows 40 to 150 cm (16 to 57 in) tall, with large, coarsely lobed leaves that are 10 to 20 cm (4–8 in) long and 5 to 10 cm (2–4 in) broad. Semi wild types can grow much larger, to 225 cm (7 ft) with large leaves over 30 cm (12 in) long and 15 cm (6 in) broad. The stem is often spiny. The cut surface of the flesh rapidly turns brown when the fruit is cut open. On wild plants, the fruit is less than 3 cm (1.2 in) in diameter, but very much larger in cultivated forms, reaching 30 cm (12 in) or more in length. Diseases that affect brinjal includes,Damping off, Bacterial wilt and Foot Rot are the major diseases that affect this crop. Major pests that affect brinjal are Shoot and Fruit Borer (SFB), Mites, Thrips and Hoppers.Bacterial wilt-Common disease which affects the production of brinjal is bacterial wilt. There is no chemical control for this disease which said to be the number one diseases for all solanaeceous crops. Cultural practices such as deep drains to facilitate drainage and the use of resistant varieties can be recommended to control the incidence. Footrot-Causal agent of this disease is a fungus. Symptoms of this disease are similar to that of bacterial wilt. At the collar region of the affected plant lesions are visible. By improving drainage this can be prevented. Redomil as a soil application is very effective in controlling this disease.

B) Lady's Finger

The species is an annual and perennial, growing to 2 m tall. It is related to such species as cotton, cocoa, and hibiscus. The leaves are 10–20 cm long and broad, palmately lobed with 5–7 lobes. The flowers are 4–8 cm in diameter, with five white to yellow petals, often with a red or purple spot at the base of each petal. The fruit is a capsule up to 18 cm long, containing numerous seeds.*Abelmoschusesculentus* is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat- and drought-tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture but frost can damage the pods. In cultivation, the seeds are soaked overnight prior to planting to a depth of 1–2 cm. Germination occurs between six days (soaked seeds) and three weeks. Seedlings require ample water. The seed pods rapidly become fibrous and woody, and, to be edible, must be harvested within a week of the fruit having been pollinated. The fruits are harvested when immature and eaten as a vegetable. Diseases that include are,**Powdery mildew** Symptom-Scattered white patches appear on the upper surface of leaves and coalesce to form a powdery coating. Heavily attack leaves dryup and drop off.Control-Crop rotation, Use a recommended fungicides (Bitertanol, captafol ,sulphur, thiophanate methyl .**Yellow Vein Mosaic (YVM)**Symptoms- clearing of leaf margins followed by vein chlorosis, Younger leaves develop yellow veins surrounded by dark and light green patches, Fruits are small, distorted and chlorotic, Affected seedlings are stunted resulting in reduced yields. Control- Remove infected plants, Plant disease free seeds, Control weeds (eg : *ageratiumconyzoides* L. Hunlantala in sinhala) which are altanate hosts for the virus Adhere to the time of planting, Delay in planting can increase incidence of the disease.

III. DATA GATHERING WITH ARDUINOFROM SENSORS

Fig. 1 shows the overview of the data collection mechanism from the plants which are connected to the sensors and are interfaced to ArduinoUNO board.

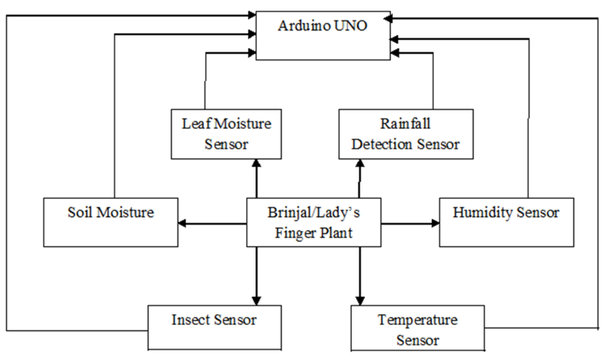

Fig1: Block Diagram ofthe Arduino interfaced Sensor and Connected to the Plants

Arduino is an open source electronic platform to which the sensors could be easily interfaced and monitored. The sensors are available that support Arduino which needs to be connected to the Arduino board. The input to the Arduino board is as low as 5V adapter/battery. It suits well for any connection in a single board and implementation of project in Arduino is cost effective as it could be replaced very easily. There are several versions of Arduino board, the one which we are using in the project is Arduino UNO.

