Agricultural Robot Can Be Controlled and Monitored Through the LABVIEW

K. Subbulakshmi and A. Geetha

Department of Electronics and Communication Engineering,
Bharath University, Chennai, India

Abstract: This paper explains the microcontroller based fuzzy controller for an agricultural robot which can be used to plough the field, seeding and soil moisture sensing. By using the agricultural robots in field which can be used to reduce manpower and can be operated using remote controls from a distant place. In this paper, an agricultural robot is designed with an internet based remote control by using LAB VIEW and its position and speed control are discussed. Fuzzy controller is designed to change the steering angle and the speed of the robot according to the desired reference position. The control was implemented using Atmega16 Microcontroller and the results are documented. The Robot control is implemented from a remote place using internet and web publishing tool in LabVIEW. Thus this agricultural Robot control reduces the manpower and becomes advantageous and cost-effective. In existing they are using RF technology for transmitting and receiving purposes. But RF module operates at 433.92 MHZ. and it can transmits the information about a single robot. This is is one of the main disadvantages in existing system. so only GPRS technology is proposed to overcome this problem. By using the GPRS transmission of data is very fast,long distance communication and transmits the information about multiple number of robots.

Key words: LABVIEW · GPRSModem · Sensors (LDR,CO2,IR) · ATmega16 Microcontroller

INTRODUCTION

Many methods exists for plough the field. Earlier days using Cattle to plough the field and after that tractor is used for this application. For Seeding more man power is required and also it is a slow process. The distance between the seeds depends upon the person who is doing that work. Now days we are using special tools for these applications. During irrigation, farmer supply water to the crop, the moisture content of soil may vary depends on the season. It will affect the crop and it results to reduction in overall quality of output crop [1].

To overcome all these difficulties by using the Agriculture robot, this robot consists of a ploughingtool, seed box and soil moisture sensor. The robot is controlled through LabVIEW software. Remote control real-time processes are getting considerable attention in the academic, industrial communities used in process control applications.

Related Works

Masoud Naghedolfeizi, Sanjeev Arora and Singli Garcia, Survey of Lab YIEW Technologies for Building Web/Internet-Enabled Experimental Setups", Proceedings of American Society: This paper presents a survey of Web/Internet-enabled technologies to build experimental setups that can fully be operated,controlled and monitored remotely. This paper discusses the major methods of interfacing LabVIEW applications with theInternet/WWW that could be employed for remote operation of experimental setups [2].

Disadvantages: The user cannot interact with the Virtual Instrument.

A relatively notable slowdown in the execution of application may occur if a large number of users co-currently access the application.
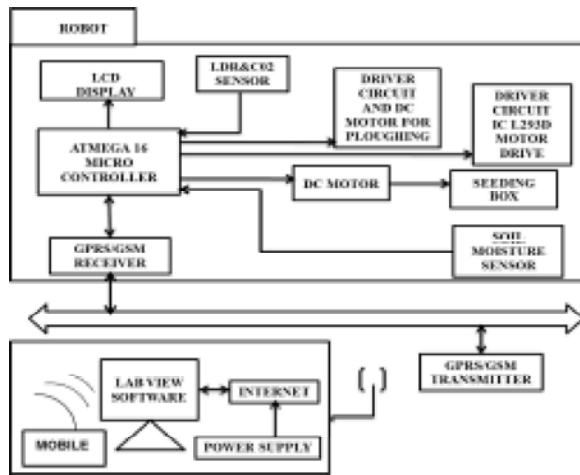
Corresponding Author: K. Subbulakshmi, Department of Electronics and Communication Engineering,
Bharath University, Chennai, India.

Fig. 1: Block Diagram of the proposed system

Autonomous Agricultural Robot and Its Row GuidanceXUE Jinlin1, XU Liming2: A vision-based row guidance method is presented to guide a robot platform which is designed independently to drive through the rowcrops in a field according to the design concept of open architecture. Then, the offset and heading angle of the robot platform are detected in real time to guide the platform on the basis of recognition of a crop row using machineheaccuracy of rowguidance is up to ± 35mm, which means that the robot can movewith a sufficiently high accuracy [3].

