Volume 4, Issue 2, February 2014 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Automated Pantry Car System

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Abstract— The main aim of the project is to design a system for pantry updating using memory device and wireless communication. The wireless communication system takes the menu from each coach and transmits the information to the pantry section. For wireless communication IEEE 802.15.4 based ZigBee communication protocol is used between Host and Agents to establish wireless communication. ZigBee gives a low data rate, long battery life, and secure networking. It has a defined rate of 250 kbit/s; also the technology defined by the ZigBee specification is simpler and less expensive than other WPANs, such as Bluetooth. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network. 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. Mesh networking provides high reliability and more extensive range. Hence it is used for various applications like wireless home area networks (WHANs), such as wireless light switches with lamps, electrical meters with in-home-displays, and consumer electronics equipment via short-range radio. Another important component which forms the heart of the project and plays an important role in establishing communication between transceivers is the microcontroller which communicates with ZigBee transceiver and sends the data to the transceiver. The microcontroller used is ATmega16 which is a High-performance, Low-power AVR® 8-bit Microcontroller with 16K Bytes in-System Programmable Flash.

Keywords— ZigBee, WPAN, WHAN.

I. INTRODUCTION

Most of the important trains in India have pantry car facilities. the present pantry system in Indian railways is such that a vendor from Pantry service comes and asks for Dinner to the passengers, he tells about the menu and accordingly as per the demand brings the order placed in some time or To ensure proper and good quality catering services on trains and at stations, passengers are requested to Place their orders for meals well in advance, with the Coach Attendant/Conductor or Waiters in Trains to facilitate information being sent to the serving stations. In short if we want to avail the catering facility on board one has to contact the coach attendants or other authorized catering staff or Waiters. The major problems faced in this system are the factor i.e. the passengers have to wait for much more time than required because the limited no of waiters have to satisfy the demand of all passengers. In this system many of the waiters or vendors spend a lot of their time in taking the order from the passengers rather than the time required to serve them. Sometimes there are confusion regarding the items ordered by different people and their bills etc. Some foreign countries have come up with different pantry system to avoid all these problems like Cansolidator Pantry (US):-Featuring SmarTrac technology, the Cansolidator Pantry is a front loading system that automatically rotates up to 40 cans. This adjustable, expandable, stackable system takes the hassle out of can rotation and allows you to organize cans the way you want. The Cansolidator is easy to assemble and guarantees a more organized pantry in minutes. Sturdy, compact, and reliable, the Cansolidator Pantry is the perfect stand-alone solution for any pantry. The Cansolidator Pantry holds both small and medium cans. Rotates cans on a first in first out basis, holds up to 40 cans Holds over 100 pounds. It has adjustable width (20" at its widest) and units can be stacked for space optimization. But still this system has some drawbacks. In order to avoid all these problems faced by the present pantry system in railways we can implement an automated railway pantry system using a microcontroller and the ZigBee module as the heart of our circuit. This automated system will remove all of the problems faced by the present system.

ZigBee is a low-cost, low-power, wireless mesh networking standard. First, the low cost allows the technology to be widely deployed in wireless control and monitoring applications. Second, the low power-usage allows longer life with smaller batteries. Third, the mesh networking provides high reliability and more extensive range. The ZigBee Alliance is an association of companies working together to enable reliable, cost-effective, and low-power wirelessly networked monitoring and control products based on an open global standard. As per its main role, it standardizes the body that defines ZigBee, and also publishes application profiles that allow multiple OEM vendors to create interoperable products.

