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SMART MULTI-STORED ROTARY CAR PARKING SYSTEM

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ABSTRACT: ***We are living in the 21st century, where number of cars increasing day by day and the requirement of spaces for Parking those number of car is less. So space has become a very big problem and hence it's become a very crucial necessity to avoid the wastage of space. Lack of space availability has always been a problem. The major cities are car parked callously on the streets. Hence, rotary car parking system could be one of alternative solution. In order to handle the issue of parking in busy places various types of vehicle parking systems are used worldwide namely Multi-level Automated Car Parking, Automated Car Parking System, Volkswagen Car Parking[1] and many more. This makes the system modernized and evens a space-saving one. This idea is developed by using Atmega16 Microcontroller.***

Keywords: **Rotary car parking system,**

I. INTRODUCTION

Aim of the proposed work is to develop the Automatic rotary car parking system which can be used for parking number of cars on very less amount of place. The rotary model is specifically designed to accommodate multiple cars in the horizontal space of two. The structure can accommodate six cars in the space of two and can even be customised to hold a greater number depending upon the requirements of the user and can be efficiently put to use in much space crunched areas. Parking spaces cannot cope with the growth of the number of vehicles. The system will consist of Keyboard section, Display section and Car parking section. The car parking section consists of six pallets for parking the cars. The pallets are connected with a rotary assembly which will rotate the pallets in clockwise direction with the help of stepper motor. The rotary assembly is mechanical structure which consists of chains placed on the gears, as gears rotate the chain will also rotate and as soon as the chain rotates the pallets will also rotates. Stepper motor rotates according to the signals from the microcontroller.Atmega16 Micro-controller is used to perform various actions like Get key inputs from keyboard, Send message to display section. LCD is used to display various messages.

Car Parking can be categorized in two types, which is conventional/self parking, and mechanical /elevator automated. Conventional Parking consists of layout, ramp and floor system. But this system consumes space. A Mechanized car park system can be defined as optimum spaced car storage with the aid of mechanical system powered by electrical source and has automatic storage and retrieval method. Therefore it is the possible solution for parking problem. As per shown in figure. Rotary car parking concept is one of mechanized car park system where it is an automatically controlled parking system with a vertical chain drive and storage shelves arranged on both sides. The main idea is to stack six cars in a space normally occupied by two cars. A rotary chain drive is used to drive the system.

.Fig. Smart Multi-Stored Rotary Car Parking System Concept

II. MECHANICAL ASSEMBLY

Mechanical assembly is nothing but car parking structure itself. Here the two gears are attached on either end of the single shaft and likewise two shafts are made. One shaft is placed on the top of the structure and other shaft is placed at the bottom side of the structure. A metal chain is placed on the gear of the both shaft in such manner that the right gears of the upper and lower shaft are connected with same chain. Same is done with left side gears.

The shafts are placed using the small ball bearings that allows the very low frictional force on the rotating structure.

Materials of mechanical structure:

- Iron rode of 1 inch width.
- Motor –bike Chains
- Gears
- Aluminum Sheet
- Plywood
- Shaft
- Ball-Bearings
- Plastic Gears
- Welding rod

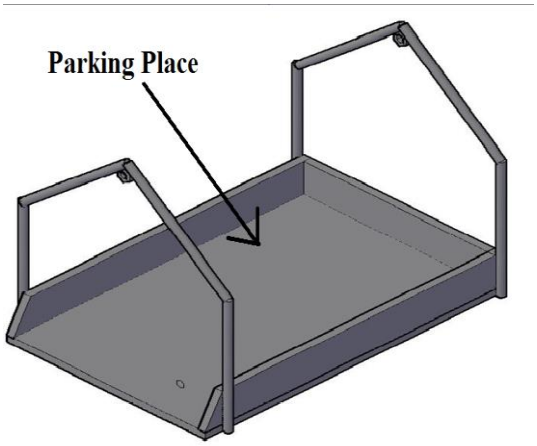

Fig. Parking Pallet place

III.HARDWARE IMPLEMENTATION

This project is developed around the Microcontroller Atmega16. The Atmega16 Microcontroller was chosen because of its versatility and ease of availability. The main function of the Atmega16 microcontroller is to sense the channels and send it via serial communication.

