



FPGA Based Real Time Bluetooth Communication for Tele health, Household Security and Industry Safety

Piyush V. Savaliya¹, Sunil B. Somani², Virendra V. Shete³

ME Student, Department of VLSI & Embedded, MITCOE, Pune, India ¹

Professor, Department of E&TC, MITCOE, Pune, India²

Professor & HOD, Department of E&TC, MITCOE, Pune, India ³

ABSTRACT: Introducing Real-time Bluetooth monitoring system which used to enhance the people's health guarantee, Home security and industry safety using android smart phone. It is mainly used to detect the pulse of patient, smoke level in home and temperature of the industry, the end users are received the monitor data by Bluetooth wireless communication device. Android OS based smartphones are progressively used these days as a result of its simplicity and is open source to make application. FPGA based embedded systems have faster processing capability, low power usage and is reconfigurable according to necessity. In this paper we present the design and implementation of the real time remote monitoring using Bluetooth between FPGA based embedded system and android smartphones. This system offers a complete higher processing capability and lower power and user friendly way of 24 hours real time remote monitoring for tele health, household security and industry safety using SMS (short messaging service) message.

KEYWORDS: Field-programmable gate array (FPGA), Android platform, Wireless, Bluetooth.

I. INTRODUCTION

Android based smartphone are primary choice of people because these devices are inherited with huge compatibility and mobility, although they are low cost devices This assists in interfacing the device with different electronics hardware system, for example health monitoring equipment, industrial safety equipment and household security equipment. Android applications are easy to develop and are an open source so no expense is consolidated in creating android application and also offer flexibility in development.

Human health is unpredictable these days due to many reasons. During an emergency, a person may need to alert their close one if medical help is needed and in case it is not available at right time, it may lead to death of the person. Similarly, in case of a breakout of fire at home there is no mechanism available to alert the owner regarding the emergency. During any manufacturing process it is necessary to maintain the temperature and pressure standards set as per the procedure to ensure that there is no defect in the product and no mechanism is available to alert the personal on floor for any fluctuations in the set values to avoid the degradation in the product quality.

To overcome the above mentioned problems we establish Real-Time Bluetooth communication between an FPGA based embedded system and an android Phone and develop application for Tele health, household security and industry safety for people comfort.

This paper represents the method of establishing a wireless communication between the FPGA and Android operating system (OS) running smartphone via Bluetooth connection. The system is most suitable for application where continuous observing (real time monitoring) and quick activity is needed as expressed in above cases. For this reason, sensors were synchronized with FPGA along with Bluetooth connector for communicating with android application on any android smartphone to read and display real time data. The wireless communication eliminates the huge



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maintenance cost incurred with wired communication system also it provides long distance connectivity and reduce complexity because of these points of interest, we have chosen wireless communication as transmission medium [2]. If a person is not in a Bluetooth range then via short message services (SMS) alerts the end user.

II. LITERATURE SURVEY

In this section, a motivation into the targeted research topic is given. In order to introduce the research field, some background topics, especially FPGAs, Bluetooth, and Android are described.

A. FPGA

The Field-programmable gate array (FPGA) system is capable of high speed parallel processing and build a hierarchy design, which is powerful and fast enough to fulfil all the need of functionality, making it preferable over general purpose processor or micro-controller and has the added advantage of being reconfigurable for future development. Also Benefits of FPGA Technology like high Performance, low Time to Market, low Cost, high Reliability, and Long-Term Maintenance. Real time applications FPGAs are perfectly suitable for applications in time-critical systems.

B. Bluetooth

Bluetooth is one of the fast growing technology which offers short distance communication. Because of this there is high demand for both Bluetooth software and hardware. The main advantage of Bluetooth is low consumption which make suitable for mobile devices [5]. It operates in the license-free 2.4 GHz band and supports data rates up to 600Kbps.

The Bluetooth 2.0 protocol has high speed margins, low power consumption, wide operational range, freedom of transceivers position, and simplicity.

C. Android

In this system a particular android app is created and that will display status of health of the person, home and industry to the end user. Android is an operating system based on the Linux kernel, and designed primarily for touch screen mobile devices such as smart phones and tablet computers. This open-source code allows the software to be freely modified and distributed by device manufacturers [5].

Table 1 shows various parameters variation in different methods used for monitoring the data. From the table its clearly seen why we select android OS to monitoring the filed. Android provides high speed, low power consumption, flexibility and portability as compare to other.