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; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.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.

Let's discuss the interfacing of all the sensors to theArduino UNO board.

Soil moisture sensor(#1)- The soil moisture sensor uses immersion gold which protects the nickel from oxidation. Electroless nickel immersion gold (ENIG) has several advantages over more conventional surface plating such as HASL(solder), including excellent surface planarity, good oxidation resistance and usability for untreated contact surfaces such as membrane switches and contact points

The moisture sensor can read the amount of moisture present in the soil surrounding it. This is a must tool for connected garden. This moisture sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level, wet soil conduct electricity more easily(less resistance), while dry soil conducts electricity poorly(high resistance). The IO expansion shield is the perfect shield to connect this sensor to Arduino. Its features include working voltage of 5V, working current less than 20mA, interface is analog, low power consumption, high sensitivity and output voltage level is (0-4.2)V.

Rainfall detection sensor(#2)- rain sensor, can be used for all kinds of weather monitoring, and translated into output signals and AO. The sensor uses the high quality FR - 04 double material, large area of 5.5 * 4.0 CM, treatment of nickel plating and surface, have fight oxidation, electrical conductivity, and life has more superior performance; The comparator output, signal clean, good waveform and driving ability is strong, for more than 15 mA; its fabricated with potentiometer sensitivity adjustment. The working voltage of 3.3 V to 5 V. The output format: digital switch output (0 and 1) and analog AO voltage output.

Temperature sensor(#3)- The LM35 series are precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ˚ Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4˚C at room temperature and ±3⁄4˚Cover a full −55 to +150˚C temperature range.

Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make

Interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1˚C in still air.

Humidity sensor(#4)-The module can detect surrounding environment of the humidity and temperature. It's a highly reliable and excellent long-term stability device. The output is obtained in both analog and digital form. The device has a fixed bolt hole and hence installation in simple. Humidity measurement range: 20%~90%RH. Humidity measurement error: ±5%RH. Working voltage: 5 V

Insect sensor(#5)-The Ping))) is an ultrasonic range finder from Parallax. It detects the distance of the closest object in front of the sensor (from 2 cm up to 3m). It works by sending out a burst of ultrasound and listening for the echo when it bounces off of an object. The Arduino board sends a short pulse to trigger the detection, then listens for a pulse on the same pin using thepulseIn() function. The duration of this second pulse is equal to the time taken by the ultrasound to travel to the object and back to the sensor. Using the speed of sound, this time can be converted to distance and any insect approaching the plant could be detected.The entire project includes the Arduinoand sensors interfaced to them, the input to the Arduinois very low as 9V, using a simple adapter the board will work, but under an agricultural scenario this is adapter power supply connection is not easy. Hence as anatural power supply we use the power derived from the solar panel and during night hours the panel stores the charge and supplies power to the Arduinoboard.

IV. DISPLAYING COLLECTED DATA ON LIFA

LIFA stands for LabVIEW Inter Faced Arduino. The NI LabVIEW toolkit helps us easily to interface LabVIEW software with Arduinomicrocontroller. With this toolkit and LabVIEW, you can control or acquire data from the Arduinomicrocontroller. Once the information is in LabVIEW, analyze it using the hundreds of built-in LabVIEW libraries, develop algorithms to control the Arduinohardware, and present your findings on a polished User Interface (UI).

A sketch for the Arduinomicrocontroller acts as an I/O engine that interfaces with LabVIEW VI's through a serial connection. This helps to quickly move information from Arduinopins to LabVIEW without adjusting the communication, synchronization, or even a single line of C code. Using the common Open, Read/Write, and Close convention in LabVIEW, you can access the digital, analog, pulse-width modulated, I2C, and SPI signals of the Arduinomicrocontroller. It acts as a front end to our project. The sequence of data's that are obtained from the kit needs to be transmitted to the main server.

