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Design of ECG Monitoring System of Multiple Patients Using GSM

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ABSTRACT

The Electro Cardiogram signal is used for analyzing the cardiac diseases of patients. The conventional analyzing system requires the patients to go stay at the hospital or go to the hospital for frequent check-ups. The idea here is to design a wireless ECG monitoring system using remote access. Our project focuses on the design of wireless ECG monitoring system of multiple patients using GSM. We propose a design of remote monitoring system where the nodes of the wireless sensor network are installed at the patient's home. The collected details are sent to the doctor for analyses using a GSM modem. This method greatly reduces human efforts. Each module of the patient's home consists of ECG sensors, microcontrollers and wireless module. The ECG values are sensed by an ECG sensor attached to each patient's node and are fed to the PIC microcontroller, the microcontroller converts the analog signal from the sensor to digital form. The digital signals are then transmitted to mobile phone of the doctor and patient's relative using a GSM modem. The monitoring system comprises of two sections first section is the sensor section where the ECG signals are sensed and sampled and second is the transmitter-receiver section consisting of GSM modem and mobile phone.

Key words: EEG, GSM, transmitter-receiver

INTRODUCTION

The Electro Cardiogram signal is used for analyzing the cardiac diseases of patients. The conventional analyzing system requires the patients to go stay at the hospital or go to the hospital for frequent check-ups. The idea here is to design a wireless ECG monitoring system using remote access. Our project focuses on the design of wireless ECG monitoring system of multiple patients using GSM. We propose a design of remote monitoring system where the nodes of the wireless sensor network are installed at the patient's home. The collected details are sent to the doctor for analyses using a GSM modem. This method greatly reduces human efforts. In the existing system, even though we are using ECG sensor we require manpower for observing the graphical representation of heart condition and abnormality indication whenever the abnormality condition is detected. Due to this we require the individual person for every patient. This is the disadvantage of the existing system. Hence we propose a new system. Each module of the patient's home consists of ECG sensors, microcontrollers and wireless module. The ECG values are sensed by an ECG sensor attached to each patient's node and are fed to the PIC microcontroller, the microcontroller converts the analog signal from the sensor to digital form. The digital signals are then transmitted to mobile phone of the doctor and patient's relative using a GSM modem.

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BLOCK DIAGRAM AND DESCRPTION

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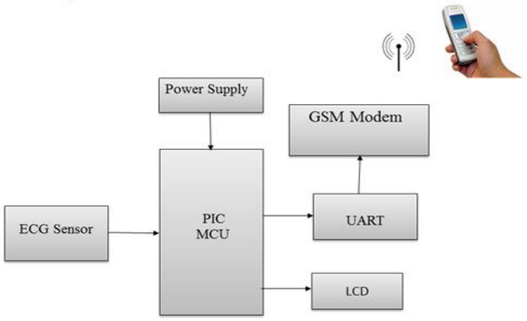

Figure.1. Patient 1: Transmitter Section

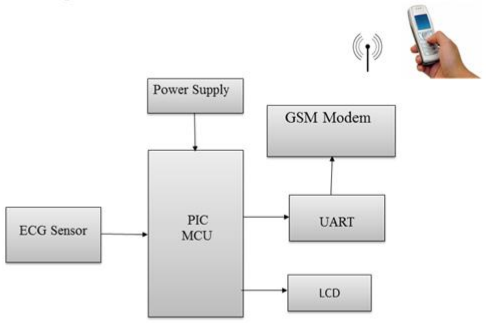

Figure.1.Patient 2:Transmitter Section

Hardware requirements and software requirements:

PIC16F877A Microcontroller
ECG Sensor, GSM Modem
LCD, Mobile phone
Embedded C, CCS or MPLAB compiler.

Global Subscriber Module (GSM): Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. In a GSM network, this decentralized intelligence is implemented by dividing the whole network into three separate subsystems:

Network Switching Subsystem (NSS)
Base Station Subsystem (BSS)
Operation and Support system (OSS)

