

Smart Accident Management Model: a collaboration of IOT and Body Area Network

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Abstract—Accidents are the major cause of death in most of the countries. Even though there is a vast development of traffic control system and automotive technologies, the number of accidents increases day to day. In most of the cases of accidents it is the lack in providing quick first aid and timely medical service is the cause for loss of life. We try to make use of human and computer interaction to develop an accident management system. Accident management doesn't only contain accident detection, but also it has to include automatic and quick notification to first responder (ambulance) and to alert nearby hospitals, controlling traffic in accident zone. In this paper, we propose an automatic accident management system by making use of IOT.

Keywords—Accident management, Human computer interaction, Internet of Things.

I. INTRODUCTION

Due to the increase in the number of vehicles in globe, world's road becomes overcrowded and increases road accident. Most of the developing countries are the mainly suffering from road accidents. Among over all road accidents most of the accidents and loss of lives are happening in India [1]. Also, 90% of the world accident happens in developing countries due to the increasing number of vehicles and lack of proper road traffic management.

In our approach we use IoT, BAN (Body Area Network), GPS to develop an accident management model. IoT is the emerging technology that has huge impact on society and day to day activities. It is the network of millions of things (things may be anything from humans, vehicles to even small pen). With IoT sensors are ubiquitously embedded in our environment that collects information about the things and they share this information with each other to create a big picture about the environment. In our approach IoT is used as the backbone of our model that connects humans, roadways, vehicles, ambulances, medical clouds and traffic signals and collect information and process the information to create huge emergency medical IOT network.

In our approach we use a body area network to detect the accident. In most of the accident management system depends

on sensors in the vehicles like acceleration sensor, vibration sensor and seat belt sensor. But using these sensors we are unable to get an exact picture about the accident scene. Recent development in BAN allows ubiquitous body sensing with the help of micro sensors.

In order to ensure timely delivery of medical service we use GPS. We can locate the accident scene and calculate the optimal path for the ambulance using GPS. We use medical cloud service for ensuring delivery of a patient's health status and medical history to the corresponding hospitals and reduce initial delay in treatment.

II. RELATED WORK

BAN, IOT is the research field where a lot of recent research works are carried out. But only very few works only combine these two techniques. In an emergency handling system most of the work concentrates on accident detection with the help of sensors in a car or other external sensor like [2] where the smartphone is used to detect the accident. In this paper author proposed an approach that detects accident with the help of the accelerometer in the phone. Few papers only use BAN to detect an accident. Prabakar et al. Proposes an approach that uses a heartbeat sensor to detect an accident.

A lot of papers deals with the transmission of the accident information to the nearby region[3]–[6]. In [7] author makes use of GPs to find the shortest path for ambulance to avoid traffic and quick delivery of medical service to victims. Papers [8], [9] proposes an approach for traffic control in 4 author uses the font to collect speed, location and other various parameters of the vehicle to create real time traffic map that is used to control traffic. In 2 iot is used for traffic control. It makes use of m2m communication and 3gpp for traffic management.

III. SYSTEM OVERVIEW

The overall architecture of the system is described in the fig 1.1. The ubiquitous patient monitor is located in the vehicle. It is responsible for the initial detection of the accident. It contains two components BAN and Local processor (loc.proc).BAN continuously monitors the passengers critical physical attributes. A local processor is a low power processor in the vehicle that is capable of finding abnormalities in the physical parameter and decide whether accident happen or not. It has Warning Generator (W.G) and Emergency Caller (E.C).

Central processor is the core part of the architecture, it will receive accident message from various vehicles and take necessary actions like finding nearby hospital and ambulances, hospital and traffic control unit.

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Ambulance monitor unit is connected with GPS and detect shortest path for that ambulance. Traffic controller receiver information from central processor and ambulance monitor units. It has Signal Controller (S.C) to control traffic lights when ambulance crossing and Warning Signaller to transmit warning message to all the vehicle near the accident zone to avoid secondary accidents.