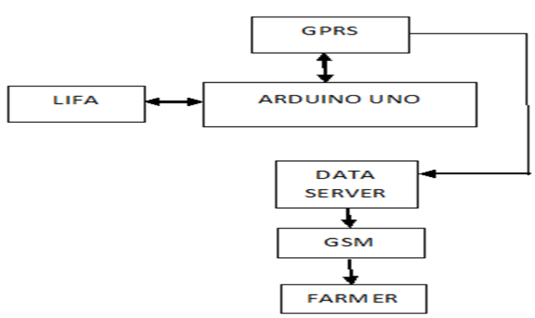

Fig2.Block Diagram OfFront End And Back-End Of The System

Interfacing Arduinowith LabVIEW keeps intrack of all the data that is been transmitted to the main server. The time of transmission the data which has been transmitted all gets stored in this software. The stored data will be very useful for the analysis of the project yield. The statistical study of the data that is stored will help manipulate the growth in agriculture.

V. DATA ACCUMULATING WITH GPRS SHIELD FROM ARDUINO

A) The GPRS Shield provides the way to use the GSM cell phone network to receive data from a remote location. The shield allows to achieve this via any of the three methods: Short Message Service, Audio and GPRS Service. The GPRS Shield is compatible with all boards which have the same form factor (and pinout) as a standard ArduinoBoard. The GPRS Shield is configured and controlled via its UART using simple AT commands. Based on the SIM900 module from SIMCOM, the GPRS Shield is like a cell phone. Besides the communications features, the GPRS Shield has 12 GPIOs, 2 PWMs and an ADC.

Fig 3. GPRS Shield Interfaced To Arduino Uno

B) The following graph explains only the temperature change that has been obtained and it proved successful transmission to the main server.

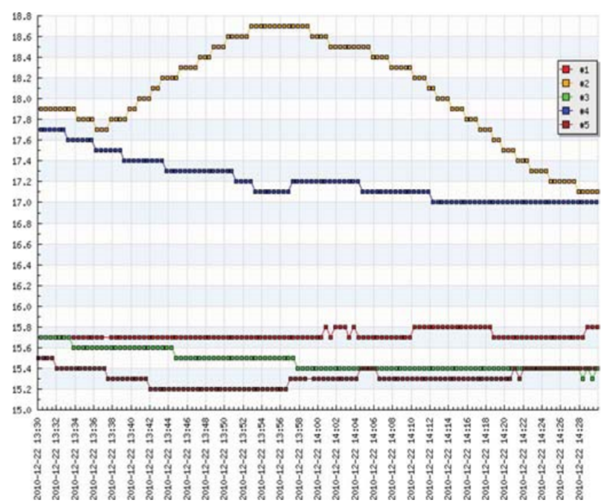

Fig. 4. Collected temperature from temperature sensor The experiment achieved almost 100% delivery and provided sufficient time-granularity in the gathered data.

The data gathered on the main server has to the reach farmer as a short text message or a voice message. This is done by using GSM. The global system for mobile communication does this task very rapidly and the farmer is guided for his better yield.

VI. DISCUSSION AND RELATED WORK

We have demonstrated with real implementation that the application of Arduinoand GPRS allows sensor data gathering with sufficient success rate. The data gathering from the sensor and performing certain calculations and pre-defined iterations the data will be manipulated at the main server level. This was also found successful and the data which may cause damage to the crop will be notified to the farmer. The GSM also proved successful in taking the information to the farmer for successful farming. This project provides,Real-time surveillance of crop growth, Real-time solution to the farmers for crop management, Precision farming- a new way of farming using technological interventions, reduced cost of cultivation, reduced economic loss and Enhanced income to farmers.

Sensordata gatheringwiththe application ofDTNwas identified, for example, by DFT-MSN [22] and vehicular sensor networks [12]. Ren *et al.* [14] proposed a hybrid approach with

Cellular phones. However, their research targets were theoretical improvements of, for example, success rate and power consumption with only simulation-based experiments. Implementation work or feasibility study (i.e., *proof-of-concept*) were left untouched.

An earlier version of this paper [15] has provided a smaller scale experiment with 2 sensors, which can be called as a preliminary experiment. In this paper, we carried out a larger-scale experiment with 5 to 6 sensors. Both experiments have shown great delivery success rate and sufficient usefulness.

