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Wireless Signal Transmission using an Android Mobile and FPGA

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Abstract: Today's networking technology uses wireless systems widely for the Internet of Things (IOT). Exchange of control commands and data between devices can be done using wireless technology although they were initially designed for voice communication systems. In this paper, we present the interfacing of the Bluetooth module with the FPGA board so that the FPGA board can be connected to an android device using the Bluetooth connection. Wireless signal transmission is possible once the FPGA board and an Android mobile are connected. The hardware used for the project include a Bluetooth module interfaced with FPGA board, an Android mobile with Blueterm application installed on it and a LED light connected to the FPGA board to indicate the successful signal transmission. The wireless technology is the most promising and popular technology to control devices remotely hence the work in this paper, with some modification and improvement, can be used to build the efficient remote controlled applications.

Keywords: Avnet LX9 FPGA micro board, Android mobile, Bluetooth HC-05, Remote control, Spartan 6.

I. INTRODUCTION

The work presented in this paper is the novel approach to build the base for the future remote controlled applications. The FPGA is the most versatile device that can be used to design hardware for any application. Interfacing of Bluetooth will make the FPGA device more useful to design the wireless signal applications. From many of the previous works it is seen interfacing of Bluetooth with the microcontroller or Arduino boards [1], [2], [3]. Microcontroller or Arduino boards have many limitations to design an application; on the other hand FPGA enables true scalability and flexibility with its integrated fully customizable soft processing capability. It can also address custom needs with programmable hardware and software in a single chip. The interfacing of the Bluetooth is the addition to the capability of the FPGA.

II. BLOCK DIAGRAM

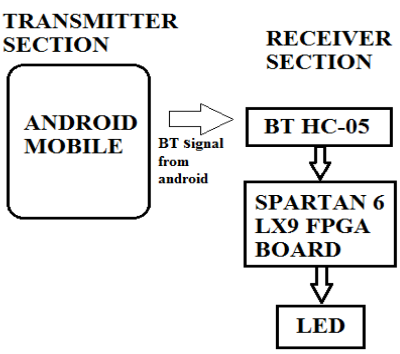

Fig. 1 Block diagram

The above Fig. 1 shows the block diagram of the system which includes two main sections: Transmitter section and the Receiver section. The block diagram is discussed in details as follows:

A. Transmitter section
Transmitter section is the android mobile with Blueterm application installed on it. Blueterm is an application that can be downloaded for free from android's play store [4]. This application is used to transmit any signal serially via Bluetooth to the receiver section i.e. FPGA board.

B. Receiver section
Receiver section has three main components, viz. Bluetooth module HC-05, Avnet's Spartan 6 LX9 FPGA microboard and a small red LED. The same is discussed below:

1) Bluetooth module 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 [7]. The model number 05 indicates that the Bluetooth can be operated both as master and slave [7].

2) Avnet's Spartan 6 LX9 FPGA board :
The low-cost Spartan-6 FPGA LX9 MicroBoard is a good option for testing. The kit comes with several pre-built MicroBlaze system. This allows users to start developing software just like any standard off-the-shelf microprocessor [5].

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 MicroBoard is a valuable tool for general purpose prototyping and testing for FPGA users [5].

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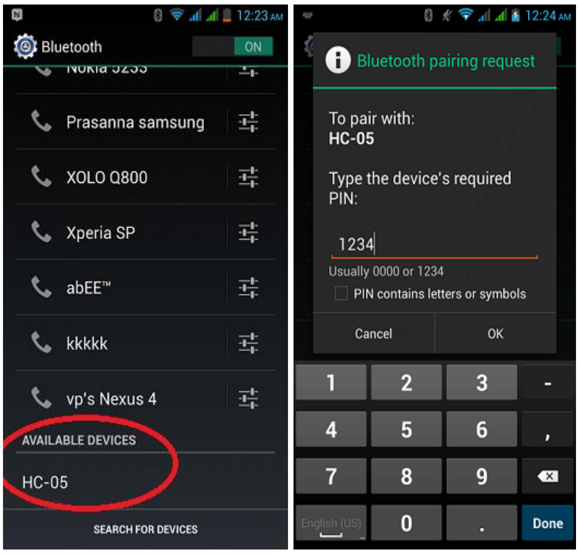
3) Indication LED :
Though the board includes on board LEDs, use of the external LED is done on purpose. Here it is used to indicate the successful transmission of the signal. But this LED can be replaced with servo motors, actuators, etc. in developing remote controlled applications in future.

III. IMPLEMENTATION

The Bluetooth module HC-05 is connected to the FPGA board. The module requires 3.3V power supply to power ON. The supply to this module is given using the available onboard 3.3V supply and ground. When the module is supplied power, LED flickers quickly indicating the module is at the pairable mode. In this mode the Bluetooth can be detected by the android mobile. When the module is supplied power and is in pairable mode it is ready to be paired with the mobile. The following Fig. 2 shows the screenshots showing pairing and detection. The default passkey for pairing the HC-05 module is “1234” [7].



(a) (b)
Fig. 2 (a) Detection and (b) Pairing of Bluetooth with Android mobile

After the pairing is successful, FPGA board is ready to receive the signal from the android device. FPGA board is programmed such that whenever the data ‘1’ is received, red LED glows.

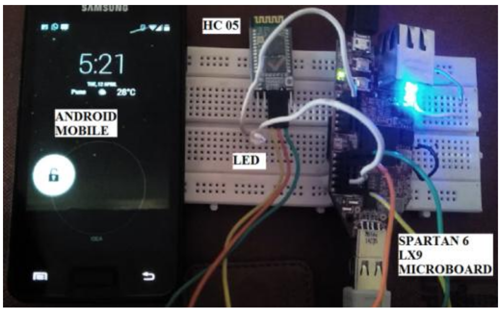


Fig. 3 Bluetooth module HC 05 is interfaced with Spartan 6 LX9 microboard which is then connected to an android mobile.

