Smart Emergency Management with IoT for Integration of Emergency Centers and Patients

G.N.Keshava Murthy

Abstract: In highly populated countries like India, there is queue for almost all services and this is true for health care services too. It is very difficult to check the occupancy of emergency wards in hospitals and availability of blood bank due to infrastructure disconnectivity. There is a considerable delay in placing the emergency cases to bed and blood availability like accidents. This delay must be reduced to save lives. Internet of Things (IoT) is the emerging technology which helps in device connectivity. In this work, an emergency management solution for bed and blood booking is implemented using IoT with better integration between hospitals, blood banks and patients.

Index Terms: Electrocardiogram, IR Sensor, Raspberry Pi, RFID.

I. INTRODUCTION

In India, hospitals are distributed and emergency departments in hospital are loaded differently. During emergency situations, lot of delay is experienced before the patient gets bed and blood availability. This delay can be catastrophic and may result in loss of lives. The reason for delay is the inability to find the emergency center with vacant beds and ordering of blood to that center. Infrastructure disconnectivity and relying on typical call based enquire methods to find availability is not efficient to handle the emergency. There is an automated way to handle booking of bed and blood for better managing the emergencies. The wide concept of reflecting connected set to any network, any service, any place, any time, any thing and any one is IoT, which is now becoming quite a megatrend for forth coming generation technologies which can impact the entire spectrum of business that can be considered as interconnection of specific, unique devices and smart objects in current internet infrastructure with benefits being extended. These benefits include advances in device connectivity and also the services which goes beyond the Machine-to-Machine (M2M) scenarios.

Thus automation introduction is quite conceivable in all fields. For a large range of applications of IoT like security, emergency services, traffic congestion, structural health, health care, industrial control and many others IoT provides suitable solutions. Along with this IoT also has ability and potential giving clarification, explanations and solutions, even to medical applications like remote health monitoring, elderly care and many others. Another significant application is the compliance along with the treatment and medication at home itself by healthcare providers.Thus there are large number of different sensors, medical and imaging devices, that can be observed as smart devices or the objects that is being constituted as core of IoT. Health care services that is IoT-based not only reduces costs but also increases life quality and enriches users experience. In the point of view of healthcare providers IoT bears energy, strength and potential to decrease downtime of the device via remote provision. Additionally IoT can also clearly specify the optimum times for replacing the supplies for different devices for the continuous, smooth and problem free operation. Thus IoT is providing efficient scheduling of limited resources thus guaranting the best usage and better service for huge number of patients. In this work, emergency management in terms of bed and blood booking is handled using IoT. Beds in hospitals are fitted with sensors that keeps monitoring availability and updated to server in real time. Blood availability data in blood bank is also integrated to the server. During emergency, bed and blood can be booked in real time by patients or on behalf of the patients.

II. RELATED WORK

A survey of IoT technologies in health care services is discussed in this section. For elderly monitoring in [1] the authors have proposed a real time mobile health system. The system used a biosignal sensor worn by the patient that keeps location monitoring as well as the vital signs like Sp02, heart rate and these remote users also had real time access to the information provided by the biosignal sensors. There was a approach for machine learning that could interpret huge quantity of physiological data (multivariate) by using wearable patient monitors, that provides the goal of early warning of emergency physiological determinations like predictive care was proposd in Author [2]. A new hybrid mobile-cloud computational solution for personalized medical monitoring is proposed in [3]. Computation tasks are moved to cloud for execution, thereby reducing the workload at mobile devices in this work.

Retrieval Number: D8506118419/2019©BEIESP
DOI:10.35940/ijrte.D8506.118419
Journal Website: www.ijrte.org

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Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

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A remote monitoring system for temperature signals and electrocardiographic was developed by authors in [4]. The system had a hardware module for acquisition and also consisted of Bluetooth transmission module with a displaying module which could be either PC or mobile device. Received information is sent to database server via IP i.e GPRS or WiFi, which contained clinical data, that can be accessed via web application.