Parameter	Different Technologies		
	RF	GPRS	Android
Area	Less	More	Less
Power	Low	High	Low
Speed	High	Moderate	High
Flexibility	No	No	Yes
Portability	No	No	Yes

Table 1 Difference between the Methodologies

III. SYSTEM DESIGN

From the referred papers it is seen that they have used the FPGA as the principle controlling device which supports our choice of utilizing FPGA as fundamental controlling device for our system. It is additionally watched that they have utilized GSM, GPRS or Bluetooth as communication medium. For this system we have used Bluetooth as communication medium in view of its points of interest like low power, standardized protocol, automatic, inexpensive and low interference.

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The figure 1 demonstrates the block diagram of proposed architecture. The proposed system consist of distinctive sensors, FPGA, Bluetooth module and android smartphone.

The implementation includes an embedded system that has the sensors interfaced to the main controller. The controller utilized here is FPGA (XC3S100E) and the parameters that are to be measured are temperature, smoke and heartbeat rate. According to the application, LM35 as temperature sensor, MQ-7 as smoke sensor and XA001 as heartbeat sensor are interfaced with FPGA. The output of LM35D temperature sensing element is in voltage and is applied to the ADC0808. The analog voltage signal is regenerate to the digital equivalent and is then processed by the FPGA that shows the temperature value. Similarly, for smoke sensing element analog to digital conversion of sign is performed by ADC0808 and fed to FPGA system for show. The Pulse sensing element has output within the kind of digital signal that is directly given to FPGA without conversion.

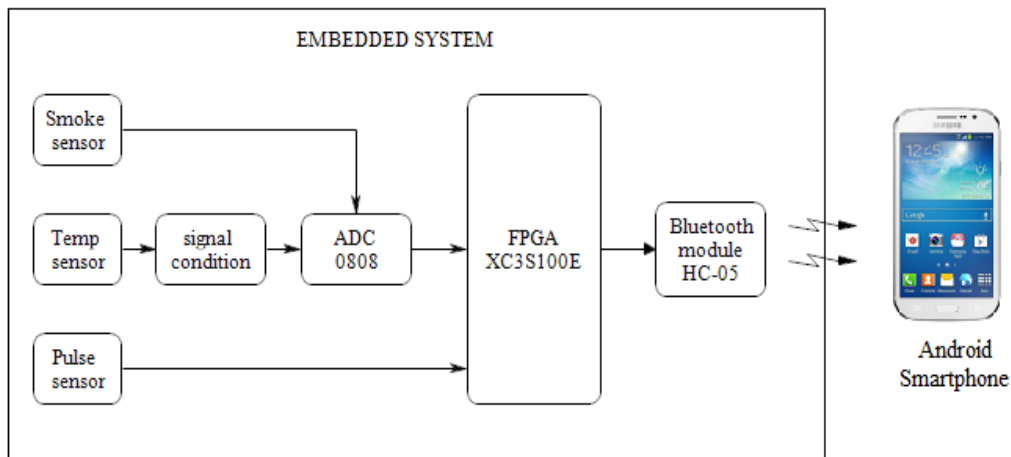


Fig 1: Block diagram of system implementation

The information is then sent to UART where the HC-05 Bluetooth module is joined. This module works on AT commands and it is designed to be paired with the android smartphone. At the smartphone end, we created android application for individuals comfort so they can without much of a stretch access information anyplace at whatever time. Since Bluetooth have drawback i.e. the data could be sent to very limited distance, to overcome this drawback Short Message Service (SMS) feature is added on Android smartphone for wider range communication.

IV. HARDWARE SYSTEM DESIGN

The hardware required for this system is Bluetooth module HC-05, Spartan 3E-FPGA, different types of sensors and android smart phone.

A. FPGA (XC3S100E)

XC3S100E belongs to FPGA family, having high clocking speed and great interfacing feature which will be required for sensors and Bluetooth module. The main advantage of using FPGA are its high speed and it needs low power for its functioning [3] [4].

Features of FPGA:

- Low power, high performance logic solution for high volume, consumer-oriented applications.
- Multi voltage, multi standard, select I/O interface pins
- Abundant, flexible logic resources
- Low-cost QFP and BGA packaging options

B. Bluetooth module (HC-05)

HC-05 is a class 2 Bluetooth module with serial port profile which can configure as either master or slave with the help of AT command, design for transparent wireless serial connection setup

- Typical -80dBm sensitivity



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- Up to 4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- UART interface with programmable baud rate
- Integrated antenna
- Auto-connect to the last device on power as default

C. Sensors

- *Temperature sensor LM35*

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in C). Here we can measure temperature more accurately then using the thermistor.

- *Smoke sensor MQ-7*

MQ-7 smoke sensor is simple to use carbon monoxide sensor suitable for sensing CO concentration in the air and output its concentration anywhere from 20 to 2000 ppm.

- *Pulse sensor XA001*

The pulse sensor is a plug and play heart rate sensor. Simply clip it to your finger tip and you are ready to read heart rate data. The Pulse Sensor is designed to provide digital (TTL) output of heart beat rate when a finger is placed on sensor.