This system was designed automatic rotary car parking system. In this system we can park minimum 6 numbers of cars in circular manner or pattern. We implemented 6 pallets to park the cars. For this system operation Atmega16 controller and we interface it with stepper motor, keyboard, Camera unit and LCD display.

Stepper motor is used to rotate the pallets in circular pattern. Keypad is used to get the required pallet at the ground level so that user can park or unpark his or her car. LCD is used to display the commands like Please wait, Thank you and Welcome to car parking system. Camera unit is used for security purpose.

Now the question is how does this system works?

At the start the first pallet is by default at the ground level. So any user can park his car in that pallet. Once he parked his car and come out from the system then the operator will press the enter key on the keypad and "Please wait" command will be displayed on the LCD. Hence the next pallet comes to the ground level then LCD will display "Thank you" command and next car get parked. This procedure is repeated till all the pallets are fully loaded.

But in case before the fully loaded condition any user wanted to unpark his car then also we can get his car at ground level by just simply pressing his pallet number on the keypad where he parked his car.

This is how our car parking system works. This system reduces the space which is required for ground level parking as well as it provides more security for the cars.

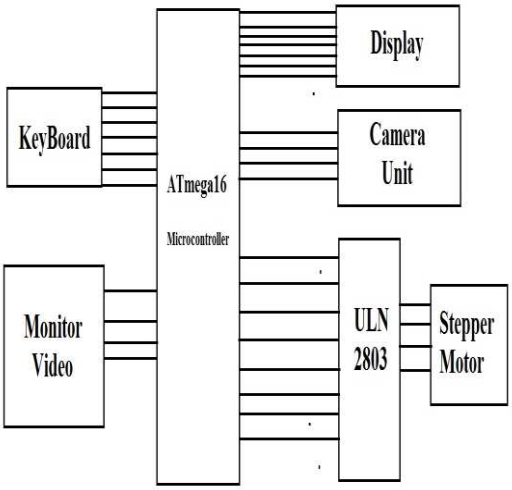

Fig. Block Diagram of Car Parking System

Embedded Controlling system:

1. Atmega16 Microcontroller

For controlling of this system, we are using ATMEGA16 microcontroller. The stepper motor unit (including ULN2803 motor driver IC) interface with the ATMEGA16 controller to rotate the mechanical structure. Each pallet is drive with the stepper motor. Keypad unit interface with the ATMEGA16 controller to enter the exact pallet number to park or unpark the car in desire pallet. LCD display unit interface with the ATMEGA16 controller to display the message or instruction for user. Wireless camera unit used for security purpose, video through the camera continuously monitor & displayed it on pc in monitoring room.

Atmega16 Microcontroller can best handle the computing needs of the task most effectively. This is the main central controller of the complete hardware. Its job is to scan all the channels continuously from keypad. Atmega16 Micro-controller also accept the signals coming from the keypad and according to that it executes the instruction to rotate the stepper motor and displays regarding message on the Lcd display.

2. ULN2803

A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads. The chip takes low level signals (TLL, CMOS, PMOS, NMOS - which operate at low voltages and low currents) and acts as a relay of sorts itself, switching on or off a higher level

signal on the opposite side. A TTL signal operates from 0-5V, with everything between 0.0 and 0.8V considered "low" or off, and 2.2 to 5.0V being considered "high" or on. The maximum power available on a TTL signal depends on the type, but generally does not exceed 25mW (~5mA @ 5V), so it is not useful for providing power to something like a relay coil. Microcontroller and other electronic devices frequently generate TTL signals. On the output side the ULN2803 is generally rated at 50V/500mA, so it can operate small loads directly. Alternatively, it is frequently used to power the coil of stepper motor. In electrical terms, the ULN2803 uses the low level (TTL) signal to switch on/turn off the higher voltage/current signal on the output side.

We have used the 16 by 2 LCD that means that it can display the two lines containing 16 characters each. The Pixel Matrix is of 7 by 5 pixels that are each character can be displayed using 7 columns of the pixels and 5 rows of the pixels**.** It will display the message given by the microcontroller.

