

Design of Smart Examination Link Using Zigbee

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Abstract: Examinations are a regular event in academics at schools and colleges. It is a sole responsible to Management and Staff members to conduct the Examination smooth fully without any interference. During the examination the following issues have been identified and they are Shortage of question papers, Shortfall of Answer sheet, Malpractice Identification, Staff alteration ,Student Requirement (Like Water, Graph, Tables, Data Book , etc.,,)The examiner has to depend on a man power to convey this information to Examination Cell. This process is time consuming and the student’s requirement may not be fulfilled at the right time. In order to solve the above issues a remote keypad module is given to the exam invigilator which indicate the needs of the examiner. When they press any of these keys, then a signal is sent to the Exam cell via ZigBee communication. The notification will be seen in the virtual panel in the Exam cell so the concerned person can act accordingly.

Keywords: Microcontroller, ZigBee, LCD.

1. INTRODUCTION

As of now there are no existing systems present to indicate the shortage items like question papers, answer sheets and staff/student requirement in the examination hall through wireless transmission. To convey this information the examiner has to depend upon man power. In order to overcome this drawback the project establishes a reliable wireless communication link between the Examiner and the Exam cell.

1.1 LITERATURE SURVEY

COMPARISON OF BLUETOOTH, WI-FI AND ZIGBEE:

Bluetooth is a standard and a communication protocol primarily designed for low power consumption, with a short range based on low-cost transceiver microchips in each device. Bluetooth uses a radio technology called frequency –hopping spread spectrum, which chops up the data being sent [16].

Wi-Fi is a trademark of the Wi-Fi alliance that may be used with certified products that belong to a class of wireless local area network devices. Wi-Fi allows the local area network to be deployed without wires for client devices, typically reducing the costs of network deployment and expansion. Wi-Fi is used in point to hub network topology, which can be used in a range of nearly 100 meters. Wi-Fi technology is selected to be the network infrastructure that connects server and hardware interface modules. Wi-Fi is chosen to improve system security (by using secure WiFi connection), and to increase mobility and scalability[12].Even if, user intends to add new hardware interface modules out of the coverage of central access point, repeaters or managed wireless LAN will perfectly solve that problem. The main functions of the server is to manage, control, and monitor distrusted system components, that enables hardware interface modules to

execute their assigned tasks (through actuators), and to report server with triggered events[5]. ZigBee is a specification for a suite of high level communication protocols using tiny, low-power digital radios based on an IEEE 802.15.4 standard for personal area networks [6]. ZigBee has a defined rate of 250 Kbit/s best suited for periodic or irregular data or a single signal transmission from a sensor or input device ZigBee is a low-cost, low-power, wireless network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries [7].

Category	ZigBee	Bluetooth	Wi-Fi
Distance	50-1000m	50m	10m
Power supply	years	days	hours
Complicity	simple	complicated	Very complicated
Transmission speed	250kbps	1Mbps	1-54Mbps
Frequency range	868Mhz 916Mhz 2.4Ghz	2.4Ghz	2.4Ghz
Linking time	30ms	Up to 10s	Up to 3s
Network nodes	65535	8	50
Security	128 bit AES	64bit, 128 bit	SSID

Thus ZigBee has been chosen as a communication device in my project because of low cost, coverage distance and it can be easily deployed because of simple complicity.

1.2 PROPOSED SYSTEM

Based on the wireless network the project consists of a remote module and a receiver.

REMOTE MODULE

The remote module consists of a keypad, LCD, PIC16F877A and ZigBee.

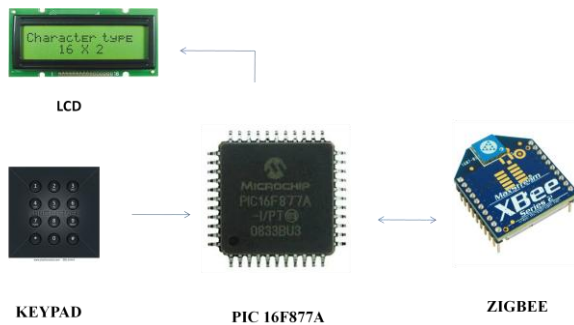


Fig .1 Remote modules

RECIEVER MODULE

The receiver module is the exam cell where the information is displayed in the virtual panel. The receiver module contains PIC16F877A, ZigBee and a personal computer.



Fig .2 Receiver module

ZigBee/IEEE 802.15.4 – General Characteristics: The general characteristics of ZigBee [6]

- PHY (2.4GHz and 868/915 MHz), Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz) , Optimized for low duty-cycle applications (<0.1%) ,CSMA-CA channel access.
- Yields high throughput and low latency for low duty cycle devices like sensors and controls.
- Low power (battery life multi-month to years).-Multiple topologies: star, peer-to-peer, mesh topology.
- Addressing space range of up to: 18,450,000,000,000,000 devices (64 bit IEEE address) and 65,535 network
- Optional guaranteed time slot for applications requiring Dual low latency Fully hand-shaked protocol for transfer reliability
- Range: 150m typical.

