



Implementation of ZigBee based Personal Area Network (PAN) for Assisting Communication for the Speech Impaired

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Abstract:

The main aim of this paper is to implement a PAN (Personal Area Network) which will assist communication among the speech impaired and also help them communicate with others. In this fast growing world no one should be left behind, especially not because of impairment at least. Thus this paper is an attempt to create a robust environment for the progress of the speech impaired by utilizing ZigBee technology mainly. ZigBee technology is used because it is appropriate for bulk and fast data transmission over low cost, low power wireless networks. GLCD screen and Touch screen pad are utilized to ease communication by displaying the basic required data. Thus a system can be implemented in which ZigBee will be used to transmit the wireless signals according to the inputs given by the user using the programmed touch screen pad. This information after processing will be transmitted using ZigBee transmitter. At the receiver the information will be displayed on the GLCD screen in English.

Key words: GLCD, MAC, Microcontroller, Personal Area Network (PAN), Intel-8051, Arduino Uno, Speech Impaired, ZigBee

I. INTRODUCTION

In India itself there are over 2.7 million people with speech impairment. [6]. these speech disorders can occur at any age. Regardless of the severity, a person's ability to interact and communicate with others is affected. The speech impaired does not have any problem in processing their thoughts but only to express them. In the 21st century everyone has to have an equal opportunity to success. But the disabled people like the speech impaired face obstacles in their way to success just because of their disability. The obstacles are mainly due to the fact that they do not have enough resources to communicate their thoughts. The main motive of this paper is to implement a system such that it aides the speech impaired to communicate at least the basic needs. This communication could be between two speech impaired personals or between a speech impaired and a person with no impairment. To implement this system ZigBee technology is selected because ZigBee is a wireless technology developed as an open global standard to address the unique needs of low cost, low power, wireless sensor networks. ZigBee is the set of specifications built around the IEEE 802.15.4 wireless protocol. [1]. as ZigBee is the reliable technology in wireless field, an attempt is made to demonstrate its way of functionality through ZigBee transmitter. The information received by the ZigBee receiver will be displayed on GLCD.

2. LITERATURE SURVEY

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios. [5]. LANs and WLANs evolved and WPANs which were its part were used to cover small areas using less power required for transmission. The technology defined by the ZigBee specification is intended to be

simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. [1], [5]

3. PROPOSED SYSTEM

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are microprocessors and microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. [2]. This system will be implemented by using not just ZigBee but also PIC18F452 and PIC16F73 microcontrollers. The system design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the Touch screen sensor, ZigBee and GLCD while the software implementation focuses on the programming of the microcontroller using Proteus 7 (Embedded C).

4. ZIGBEE OVERVIEW

4.1 Introduction to ZigBee: The new standards in the ISM radio band are frequencies 868 MHz, 915 MHz and 2.4 GHz. From these the frequency of 2.4GHz is used worldwide. There was a need for a standard communication and as a result the ZigBee Alliance created ZigBee. [1], [5], [7] ZigBee is a specification based on IEEE 802.15-4 standard used for high level communication protocols, creating a personal area networks from

small and low-powered digital radio system. ZigBee is capable of transmitting data by passing data through intermediate devices, reaching more distant ones, thus creating a network. The key components of a ZigBee network are- PAN coordinator, routers and end devices. All of them can be configured to deal with multiple applications as large as 124 simultaneously. [7] ZigBee is employed in applications which require a lower data rate, longer battery life, and secured networking. It has a defined data rate of 250kb/s. [7], [9].

4.2 Data Security in ZigBee: The encryption algorithm used is AES (Advanced Encryption Standard) with a 128bit key length (16 Bytes). [10]. It is really important to count with a unique kind of encryption method due to the fact that most of the 802.15.4/ZigBee transceivers have a specific hardware design to cope with this work at the electronic level (embedded low resources devices). The AES algorithm is not only used to encrypt the information but to validate the data which is sent. This concept is called Data Integrity and it is achieved using a Message Integrity Code (MIC) also named as Message Authentication Code (MAC) which is appended to the message. [10],[8] This code ensures integrity of the MAC header and payload data attached. It is created encrypting parts of the IEEE MAC frame using the Key of the network, so if we receive a message from a non-trusted node we will see that the MAC generated for the sent message does not correspond to the one what would be generated using the message with the current secret Key, so we can discard this message. The MAC can have different sizes: 32, 64, 128 bits, however it is always created using the 128bit AES algorithm. Its size is just the bits length which is attached to each frame. [8], [9].

