Innovations

Motion Based Message Conveyor for Disabled Patients using IoT

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Abstract

The main aim of the project is to implement a low-cost reliable system which will help to establish communication between paralytic or disabled patients and a nurse. A patient can easily send messages to the nurse by just tilting an accelerometer connected to a body part capable of movement. This angle of tilt is sent to a central controller which then initiates communication between the patient (transmitter) and nurse (receiver) and also decides which message is to be transmitted based on the tilt angle. Each patient will have such a device installed on or around his body and all such patients will be centrally linked to the receiver at the nurse side. Along with this a real time medicine reminder and an emergency buzzer to simplify the work of the nurse was implemented.

Index Terms: *Patient communication, Accelerometer, RF communication*

1. Introduction

In today's world population is increasing rapidly. So, there is a need for proper health care centers which need to be well maintained and developed [1-2]. It not only reduced mobility of patients from one ward to other but also increased burden on patients. Also, it consumes more space and has more power consumption [3-4]. Moreover, in hospitals bedside patient monitoring is done which allows multiple patients in one room. This not only causes disturbance but also lays the foundation of patient monitoring system [5-7]. Patient monitoring is done at individual level in one room one patient is there and multiple patient physiological parameters are measured individually. If there seems to be an emergency, an alarm system which is at receiver side informs to the nurse and the doctor. The user needs to have a transmitting device on his hand which consists of a sensor, i.e., 4- axis accelerometer. Movement of the hand in a particular direction will send a command to the LCD screen which will then display the information specified in direction [8-9]. The transmitting device consists of a comparator

IC for assigning proper levels to input voltages from the accelerometer & an encoder IC whose function is to encode the four-bit data & after that it will be transmitted by a RF transmitter module [10-14].

2. Literature Survey

"Zigbee-based centralized patient monitoring system" This system is to make a centralized patient monitoring system. Zigbee is wireless transmission technology adopted [15-18]. This paper is divided into two sections. In the first section, we have patient monitoring of several patients, whereby several physiological parameters are measured on the respective unit and these values are displayed on the LCD screen of each patient unit [19-24]. In the second section, a central patient monitoring system is created in which all patients are displayed with several parameters with the MATLAB software on the central monitor [25-29]. Real Time Health Monitoring System using Arduino" This system is used to measure physical parameters like temperature, heartbeat rate and oxygen level monitoring with the help of biosensors [30-34]. In this system, Arduino is used at the transmitter and receiver side. Direct communication between the patient and Doctor or nurse can be established by sending a message based on motion [35-39]. The main part of the system is Arduino Uno. That ZigBee module is used for the transmission and reception of the signal and the physical parameters of the patient can be measured. Across hospitals and NGOs serving disabled people [40-43]. Now, these people are not capable of full-body movement as compared to a normal person. In such a situation we propose a system that helps disable person display a message by just simple motion of any part of his body [44-48]. The device needs to be mounted on the user's finger or hand. Movement of the hand in a particular direction will send a command to the LCD screen which will then display the information specified in direction [49-54]. The user now just needs to tilt the device at a particular angle to convey a message. The accelerometer outputs constant analog voltage levels by recording the change in X and Y direction [55-61]. These voltages are sent to the comparator IC which compares it with the references voltages that have been set via variable resistors attached to the IC. The levels can be set between any two voltages. Every voltage generated by the accelerometer is compared with these set voltages and an analog 1 or 0 signal is generated by the comparator IC [62-66]. The analog signal so generated is fed as input to the encoder IC .Encoder converts that parallel analog signal waveform into serial analog signal waveform which is compatible for transmission [67-71]. Push button which is attached with the transmitting pin enables transmission of the signal. The coded data will be passed onto the RF module only when the button is pressed. This button helps in making sure that no data is transmitted unless required [72-75]. Working frequency of RF is 315 MHz. The receiver receives the signal from transmitter, demodulates it and passes it to decoder IC. Original data bits are recovered by decoding the signal received by the decoder. Decoder converts the serial waveform to parallel waveform which is suitable for microcontroller use [76-78]. The input is a serial coded modulated waveform while the output is parallel [79-80]. The parallel binary data from the encoder is fed to the microcontroller. After comparison with old statistics, the microcontroller gives output towards the LCD.