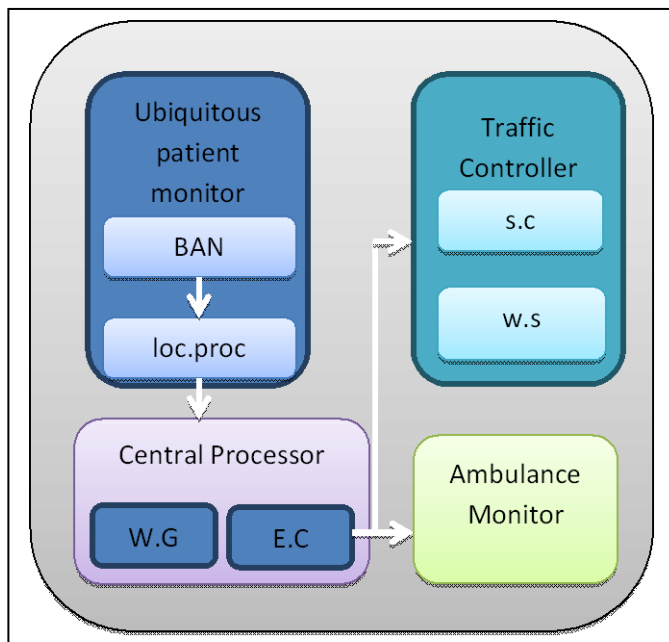


Fig. 1 system architecture

IV. WORKING PROCEDURE

A. Ubiquitous Sensing

This is responsible for monitoring the physical parameters and taking decisions about the accident. Here to detect an accident, we use BAN network. In BAN network various wireless sensors are used to sense a physical parameter which is processed to create overall health mappings. This unit has two major components that discussed below.

1) Heartbeat and temperature sensor

In order to ubiquitously monitor the parameters of the passenger we fix all the sensors in the seat belt



Fig. 2 seat belt BAN sensor

Hart rate monitors use the diaphragm and microphone to calculate the y beat of the passenger and sends it continuously to the local processor. Plethysmography is also used to sense the pulsatile flow of blood. Temperature sensor sense the body temperature and reading of all the sensor is sent to the local processor.

2) Vibration and seat belt sensor

Vibration sensor is attached to the vehicle. It contains two quarts crystal of one with high and another with low frequency that is cut in the shape of rectangular plate and tuning fork respectively. It creates a circuit that has a sharp resonant frequency. Thus, it can be used as vibration sensor. Seatbelt sensors are used to send a warning signal to the local processor in the case of seat belt locking.

3) Local processor

The local processor receives signal from all the sensors. It also contains GPS connection, hence it can able to obtain the vehicles current location all the times. All the threshold levels of the sensors are defined initially in the local processor. When it receives seat belt warning and vibration warning signal it checks for the threshold levels of BAN sensors. If that value is out of threshold value, then it confirms accident and send a warning alarm to the central processor along with its GPS coordinates and the latest or last recorded BAN sensor data.

B. Central Processor

Central Processor is connected with all the units in our system

1) Warning Generator

Warning Generator of Central Processor waits for the alert signal from the vehicles local server. Once it receives the alert signal it takes the GPS coordinates and BAN sensor data from alert message. It sends this information to Emergency caller

2) Emergency Caller

Emergency caller creates three emergency alert message. First, it takes the location information and it sends it to the ambulance monitor unit. Second, it takes sends the another message to the traffic controller about accident scene. E.C gets the detail about the hospital to which passengers are taken from ambulance monitor and finally it sends the passengers BAN network data to the hospital where the passenger is taken.

3) Ambulance monitor

Ambulance monitor has three important functions. First, it keeps track of all the ambulances in the city. Secondly, It contains the location of all the hospitals in the city. From this information it creates a real time health care map. Finally finding the optimal route for ambulance service. After receiving accident location it finds the nearest ambulance and the nearest hospital. Here we use dijkstra's algorithm to find the nearest path, but instead of path cost we take time to reach between the nodes as a cost. This algorithm takes speed and distance variable as input. In order to make computation simple and fast we consider speed as a constant average speed. After shortest path is computed it send the location of accident, location of nearby hospital and shortest path to the ambulance near the accident scene. Finally, it sends the hospital detail to the central controller.



Fig. 3 ambulance monitor map

C. Traffic Controller

Traffic controller receives continuous data from both central processor and ambulance monitor.

1) Signal controller

Signal controller is used to manage signal during the arrival of the ambulance so that ambulance don't face delays. It uses the WiMax standard for communicating with the ambulance. An ambulance approaching near the traffic signal sends the alert signal to it. On receiving the alert traffic controller change the light according to its.

2) Warning spreading

This unit is used to avoid secondary accident at the traffic scene. Here the traffic controller sends the alert message to traffic signal near the accident scene. Using the available WiMax connection, it floods warning message to all the nearby vehicles so that they can pass the region carefully.

V. CONCLUSION

According to survey by 2030 accidents going to be the 5th place in causing death to people. Hence it is necessary to develop and strengthen our accident management technologies. In this paper, we proposed a model that makes use of IoT and BAN to develop a complete accident management. Our approach doesn't focus on any one of the particular area in accident management, but includes a solution for accident detection till delivery of the patient to hospital.

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