5 . HARDWARE IMPLEMENTATION

5.1 Block Diagram of Transmitter

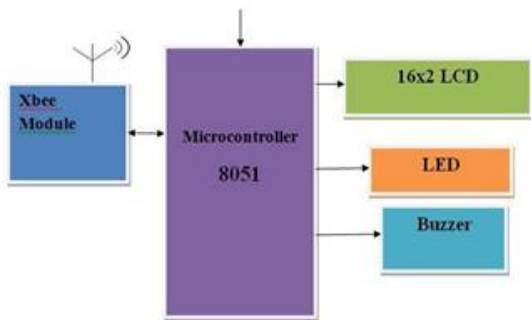


Figure.1. Block Diagram of Transmitting system

5.2 Block Diagram of Receiver

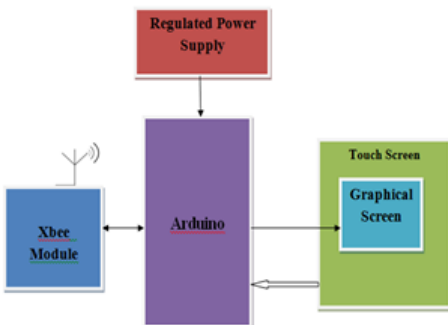


Figure.2. Block Diagram of Receiving System

5.3 Arduino Uno: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. [12].

5.4 Intel MCS-51: The Intel MCS-51 (commonly termed 8051) is an internally Harvard architecture, complex instruction set computer (CISC) instruction set, single chip microcontroller (μC) series developed by Intel in 1980 for use in embedded systems .The 8051 architecture provides many functions (central processing unit (CPU), random access memory (RAM), read-only memory (ROM), input/output (I/O), interrupt logic, timer, etc.) in one package: 8-bit arithmetic logic unit (ALU) and accumulator, 8-bit registers (one 16-bit register with special move instructions), 8-bit data bus and 2x16-bit address bus/ program counter/data pointer and related 8/11/16-bit operations; hence it is mainly an 8-bit microcontroller.[2],[13].

5.5 GLCD

The 128x64 LCD is divided into two equal halves with each half being controlled by a separate KS0108 controller. Such LCDs (using KS0108 controller) involve paging scheme, i.e., whole LCD is divided equally into pages. These GLCD have common display drivers like KS0108 and T6963C and 4 wire resistive touch screen. [11]. There is no need for touch screen digitizer/controller for microcontrollers having on chip ADC with four analog channels.

5.6 Alpha Numeric LCD

A 16x2 LCD (Liquid Crystal Display) is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. [14]. The command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

5.7 Touch Screen Sensors

Touch screen is an electronic visual device that helps the user to operate by touching the icons displayed on the screen. Touch screen based system allows an easy navigation around a GUI (Graphical User Interface) based environment. [3], [4]. Whereas a touch screen sensor is a clear transparent glass or polymer panel having touch response surface. It is placed over the screen so that the responsive area of the panel covers the area of the display. [3]. in most sensors, the electrical signal flows over the panel and on touching the signal or voltage changes. This change is used for detecting the location of touch on the screen.

5.8 Working of the System

The transmitting section of the proposed system will work such that when the speech impaired user will start the system, he will

observe a welcome screen with multiple options that will be programmed into the system. The user will have to select the option he wishes to use and further the display will showcase icons on the touch screen display under that option. The user will have to recognize the required icon and touch it to select it. The data of the selected icon will be processed by the microcontroller and transmitted via ZigBee transmitter. At the receiving section of the proposed system, the unit must be first switched on. The ZigBee Receiver will receive the data transmitted by the ZigBee transmitter. The microcontroller will process the data and it will be displayed in verbal form on the screen at the receiver system. LED indicators and buzzers are used for prompting the user that new data is available.