3. Proposed System

We propose a system which mainly consists of a transmitter and a receiver section. In the transmitter section (at the patient side), a four-axis accelerometer will be placed on the any moveable part of the patient. Whenever patient needs any help, he tilts the accelerometer in different directions. This acts as an input to the

accelerometer while output of it is in volts that is connected to the controller board which acts as the processing unit. The output of the accelerometer depends on the tilt angles and is read by the controller. The controller maps the input voltages between 0 and 5 volts into integer values between 0 and 1023 as analog data from the range of 0-1023. This range provides a lot of sensitivity and a slight shift can lead to change in value. To reduce the complexity and provide a simple way for the patients, we reduced its sensitivity by mapping it to 0-5 volts and then provided a range for front, back, forward and backward.

These directions can be easily understood and used by any person using his/her thumb or any part of the body capable of moving in these directions. The RF transmitter becomes active when a message is sent from the controller for transmission. RF transmitter and receiver works on the frequency of 434 MHz the accelerometer will be connected to each patient and each patient will have a controller board and transmitter for sending his messages.

For identification of different patients their name or number is sent to the nurse. All these transmitters can be connected centrally to one RF receiver which works on the same frequency as the transmitter. Thus, the proposed system will provide a many to one communication. In case of emergency the patient has to just press a push button which will signal the processing board to send an emergency alarm to the receiver. The receiver will then signal the controller to activate the buzzer. This will help the nurse to take care of the emergency as soon as possible.

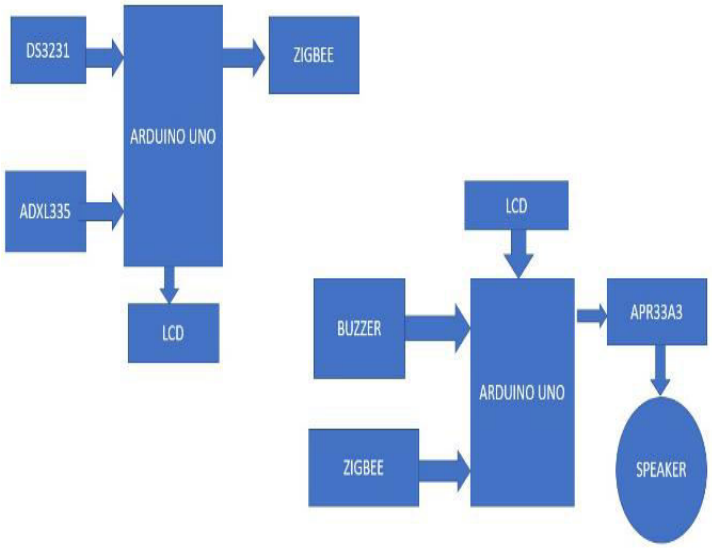

Fig.1: Block diagram

4. Hardware Requirements

4.1.1 Arduino UNO

The board contains 14 digital input/ output pins in which 6 are analog input pin, one power jack, USB connector, one reset button, ICSP header, and other components. All these components are attached in the Arduino Uno board to make it functioning and can be used in the project. As well there GND, VCC, reset pin available in this IC. The voltage regulator converts the input voltage to 5V. The primary function of voltage

regulator is to regulate the voltage level in the Arduino board. For any changes in the input voltage of the regulator, the output voltage is constant and steady [81-86].

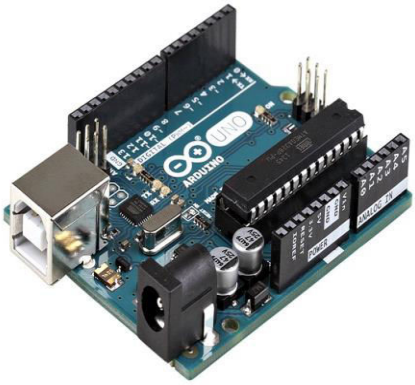

Fig: 2. Arduino Uno

4.1.2 Accelerometer (ADXL335):

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

Fig.3: Accelerometer (ADL335)

4.1.3 Zigbee (HC 12)

It Supports Long-distance wireless transmission (1,000m in open space/baud rate 5,000bps in the air) Working frequency range (433.4-473.0MHz, up to 100 communication channels) Maximum 100mW (20dBm) transmitting power (8 gears of power can be set) Three working modes, adapting to different application situations Built-in MCU, performing communication with external device through serial port the number of bytes transmitted unlimited to one time.

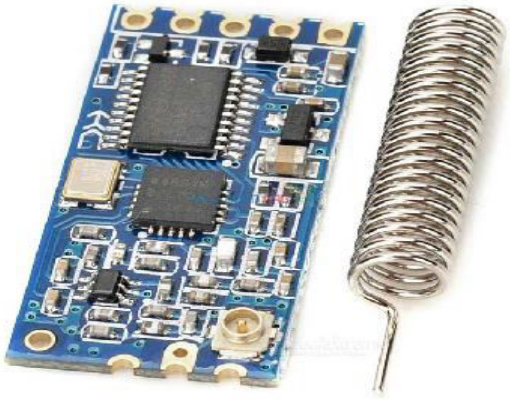

Fig.4: Zigbee HC 12

4.1.4 Buzzer

A buzzer or beeper is an audio signaling device. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click.

