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EVALUATION OF SNR WITH WIRELESS ECG SIGNAL ACROSS DISTANCE.

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***Abstract**: Development of a wireless electrocardiogram monitoring system using ZigBee. This system is designed for home use by patients who are not in critical condition but require ongoing or periodic monitoring by their clinician or family. Patient monitoring is the cornerstone of good medical care. It gives clinicians essential information about a person's current health status, so they can act accordingly if there is a problem. Today, sophisticated patient monitoring systems provide the ability to continuously monitor a multitude of biological signals, analyze, interpret them, and act accordingly; or notify the clinician if necessary. The usual shortfalls of most of these systems are patient mobility and home comfort. Patients should be seated on a bed connected to these devices to have their vital signs monitored. This system measures, records and presents in real time the electrical activity of the heart while maintaining patient comfort. The device is designed as a low power, small size and low cost solution suitable for monitoring the elderly at home or in a nursing facility without interfering with the patient's daily activities. It must provide full information in real time and provide remote information. The aim is not to achieve perfect clinical accuracy, but the device can detect abnormalities in the measured data and it also has an alarm function. Authorized observers (clinician or family) can monitor the patient's condition at any time via Internet[1]*

Introduction:

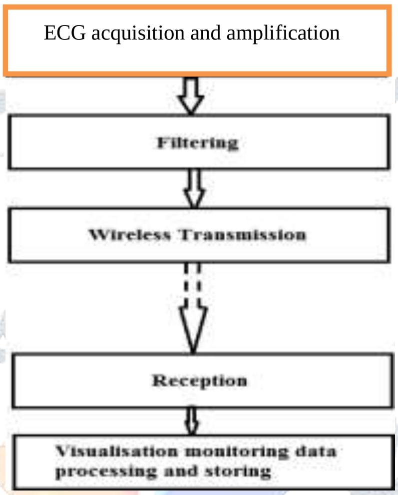
An electrocardiogram (ECG) is a simple test that can be used to check your heart`s rhythm and electrical activity. Sensors attached to the skin are used to detect the electrical signals produced by your heart each time it beats. The main objective of this system is to acquire the physiological parameter using sensors. We have integrated ECG sensor in this system Wireless connectivity has been one of the prominent technological innovations of recent years, allowing freedom and ease of access to information& In particular in Telemedicine, which puts emphasis on the absence of direct contact between the patient and the physician, wireless devices are the basis for the development of efficient remote monitoring systems, able to provide continuous, realtime, and accurate information on the health condition of the patient& (ue to actual si)e of electronic components, it is possible to integrate in a single board a device for signal acquisition, processing and wireless transmission This can lead to ,Body Area networks where a certain number of motes can acquire a full range of bio signals including ECG, blood pressure, body temperature. and complementary ones position, activity., and transmit them to a remote Base Station for processing, using wireless connection as a medium, a number of issues must be considered ease of network creation, network robustness, data throughput, data loss, and in particular power consumption In fact, radio transmission puts a heavy load on batteries in terms of absorbed current and, in case of long term monitoring, battery life is of prime importance& In order to confront this issue, new wireless protocols have been implemented, focusing on reducing power consumption as much as possible, achieving good compromises between data throughput, covering range and robustness & ZigBee is one of the most prominent wireless protocols and we believe that transmitting real time ECG data can be a good in order to know various capabilities[8] METHODOLOGY

The development of a system for wireless ECG monitoring using ZigBee. The system is intended for home use by patients that are not in a critical condition but need to be constant or periodically monitored by clinicians or family. Patient monitoring is the cornerstone of proper medical care. It provides clinicians the much needed information about a person's current health status, so that they can act accordingly if anything goes wrong. Nowadays, complex patient monitoring systems offer the possibility of continuously monitoring a multitude of biological signals, analyze them, interpret them and take the appropriate action; or alert clinicians if necessary. The usual shortcomings of most of these systems reside in affecting patient mobility and home comfort. A patient would need to be sitting on a bed wired to these devices in order for his vital signs to be monitored. This system measures, records and presents in real-time the electrical activity of the heart while preserving comfort of the patient. The device is built as a low-power, small-sized, low-cost solution suitable for monitoring elderly people at home or in a nursing facility without interfering with the daily activity of a patient. It should give sufficient information in real time, and make it available remotely. The intention is not to achieve perfect clinical accuracy but the device is able to detect anomalies in the measured data and it also has alerting features. Authorized observers (clinicians or family) can monitor at any moment the state of the patient through the internet[9]

PROPOSED ALGORITHM

- Different sensors measure different readings and passes it to the microcontroller.
- Microcontroller reads the reading and displays it on the LCD. ECG graph is displayed on Serial Monitor.
- If the reading is above or below threshold value emergency is displayed on LCD and alarm and LED blinks.
- This represents patient monitoring system of a single patient.
- Similarly N patients multiple physiological parameters are measured and displayed on LCD at particular patient unit and LED blinks according to the conditions.

