

A Novel Way of Managing Passenger Safety in Railway Through Embedded Circuitry and ZigBee Interface

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Abstract: Technological innovations must be brought to the people who need it maximum. Crime records in moving train has brought the vulnerability of innocent passengers and women folks of our country into a sharper focus now and has made us revisit the present day safety status during surface transportation in train. ZigBee module capable of sending information packets up to a couple of kilometers can relay this information to the motor man's cabin when such modules are fitted in every compartment including the motor man's cabin with some switches for the passengers to request for help during desperate situations.

Keywords: EMI-Electromagnetic Interference, ISM-Industrial, Scientific and medical radio band, Microcontroller, Wi-Fi, ZigBee

I. INTRODUCTION

Railway is the cheapest modes of transportation are preferred over all other means of transportation. When we go through the daily newspapers we come across many incidents are happened in a running train like Maoist attack, fire in a running train, robbery, women are molested, various accidents in a railroad etc. We do know that of-late there are lots of train accidents happening in India. Once everything happened, Government informs some amount of relief packages for the life that has been lost in the mishap. But I think they have not upgraded the technology in order to overcome this problem in the future. Instead of paying compensation to the victims, if they invest that money on Safety measure like placing a Fire Extinguishers, smoke detectors, high end alarms, Collision avoidance mechanism we can overcome. We know how precious human life is. I thought it's a high time for Indian railways to upgrade the technology for the welfare of the passengers. So to save the lives of the passengers and to make the journey of them more secure we are going to propose a new Automatic Railway Security Monitoring System. In this project we use 8051Microcontroller kit interfacing with LCD and ZigBee and some switches. So that whenever some incident will happen passengers in a train just press one switch according to their need and the message will be display in all the compartments along with the engine of the train. So that it is very easier to know for all the passengers in a train what is happened and also the necessary steps should be taken immediately. Each switch is used to display some messages like switch 1 is used to

display fire; switch 2 is used to display help etc. In the similar way if the driver wants to send any message to the passengers he can do it easily. Actually in the foreign countries like Singapore, Canada, Spain etc are used Wi-Fi system CCTV camera etc. for monitoring the security of the passengers in a running train. Installation of Wi-Fi systems on railway tracks, fitting CCTV cameras on the carriage ceilings of the railway coaches and an on line monitoring and a strong back up of railway protection force and its quick mobilization to the spot of distress is the ultimate solution to the problems of our country. This, however, is prohibitively costly for implementation for the entire Rail network. Effective Railway Police system can make railway premises crime free. There should be no incidence of pick-pocketing, theft or looting in those areas. Railway guards should be equipped with effective communication system. But in our country implementation of such kind of security system is possible phase wise in critical and criminal infested areas. For getting over the cost barrier, utilization of latest technologies like ZigBee communication can be tried as a good substitution. Passengers who see any unusual or unsafe activity onboard our trains should contact with the motorman immediately. Railway security guards are equipped to handle a variety of emergency situations. Additionally, the driver can communicate directly with the nearest security set-up to get instant assistance from law enforcement officials and emergency response teams during an emergency. So for the communication between the distressed passengers and the driver of the train should made in no time. Against this back ground, our proposed model, is very effective and can be used for life line for many unsafe exigencies in the speeding carriages of the running train. The purpose of this project is to improve transportation security by developing a prototype system for leveraging the use of microcontroller kits interfacing with ZigBee Module in security applications. This study introduces the idea of utilizing low cost ZigBee technology in emergency communications.

II. ZIGBEE TECHNOLOGY

ZigBee has often been regarded as a mini version of Wi-Fi. Keeping some features like range, power consumption apart, ZigBee and Wi-Fi are often used in similar applications in terms of household based wireless

communication. These short range wireless technologies even share common ISM band of 2.4GHz, use same spread spectrum technique. Interestingly, both of have been developed and proposed in a different mindset and hence some significant differences exist between these two. In the following table we can see the difference between ZigBee and Wi-Fi .ZigBee is given priority over the other short range wireless technologies like Wi-Fi, Bluetooth is that in this project only few bytes of data is to be transferred using short range wireless technologies, no heavy data like Audio or Video is transferred so ZigBee seems to be a good alternative to Wi-Fi and Bluetooth [1].