Fig.5. Buzzer

4.1.5 LCD

LCD (Liquid Crystal Display) screen is an electronic display module. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.

Fig.6: LCD

4.1.6 APR33A3

It provides high quality recording and playback with 11 minutes audio at 8 Khz Sampling rate with 16-bit resolution. The APR33A3 series C2.x is specially designed for simple key trigger, user can record and playback the message averagely for 1, 2, 4 or 8 voice message(s) by switch.

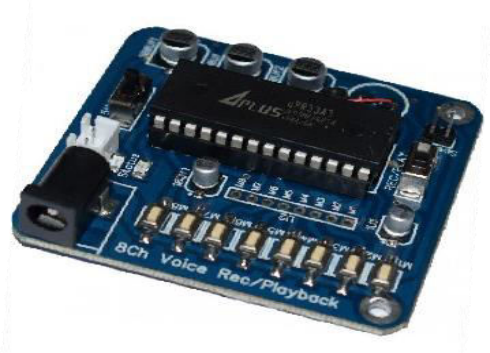

Fig.7: APR33A3

4.1.7 DS3231 (Real Time Clock Module)

The DS3231 is a low-cost, extremely accurate I2C real time clock with an integrated temperature compensated crystal oscillator and crystal.

The DS3231 is available in offered in a 16-pin, 300-mil SO package. The Time Clock Module (or DS3231) is a module that measures the time, dependently or independently of his Arduino card through of his cell.

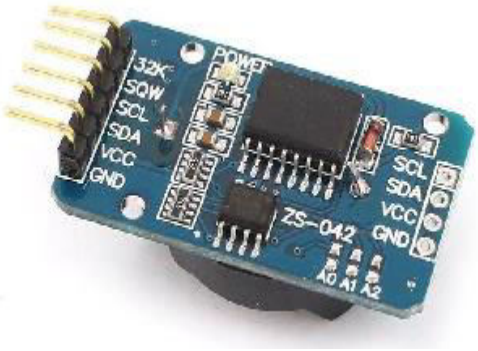

Fig.8: DS3231

4.2 Software Requirements

4.2.1 Arduino IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software.

Arduino board are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

5. Implementation and Working

We proposed a system which mainly consists of a transmitter and a receiver section. In the transmitter section (at the patient side), a two-axis accelerometer will be placed on the any movable part of the patient. This accelerometer is capable of measuring the static acceleration due to gravity and thus finding the angle at which the device is tilted with respect to the earth.

Whenever patient needs any help, he tilts the accelerometer in different directions. This acts as input to the accelerometer while output of it is in volts that are connected to the controller board which acts as the processing unit. The output of the accelerometer depends on the tilt angles and is read by the controller. The controller maps the input voltages between 0 and 5 volts into integer values between 0 and 1023 as analog data from the range of 0-1023. This range provides a lot of sensitivity and a slight shift can lead to change in value. To reduce the complexity and provide a simple way for the patients, we reduced its sensitivity by mapping it to 0-5 volts and then provided a range for movement verification. These directions can be easily understood and used by any person using his/her thumb or any part of the body capable of moving in these directions. A predefined message catering to the basic needs of the patients and those required for emergency will be stored in the ranges assigned to a particular direction as mentioned above. For example: food/water is the message displayed when the patient moves his finger to the right. So, on tilting the accelerometer to the right, it will send its value to the controller. If this value varies with threshold level in the predefined message in this case will be sent to the next module that is the ZIGBEE transmitter module. The ZIGBEE transmitter becomes active when a message is sent from the controller for transmission. ZIGBEE transmitter and receiver works on the frequency of 2.4GHz. The accelerometer will be connected to each patient and each patient will have a controller board and transmitter for sending his messages. For identification of different patients their name or number is sent to the nurse. All these transmitters can be connected centrally to one ZIGBEE receiver which works on the same frequency as the transmitter. Thus, the proposed system will provide a many to one communication. At the receiver side, ZIGBEE receiver will receive the message and send it to the controller board on the receiver side which will then display the message on the LCD. On reception of the message, nurse will remotely take the required action to cater to the needs of the message. In case of emergency the patient has to just press a push button which will signal the processing board to send an emergency alarm to the receiver. The receiver will then signal the controller to activate the buzzer. This will help the nurse to take care of the emergency as soon as possible. Taking medication at the right time is a serious business, the Medicine Reminder is another feature of this device to prompt the nurse the time to give patients their medicines. The Medicine Reminder is intended to be used by the nurse or caretaker so that a mistake is never made in giving the medicines. The medicine reminder is implemented using a real time clock. Usually for DS3231Real time clock chip along with a battery is used, but this increases the amount of hardware used and makes the device bulky. So, we propose a system in which the time table of all the patients will be stored in the database and the nurse will be reminded automatically when it's time to attend any patient according to the time table. This will be implemented by programming the controller board. On interfacing the LCD with the controller and feeding the code in the software, the real time clock runs the time on the display. Furthermore, we can set an alarm time for medication schedule of a group of patients. When a particular alarm turns on, the display indicates Patient. The system proposed will be user defined so that the nurse can change the timetable according to the needs as and when the patient changes.

