JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

IOT BASED BLOOD BANK MANAGEMENT SYSTEM

MR.K. ELAMATHI[1], C. KAVIYA[2], D. MYTHILI[3], G. PRIYADHARSHINI[4], R. SIVARANJANI[5]
1 ASSISANT PROFESSOR 2,3,4,5 UG SCHOLAR
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
VIVEKANANDHA COLLEGE OF TECHNOLOGY FOR WOMEN
TIRUCHENGODE, NAMAKKAL, TAMIL NADU, INDIA

ABSTACRT
Blood banks play a critical role in healthcare systems by ensuring the availability of safe and adequate blood supplies. However, improper storage conditions, poor inventory tracking, and lack of real-time monitoring often lead to blood wastage and shortages. This project presents an **IoT-based Blood Bank Management System** that integrates temperature and humidity monitoring with RFID-based blood stock management to ensure efficient, safe, and transparent blood storage operations. The proposed system continuously monitors environmental parameters such as temperature and humidity inside blood storage refrigerators using sensors connected to an IoT-enabled microcontroller. RFID technology is employed to uniquely identify and track each blood bag, enabling real-time inventory management and status updates. All data is transmitted to a cloud-based IoT platform, where it can be accessed by authorized medical staff through dashboards and alerts. This system minimizes human error, reduces wastage, and enhances blood availability during emergencies.

Keyword's: Blood bank, blood transfusion, Temperature Sensor, Weight sensor, RFID Module, Arduino, Wi-fi Module, Web page.

1. INTRODUCTION

Blood plays a vital role in saving lives, especially during surgeries, accidents, medical emergencies, and for patients suffering from chronic diseases like cancer or anaemia. Blood banks are the primary source of this life-saving resource, and they must ensure an uninterrupted supply of safe and compatible blood units. However, despite advances in medical science, many blood banks still face difficulties in managing blood inventory efficiently. Manual methods of tracking bloodstock and storage conditions often lead to human errors, delays in replenishment, and even spoilage of stored blood due to improper monitoring. As a result, there is an urgent need to enhance the reliability and accuracy of blood bank management through the use of technology. The traditional blood bank management systems are not equipped with real-time monitoring capabilities. This significant communication gap between hospitals, donors, and blood storage facilities. In many emergency cases, by the time the required blood group is arranged, critical time is lost, affecting the patient's chances of survival. Furthermore, lack of effective monitoring also leads to blood wastage due to expiry or temperature mishandling. This inefficiency not only affects patient care but also leads to financial losses and operational difficulties for healthcare providers. The evolution of the Internet of Things (IoT) provides a promising opportunity to overcome these challenges. IoT enables physical devices to collect and share data through the internet, allowing real-time monitoring, automation, and remote management. In the context of blood banks, IoT can be used to automate stock tracking, monitor environmental conditions, and send alerts to responsible authorities when action is required. Such a system not only increases efficiency but also ensures transparency and safety throughout the supply chain of blood management. In the proposed system, every blood pouch is embedded with an RFID tag, which uniquely identifies the blood group and unit. An RFID scanner placed inside the storage bin continuously reads the tags and updates the database accordingly. This helps in maintaining an accurate count of the available units of each blood group in real time. The data is then transmitted to a cloud server and displayed on a dashboard that can be accessed by hospital staff, blood bank officials, and authorities responsible for blood distribution and donations. Temperature plays a crucial role in the preservation of blood.