Author in [5] developed STAlz, which is a mobile based system that provides caregivers and the medical professionals a path to be in touch so as to share some important information, and also to provide Alzheimer's patients with a tool which could give the potentiate the exercise of their cognitive functions. Traffic junctions on the way to hospital are controlled using IoT to provide fast navigation of ambulance. In [6] IoT based solution for position and orientation determination of hospital equipments is proposed. The system used passive technology Radio Frequency Identification (RFID) to monitor the flow of material, equipment, personal, and patients in the hospital. Authors in [7] gave a very less cost approach to keep monitoring the parameters of real time of patient making use of Active UHF RFID along with correct parameter monitoring sensor. RFID is being integrated with Health Monitoring sensors to clearly distinguish individual patient in the ward. Architecture which connected intelligent things in smart hospitals that was being based on narrow band IoT was discussed by authors in [8]. To deal with the latency in medical process Edge computing was made used. A monitoring system to acquire ElectroCardioGram (ECG) signals via the 2-lead ECG sensor and also to transmit the same via the Bluetooth wireless link and to process and display these waveforms in smart-phone was proposed in [9]. The physical constraints that was being imposed by hard-wired link was eliminated by the use of of Bluetooth Low Energy (BLE) technology. Authors in [10] demonstrated clinical usability of combined blood temperature management and tracking system with the usage of RFID and the technology of Ubiquitous Sensor Network (USN). This blood monitoring and management system keep reporting the temperature of the blood-bank's refrigerator continuously and also performs the job of tracking location of blood bag and will confirm that, the assigned blood bag was correctly sent to the intended patient itself in need of transfusion. Authors in [11] proposed a RFID based blood bank management system which focused reducing number of transfusion errors that usally would occur and also have developed a prototype for the system that made use of 13.56 MHz HF RFID reader/writer which could continuously track inventory status of blood bank in real time and also has a cross-point checks at different locations to make sure correct transfusion.

III. PROPOSED SOLUTION

The IOT based bed and blood booking systems block diagram is given in Fig. 1.

The system has three important parts of which first one is a hardware part where Raspberry Pi is interfaced with motion detection sensor to identify whether person is fine, fainted or has fallen down. The IR sensors to monitor the patient beds whether they are filled or empty. The alarm is to notify the surrounding people regarding the status. IoT modem is to link Raspberry Pi with server. The second part of the work is the server with data base to store the data and to link hardware with Web app. The third part of the system is Web app provided for ambulance driver or common people so as to pre-book the patient bed and blood if its needed before reaching any hospital. In case the patient falls down then the motion detection sensor will sense the information and intimates the status to ambulance with GPS location of patient. The ambulance driver using his app will reach the patient using the maps. Before the driver takes the patient to any hospital checks for the availability of beds or wards using the smart Web app. If there is availability then he can book the bed instantly and can reach the destination easily. If not he can take the patient to another hospital. After reaching the hospital if patient needs blood immediately, then by using Web app one can book the blood easily. Using load cell glucose level of glucose bottles can be easily measured and if the level goes low the alarm will turn on giving an indication to replace the glucose bottle injected to patient so as to avoid reverse flow of the blood.

