Implementing all in One Platform to Optimize the Blood Donation Chain

Baladewa A.H.A.N.
Faculty of Computing
Sri Lanka Institute of Information Technology,
Malabe, Sri Lanka

Madhuwanthi A.V.P.
Faculty of Computing
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

Pieris M.V.M.
Faculty of Computing
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

Vimukthi S.M.Y.R.
Faculty of Computing
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

Pradeepa Bandara
Faculty of Computing
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

Pipuni Wijesiri
Faculty of Computing
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

ABSTRACT
Every second, someone needs donated blood or blood products to stay alive. So, the demand has to be filled with an efficient and optimized supply chain. Considering the importance of utilized communication tool between the blood donors, blood receivers, blood banks and blood donation campaigns organizers including the health services in Sri Lanka, a web based solution optimizing the blood donation chain was proceeded. In the system through the machine learning based implementations, all the users will be benefited to aware their eligibility on donating blood before a blood donation inputting their details while also get to know the upcoming monthly blood requirement of the country and get alerted on predicted requirements. Detection blood cells and analyze percentages is another function accomplished through the system along with a specified chat bot to assist the blood donors and campaign organizers for the blood donation process. The system's ultimate goal is to eliminate the time-consuming communication barrier by connecting the responding parties and facilitating awareness of the blood donation procedure.

Keywords
Blood donation, Machine learning, Donors

1. INTRODUCTION
Blood donation is a process of taking blood from a person voluntarily to be stored in a blood bank for later use in blood transfusions [14]. Many patients with a variety of medical issues can benefit from blood donations. Emphasizing the act of blood donation, World Health Organization highlight the fact that safe blood saves lives including women with complications during pregnancy and childbirth, children with severe anemia, often resulting from malaria or malnutrition, accident victims and surgical and cancer patients. Human blood is a necessary component of human existence for which there is no alternative.Blood cannot be appraised in term of cost, has a limited shelf-life, which must be utilized in a relatively short period [13]. Since that, a constant need of regular supply must be maintained.

Sri Lanka annually collects more than 350,000 blood units. To supply the sufficient amount, it is important to make the services available easily, effectively and efficiently. The proposed solution is a comprehensive fully fledged system works on optimizing the blood donation chain. The blood donators will be registered to a system where they can be aware about the concerns of blood donating, and get notified in an emergency blood requirement, responding to the monthly blood requirements and aware about the nearby blood donations. The blood receivers will be ensured with the ability of requesting potential blood donors, locating the nearby places for blood transfusion, and viewing the current availability of blood on different blood banks. The benefactors who are willing to organize blood campaigns doesn't have to waste their time on seeking the potential places and resource suppliers. The proposed system will filter them the best locations to organize blood donation campaigns and recommend the responsible resource holders within a short time. Also, the system supposed to encourage all related parties of the system to enhance the blood donation via sending promoting messages and notifications, fulfilling the national cause of ensuring the sufficient, quality and adequacy blood supply to give the life to someone.

2. LITERATURE REVIEW
Many studies have investigated people's attitudes toward blood donation.Even if the primary way tomeet blood requirement is to receive regular donations from healthy volunteers, unfortunately, only 5% of eligible donor population regularly donates [1]. Non-donors provide various reasons for never donating blood, such as lack of knowledge, fear of contracting the disease, insufficient time, not being asked, or being medically unfit [11]. If these non-donors can be assured that they are safe after a blood donation, whether they are eligible to donate blood, that blood donation is a less time-consuming process it will be a greater sustenance to strengthen the blood supply chain [12,13].