II. LITERATURE REVIEW

The name "ZigBee" refers to the waggle dance of honey bees after their return to the beehive. The past several years have witnessed a rapid development in the wireless network area. So far wireless networking has been focused on high-speed and long range applications. However, there are many wireless monitoring and control applications for industrial and home environments which require longer battery life, lower data rates and less complexity than those from existing standards. What the market need is a global standard that meets the requirement for reliability, security, low power and low cost. For such wireless applications a new standard called ZigBee has been developed by the ZigBee Alliance based upon the IEEE 802.15.4 standard. ZigBee-style networks began to be conceived around 1998, when many installers realized that both Wi-Fi and Bluetooth were going to be unsuitable for many applications. In particular, many engineers saw a need for self-organizing ad-hoc digital radio networks. The IEEE 802.15.4-2003 standard was completed in May 2003 and has been superseded by the publication of IEEE 802.15.4-2006 The ZigBee Alliance was announced in October 2004 The ZigBee specifications were ratified on 14 December 2004. The ZigBee Alliance announced availability of Specification 1.0 on 13 June 2005, known as ZigBee 2004 Specification. In September 2006, ZigBee 2006 Specification is announced. In 2007, ZigBee PRO, the enhanced ZigBee specification was finalized. ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network. ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. As ZigBee is a low-cost, low-power, wireless mesh 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. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee is not intended to support power line but to interface with it at least for smart metering and smart appliance purposes.

Typical application areas of Zigbee include Home Entertainment and Control — Home automation, smart lighting, advanced temperature control, safety and security, movies and music Starting with individual sensors like Telosb/Tmote and Iris from Memsic, Industrial control, Embedded sensing, Medical data collection, Smoke and intruder warning, Building automation.

III. SYSTEM ARCHITECTURE & WORKING

A. ZigBee

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless home area networks (WHANs), such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment via short-range radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

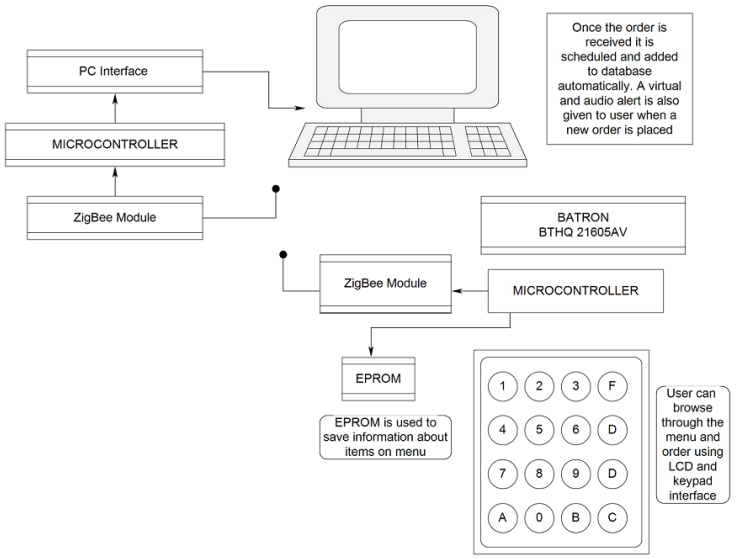

Fig. 1 Block Diagram for Transmission & Reception.

Our aim is to build an automated wireless pantry order system using ZigBee. We shall provide each bogie/compartment with a microcontroller based order placement unit. The unit shall have a keypad to browse through the menu. The menu items, their cost and information shall be displayed on the LCD connected to microcontroller. User can navigate through menu using keypad provided. The data for the menu can be written on an EEPROM connected to each such microcontroller based unit, so that portable data updating is possible (by changing only the EEPROM). Upon finalizing the order the user will be able to place it using keypad. The order placed shall be transmitted to the central server (PC) which will also have a ZigBee module connected to it for data reception. Multiple such slave units can be installed; one in each compartment and so on.

Table 1 Specification for ZigBee.