The schematic diagram of IoT based instant bed and blood booking for hospitals with systematic facility management system using Raspberry Pi is shown in Fig. 2 and its various blocks are briefly explained below:
Pin 2 of Raspberry Pi connected to transmitter of IR sensor of pin 3 of Raspberry Pi connected to receiver of IR sensor. VCC is connected to 5V of Raspberry pi. Output of IR sensor is connected to pin 14. RS of lcd is connected to pin no.12. Enable of lcd is connected to pin no.16. D4 is connected to GPIO pin no.18. D5 is connected to GPIO pin no.36. D6 is connected to GPIO pin no. 38. D7 is connected to GPIO pin no.40. Trig pin of ultrasonic sensor is connected to pin 8 of Raspberry Pi. Echoof ultrasonic sensor is connected to pin 9 of Raspberry Pi. Vcc is connected to +5V and Gnd is connected to Gnd pin.
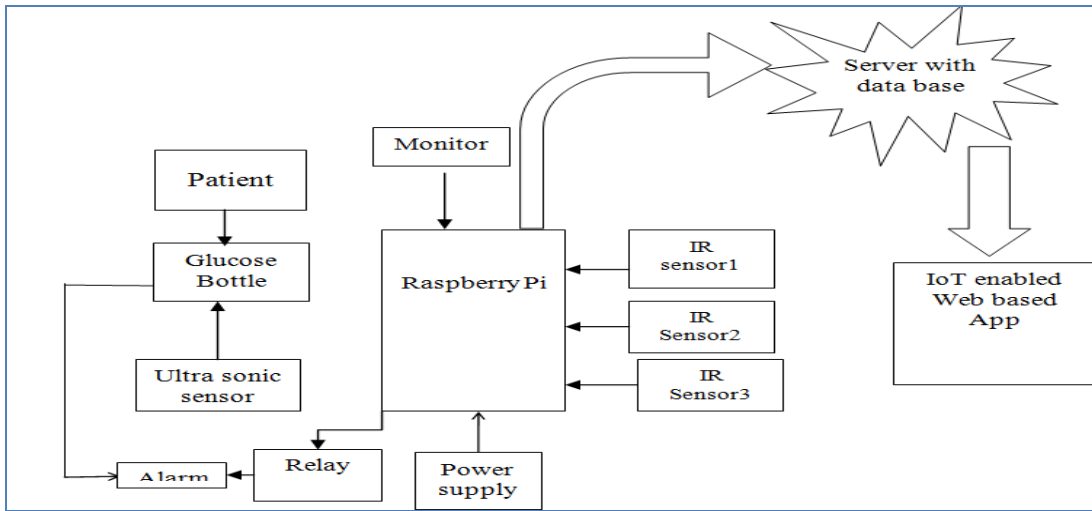
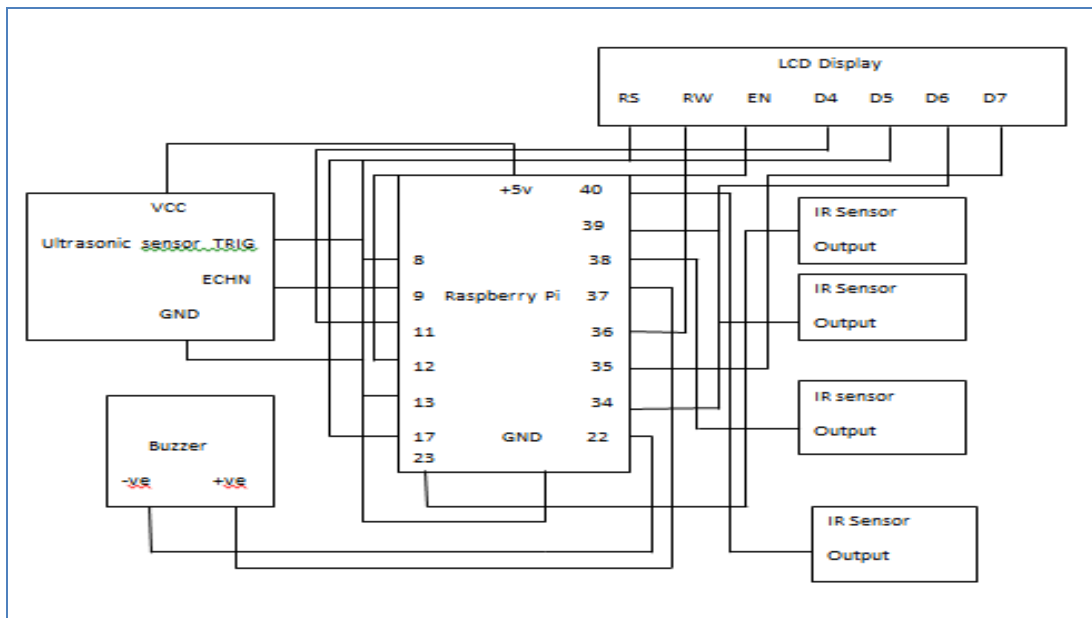**Fig. 1: Block diagram of IoT bed/blood booking system**

Fig. 2: Interface diagram

IV. RESULTS

The IoT based instant bed and blood booking for hospitals with systematic facility management system using Raspberry Pi is developed and is tested by placing the parameters (IR sensor) in the path of the sensor. The results of blood and bed booking system is obtained. Availability of bed in the hospital is as shown below in Fig. 3(a), Fig. 3(b) and Fig. 3(c).