If not maintained within the prescribed limits, blood can degrade and become unsafe for transfusion. To prevent such occurrences, a temperature sensor is installed within the storage bintomonitor the internal environment continuously. If the temperature crosses the permissible range, the system sends immediate alerts to the authorities and also triggers a buzzer alarm. This ensures that preventive measures can be taken before the blood gets spoilt, thereby enhancing patient safety. The integration of Flask-based web technology in this system adds an efficient interface for users to interact with the data. The Flask dashboard provides real-time statistics, graphical representations of stock levels, temperature logs, and notification alerts. Users can access this data through any internet-connected device, making remote monitoring feasible and efficient. This level of automation reduces dependency on manual labour, improves data accuracy, and speeds up decision-making processes, especially during emergencies. In conclusion, the IoT-based Smart Blood Bank Management System bridges the critical gaps in traditional blood bank operations. It creates a more efficient, transparent, and reliable platform for managing blood stock and storage conditions. With real-time tracking, remote access, and instant alerts, the system ensures better preparedness in medical emergencies, reduces wastage, and ultimately contributes to saving more lives. The integration of RFID, temperature monitoring, cloud computing, and a web dashboard makes this system a modern, scalable, and impactful solution for the healthcare sector.

BLOOD DONATION SYSTEMS - Traditional blood donation systems often rely on manual processes for donor registration, blood collection, testing, and distribution. While these systems have been effective to some extent, they face challenges such as inefficiency, lack of real-time data tracking, and limited accessibility for donors and blood banks. Moreover, the demand for blood products continues to increase due to various factors, including population growth, medical advancements, and emergencies.

2. PROBLEM STATEMENT

Blood banks play a vital role in modern healthcare systems by ensuring the availability of safe and adequate blood supplies for emergencies, surgeries, and critical treatments. However, conventional blood bank management systems often face challenges such as improper storage conditions, inaccurate inventory tracking, lack of real-time monitoring, and manual record-keeping errors. These issues frequently result in blood wastage, shortages, and compromised patient safety. To address these challenges, this project proposes an **IoT-Based Blood Bank Management System** that integrates environmental monitoring with RFID-based inventory tracking to ensure efficient, safe, and transparent blood storage operations.

3. LITERATURE SURVEY

IOT BASED BLOOD BANK SERVICES - AUTHOR- T. SRAVANI, VANDANA KHARE, VANDANA SHARMA YEAR-2023 - IOT based Blood Bank is an associate work that brings voluntary blood donors and those in need of blood on to a common platform. The mission is to complete every blood request in the country with a promise android application and motivated individuals who are willing to donate blood. Donor will be provoked to enter a person's points of interest, similar to name, telephone number, and blood gathering. In the earnest time of a blood prerequisite, you can rapidly check for blood donation centers or healing centers coordinating a specific or related blood gathering and contact them through the App. Blood donation center.

BLOOD BANK MANAGEMENT SYSTEM - AUTHOR -MS. SHUBHI VERMA1, RIYA JAIN, VAISHNAVI - The increasing demand for timely and efficient blood supply has made the implementation of automated Blood Bank Management Systems (BBMS) a necessity in modern healthcare. This paper presents a comprehensive study and design of a digital BBMS that streamlines the processes of donor registration, blood inventory tracking, and request fulfillment. The system is developed to minimize human error, reduce processing time, and improve the accessibility and reliability of blood data across hospitals and blood donation centers. The proposed model integrates real-time data management, user authentication, and alert mechanisms for low inventory, ensuring critical resources are available when needed. By employing modern software technologies and database systems, the BBMS enhances coordination between donors, recipients, and medical staff, ultimately contributing to a more responsive and efficient healthcare infrastructure. The research highlights key challenges in current manual systems and demonstrates how automation can lead to significant improvements in operational efficiency and patient care outcomes.

IOT BASED SMART BLOOD BANK DATA MANAGEMENT SYSTEM USING WI-FI - AUTHOR-B. DINESH, A. JEYASRE, M. PAVITHRA, S. PREETHI, K. SUMITHRA - Blood Donation and Blood Transfusion Services are crucial for saving people's lives. Blood banks suffer frequent shortage of blood and

Transfusion safety so We are proposing a paper "I0T Based smart blood bank data management system using WI-FI" This system uses Wi-Fi based smart bud vase and smart tag to provide transfusion safety and web applications which allows the user to search blood bag details to get the specific blood group based on their availability, in a short period of time. In this smart tag is attached with the blood bags. This tag is used to communicate the blood identity as well as donor information. The smart bud vase has smart tag reader reads information which stored in smart tag and sends to web server through Wi-Fi.

