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Farm Field Monitoring and Fruit Detection System Using LabVIEW

Balakumar.B, Divya.R, Gayathri.N.K*, Janarthanan.S
Department of Electronics and Communication Engineering
K.S.Rangasamy College of Technology, Tiruchengode, Namakkal
*Mail.id: gayathri01.gayu@gmail.com

Abstract* -This project is designed for farm field monitoring system that assists the farmer in analyzing the farm conditions. In addition to monitoring the field, this project is used to detect the maturity of fruit and gives alert message to the farmer. Our system aims at automating the agricultural field processes, by assisting to the farmers a portable and easy tool to use that will automate the various processes that the farmer does in the field. To the above mentioned problem, we propose a remote controlled tool equipped with a system of wireless camera, whose operation will be controlled by LabVIEW to make easier the task of the farmer by using the various tools. This LabVIEW based station processes the acquired images with sensor values and gives results such as the temperature, the soil moisture, fruit maturity, etc. The mechanism for assuring an accurate temperature, humidity and soil moisture, the LabVIEW station transmits the various data that it has acquired from the farm, to the farmer.

Keywords— Agricultural automation; LabVIEW; Field monitor; Fruit Detection

I. INTRODUCTION

With the world's population growing day by day, and land resources remaining unchanged, there is a growing need in optimization of agricultural productivity, and this passes by automation of agriculture. Land preparation, harvesting, threshing and irrigation are the operations, which utilize most of the energy used in agriculture. Irrigation water is becoming a scarce commodity. Thus proper maintenance and efficient utilization of water is of great importance. Automating the maintenance process is of high importance. In agricultural field human labors are required to monitor the farm and plants. Some plants require 24 hours care and attention from the human labor for the quantity and quality management of the productivity. Due to large farm field and lack of labors the maintenance of a farm is very difficult. This problem leads to fewer yields in the farm.

II. METHODOLOGY

Monitoring agricultural environment for various factors such as soil moisture, temperature and humidity along with other factors can be of significance. A traditional approach to measure these factors in an agricultural environment meant individuals manually taking measurements and checking them at various times. Our goal is to develop a system, with one end being a Senor and camera, and the other end being the LabVIEW end, with a module that performs the tasks of the famer such as monitoring the plants, analyzing the conditions of crops, and controlling the irrigation. To the above mentioned problem, we propose a module with sensors and a camera, whose operation will be controlled by LabVIEW to make easier the task of the farmer by using the various tools. The LabVIEW station transmits the various data that it has acquired from the farm to the LabVIEW application, which the farmer can monitor using his android, and from which he can enable some actions remotely such as to monitor sensor values, detect fruits, etc.

III. HARDWARES USED

A.Temperature Sensor

LM35 is a precision IC temperature sensor with its output proportional to the temperature (Celsius).with LM 35 temperature can be measured accurately than with a thermistor. It also possess self-

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heating and does not cause more than 0.1 temperature rise in still air.

Features of Lm35

- It has an output voltage that is proportional to the Celsius temperature.
- The scale factor is .01V/^{o}C
- The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ^{o}C at room temperature and +/- 0.8 ^{o}C over a range of 0 ^{o}C to +100 ^{o}C.

B.Soil Moisture Sensor

Soil measure sensor measures the volumetric water content in soil. Since the direct galvanometric measurement of free soil moisture requires removing, drying and weighing of a sample soil moisture sensor measures the volumetric water content indirectly by using some other property of the soil such as electrical resistance, dielectric constant or interaction with neutrons as a proxy for the moisture content. [5] proposed a system about Efficient Sensor Network for Vehicle Security. Today vehicle theft rate is very high, greater challenges are coming from thieves thus tracking/ alarming systems are being deployed with an increasingly popularity .

Features of Soil Moisture Sensor:

- Operating voltage: 3.3V~5V; Dual output mode, analog output more accurate; A fixed bolt hole for easy installation
- With power indicator (red) and digital switching output indicator (green); Having LM393 comparator chip, stable
- Interface Description(4-wire); VCC: 3.3V-5V; GND: GND
- DO: digital output interface(0 and 1); AO: analog output interface

C. Humidity Sensor

The DHT11 is a basic, ultra low-cost digital humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).

Features of Humidity Sensor:

- Low cost
- 3 to 5V power and I/O
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

D. Water Level Sensor

A float sensor is a device used to detect the level of liquid within a tank. The switch may be used in a pump, an indicator, an alarm, or other devices. Magnetic float sensor is an electromagnetic ON/OFF switch. It helps to sense the level of water present in the overhead tank or sump.

