iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5501

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

Kidney Transplantation System for Matching and Donor Recipient Verification using BlockChain

Abhinav C[1], Arjun Govindan[2], Ajay Joy[3], Midhun Devasia[4], Akhila Mathew[5]
[1, 2, 3, 4]*First BTech Students,* [5]*Second Assistant Professor, Department of Computer Science and Engineering, Vimal Jyothi Engineering College Chemperi, Kerala, India - 670632*

Abstract: ***Kidney failure or end-stage renal disease (ESRD) is the last stage of chronic kidney disease. Kidney transplantation is the only one solution for this problem. Individuals suffering from kidney failure today face significant challenges in order to obtain a Donor. The use of Blockchain promises to provide an avenue of decentralized system for kidney transplantation. In kidney transplantation, time is a critical factor so by using the Kidney transplantation system with BlockChain can give a transparent and time effective Kidney match. Originally devised for the digital currency, Bitcoin, but there are other potential uses for the technology such as security and transparency. Hence we propose a system using Blockchain that can verify and validate which matches a potential donor and recipient. Our system is based on Blockchain that can match a recipient with a potential donor. Various parameters are evaluated and a suitable match for the recipient is found. The involvement of third parties will not be there in the transplantation procedure. The patient gets the kidney in a time effective manner. And we have more reliable and secure procedures for kidney matching. The willing donor can easily register in the system and make transparent transplantation.***

Keywords: Kidney; Transplantation; BlockChain; Donor; Recipient; Doctor;

I. INTRODUCTION

Individuals suffering from kidney failure today face significant challenges to obtain a donor. With a global ageing population, we are starting to face a shortage in kidney donation. The kidney trafficking market is on the rise worldwide. Only in the year 2019, numerous stories of networks of peoples, technicians, physicians, and hospitals that participate in illegal trade by working undercover in various under resourced countries, such as India, Nepal, and Australia, were featured in the media, including The Hindhu. In kidney transplantation, time is a critical factor. The current system is inefficient and time consuming. So by using the Kidney matching system with blockchain can give a transparent and time effective Kidney match.

Blockchain is a chain of blocks linked with cryptography. Blockchain is a simple but secret way of passing information from A to B in a fully automated and safe manner. Each transaction is stored in a block. This block is verified by thousands of entities thus making it more secure than the traditional approach. The verified block is added to a growing chain of blocks, which is stored across the net, creating not just a unique block, but a unique block with a unique history. Changing a single record would mean changing the entire chain in billions of instances[2]. That is virtually impossible. Bitcoin uses this model for transactions, but it can also be deployed in many other ways.

In this system both patient and donor can register into web portal by providing personal information's and other body parameters. Then our algorithm find a proper donor recipient match and this match is verified by patient doctor and then it add to the blockchain. Then after the transplantation this match is validated by a second doctor. Then it stored into blockchain. Through the introduction of blockchain it provide a transparent kidney matching and verification platform.

There are different types of blockchain platforms available for implementation. This system uses hyperledger fabric platform for implementing Blockchain. There are different features available in fabric such as there's no cryptocurrency, peer can communicate using separate channels, it can be progrramble in each peer and it's a permissioned network. Our requirements are closely related with features of hyperledger fabric. Hence this system provides a distributed secure and transparent platform for kidney transplantation. It reduces third party involvement in the kidney transplantation process. This system finds a proper and effective donor recipient pair in an effective interval of time. Patients can easily monitor the matching pair through their portal and it provides a much secure way of efficient matching system.

©IJRASET: All Rights are Reserved

II. MODULAR DECOMPOSITION

System is divided into 5 Modules

A. Donor and Patient Registration

The user can directly register into the web portal with following details:

Name
Gender
Aadhar ID
Location
BMI
Blood Group
HLA
PRA
Serum Crossmatch Value

Fig. 1 Overview of Certificate Structure

The patient/Donor required to upload doctors certificate which certify that he/she is a kidney patient. The patient can also set preferable area of location of donor. The details of individual users and stored in a Database. When each patient/donor is verified by a doctor then he/she is valid. Once verification is done patient/donor becomes a participant in Blockchain System.

B. Doctor Registration

All doctors are registered in the portal. Details of each doctor such as name, gender, license number and specialisation .System checks if the license number is valid using a government database. Once a doctor is verified he or she has the right to perform a transplant.

C. Donor and Recipient Mapping (Matching System)

Each patient and donor is matched with an algorithm in the chaincode, while matching the high priority parameters(blood group and antigen type) have to be precise whereas the low priority parameters(location, BMI) can vary within a range. The mapping system is entirely designed in chaincode[4].