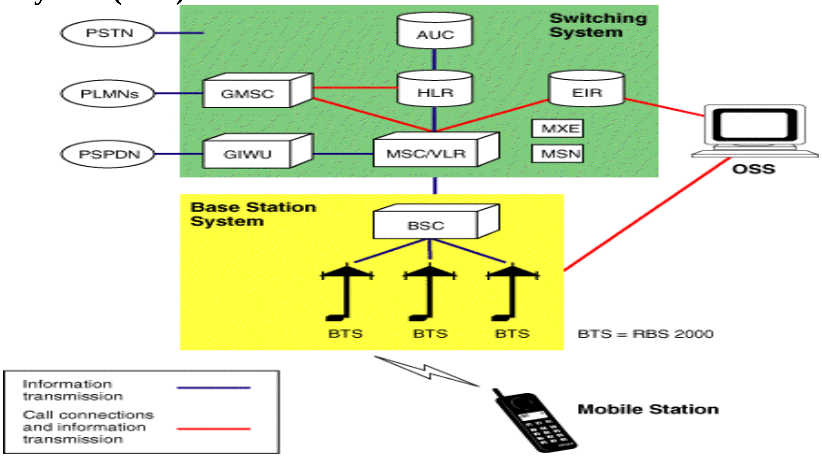

Figure.4.GSM Network

The switching system (SS) is responsible for performing call processing and subscriber-related functions. The switching system includes the following functional units. Home location registers (HLR)—The HLR is a database used for storage and management of subscriptions. The HLR is considered the most important database, as it stores permanent data about subscribers, including a subscriber's service profile, location information, and activity status. When an individual buys a subscription from one of the PCS operators, he or she is registered in the HLR of that operator. All radio-related functions are performed in the BSS, which consists of base station controllers (BSCs) and the base transceiver stations (BTSs), and Transcoder.

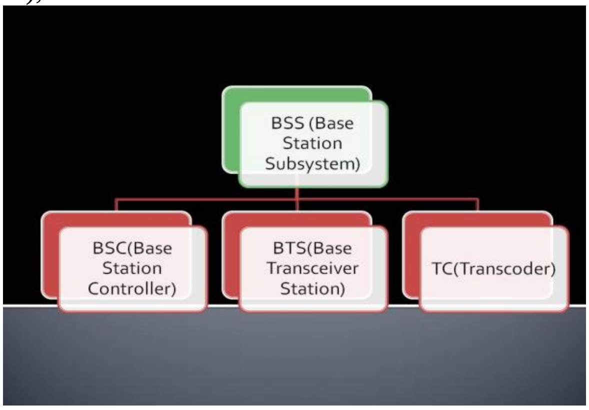

Figure.5. Block Diagram of Base Station System

Base Tranciever Station: By The BTS handles the radio interface to the mobile station. The BTS is the radio equipment (transceivers and antennas) needed to service each cell in the network. A group of BTSs are controlled a BSC.

Transcoder: The Transcoder (TC) thus takes care of the change from one bit rate to another. If the TC is located as close as possible to the MSC with standard PCM lines connecting the network elements, we can, in theory, multiplex four traffic channels in one PCM channel. This increases the efficiency of the PCM lines, and thus lowers the costs for the operator. When we connect to the MSC, the multiplexed lines have to be de-multiplexed. In this case the unit is called Transcoder and Sub multiplexer (TCSM).

The operation and support system: The operations and maintenance center (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of OMC is called the operation and support system (OSS). The OSS is the functional entity from which the network operator monitors and controls the system. The purpose of OSS is to offer the customer cost-effective support for centralized, regional and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

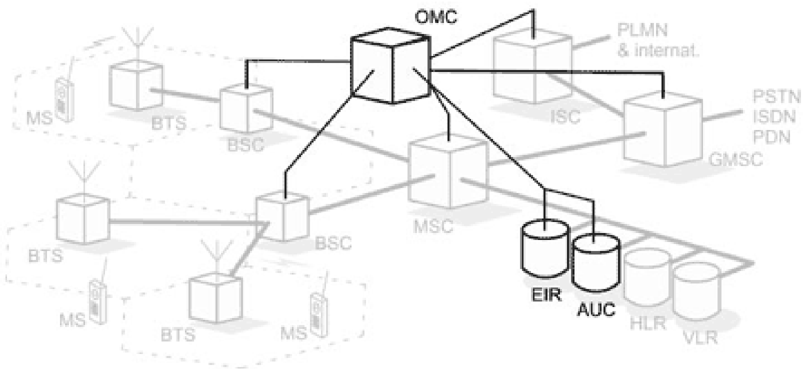

Figure.6. Location of Transcoder and Submultiplexer

Electrocardiogram sensor: The ECG (Electrocardiogram) records the pathway of electrical impulses through the heart muscle, and can be recorded on resting and ambulatory subjects, or during exercise to provide information on the heart's response to physical exertion. The three Lead, two channels ECG connects to the internal connector pin on the sensor unit, with application to the skin via four conventional disposable electrodes. ECG uses low offset precision amplification with ~15pA of leakage for high impedance matching. The unique AC-coupled topology with clamping diodes provides excellent transient recovery.

The heart functions as a pump for circulating blood to the body by repetition of contraction and enlargement. The cardiac electric potential is produced in the body during heart contraction. Electrocardiogram can be measured by leading these electrical signals to other body position and amplify. Inventory of Items Included with the EKG Sensor Please check the composition of the product. Electrocardiogram sensor (EKG sensors) EKG Electrode patch 100EA (1 Pack).

Electrocardiogram waveform: Electrocardiogram wave form is influenced by activation step which consists of P, Q, R, S and T.

