



A Review on Real Time Ethernet Communication for Robotic Arm Application

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ABSTRACT

A real time Ethernet communication has become an important issue in electronics field regarding to various robotics applications. Nowadays, robots are increasingly being integrated into working tasks to replace humans specially to perform the repetitive task. These robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. So many researcher's have worked on different techniques with robotic arm application. In this context further review has been taken.

Keywords: *Ethernet, Robotic arm*

Introduction

Real time system is a system that produces instant output response within a specific amount of time without delay after receiving input signal. It has the advantages over the non-real time system because non real time systems do not produce immediate response and do not have accountability. Embedded communication network real time system is used in applications which require a set of synchronized data to be delivered in time and high response speed. Many field of application especially safety critical application use embedded communication network control to interact with real world due to flexible of designed system and less wiring complexity. Examples of safety critical application are military, robotics, medical, transportation system and avionics. Various types of communication control protocols which developed for network embedded real time system are used as a solution for communication problems. Currently, robots are increasingly being integrated into working tasks to replace humans especially to perform the repetitive task. Besides, it might be difficulties to the worker whose must pick and place something that can

affect itself. For example, things like chemistry that cannot be picked by human and for the military such as defuse bomb that needed robot to pick and place the bomb to somewhere and for user that needed robot to do pick and place item while sitting and much more. Therefore a locomotion robot can be replaced human to do work. The development of FPGA controller is necessary to achieve higher control performance on the robotic arm.

LITERATURE REVIEW

A. Mohamad Khairi Ishak, Ho Kar Hwai and Lee Kong Lam[1] proposed the control communication is successfully developed at high data transfer for real-time control communication to communicate with other controller device for robotic arm with Arduino board and FPGA board via Ethernet. Through this implementation, the ability to communicate safety data directly over an Ethernet/IP network is achieved. The practical test results have shown that the delay is reduced by 93.3% after the receiver in a communication system is changed from Arduino board to FPGA board. The result shows that the Ethernet communication with Arduino has less speed as compare to two FPGA board communication for robotic arm application.

B. V. Sirisha, V. Sachin Kumar[2] In this paper, the diligent features of embedded systems are introduced. It deals about how a robot is controlled using embedded operating system and ARM. Based on the combination of ARM, DSP and ARM Linux, the robot is controlled. The paper introduces development of embedded robot control system using

Wi-Fi and also IOT. The embedded control system design includes four aspects. i.e., system structure, functions, hardware design and software design. By using these aspects (hardware and software adjustments many robotic applications can be developed. Due to the fast execution speed and reasonable Ethernet speed in ARM processor, this system can be used in industrial oriented applications where there is very much necessity of safety and security.

C. Alen Rajan ,A. K. Thomas[3]

Embedded technology is one of the emerging technologies in this most modern era. When networking technology is incorporated with the former, there is no doubt that the scope of embedded systems would be further more. Here they have designed an embedded web server by interfacing ENC28J60 with LPC2148 ARM controller. Also a second web server is made with LPC1768 controller with an integrated Ethernet Interface. Industrial appliances that require continuous monitoring are interfaced to both the web servers. Also sensors are interfaced to monitor various parameters in the Industrial area. Analysis of the performance of both the web servers is done. Both the systems are suitable for a wide variety of Industrial Applications.

D. Li Yanhong^a, Li Shuliang[4]

The system is based on ARM embedded system as the main control circuit, the angle sensor is responsible for signal acquisition, software implement PID operation, the microprocessor outputs control command to drive motor, so that the whole system run smoothly and achieve the predetermined requirements. By practical testing, the system can realize the automatic adjustment and control, control precision and speed can reach the requirement. The system's hardware circuit is simple, software facilitate transplant, the whole system is stable, in the industry control and robot field has a certain reference value.

E. Mohd Ashiq Kamaril Yusoff^a, Reza Ezuan Samin^b, Babul Salam Kader Ibrahim[5]

This paper presents the development of a wireless mobile robot arm. A mobile robot that functional to do pick and place operation and be controlled by using wireless PS2 controller. It can move forward, reverse, turn right and left for a specific distance according to the controller specification. The development of this robot is based on Arduino Mega platform that will be interfaced with the wireless controller to the mobile robotic arm.

F. Chitra Venkatramani, Tzi-cker Chiueh[7]

They proposed in this paper the distributed multimedia with applications require performance guarantees from the underlying network subsystem. Ethernet has been the dominant local area network architecture in the last decade, and they believe that it will remain popular because of its cost effectiveness and the availability of higher- bandwidth Ethernets. They present the design, implementation and evaluation of a software-based timed-token protocol called rather that provides real-time performance guarantees multimedia applications without requiring modifications to existing Ethernet hardware.

G. Mohamad Khairi Ishak_, Guido Herrmann_, Martin Pearson[8]

In this paper, they constructed and simulated the original CSMA/CD protocol through Simevents-Matlab block. They created a time synchronized bus communication by taking inspiration from CAN open, i.e. packets are sent at given time And Linear Back off schemes of Ethernet in a random approach for the minimal back off time. They analyzed the effect of the back off time on the system performance, in terms of jitter and delay. The simulated test results have shown that the delay jitter can be reduced by choosing the correct back off time to be implemented in the MAC controller. The special assignment of the minimal back off times to each MAC unit allowed minimizing the packet transmission time jitter by up to 55%. The key results were that a Linear Back off scheme exhibits lower jitter and access delay than a BEB scheme. Linear Back off appears to be more deterministic. Our approach of an Ethernet network based communication system improves determinism at low cost.