Disadvantages: Design is complex.

Verification of aWeeding Robot "AIGAMO-ROBOT" for Paddy FieldsTeruaki Mitsui, Takahiro Kobayashi, ToshikiKagiya, Akio Inaba, and Shinya Ooba: Increased public interest in food safety and clean agriculture is driving a production system change from dependence on and use of agrochemicals toward their elimination. However, this raises a huge time- and labor-consuming problem with weeds. The weeding robot "AIGAMO-ROBOT"we propose decreases weeds in paddy fields without resorting to herbicides [4].

Disadvantages:

Not compatibility
High cost

Proposed Syste: Figure 1 shows an agricultural robot is treated as server system, internet connection and assigned static IP address. The client system can be any

PC with internet connection. The system is composed of monitoring terminal, data transmission networks and monitoring center. Monitoring center server is provided with a fixed IP address. The system of data transmission network is formed by GPRS network and the Internet, which is the data transmission channel between the monitoring terminal and monitoring center, monitoring terminal on which integrates GPRS communication module collects the operating data of AgriRobo through the transmitter of field meter [5-7].

The GPRS communication module controlled by microcontroller sends the data to monitoring center via GPRS wireless network. A 16x2 LCD means it is an ALTRONIC alphanumeric 16 character, 2 line dot matrix liquid crystal display. This is used to sense the obstacle range up to 5cm, it requires 5V power supply. The LCD Display is used to display the functions like soil moisture level, robot motions [8-11].

At the boundaries of field obstacles are placed. When the IR sensor senses the obstacles the set speed of the motors are changed by the control to change its directions either left or right side alternatively.

The designed FLC was then implementedmicrocontroller. The fuzzy controller will attempt to reduce the error to zero by changing duty cycle of switching signal.speed and steering angle is controlled by using fuzzy controller.

Mathematical Modelof DC
Motor: In any electric motor operation is based on simple electromagnetism. A current carrying conductor generates a magneticfield; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor. The stator is stationary part of the motor, this includes the motor casing as well as two or more permanent magnet pole pieces. The rotor consists of windings which is electrically connected to the commutator.

The simulation and design of the controller was done using equation models of the motor and H-bridge converter. The DC motor has been modeled with the following equations. By Krichoffs law

$$I_a R_a + L_a dia/dt + e_b = V_a \qquad (1)$$

$$T = K_t J_a \qquad (2)$$

$$J \, d^2\theta/dt^2 + B \, d\theta/dt = T \qquad (3)$$

$$e_b = K_b d\theta/dt$$

where

I$_a$ - Armature current
V$_a$ - Armature voltage applied
R$_a$ - Armature resistance
L$_a$ - Armature inductance eb -Back Emf
J - Moment of Inertia of the motor B - Friction coefficient of the motor
K$_t$ - Torque constant of the motor K$_b$ - Motor back emf constant
T - Torque developed by motor e - Angular displacement of shaft
W - Angular velocity of the shaft

Fuzzy System: Fuzzy Logic (FL) is a multivalued logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc.

The steering angle and the driving speed of Robot are controlled by using DC Motors simulation module. Control logic is developed to decide the direction of Robot movement based on the starting position and current position values of the Robot.

The actual speed is fed back and is compared with the reference speed. After comparison, the error and the change in error are calculated and are given as input to fuzzy controller.The fuzzy controller will attempt to reduce the error to zero by changing duty cycle of switching signal [12].

The control algorithm of a process that is based on fuzzy is defined as fuzzy control. The controller which uses control based on fuzzy is called as fuzzy controller.

It tends to mimic human thinking which is fuzzy in nature.fuzzy set theory based on fuzzy , a particular object has a degree of membership in a given set that may be anywhere in the range of 0 to 1.

Fuzzy Controller: Fuzzy control is derived from fuzzy set theory introduced by Zadeh in 1965. In fuzzy set theory, the transition between membership and non-membership can be gradual.. Fuzzy controller (FLC) is an attractive choice when precise mathematical formulations are not possible. Other advantages of FLC are

- It can work with less precise inputs.
- It doesn't need fast processors.
- It is more robust than other non-linear controllers.