4. PROJECT DECRIPTION

4.1 EXISTING SYSTEM

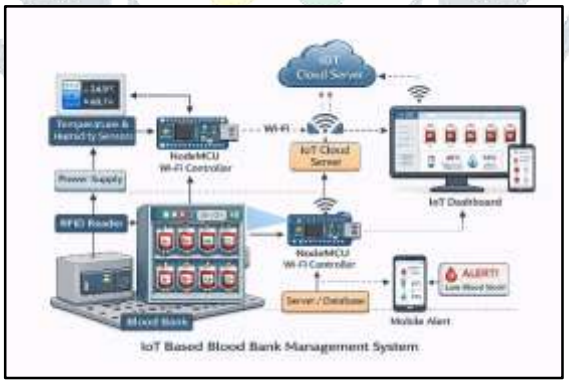
Traditional blood bank systems rely on manual record-keeping or basic computer databases for inventory management. Temperature and humidity are often monitored manually using thermometers and hygrometers, requiring frequent human intervention.
RFID or barcode systems, if present, are typically used only during blood issue or receipt and not integrated with real-time monitoring platforms. As a result, blood spoilage, delayed response to storage failures, and inaccurate stock data are common issues.

DISADVANTAGES
Manual monitoring leads to human error
No real-time alerts for temperature or humidity deviation
Inefficient blood stock tracking
Higher risk of blood wastage
Limited data accessibility and transparency

4.2 PROPOSED SYSTEM

The proposed IoT-based blood bank management system integrates environmental monitoring and RFID-based inventory control into a single smart platform. Temperature and humidity sensors continuously monitor storage conditions and send data to a microcontroller (ESP32/NodeMCU).

Each blood bag is tagged with an RFID tag, and RFID readers are installed at storage and issue points. The system updates stock levels automatically and displays them on an IoT dashboard. Alerts are generated if environmental conditions deviate from safe limits or if stock levels fall below predefined thresholds.



ADVANTAGES

Continuous real-time temperature and humidity monitoring
Automated RFID-based blood stock tracking
Reduced human error and improved transparency
Early alerts for storage condition violations
Minimized blood wastage
Improved availability during emergency situations

5. WORKING PRINCIPLE

The system operates by continuously sensing temperature and humidity inside the blood storage unit. Sensor data is processed by the microcontroller and transmitted to the IoT cloud. RFID readers scan blood bags to log entry, storage, and issue events.

All collected data is stored and visualized on a cloud dashboard. If abnormal conditions or critical stock shortages are detected, instant alerts are sent to medical staff via notifications or email.

Temperature Sensor → Microcontroller → IoT Cloud
Humidity Sensor → Microcontroller → IoT Cloud
RFID Reader → Microcontroller → IoT Cloud

IoT Cloud → Dashboard / Alerts
Power Supply → All Modules

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 sicklecell
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

Blood banks play a vital role in modern healthcare systems by ensuring the availability of safe and adequate blood supplies for emergencies, surgeries, and critical treatments. However, conventional blood bank management systems often face challenges such as improper storage conditions, inaccurate inventory tracking, lack of real-time monitoring, and manual record-keeping errors. These issues frequently result in blood wastage, shortages, and compromised patient safety.

To address these challenges, this project proposes an **IoT-Based Blood Bank Management System** that integrates environmental monitoring with RFID-based inventory tracking to ensure efficient, safe, and transparent blood storage operations.

The proposed system continuously monitors crucial environmental parameters such as **temperature and humidity** inside blood storage refrigerators using sensors connected to an IoT-enabled microcontroller (such as NodeMCU/ESP8266 or Arduino with Wi-Fi module). Maintaining optimal storage conditions is critical to preserving blood quality and preventing spoilage.

