Prominent Technique for Aided Viable Farming

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ABSTRACT

In this paper the implementation of embedded system is to demonstrate that the automatic irrigation and maintenance can be used in agricultural area to enhance the growth. The system can be developed with the threshold values of the temperature and soil moisture that is programmed into a microcontroller-based gateway to control water quantity. At the same time wireless camera is used to monitor the condition of the growing plant and it is analyzed using Matlab software. The system presents a wireless sensor network where each sensor node takes images from the field and internally uses image processing techniques to detect any unusual status in the leaves. This symptom could be caused by a deficiency, pest, disease or other harmful agent. When it is detected, the sensor node sends a message to a sink node through the wireless sensor network in order to notify the problem to the farmer regarding the disease affected to the crop along with the type of fertilizer which can be used to rectify from the disease. The above parameters can be achieved with Microcontroller, soil moisture sensor, temperature sensor, ADC, signal conditioning unit, Zigbee, GSM Module, camera, motor pump and control circuit.

Keywords : Matlab, GSM, Zigbee, Fertilizer, Image Processing, ADC, WSN, LM35D, LM35CA, LM35

I. INTRODUCTION

In certain circumstances the farmer, who plays multiple role in crop production and sales , is the only responsible for the cultivation, where he mainly applies his empirical but effective agronomic competence. In the recent years there are many crises such as insufficient wealth, and new diseases and infections arise almost every season. Adopting external consultancy by an expert is not possible, for economical reasons, but also for logistic complexity, regions lack of experts and the few available cannot travel regularly to any field. If the farmer has the possibility, he may adopt chemical treatments, which are very expensive and reduce his net margin. In this way, the sustainability of the cultivation, as well as the natural quality of the goods, is drastically affected. In order to support farmers to overcome the crises this study and system can be undertaken.

II. METHODS AND MATERIAL

1. Related Works

Wireless sensor network (WSN) platform is used to senses various parameters. The sensor node (SN) is the relevant component of the system. The node controls the environmental sensors and the camera when present. The data acquisition is managed by the transceiver, together with the transmission to the BS. The antenna is specifically designed and integrated on board, and the power supply is provided by a dedicated photovoltaic harvester. Several sensors can be managed by the transceiver. For the first implementation, we have selected localized temperature and humidity units . Furthermore, it is able to compress images and to generate a JPEG data stream.

Our proposal is an ad-hoc platform similar to the ones used to acquire environmental and meteorological data, where the manufacturing cost of the sensor node is minimized, by an efficient selection of the system components. The aim is the realization of an ergonomic, low-cost, miniaturized platform, characterized by low environmental impact, low power consumption and high performance. Clearly, this

monitoring solution cannot prevent all possible diseases, and the efficiency of a consultant through the Internet is much lower, compared to the one that he might give on site.

An external microcontroller can be interfaced in order to set the camera. The image acquisition processing is carried out without external intervention and the image data are sent to the microcontroller through a serial interface. The module has a power save mode which aims to increase the energy autonomy, ranging from 270mA in active mode (when the image is taken) to 25uA in power save mode. As a transceiver, the same component exploited for the BS has been implemented. Even if in this case the transceiver is used to acquire/store data from the sensors and the camera, in addiction to commands reception and data transmission. The typology chosen for the mentioned application is the resonating magnetic radiator, which is significantly efficient in lossy media. The field region is characterized by a wave impedance as small as the one of the medium surrounding the antenna. The radiator is omnidirectional, and consequently the communication range is limited. Assuming that the system works 10 hours per day, the total power consumption is 330 Mw/day. Data, once acquired, are transferred to the BS, and from there they are copied on a remote database, via an ftp channel over the Internet.