Fuzzification: Fuzzy uses linguistic variables instead of numerical Variables. The process of converting a numerical variable (real number) into a linguistic variable (fuzzy number) is called fuzzification.The seven linguistic variables used for 'error' and 'change in error' are negative big (NB), negative medium (NM), negative small (NS), zero (Z), positive big (PB), positive medium (PM) and positive small (PS).

Constructing a fuzzy controller steps are

- Create a membership values
- Specify the rule table.
- Determine the procedure for defuzzyfying the result.
- Membership values

First step is to fuzzify the data or create membership values for the data and put these in to the fuzzy sets.each set of data is to divide in to ranges.X is used to determine the arbitrary range and Y is used to determine the range of 0 to 1.(theoretically 0 to 100%).

Defuzzification: The reverse of fuzzification is called defuzzification. The Fuzzy controller (FLC) produces required output in a linguistic variable (fuzzy number). According to real world requirements, the linguistic variables have to be transformed to crisp output.

The error is calculated by subtracting reference speed from the actual rotor speed as follows:

e1 [n] =s[n] - a[n]

where e[n] is the error, s[n] is the reference speed, and a[n]is the actual motor Speed. The change in error is calculated by above Equation where e[n] is the previous error value.

e2 [n] =e1 [n] - e1 [n-1]

In the fuzzy logic control system, two normalization parameters for input and output are defined. In normalization Process, the input values are scaled between (-1, +1) and in the de-normalization process, the output values of fuzzy controller are converted to a value depending on the terminal control element [13].

Fuzzy l ogic differs from traditional Boolean logic in that fuzzy logic allows for partial membership in a set. It can use fuzzy logic to control processes represented by subjective, linguistic descriptions. A fuzzy system is a system of variables that are associated using fuzzy logic. A fuzzy controller uses defined rules to control a fuzzy system based on the current values of input variables.

Table 1: FUZZY RULES

CE/E	NB	NM	NS	Z	PS	PM	PB
NB	NB	NB	NB	NB	NM	NS	Z
NM	NB	NB	NB	NM	NS	Z	PS
NS	NB	NB	NM	NS	Z	PS	PM
Z	NB	NM	NS	Z	PS	PM	PB
PS	NM	NS	Z	PS	PM	PB	PB
PM	NS	Z	PS	PM	PB	PB	PB
PB	Z	PS	PM	PB	PB	PB	PB

Rule Table and Inference Engine: The rules are in the following format: If error is Ai and change in error is Bi then output is Ci. Here, if "part" of a rule is called the rule-antecedent and is a description of a process state in terms of all combination of atomic fuzzypropositions the "then" part of the rule is called the rule consequent and is a description of the control output in terms of al combinations of fuzzy propositions. This rule table corresponds to Fuzzy PI controller [9]. The rule table for the designed fuzzy controller is given in Table 1. From the rule table , the rules are manipulated as follows. If error is NB, and change in error is NB then output is NB.

The Web Publishing Tool is used to create an HTML document and to embed a front panel in an HTML document so a client computer can view and control the front panel remotely. By Using the Snapshot option is to return a static image of the front panel of a VI currently in memory on the server computer. The Monitor option is used to return an animated image of the front panel of a VI currently in memory on the server computer. Embedded option is to embed a front panel in an HTML document so a client computer can view and control the front panel remotely. The front panel of the VI to be published might be large. It takes the Web Server longer to create a large image, which can slow the execution of the VI. Therefore the front panels of VIs used to publish are reduced to a reasonable size [14].