IV. SOFTWARE IMPEMENTATION

1. AVR Studio6

Atmel® AVR Studio® 5 is the Integrated Development Environment (IDE) for developing and debugging embedded Atmel AVR® applications. The AVR Studio 5 IDE gives seamless and easy-to-use environment to write, build, and debug your C/C++ and assembler code. This Software used for programming of the ATMEGA16 controller using embedded C language. Hex file of program will be burn into the controller using boot loader programming technique.

2. Proteus7 professional

Proteus is a single integrated application with ISIS, ARES and 3D Viewer modules appearing as tabbed modules. The program enables changes on the schematic to be reflected across PCB, BOM and Design Explorer in real time. Proteus stores the design (DSN), layout (LYT) and common database in a single project file (PDSPRJ). Proteus software is used for designing & implementation of circuit of project & debug analysis code through the software.

General Logic of Program:

Initially msg displayed on LCD Display "Enter Your Choice: 1: Park, 2: Unpark".
If the user selected 1: choice of parking then Again msg will display on LCD Display "Enter Your Pallet:"
Key Present on keypad 1, 2, 3, 4, 5, 6, 7, 8, 9, OK, 0, EXIT.
For pallet option only 1-6 key will be enable.

In feature scope we can use all key for password protection. After pressing desire pallet key Stepper motor will move forward until selected pallet comes down. Afterward user will be able to park the car. While user doing the procedure of parking car, keypads all key will be deactivated except 'OK' and 'EXIT' Key & same motor movement will be standstill in this parking state. In this case buzzer alarm will be used for safety. This is for user safety purpose. In parking state, "Car Parked?"Press OK"
Msg continuously displayed on LCD. After Pressing 'OK' key again "Thank You" Msg will be displayed and again starting msg "Enter Your Choice:"1: Park, 2: Unpark"
Msg displayed and starting procedure will be continued.

Same procedure will be follow in case of "2: Unpark" option. While user parking or unparking the car in the pallet, by pressing the 'EXIT' key, user can exit from procedure. Logic will be varying at real time implementation.

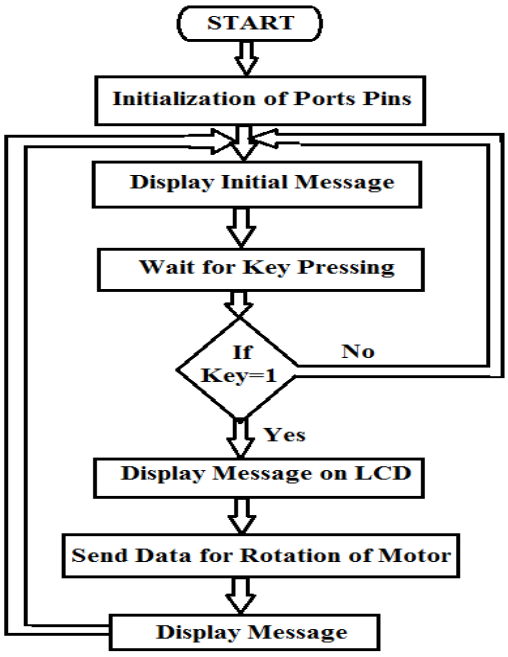

Fig. Flowchart of Working Steps

At the start the system is in off status. When we provide the supply to the system, the "Welcome" message will be displayed on the LCD. That is "Welcome to Smart Car Parking". Now keypad comes into the picture, when we press key on the keypad, first "Please wait" message will be display on the LCD. After that the command will go to stepper motor and it will start rotating till that number which we pressed on the keypad.

Once the motor stop rotating "Thank you" message will be display on the LCD. Now next time when we press any key on the keypad then the respective pallet will come down with compare to the ground level pallet. The same process repeats continuously whenever we press any key on keypad.

V. MATHEMATICAL EQUATION

- Output Step Angle.
- Power & Size Constraints.
- Running Torque.
- Load, Friction & Speed.

We are going to use Unipolar Stepper Motor for this project.

