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Smart Blood Bank System Based on IoT

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Abstract - *The unit which administers and manages the requisition and distribution of the blood is named as a blood bank. The main objectives of the blood banks are providing blood to the patients with minimal blood transfusion error. The blood is very important medical supplies so it should be managed well. As the blood bank management consists of a number of manual steps, therefore it will become difficult for the blood banks to provide a high level of accuracy, reliability, automation in blood storage and transfusion process. The system proposed is divided into three segments, the first segment consists Temperature sensor, IR sensor nodes which is installed in rack of blood bank, and the GSM Module for sending request of blood to the donors and blood banks all these are interfaced with Arduino Mega. Second segment consists of wi-fi module for data transfer to the server and third segment is displaying the status of available blood stock. All the real time status relates to the available blood stock of the blood bank is are displayed on web page, so that the blood seeker can get the blood from their nearest blood bank.*

Key Words: Blood bank, blood transfusion, Temperature Sensor, IR sensor, GSM Module, Arduino, Wi-fi Module, Web page.

1. INTRODUCTION

The process of managing the blood bag that is received from the blood donation events needs a proper and systematic management that is done by the blood banks. As the blood is related to someone's life so the bags of must be handled with care and treated thoroughly. The blood consists of different blood constituents and every constituent of blood is having a specific function. Statistics say that in our India every two seconds someone needs a blood transfusion. The Blood transfusions are used for trauma victims - due to accidents and burns - heart surgery, organ transplants, women with complications during childbirth, newborns and premature babies, and patients receiving treatment for leukaemia, cancer or other diseases, such as sickle cell disease and thalassemia [6].The different blood constituent is applied to the patient for different type's disease given in table1.

India today faces a blood shortage of 10% relative to its blood requirements. It means that we require covering a shortfall of over 12 lakhs of blood units. Given that the eligible donor population of our India is more than 512 million, this deficit is surprising. Every day more than 1200 road crashes occurring in our India, 60 million trauma induced surgeries are performed in the country every year. Near about 230 million major operations, 331 million cancer-related procedures like chemotherapy and 10 million pregnancy complications all these require the blood transfusion [9]. Besides all this, the patients which are for sickle cell anaemia, thalassemia and haemophilia require large quantities of blood daily. Another reason for the shortage of the blood supply is the ban on payment to blood donors that was enacted in 1995. Previously near about one-third of the blood supply was from paid donors. But with the ban, both private and government hospitals have faced a larger shortage in the blood supply.

Table -1: Different Blood Constituents with their uses for different diseases and there functions

Blood Constituents	Functions	Diseases
Plasma	Medium in which the blood cells are transported around the body	Burn patients, Shock, Bleeding disorders
Red blood cells	Carries oxygen	Surgery, Any blood loss , Blood disorders such as sickle cell
White blood cells	Part of the immune System	Infectious disease and foreign invaders
Platelets	To facilitate blood clotting	Cancer treatments, Organ transplants , lower platelet counts, suffering from leukemia

The current system that is using by the blood bank is manual system. With the manual system, there are problems in managing the records related with blood stock. There is no centralized database of volunteer donors. So, it becomes really tedious for a person to search blood in case of emergency. Without an automated management system, there are also problems in keeping track of the actual amount of each and every blood type in the blood bank. In addition, there is also no alert available when the blood quantity is below its par level or it become zero. Healthcare as a sector is a definite beneficiary of the increasing adoption of technologies such as the Internet of Things. One of the areas where IoT can be used is blood bank management. In our country thousands of litters of blood get wasted every day due to less than adequate management practices,

thousands of litres of this precious resource get wasted every day across the country. Such a wastage is occurring during a day and age when healthcare providers are battling an acute shortage of blood units for various medical procedures. Given this backdrop, the significance of deploying technologies that encourage efficient management of blood banks cannot be understated. The purpose of the blood bank management system is to simplify and automate the process of searching for blood in case of emergency and maintain the records of blood stocks in the bank.

2. METHODOLOGY

The proposed system is an embedded system which will closely monitor the available status of the blood and temperature of the refrigerator which is present inside the blood bank. The proposed system includes service domain and administration domain. Service domain has blood bank that has sensing unit installed to it which has array IR sensor, temperature sensor, Arduino mega as a gateway with Wi-Fi module using wireless protocol for wireless communication between blood bank and cloud, RTC for real-time operation.

