IoT based mobile health hub

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IoT based mobile health hub

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Abstract. Technological innovations have a great influence on bio medical field. Even in this advanced era people are struggling due to lack of medical attention or delay in arranging adequate health care. Most of the hospitals have emergency vehicle facility and they are successful in providing emergency response to the needy patient. But the delay in arranging medical attention in hospital is still a big issue. One solution to the above problem is to provide a channel of communication between the emergency vehicle and hospital such that the patient information along with the vitals can be made available to the hospital prior to the arrival of emergency vehicle. This paper proposes such a system where the patient information and vitals are measured and uploaded to a cloud facility. This information helps the doctor to arrange quick medical response.

1. Introduction

In an emergency, every second is valuable. The lack of providing quick medical care for an emergency situation can lead to the death of the patient. There are mainly two types of emergencies. First one is due to accidents and the second one is due to any medical conditions like heart attack stroke or any other disorder. According to the data released by Census department around 27% of the deaths happen in hospital due to lack of medical attention even after reaching the hospital [2].

The primary goal in accessing the patient health status is to measure the patient's vitals which include heartbeat rate, blood pressure, body temperature etc. Sensors are available to measure almost every vital signs of a patient. Theses sensors can be used in the emergency vehicle to estimate the health condition of the patient. Apart from the sensor readings a camera module is also used this helps to capture the video of the patient. Since this information should reach the hospital prior to his arrival, a proper high speed communication methodology is required. IoT can be used for this purpose. The advantage of IoT is that it has enough bandwidth to support video streaming [13].

The proposed system uses sensors for measuring heartbeat, temperature etc. Image Capturing is made possible by interfacing camera. Since the entire data need to be uploaded to a cloud, a Wi-Fi supported system is needed. Hence we are using Raspberry Pi 3 as it has inbuilt Wi-Fi support [15]. This information will be stored to a cloud server with the help of IoT. The cloud platforms used in this project are ThinkSpeak and Dropbox. The ThinkSpeak Cloud service supports only numerical data to be uploaded. Hence we are using Dropbox to upload image frames. The image frames captured is processed to detect presence of blood and then the final processed image is uploaded. The sensor data

along with the processed image can be accessed by the hospital authority to make arrangements prior to the arrival of the patient.

2. Proposed Method

The proposed system has three modules:

2.1. Ambulance module

This is the unit to be used inside the ambulance as shown in figure 2. This module consists of the Raspberry Pi with the sensor units interface to it. The patient's body parameters are measured using sensors. The parameters include heartbeat, temperature and blood pressure. This unit also includes a camera module to capture the image of the patient at regular intervals. After processing the ambulance module upload the data to the cloud.

2.2. Cloud module

The Cloud module consists of two cloud service. They are ThinkSpeak and Dropbox. The ThinkSpeak cloud platform supports numerical data to be uploaded. The ThinkSpeak cloud also supports graphical representation of the uploaded data. The image uploading is done on Dropbox cloud.

2.3. Hospital module

In the hospital module the doctor monitor the data uploaded into the cloud. The red color detected image helps the doctors to identify the severity of the wounds. The hospital module consists of a simple application that can download the data from the cloud. With data received the doctors prepare for immediate medical response. The figure 1 shows the complete system block diagram.

3. Methodology

Monitoring of patient's health can be done in many ways. Most commonly methods for monitoring are:

- Wireless sensor networks
- Image processing
- Video surveillance
- IoT with cloud services
- Zigbee
- GSM
- NFC
- Ad hoc network

The patient's health condition can be identified using Image processing [1]. Image processing can be used to identify the extent of injury by detecting the amount of blood spread due to injury. But the drawback of this application is that it is specific to accident cases where there should be open wounds on patient's body. This method is not applicable for emergency cases like cardiac arrest; stroke etc. where open wounds are missing.

To the existing emergency vehicle system video surveillance feature can be used as add-on which helps the doctor to have a close look on the patient even before the patient reaching the hospital. Numerous sensors help in precisely estimating the health condition of the patient. These sensors can be used to measure blood pressure, heart beat rate, temperature etc. These collected data help the doctor to determine the health condition of the patient. If these real-time data can be made available for the access to the doctor, it can help him to give adequate feedback to the emergency vehicle as well as arrange hospital facilities for the patient [4].

