MR999-E Wireless Robotic Arm

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ABSTRACT

MR-999-E is a robotic arm that has five separate movements to grab or release, lift or lower, rotate wrist and pivot sideways controlled by five servo motors. For the time being it has been used as a trainer in the university lab. A physical wire from the controller to the interface of the robotic arm contributes its major movements. This paper is to describe a new approach from wired to wireless technology added with Graphical user Interface (GUI) application to make it more user-friendly. The transmitter will be connected to the computer whereas the receiver will be connected to the robotic arm interface. In the GUI, the robotic arm is modeled using SolidWork 2005 software and implemented into Visual Basic environment. As a result, real-time and simultaneous movements from simulation to actual environment will be performed. All the movements have been calibrated to ensure that the transmission of data is correct. MR-999-E wireless robotic arm is one of the products that employ wireless technology to support applications such as remote monitoring and surgery.

Keywords:
Wireless Communications, Remote Monitoring, Robotic Arm

1.0 INTRODUCTION

'Right now, wireless is scarcely found in plant operations; in seven to ten years wireless will be everywhere and somewhere between all hell breaks loose.' This transition might follow an easier route, predicts' Ian McPherson (Ian McPherson is the current vice president of marketing at Apprion and founder of the Wireless Data Research Group) (Technical article). There is doubt on the importance of wireless technology in today's life which improves tremendously day by day. Controlling robots using wireless technology is one of the applications which have created interest in production lines to create more space and flexibility. The robots can move freely and work on difficult areas not accessible to human. For example NASA’s mission to Mars the Spirit and Opportunity drone and robot device. However, it is realized that several factors impede the rapid progress towards full scale implementation of wireless technology, namely deterioration of signal quality due to propagation effects such as attenuation and dispersion apart from electromagnetic interference from natural and man-made sources. It is important to understand the impact of these factors to the reliability of the system.

In this paper we discuss the implementation of controlling a robotic arm using wireless technology
as a first step towards understanding the performance of the system. We worked on a static robot and study the accuracy of the various functions that it can perform.

2.0 PREVIOUS WORKS

Rodriguez, N. E. et. al (2006) has adapted a remote operation system for a robotic arm by using infrared sensors to controls its movement. Visual Basic was developed to have a graphic interface. This project has a limitation where the infrared can only communicate in a short range. Joaquin Ortiz et. al. (2005) worked on a robotic arm that can distinguish a color for a golf ball using LabVIEW as a program to control the robot. However, LabVIEW becomes inefficient when designing complex control algorithm and this will affect the results of the system Francesco Mondada et. al (1993).

3.0 3.0 CONTROLLING THE ROBOTIC ARM

Figure 1 shows the overall setup of the robotic arm controlled by the personal computer via a wireless system.

The RF transmitter will receive the signals from the output which has been written in Visual Basic language via the interface unit between computer and the transmitter. The robot arm has some segments and each segment is tied with servo motor. There are 5 movements of the robot which comprises the BASE for horizontal, arms & shoulder for vertical movements and gripper.

Figure 2: The GUI for the Robotic Arm

Figure 2 shows the GUI for the robotic arm which consists of seven buttons to control the movement from the transmitter. This GUI has been designed using SolidWork 2005 whereby the moving part of each segment is written in Visual Basic. As in Figure 2, a phone icon indicates the MSCOMM which is crucial in any data transmission between the computer to the peripheral which employ RS232. The function of MSCOMM is to transfer data bit by bit and the PortOpen command is embedded inside the programming as shown below for error correcting code (ECC) feature:

If MSComm1.PortOpen = True Then
demo = 1
Else
demo = 0
MsgBox“No hardware Connection !” vbCritical, “Demo Mode”
End If
As in Figure 3, a scroll down menu appears right after the interface selection. Then, a dialog box opens to enter the communication (COM) port when connect is selected. Finally, the GUI is ready for operation as a interface.

4.0 TRANSMITTER AND RECEIVER DESIGN

(i) Transmitter Unit

VB and PIC Basic Pro have been chosen as the core programming language for this project. VB is used in the personal computer as an indication of the movement operation. It is easy to emphasize and the interfacing to the hardware is straightforward. PIC Basic pro was used in the interface unit and was simulated using MPLAB programming. The communication command between VB to the interface unit is shown below:

```
Case 0
lbl_status.Caption "BASE ROTATE " + str_direction
If str_direction = "clockwise" Then
    If demo = 1 Then MSComm1.Output = "2"
Else
    If demo = 1 Then MSComm1.Output = "1"
End If
```

VB will send the identification number to show the base rotation being move to clockwise and anti-clockwise position. Number 2 indicates the clockwise and 1 for anti-clockwise. These numbers will be triggered to the MSComm for the signal to be sent to the external interface. The numbers are transmitted in digital form and the interface unit will received it to be processed in the microcontroller. The PIC Basic Pro programming is used to process the signal by microcontroller as indicated below:

```
If receive = 2 Then
    Serout PORTB.2, T9600, ["Base_CW",10]
    PORTB = PORTB $20
```

The microcontroller, after receiving the number 2, will then send the number $20 to the transmitter via pin 2 on PORTB. The baud rate has been set to 9600 for the wireless transmission.

(ii) Receiver Unit

The function of this unit is to receive any information which was transmitted via the RF communication and to be processed before transmitting to the interface unit of the robotic arm. In the interfacing unit, the data will be processed by the microcontroller using the PIC Basic Pro language. The computer codes on how it accept the signal as follows:

```
If coun = %0010 then
    high portb.5
    pause 300
    low portb.5
End If
```

It shows that, upon detection of the number 2, a high value will be assigned to pin 5 in PORTB for 300 seconds and this will initiate the movement of the relevant part of the robotic arm. To move the arm, the button has to be clicked several times until it reached to the desired location as it will halt after 300 seconds on each click. A low value will be triggered to stop the action of the robot.

5.0 RESULTS

Figure 4 shows the transmitted signal which operates at 331.30 MHz. The receiver is designed to receive similar frequency using a monopole antenna.
Several tests were conducted to compare the accuracy of the actual and simulated movements of the robotic arm on the computer. The results proved to be successful where acceptable accuracy was achieved. Good and fast coordination between the actual and simulated movements are proved in this project can further be enhanced to commercialization stage.

The major problems of this project are noise and attenuation. Noise is undesired disturbance within the frequency band of interest; the summation of unwanted or disturbing energy introduced into a communications system from man-made and natural sources. Besides, noise is unwanted signal inserted somewhere between transmitter and receiver.

The drawback of this system is that, the arm would not rotate to the desired destination flawlessly. To reach its target, the button has to be clicked all the time frequently which contributes to the not user friendly system.

6.0 CONCLUSIONS

The MR 999-E robotic arm is a successful development. Going to wireless from wired is much easier with less hassle. PIC microcontroller is used to control the transmitting and receiving process. GUI is important for the user to communicate with the system. In conclusion, this project helps the user to choose the movement of the arm robot.

As the technology grows, the selection of the type of wireless system must be studied to see their ability when the robot is out of range. If a robot has GPS or another positioning technology, it might even build up a map of signal strength to identify network weak spots (Erik Zoltan, 2005).

REFERENCES