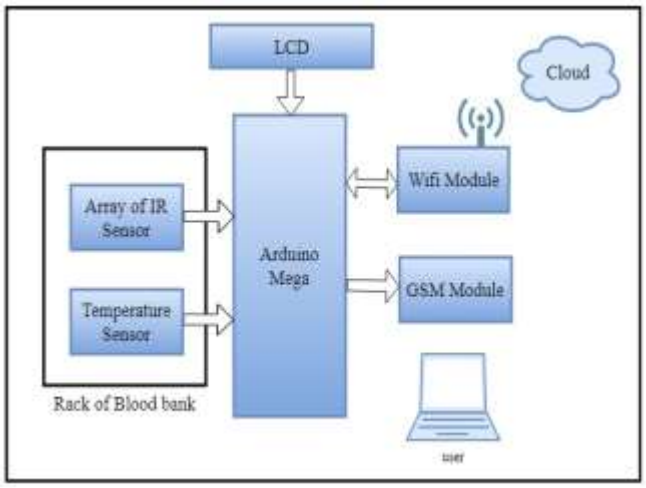


Figure -2: Block diagram of IoT Based blood bank system

In Administration domain information transferred from the blood bank is analyzed and processed. It includes webpage hosted on a server, for analysis and processing of the received data from the blood bank, depending on which corresponding notifications are displayed. It uses HTTP protocol for secure communication between server and blood bank in an application layer of IoT. For the more efficient operation, the called blood bank locations are located using maps. The two domain of proposed system is given below.

2.1 Service domain:

The service domain consists the hardware part of the system. It includes IR sensors, Temperature sensor, Arduino Mega, LCD, GSM module and ESP Module. The IR sensors are used for providing information of the available bloodstock, if the blood bottle is placed at rack then the LED rays of IR sensor gets reflect back then signal from IR to Arduino has been send. If the bottle is not placed in such condition the Rays not gets reflect back and its show the bottle is not present. For displaying the temperature of the refrigerator the temperature sensor is used which is display on the LCD. If the bloodstock is not available in such condition the Request message for donating blood is sent to the blood donor as well as one request message is sent to the nearest blood blank to provide the blood if they have availability of specific blood group of blood. All the data related to available bloodstock is displayed on the website using ESP module.

2.2 Administration domain:

In this domain, the Blood bank information, Blood status information, location of blood bank, the data received is collected. To achieve this web hosting is used where server is used. Server manages database for the information received from service domain i.e. values for each sensor for blood unit of each blood bank.

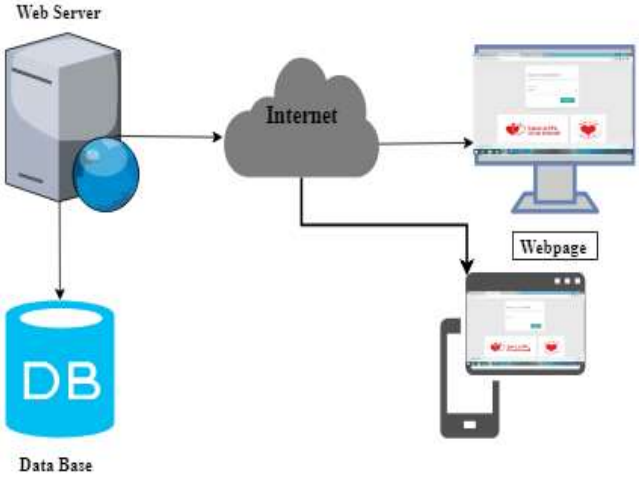


Figure -2.2: Administrator Domain for Smart Blood Bank System

It consists the IoT part, as ESP module sends the information of available blood is sent to the cloud. The cloud is connected to the website so the website will show all available bloodstock on 24*7 basis. So initially user has to select their region from options of the website the according to that the website will display all the blood bank of that region. And that blood bank provides real-time available bloodstock on the webpage. Also, the direction of that specific blood bank is provided on the google map for that one tab is provide as locate on the map.

3. RESULTS

Blood bank centers and various organizations needs to register on website of blood bank. So that each blood bank is getting connected with the cloud so that data of available blood stock of every data registered blood bank is displayed on the webpage. Also the log related with blood stock also available on the webpage so that it become easy to cross check the data of the blood stock.

Figure - 3.1: Homepage of website

The results of the system going to be displayed on the webpage hosted over server i.e. the real time data frames sent in bytes by service domain module with the HTTP protocol to server. By using the domain name or IP address of the webpage in browser the real time data is seen on the computer or mobile that is connected to internet. Initially from homepage blood seeker has to choose the specific district of Maharashtra state, then after choosing the specific district of Maharashtra the page will show the status of available blood stock in each blood bank of specific region.

The webpage display real time information of available blood stock over. This saves time and is useful for minimizing the route in turn saving the time and fuel. The Screen shot of websites home page is shown above in figure 3.1.

After choosing the district the webpage directed to the next webpage, which is displaying available blood stock in the all blood banks. The Figure. 3.2 Shows the search result of Amravati District, it is showing four blood bank status located at the Amravati region. It is displaying status of four blood group as A, B, AB and O. Also the route of the Blood bank also provided on the webpage.

Figure -3.2: Search Result of Website

After finding availability of the blood the users need location of blood bank. So the webpage providing google map facility so that the user will finding the exact location of blood bank and also user will gets the exact distance of that blood bank so it will become easy to choose blood bank which is placed at the minimum distance from them. The Figure. 3.3 Shows Map it locate the blood bank, so any blood seeker can get the route of the blood bank. The direction toward any nearest blood can be obtained from the Google map.

