Development of Advanced Healthcare System in Ambulance using IoT Environment

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Abstract. Every year, many people, due to traffic rules' negligence, become victims of road accidents and lose their lives. No matter which mode of transport they are from, even the ones on foot are not safe. Often there is a delay in response of EMS (Emergency Medical System), Ambulance and thus delay in treatment. This delay can cause the patients to lose their life [1]. The emergence of IoT has led to an evolution in EMS that makes our global society more streamlined and fecund. Thus, appending ambulance (EMS) with IoT makes it a smart ambulance. The bleeding person’s health state could be collected and communicated to the nearby hospital on the Internet. Thus, the doctors would know the victims' physical condition before they arrive at the hospital itself. Shortly, the hospital's arrangements could be made based on the patient's health condition by detecting the parameters, like heart rate, respiratory rate, temperature, etc.

Keywords: EMS, smart ambulance, health care, safety, security.

1. Introduction
The health care industry is in great despondency. The global population is mellowing, services are costlier than ever, and the number of accidents is on the ascent. As technology cannot stop aging, it can make health care facile on the pocket and more approachable [1]. IoT devices inflate the quality of the health care services received by the patients. With the help of connectivity protocols such as Z wave, Zig Bee, Bluetooth LE[2], Wi-Fi, and other modern conventions, health care personnel can change the way of spotting illness and ailments in patients. It can also bring profound ways of treating these ailments [3].

2. Related Work
2.1. Background and limitations in the present system
A one-month medical field test phase work has led to various upshots, which shows the present scenario is not ideal [4]. There is no automated system for information sharing of the patient [5]. Also, there is a delay in timing for the treatment to occur.

2.2. Proposed work
The profound system consists of the hospital system and ambulance system. The ambulance section can be further divided into three sections of timely traveling of EMS, monitoring the health using sensors that would record patient's live health parameters that are implemented [6] in a stretcher, and then sending the information to the hospital, relatives, and cops [7]. After the ambulance follows the shortest
path to reach the patient's landing place, it records the patient's personal information using fingerprint sensors. IoT amended this information to the hospital and police station. The hospital section involves receiving the desired information [8]. The perceptible Gross fallacy in the current system can be reduced with technological advancement [9]. Many issues may occur given the patient's conditions. These issues can be classified as:

✓ Providing an immediate response to the patient's health status.
✓ Material sensors to inscribe data from the ambulance.
✓ Calculation capacity to cache and inspect the data.
✓ The means to deliver either practical advice bespoke, or self-operation based on the data input.

These are the real-time services that are supported. Therefore, a model design is required to cover all aspects of time. Data can be transmitted to the patient tracking system via the proposed system wirelessly (in the hospital) [9]. An application-connected biometric sensor enables all the data produced by the sensors to be accessed in real-time [10] (heart rate, body temperature, and blood oxygenation). Through obtaining the information through IoT [11], the hospital will track the patient’s identification and, therefore, the patient’s health status [12]. Arduino Uno serves as a server on the Internet that instantly transfers data to the web, and providers of treatment may decide on their patients' health status [13].

FLOWCHART: As soon as the ambulance gets a call, it reaches the destination using the Dijkstra algorithm and perceives the shortest path to reach the destination address identified through the biometric sensor to identify the patient's identity medical history [2]. If biometric recognition does not match, again, it is noted using another finger using the biometric sensor. Many healths monitoring sensors help get the live health parameters. These include BP, heart rate, and respiratory sensors [14]. Thus, the information is updated using IoT to hospital for every second. The two-way communication helps inform about the accident to a nearby police station and guardian through GSM. Finally, the heart rate is monitored by the doctor. Figure 1 discusses about block diagram of advance health care system in ambulance using IOT environment.
3. **Methodology**

DIJKSTRA algorithm helps to find the shortest path to reach the accident spot and then to the hospital. The server involves the node and distance from the surrounding nodes. The nodes on the road to the hospital are traced, taking the accident as the source and the hospital as the destination. When the distance between the nodes is nil, it is said to have reached the destination [5]. GPS can help track the patient's location, as the hospital database contains their locations (GPS points). The nearest neighbor to examine the most appropriate path to reach the destination by giving the shortest distance is obtained [9]. As the data reaches the hospital server, the doctor can analyze the data and the situation and take appropriate action [4]. Thus, he can find the BPM average in the MATLAB workspace. These values play a crucial role in identifying if the patient is in a stable condition or not. The biometric sensor, heart rate, and respiratory sensors give the important body parameters [6].