Currently, the blood bank's working process and storage system in Sri Lanka is mostly focused on documentations and files. Existing method of the blood donation camp organizing is selecting a date and place for the camp and contact the nearest blood bank. Then organizers should meet the relevant officers and make a request providing a letter. After that need to wait for their acceptance and recommendations. Also, they haven't a proper guidance and instructions system. If any person has a problem or question regarding the blood

donation camp organizing or any kind of problem regarding the process, that person need to contact the blood bank or need to visit the blood bank to solve their problem. Data and knowledge about blood, donors, recipients, blood donation camps and camp organizers are stored in documents and archives. As a result, data and information processing becomes tough and time-consuming [1]. All blood donation and transfusion tests and donation camp request details are also documented on physical papers. This renders information vulnerable to human mistakes and blunders, putting human lives in jeopardy. Another concern with this framework is, its lack of productivity. Organizing blood donation campaigns is the most common way for collecting blood. Some organizations, Non-Government Organizations and some groups of people desire to organize blood donation campaigns. Since it is a long process, it takes some time to arrange and need to contact many people in the health sector to get health aids, guidance and another parties to take the necessary arrangements. It takes a lot of time and work to retrieve blood, whether it's donor, receiver, or donation camp information. Because information retrieval is such a time-consuming procedure, hospitals have a difficult time saving lives at critical periods. Information security and backup are also important considerations because papers and documents are easily stolen or misplaced. As a result, it's a shaky structure [2].A intention of the study is to create a platform to help and guide the campaign organizers to organize blood donation campaigns easily through online and make a platform to solve their problems and questions easily and quickly regarding the camp organizing or any other problem about blood bank or blood donation process [3]. Spent time learning everything can about blood management systems and processes, and used everything learned to make project the best it can be. It was critical for us to identify vulnerabilities in the existing systems. So that discover fixes and include them into project [4].

Blood Transfusion is a important component of any health care industry. The timely availability of safe blood and blood stocks is essential in health facilities where transfusion is performed [1].There are numerous existing Web-based and Android-based systems that record donor data and offer a system that helps other blood banks in emergency. This system differs from existing systems due to future scope or view which reduces the risk of null storage at crucial times [5]. The way that this system predicts future blood requirements is one way in which it differs from the current system. By maintaining and analyzing the saved data, this system assists in forecasting the quantity of blood donations that will be needed in the future [6]. This analysis and management of data is lacking in the existing methods, so the proposed methodology overcomes it with the use of machine learning algorithms. The output is helps us understand the future requirements. The need and the actual number of donations are not met in country. The level of knowledge, attitude and awareness difficulties may be the main contributing factors. The current study also aims to make people aware of the blood donations across the county. Considering the current existing monthly blood donation count with the future requirement, encouraging blood donors spread across the country at emergency situations through a centralized system by SMS or Email distributed through the system is also projected [7].

When counting blood cells automatically, there are often two basic ways used. The two methods are machine learning and image processing. An image processing method for RBC count was proposed by Acharya and Kumar. As well as

counting RBCs and differentiating between normal and pathological cells, it processed the blood smear image. They first extracted the WBCs from the image using the K-medoids technique and separated the RBCs from the WBCs using granulometric analysis. Next, they labeled the image and used a circular Hough transform to count the number of cells (CHT). For the purpose of counting RBCs on the greyscale image, Sarrafzadeh et alcirclet .'s transform was proposed The circlet transform suggested by [8] can be used to count RBCs on a greyscale image. For the objectives of counting and identification, they adopted the iterative soft-thresholding method. Kaur and al. suggested a technique to automatically count platelets by applying a CHT to a picture of tiny blood cells When using the characteristics of platelets' size and shape from the CHT in the counting method. Cruz et al. provided a method for processing images. a method for counting blood cells. Color, Saturation, and Value were employed. the associated component labeling for the thresholding method blood cell counts and identification. [9] Acharjee et al. using a Hough transform to suggest a semi-automated procedure. Change to count RBC by spotting their biconcave and oval shapes. shape. An automated counting approach was developed by Lou et al. RBCs using support vector machines and spectral angle imaging (SVM). Using a convolutional neural network, Zhao et al. [10] proposed an automatic identification and classification system for WBCs (CNN). They first identified WBCs from the microscopic images, and then they used CNN to identify different types of WBCs. Five different types of WBCs were categorized by Habib Zadeh et al. They employed two distinct SVMs and one CNN classifier, totaling three classifiers.

