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Automated Gurney System: A new paradigm for Health monitoring system using Internet of Things

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Abstract

A smart health monitoring system has rapidly evolved in past few decades. IoT has facilitated the health monitoring system by implementing many challenging process contributing to the advancement in medical efficiency and clinical approachability. Though limited ambulances are equipped with ALS (Advanced Life Support), situation probing to the requirement of alerting the doctors and hospitals thereby improving the efficiency in clinical settings has exponentially increased. The aim of this paper is to provide a smart health monitoring system by embedding sensors and IoT technology in Gurneys of an Ambulance. The emergency medical care is highly required and time sensitive demanding specialized persons.
The patient's condition is monitored continuously and communicated to the hospitals. In case of an emergency an SMS will be sent to the Doctors and family members through IoT thereby reducing the causality caused due to the delay caused in analyzing the condition and required clinical treatment.

KEYWORDS*: Gurney, IoT, Biometric Sensor, Health monitoring system*

I. INTRODUCTION

A major burden is reflected due to Trauma related death that affects the health system and the country's economy[1][2] . The focus on emergency medical support plays a vital role in the current era. To minimize the preventable deaths, the country needs a efficient system which caters to the need of people at emergency period.

With the alarming rate of increasing accidents, this paper addresses the solution of the emergency victim using IoT. IoT with its optimization improves the operational efficiency [3]. Embedding IoT technology with various sensors in Gurneys of Ambulance transforms to a smart system which collects and transmits the patient health condition to the nearer health care center through the internet. This alerts the doctors with the physical condition of the patient. Based on the conditions of the victim, the arrangements for the treatment can be made by the hospital before the arrival of the victim [4].

This work proposes a smart health monitoring system in Ambulance .The aim is to embed the existing healthcare services with the enhancement of sensors, medical devices and IoT with software applications. For an advanced health monitoring system, the physiological status of the victim should be regularly collected and transferred through a highly capable communication system [6][15]. With periodic data, these systems must add emergency reports under critical situations.

II. RELATED WORK

"Maria Sobitham Princy A, Monisha S, Nandini K'' in their work "Smart Ambulance rescue system with patient monitoring using" ,have embedded various sensors for detecting patient's health condition but with a time delay .

"Xiaopei Wu, Robert Dunne, Zhifeng Yu and Weisong Shi " in "STREMS: A Smart Real-time Solution Toward Enhancing EMS Prehospital Quality", personally explored the use of wearable sensing with mobile device and video technology to propose STREMS.

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"Chandra Sukanya Nandayala and Haeng-Kon Kim" in their work "From Cloud to Fog and IoT-Based Real-Time U-Health Care Monitoring for Smart Homes and Hospitals", Cloud Paradigm stands as the backbone for on demand network use but needed to analyze and act on the data in milliseconds.

"Antonia J.Jara, A.Zamor a-lzquierdo and Antonia F.Skarmeta" in "Interconnection Framework for mHealth and Remote Monitoring Based using Internet of Things". Communication and information approach defines the basis to reach a personalized health end-to-end framework but YOAPY algorithm depends on domain knowledge with respect to HDP.

"Basem Almadani, Manaf Bin-Yahya, Elhadi M. Shakshuki" in their proposed work "E-AMBULANCE: Real-Time Integration Platform for Heterogenous Medical Telemetry System", Sensor networks record and distribute health status information to system but failure in delivering patients status information may result in poor patient outcome.

The proposed system combines the health monitoring, supporting and transmission of health conditions lively through IOT.

III. PROPOSED SYSTEM

The proposed system consists of three modules (i) ambulance module (Input module),(ii) communication module (iii) Hospital module.

Module 1(Input Module):

In ambulance module, the gurney has few health monitoring sensors to check the live health parameters of the patient. The collected information from the sensors is shared to hospital through server instantaneously and periodically. Simultaneously, the victims details regarding the accident are shared to nearest police station through an alert message. This is achieved by a biometric sensor, used for obtaining the patient information.