D. Verification

Doctor verifies the appropriate documents of both donor and patient. Once approved then patient and donor authenticate with their signatures accepting the terms and conditions. Doctor will also authenticate the match with his signature. After Doctor receives a successful pair, transplantation procedure can be done. Once the transplant is done the distributed ledger is updated.

E. Validation

Validation is performed by another doctor. The identity of the doctor will be revealed only after the transplant, the doctor will authenticate the match with his signature. then this pair will hashed and ledger will be updated.

III.ARCHITECTURE DIAGRAM

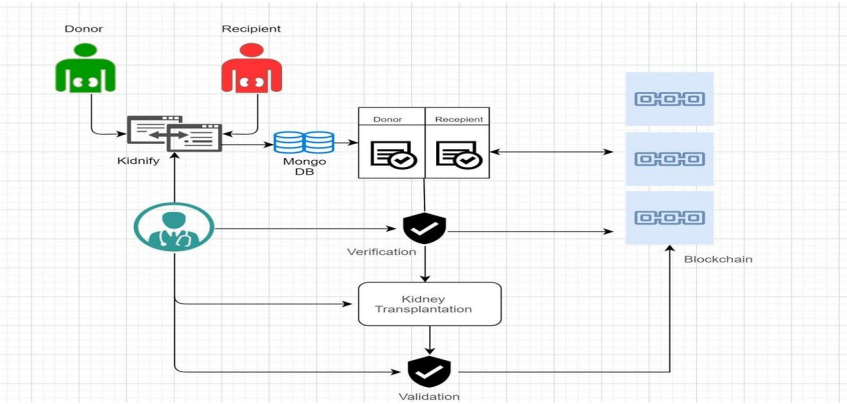


Fig. 2 Architecture Diagram

©IJRASET: All Rights are Reserved

Here first patient registers into the network by entering personal informations and other parameters specified. Patient can set their own username and password for accessing the portal. Similarly the donor can also register into the network. The patient is required to upload doctor's certificate indicating that he or she is a kidney patient. Donor also needs to upload doctor certificate indicating that he or she is healthy person and is a potential candidate for kidney donation. Then by using chaincode in the network a proper donor recipient match is generated. For matching the donor and recipient parameters as blood group, HLA value, PRA percentage and serum crossmatch value is used.

For a proper match blood group with O can donate to anyone. Blood group with AB can receive kidney from any one.If these cases are not satisfied then same blood group for donor and recipient is needed[3].The HLA value of patient must be in a specific range. PRA percentage of patient must be less than one. After finding a proper match this pairs will get a notification suggesting common time for visiting patient doctor. Doctor will also get details and notification about the match. If more than one match is found, the pair with the minimum distance is selected. If doctor verifies the match by checking certificates and other parameters then this pair is hashed using Sha-256 and added to block. Otherwise the match becomes invalid and a new search is performed.

IV. SEQUENCE DIAGRAM

System has three participants: patient, donor and doctor. Initially all of them register with blockchain platform.

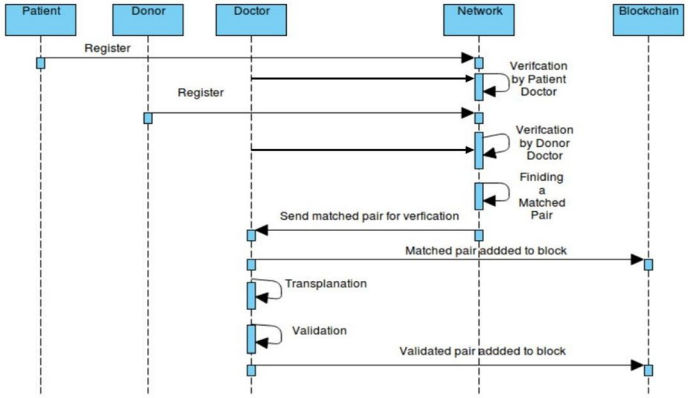


Fig. 3 Sequence Diagram

All these participants have to register with our system. Patient and donor registration is verified by doctors from both ends. After verification and registration system will find a match between the most suitable patient and donor. Again the donor's doctor verifies the matched pair, only then this matched pair is added to the block.

Chain code will be deployed in the blockchain system to find a matched patient and donor. Also, we have verification in each stage from registration to ensure transparency. After the transplantation validation of the same is done using our system. A third doctor will verify the transplantation. These validated pair is added to the block.