3. PROPOSED SYSTEM

3.1 Predicting the person's probability of donating blood and sending related notifications on blood donation

Donating blood is a noble act that saves lives. Yet the health care services of low-income countries like Sri Lanka still face the problem of collecting sufficient blood compared to the actual needs. So, A feature to identify the probability of a certain person to donate blood is planned. The perspectives of the donors and non-donors on donating blood will be gathered, the data will be clustered based on age, health compatibility, willingness and etc. feeding the collected data set, a module will be trained to generate an algorithm to find out the probability to donate blood. They will be encouraged emphasizing the requirement of donating blood through the system generated notifications and SMS reminders.

3.2 Helping and guiding the blood donors and campaign organizers for the blood donation process through a chatbot

Many clinics and hospitals constantly require blood for several purposes. Most people haven't a proper idea about the blood donation process. So they have many questions about this process. If they need to know more details about the blood donation process or blood donation camp organization process, they need to contact a doctor or blood bank. This system intends to give information and guidance to blood donors and camp organizers for the blood donation and camp organizing processes through a chatbot. Users can know about the nearest blood bank, contact details of all the blood banks in the country, details about the blood donation process, details about the blood donation camp organizing process, available dates for the blood donation camps, limitations of

the blood donation process, information about blood types and many more information about the blood donations. Also, organizing blood donation campaigns is the most common way of collecting blood. Some organizations, NGOs and some groups of people desire to organize blood donation campaigns. Since it is a long process, it takes some time to arrange and needs to contact many people in the health sector to get health aid and other parties to take the necessary arrangements. Through the system, a solution is proposed to overcome the difficulties faced when organizing the blood donation campaigns via implementing an online process to organize blood donation campaigns easily gaining information through a chatbot on potential resource holders, places, processes, limitations, etc.

This Chatbot can be used as a conversational chatbot. Users can ask questions and the chatbot gives the answer. Natural Language Processing (NLP) and Convolutional Neural Networks (CNN) are the main methodologies used for the chatbot. When the user adds a question, the chatbot auto generating the answer using NLP and CNN. PyCharm is the IDE that is used for the chatbot. PyTorch is also used for this chatbot. PyTorch is an open-source machine learning (ML) framework based on the Python programming language and the Torch library. It is one of the preferred platforms for deep learning research. The framework is built to speed up the process between research prototyping and deployment. Python language is used for chatbot development. When having a good interaction with the chatbot, can get better precision. Including deep learning, natural language processing, and machine learning (ML) algorithms, and it requires a huge amount of data to give accurate results. So used a huge dataset for this chatbot.

3.3 Predicting upcoming monthly blood requirement and encouraging people to donate blood according to the predicted requirements

Blood is a limited resource and a delicate product with a short life cycle, therefore demand and supply are unstable. This system intends to computerize in order to predict upcoming monthly blood requirement. A module will be trained using machine learning concepts. For this, past years data related to monthly wise blood requirement will be gathered. Using the past data (Date, Blood donation count) as the data set a model will be trained. After that Past data, current data, and predictions of future data will be shown in a graph. The need and the actual number of donations are not met in country. The level of knowledge, attitude and awareness difficulties may be the main contributing factors. This system aims to make people aware of the blood donations according to the predicted requirements.