System Implementation: The entire control was implemented practically using atmega16 microcontroller and DC Motor Controller Trainer. Fuzzy Controller with the H-bridge converter was tested on the DC Motor. The AT89CS1 microcontroller is made up of Atmega16's high density non-volatile memory technology and incompatible with the industry standard MCS-S1 instruction set and pin out. Atmega16 is a high performance CMOS 8bit microcontroller with 4k bytes of flash memory (PEROM). It requires less power. It is combination of a versatile 8-bit CPU with flash on a Monolithic chip. It is a powerful microcontroller; it provides a more flexible and cost effective solution to many embedded control applications.
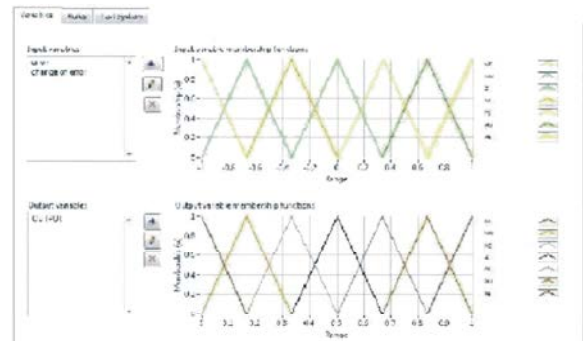

Fig. 4: Fuzzy membership functions
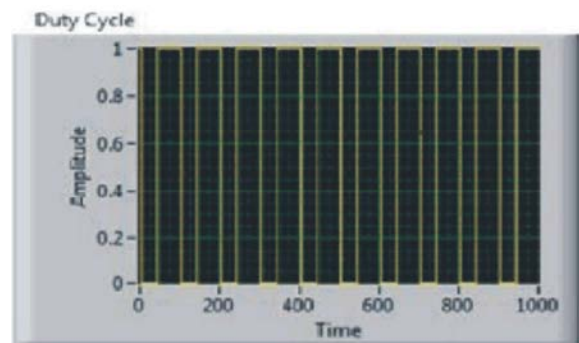

Fig. 5: Response of motor set speed 235rpm

Fig. 6: Graph for PWM waveform generated by the micro-controller for duty cycle of 0.4

RESULTS AND CONCLUSION

Using LabVIEW, the designed fuzzy controller was tested. The simulation results were compared and verified by Real time implementation. The simulated graph of speed of the motor for a set speed 23S rpm is given in figure S. The speed regulation using fuzzy controller was implemented and verified in this [15-16].

Fuzzy controller was implemented in Atmega16 microcontroller by using LabVIEW Embedded Toolkit. The Figures 6 and 7 show the PWM waveform generated
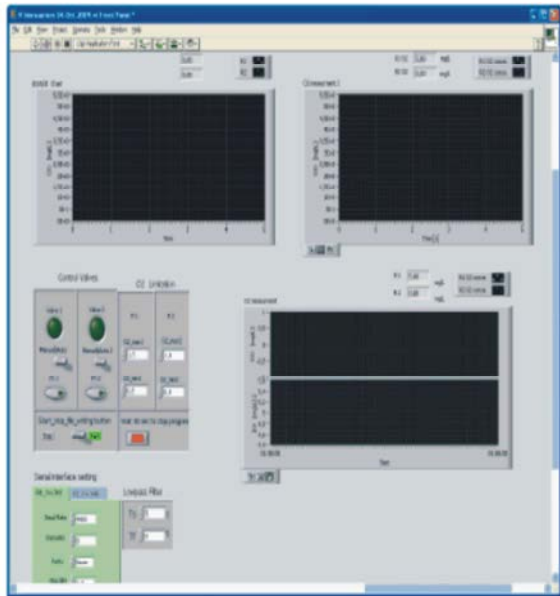
Fig. 7: Graph for PWM waveform generated by the micro-controller for duty cycle of 0.8
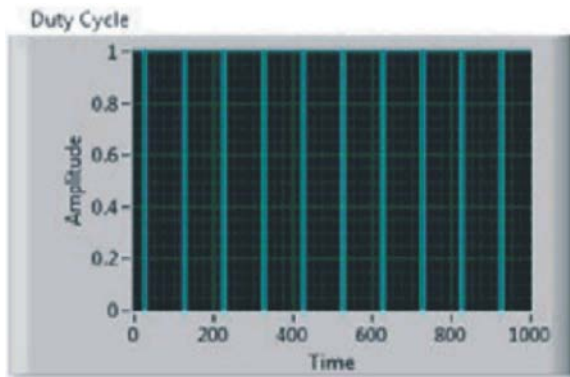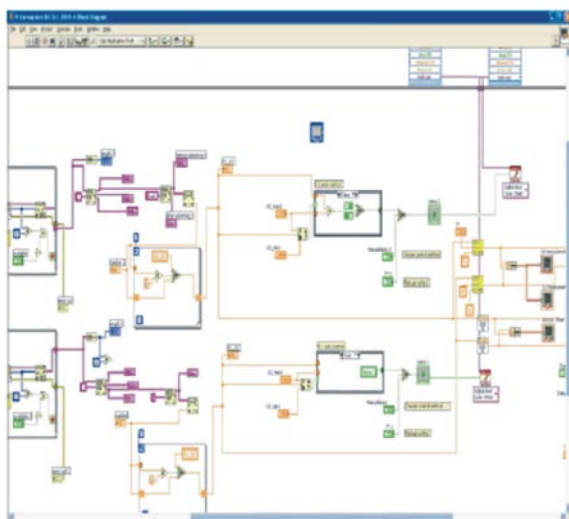

