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Design and Implementation of FPGA Based High Speed Data Communication

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ABSTRACT
This project presents an economic,reconfigurable,wired and wireless communication system between two FPGA (Spartan 6 kit). In wireless communication system communication takes place using Arduino ATMEGA 16U2 with Bluetooth configuration HC05 module in between those two FPGA. This paper brings out domains of Digital VLSI, Embedded system and wireless communication to accomplish task of conveying data from source to destination. In this 8 bit data provided at transmitter those serially transmitted to receiver.Similarly, in case of wired communication the two FPGA (transmitter and receiver) were come in contact with wired medium. In such case clock synchronization takes place quickly. Here input provided via switches present in FPGA and the output received has been denoted by the LEDs. This system can be applicable for industrial automation.

Keywords: FPGA, ARDUINO, Bluetooth, Wireless communication, Embedded system, Digital VLSI

I. INTRODUCTION

A field-programmable gate array is an integrated circuit designed to be configured by a customer or designer after manufacturing. Here we used verilog to model our system through FPGA can reconfigure using any hardware description language (HDL). Since FPGA contain an array of PLB and order of reconfigurable interconnects. The main advantage of FPGA is reconfiguration. ARDUINO is a microcontroller based prototyping board which can be used in developing devices. Its main advantage is flexible enough for advanced users.

This paper includes three major area of electronics field i.e Digital VLSI, Wireless communication, Embedded system. We all known that wireless communication plays a vital role in our daily life. In nature, one output must needed to be input to other system similarly in case of wireless communication the output of any system need to be input of other system. Hence this system utility can be extend to industrial automation.

The 8 bit data transmitted from FPGA present at transmitter side in which inputs provided via switches present within FPGA. Those data's serially sent to the arduino which interfaces FPGA by means of serial peripheral interface (SPI). When the data reached arduino it ready to transmit to the receiver side through Bluetooth. Hence through Bluetooth the data provided at transmitter side will reach the arduino present at the receiver side. Then those data sent to FPGA at the receiver.

In the rest of the paper we can discuss the development and working of our wireless communication.

Theory of wireless module

Normally, the main drawback in communication is data loss. Our research is to overcome those drawbacks. Our project split into three modules in wireless communication. They are I)Transmitter module II)Bluetooth module III)Receiver module.

I) Transmitter module

In the transmitter side we have two components. One is FPGA kit and another one is arduino. They both connected via serial peripheral interface (SPI). Therefore clock synchronization happens between FPGA and arduino. In the transmitter side the input provided via the switches present within the FPGA. Hence we provide input data via switches by "ON" and "OFF" the switch. Naturally , if the switch is

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"OFF" then FPGA took it as "0" . If the switch is "ON" then FPGA took it as "1". Hence these kind of data programmed to sent serially to the arduino. These were the operations taken place at transmitter side.

II) Bluetooth module

The Bluetooth HC05 connected to the arduino at transmitter pin. Similarly, the another Bluetooth HC05 connected to the arduino at the receiver side. These Bluetooth modules helps to have wireless communication for a short range of distances.

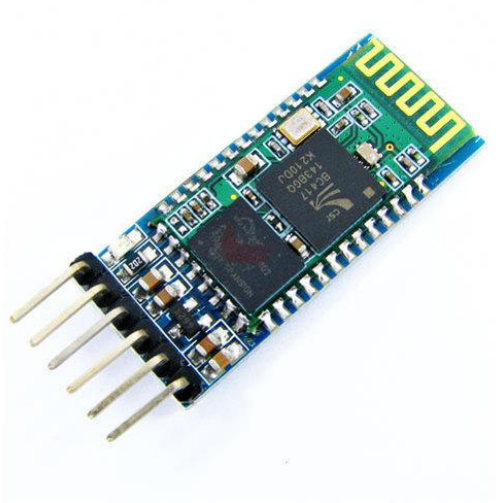

Fig.1 Bluetooth module

Initially the two Bluetooth module need to configure so that they can transmit and receive data. The Bluetooth module at transmitter side receives the given data from arduino and sent serially to the configured module serially. Similarly ,the Bluetooth present at the receiver receives those data serially sent to the arduino present at the receiver side.

III) Receiver module

At the receiver side the data received from the Bluetooth module present at the transmitter side via Bluetooth module present at receiver side. Those data sent to the arduino present at the receiver side. Hence using serial peripheral interface the arduino sent those data to the receiver side FPGA. Hence arduino present at both transmitter and receiver need to act as master and slave.

Implementation methodology

A) Introduction

The essence of wireless communication on FPGAs becamethe sole motive of this project. In implementing the setup, forachieving the objective, various parameters were taken care off.Various components were used to receive the result. They were as follows. The following table carried out the required components.