Specification	**XBee**	**XBee-PRO**
Performance		
Indoor/Urban Range	Up to 100 ft (30 m)	Up to 300 ft. (90 m), up to 200 ft (60 m) International variant
Outdoor RF line-of-sight Range	Up to 300 ft (90 m)	Up to 1 mile (1600 m), up to 2500 ft (750 m) international variant
Transmit Power Output (software selectable)	1mW (0 dBm)	63mW (18dBm)* 10mW (10 dBm) for International variant
RF Data Rate	250,000 bps	250,000 bps
Serial Interface Data Rate (software selectable)	1200 bps - 250 kbps (non-standard baud rates also supported)	1200 bps - 250 kbps (non-standard baud rates also supported)
Receiver Sensitivity	-92 dBm (1% packet error rate)	-100 dBm (1% packet error rate)
Power Requirements		
Supply Voltage	2.8 – 3.4 V	2.8 – 3.4 V
Transmit Current (typical)	45mA (@ 3.3 V)	250mA (@3.3 V) (150mA for international variant) RPSMA module only: 340mA (@3.3 V) (180mA for international variant)
Idle / Receive Current (typical)	50mA (@ 3.3 V)	55mA (@ 3.3 V)
Power-down Current	< 10 µA	< 10 µA
General		
Operating Frequency	ISM 2.4 GHz	ISM 2.4 GHz
Dimensions	0.960” x 1.087” (2.438cm x 2.761cm)	0.960” x 1.297” (2.438cm x 3.294cm)
Operating Temperature	-40 to 85º C (industrial)	-40 to 85º C (industrial)
Antenna Options	Integrated Whip, Chip or U.FL Connector, RPSMA Connector	Integrated Whip, Chip or U.FL Connector, RPSMA Connector
Networking & Security		
Supported Network Topologies	Point-to-point, Point-to-multipoint & Peer-to-peer	
Number of Channels (software selectable)	16 Direct Sequence Channels	12 Direct Sequence Channels
Addressing Options	PAN ID, Channel and Addresses	PAN ID, Channel and Addresses
Agency Approvals		
United States (FCC Part 15.247)	OUR-XBEE	OUR-XBEEPRO
Industry Canada (IC)	4214A XBEE	4214A XBEEPRO
Europe (CE)	ETSI	ETSI (Max. 10 dBm transmit power output)*

Japan	R201WW07215214	R201WW08215111 (Max. 10 dBm transmit power output)*
Australia	C-Tick	C-Tick

- ADC and I/O line support
- Analog-to-digital conversion, Digital I/O I/O Line Passing
- Easy-to-Use
- No configuration necessary for out-of box
- RF communications
- Free X-CTU Software (Testing and configuration software)
  AT and API Command Modes for configuring module parameters
- Extensive command set
- Small form factor

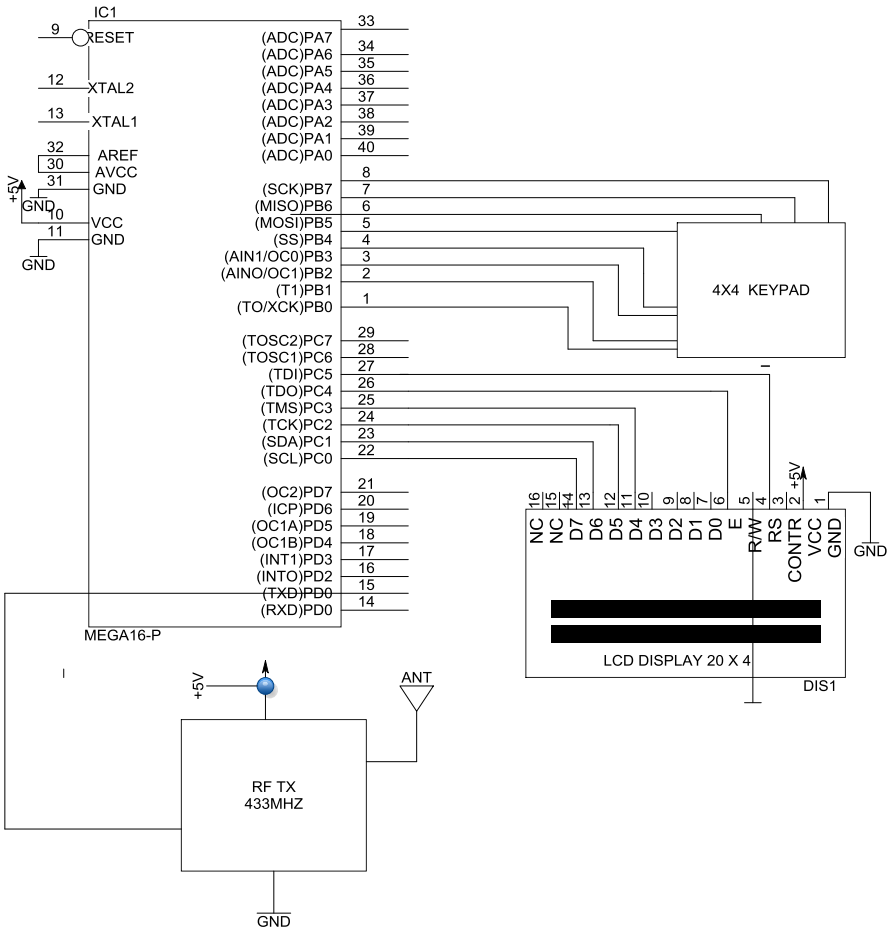

Fig. 2 Pin Diagram for Transmission and Reception.