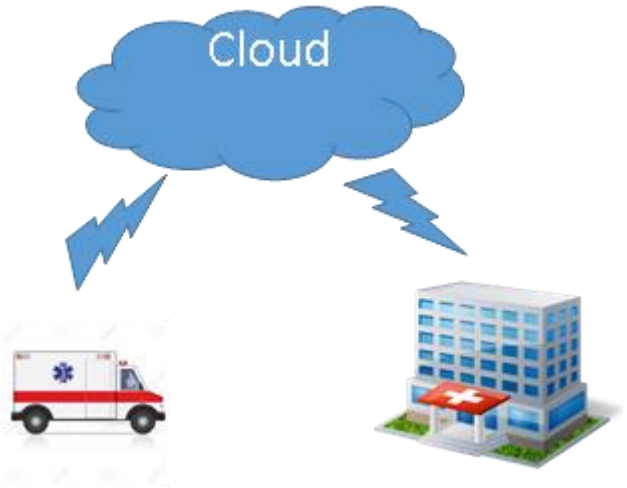

Figure 1. Proposed Method

There are many communication standards available to send these data remotely to the hospital. One common method is ZigBee [3] [5] [8]. But the range of ZigBee is limited thus the real time updating data is difficult. IoT [7] [10] [11] is the next best available choice for the purpose. For this technology requires an active internet connection. In the proposed method the patient‘s physiological data as well as his live video is uploaded to the cloud via IoT. This data is then monitored by the doctor and doctor gives feedback if necessary.

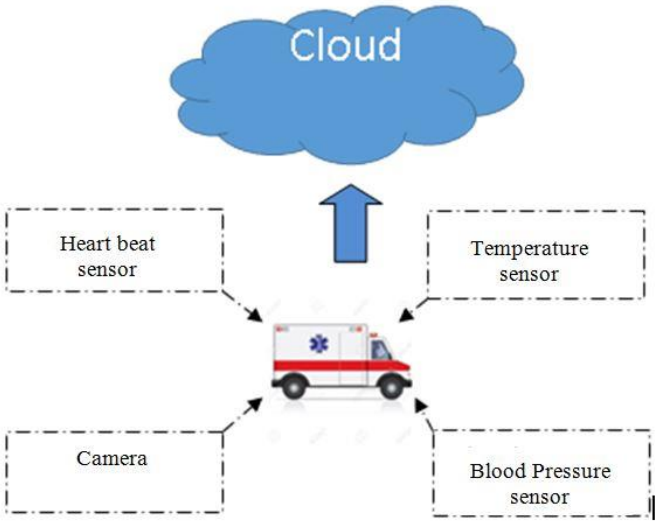

Figure 2. Ambulance module

Ad hoc [9] [11] networks can also be used. But the system needs dedicated servers and their expense is huge. GSM [6] [16] [17] is an option but due to its limited bandwidth video streaming is difficult.

4. Experimental Setup

The experiment is done as three modules-

4.1. Ambulance module

In this module different physiological parameters of the patient are measured. The parameters measured are heartbeat and body temperature of the patient. These parameters are then fed to a controller. A camera module is also interfaced with the controller which captures the live video of the patient and then transmits it to the controller. The controller then uploads the fetched data which comprises of physiological parameters and the video of the patient to the cloud.

As controller, we are using Raspberry Pi 3. The picture of Raspberry Pi is shown in figure 3. It is a third-generation Raspberry Pi with 1.2 GHz 64-bit quad core ARM Cortex-A53 CPU. It comprises of 1GB ram, 40 GPIO pins, one camera interface (CSI), micro SD slot etc.

Figure 3. Raspberry Pi

For measuring the body temperature, we are using DHT11 temperature sensor as shown in figure 4.

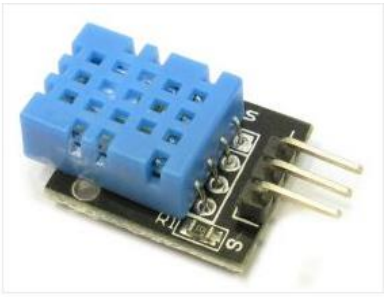

Figure 4. DHT11 Sensor

The sensor measures temperature via NTC temperature sensor [12]. It is a thermistor mounted on the surface. The temperature measured is transmitted serially to the controller.

For measuring heart beat we are using NSK TCRT1000 heartbeat sensor. It works based on the principle of photo plethysmography as shown in figure 5. For measurement purpose, a light detector and a light source are placed on the same side inside the sensor. Then finger is placed at the opposite side. Thereafter the light source emits light which is passed into the finger of the patient and the light reflected is measured by the light detector placed inside the sensor. The amount of light reflected by the finger varies in accordance with the blood flow caused due to the heart beating.