FLOW CHART



ECG Acquisation and Amlipfication

An ECG acquisition system consisting of an instrumentation amplifier is used to amplify the potential and reject the common mode signal with a gain of 364 collected from the electrodes[10].

An electrocardiogram (ECG) amplifier is an electronic component that converts a relatively weak electrical signal from the heart into a signal that can be output to a monitoring system. Body electrodes are usually where the signal is first picked[10]

Filtering

The filtering techniques are primarily used for preprocessing of the signal and have been implemented in a wide variety of systems for ECG analysis. Filtering of the ECG is contextual and should be performed only when the desired information remains ambiguous. Many researches have worked towards reduction of noise in ECG signal. Most types of interference that affect ECG signals may be removed by band pass filters; but the limitation with band pass filter is discouraging, as they do not give best result. At the same time, the filtering method depends on the type of noises in ECG signal[12]

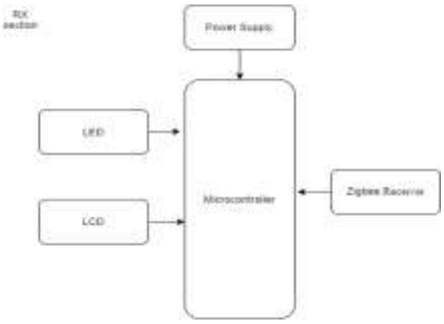
Zibee Wireless Transmission

Zigbee is an IEEE 802.15.4based specification for a suite of highlevel communication protocols used to create personal area networks with small, low power digital radios, such as for home automation, medical device data collection, and other low power low bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a lowpower, low data rate, and close proximity (i.e., personal area) wireless ad hoc network. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as WiFi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires shortrange lowrate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters lineofsight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking. (The Zigbee network is protected by a 128-bit symmetric encryption key.) Zigbee's defined rate is 250 kbps, which is ideal for intermittent data transmission from sensors or input devices.

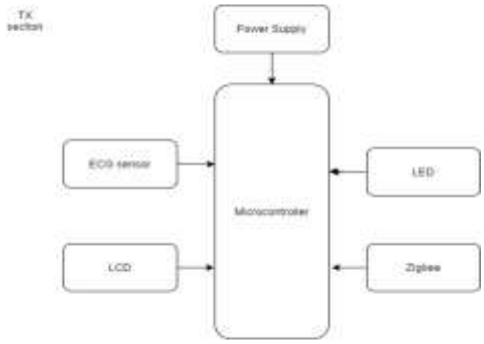
Acquire data will be send using wireless transmission Using Zigbee Trasnsmitter Module[14]

Block Diagram

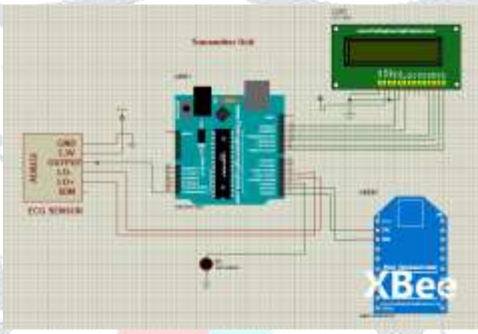
Block Diagram Receiver



Block Diagram of Transmitter

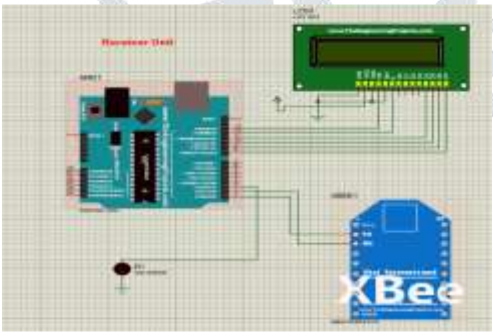


Circuit Diagram of Transmitter



As We can See From the connection initially in input section, ECG sensor is connected to the Arduino UNO For Sensing the physiological parameter of the patient and in Output section we have connected LCD Display,LED and Zigbee Transmitter module.