A machine learning algorithm is used to implement it in the datasets. Machine learning algorithms are used to automate a model or system, resulting in the desired output. It's done by training the model. Using Long Short-Term Memory (LSTM), Time series forecasting model can predict upcoming future values based on previous sequential data. This provides greater accuracy for forecasting and provide better decision making for future. Time-series model is used to portrait the monthly wise number of blood donation count. And the future trend predictions for those measures. Past data (Date, Blood donation count) will be needed to train and evaluate model to predict upcoming monthly blood requirement. With this method, the upcoming blood requirement prediction can be done in automation way. The dataset will be containing date

and the quantity of blood donation count of every month. This will be used to predict the further blood requirement using the LSTM algorithm of Machine Learning. Keras and Tensorflow libraries can be used for model training. Artificial Neural Network will be fed with flattened set of data array and learning model will be optimized with the loss function and other optimization algorithms. Once the model is trained after several epochs, model can be saved for predictions.

3.4 Detection blood cells and analyze percentages

The field of blood cell analysis has become increasingly important when taking into account the reach of bio information technology. Red blood cells (RBC), white blood cells (WBC), and platelets can now be distinguished and counted using a variety of techniques. Currently, counting and analyzing blood cells are done manually, which leads to numerous human errors. Previous studies suggested a software-web-based, economical, and effective alternative for identifying and analyzing blood cells as a solution to this issue. Digital image processing is used in the suggested method. In the majority of investigations, RBCs, WBCs, and platelets were found and extracted from the images collected using image pre-processing and enhancement techniques like edge detection, spatial filtering, and adaptive histogram equalization.

Object detection aims to find the coordinates of objects in an image and classify its category. The proposed detector regards object detection as a regression problem in this research, equivalent to the YOLOV5 detector's methodology. Also, the proposed sensor that only uses the last output feature of the backbone can converge faster and achieves promising performance, compared to YOLOv5, which uses the feature pyramid network to enhance performance. This proposed detector is modified by YOLOV5.

4. RESULT AND EXPERIMENT

The prediction on eligibility of a blood donor gives 77% accuracy by light BGM algorithm, the Gradient Boosting machine and the regression algorithm follows the respective second and third highest accuracy. While the LSTM (Time series forecasting) algorithm predicts the upcoming monthly wise blood requirements with 74% accuracy. The system predicts detection blood cells and analyze the percentages on 70.5 % accuracy level.

The research team got feedback about this system using a few sets of blood donors and doctors. Accordingly, 12 people were involved in the testing phase. Overall results indicate that most people are satisfied with the system. Also, all the people agreed that the system is good for blood donation and blood donation camp organizing processes, and it is better than the traditional blood donation camp organizing process. One of the doctors suggested it is better to add some more details to the chatbot about the limitations used in the blood donation process. According to that suggestion, the research team decided to improve the data set of the chatbot. While considering all the facts it is evident that "Blood Care" would be a web application that can help blood donors and camp organizers with the blood donation process.

The hospital - blood bank current system is a manually operated device. The manual approach has issues with keeping track of blood stock records, future blood requirements. These records may not be preserved securely, and records may go missing as a result of human error or any other way. This system aims to resolve these issues faced by

hospitals. So, this system shifting their traditional processes into digital technology which would not only provide a highly efficient method capable of resolving huge complexities but also the proper analysis of enormous data to achieve predictions which would help us to prevent future anomalies and medical emergencies occurring due to poor traditional data management and processing techniques. These prediction results would help to maintain a proper track record of future blood requirements.
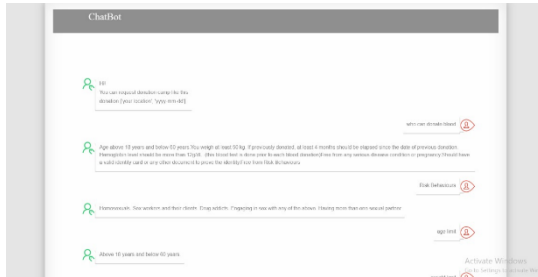

Fig 1: Chat bot result

5. CONCLUSION

The health care services of low-income countries like Sri Lanka still struggle to collect enough blood compared to real needs in their health care systems. Therefore, a feature to determine the probability that a certain person will donate blood is planned. Additionally, they will be encouraged to donate blood by being reminded through system-generated notifications and SMS messages. According to the feedback of the people who were involved in the testing phase, chatbot and online blood donation camp organizing platform are important for the users and it is better than the traditional process. It can be used easily by people also who haven't a good idea about the blood donation process. Evaluated the traditional procedures used by blood banks for storage of blood donation records. Based on this, a more effective, high processing, and large amounts of data, while removing the complexity and limitations of the present technology. This proposed system would assist in comprehending effective data management techniques for blood banks. And also, this system aim to spice up cell detection accuracy, that's achieved by adding channel attention and spatial attention mechanisms to the feature extraction network.