Fig. 8: Interfacing of AgriRobo with LABVIEW

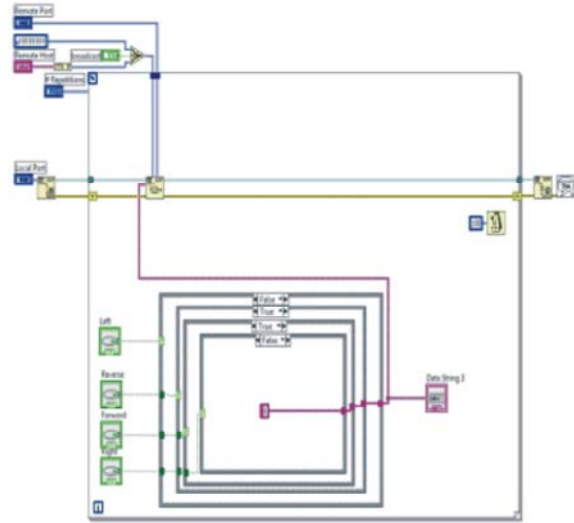Fig. 9: Schematic Representation of Agri Robot

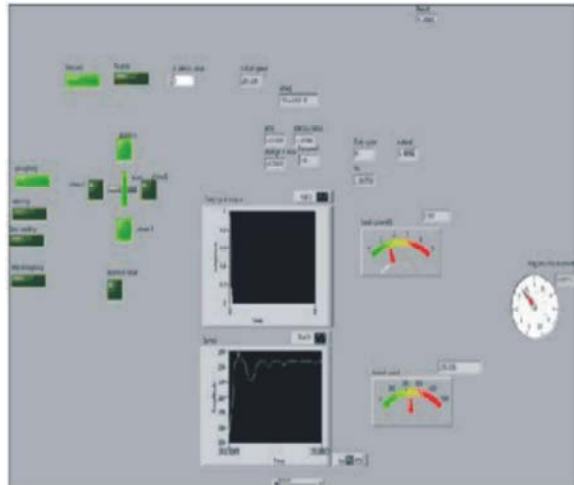Fig. 10: Block Diagram of the Agricultural Robot

Fig. 11: Front Panel of the Agricultural Robot

by the microcontroller unit for two different duty cycles. The dynamic response of the dc motor speed variation with fuzzy controller was tested and found to be giving satisfactory results.

The LabVIEW Embedded toolkit has the advantage of reduced cost, increased performance and reduced time to implement the design. The conventional control needs design objectives such as steady state and transient characteristics of the closed loop system to be specified. But fuzzy control overcomes the problems with uncertainties in the plant parameters and structures encountered in the classical model based design.

Simulation: The simulation of control for Ploughing and seeding, steering angle and driving speed control of an autonomous agricultural Robot is done based on equation

modeling technique in LabVIEW. The ploughing and seeding VI consists of stepper motor simulation. When ploughing task is selected phase 2 and phase 4 will energize then stepper motor will rotate 90 degrees. Seeding task is selected phase 2 and phase 4 will energize and also solenoid valve will open.

Agriculture robot VI consists of dc motor, fuzzy control and H Bridge. Two DC motor is used for direction control. If robot is moving in forward direction motor will rotate in maximum speed, for moving right side one DC motor will rotate in maximum speed and other will become zero.

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