

A Wireless Infrastructure for Emergency Medical Care

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Abstract: Incorporating new healthcare technologies for emergency cases and elder care will become a major priority in this decade, as medical care systems world-wide become strained by the aging boomer population. In this paper we discuss a wireless infrastructure intended for development in emergency medical care, integrating low power, wireless vital sign sensors, smart phone, GPS and GSM modules. The idea is to deliver the status of patient and location of patient within hospitals and globally. To transfer the data to respective doctor, we are using IoT platform and serial communication methods. By receiving the information, doctor will give his opinion and accordingly forward the information to nurse regarding the prescription of the patient before he arrives.

Keywords: Heart rate, Bluetooth, Biosensors, Smartphone, IoT platform, Network services, GPS and GSM.

I. INTRODUCTION

Wireless sensor network is an emerging technology consisting of compacted chip and low power that integrates limited computation, sensing and radio communication capabilities. This technology has the potential to have enormous impact on many aspects of emergency medical care. Sensor devices can be used to capture continuous, real-time vital signs from a large number of patients, relaying the data to handheld computers carried by emergency medical technicians (EMTs), physicians and nurses. Wearable sensor nodes can store patient's history such as identification and treatment. Sensor networks can greatly improve the ability of first responders to assessment and treat multiple patients equipped with wireless monitors.

While there have been many recent advances in biomedical sensors, low-power radio communications and embedded systems henceforth communication infrastructure is required to integrate these devices into an emergency care setting. In this paper, developing an efficient wireless communication device for emergency care and that forms a network, security, as well as filtration and aggregation of processor data. This technology is designed to operate a wide range of devices and to treat the patient in emergency conditions.

This project presents an automotive localization system using GPS and GSM-SMS services. In this paper, this system is focused on enhancing the quality of healthcare service for people who do not visit their physicians on a regular basis in medical interpreting aspects. It not only provides healthcare comment to patient but also sends the physical data to physicians for review and consultation. This technology can also be used as tracking system. This tracking system composed of a GPS receiver, Microcontroller and a GSM Modem. GPS receiver gets the information from satellites. The Microcontroller processes this information and this information is sent to the user using GSM Modem.

The organization of the paper is as follows. In section I, we discuss the Features. In section II, we discuss the technologies involved. In section III, we describe the system design and implementation of entire system. In

section IV, simulated results. In section V, we conclude the paper.

II. FEATURES

1. Remote communication using GSM Modem from anywhere in world.
2. GPS based location identification.
3. Sends location in the form of latitude and longitude.
4. Accident location alerts to police/ambulance.
5. Emergency control in hospital through GSM short message service.
6. A Mobile application for patient status.

III. TECHNOLOGIES

A new number of technologies are coming viable for introduction into pre-hospital and in-hospital. This device includes wireless sensor devices such as Biosensors, GPS receiver, GSM Modem, Atmel Mega320P Microcontroller and an IoT platform.

BIOSENSORS:

A biosensor is an analytical device, used for the detection of an analyte that combines a biological component with a physicochemical detector. Biosensor typically consists of a bio-recognition component, bio-transducer component and electronic system which include an amplifier, processor and display. The transducer or detector element transforms the signal resulting from the interaction of the analyte with the biological element into another signal that can be more easily measured and qualified. In this paper, we use biosensor like accelerometer, ECG, EDA, EMG and LUX.

"Accelerometer" has a limited bandwidth, especially designed to acquire data from kinematic and biomedical events. The analog output of each axis can be accessed individually, extending its potential uses typical applications include posture detection, activity monitoring, range of motion estimating, vibration analysis and shock detection.

"Electrocardiography" enables the translation of these electrical signals into numerical values, enabling

them to be used in a wide array of applications. Heartbeats are triggered by bioelectrical signal of very low amplitude generated by a special set of cells in the heart. This sensor allows data acquisition not only at the chest, but also at the hand palms.

“Electromyography” (EMG) means muscle activation is triggered by bioelectrical signal of very low amplitude sent from motor control neurons on our brain to the muscle fibers.

“Electrodermal Activity” means sweat glands secretion is a process that allows our body to regulate its temperature, but is also associated the sympathetic nervous system activity. Whenever we become relaxed that state is partially translated into the sweat production or inhibition at the glands on our hands palms and feet.

“LUX” means light sensors are typically used for ambient light measurement. However, a common need when working with biosignals is the synchronization of the recorded data with specific light sources. LUX sensor can be used to detect chromatic changes in the stimuli and optical synchronization.

GPS receiver:

A GPS navigation device is any device that receives Global Positioning System (GPS) signals for the purpose of location on earth. Each GPS satellite transmits radio signals that enable the GPS receivers to calculate where it's location on earth and convert the calculations into geodetic latitude, longitude and velocity. A receiver needs signals at least three GPS satellites to pinpoint the person location.

GSM Modem:

A GSM modem is a specialized type of modem which accepts a sim card and operates over a subscription to a mobile operator, just like a mobile phone. Both GSM modem and Dial-up modem support a common set of standard AT commands. AT commands means “Attention Terminal” commands. AT commands allow giving instructions to mobile devices. The commands are sent to the GSM modem.