VII. CONCLUSION

In this paper, we have presented our practical study on Arduinobased sensor data gathering for agricultural-field sensors. We recognize that cellular and mobile phones could be also used for data collection from remote sensors. However, we demonstrated that Arduino-based approach can develop data gathering by making farming simpler and with a good yield.

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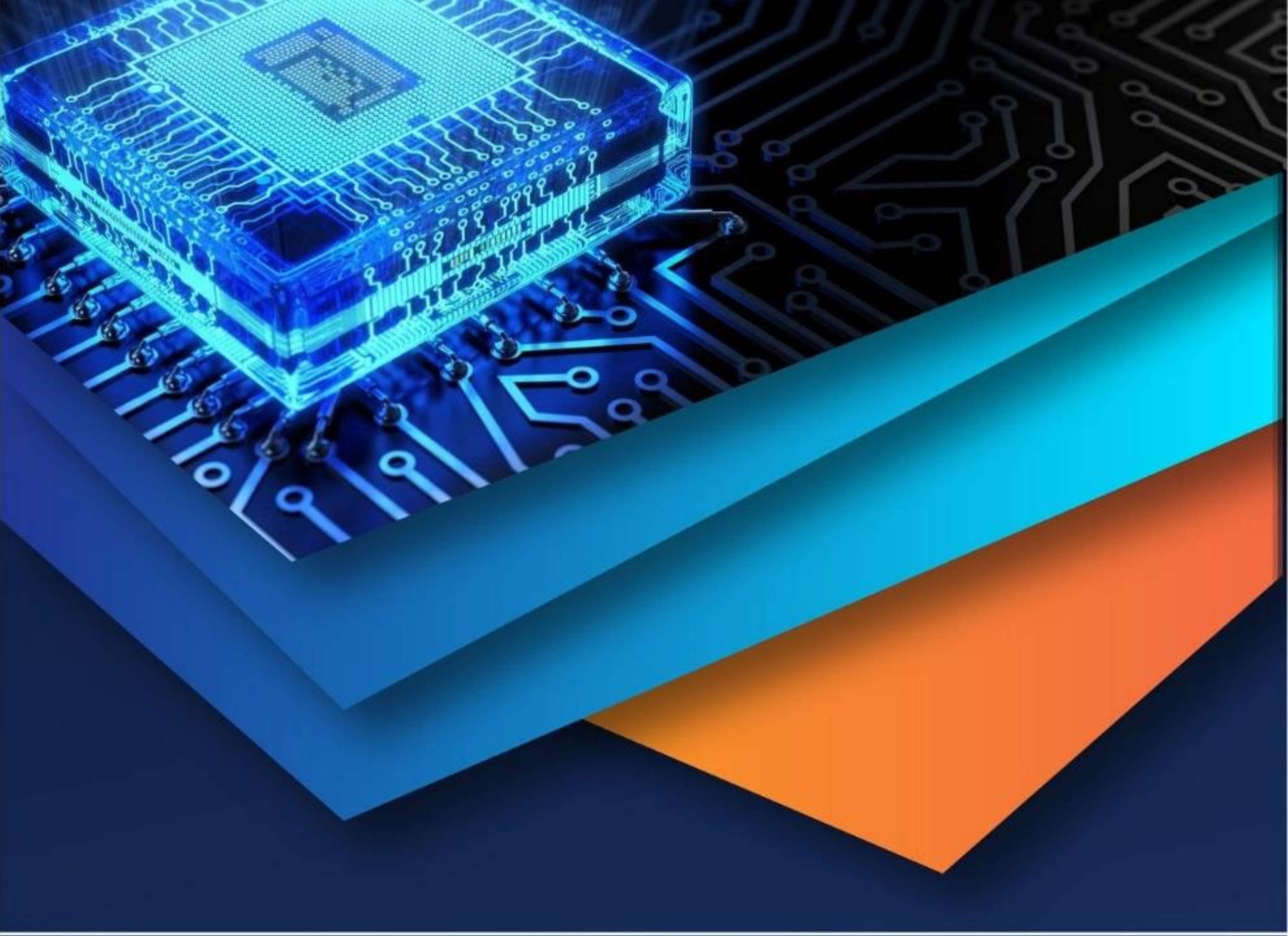

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