B. COMPONENTS

1. ATMEGA16, 8-bit Microcontroller with 16K Bytes in-System Programmable Flash

It is a power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

Features

i. High-performance, Low-power AVR 8-bit Microcontroller

ii. Advanced RISC Architecture

- 131 Powerful Instructions – Most Single-clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 16 MIPS Throughput at 16 MHz
- On-chip 2-cycle Multiplier

iii. Nonvolatile Program and Data Memories

- 16K Bytes of In-System Self-Programmable Flash Endurance: 10,000 Write/Erase Cycles
- Optional Boot Code Section with Independent Lock Bits In-System Programming by on-chip Boot Program

True Read-While-Write Operation
- 512 Bytes EEPROM Endurance: 100,000 Write/Erase Cycles
- 1K Byte Internal SRAM
- Programming Lock for Software Security

iv. JTAG (IEEE std. 1149.1 Compliant) Interface
- Boundary-scan Capabilities According to the JTAG Standard
- Extensive On-chip Debug Support
- Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface

v. Peripheral Features
- Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
- O n e 16-bit Timer/Counter with Separate Prescaler, Compare Mode and Capture Mode.
- Real Time Counter with Separate Oscillator
- Four PWM Channels
- 8-channel, 10-bit ADC
- 8 Single-ended Channels
- 7 Differential Channels in TQFP Package Only
- 2 Differential Channels with Programmable Gain at 1x, 10x, or 200x
- Byte-oriented Two-wire Serial Interface
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator

vi. Special Microcontroller Features
- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby.

vii. I/O and Packages
- 32 Programmable I/O Lines
- 40-pin PDIP, 44-lead TQFP, and 44-pad MLF

viii. Operating Voltages
- 2.7 - 5.5V for ATmega16L
- 4.5 - 5.5V for ATmega16

ix. Speed Grades
- 0 - 8 MHz for ATmega16L
- 0 - 16 MHz for ATmega16

2. Systronix 20x4 LCD

Here is brief data for the Systronix 20x4 character LCD. It is a Data Vision part and uses the Samsung KS0066 LCD controller. This 20x4 LCD is electrically and mechanically interchangeable with 20x4 LCDs from several other vendors. The only differences we've seen among different 20x4 LCDs are: 1) LED backlight brightness, voltage and current vary widely, as does the quality of the display 2) There is a resistor "Rf" which sets the speed of the LCD interface by controlling the internal oscillator frequency. Several displays we have evaluated have a low resistor value. This makes the display too slow. Looking at the Hitachi data sheet page 56, it appears that perhaps the "incorrect" resistor is really intended for 3V use of the displays. At 5V the resistor Rf should be 91 Kohms. At 3V it should be 75 Kohms. Using a 3V display at 5V is acceptable from a voltage standpoint (the display can operate on 3-5V) but the oscillator will then be running too slowly. One fix is to always check the busy flag and not use a fixed time delay in your code, and then it will work regardless of the LCD speed. The other option is to always allow enough delay for the slower display.All Systronix 20x4 LCDs have the 91 Kohm resistor and are intended for 5V operation

Table No. 2: Specification of Pin Diagram

Pin	Name	Direction	Description
1	VCC	-	Power supply
2	DOUT	Output	UART Data Out
3	DIN / **CONFIG**	Input	UART Data In
4	DO8*	Output	Digital Output 8
5	**RESET**	Input	Module Reset (reset pulse must be at least 200 ns)