The communication channel is realized by means of a standard 3G modem, directly implemented on the BS SBC. A web interface has been implemented, in order to allow the agronomist to access the database, to review images, to select the relevant ones, comparing them in a dedicated framework. Moreover, the user has the possibility to analyze the evolution of the environmental parameters, generating automatic graphs and crosscomparing the evolution of the vineyard along the years. The automatic irrigation and maintenance can be used in agricultural area to enhance the growth. The system can be developed with the threshold values of the temperature and soil moisture that is programmed into a microcontroller based gateway to control water quantity. At the same time wireless camera is used to monitor the condition of the growing plant and it is analyzed using Matlab software. The system presents a wireless sensor network where each sensor node takes images from the field and internally uses image processing techniques to detect any unusual status in the leaves.

This symptom could be caused by a deficiency, pest, disease or other harmful agent. When it is detected, the sensor node sends a message to a sink node through the wireless sensor network in order to notify the problem to the farmer regarding the disease affected to the crop along with the type of fertilizer which can be used to rectify from the disease. The above parameters can be achieved with Microcontroller, soil moisture sensor, temperature sensor, ADC, signal conditioning unit, Zigbee, GSM Module, camera, motor pump and control circuit.

The image of the plant is recorded and it is analyzed by using matlab. In matlab the technique called cluster analysis and svm is used. In cluster analysis, the clustering algorithm form groupings or clusters in such a way that data within a cluster have a higher measure of similarity than data in any other cluster. The clustering algorithm which is used in this work is k-means clustering. This partitions data into k distinct cluster based on the distance to the centroid of a cluster. SVM is a Support Vector Machine which is mainly used for classification when the data has exactly two classes. Based on these algorithms the recorded images can be analyzed. In this analysis there are two types of clusters will be formed. On selecting the type of the cluster the disease affected to the crop will be displayed on the command window and the pesticide corresponding to the disease will be sent as a text message to the farmer.
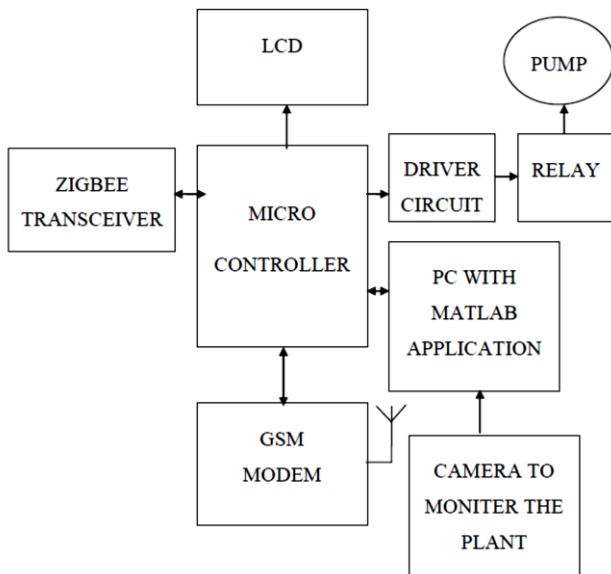
2. Hardware Block Diagrams

✓ **Wireless Sensor Unit (WSU)**
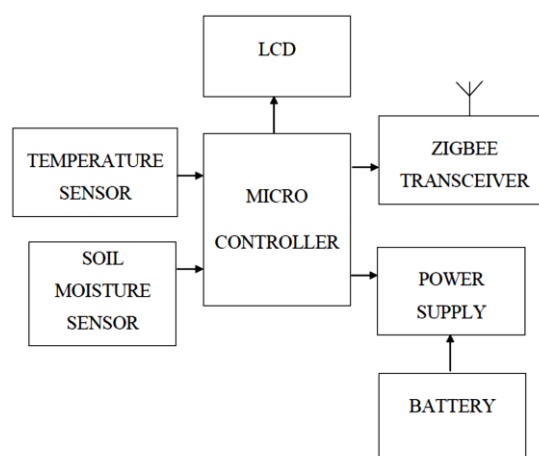
The above figure is a transceiver temperature sensor and soil moisture sensor. temperature of the soil and sends it to WI unit.