D. Android Smartphone

Android is most widely used smartphone OS. It is user friendly, easy to use, open source to create any application as per requirement. The android smartphone has the Bluetooth connectivity making it easy to connect to our system and obtain data wirelessly [6].

V. SOFTWARE SYSTEM DESIGN

The software used for this system are Xilinx ISE and android studio.

A. Xilinx ISE

Xilinx ISE is a design environment for FPGA. It is used for circuit synthesis and design while the modelsim logic simulator is used for system level testing. This powerful design environment is capable of simulating functional VHDL before synthesis, or simulating after the implementation process for timing verification.

B. Eclipse LUNA

Eclipse is an integrated development environment (IDE) for Android developers. Java language is basic platform for app creation. This app is only created for android smartphones. It contains a base workspace and an extensible plug-in system for customizing the environment.

The Eclipse platform support both GUI as well a non-GUI based application development environments and also Support the construction of a variety of tools for application development.

VI. RESULTS AND DISCUSSION

We develop a versatile embedded system with an FPGA platform which will communicate information wirelessly to an android phone through Bluetooth while not interruption or error, as values send from the board to the phone's display accurately and in real time.

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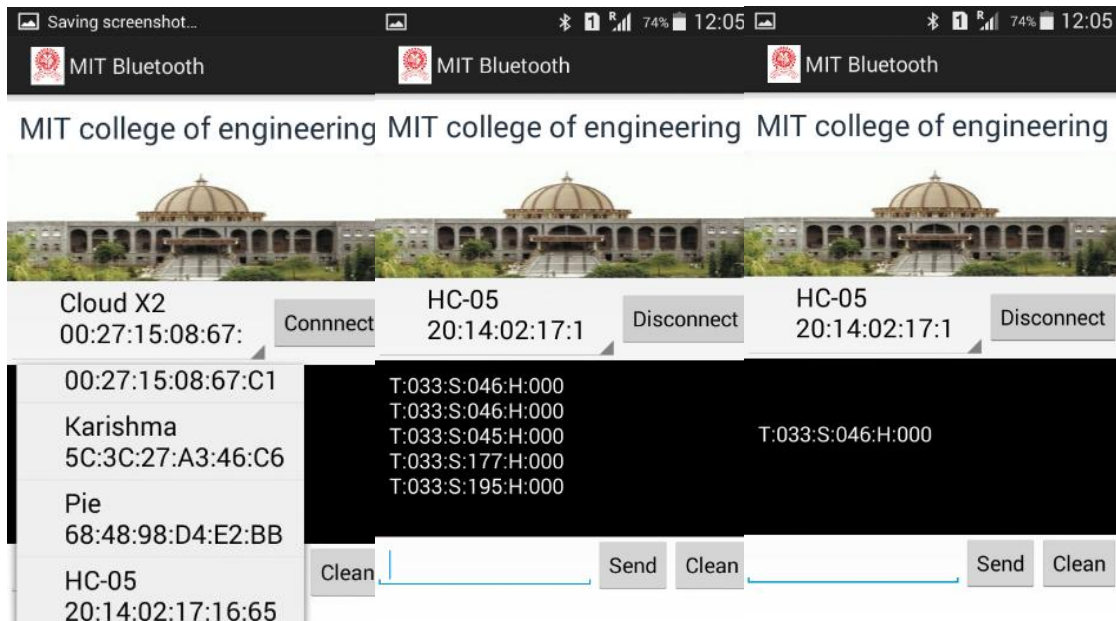


Fig 2: Android application Activity and Android application

Figure 2 show the Android application activity that activity guide the user through the options such as Bluetooth initialization, operations etc. and we have created this activity using Eclipse. And also the screen shot of the android application, which shows information regarding temperature for industry safety, smoke for home security, and pulse rate for health monitoring.

Whenever sensors cross it desire limit, then an emergency message will be send to end user. Below Figure shows the emergency message that shows the status of the field.