As in my project I am in need of coverage of 200m.The ZigBee wireless communication network has been implemented with the use of Digi-Max Stream radio-

frequency modules called XBee modules, which are available in Standard and Pro versions (pin-to-pin compatible). The Standard Xbee modules have an operation range of tens of meters indoors and hundreds of meters outdoors, while the XBee Pro modules have a wider spread range in the order of hundreds of meters indoors and of about 1.5 km outdoors, because the Pro modules have higher transmission power[13].

TRAFFIC TYPES

ZigBee employs either of two modes, beacon or non-beacon to enable the to-and-fro data traffic [1].

The non-beacon mode will be included in a system where devices are 'asleep' nearly always, as in smoke detectors and burglar alarms. The devices wake up and confirm their continued presence in the network at random intervals. On detection of activity, the sensors 'spring to attention', as it were, and transmit to the ever waiting coordinator's receiver (since it is mains powered).However, there is the remotest of chances that a sensor finds the channel busy, in which case the receiver unfortunately would 'miss a call.Thus the non-beacon mode is used for communicating with the exam cell where the devices are 'asleep' always. The devices wake up and confirm their continued presence in the network at random intervals whenever the examiner comes across the issues. On the indication of information the coordinator acts accordingly [1].

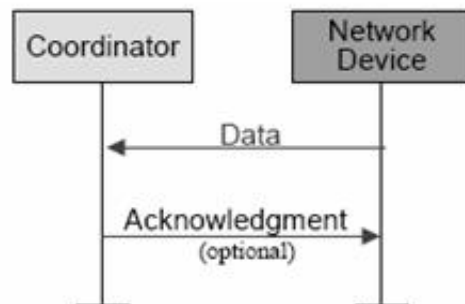


Fig .3 Non-Beacon mode of communication

ZIGBEE DEVICE TYPES

Zigbee devices are of three types [8]:

ZigBee coordinator (ZC):

The most capable device is the coordinator which forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. The exam cell act as o coordinator where it stores information about the exam hall where it acts as the Trust Center & repository for security keys. It is also called Full Function device [14].

ZigBee End Device (ZED):

The end device is the exam hall where the invigilator has the remote keypad module Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a

significant amount of the time thereby giving long battery life. It is also called Reduced Function Device[7][14] . A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than ZR or ZC.

NETWORK TOPOLOGY

Physical Network Topology emphasizes the hardware associated with the system including workstations, remote terminals, servers, and the associated wiring between assets [10]. Physical topology defines how the systems are physically connected.

Star topology:

Star topology is one of the most common network setups where each exam hall of the devices or nodes on a network connects to a central hub exam coordinator [4].

The number of bit processing at a time is different for each microcontroller. The microcontroller 8051 has 8 bit Accumulator allowing 8 bits to process at a time. Whereas the PIC controller can process more than 12 bit at a time.8051 microcontroller has no in built A/D Converters but PIC has it[11].

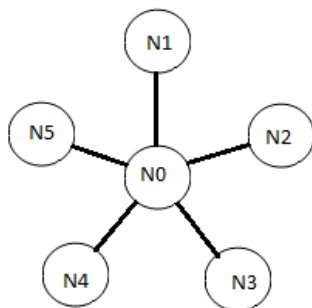


Fig .4 – Star Topology

2. SELECTION OF MICROCONTROLLER

8051 microcontroller is based on CISC architecture while PIC based on RISC architecture. 8051 has 250 instruction which take 1 to 4 machine cycle to execute while PIC has nearly 40 instruction.ARM also have RISC based architecture since ARM is expensive I have selected PIC16F877A.

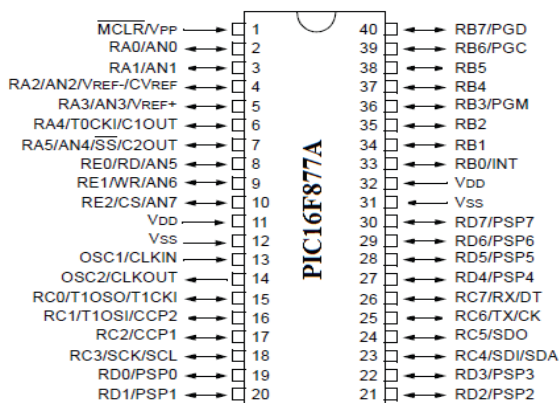


Fig. 5 – Pin configuration of the PIC16F877A

PIC 16F877A

For the development of the system, PIC16F877A microcontroller based on the modified Harvard architecture developed by microchip technology is used. It is a 40-pin dip having low power consumption. It has 256 bytes EEPROM memory and high speed FLASH/EEPROM technology [15]. There is a synchronous serial port in the microcontroller used here which is configured either as a 3-wire Serial Peripheral Interface or a 2-wire Inter-Integrated Circuit bus and a Universal Synchronous Asynchronous Receiver Transmitter