The basic block diagram of the proposed system consists of modules such as Fingerprint module, Temperature sensor, Heart Beat Sensor, Respiratory system.

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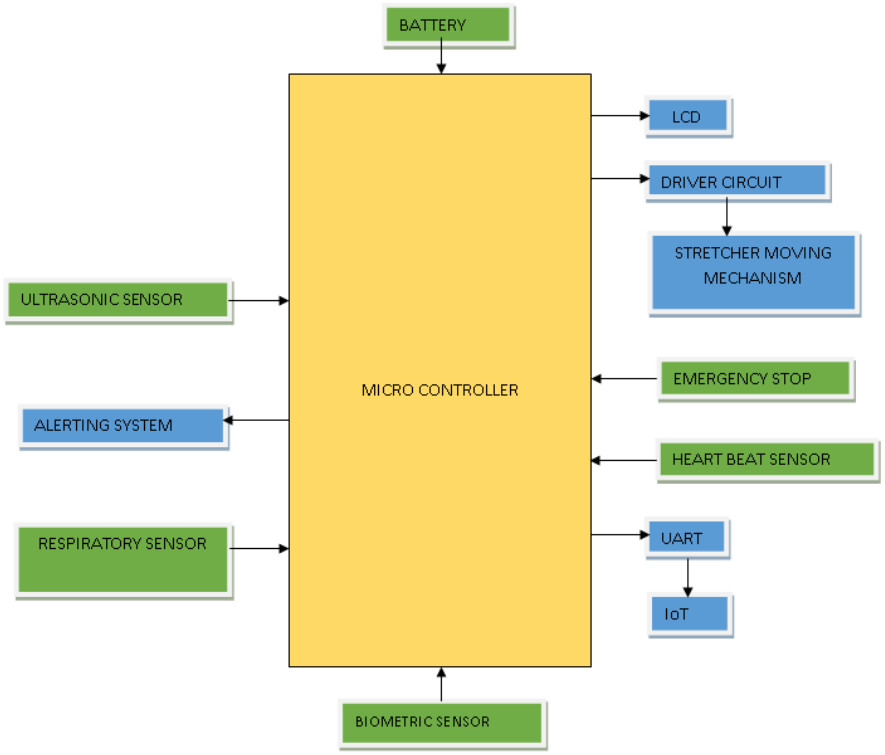

Figure 1: Ambulance Module

(i) **Fingerprint module**

The module is connected to an Arduino pin. The module senses the finger print of patient. Once the patient fingerprint is sensed, the alert message is sent to corresponding number through GSM.

Figure 2 : Finger print sensor

Finger print sensor, commonly called as finger print reader, is a fingerprint image capture device, which forms the front end of the biometric fingerprint identification/verification module.

(ii) HEART BEAT SENSOR

The heart beat sensor is a measuring device to record the heart rate using optical LED light source and an LED light sensor based on the principle of light reflection which varies based on the blood vessels.

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Figure 3: Heart Beat Sensor

(iii) **TEMPERATURE SENSOR**

The temperature sensor is a precision integrated- material with an output voltage comparable to the temperature in Centigrade.

Figure 4: Temperature sensor

(iv) RESPIRATORY SYSTEM

The Respiration Sensor is a device which monitors abdominal or thoracic breathing and measures breathing rate.

Figure 5: Respiratory System

Respiratory sensor, heart beat sensor and temperature sensor are connected to analog pins of microcontroller for processing and communication.

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(v) Arduino UNO Pin Out:

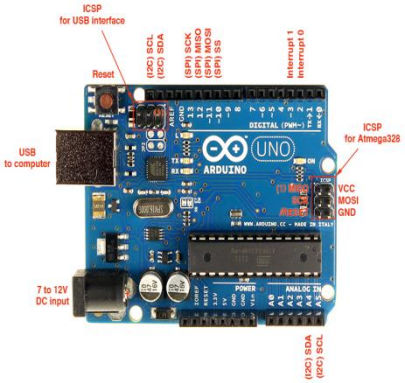

Figure 6: Arduino UNO Pin Out

Arduino Uno is a microcontroller board with the 14 digital pins to support an input or output. They operate at 5 volts. It is an open-source platform that reads the sensor outputs and turn it into an output in form of LED / LCD display or publishing the output online.