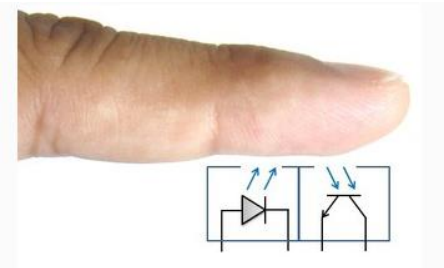

Figure 5. Heart beat Sensor

The image frame of the patient is captured by the camera placed in the ambulance and the image is later fed to the controller. Before uploading image the part of the body covered with blood is identified by using image processing and this part is highlighted by using a red box. Each image is processed individually to track the required region. These images are first threshold to get a mask image, which is used to get the binary image from the original image. The white portion in the binary image enclosed within a rectangle box. The coordinates of this rectangle is used to draw red box in the uploaded image.

4.2. Cloud module

Here we are using two cloud servers. Thinkspeak cloud and Dropbox. Thinkspeak is an IoT cloud service provider. It provides Application Program Interfaces (API's) to upload, to download and to visualize data from IoT devices over cloud. Dropbox is also a cloud service provider which is simple as well as reliable. It provides a full featured file syncing mechanism and a storage service with real time collaboration of documents. We are uploading the physiological parameters to the Thinkspeak cloud and the video of the patient is uploaded to the Dropbox cloud [13] [14].

4.3. Hospital Module

In this module the patient data is fetched from the cloud module and is analysed. If the doctor needs to convey dome message to the ambulance regarding first aid etc. a field in the Thinkspeak cloud is updated which later is downloaded by the ambulance module.

5. Results and Discussions

After image processing the frames of video are uploaded to the Dropbox. Figure 6 shows the frame uploaded to the Dropbox. The values obtained from the sensors are uploaded to Thinkspeak and a graph is generated depending on the sensor values. Figure 7 shows the graph of the temperature values uploaded to the ThingSpeak.

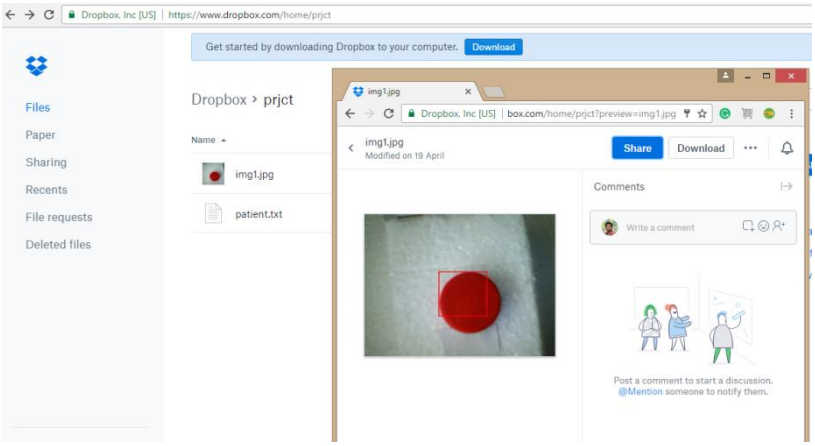

Figure 6. Image uploaded to cloud

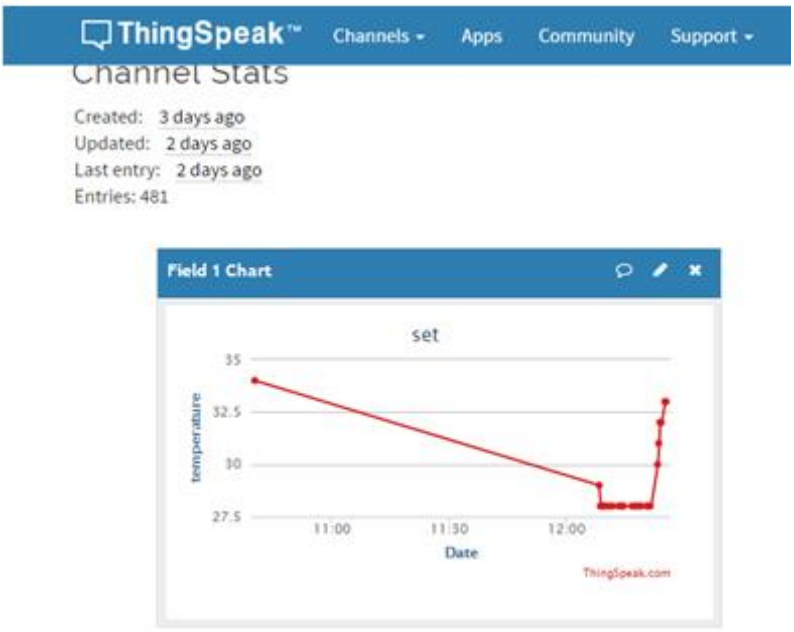

Figure 7. Data uploaded to cloud

6. Future Scope

The system provides a channel of communication between ambulance and hospital module. This can be employed in other applications. The system can be modified to act as a remote healthcare unit where the doctor can monitor patient remotely. The system currently uses only few sensors to measure the patients' health status. If more number of sensors are added then the accuracy of the system can be improved