![Flowchart of Proposed System](image)

**Figure 2**: Flowchart of Proposed System

Human fingerprints are unique, detailed, durable, and difficult to alter, making them suitable for human identity. They may be employed to identify unfit or dead people and thus cannot identify themselves in a natural disaster or can be used to identify patients' identities for medical purposes. A biometric sensor (fingerprint sensor) is a fingerprint image capturing device [7]. The fingerprint image is registered, fits each print's features read by the sensor, and compares with the module's images or local archive. However, the imaging capabilities are affected by the quality of the skin. The LM35 series is a precise IC temperature device.

The respiration sensor monitors abdominal or thoracic breathing and measures the relative depth of breathing and breathing frequency. The first step involves inhalation and exhalation. In the second step, the oxygen diffuses into the blood, and carbon dioxide diffuses out of the blood. The third step is the production of carbon dioxide and chemical energy for body cells. Finally, carbon dioxide gas is breathed into the lungs. LCD is a unit for the display of different sensor values of 16 characters x 2 rows. The E-blocks and most e-block I/O ports are compatible. The data is submitted after 30 ms when the LCD board is triggered (i.e., the time taken for the LCD to format). The programming code is low in cost and can be conveniently built with flow code icons.

A GSM modem works with any SIM card like a mobile phone, having its unique phone number. RS232 sends/receives SMS and voice calls. GPRS connects to the Internet and runs applications for data logging and control [8]. GPRS mode connects remote FTP server and uploads files for data record to the hospital.

ESP8266 is a low-cost stand-alone Wi-Fi-enabled system on chip (SoC). It develops IoT embedded applications. Click the SW2 switch and keep the GPIO-0 pin to the ground and load the code into the programming mode [9]. The switch can be released until the code is supplied. Monitoring the patient's health criteria using Arduino Uno links the Internet, serves as a portal and automatically transfers data to the
website. The healthcare providers may decide about their patients' health status. The sensor data are given in Table 1:

**Table 1**: Threshold values of sensors

| Sensor            | Input Position | Expected output | Threshold          |
|-------------------|----------------|-----------------|--------------------|
| Temperature sensor| Hand           | 36.1-37.2 deg   | 37 deg             |
| Heartbeat sensor  | Fingertip/wrist| 50-100 per min  | For 18+ : 60-100 bpm For age 6-15 : 70-100 bpm |
| Respiratory sensor| Blow air with mouth | 14 per min | 12-20              |

**Figure 3**: Model of Advance health care system in an ambulance using IoT Environment

The output data are obtained from the advanced health care system unit as follows:

a) The body temperature, respiration rate, blood pressure, and heart rate are prime parameters to diagnose a condition. This project gives these values using IoT and sends them to the server and patients' relatives through SMS (as shown below) using GSM Modem.

b) Average BPM is calculated in MATLAB workspace, which makes the decision-making easier and more analytical
4. Result
Thus, a cost-effective way of providing treatment to the patient is implemented to save treatment time and get the right treatment on time. Thus the lives can be saved within the golden hour. Figure 3 elaborates the model of Advance health care system in an ambulance using IoT Environment. Figure 4 shows Sample Screen of implemented results.

5. Conclusion
The right diagnosis would allay the need for hospitalization. Health care operations allow organizations to get requisite data-driven perceptions and health care analytics that speed up decision-making. The technology-driven setup trims the cost by slashing down unnecessary visits, utilizing better standard resources, and improving the grant and forethought. Moreover, it is less susceptible to errors.

6. Future Work
Vast opportunities are opened up due to snowballing of healthcare-specific IoT products. Health care can be transmuted by connected devices that generate a huge amount of data. Through real-time health monitoring, IoT can traverse new patient care dimensions and ingress patients' health data. This data would help the stakeholders to refine the patient's health and experiences to make revenue scopes and revamp health care operations.

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