✓ **Wireless Information Unit**

The above figure is a transceiver system which consists of the camera unit and control circuit. It receives the moisture level and temperature from the WI unit. Processes the values and sent to the control unit to switch on the motor.

3. Block Description

✓ **Temperature Sensor LM35**

The LM35 series are precision integrated-circuit temperature sensors, 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 $\pm1⁄4°C$ at room temperature and $\pm3⁄4°C$ over 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.

The LM35 is rated to operate over a $-55°$ to $+150°C$

temperature range, while the LM35C is rated for a $-40°$ to $+110°C$ range $-10°$ with improved accuracy. The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

✓ **Soil Moisture Sensor**

The version we are building is very low tech, but it is also very cheap and easy to build. It consists of a block of packing foam with a couple of wires shoved into it. And the great thing is that it's possible to use reclaimed materials in much of it's construction.

If you cruise around the web, you will find many other types of soil moisture sensor some home-made, some commercial. If you want to read a breakdown of what's available and how things work, read the note on different types of soil moisture sensors below.

- Galvanized steel wire - 12 gage or equivalent.
- Packing foam block inside a product box for home electronics the slightly flexible kind is better (less brittle than styrofoam).
- Soldering iron and solder.
- Lead wires.

The general idea is that we want two probes - metal rods, kept about equal distance apart, that we can bury in the soil. We will need an electrically non-conductive material to help keep the rods in their fixed position. And we will also want the probes to be insulated everywhere except where we want to take a reading.

When you bury the moisture sensor, you may want to bury a soil temperature sensor also as the reading from this sensor is affected by temperature. It can adjust this sensor by changing the resistor that makes up the other part of the voltage divider.

4. Software Description

✓ **SOFTWARE TOOLS**
MPLAB
MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for

various Microchip devices

MPLAB IDE is a Windows based Integrated Development Environment for the Microchip Technology Incorporated PIC microcontroller (MCU) and dsPIC digital signal controller (DSC) families. In the MPLAB IDE, you can:

- Create source code using the built-in editor.
- Assemble, compile and link source code using various language tools. An assembler, linker and librarian come with MPLAB IDE. C compilers are available from Microchip and other third party vendors.
- Debug the executable logic by watching program flow with a simulator, such as MPLAB SIM, or in real time with an emulator, such as MPLAB ICE.
- Program firmware into devices with programmers such as PICSTART Plus or PRO MATE II.
- Find quick answers to questions from the MPLAB IDE on-line Help.

In this paper the mplab is used to create a program and interface the PIC microcontroller along with the sensors and camera which output is taken as the input for the system.

MATLAB is an interactive software package which was developed to perform numerical calculations on vectors and matrices. Initially, it was simply a Matrix Laboratory. However, today it is much more powerful.

- It can do quite sophisticated graphics in two and three dimensions.
- It contains a high level programming language (a "baby C") which makes it quite easy to code complicated algorithms involving vectors and matrices.
- It can numerically solve nonlinear initial value ordinary differential equations.
- It can numerically solve nonlinear boundary value ordinary differential equations.
- It contains a wide variety of toolboxes which allow it to perform a wide range of applications from science and engineering. Since users can write their own toolboxes, the breadth of applications is quite amazing.

Mathematics is the basic building block of science and engineering, and MATLAB makes it easy to handle many of the computations involved. MATLAB is not another complication programming language, but is a powerful calculator that gives access to exploring interesting problems in science, engineering, and mathematics.

And this access is available by using only a small number of commands and function because MATLAB's basic data element is a matrix or an array. This is a crucial feature of MATLAB it was designed to group large amounts of data in arrays and to perform mathematical operations on this data as individual arrays rather than as groups of data. This makes it very easy to apply complicated operations to the data and make it very difficult to do it wrong. In high-level computer languages we would usually have to work on each piece of data separately and use loops to cycle over all the pieces. In MATLAB this can frequently do complicated things in one or a few statements and no loops.