6. Results and Discussions

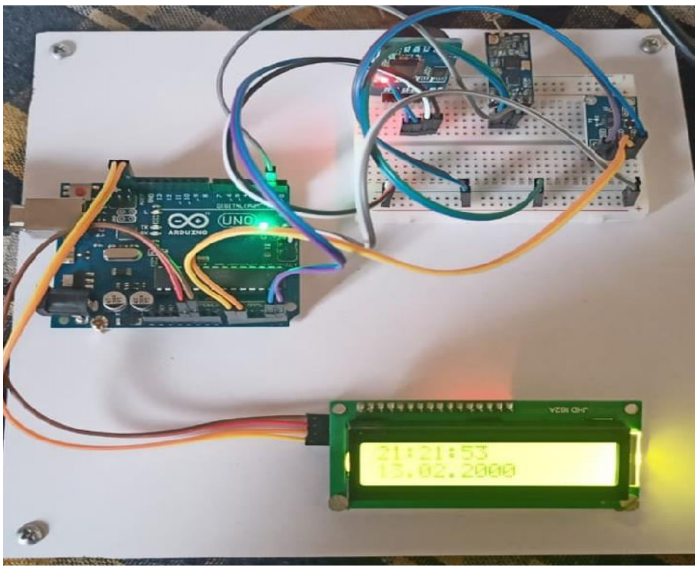

Fig.9: Transmitter

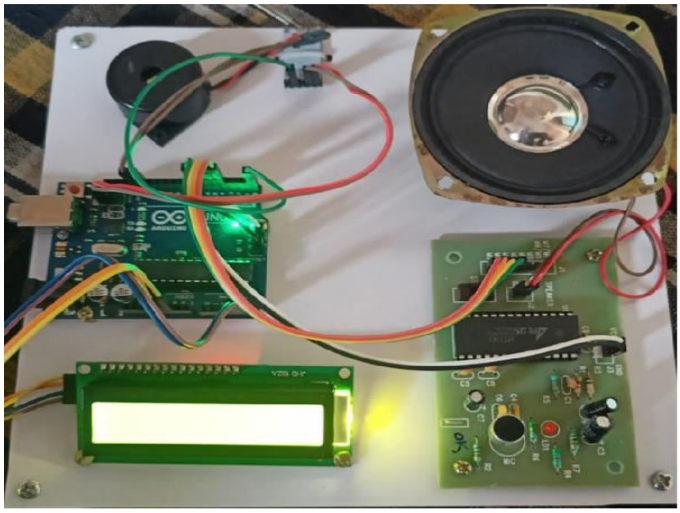

Fig.10: Receiver

7. Conclusion

In this system where we can send the signal given by patients wirelessly through the gesture movement by body parts to the nurse, the information hence will be displayed on the LCD display. Each patient will have such a device installed on or around his body and all such patients will be centrally linked to the receiver at the nurse side along with an emergency buzzer to simplify the work of the nurse was implemented. Our system provides a reliable, effective and simple yet important solution to various issues faced by nurses in traditionally communicating with disabled patients. This project will definitely help the people who are not able to do the full

movement of the body. As motion-based message conveyor system design is based on the idea that means patients need. So just tilting the accelerometer to different direction they can easily communicate with the nurse or doctor. So that paralytic and disabled people don't need to depend on other person's correlative for any kind of help.

8. Future Scope

By using Wi-Fi system, we will expand the communication distance and transmit and receive message at the specific distance at the transmitter, we connected the accelerometer to the Arduino which sense the motion of the patient, also there is the heart beat sensor and blood pressure sensor which measure the heart beat and blood pressure of patient. The temperature sensor is used to detect the body temperature of a patient.

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