- Stepper Motor Output step: 1.8 degree at full wave drive.
- Power: 12V DC /400mA.
- Torque: choose on the base load.
- Load carrying capacity: Up to 5-8 kg around.
- Speed: 300 rpm.
- Output Step angle explained in details: Most affected parameter which we have to consider in software program.

Maths Formulae:

- Step per Revolution: 360 degree / step angle degree.
- Step angle = 360 / SPR
- SPR = NR * no. of Motor phase

Where, SPR - No. of Step per Revolution
NR - Total No. of Rotor teeth.

Unipolar Stepper Motor Specification: 1.8 degree step angle.

- Step angle of full mode sequence =360/ 4=90 degree.
- Step angle of half mode sequence =360/8=45 degree.
- Step per Revolution = 360/1.8=200

We need to give 200 rotation commands to motor in Full Mode sequence or 400 rotation commands in Half Mode sequence.

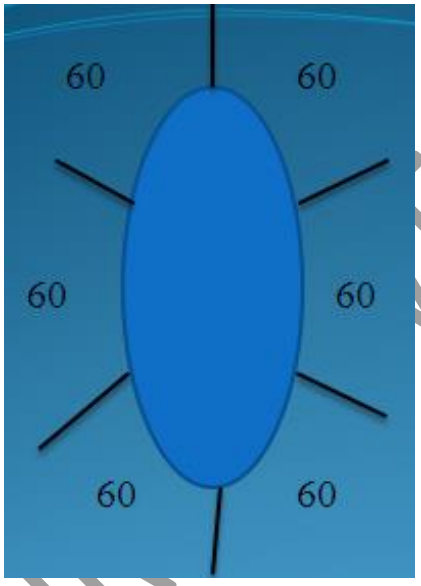

Fig. Structure Design with stepper motor angle.

Pallet located 60 degrees from each other. We need to rotate this structure as a Giant wheel with 60 degree angle only, because we have design 6 pallets in this Smart Car Parking system.

Then each pallet situates in 60 degree.

- Step per 60 degree = 60/1.8 degree = 33.33.

II. HEALTH MONITORING SYSTEM

A.System Overview

The system mainly consists of sensing unit, monitoring unit and controlling unit. The sensing unit is used to measure temperature, heart beat rate and fall detection of a patient from different sensors. Microcontroller is responsible for collecting data from different sensors and does analogue to digital conversion. The monitoring is done through GUI made using LABVIEW and also a SMS is sent to doctors in critical conditions [2].

Fig. 1 shows the functional block diagram of the monitoring system. The several inputs such as temperature, heart beat rate, and fall detection from the various sensors are acquired and processed. The results are sent through the ZigBee Module to a host computer. The values are displayed on the Graphical User Interface (GUI) running on a computer. In case of any emergencies message will be sent to the particulars. The system design is made modular to add extra sensors for measuring and monitoring other parameters too [1].

B. Sensing Unit

The system consist of temperature sensor, heart beat rate sensor and impact sensor used to monitor physiological parameters of patient like temperature, heart beat rate and fall detection respectively. The analogue output of sensors is converted into digital values by an ADC of microcontroller. The data is then sent to USART of microcontroller and then through Zigbee, the ATXMEGA microcontroller sends the data to the monitoring unit.