Table 1
Equipments used

S.No	Components used
1.	FPGA (Spartan 6)
2.	ARDUINO (ATmega328P)
3.	Bluetooth (HC-05)

1) Transmitter side

Therefore at the transmitter side FPGA acts as master and the Arduino act as slave after clock synchronization taken place between the two components (FPGA and Arduino). In our project we used to send 8 bit data from one terminal to another terminal. Those data should be in the form of 1's and 0's provided at switches present within the FPGA.

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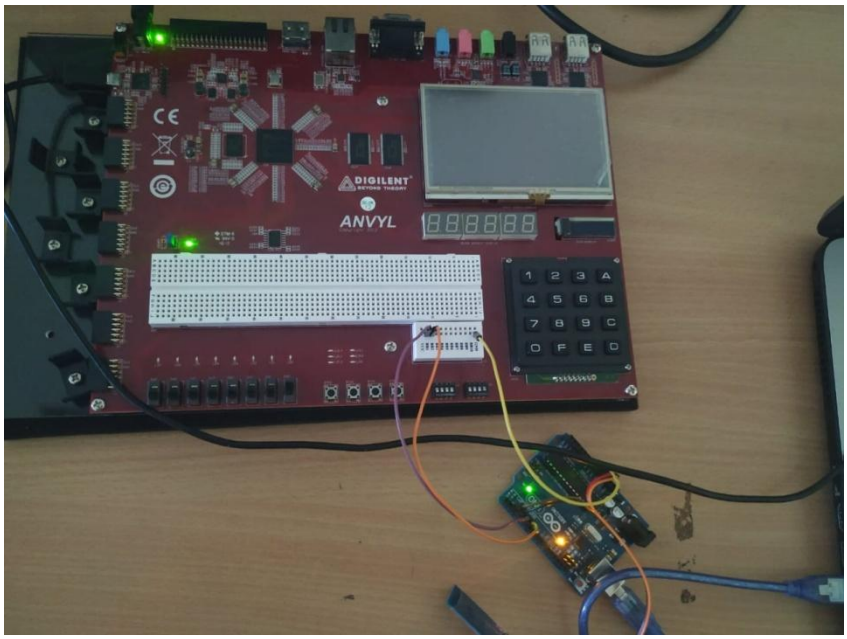

Fig.2 Transmitter side

2) Bluetooth module

In Bluetooth module initially we want to configure and pair two HC-05 Bluetooth module.HC-05 Bluetooth Module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