7. Conclusion

The system has been implemented successfully. The system acquires data from sensors. This data is uploaded to the ThinkSpeak Cloud. The Image is uploaded using Dropbox cloud services. The hospital module can monitor these data and do the needy arrangement for the patient.

References

[1] Anang Hudaya Muhamad Amin, Nazrul Muhaimin Ahmad, Afiq Muzakkir Mat Ali 2016 Decentralized Face Recognition Scheme for Distributed Video Surveillance in IoT-Cloud Infrastructure *2016 IEEE Region 10 Symposium (TENSYMP)*, Bali, Indonesia

[2] Hoda Ramin Hossein M S, and Shaikh S S 2016 SPHPMS: Smart Personnel m-Healthcare Patient Monitoring System *International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT).*

[3] Andrew Yearp, David Newell, Philip Davies, Russell Wade and Reza Sahandi 2016 Wireless Remote Patient Monitoring System: Effects of Interference *2016 10th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing*.

[4] Mithun Chandra Paul, Suman Sarkar, Mahfujur Rahman MD and Sayed Mohsin Reza 2016 Low Cost and Portable Patient Monitoring System for e-Health Services in Bangladesh *2016 International Conference on Computer Communication and Informatics (ICCCI - 2016).*

[5] Sakshi Sharma and RashmiVashisth 2015 Zigbee Based Centralized Patient Monitoring System *International Conference on Computational Intelligence and Communication Networks*.

[6] Arun Fera M, R.Aswini, Santhiya M, Gayathiri Deepa K.R.and Thangaprabha M 2015 HEAL ±Health monitoring in Emergency vehicles with their Authentication by RFID and Location tracking by GPS *2015 Seventh International Conference on Advanced Computing*.

[7] Kumar R and Pallikonda Rajasekaran M 2016 An Iot Based Patient Monitoring System Using Raspberry PI *International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE)* .

[8] Fathur Zaini Rachman 2015 Prototype Development of Monitoring System in Patient Infusion with Wireless Sensor Network *International Seminar on Intelligent Technology and Its Applications.*

[9] Avleen Kaur Malhi and Shalini Batra 2015 XML based Wireless Patient Monitoring System using Vehicular Ad-Hoc Networks *IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing*.

[10] Maria Fazio, Antonio Celesti, Ferm´ın Galan and M Arquez 2015 Exploiting the FIWARE Cloud Platform to Develop a Remote Patient Monitoring System *Fifth International Workshop on Management of Cloud and Smart City Systems* .

[11] Zhang Yuye and Yan Weisheng 2015 Building an IoT-aware healthcare monitoring system *International conference on Computer Science Society (SCCC)* .

[12] Shraddha D. Deshmukh, and Swati N. Shilaskar 2015 Wearable sensors and patient monitoring system: A Review *2015 International Conference on Pervasive Computing*.

[13] Andrea Corradini and Constantin Alexandru Gheorghiasa 2015 CAMbulance: A Live Video Streaming System For Ambulance Services *2015 International Conference on Information and Communication Technology Research (ICTRC2015).*

[14] Alexsis Bell, Paul Rogers, Chris Farnell and Brett Sparkman 2014 Wireless Patient Monitoring System *2014 Health Innovations and Point-of-Care Technologies Conference Seattle*, Washington USA.

[15] Ernando Marins, Rui Rodrigues and Filipe Portela 2013 Extending a Patient Monitoring System with Identification and Localisation *Proceedings of the 2013 IEEE IEEM*.

[16] Nitin P. Jain, Preeti N. Jain and Trupti P. Agarkar 2012 An Embedded, GSM based Multiparameter, Realtime Patient Monitoring System and Control – An Implementation for ICU Patients *Information and Communication Technologies (WICT), 2012 World Congress.*

[17] Gaddi Blumrosen and Netanel Avisdris 2011 C-SMART: Efficient Seamless Cellular Phone Based Patient Monitoring System IEEE International Symposium on *World of Wireless, Mobile and Multimedia Networks (WoWMoM)*