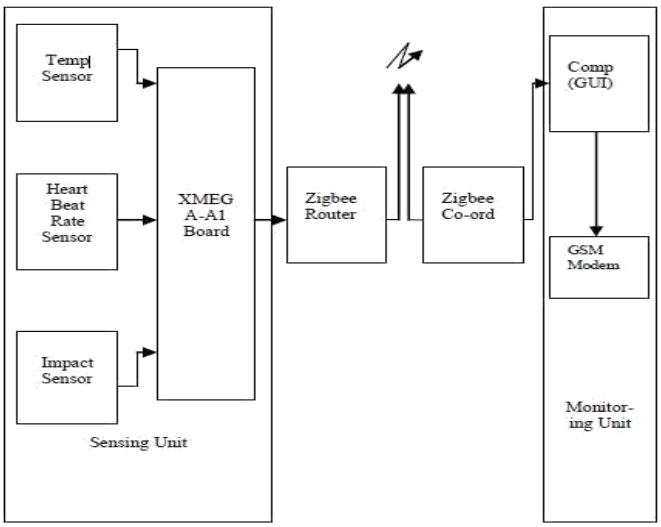

Fig.1 System Overview

1) Zigbee: Wireless Transmission

Zigbee is IEEE 802.15.4 standard based communication protocol, known as Wireless Personal Area Networks (WPAN). The Zigbee is used in most of the industries for wireless transmission due to its low cost, low power consumption and low data rate (up to 250 kbps). The system has zigbee router and co-ordinator, which will have the wireless communication and through which the physiological parameters will be transmitted. The data i.e. physiological parameters received through zigbee serial board, is then sent to PC and on the zigbee terminal i.e. X-CTU the data can be seen [11].

C. Monitoring Unit

The wireless communication is held between zigbee; physiological parameters are received and displayed on PC. Here using GUI the data is monitored continuously. The higher fluctuations in rate of physiological parameters are analyzed and signal will be sent to doctors through GSM.

1) Graphical User Interface (GUI)

The Graphical User interface in LABVIEW is used to monitor the physiological parameters graphically. LABVIEW is a graphical programming language as it uses icons to create applications instead of lines of text. In LABVIEW user interface is designed with a set of tools and objects. NI LABVIEW software helps you acquire data from any standalone instrument over any bus and provides extensive libraries for signal processing and data visualization. Here VISA functions are used to read and write the data serially [8].

2) GSM: Emergency Case

Global System for Mobile Communications (GSM) is a global digital mobile communication system, where the limited data or text message can be transmitted [12]. A GSM modem which consist of a SIM card to operate in wireless carrier and is connected to computer through USB cable or a serial cable [2]. In this system GSM is used to send SMS to medical professionals; if there are high fluctuations in any of the physiological parameters. This will provide help to patients as soon as possible.

D. Basic Components Used

1) Microcontroller: ATXMEGA128A1

The ATXMEGA128A1 microcontroller present on XMEGA-A Board is used to acquire the physiological parameters from sensing unit. The operating frequency of microcontroller is 0-32MHz and its operating voltage range is from 1.6 to 3.6 V. It has two sixteen channel-12 bit ADCs and eight USARTs. The ADC and USART of microcontroller will be used here, for analogue to digital conversion and communication respectively [4].

2) Zigbee series 2

The Zigbee module used in this wireless sensor network is an XBEE module built by, DIGI International. The main advantage of using this module is low cost and low power consumption. The zigbee series 2 uses ISM frequency band of 2.4 GHz. Its indoor range is up to 40 meters and outdoor range is up to 130 meters [7].

3) Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. It is used to measure the body temperature in degree Celsius. It has sensitivity of +10 mV/°C and has typical accuracies ±¼°C at room temperature; ±¾°C over a full −55°C to +150°C temperature range.[5].

4) ECG Sensor

In human body, the heart is one of the important organ. From ECG, the heart beat rate is observed by detecting the voltages created by the heart during its beating. The Fig. 2 shows ECG electrodes [9] that can act as a sensor for measuring ECG.