This device continuously supports the sensors to monitor patients heart beat, temperature and the values are displayed in LCD. If the heart beat and temperature values vary with respect to the threshold value, the alert is indicated to mark the normal or abnormal condition. This sensor values are communicated to hospital through server, also restored in cloud.

Module 2: Communication module:

The Communication module provides the wireless communication capabilities between the sensors, controllers and processors with end applicants.

Fig.4 shows the general block diagram of communication module

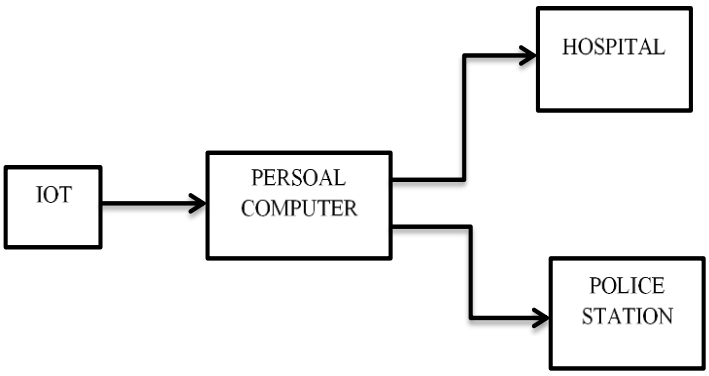

Figure 7: Communication module

(i) **SIMCOM GSM:**

It is a communication Modem which act as SIM card with it's private number. The RS232 port in the Modem communicates and progresses embedded applications.

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Figure 8: SIMCOM GSM

The SIM800C highlights a industry standard interface .It is a complete a quad-band GSM/GPRS module that works on frequencies
GSM850MHz, and supports voice, SMS, Data, and Fax with minimum power utilization.

(ii) IOT MODULE-ESP 8266

This is a Wi-Fi microchip module with complete microcontroller capability and TCP/IP stack and. It is essentially used for development of IoT (Internet of Things) embedded applications.

Figure 9 : IOT Module -ESP 8266

ESP8266 component act as a standalone wireless transceiver that is implemented at end-point IoT developments. To communicate with the ESP8266 component, microcontroller uses set of AT command.

Module 3: Hospital Module

After reaching hospital, based on the emergency conditions it becomes mandatory to move the patient to intensive care unit. There are many obstacles interfering between entrance and care unit. Till date, the stretcher is moved manually causing time delay. To overcome this issue, a control mechanism is embedded in the gurney which is controlled by microcontroller.

Stretcher moving mechanism is connected to relays and emergency switches are connected to Arduino. By initiating this stretcher moving mechanism, stretcher moves automatically with guidance of human. When first switch is pressed, the stretcher moves in forward direction. When second switch is pressed, the stretcher stops. The stretcher is equipped with Ultrasonic sensor. The two pins in this

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sensor is used as trigger pin and echo pin connected to Arduino pin. This sensor is used for calculating the distance of an object. If any object is near to stretcher, ultrasonic sensor senses the object and the stretcher will be automatically stop.

Advantages of this system combines easy installation, reduction in deciding the treatment process prior to patient's arrival to hospital hence reducing the delay of treatment thereby reducing the fatal death rate.

Table 1: Relation dataset in Smart Gurney System using Cloud

S.No	Data Sets	Parameters	IOT Technology	Instance of Sensitive Events
1.	Health Related Datasets (HRD)	Heart beat Rate, Respiration Rate.	Smart Wearable's, Body Sensors, Heart Sensors.	High Heart Rate, High Blood Pressure.
2.	Environment Related Datasets (ERD)	Temperature of the patient.	Temperature Sensors.	High Room Temperature.