In addition, in a high-level language many mathematical operations require the use of sophisticated software packages, which we have to end and, much worse, to understand since the interfaces to these packages are frequently quite complicated and the documentation must be read and mastered. In MATLAB, on the other hand, these operations have simple and consistent interfaces which are quite easy to master.

For this paper the MATLAB is used to get the images from the camera or recorded images as input and process those images in order to find the disease by using cluster analysis and support vector matrix. After analyzing and categorizing the disease affected to crop will be found by comparing the result with the pre recorded images. Thus found disease and its prescribed pesticide will be sent as a message to the farmer and to the nearby agronomist. this helps the farmer to immediately respond over the threats to the crop.

III. RESULTS AND DISCUSSION

HARDWARE RESULTS

MOISTURE LEVEL IN DRY SAND

Figure 1. Evaluating Dry Soil Moisture

Figure 2. Displaying Result

In the above two assessments the soil moisture of the soil at dry condition is evaluated and displayed.

MOISTURE LEVEL IN WET SAND

Figure 3. Evaluating Wet Soil Moisture

Figure 4. Displaying Result

In this analysis some amount of water is added to the soil and then it is evaluated, now the moisture level is 84 and it is displayed in the LCD display.

TRANSMITTER AND RECEIVER MODULE

Figure 5. Transimitting the moisture level

In the above figure the analysed moisture and temperature levels are transmitted to the reciever for analysing the moisture level of the field and and the motor is switched on based on the prescribed lebel of moisture.

In the below figure the default setup is given based on the tomato crop and its growing condition. For tomato crop the water level requied is minimum 40 to 80 percentage. So if the soil moisture sensor senses that the moisture level is below 40-80 then the signal will be sent to the reciever side and the motor will be switched on.

MOISTURE LEVEL OF VARIOUS CROPS

Table 1. Moisture levels

CROPS	MOISTURE LEVEL
BEANS	60-85
CARROT	45-85
CORN	60-90
ONION	50-95
TOMATO	60-85

EXPERIMENTAL VERIFICATION

Figure 6. Verification for Tomato Crop
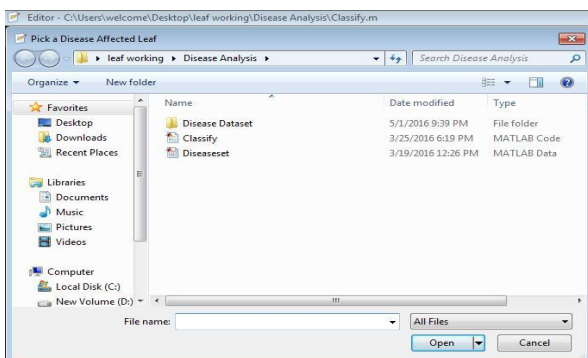
SOFTWARE RESULTS

✓ **Disease Analysis**

Figure 7. Selecting image for analysis

The image for analyzing should be selected from the folder then the selected image will be opened in matlab tool as shown.
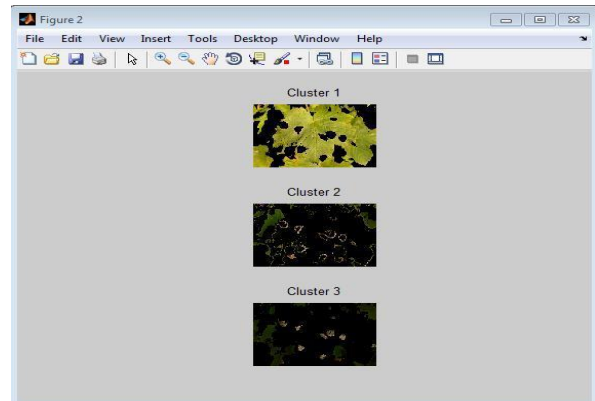