Fig. 2 ECG Electrode

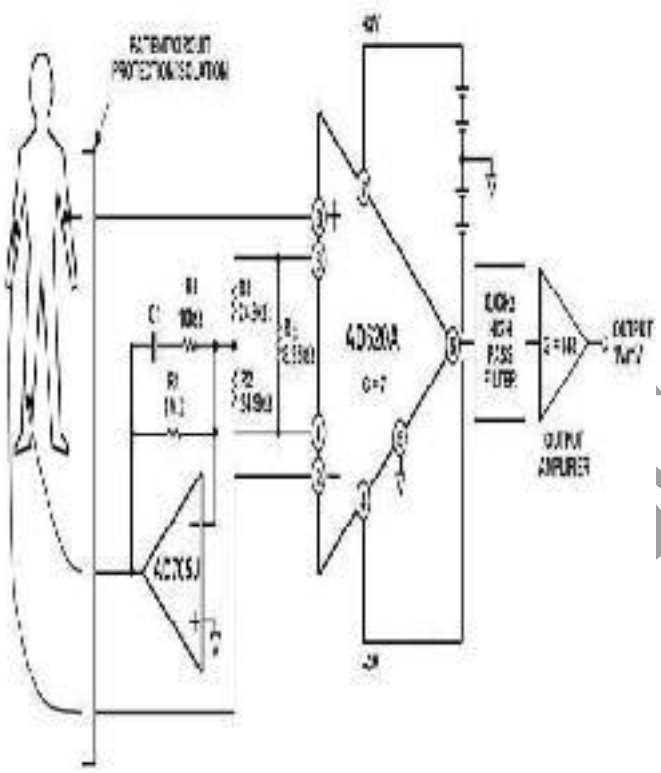

Fig. 3 Instrumentation Amplifier

Fig. 3 shows the instrumentation amplifier for ECG. The instrumentation amplifier is required to boost the ECG signal acquired from the patients. The AD620 instrumentation amplifier is low current noise which allows its use in the ECG monitors. The capacitor C1 maintains the stability of right leg drive loop. An isolation addition to this circuit may protect the patient from possible danger [10]. The analogue output value of the instrumentation amplifier is filtered and converted into digital value by ADC of controller, and then is sent via zigbee.

5) Impact Sensor

The impact sensor is used for fall detection due to instabilities and prevents injuries to patients. ADXL335 is a 3 axis accelerometer which is used here as impact sensor. It has sensitivity of 360 mV/g and 195 mV/g at 3.6V and 2Vrespectively. The output signals are analogue voltages that are proportional to acceleration. This sensor is fitted on chest of apatient, as chest is the high location which will have more changes in acceleration [6].

III. SOFTWARE and HARDWARE TOOLS

A. ATMEL STUDIO 6.1

The AVR Studio 6 is the new integrated modern and powerful development environment from Atmel. It supports all 8-bit and 32-bit microcontrollers, also carries and integrates the AVR GCC tool-chain, AVR Software framework, assembler and simulator [14].

B. LABVIEW

LABVIEW is a system design platform and development environment for a visual programming language from National Instruments. It adds power and flexibility through software [8]. The various functions like VISA Read, VISA Write, VISA Configure Serial Port, String Subset function and Search/ Split function. Each string of Temperature, Impact and ECG is sent with headers. Theses strings are separated using string subset and search/split string.

C. X-CTU

The Windows-based application provided by DIGI, X-CTU is used in this system to monitor the parameters. A graphical user interface to RF products which is simple and a design to interact with firmware files present on RF products of DIGI is provided here[13].

D. XMEGA-A1 BOARD

The XMEGA A microcontrollers is a family of AVR enhanced RISC architecture, peripheral-rich CMOS 8/16-bit, high-performance and low-power microcontrollers. The XMEGA A devices provide the following features: in system programmable flash with read-while-write capabilities; internal EEPROM; 16- or 32-bit real time counter (RTC); up to eight flexible, 16-bit timer/counters with capture, compare and PWM modes; up to eight USARTs; up to two 16-channel, 12-bit ADCs with programmable gain; up to two 2-channel, 12-bit DACs [14].

E. AVR Dragon

AVR Dragon supports all programming modes for the Atmel AVR device families and is a low cost development tool. It also supports full debugging for most Atmel AVR devices. AVR Studio easily upgrades the AVR Dragon which supports new devices as the AVR dragon has a flexible and secure firmware upgrade [14].

F. Zigbee Serial Board

Zigbee serial board is a RS232 to serial base unit which is simple to use. This unit works with all ZigBee modules including the Series 1 and Series 2, Pro version and standard. The direct access to the serial and programming pins on the ZigBee unit can be obtained by simply plugging the unit into the ZigBee Explorer and attaching a RS232 cable. The ZigBee unit can be reprogrammed and configured, as the board also supports DTR communication.