1. Comparison table between Wi-Fi and ZigBee

Serial No.	Wireless Parameter	Wi-Fi	ZigBee
1.	Frequency Band	2.4 GHz	2.4GHz
2.	Raw data rate	11 mbps	250 kbps
3.	Protocol Stack Size	1MB	32KB 4KB(for limited function end device)
4.	No.of channels	13	16
5.	Interference avoidance method	DSSS	DSSS

Table-1.Comparison between Wi-Fi and ZigBee

III. MICROCONTROLLER

Microcontrollers are usually dedicated devices embedded within an application. For example, microcontrollers are used as engine controllers in automobiles and as exposure and focus controllers in cameras. In order to serve these applications, they have a high concentration of on-chip facilities such as serial ports, parallel input output ports, timers, counters, interrupt control, analog-to-digital converters, random access memory, read only memory, etc. The I/O, memory, and on-chip peripherals of a microcontroller are selected depending on the specifics of the target application. Since microcontrollers are powerful digital processors, the degree of control and programmability they provide significantly enhances the effectiveness of the application. Criteria for selection of microcontroller in any embedded system are -It can provide up to 12MHz-20 MHz speed, 1Serial Port, 128 bytes RAM 4K bytes ROM, 32 I/O pins and 2 Timers all are embedded together in a single chip and wide availability of software development tools such as debugger, compiler, etc [2].

IV. SYSTEM HARDWARE DESCRIPTION

For doing this project we use Educational Practice Board in which Single chip design with 89C51RD2 chip [3]. The board has in circuit programming facility thus eliminating the need of having a separate programmer and on board 64k Flash Program Memory is available. The photocopy of the board is shown in the following figure-1.



Figure-1. The photocopy of the Educational practice Board

V. SOFTWARES

In this research work we use Virtual Program Builder Software which provides the facility to write the program in assembly language and WINISP software is used to download or erase the program to the microcontroller board [3].

VI. DESIGN METHODOLOGY

1. Configuration of the kits as Trans-receiver module through three wire communication

In this project we have configured the two microcontroller kits as a trans-receiver module via 3-wire communication i.e. the connection of TXD pin of kit-1 with the RXD of kit-2 and similarly the TXD pin of kit -2 will be connected with the RXD pin of kit-1 and making common ground of these kits. as shown in the following figure-2.

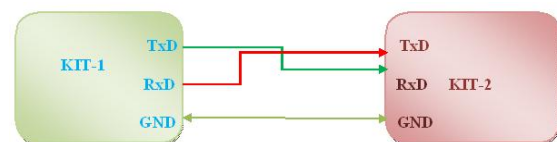


Figure-2.Three wire Communication between the two Microcontroller Kits

These trans-receiver modules can be used for the safety of the passengers in distress in a running train so that whenever any untoward incident happens the passengers in a running train just press the relevant switch for calling attention of the motorman while the selected message will be transmitted and displayed in each and every compartment including that of the engine of the train. Similarly, the driver after receipt of the distress signal initiates appropriate action and replies to the sender about

the action taken by pressing appropriate switch to the great relief of the distressed and helpless passengers. Now these two kits are configured as trans-receiver modules and we have engineered them further so that whenever any key switch is pressed the message will be transmitted and displayed in the LCD screen of the transmitter kit and receiver kit by the three wire communication set up in the laboratory. For receiving the acknowledgement from the driver (kit-2 to kit-1) the corresponding switch can be pressed for transmitting the acknowledgement to the passengers via line communication as shown in the figure-22. We have taken two similar kind of microcontroller kit interfaced with LCD and 5X5 matrix keypad. As discussed earlier, whenever any switch is pressed a message will be displayed and transmitted in the entire train. Each switch is meant to transmit and display a particular telegraphic message, most appropriate to convey the exact kind of distress and its location. For doing this we have configured switch F1 and F2 of the keypad so that when F2 will be pressed the passengers can see the message on the LCD screen as "PRESS_KEY F1" shown in the figure-3. When F1 is pressed the corresponding message "HARASSING WOMEN Comp_2" will be transmitted and displayed on the LCD from the compartment's kit as shown the following figure-4. Similarly the Driver's kit will receive and display that message on the LCD. After seeing that message the driver will be able to reply to that message by pressing the necessary key. The driver's kit also is engineered in the similar way so that when F2 will be pressed and the message "MARSHALS SENT" will be transmitted and displayed on the LCD screen from the driver's kit.