Figure 8. Selected leaf image

Figure 9. Cluster Analysis

Thus selected image will be converted from RGB color space to luminosity and chromaticity layers. Then based on the colors clustering is done. In this three clustering is done as cluster 1, cluster 2 and cluster 3. The clustered image shows the affected parts as shown above.
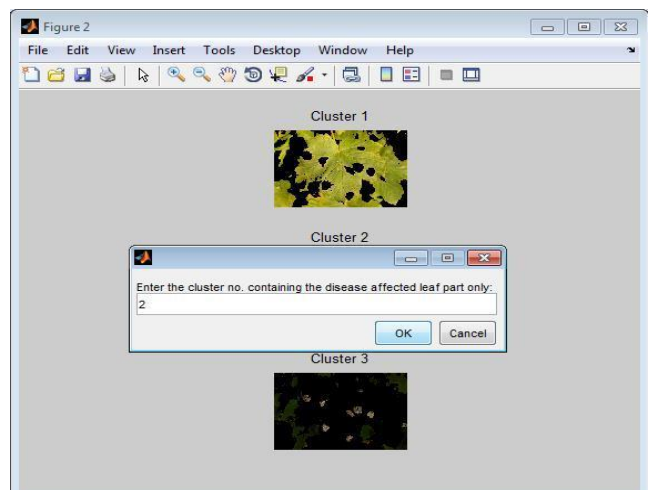

Figure 10. Selecting Type of Cluster

After displaying the clustered images a dialog box will open by asking us to enter the cluster number of the leaf part which is affected. The disease affected cluster part will be entered as shown above.

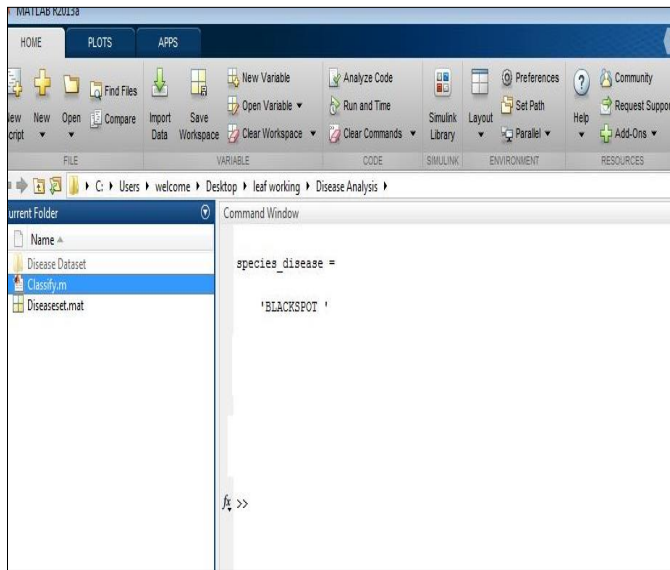After selecting the cluster number the disease corresponding to that will be displayed in command window.

Figure 10. Corresponding disease

Once the disease is found, the pesticide for that corresponding disease will be sent as an text message to the former.

Figure 11. Screen shot of received message

IV. CONCLUSION

The work presented in this paper proposes a remote monitoring solution to provide farmers with high level, low cost assistance to accelerate the efficiency of their cultivations, improving the environmental sustainability of the whole process and the quality of the production. The technological platform, the agronomical result, and the economical outcome were evaluated and validated on a lower scale. The next step will involve a large scale set-up in a real Developing scenario. Currently I have chosen tomato crop for complete analysis of the project. The moisture level for the crop is set and pump is controlled such it is automatically switched on and off when the water level goes down. Continuous surveillance will be made in the field and will be recorded. Here for the convenience pre-recorded images is analysed to find any infectious affect to the crop. Thus classified disease and pesticide is sent as text to the farmer.

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