Book a Bed

Bed 1	Bed 2	Bed 3	Bed 4
○	○	○	○
Submit			

Fig. 3(b). Bed Availability

Current bed status

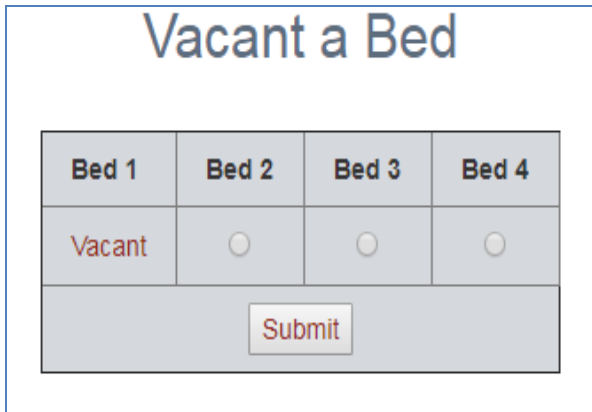| Bed 1	Bed 2	Bed 3	Bed 4
Vacant	Vacant	Vacant	Vacant

Fig. 3(a). Bed Availability

Fig. 3(c). Bed Availability

If the patient is present on the bed the system shows the bed is booked. If the patient is not present on the bed the system shows the bed is vacant. The availability of blood groups in the hospital is displayed in the Web app as in Fig. 4. It also shows the numbers of particular blood group bottles present in the hospital.

The facilities available in the hospital and the blood availability are displayed in Fig. 5. The advantages in the proposed system are:

- One can pre-book the hospital bed for patient before reaching the hospital using Web app.
- One can easily check the availability of blood in blood banks and book for the needed group instantly.
- Glucose bottle level can be easily monitored to avoid blood reverse flow.
- A good and healthier link can be established between hospitals and patients.

The applications of the proposed system are as follows:

- It can be used for wireless health monitoring for aged people.
- The concept can be used in agriculture with different sensors to monitor the health of crops.
- The concept can be used in industries to maintain the healthy condition of machineries.
- The concept can be used in Making of smart cities.
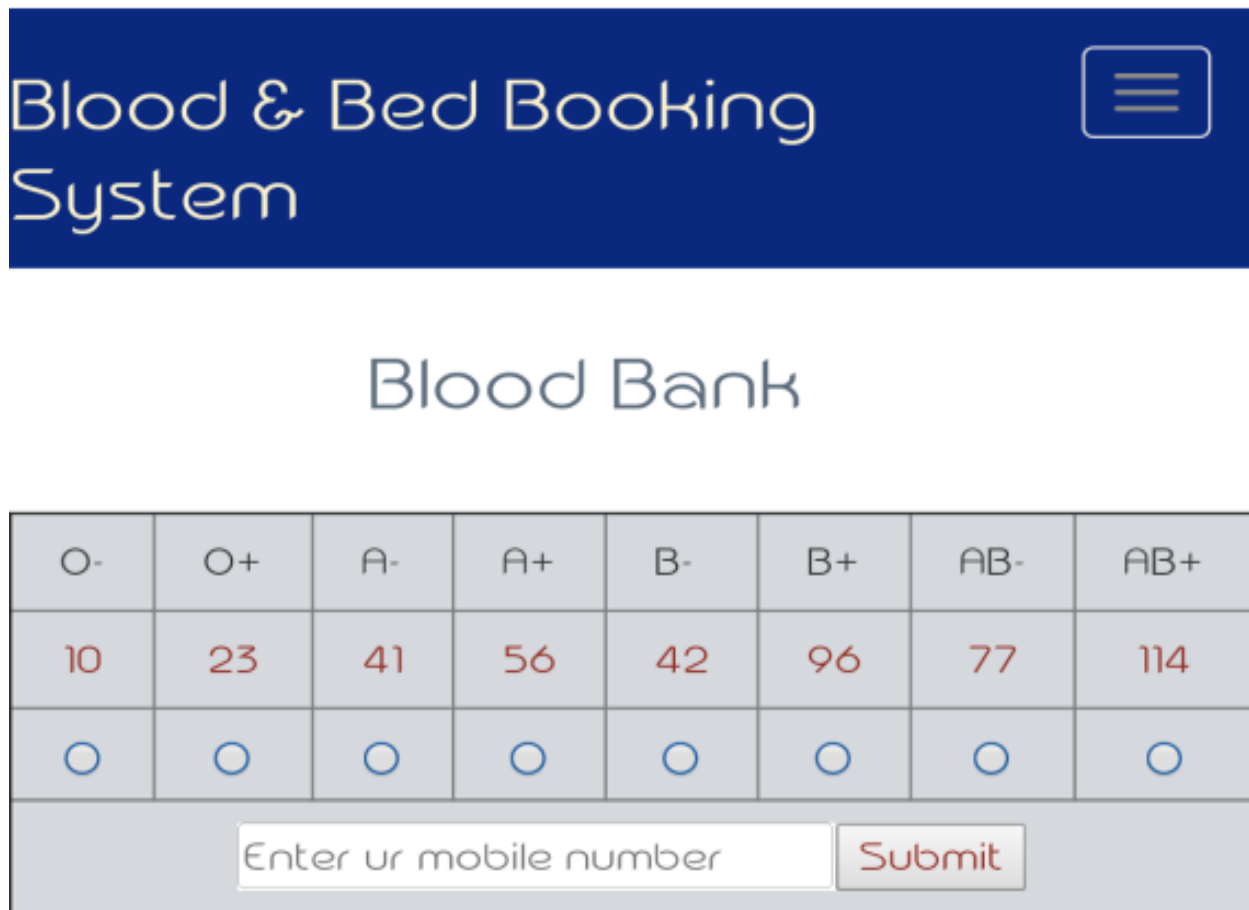- The concept can be used in Common Entrance Test counselling for seat booking.