The Fig. 3 above shows the simple and easy hardware setup. Starting from left the image shows: An Android mobile, Bluetooth module HC-05, red LED and the Spartan 6 LX9 FPGA microboard. The pins of Bluetooth module HC-05 are connected to the GPIO pins of the FPGA board. The power supply to the Bluetooth module is also taken from the FPGA board. Red LED also is connected to the GPIO pin of the FPGA board. The VHDL coding is used for implementation. Coding is done and synthesized in the Xilinx ISE Design Suite 14.7. FPGA board used here has the internal receiver and transmitter FPGA pins as R7 and T7 respectively [6]. However the board doesn’t have external Rx and Tx pins. Hence, the GPIO pin that receives the serial data on the FPGA board is mapped to internal Rx FPGA pin in the user constraint file. By designing the UART using the VHDL code this is possible. Fig. 4 below shows the flowchart of the VHDL code used to transmit the signal.

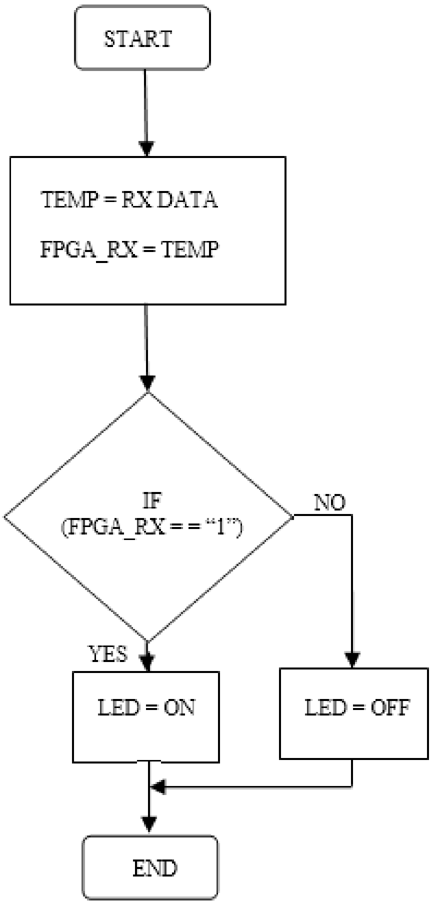


Fig. 4 Flowchart of the system

The algorithm of the VHDL code used is as follows:
Algorithm:
1) Start
2) Receive data store in temp
3) Map temp data to Rx pin
4) Check the data
5) if data = 1 then LED= ON
6) else LED off
7) end

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IV. RESULTS

The design was tested for successful wireless signal transmission. According to the VHDL program in the FPGA board whenever the data '1' is received the red LED should glow. This expected result is obtained successfully. Following Fig. 5 shows the successful wireless signal transmission from android mobile to FPGA board.

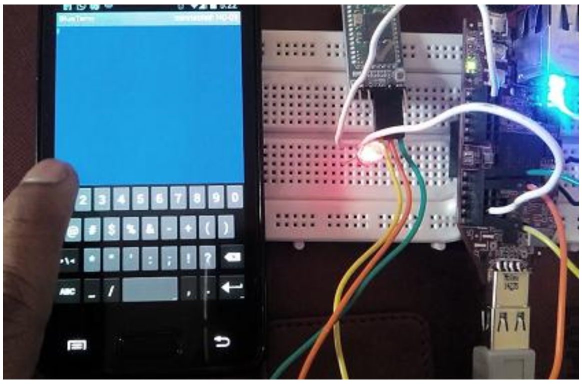

Fig. 5 Glowing red LED indicating successful wireless transmission

V. CONCLUSION

The signal transmission from android mobile to the FPGA is successful. From the result presented it can be concluded that by designing a UART using VHDL coding we can transmit a wireless signal. This work can be seen as the base for wireless signal transmission applications. It can be extended and used in the trending Internet of things to build a remote controlled embedded system in the future.

REFERENCES

[1]. Chandrasinh D Parmar; V. V. Dwivedi; H. H. Wandra, "Firmware for file transfer between Bluetooth module and flash memory through microcontroller in an emerging concept of wireless portable memory access," IEEE International Conference on Communication Control and Computing Technologies (ICCCCT), pp. 42 – 46,Year: 2010

[2]. J.F. M. C. Silva, D. M. S. Santos, V. C. Marques, K. D. Oliveira, T. O. Rodrigues, R. G. F. Texeira, J. W. M. Menezes and F. D. Silva, "A Study of Bluetooth Application for Remote Controlling of Mobile Embedded Systems", 2012 Brazilian Symposium on Computing System Engineering (SBESC), pp. 116-116, 2012

[3]. S. van Delden and A. Whigham, "A bluetooth-based architecture for android communication with an articulated robot", 2012 International Conference on Collaboration Technologies and Systems (CTS), pp. 104-108

[4]. Blueterm application on Google play store [online] Available: https://play.google.com/store/apps/details?id=es.pymasde.blueterm &hl=en

[5]. Avnet Spartan 6 LX9 microboard Product description[online] Available: http:// www. xilinx. Com /products/boards-and-kits/1-3i2dfk.html

[6]. Avnet Spartan-6 LX9 Microboard User Guide RevD 150424 Available: avnetexpress. avnet.com/ content/ adx/ documents/ en_us/GS- AES-S6MB-LX9-G-12_4-v1_1.pdf

[7]. HC Serial Bluetooth Products, User Instructional Manual.