Features of Water Level Sensor:

- No electrical contact with water.
- Shock proof
- Corrosion free and rust free
- Sensor with 1.5 meter cable

E. NI-DAQ

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software. Compared to traditional measurement systems, PC-based DAQ systems exploit the processing power, productivity, display, and connectivity capabilities of industry-standard computers providing a more powerful, flexible, and cost-effective measurement solution.

F. LabVIEW

National Instruments LabVIEW is a graphical programming platform that helps engineers scale from design to test and from small to large systems. It offers unprecedented integration with existing legacy software, IP, and hardware while capitalizing on the latest computing technologies. LabVIEW provides tools to solve today's problems—and the capacity for future innovation—faster and more effectively.

Performance

LabVIEW tends to produce applications that are slower than hand coded native languages such as

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C, although high performance can be achieved when using multi-core machines or dedicated toolkits for specific operations. LabVIEW makes multi-core programming much simpler than many other languages, due to its implicit parallelism and automatic thread management

Interfacing to devices

LabVIEW includes extensive support for interfacing to devices, instruments, cameras, and other devices. Users interface to hardware by either writing direct bus commands (USB, GPIB, and Serial) or using high-level, device-specific, drivers that provide native LabVIEW function nodes for controlling the device.

LabVIEW includes built-in support for NI hardware platform such as CDAQ and CRIO. The Measurement and Automation eXplorer(MAX) and Virtual Instrument SoftwareArchitecture (VISA) are the toolsets.

G. *Camera Input*

A webcam can be used as an input to capture images. The USB based webcam can be given as input to the RIO system or DAQ to obtain the images of the system. The obtained images are fed to the LabVIEW program for identifying the fruits based on the classification required.

IV. BLOCK DIAGRAM

The block diagram of the field system is shown in the figure below:

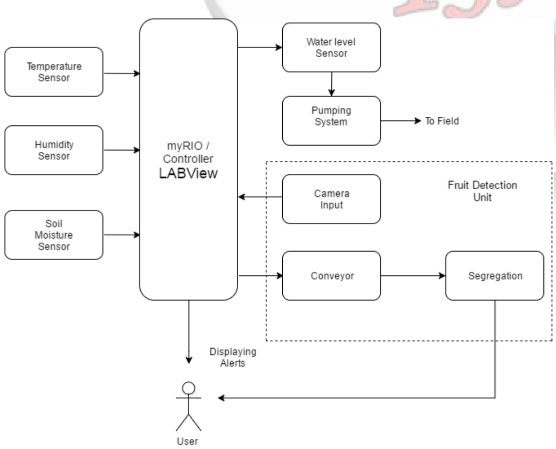

Figure 1 Block Diagram for the Farm Field Monitoring and Fruit Detection System

V. EXPLANATION

The value of the temperature, Humidity, Soil moisture is recorded from their respective sensors namely Temperature Sensor, Soil Moisture and Humidity Sensors. The collected values are fed to the NIDAQ module. The module is preprogrammed using LabVIEW for recording these input data from the environment. Ideally, the range of these sensors should be under normal conditions for the proper irrigation. If any of these values exceed or go below the predefined range then the user should have to be given alert messages. These alert messages can be given through NI Data Dashboard application or through PC. If the soil goes dry water is sprinkled. The condition of the soil (dry or wet) can be detected from the values of the soil moisture sensor.

A. *Sensor and Pumping System*

A small water tank is attached to the system so that water is sprinkled whenever needed. Also a water level sensor is also placed so that if the tank level goes low it alerts the user to refill the tank up to the maximum level. The voltage to temperature conversion formula is given by,

temp = (5.0 * analogRead(tempPin) * 100.0) / 1024 -- (1)

The range of the temperature of soil for an ideal agricultural environment range is from 10^{o} C to 15^{o} C. The dry and wet condition of the soil is determined by the soil moisture sensor. If the voltage of the soil moisture sensor is above 5V then the soil is a dry soil and if the value of the sensor goes below 3V then the soil is a wet soil. From this the condition of the soil can be monitored for ideal irrigation purpose.

B. *Standalone System*

The current work monitors the farm field using the sensors and updates the results to the end user. This system however is not a standalone system as it requires the support of the PC and DAQ to collect the data, process it and display the results to the user. Thus this system should be made to work without a PC so that it can be installed on a remote location and monitored on some other location. This can be done by either implementing the system in a controller or myRIO which is a NI module supported by LabVIEW.