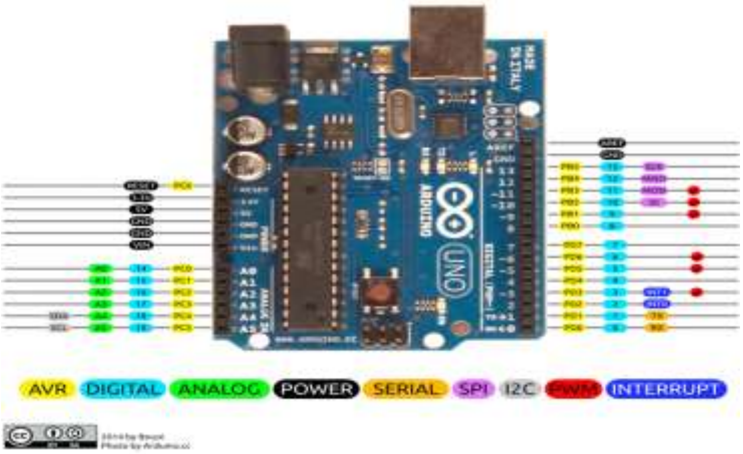
Circuit Diagram Receiver



HARDWARE REQUIREMENTS

The various Hardware device which we require for making Wireless monitoring of patient using zigbee are Microcontroller, ECG Sensor, Zigbee, LCD 16x2,LED,Power supply,Connecting wires etc

Microcontroller :-



Microcontroller :Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

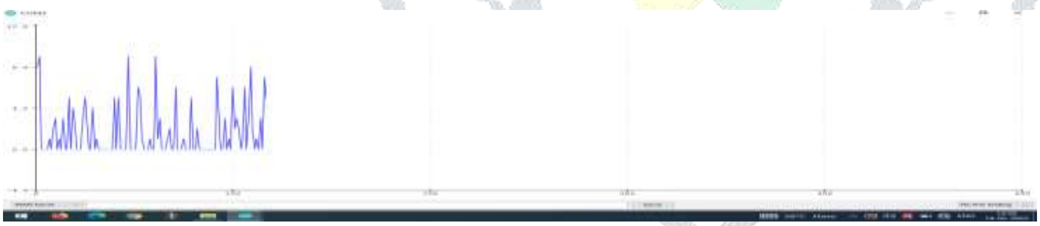
"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards[10]

RESULT AND CONCLUSION

The following results were obtained using the ARDUINO IDE software embedded in C which has its own serial plotter for Transmitter and Receiver side. Results were recorded for 5 patients Patient A: 58-year-old woman Patient B: 32-year-old man Patient C: Female, 51 years old Patient D: Male, 62 years old Patient E: Male, 56 years old All measurements were taken at home as a baseline ECG for home monitoring using Zigbee. Use the transmitter window when making measurements on the transmitter side, and use the receiver window available in the tool when making measurements on the receiver side.

Signal to Noise Ratio for various patient at receiver side at short distance and receiver side at long distance:

Patient – A



Patient – A at Receiver and short distance: Vsig = 9, Vnoise = 0.8 we can calculate SNR

SNR = 2 $\log_{10}$ (Vsig / Vnoise)

= 2 $\log_{10}$ (9 / 0.8)

SNR = 2.10 dB.

Therefore , SNR = 2.10 dB

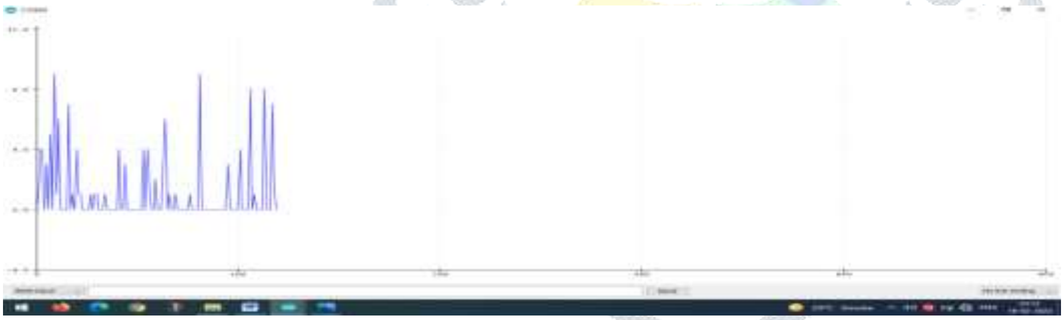
Patient – A at Receiver side and long distance: Vsig = 9,Vnoise = 1 Therefore SNR = 1.9 dB

Patient B

Patient – B at Receiver side short distance: Vsig = 8 ,Vnoise = 0.7, Therefore, SNR = 2.11 dB

Patient B At Receiver side and long distance:Vsig = 9.2 ,Vnoise = 1,Therefore SNR = 1.92 dB