3. ZIGBEE/ZIGBEEPRO HARDWARE INTERFACE WITH MICROCONTROLLER

In the remote keypad module the microcontroller AT89C51 has to be interfaced with ZigBee IEEE802.15.4 for this we have to ensure the hardware connection between Zigbee to microcontroller is complete. Any microcontroller with UART peripheral can be used to interface with ZigBee as shown below [11]:

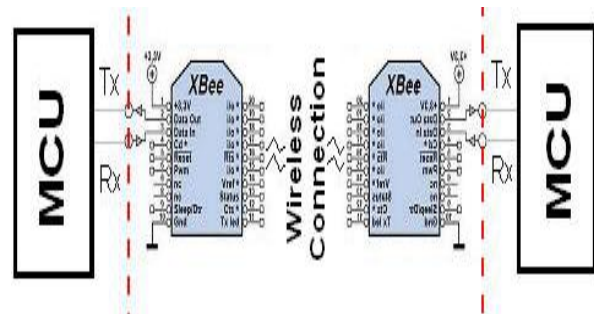


Fig .6 standard ZigBee wireless communication link with microcontroller

The way we will be using the Zigbee is far easier. Straight out of the box, the Zigbee is normally configured for 9600bps serial communication and so to make things easier, we haven't change any of the configuration options. This means we will only be using the Vcc, GND, Din and Dout pins and left other pins unconnected. In Fig.9RXD pin no.3of ZigBee is connected to TXD pin of microcontroller and ZigBee TXD pin no. 2 to RXD pin of microcontroller.

Liquid Crystal Display

A Liquid Crystal Display is dot matrix display that displays alphanumeric characters and symbols. Liquid crystal displays are used in battery powered[11] devices, such as digital watches, calculators, digital thermometers etc. 16X2 LCD has been used in the system to display the information when the examiner press the telephonic keypad.

Keypad matrix

Keypad may be similar as telephone set keypad. Function of this keypad is also same as the telephone. When you press buttons on the keypad, a connection is made that

generates two tones at the same time. A “Row” tone and a “column” tone. These two tones identify the key you pressed to any equipment you are controlling. If the keypad is on your phone, the telephone company “central office” “equipment knows what number you are dialing by these tones, and will switch your call accordingly [2]. If you are using a DTMF keypad to remotely control equipment, the tones can identify what unit you want to control, as well as which unique function you want it to perform. When you press the digit 1 on the keypad, you generate the tones 1209 Hz and 697 Hz. Pressing the digit 2 will generate the tones 1336 Hz and 697 Hz. Sure, the tone 697 is the same for both digits, but it takes two tones to make a digit and the decoding equipment knows the difference between the 1209 Hz that would complete the digit 1, and a 1336 Hz that completes a digit 2 [14]. There are many methods but the basic logic is same.

4. MECHANISM OF DATA TRANSFER

Whenever a device wants to send a data packet, it has to check for channel. If the channel is idle, device can send a packet else it has to wait. If the receiver is FFD then transmitter can send the packet any time because its transceiver always remains ON.

5. SOFTWARE DESCRIPTION

In order to achieve the goal for PIC microcontroller the programming is done by Keil u Vision. Visual Basic software is used in the receiver side allows the programmer to create a virtual panel where the invigilator need is displayed in the personal computer.

6. OUTPUT

The proposed system has been interfaced with a PC to obtain the output in Visual Basic environment. The output displayed in PC consists of the requirement of the examination hall. It also consists of information whether the requirement of the examination hall is cleared or not. The LCD in the remote module displays “Transmitting Data” when any requirement button is pressed. It also displays “Data received” when an acknowledgement is sent from the coordinator’s personal computer on receipt of the required information to the remote module. When information is received in the coordinators personal computer, a pop-up sound is played which helps the coordinator to know that information has arrived.

7. CONCLUSION

Examination Smart Link serves as a reliable and efficient system for communication between Examination hall and Exam cell. Wireless controlling and monitoring of Examination related requirements and activities allow the Examiners to reduce the time required for the information to reach the Exam cell and also help in avoiding misinterpretation of information. It is a device designed to

reduce the man power for communication purpose as it may incur large amount of time. Examination Smart Link is much cheaper in cost, consumes less power.

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