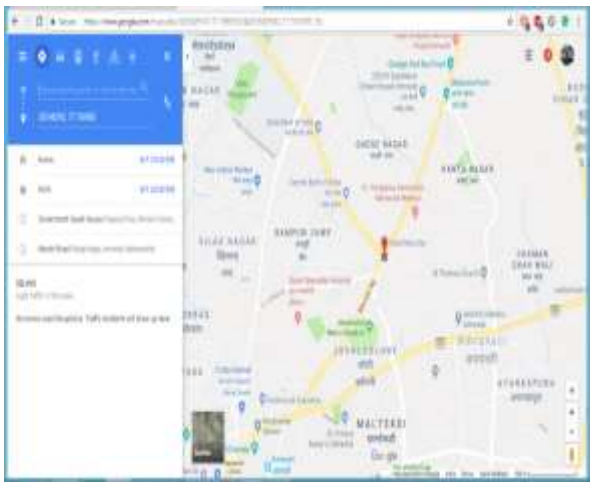
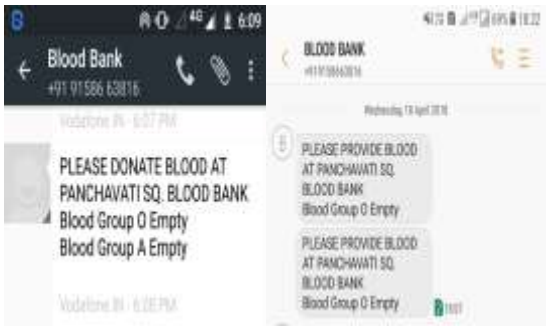


Figure -3.3: Location provided on Google Map

The System sends a short message to staff of other blood bank and blood donor's mobile phone when system senses the blood stock is below than the acceptable limits. When any blood stock reaches to zero in that case two different requests are send form the respective blood bank to full filling the blood stock. One request is send to the nearest blood bank and other request is send to the blood donor shown in figure 3.4



(a) **(b)**

Figure -3.4: (a) Screen shot of blood request Received by Blood Donor

(b) Screen shot of Blood Request Received by Nearest Blood Bank

Also the log file of the available blood stock is also obtained from the website of blood bank so that is will become easy for the blood bank employee to cross the data of the blood stock. And they can easily download that log file from the

webpage itself shown in figure 3.5. It shows data of all the four blood banks.

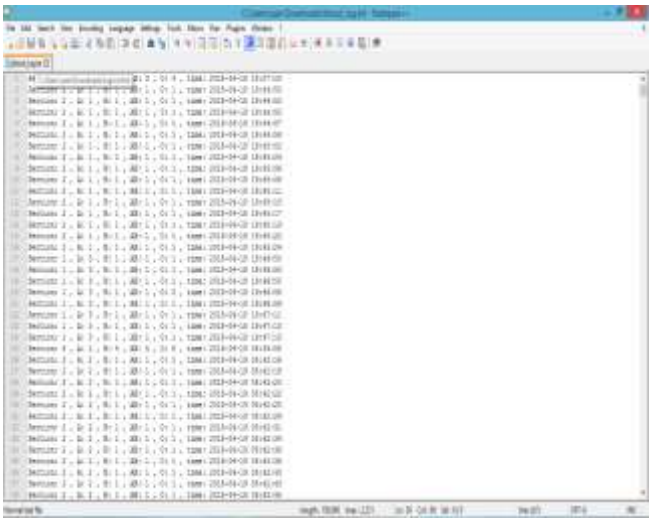


Figure -3.5: Log file of available blood stock

4. CONCLUSION

Growing population has increased the need for the blood supply for various diseases. In every two seconds, some person required blood transfusion and currently India facing problem of the blood shortage. To address the problem an effective system is designed using the Internet of things. The system provides a methodology to fulfil the requirement of blood to the patients/victims without rushing to the blood bank to know the availability of the blood. An IR Sensors are connected to the Arduino board which continuously monitors the status of the available bloodstock. The output data provided by the Arduino is displayed on the webpage using the wifi module so anyone accesses the website and obtained the information of available bloodstock in real time. It will reduce the manpower required at the blood bank to update the online data also reduces the efforts of blood seeker of searching bloodstock at each blood bank. When bloodstock reaches to zero system helps to send a request message to the donor and nearest blood bank. By using IoT the real-time available bloodstock is displaying on the website it minimizes the efforts of blood seeker.

5. FUTURE IMPLEMENTATION

There are three different topics related to the Internet of Things concept that has major future scope in terms of improvement and research: efficiency, scalability and quality of service. The developed system is prototype version which provides the information about the available bloodstock. It consists of an array of IR sensors that covers the minimal area. To cover large blood packet the IR sensors can be replaced by the load cell. It will cover the large blood packet and help efficiently to provide information on bloodstock on a real-time basis. Also, one alert system using RFID Tag with smart temperature sensor can be also added to the system for indicating the expired blood packet and its temperature.

In the future, this work can be extended in the context of total blood banks of a country. Big Data analysis can be done on the gathered data from Region. So that the specific domain names can also be allocated to the blood bank site. Also on the website of blood bank, the login id and passwords can be provided to the blood seekers so that they can be made the online request for the blood units.

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