MICROCONTROLLER:

A Microcontroller is a compact microcontroller designed to govern the operation of embedded systems in motor vehicles, robots, complex medical devices and home appliances. A typical microcontroller includes a processor, memory and peripherals. Here we are using Atmel Mega320P Unit (MCU) with 32KB flash memory, 2048 bytes of data RAM and internally Watchdog Timer. It is a 32-pin DIP IC, operates at 5V power supply. This Microcontroller unit block is designed for accurate and reliable real time data streaming over any UART-compatible interface (example: Bluetooth). Its high performance firmware, made available in open source, can acquire and control up to 6analog inputs and 1 analog output, 2 digital inputs and 2 digital outputs at up to 1Khz. Features are real time data sampling and real time data recording.

INTERNET OF THINGS:

IoT platform which helps in connecting products and users, manage the information and an interface to for product deployment and health check. The current revolution in internet, mobile and machine to machine technologies can be seen as the first phase of the IoT. In the

coming years, the IoT is expected to bridge diverse technologies to enable new applications by connecting physical objects together in support of intelligent decision making. The IoT is enabled by the latest developments in RFID, smart sensors, communication technologies and internet protocols. The basic premise is to have smart sensors collaborate directly without human involvement to deliver a new class of applications.

BLUETOOTH:

Bluetooth is a wireless technology standard for exchanging data over short distances from fixed and mobile devices. This technology was invented by telecom vendor Ericsson in 1994. It was originally conceived as a wireless alternative to RS-232 data cables. Here we use HC-06 module with UART interface. It is a programmable baud rate with 115200kbps.

IV. IMPLEMENTATION OF THIS SYSTEM

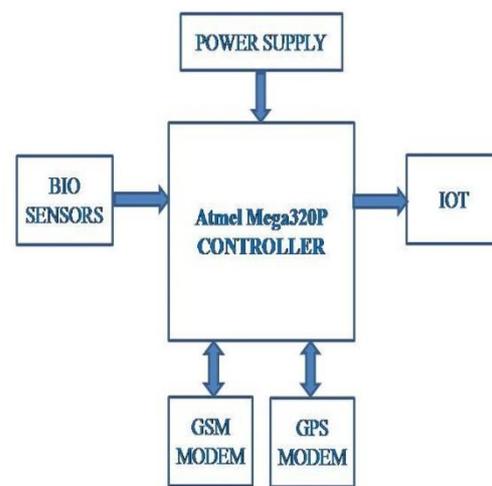


Figure 1:

Block diagram
An Android Application to monitor Health care of a Patient

By using Android Studio we designed an Android Application to access users and physicians in Smart Phone. In this application we observe the location of the patient. We can monitor heart-rate of a patient and send prescription to respective physicians from doctors of a patient.

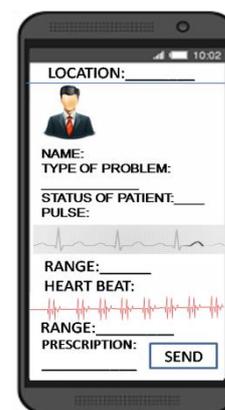


Figure 2: Android application to monitor health status of the patient.

This project describes a design of an effective alarm system that can monitor a patient in hospital. This is designed to inform about heart-rate increases that is occurred to the patient of the hospital. This project uses biosensors which detects the blood flow, muscle contraction and heart-rate. This sends a signal to microcontroller. This device presents an automatic emergency detection system using GPS and GSM modems. This system can be interconnected with the patient and alerts the doctor on his mobile phone. This detection and messaging system is consists of Bluetooth, IoT platform, GPS receiver, Microcontroller and a GSM modem. The Microcontroller processes the information and this processed information is sent to the doctor using GSM modem and Internet protocols.

A GSM Modem is interfaced to MCU. The GSM modem sends an SMS to the predefined mobile number and informs about this situation by initially giving fixed message. This enables it to monitor the situation and it can immediately alert the doctor or nurse with respect to the location of patient. To observe the patient data when patient data is in severe situation, here we are use IoT technique. This will show the recorded data of patient heart-rate. Then the doctor observes the patient data and the prescription to the nurse through an Android Application. Finally nurse will take care of the patient until the doctor comes. This Microcontroller provides all the functionality of the SMS alert system.

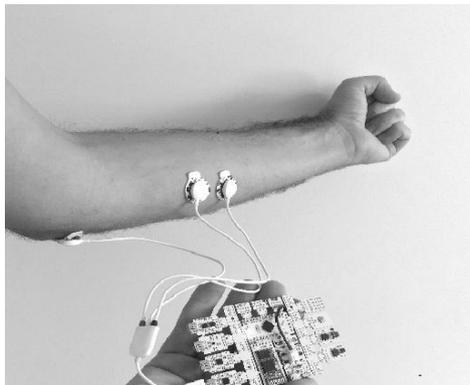


Figure 3: Implementation of the Prototype System

V. SIMULATED RESULTS



Figure 4: Results observed in personal computer



Figure 5: Results observed on android application

VI. CONCLUSION

The device “Smart Emergency Medical Care” is a flexible device. This monitoring system can be activated when threshold level exceeds, the alarm system is going to on such that the doctor will receive a message regarding the critical situation of the patient and can take immediate measures without any delay with location of patient. The same paper can be implemented as a voice based alert system so that the doctor can be alerted with a voice message if he is out of data connection.

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