V. MATCHING ALGORITHM

A. Algorithm At Donor Side

1) Inputs

dbg -Donor blood Group rbg -Recipient blood Group
rpra -Recipient Percent reactive antibody
rhla -Recipient Human leukocyte antigen value dhla -Donor Human leukocyte antigen value

a) Begin
b) Declare donor d, pair and match_array[] 3 : For each Recipient
c) IF (dbg == rbg or dbg == 'O' or rbg == 'AB') 5 : IF(rpra < 0)
d) IF(rhla == dhla)
e) add recipient_id to match_array[] 8 : ENDIF
f) ENDIF
g) ENDIF
h) ENDFOR

©IJRASET: All Rights are Reserved

i) IF(count(match_array) > 1)
j) pair=min_distance(d,match_array)
k) update status of d and pair to "matched" 15 :IF(count(match_array) == 1)
l) pair=match_array[0]
m) update status of d and pair to "matched" 18 :ENDIF
n) END

2) Output
a) pair - contains matched recipient closest to the donor

B. Algorithm At Recipient Side
1) Inputs
dbg -Donor blood Group rbg -Recipient blood Group
rpra -Recipient Percent reactive antibody
rhla -Recipient Human leukocyte antigen value dhla -Donor Human leukocyte antigen value
a) Begin
b) Declare recipient r, pair and match_array[] 3 : For each Donor d
c) IF (dbg == rbg or dbg == 'O' or rbg == 'AB') 5 : IF(rpra < 0)
d) IF(rhla == dhla)
e) add donor_id to match_array[] 8 : ENDIF
f) ENDIF
g) ENDIF
h) ENDFOR
i) IF(count(match_array) > 1)
j) pair=min_distance(r, match_array)
k) update status of r and pair to "matched" 15 :IF(count(match_array) == 1)
l) pair=match_array[0]
m) update status of r and pair to "matched" 18 :ENDIF
n) END

2) Output
a) pair - contains matched donor closest to the recipient

VI. IMPLEMENTATION

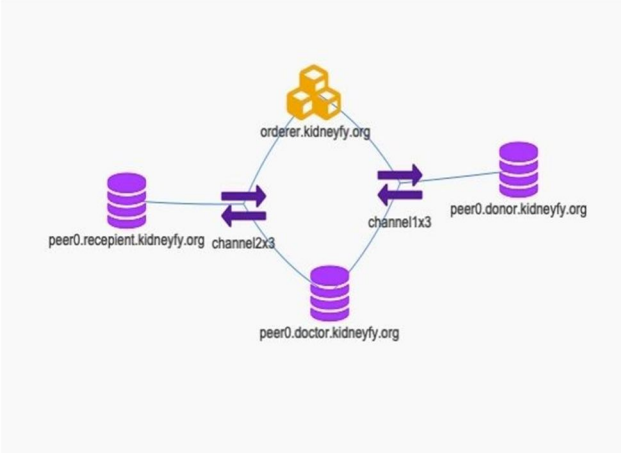


Fig. 4 Schematic Diagram

©IJRASET: All Rights are Reserved

In the implementation diagram we have to define 3 Organisation Patient, Donor, and Doctor. In hyperledger fabric we have to define the organization then we need to generate certificates for each of the organization .We define orderer for verifying the transactions happening through the blockchain network. In the configtx file we define each of the organisations id and corresponding anchor peer for the organizations. Hyperledger allows us to create separate channels between the organization and the communication can be done through this seperate channels. But, we are using one channel for connecting three organisations. Each organization has two peer, in which one of them communicate with the channel and is called anchor peer. By using these information genesis block is created and channel definition and anchor peer is updated.

Each peer have a couchDB (Database) which acts as a world state database. CouchDB is a no SQL database which has to be integrated with backend. Chaincode, which is a smart-contract for hyperledger fabric is written for the application and it stores data in the blockchain. We are deploying chaincode in Node.Js.'putstate()' and 'getstate()' are two functions used in chaincode for read write operations in blockchain.

Integration of blockchain and frontend is performed using SDK(Software Development Kit) deployed in Node.js.All the participants of the system will be registered using a web-portal front end. Patient, donor and doctor can register using the website and their corresponding details are stored in both MongoDB and blockchain. Our system also gives the option of login in the front end which can show status of each user.In the case of a doctor he/she can login, verify and download certificates of donor or patient inorder to successfully complete a patient or donor registration.

VII. CONCLUSIONS

This project was developed to address the security and efficiency of the current process. Project aims at creating a transparent process by leveraging the technology of blockchain. It aims at creating a unified portal for both recipient and donor, also using algorithms to create a match with complete anonymity.

REFERENCES

[1] W.A. Sunil. 2017. Chronic kidney disease spreads in rural Sri Lanka -World Socialist Web Site. [ONLINE] Available at:https://www.wsws.org/en/articles/2014/03/05/slfm-m05.html.[Accessed 10 September 2019

[2] Jayasumana, C., Gajanayake, R. and Siribaddana, S. (2014) 'Importance of arsenic and pesticides in epidemic chronic kidney disease in Sri Lanka', BMC Nephrology, 15(1). doi: 10.1186/1471-2369-15-1.

