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An Internet Controlled Robotic Arm Using an Android Mobile and FPGA Board

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Abstract: Internet and the smart phones especially android are the most common things used by people around the globe. Integration of this commonly used terms internet, android mobile and wireless technology can be used to develop a remote control robotic system. In this paper, we present the internet controlled robotic arm using the android mobile and fpga board. The robotic arm presented in this paper, with some fine tuning, can be used in many applications like internet based robot system, hospitals, control systems, etc. Wireless medium is the most popular medium of communication and is the future of all the technologies. The work presented in the paper is a step towards the future of the wireless robotic arm system.

Keywords: Android mobile, Bluetooth HC-05, Gripper, Robotic arm, Spartan 6.

I. INTRODUCTION

An internet controlled robotic arm is the application of the previously published paper wireless signal transmission using an Android mobile and FPGA [1]. An android mobile and Bluetooth interfacing is done in the work before which is extended in this paper [1]. The android mobile acts as the control panel for robotic arm. The robotic arm designed comprises of the gripper mechanism, wrist mechanism and arm rotation movement. Three servo motors are used for the three mechanisms. The use of servo motors gives us the liberty to rotate the motor in the specific angle by setting the PWM value. The servo motor operates on the 5V only hence the power consumption is also low.

The idea is to control the android mobile remotely using the laptop with the internet connection in it. This application can be used in automation industries with number of robotic arms controlled remotely from a laptop. The software TeamViewer is used to control the android mobile. With the remote control access of android mobile it is possible to send the commands to FPGA board remotely thus controlling the servo motors indirectly.

II. BLOCK DIAGRAM

The figure 1 below shows the block diagram of the robotic system developed. The block diagram has the two main units control unit and the robotic arm unit. The control until is the laptop with an internet connection while the robotic arm unit is the android mobile, Bluetooth module interfaced with FPGA and the servo motors interfaced with the FPGA. The block diagram in details is as follows:

A] Control unit

Control unit is laptop with the team viewer software installed in it. The Teamviewer software is used to remote control the android mobile present in robotic arm section [2]. The screen of the android mobile is visible on the laptop and can be controlled to send the commands to fpga board to control the operation of the servo motors.

B] Robotic arm section

The robotic arm section has four main components viz. Android mobile, Bluetooth module HC-05, FPGA board and servo motors.

(i) Android mobile

The android mobile used in the work presented is the Micromax A210. The application Bluetooth serial controller is used to send the data to the FPGA board using the serial mode of communication [3]. This application in the mobile has the customized buttons with the help of which the movement of the arm is controlled. The buttons are used for the operations like picking, dropping and rotation of the arm.

(ii) Bluetooth HC-05

The Bluetooth module used for this project is HC-05. HC-05 module is an easy to use Bluetooth Serial Port Protocol module. It is designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth Version 2.0 with speed of 3Mbps [6]. The model number 05 indicates that the Bluetooth can be operated both as master and slave [6].

(iii) FPGA board

The low-cost Spartan-6 FPGA LX9 MicroBoard is used to complete the work. The kit comes with several pre-built MicroBlaze system [4]. This allows users to start developing software just like any standard off-the-shelf microprocessor. The included Embedded Development Kit (EDK) provides tool like an embedded hardware development (Xilinx Platform Studio - XPS) for writing and debugging code. This Avnet's Spartan 6 LX9

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MicroBoard is a valuable tool for general purpose prototyping and testing for FPGA users [4].

(iv) Servo Motor

The purpose of using the servo motors is the low power consumption and the control of the rotation. Servo motors that are used for the here are Tower Pro's MG995. Total 3 servo motors are used for gripper, wrist and arm respectively.

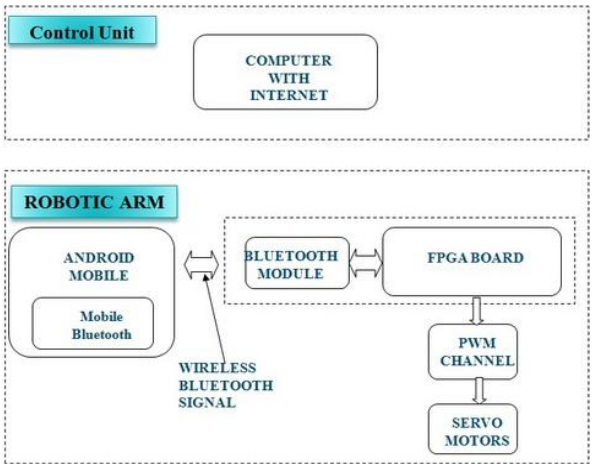

Fig. 1: Block diagram

III.IMPLEMENTATION

1) Hardware Implementation

The figure 2 below shows the implementation of the robotic arm. The arm has gripper, arm and wrist. The gripper mechanism is used to pick and drop any object. The wrist mechanism is used to rotate the wrist. The arm mechanism is used for arm rotation.