IV. RESULTS

A. Temperature Sensor

1) Terminal window of ATMEL STUDIO

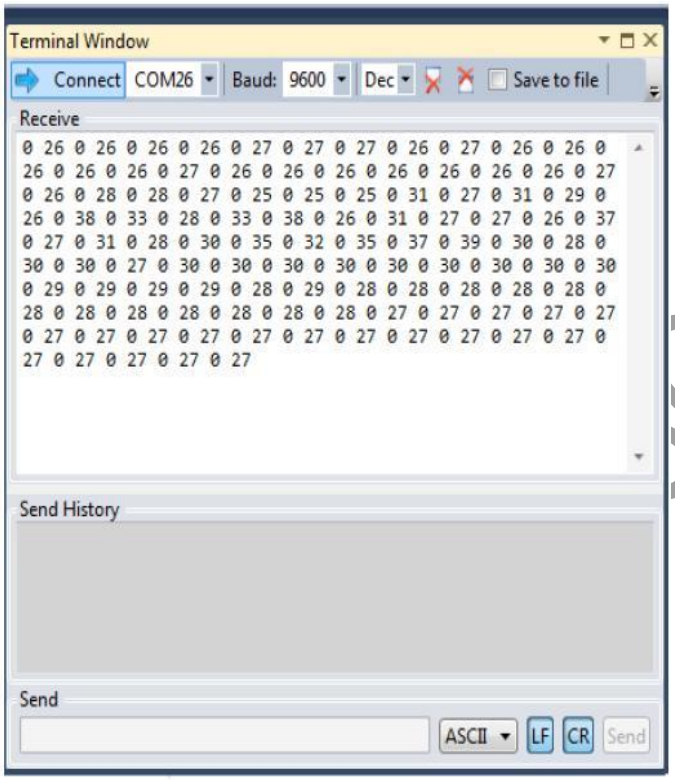

Fig 4. Decimal values of room temperature

The fig 4 shows decimal values of room temperature on terminal window of ATMEL STUDIO.

2) X-CTU

The Fig. 5 shows the hexadecimal values of room temperature on X-CTU with "00" as a header of temperature. The value "$(1A)_{16}$" represents "$(26)_{10}$" i.e. room temperature.