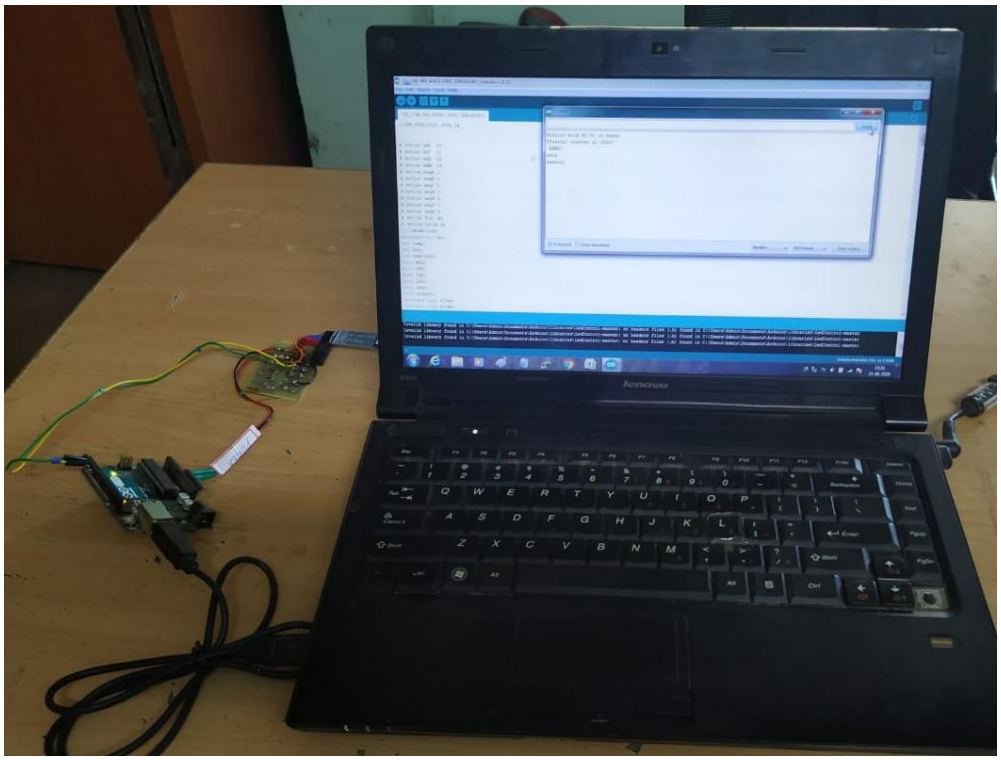

Fig.3 Bluetooth configuration I

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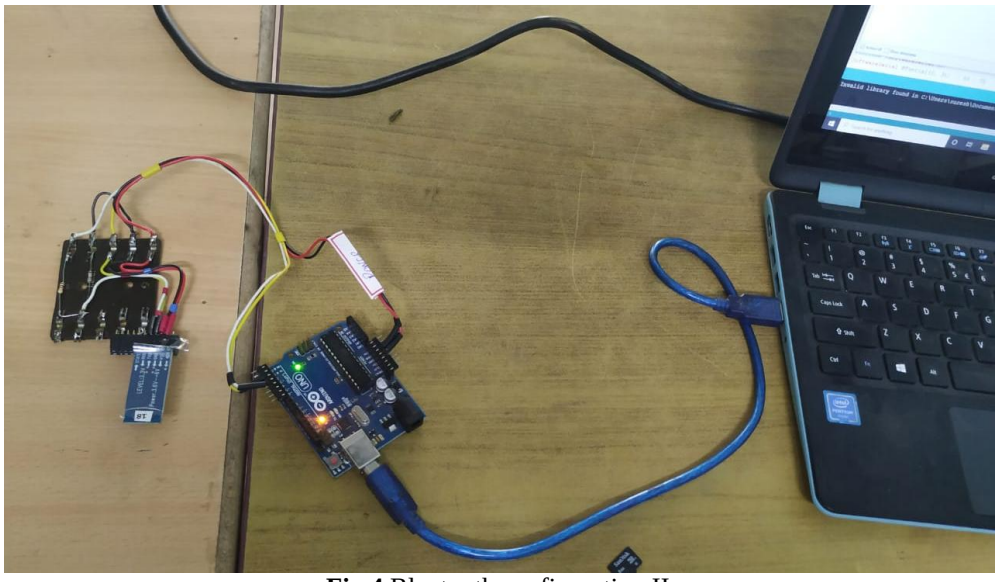

Fig.4 Bluetooth configuration II

3) Receiver module

At the receiver side transmitted bits were received at Arduino which present in receiver side. Those bits(1's and 0's) were sent serially to the receiver FPGA. The output has been denoted by blinking of LED'S present within the FPGA which known to be output. Since we have some delay in receiving those 8 bit at the receiver FPGA.

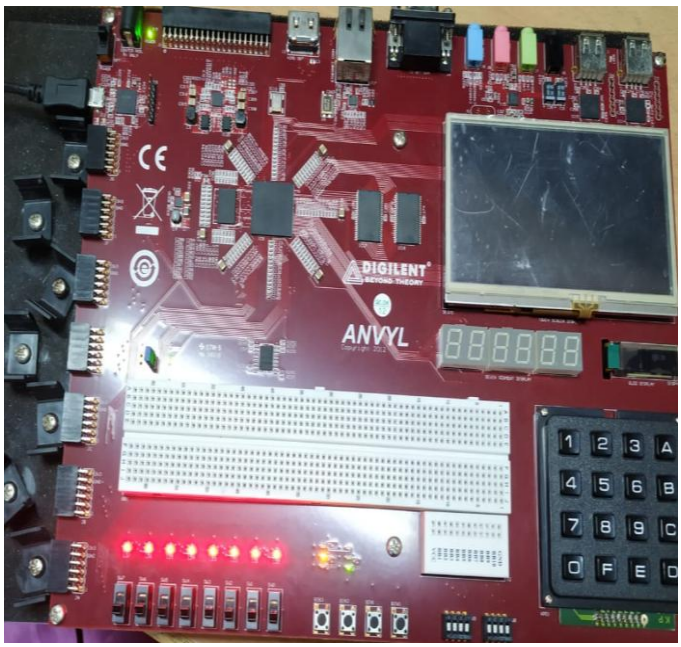

Fig.5 Receiver side

As we try to transmit 8 bit data from one FPGA to another FPGA using arduino with blutooth module as intermediate component. But we have delay in receiving data at the receiver side it is due to problem in clock synchronization between FPGA and arduino at the receiver side.