VI. RESULTS AND DISCUSSIONS

The figure represents the hardware connections of the Gurney. Arduino, Motor, Push Button and LCD, Temperature sensor and Ultra sonic sensor are interconnected. Simulation is performed to represent the functionalities of temperature sensor and ultra sonic sensor, heart beat sensor, Arduino, and LCD.

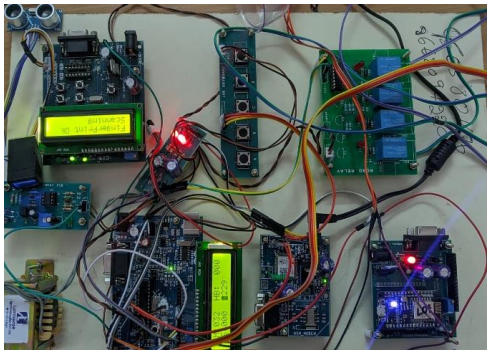

Figure 10: Prototype of Gurney Hardware system

The simulation results are summarized reflecting the working of motor with respect to ultrasonic sensor.

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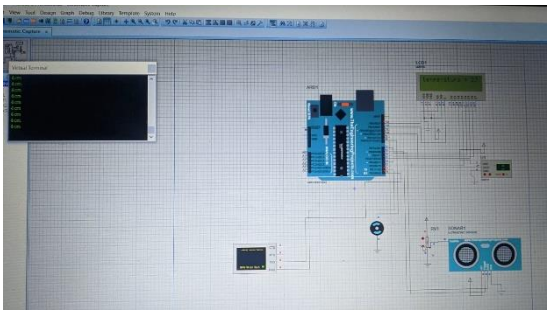

Figure 11: Simulation Output of ultrasonic sensor with less than 10cm

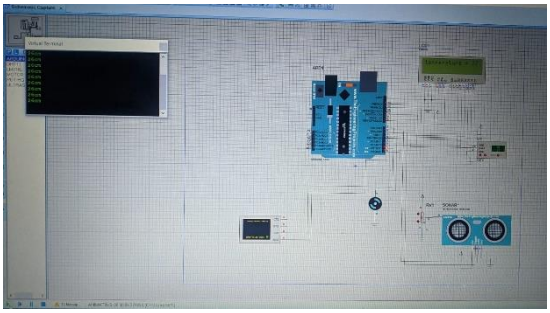

Figure 12: Simulation Output of ultrasonic sensor with more than 10cm

During simulation process, LCD displays the current Heart beat rate per second and minute.

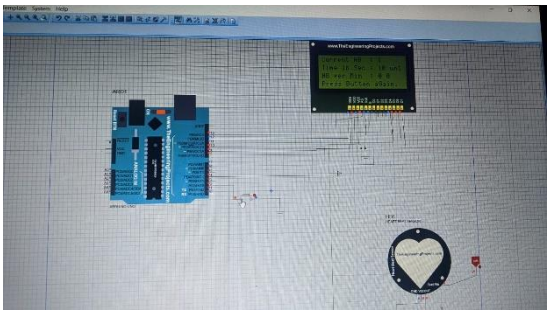

Figure 13: Simulation output for Heart Beat sensor

VII. CONCLUSION AND FUTURE WORK

Delays in detecting and providing health support to the victims under medical emergency increases the fatal death. Emergency medical treatment is highly time sensitive and delays of seconds would make a difference between survival and death.

In this proposed system, a prototype has been developed to maximize prior arrangements in the hospital by measuring the body condition of the victim through the sensor and IoT technology. Also, using the biometric system the details are collected from the centralized database. Information regarding the accident is sent to the doctor for the arrangements as well the victim's family.

The future scope is to implement simultaneous GPS location tracking sharing the traffic information for automatic road clearance thereby reducing the delay in treatment and proportionally reducing further fatal deaths.

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