Fig. 4: Blood booking system

Hospital Details and Facilities

Hospital Name	Bed Availability	Blood Availability	ICU	Ambulance	Subsidy for POOR	Contact Us
AIMS	Available	All Groups	In good condition	Free	For BPL cards	https://www.nhp.gov.in/hospital/sri-adichunchanagiri-hospital-and-research-center-mandya-karnataka
SAKRA WORLD	Not available	Only B+	Available	Payable-1000rs	Not available	https://www.sakraworldhospital.com/
JAYADEVA	Only 5 Available	A+ and B+	Not Functional	Free	Available for Elderly	http://www.jayadevacardiology.com/

Fig. 5: Hospital details and facilities

V. CONCLUSION AND FUTURE SCOPE

IoT based instant bed and blood booking for hospitals with systematic facility management system is proposed in this work. The system is implemented using IR sensor, ultrasonic sensor, server and Raspberry Pi. The IR sensors monitor the patient beds whether they are filled or empty. IoT modem is to link Raspberry Pi with server. The server with integrated data base to store the data and to link hardware with Web app. Web app is provided for ambulance driver or common people so as to pre-book the patient bed and blood if its needed before reaching any hospital. By pre-booking the hospital bed and blood for patient before reaching the hospital, the delay in treatment is reduced and thus there is a increased chance of saving the life. IoT based instant bed and blood booking for hospitals with systematic facility management system using Raspberry Pi to provide systematic facility to the hospitals. To provide bed and blood booking facility before reaching the hospitals. People are losing their lives due to insufficient treatment. The person who is under risk will not get the bed in hospitals and there may be no blood which ever group is needed. "Health is wealth" and health is most important than any other in life. This statement inspires us to conceptualize this work. Using this system one can pre-book the hospital bed for patient before reaching the hospital using Web app. One can easily check the availability of blood in blood banks and book for the needed group instantly. Glucose bottle level can be easily monitored to avoid blood reverse flow. A good and healthier link can be established between hospitals and patients.

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Dr.G.N.Keshava Murthy received his B.E degree from Siddaganga Institute of Technolgy, Tumakuru, Bangalore University, Karnataka, India in 1996. He obtained his M.E. degree from University of Visvesvaraya College of Engineering, Bangalore, Karnataka, India in 2001 and was awarded Ph.D. degree in 2016 from VIT University, Tamil Nadu, India. He is currently working as Assistant Professor in the department of Electronics and Instrumentation Engineering at Siddaganga Institute of Technology, Tumakuru. Karnataka, India. His research interests include Biomedical Engineering, Biosciences and Cognitive neuroscience. He has 4 papers and 5 conferences published in peer-reviewed International journals in his credit and has received research awards at VIT University for his publications. He has served as program chair for few conferences and is BOE member for few colleges. As an extension of his work and knowledge he also is guiding Ph.D. students in the same field.

Retrieval Number: D8506118419/2019©BEIESP
DOI:10.35940/ijrte.D8506.118419
Journal Website: www.ijrte.org

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