H. Wan Muhamad Hanif Wan Kadira, Reza Ezuan Samin^b, Babul Salam Kader Ibrahim[9]

Overall, this project is divided into two major sections that are hardware development and software development. The hardware operations include the automation process of controlling servo motors and also develop the robotic arm link and joint. Software development consists of developing the web server and also programming the Arduino Uno .From the analyses that have been made, it was clearly shown that controlling a servo motor was quiet easy and the output was accurate. Thus, it was the right choice to choose servo motor for the actuator of the robot arm.

The purpose of this project was to show that robots not only restricted to industrial usage only but also suitable for household usage. Taking advantage of the widespread usage of internet connectivity nowadays, robots can be controlled via internet instead of a dedicated controller just for the robots. The main features of this robot is quite the same as . This project was successful and proved that robots can be controlled via internet and it is suitable for household usage.

I. Vaishak N. L, C.G. Ram Chandra

They have proposed that when the case of monitoring multiple parameters comes, the EWS with integrated Ethernet is showing better performance when speed and reliability comes into picture. Thus EWS with integrated Ethernet is suitable for real-time monitoring of Industrial appliances. Moreover this system has a wide variety of Industrial applications such as supervisory data control, Fault diagnosis, remote monitoring and controlling etc. Since ARM processor has fast execution capability and Ethernet standard can provide internet access with reasonable speed, this system is suitable for enhancing security in industrial conditions by remotely monitoring various industrial appliances where high safety and care is a necessity. There is no doubt that this system will be useful for a wide variety of industrial applications.

J. Rosidah Sam, Kamarul Arrifin[10]

This paper presents the design of pick and place robotics system using Solid works Soft motion software. The software is used to design a Cartesian robot and an articulated industrial robotic arm with different grippers. The robot was designed using the Solid works 3D CAD software to shorten the robot development time, and improve the speed and quality of the robot design. The Solid works 3D CAD software consist of four sections which is manual drawing, part module, assembly module and drawing module. Solid works software was chosen as it enables analysis and simulation of the pick and place industrial robotic arm design. The results of simulation Xpress study and motion study of the modelled articulated robot arm part and assembly are presented to demonstrate the pick and place robotics system. This project indicated that the Solid works Software is a suitable tool that enabled the design of a robotic system to be carried out in a short duration.

K. Mustafa Engin

In this paper presents the author's experiences using low-cost microcontroller evaluation board and a commercially available real-time operating system in the

laboratory component of an undergraduate embedded and real time system design course. This course covers both hardware and software topics in embedded and real time systems, and the course culminates in a final team-based design project to promote the students to study the building units of embedded and real time system, to achieve fundamental knowledge acquisition on embedded system, hardware and software design experiences, teamwork and problem-solving skills with the higher-order thinking.

L. Mohd Aliff, Shujiro Dohta

The purpose of this study is to develop the flexible and lightweight actuator and apply it into a flexible robot arm. In this paper, the master-slave attitude control and the trajectory control of the flexible robot arm are proposed. This robot arm has three degree-of-freedom that is bending, expanding and contracting and will be applied into a rehabilitation device for human wrist. The master-slave control system which is proposed in this paper is necessary when a physical therapist wants to give a rehabilitation motion to a patient. While the trajectory control system is necessary when a sequential rehabilitation motion is applied to a patient. In this paper, an analytical model of a flexible robot arm is proposed for master-slave attitude control and trajectory control. Then, a compact and inexpensive control system is developed and tested. The system consists of a flexible robot arm, a low-cost embedded controller, accelerometers and small-sized quasi-servo valves which are developed by using the on/off control valve in our laboratory. The results from these experiments demonstrate that the master-slave attitude control can be realized by using an accelerometer and a simple analytical model of the robot arm. The trajectory control also was realized for a square trajectory by using an analytical model and a compact control system. The error between the desired trajectory and measured one is relatively large compared with typical robot arm. This is because by a friction that is existing in a rod-less type flexible pneumatic cylinder. The control performance can be improved by reducing the friction or by improving the control scheme.

M. K.Bharath reddy, Ch. Rajendra Prasad

In the monitoring system, the existing resource of Ethernet is used to remotely monitor power network parameters. A practical design of embedded Web server for power network monitoring is introduced, which applies high speed MCU (ARM7-LPC2148) to

conveniently link to Ethernet. Adopting Ethernet interface control mode, the remote network monitoring of power network is realized under Windows. A web server in the device provides access to the user interface functions for the device through a device webpage. A web server can be embedded into any appliance and connected to the Internet so the appliance can be monitored and controlled from remote places through the browser in a desktop. The aim of the paper is to control the devices or equipment's from the remote place through a web page. The web-server circuit is connected to LAN or Internet. The client or a person on the PC is also connected to same LAN or Internet. By typing the IP-address of LAN on the web browser, the user gets a web page on screen; this page contains all the information about the status of the devices. The user can also control the devices interfaced to the web server by pressing a button provided in the web page.

In this system Ethernet communication is used to control the devices which are placed at the remote place by using LAN.

CONCLUSION

The review of various techniques for real time Ethernet communication for robotic arm applications are addressed here. By using different techniques for Ethernet communication, gives results of high speed and accuracy for sending data packets. As discussed in the review, the combination of Ethernet communication and ARM controller's techniques for robotic applications are found to be working efficiently. By studying all the techniques presented here if the comparison is made among available techniques, it can be observed that Raspberry-Pi controller can be used to obtain the maximum speed for the pick and place application of robotic arm.

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