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C. *Fruit Detection System*

The fruit detection is to be done on a separate module. It consists of a camera unit, Conveyor and a segregation part as shown in figure 1. The input of the camera is fed to the main controller system. The Conveyor is controlled by the system based on the input received from the camera. If a fruit from the Conveyor is identified as a mature fruit then it is left to go. Else the fruit is separated from the conveyor using the Segregation unit. Finally from a group of fruits matured fruits are detected and separated.

VI. SIMULATION RESULTS

Images Of Field Monitoring System

The field parameters for the system are simulated using LabVIEW software and tested. The result and images for the simulated system is shown below for temperature, Humidity, Soil Moisture and Water pump system in Figure 2, 3 and 4.

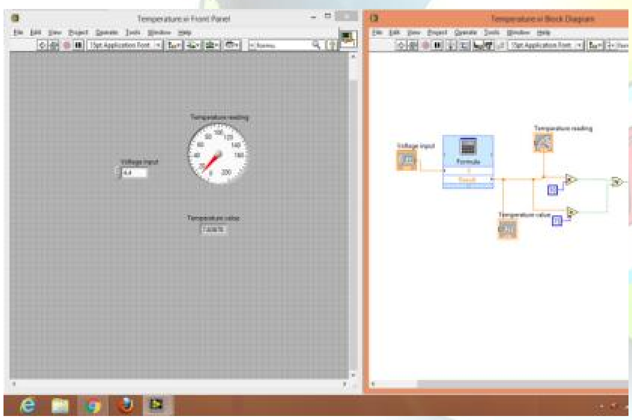

Figure 2 Front Panel and Block Diagram of Temperature Module

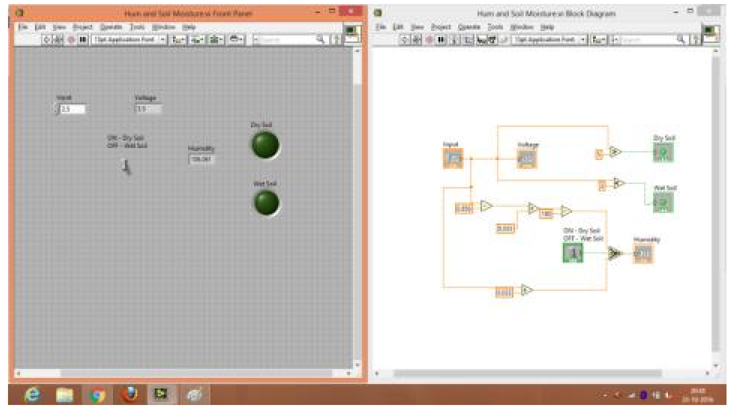

Figure 2 Front Panel and Block Diagram of Humidity Module

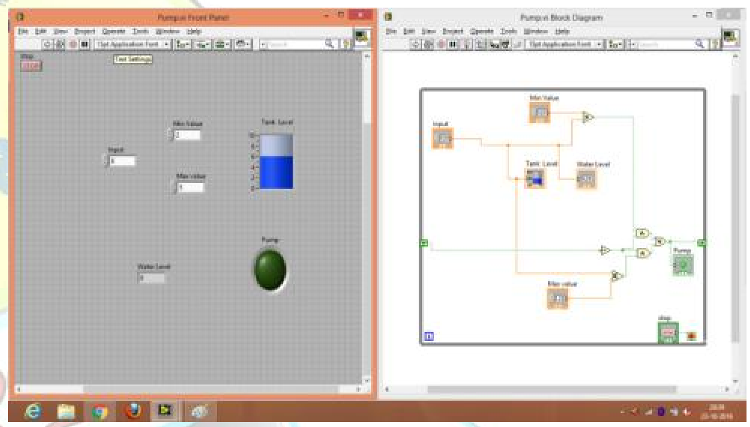

Figure 4 Front Panel and Block Diagram of Water Pump Module

VII. CONCLUSION

This system improves the way agriculture is done all over the world and help the farmers to save money, time and energy by doing some of the tasks he usually does, or for which he needs workers. This system may provide real time situation of the farm in an accurate manner to the famer's mobile, thus helping the farmer to be aware of the condition of the crops and plants, whether they have been infected by any insects, whether the soil condition is good, etc. This system also gives to the farmer a tool to activate the spraying of fertilizer and pesticides, to harvest fruits, to control the irrigation process by recycling used water, to remove unwanted elements and other dirtiness from the ground, and finally to manage the usage of power.

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