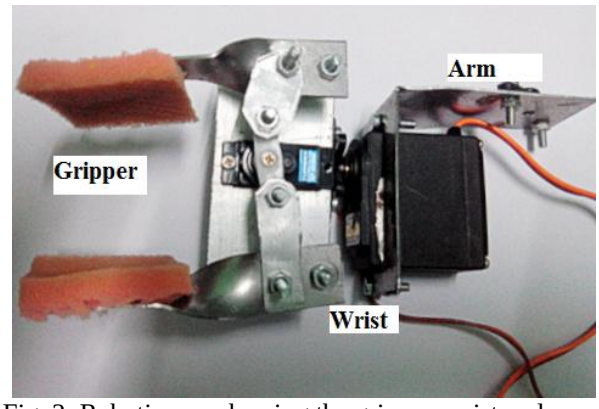

Fig. 2: Robotic arm showing the gripper, wrist and arm.

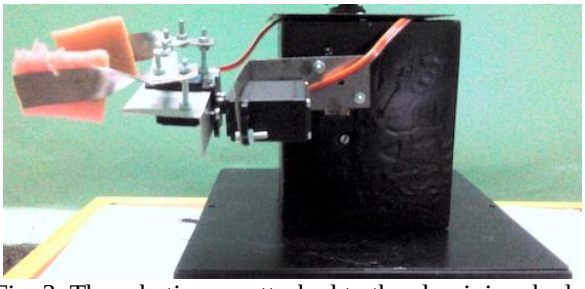

Fig. 3: The robotic arm attached to the aluminium body

2) Software Implementation

The most important part of this work was the proper interfacing of the Bluetooth module with the FPGA board. This is achieved with the proper design of the UART. The figure 4 below shows the UART designed for the receiver R7 of the FPGA in VHDL [5]. As the FPGA only receives and does not transmits signals to Bluetooth module only the receiver part was considered.

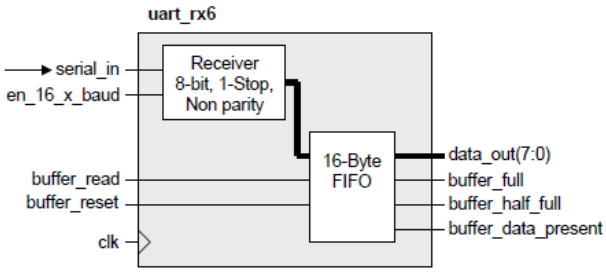

Fig. 4: UART receiver [7]

The Bluetooth serial controller is used to transmit the commands to the FPGA board. The control panel includes 6 different buttons to control the servo motor as shown in the figure 5 below:

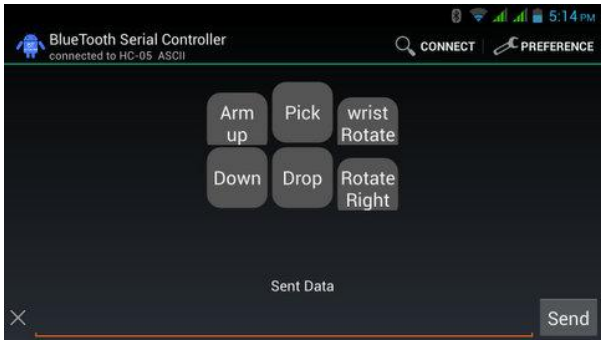

Fig. 5: Bluetooth Serial controller

IV.RESULT

Finally the Teamviewer software is used to control the mobile thus, indirectly controlling the robotic arm. The mobile screen is seen on the laptop window as shown in the figure 6 below

Fig. 6: Cropped image showing how the mobile screen is to control the robot arm is seen on the laptop

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V. CONCLUSION

It can be concluded that with the help of laptop, Spartan 6 lx9 microboard and an android mobile a remote controlled robotic arm is developed. The robotic arm can be controlled from any place to perform the small tasks such as picking objects, dropping objects and arm rotation. This design can be extended to perform many remote operations with inclusion of more servo motors and innovative ideas. Unlike the microcontrollers, in FPGA, as many pins as per the need can be used as PWM pins. The work presented in this paper can be seen as the future wireless robotic arm control technology and can be used in many remote operation applications.

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