Wired communication

One of the main advantages of wired medium communication is easy to have clock synchronization between two FPGA. The another advantage is that loss of data is very less. This kind of operation used to control the devices or components which were connected serially via wired medium.

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In this type of communication medium play a vital role hence we have to connect 8 pins from transmitter FPGA to receiver FPGA. In this communication the requirement must be two FPGA. In those two FPGA one act as transmitter another one act as receiver site.

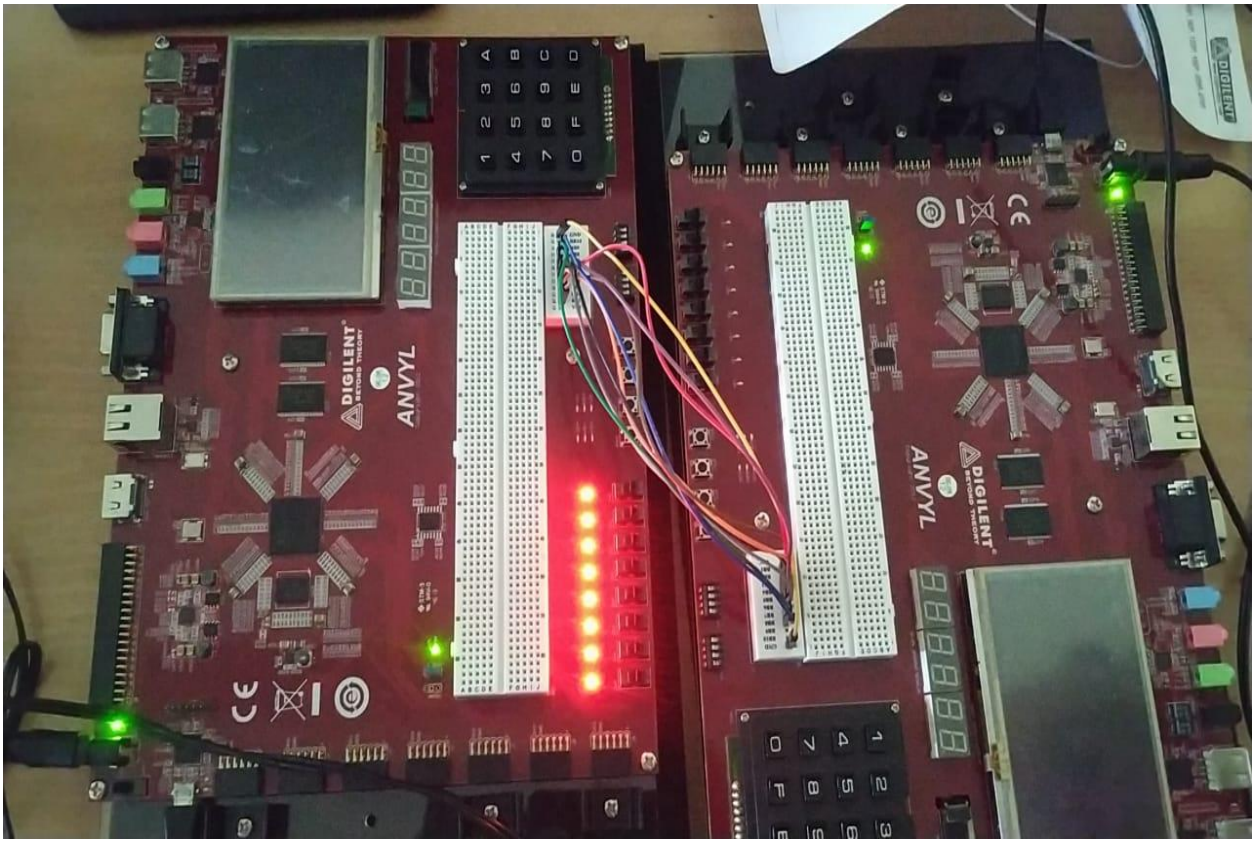

Fig.6 Wired Communication

As seen in above picture there will be 8 wires connected between transmitter and receiver FPGA. Those wires act as medium hence clock synchronization taken place. After clock synchronization happen input data denoted by inbuilt switches as 1's and 0's by switching ON and OFF the switches. The output data denoted by inbuilt LEDs.

II. CONCLUSION

In this paperwe try to have wired and wireless communication using FPGA (Spartan 6) . We successfully transmitted 8 bit in wired communication. But in wireless communication we try to transmit 8 bit but there is a delay in receiving the output at the receiver side this is due to problem in clock synchronization. We will overcome this drawback in next session. Then we move our research to transmit images from one FPGA to another FPGA. Hence it will useful in Health care monitoring.

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