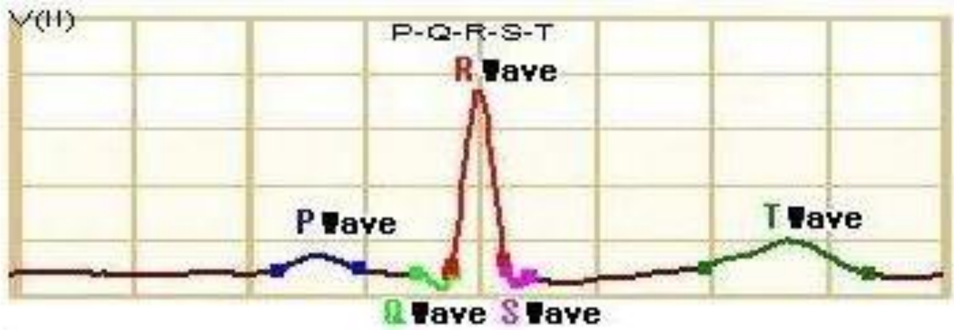

Figure.7.ECG wave form

P-Wave: The P-waveis the electrical signature or current that causes atrial contraction. Both the left and right contraction simultaneous may indicate arrhythmia. Its relationship to QRS complex determine the presence of a heart block.

QRS-Complex: The QRS complex corresponds to the current that causes the contraction of the left and right ventricles, which is more forceful than that of atria and causes more muscle mass, thus resulting in a greater ECG deflection. The Q wave, when present, represents the small horizontal (left to right) current as the action potential travels through the inter-ventricular septum. Very wide and deep Q waves do not have a septal origin, but indicate myocardial infarction. The R and S waves indicate contraction of the myocardium. Abnormalities in the QRS complex may indicate bundle branch block (when wide), ventricular origin of tachycardia, ventricular hypertrophy or other ventricular abnormalities. The complexes are often small in pericarditis.

T-Wave: The T wave represents the repolarization of the ventricles. The QRS complex usually abscures the atrial repolarization wave so that it is not usually seen. Electrically, the cardiac muscle cells are like loaded springs. A small impulse sets them off, they depolarize and contract. Setting the spring up again is repolarization

Monitor ECG after mild exercise: Using the ECG sensor monitor the ECG of the patient who is initially at rest. Disconnect the sensor wires from the electrode patches, but leave the patches on the person being monitored. Allow the person to exercise for a few minutes like jogging. Reattach the sensor wires to the electrode on the person after exercising. Record a new ECG value. Compare the ECG recorded during resting and exercise.

Investigating EKG with different body position: Record the resting EKG first. Then have the person sit, stand or lie down. Compare your results with your resting EKG.

Investigating EKG changes after mild stimulants: Record resting EKG. Drink a couple of cups of caffeinated coffee or cola.

Software development cycle: When you use the Keil µVision3, the project development cycle is roughly the same as it is for any other software development project.

1. Create a project, select the target chip from the device database, and configure the tool settings.
2. Create source files in C or assembly.
3. Build your application with the project manager.
4. Correct errors in source files.
5. Test the linked application.

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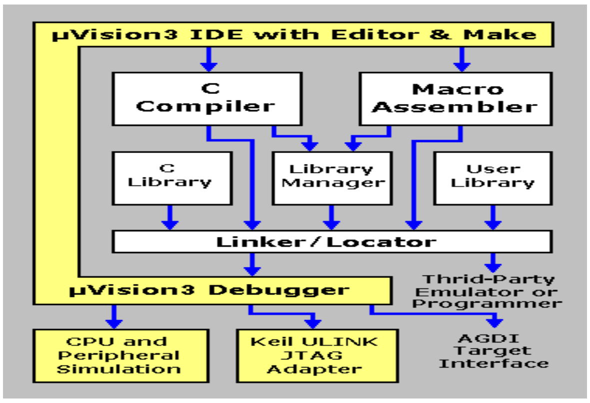

Figure.8.Software Development Cycle

CONCLUSION

In this proposed project we designed an ECG monitoring system for multiple patients using GSM. The ECG signal of the patient was sensed and captured and transmitted to the Doctors' mobile phone using a GSM using a series of steps. This system was designed to monitor health condition of several patients simultaneously. Initially we used a two electrode ECG sensor to sense the ECG signal of the patient. The sensed signal was transmitted to PIC microcontroller unit where the analog values were converted into digital values by means of an in-built analog-to-digital converter in the microcontroller unit. The microcontroller required 5v supply for operation, so a 230v supply was connected to a step-down transformer which reduced the voltage level to 12v AC. This was then passed through a bridge rectifier set-up and converted into DC voltage. The DC voltage was filtered using capacitors and regulated to constant 5v supply using voltage regulator IC 7805. When the ECG signal was normal it was displayed on the LCD. When the signal became abnormal it was transmitted to the doctors' mobile phone via GSM. Messages were sent to the doctor continuously until the ECG became normal. We found that our project worked well for multiple patients for measuring ECG signal. Future work has to be done to integrate the entire system into sensor unit to make the system compact and easy handling. Facilities to measure other patient parameters shall also be included.

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