In addition, **RFID technology** is employed to uniquely identify and track each blood bag. Each blood unit is tagged with an RFID label containing essential details such as blood group, collection date, expiry date, and donor information. RFID readers automatically scan and update stock information, enabling real-time inventory management and reducing manual errors.

All collected data is transmitted to a **cloud-based IoT platform**, where authorized medical staff can access real-time dashboards, analytics, and automated alerts in case of abnormal storage conditions or low stock levels. This enables proactive decision-making and rapid response during emergencies.

5.1 ARDUINO UNO

Arduino Uno is an open-source microcontroller board. It is based on the microchip 8-bitATmega328P microcontroller. It can operate at 5V. It includes other components such as serial communication, crystal oscillator, voltage regulator, etc. to support the microcontroller. It has 14 digital I/O pins (0-13) and 6 analog input pins (A0-A5). In this digital 14 I/O pins out of which 6 can be used as Pulse Width Modulation (PWM) outputs.it can be used to communicate with another Arduino board or other microcontrollers, computer. Arduino IDE is required to program this board. Its major advantage is that we connect the board to the computer via a USB cable which does a dual purpose of supplying power and acting as a serial port to interface the Arduino and the computer.

5.2 LCD (LIQUID CRYSTAL DISPLAY)

The LCD (Liquid Crystal Display) unit acts as the primary user interface in the Smart Blood Bank Management System, facilitating interaction between users and the system. It provides a visual display of critical information such as blood inventory levels, system status, donor registration prompts, and instructions. The LCD display enhances user experience by presenting real-time feedback and instructions, making the system more intuitive and user-friendly.

Load cells are essential components utilized for accurately measuring the weight of blood bags within storage units. In the context of the blood bank management system, load cells play a crucial role in inventory management by providing precise measurements of blood bag weights. This enables the system to monitor blood inventory levels accurately, facilitating efficient resource management and inventory control. By ensuring accurate measurements, load cells contribute to the overall effectiveness and reliability of the blood bank management system.

5.3 TEMPERATURE SENSORS

Temperature sensors are integral to monitoring temperature variations within blood storage units. These sensors continuously measure temperature levels, allowing the system to maintain optimal storage conditions for blood products. By ensuring that stored blood remains within the appropriate temperature range, temperature sensors help preserve the quality and integrity of blood products, preventing spoilage and ensuring patient safety. As a result, temperature sensors are essential components in the Smart Blood Bank Management System, contributing to the system's ability to maintain the quality and safety of stored blood products.

5.4 EM-18 RFID scanner

The EM-18 RFID scanner is a popular 125 kHz RFID reader used for applications such as access control, attendance systems, and inventory management. It operates by emitting a low-frequency electromagnetic field, which activates nearby passive RFID tags, allowing the reader to capture and transmit their unique 12-character ID. The EM-18 module can communicate with microcontrollers like the Arduino Mega using either a UART (serial) or Wiegand interface. The UART mode is the most common and convenient for Arduino projects, as it sends RFID tag data in a simple serial format. Since the Arduino Mega has multiple hardware serial ports (Serial1, Serial2, Serial3) in addition to the default Serial0 (USB communication), it is well-suited for handling RFID data without interfering with other connected peripherals. To connect the EM-18 to an Arduino Mega, wire VCC (5V), GND, TX (from EM-18) to RX1 (pin 19 on the Mega), and optionally RX (from EM-18) to TX1 (pin 18) if bidirectional. Communication is needed.