6. ACKNOWLEDGMENTS

7. REFERENCES

[1] National Blood Transfusion Service : 2022.[Online].Available: http://www.nbts.health.gov.lk/

[2] C. J. N. J. S. S. Divya Madhu, "A novel approach for medica assistance using trained chatbot," in International Conference on Inventive Communication andComputational Technologies (ICICCT), 2017.

[3] S. A. N. H. HameedullahKazi, "Effect of Chatbot Systems on Student's Learning Outcomes," SYLWAN, 2019.

[4] BORKAN, "www.blog.casper.com," 21 september 2016. [Online]. Available: https://blog.casper.com/meet-insomnobot-3000/.

[5] Dr.J.Shanthini,SanthoshiA,Manjula T, Pavithra R," Computer Aided Emergency Service System", IJIRT, National Conference on Networks, Intelligence and Computing Systems,March 2017.

[6] Ramesh S Patil, Sagar Mhetre, Madhavi Rayate, A GafoorKarache,"Analysis of Blood Donor Deferral causes in Solapur district",International Journal of Biological & Medical Research, nt J Biol Med Res,2014

[7] Javed Akhtar Khan and M.R. Alony ,"A New Concept of Blood Bank Management System using Cloud Computing for Rural Area (INDIA)", International Journal of Electrical, Electronics and Computer Engineering,2015

[8] Sarrafzadeh, O., Dehnavi, A.M., Rabbani, H., et al.,: 'Circlet based framework for red blood cells segmentation and counting'. IEEE Workshop on Signal Processing Systems, December 2015

[9] Acharjee, S., Chakrabartty, S., Alam, M.I., et al.,: 'A semiautomated approach using GUI for the detection of red blood cells'. Proc. Int. Conf. on Electrical, Electronics, and Optimization Techniques, 2016, pp. 525– 529

[10] Zhao, J., Zhang, M., Zhou, Z., et al.,:'Automation detection and classification of leukocytes using convolutional neural networks', Med. Biol. Eng. Comput., 2017, 55, (8), pp. 1287– 1301

[11] R.s. Ali, T.F.Hafez, A.B.Ali and N.Abd-Alsabour, "Blood Bag: A web application to manage allblood donation and transfution process,"2017 International Conference on Wireless Communications, Signal Processing and Networking(WiSPNET),2017,pp.2125-2130,doi: 10.1109/WiSPNET.2017.83001

[12] Domingos DC, Lima LF, Messias TF, Feijo JV, Diniz AA, Soares HB. Blood hero: An application for encouraging the blood donation by applying gamification. Annu Int Conf IEEE Eng Med Biol Soc. 2016 Aug;2016:5624-5627. doi: 10.1109/EMBC.2016.7592002. PMID: 28269530.

[13] P. KIRCI, S. AKTAS and B. SEVINC, "Analyzing Blood Donation probabilities and number of possible donors," 2020 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA), 2020, pp. 1-4, doi: 10.1109/HORA49412.2020.9152872.

[14] W. B. Zulfikar, Y. A. Gerhana and A. F. Rahmania, "An Approach to Classify Eligibility Blood Donors Using Decision Tree and Naive Bayes Classifier," 2018 6th International Conference on Cyber and IT Service Management (CITSM), 2018, pp. 1-5, doi: 10.1109/CITSM.2018.8674353.