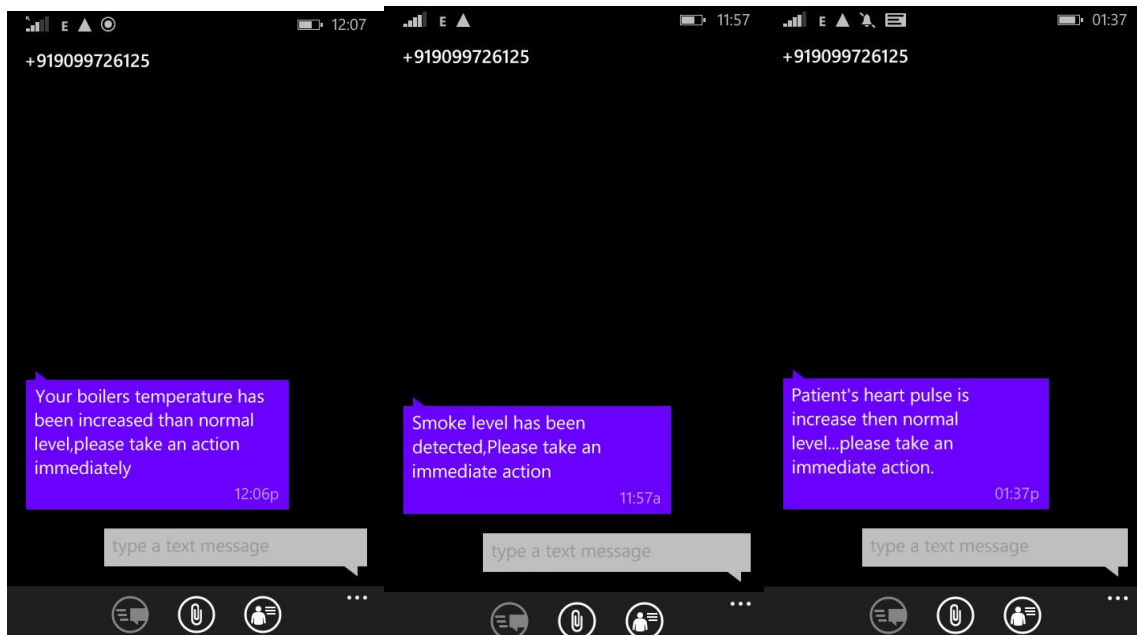


Fig 5 (a): Snapshot of SMS for Temp

Fig 5 (b): Snapshot of SMS for Smoke

Fig 5 (b): Snapshot of SMS for Pulse

- Figure Fig 5 (a) shows the emergency message that shows the status of the Temperature in Industry.

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- Figure Fig 5 (b) shows the emergency message that shows the status of the Smoke in House.
- Figure Fig 5 (c) shows the emergency message that shows the status of the Pulse of human body.

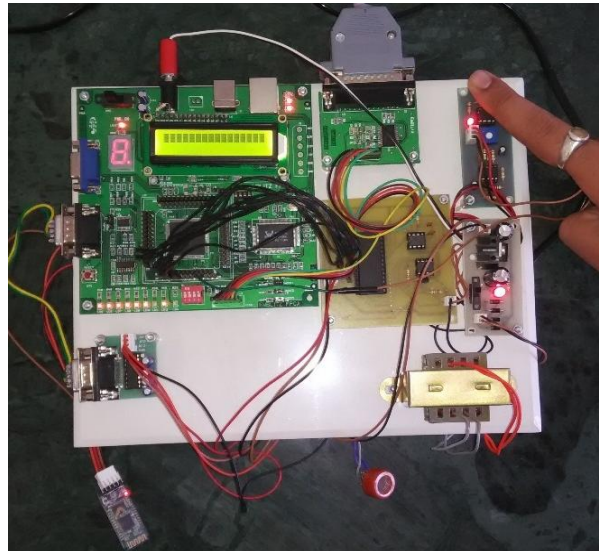


Figure 6: transmitter module.

Figure 6 indicates the full view of transmitter module. In transmitter module HC-05 Bluetooth module is connected with FPGA kit and it send the data to the Android smart phone.

VII. CONCLUSION

Real time low power wireless system can be implemented with the help of FPGA, Bluetooth and android system as user interface for applications like tele health, household security and industry safety has been introduced in this system. The use of FPGA in such systems promises higher processing capability and lower power usage and reconfigurable than traditional microprocessors. The system was simulated and tested in hardware level using Xilinx Spartan 3E development board and verify the correctness and working operation of the whole system. Lower power consumption in operation make Bluetooth suitable for mobile devices. Ease of connection between the devices makes the setting a connection faster and easy for tele health and other applications.

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BIOGRAPHY

Piyush V. Savaliya received the B.E. degree in Electronics and Telecommunication Engineering from SCET, Surat, India in 2012 and is currently pursuing the M.E. degree in VLSI and Embedded systems from MIT College of Engineering, Pune, completing project based on FPGA.

Sunil B. Somani received the M.E. degree in Electronics and Telecommunication Engineering. He has been in the teaching field since last 22 years and specialized in areas such as Advance communication, Microwave engineering and Mobile communication. He is currently working as PG coordinator at MIT College of Engineering, Pune, India.

Virendra V. Shete, Head, Department of E&TC, MITCOE Pune, affiliated to SavitribaiPhule Pune University. He has published numerous scientific papers in various domain. His area of interest are soft computing, Signal Processing, Communication.