6	PWM0 / RSSI	Output	PWM Output 0 / RX Signal Strength Indicator
7	PWM1	Output	PWM Output 1
8	[reserved]	-	Do not connect
9	DTR / SLEEP_RQ / DI8	Input	Pin Sleep Control Line or Digital Input 8
10	GND	-	Ground
11	AD4 / DIO4	Either	Analog Input 4 or Digital I/O 4
12	**CTS** / DIO7	Either	Clear-to-Send Flow Control or Digital I/O 7
13	ON / **SLEEP**	Output	Module Status Indicator
14	VREF	Input	Voltage Reference for A/D Inputs
15	Associate / AD5 / DIO5	Either	Associated Indicator, Analog Input 5 or Digital I/O 5
16	**RTS** / AD6 / DIO6	Either	Request-to-Send Flow Control, Analog Input 6 or Digital I/O 6
17	AD3 / DIO3	Either	Analog Input 3 or Digital I/O 3
18	AD2 / DIO2	Either	Analog Input 2 or Digital I/O 2
19	AD1 / DIO1	Either	Analog Input 1 or Digital I/O 1
20	AD0 / DIO0	Either	Analog Input 0 or Digital I/O 0

3. XBee/XBee-PRO RF Modules

The XBee and XBee-PRO RF Modules were engineered to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between devices. The modules operate within the ISM 2.4 GHz frequency band and are pin-for-pin compatible with each other.

Features

i. Long Range Data Integrity

XBee

- Indoor/Urban: up to 100’ (30 m)
- Outdoor line-of-sight: up to 300’ (90 m)
- Transmit Power: 1 mW (0 dBm)
- Receiver Sensitivity: -92 dBm

XBee-PRO

- Indoor/Urban: up to 300’ (90 m), 200' (60 m) for International variant
- Outdoor line-of-sight: up to 1 mile (1600 m), 2500' (750 m) for International variant
- Transmit Power: 63mW (18dBm), 10mW (10dBm) for International variant
- Receiver Sensitivity: -100 dBm
- RF Data Rate: 250,000 bps

ii. Advanced Networking & Security

iii. Retries and Acknowledgement

iv. Low Power

XBee

- TX Peak Current: 45 mA (@3.3 V)
- RX Current: 50 mA (@3.3 V)
- Power-down Current: < 10 µA

XBee-PRO

- TX Peak Current: 250mA (150mA for international variant)
- TX Peak Current (RPSMA module only): 340mA (180mA for international varian
- RX Current: 55 mA (@3.3 V)
- Power-down Current: < 10 µA

v. ADC and I/O line support

- Analog-to-digital conversion, Digital I/O I/O Line Passing

vi. Easy-to-Use

- No configuration necessary for out-of box
- RF communications
- Free X-CTU Software (Testing and configuration software)
  AT and API Command Modes for configuring module parameters

- Extensive command set
- Small form factor

IV. RESULT

After running file in VB, the Output is shown as follows.

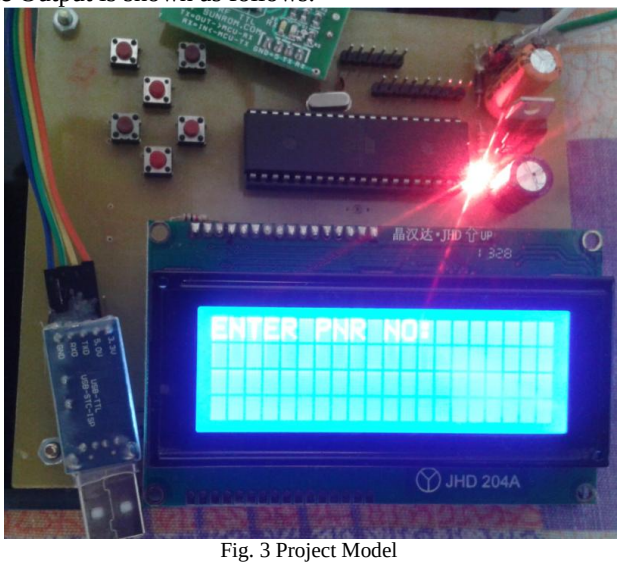

Fig. 3 Project Model

This is the project model for Pantry Car system. After running the program in VB and connecting the ZigBee module to USB port, the LCD 20 X 4 displays will show "ENTER PNR NO." After entering the PNR NO. Click on Menu button then the Display will show the menus as follows