Arduino IDE, initialize the serial communication using Serial1. begin (9600); then read the tag data using Serial1.read(); When an RFID tag is scanned, the EM-18 sends a 12-character unique ID over the serial connection, which can be displayed on the Serial Monitor or processed further for authentication. If the Wiegand interface is used, additional libraries and wiring considerations are required. Ensuring the correct baud rate (9600 bps by default) and proper grounding helps prevent communication errors. With its ease of use and reliable performance, the EM-18 RFID scanner is a great addition to Arduino Mega projects that require RFID-based identification. Because the Mega has multiple serial ports, it can integrate the EM-18 alongside other communication modules like Wi-Fi, Bluetooth, or GSM. This makes it ideal for developing smart security systems, automated attendance tracking, or industrial inventory management solutions. The low cost, plug-and-play setup, and compatibility with existing Arduino libraries make the EM-18 an efficient and effective choice for RFID-based projects.

Fig.4:EM18Scanner

5.5 GSM

The Global System for Mobile Communications (GSM) is a widely used standard for digital cellular communication, providing a reliable and efficient means of voice and data transmission. Developed to enable seamless communication across borders and different mobile networks, GSM has become the dominant technology for mobile communication globally. One of its key features is the use of SIM (Subscriber Identity Module) cards, allowing users to easily switch devices while retaining their identity and data. GSM technology facilitates voice calls, text messaging, and data transfer, making it a fundamental aspect of modern telecommunications.

6. OUTPUT

7. CONCLUSION

The Blood Bank Management System developed in this study addresses the critical challenges faced by traditional manual blood bank operations. By automating donor registration, inventory management, and blood request processing, the system enhances accuracy, efficiency, and transparency in blood handling. The integration of real-time monitoring and alert mechanisms ensures timely replenishment of blood stock, reducing the risk of shortages during emergencies. User feedback and system testing confirm its usability and potential to improve healthcare service delivery. Overall, this system represents a valuable step toward modernizing blood bank operations and supporting better patient outcomes. Future enhancements may include mobile integration and predictive analytics to further optimize blood supply management. The implementation of the Blood Bank Management System effectively streamlines the processes involved in blood donation, storage, and distribution. The system reduces human errors associated with manual record-keeping and improves communication between donors, blood banks, and hospitals. By providing real-time data access and inventory updates, it ensures that

blood is available when needed most, thereby supporting critical healthcare needs. Despite initial challenges in adoption, the system's benefits in operational efficiency and data security are evident.

8. REFERENCES

[1] Abdul Nazeer K A, Sebastian M P, "Improving the Accuracy and Efficiency of the k-means Clustering Algorithm, "Proceedings of the International Conference on Data Mining and Knowledge Engineering, London, UK, 2009.

[2] Abdur Rashid Khan et and al. 'Web based Information System for Blood Donation', International Journal of digital content Technology and its applications, Vol. 3, Issue No.2, July 2009.

[3] Akter KH, Ahmed SI. Basak SI. Basak MS. Hossain SH, "Smart blood query: a novel mobile phone based privacyaware blood donor recruitment and management system for developing regions". IEEE workshops of international conference on advanced information networking and applications (WAINA) 2011. 544-48: 22-25 March 2011.

[4] Alaahamouda et al; 'Automated Red Blood Cells counting', International Journal of Computing Science, Vol.1, No.2, February 2012.

[5] Arvind Sharma, P.C. Gupta, "Predicting the Number of Blood Donors through their Age and Blood Group by using Data Mining Tool", International Journal of Communication and Computer Technologies Volume 01 – No.6, Issue: 02 September 2012.

[6] S.Asha Rani, Dr.S.Hari Ganesh, "A comparative study of classification algorithm on blood transfusion", International Journal of Advancements in Research & Technology (IJOART), Volume 3, Issue 6, ISSN 2278-7763; June-2014 .

[7] Ashoori M, NajiMoghaddam V, Alizadeh S, and Safi M. Classification and clustering algorithm application for prediction of tablet numbers: case study diabetes Disease. Health Information Management1392; 10(5): 739-749. [In Persian] ,View 2 Jan 2015.

[8] Bing Nan Li, Ming Chui Dong and Sam Chao, "On decision making support in blood bank information systems", Expert Systems vol.34, issue 2, February 2008.