How the Transmitter will Work

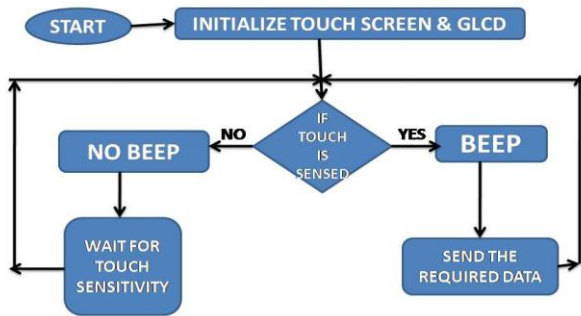


Figure.3. Flowchart of working of the transmitter



Figure.4. Implemented Transmitter

How the Receiver will work

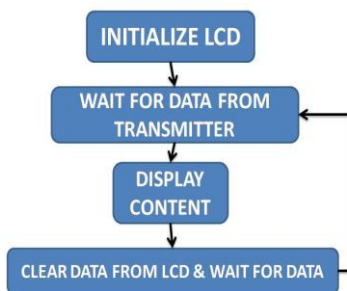


Figure.5. Flowchart of working of the Receiver

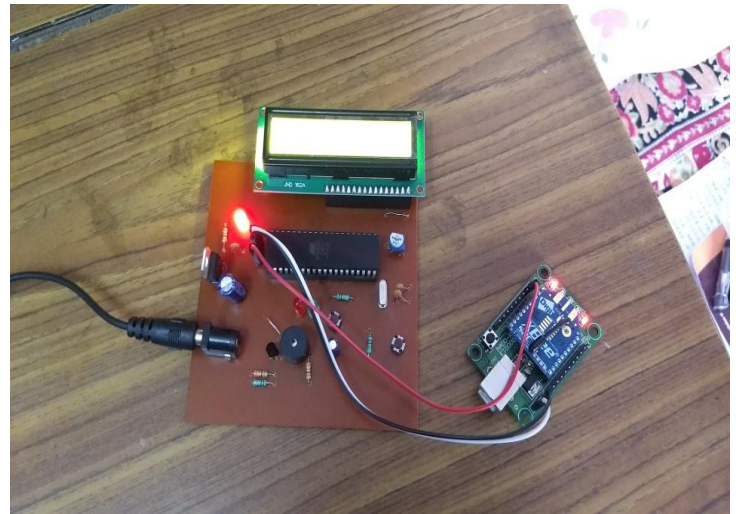


Figure.6. Implemented Receiver

6. SOFTWARE IMPLEMENTATION

6.1 Proteus 8.0

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. The software runs on the Windows operating system and is available in English, French, Spanish and Chinese languages. Proteus combines ease of use with powerful features to help you design, test and layout professional PCBs. With nearly 800 microcontroller variants ready for simulation straight from the schematic, one of the most intuitive professional PCB layout packages on the market and a world class shape based auto-router included as standard.

6.2 Flash Magic

Flash Magic is an application developed by Embedded Systems Academy to allow you to easily access the features of a microcontroller device. With this program one can erase individual blocks or the entire Flash memory of the microcontroller. This application is very useful for those who work in the electronics field. The main window of the program is composed of five sections where you can find the most common functions in order to program a microcontroller device.

6.3 Arduino 1.5.4

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

7. SIMULATION OUTPUT

The actual touch input at the transmitter GLCD and the respective output generated on the receiver LCD is pictorially represented as follows:

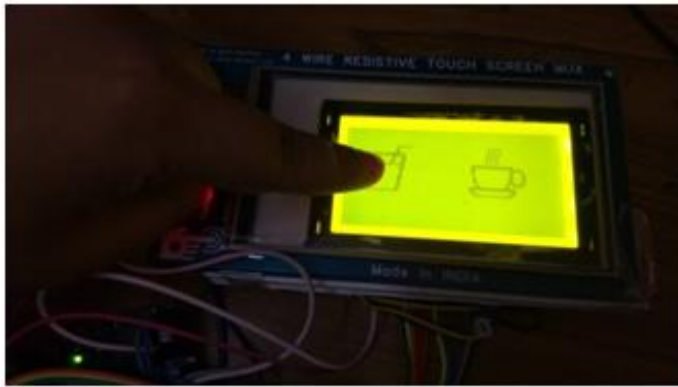


Figure.7. Input touch at Transmitter



Figure.8. Output display at Receiver

8. FUTURE ENHANCEMENTS

The system can incorporate more than one transmitter connected in the same network to establish a communication between the head receiver and the speech impaired people/customers. Further, multiple languages can be incorporated, thus enhancing communication between people who don't speak the same language. Also, the resistive GLCD touch screen can be replaced by a capacitive TFT LCD touch screen for enhanced display and touch interface.

9. CONCLUSION

The main goal of this paper is to implement successfully a PAN that will facilitate the basic communication for speech impaired. Integrating features of all the hardware components that will be used will be developed in it. Presence of every module has been reasoned out and will be placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the paper can be successfully implemented. This paper will provide an efficient device that helps the speech impaired to communicate. ZigBee used in this project will provide a typical range of 50m. By using high power ZigBee module, the range can be extended up to 1.3 km. Using ZigBee only text messages can be sent. By using IR/RF transmitter and receiver audio and video signals can also be transmitted. But ZigBee provides better data security and range is also more compared to IR. And another thing to be noted is ZigBee works in license free bands. ZigBee is most preferable where data security is important

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