Fig. 4 LCD Display Showing the Menu entered

After entering the Menu the system will show the final total amount on LCD display as follows

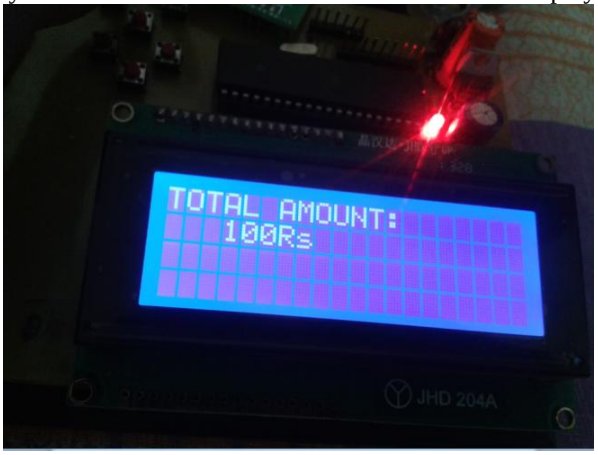

Fig. 5 LCD display showing the total amount

After showing the Amount on display the order will be sent on receiver side with the help of ZigBee module connected to receiver side as shown follows

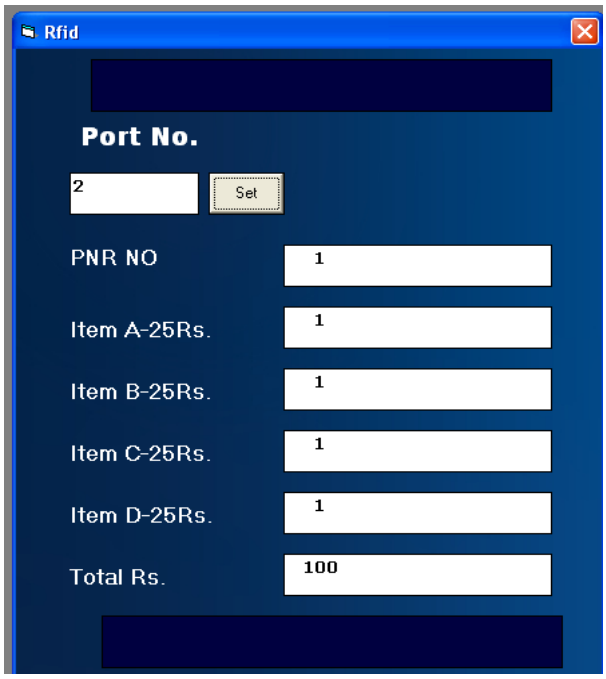

Fig. 6 Order showing on receiver side

After that bill will be printed on both the side i.e. transmitter as well as receiver.

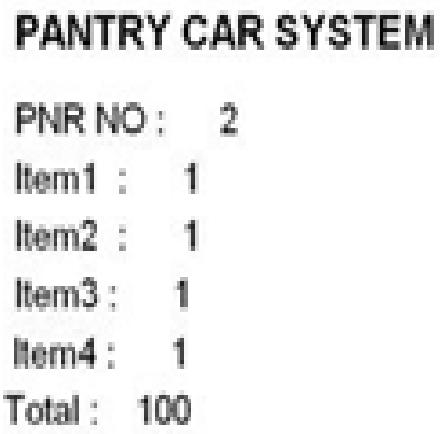

Fig. 7 Printed Bill

V. CONCLUSION

Wireless technology is becoming more and more popular because of its low cost and ease-of-use. This technology allows us a faster and more convenient access to the world. ZIGBEE technology provides the world with a variety of wireless applications. The Restaurant Automation not only gives the customers an insight into how their food is being prepared but also the nutritional content that it carries. It is amazing that the customers can actually see their food even before it's delivered to them. The Restaurant automation is a revolutionary concept & is sure to take people by surprise. It will undoubtedly change the way people dine & their dining habits. It would lead to increased revenues; give the customer a better insight into the kind of food they wish to have, given them a great touch experienced.

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