[3] .at:http://searchhealthit.techtarget.com/essentialguide/Wearable-healthtechnology-in-medical-and-consumer-arenas

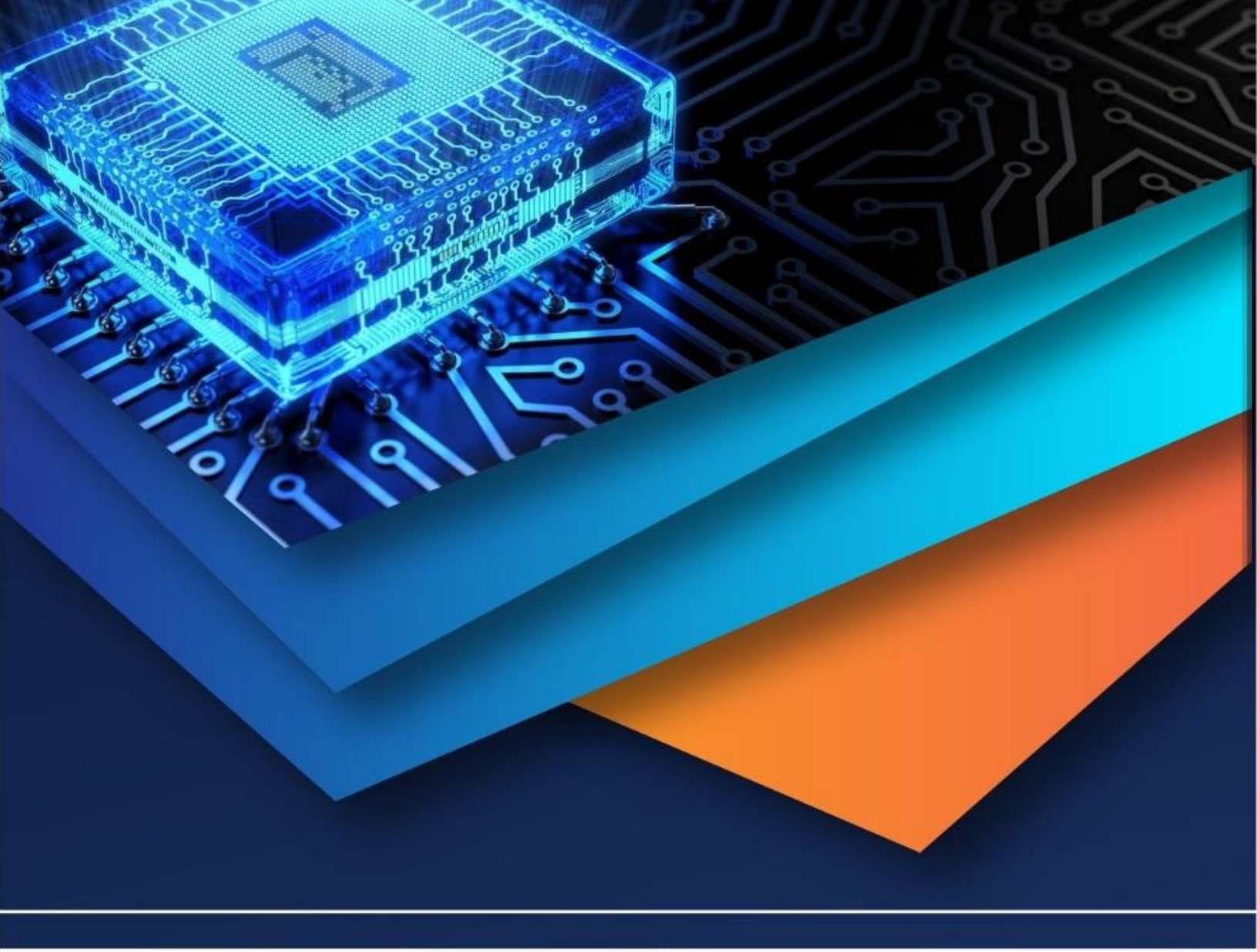
[4] S. Saidman, A. Roth, T. Somez, M. Unver, and F. Delmonico, "Increasing the opportunity of live kidney donation by matching for two and three way exchanges," Transplantation, vol. 81, no. 5, pp. 773-782, 2006. .

[5] A. Roth, T. Sonmez, and M. Unver, "Efficient kidney exchange : Coincidence of wants in a market with compatibility-based preferences," American Economic Review, vol. 97, no. 3, pp. 828-851, 2007.

[6] Roth AE. Who Gets What—and Why: The New Economics of Matchmaking and Market Design. Houghton Mifflin Harcourt; 2015.

[7] Su, X., S. A. Zenios. Patient Choice in Kidney Allocation: , A Sequential Stochastic Assignment Model.Oper. Res. 53(3)443C 455,2005.

©IJRASET: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)