Figure-3 "Press_key F1" display in the LCD



Figure-4. "HARASSING WOMEN Comp_2" display in LCDS.

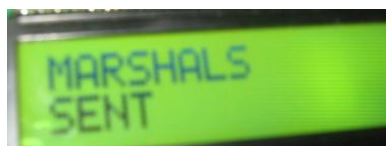


Figure-5. "MARSHALS SENT" message display on the LCDS

2. Limitation of three wire communication

Dealing with noise and electromagnetic interference (EMI) is an inevitable challenge in any high-speed digital design. The disturbance may interrupt, obstruct, or otherwise degrade or limit the effective performance of the circuit for establishing communication in a train [4]. By using ZigBee communication we can easily overcome from these problems and fastest and safest way of communication can be established.

3. Configuration the kits as a trans-receiver module through ZigBee Communication

To establish short communications during emergencies ZigBee technology can be used. We have interfaced the ZigBee modules with the microcontroller kits and also configured the kits further to transmit and receive various messages at the flick of a switch shown in figure-6. In the following figure-7 and figure-8 we can see key switches located at the compartments and the driver's cabin. For example if there is a "HARASSING WOMEN Comp_2" then the switch HARASSING WOMEN can be pressed and the corresponding message will be transmitted and displayed throughout the entire train. After receiving that message, the motor man can rush the appropriate help and press the required switch to communicate that "MARSHALS SENT" and arrange further reinforcements from the approaching junction with/without halting the train as required.



Figure-6 .Photocopy of Microcontroller kits interfacing with ZigBee



Figure-7 . Key Switches located at the Compartments



Figure-8.Key Switches located at the driver's cabin

After accessing the geological and environmental surroundings of the speeding train, the motorman will be able to decide quickly the exact set of actions that are needed to combat the situation after carefully accessing the resources at his disposal and/or will be available from the approaching junction. Corresponding message can be invoked by him to communicate with distressed passengers. In the above fig shows the switches that will be located at the compartments and the driver's cabin. As discussed earlier that if any mishaps occur in a running train the passengers can be able to inform the motor man by pressing the necessary key-switch. After seeing that message the motorman can pressed the necessary switch for giving reply to the passengers and also can inform them about the necessary action which he taken. For example if there is robbery in compartment 13 then the passengers can press the switch robbery and immediately the corresponding message "ROBBERY IN COMP_13" will be transmitted throughout the train through ZigBee Communication. Then the motor man can be able to give reply by pressing the switch force sent and the corresponding message "FORCE SENT" will transmitted and display throughout the train as shown in figure -9 and figure-10.

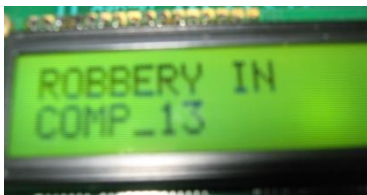


Figure-9. "ROBBERY IN COMP_13" display on LCDs



Figure-10. "FORCE SENT" display on the LCDs

VIII. FUTURE SCOPE

This project can be applied to the moving vehicles like Buss, Cars etc for improving safety of the passengers.

XI. REFERENCE

- [1] <http://en.wikipedia.org/wiki/ZigBee>
- [2] BOOK-The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi and Janice Gillispie Mazidi.
- [3] User's Manual of Edutech System
- [4] PDF on Reducing Electromagnetic Interference (EMI) With Low Voltage Differential Signaling (LVDS)

VII. CONCLUSION

This project work has explain step by step the principle and the use of a low cost state of the art ZigBee technology for effective utilization in combating ZigBee Technology for security related problems. We have demonstrate a method by this all kinds of security hazards can averted or interrupted provided all the security related distress signals are follow up in no time with utmost efficiency.