Patient - C



Patient –C At a Receiver side short distance:Vsig.= 8,Vnoise = 1,Therefore SNR = 1.8 dB

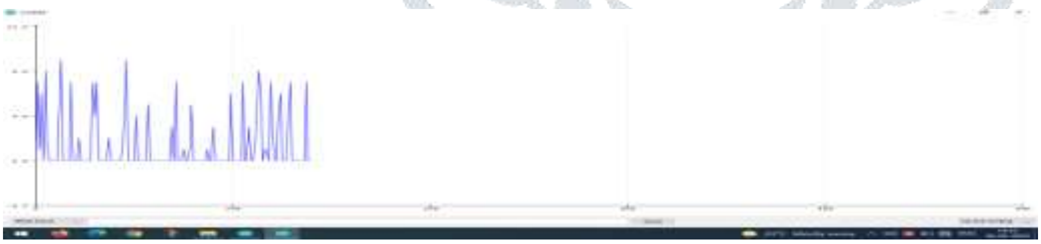
Patient – C At a Receiver side long distance:Vsig = 8, Vnoise = 1.2 Therefore, SNR = 1.6 dB

Patient - D

Patient D At Receiver side short distance: Vsig = 8, Vnoise = 1.1Therefore SNR = 1.723 dB

Patient – D At Receiver side long distance: Vsig = 8,Vnoise = 1.2,Therefore SNR = 1.647 dB

Patient – E



Patient – E At Receiver side short distance: Vsig = 8.8,Vnoise = 1.2 ,Therefore SNR = 1.730 dB

Patient – E At Receiver side long distance :Vsig = 8.8, Vnoise = 1.3 Therefore SNR = 1.6610 dB

Observation Table of Transmitter Side:

Patient	Vsignal	Vnoise	SNR
A	700	20	3.088 dB
B	450	0.5	5.9 dB
C	1120	5	4.7 dB
D	500	1.5	5.04 dB
E	460	2	4.72 dB

Observation Table of Receiver Side at Short distance:

Patient	Vsignal	Vnoise	SNR
A	9	0.8	2.10 dB
B	8	0.7	2.11 dB
C	8	1	1.8 dB
D	8	1.1	1.723 dB
E	8.8	1.2	1.730 dB

Observation Table of Receiver Side at Long distance:

Patient	Vsignal	Vnoise	SNR
A	9	1	1.9 dB
B	9.2	1	1.92 dB
C	8	1.2	1.64 dB
D	8	1.2	1.64 dB
E	8.8	1.3	1.6610 dB

Observation Table of Signal to Noise Ratio :

Patient	SNR at Transmitter side	SNR at Receiver side short distance	SNR at Receiver side long distance
A	3.088dB	2.10 dB	1.9 dB
B	5.9 dB	2.11 dB	1.92 dB
C	4.7 dB	1.8 dB	1.64 dB
D	5.04 dB	1.723 dB	1.64 dB
E	4.72 dB	1.730 dB	1.6610 dB

CONCLUSION

Wearable and mobile systems continue to evolve rapidly in order to save the patient from disturbing cable extensions and be able to follow the required measurements on the move. In this context, the structure of the wireless sensor networks and the installation methods were investigated and the implementation of a wireless ECG measurement system using ZigBEE. Result shows the Signal to Noise Ratio of various Patients A,B,C,D,E. It is observed that at Transmitter side the signal to Noise ratio is highest(higher the value better is SNR) ,but as the distance goes on increasing the SNR goes on decreasing but it is in less amount as compare to other wireless technologies designed Zigbee approximately measures 20 to 100 meters and take ECG measurements wirelessly. In addition, tests have shown that ECG measurements can be made wirelessly within a range of 20 to 80 meters if there is an obstacle between the ZigBee transmitter and receiver.

FUTURE DEVELOPMENT

In addition to the system can also provide more than one numbers so that more than one user can receive emergency message. According to availability of sensors or development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of the wireless monitoring system in biomedical field

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Using ZigBee T.Chandrasekhar 1 , J.S.Chakravarthi 2 , V.Srikanth 3

[21] International Journal of Engineering Science Invention (IJESI) ISSN (Online): 2319-6734, ISSN (Print): 2319-6726 www.ijesi.org ||Volume 11 Issue 2 Series I || February 2022 || PP 50-5 Review of development & deployment of wireless ECG monitoring systems Mr. Mangesh Deepak Vaidya, M.E. Student, Prof. V.D. Shinde, Assistant Professor, Prof. Dr. Sanjeev N. Jain, Professor, Department of Electronics Engineering, SSVPS Bapusaheb Shivajirao Deore College of Engineering