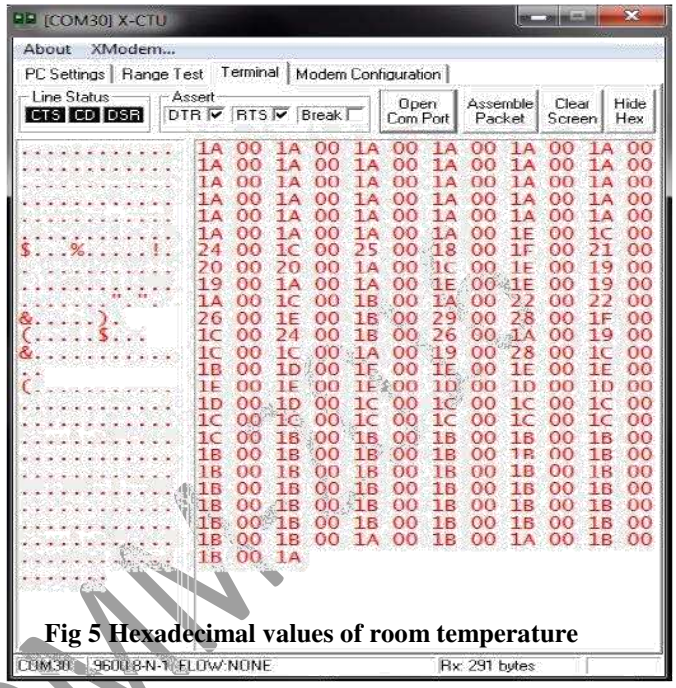

Fig 5 Hexadecimal values of room temperature

B. Impact Sensor

1) Terminal window of ATMEL STUDIO

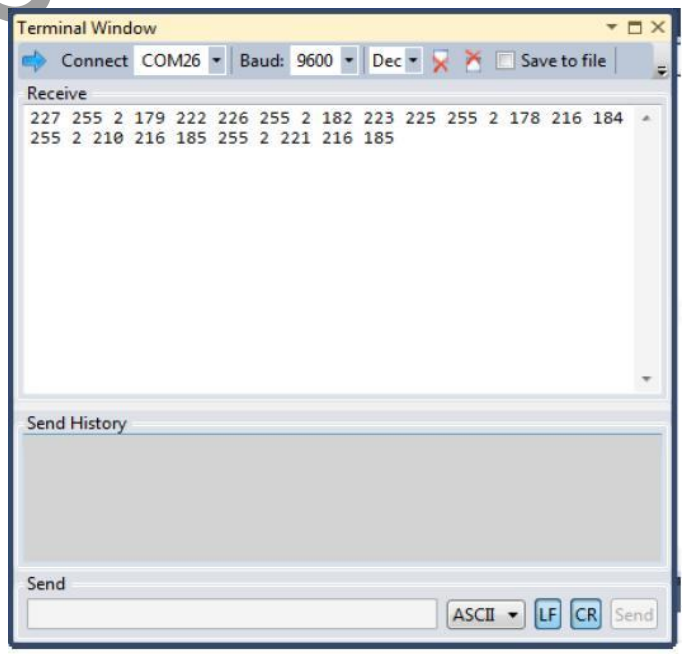

Fig 6 Decimal values of impact

Fig. 6 shows the decimal values of impacts on x, y and z axis respectively on terminal window.

The values "179", "222" and "226" represents the impacts on x, y and z axis respectively.

The impact i.e. value in g can be given by equation (1) as follows:

(((ADC value * 3.3)/255) – 1.65) / Sensitivity (1)

Eg. The value x1=179 represents 1.85g with respect to x axis when person is standing and value x2=221 represents 3.36g with respect to x axis when person suddenly falls. The drastic change in the values with respect to x axis here, detects the fall of person.

2) X-CTU

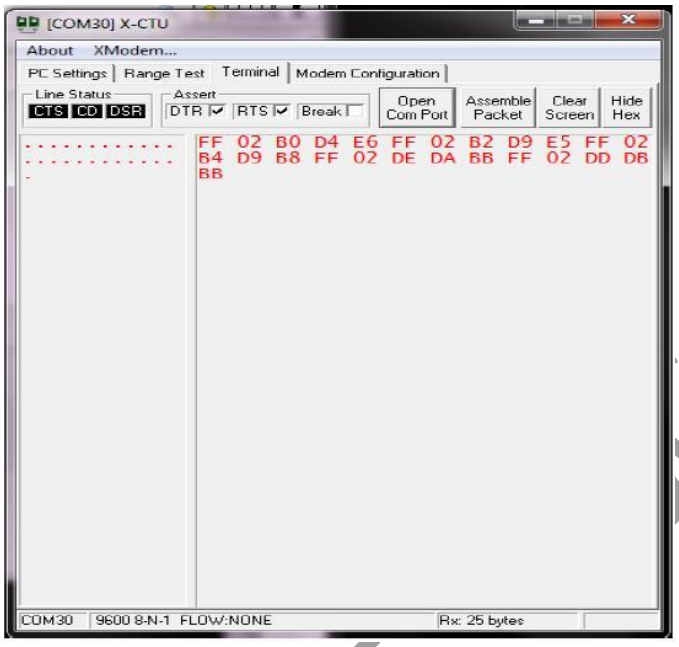

Fig 7 Hexadecimal values of impact

The fig. 7 shows the hexadecimal values of impacts on x, y and z axis respectively on X-CTU with header as "FF 02".

V. CONCLUSION

In this paper, the monitoring of some physiological parameters such as body temperature, heart beat rate and body impact has been discussed. The normal or abnormal behaviors of physiological parameters of patients are monitored using this system. The zigbee is used for wireless transmission of physiological parameters from transmitting unit to the receiving unit where they will be monitored. The GSM will generate the message to doctors, if there are any emergencies. Also the physiological parameters are seen on graphical user interface using LABVIEW which will help the medical professionals to monitor the fluctuations in parameters easily. The wireless monitoring of patients will make the patients comfortable in their own home and the time and space in hospitals can be used efficiently. This system will possibly meet the need of current medical practices in order to get ease for practitioners, patients as well as their families.

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