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Blockchain in Collection of Data for Cardio Vascular Disease (CVD)

A. Uthama Kumar[1], Dr. Raju Ramakrishna Goundkar[2]
[1]*Research Scholar, CMR University, Bangalore*
[2]*Professor, CMR University, Bangalore*

Abstract: ***Cardio Vascular Disease (CVD) is fast growing as an epidemic in the world. World Health Organization(WHO) in its latest survey observes that 31% of the total population affected now could rise considerably in the near future. The figures could be much alarming in the developing countries like India, where there are no historical track records of medical condition of the population. It's only the death of the patient and his postmortem data that is reveling these enormous numbers. The research started with the building of the model using machine learning to predict the risk of CVDs. The very fact that there exists no such data that could be used for prediction in our country is alarming. This motivated us to build a data acquisition model. This model would support our unsupervised learning. Once the data is ready it could be used for further study***
Keywords: CVD, Blockchain, Data acquisition, classification.

I. INTRODUCTION

Cardio vascular disease (CVD) is termed as a group of disorders caused in human heart or various blood vessels. The fact file of WHO indicates: 38% of deaths in South East Asia is caused by CVD, close to 2.0 million and 1.7 million of male & female respectively die due to these ailments [3]. The paper provides a data acquisition model considering all the necessary characteristics of generation of data, storage issues, historical importance and longevity of data, security, priority and scalability. The geographical conditions, life style of an individual being the important parameters option is provided for self-introduction of block to suggest the changes in lifestyle and other social changes which may be affecting the health of the person. As there exists' no single person to oversee the insertion and modification of data, a strict vigil is implemented in the technology which adds to the security of data.

A. Background

There has been a tremendous development of medical sciences and hence leading to jump in longevity of human life. There are a number of circumstances where the patients generate enormous amount of data outside the clinic which is of good significance in the long run, but is left hanging or scattered. This scatter fuels the risk of unpredicted ailments till they are blown up to disproportionate levels. On careful examination we see a direct relationship of this data generated to reflect the patients diet, sleep, mood swings, physical activity, behavior and other symptoms. This data assumes importance for the fact that when shared with clinicians, it would act as important source to identify actionable and identifiable leading ailments. There has been active research in this area, but it is still unclear on how this scattered and non-uniformly generated data can be integrated into clinical practice.
Eleventh European Alliance for innovation (EAI) International conference on Pervasive Computing Technologies for Healthcare concluded that a "one-size-fit-all" solution was not possible due to the broad and complex design space. Given the fact that there existed no such platform that would support such requirement at time, the conference concluded with set of views to understand the characterization of problem, scenarios considering stakeholders, key themes, unexplored research area, goals and reported back the system requirements as needed by the industry.

B. Blockchain Technology

Blockchain is a technology that was in the industry for quite some time now. It is recently that we have been seeing a wide application of this technology in the area of financial applications, it was first used the technology for generating Bitcoins. The capacity of this technology was now unfolding and making ripples in the industry with its introduction to various other fields of IT [1]. Blockchain being the underlying technology of Bitcoins is recognized by as a peer-to-peer cryptocurrency with distributed ledger suited for processing time ordered data[2]. It allows for integrating and integrity of ledgers, authenticity of transaction, privacy of transactions, all this without a centralized control actor[10].
The growth rate of this technology in recent times is marked by the fact in 2017 alone more than one billion dollars is pumped by venture capitalists in new startups based on this technology which is accelerating the use of this technology in all relevant area of life.

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II. OVERVIEW OF OUR CONTRIBUTION

In this work we propose a system to capture the patient data. The new system concentrates on two major features of blockchain that is, the distributed immutability and cryptography. This takes care of the security of private and sensitive information of the patient. The facility to record data as and when generated and verification of this data are an added plus to the real world model, which are embedded features of blockchain. Access control of blockchain is governed by the policy of blockchain which provides access to only authorized users eliminating the third party storage and verification using smart contracts. Malicious changes are in force as long as a minimum of fifty percent of the users are honest.

III. PROPOSED ARCHITECTURAL OF CUSTOMIZED MEDICAL BLOCKCHAIN

Blockchains can be broadly divided into three broad types based on the stake holders using the blockchain. They are Private, Consortium and public blockchains [4]. In brief based on the structure and operations the blockchains have different uses in various applications. A Public blockchain is built on the open source concept. The structure is built on non-permission requirements so that the protocols and the source can be downloaded and used to be a part of the blockchain. Such blockchains are regulated using the proof of work done.[6] All transactions submitted to this blockchain are evaluated and after consensus process added to the blockchain. Reading is through public book explorer. Eg. Bitcoin, Monero, Dogecoin, etc. [5]

Consortium blockchain are lead and operated under the leadership of a common interest community. Such blockchains need permission to join the group and verify the transactions. However these blockchains are quick in insertion as compared to public blockchains[8]. They have a set of pre designated nodes that control the consensus approach of adding blocks. Reading may or may not needs permission and could be limited to the members or could be public. Eg., Bank, Insurance, etc.

Private blockchains is managed by one single central organization. In an organization, there would be a group of nodes assigned for each type of transaction internally and are monitored internally[7]. This increases the risk of security and hence additional checks like the game theoretic incentive methods are used. These are used when scalability, compliance, data privacy, regulations, rules, etc take a front seat during the design of the blockchain.[9] This could also lead in escalation of cost of maintenance and building of blockchain. A perusal on the above types nictitates a different type of blockchain for our purpose of collection, process and inference our system. Hence the paper proposes a system which has properties of Consortium and also a few features of the Public blockchain [11][12]. The flexibility of the Consortium blockchain leads us to include different stake holders for a short time and also make the data available publically as and when it is needed. The method is called as the Semi-Consortium method.

A. Proposed Semi-Consortium method

Semi-consortium type of blockchain is proposed to have the properties of the public and consortium blockchain as follows:

1) Blockchain is built on the open source concept.
2) Blockchain are lead and operated under the leadership of a common interest community including all dynamic stakeholders.
3) Protocols and the source can be downloaded and used however a standard blockchain methodology needs to be established, which is being worked out by various standards organization[16].
4) “Quick in insertion” is the moto of the method.
5) All transactions submitted to this blockchain are evaluated and after “consensus process” are added to the blockchain [14].
6) Reading is through Semi-Consortium public book explorer**,** which will have the authority to grant read permission.

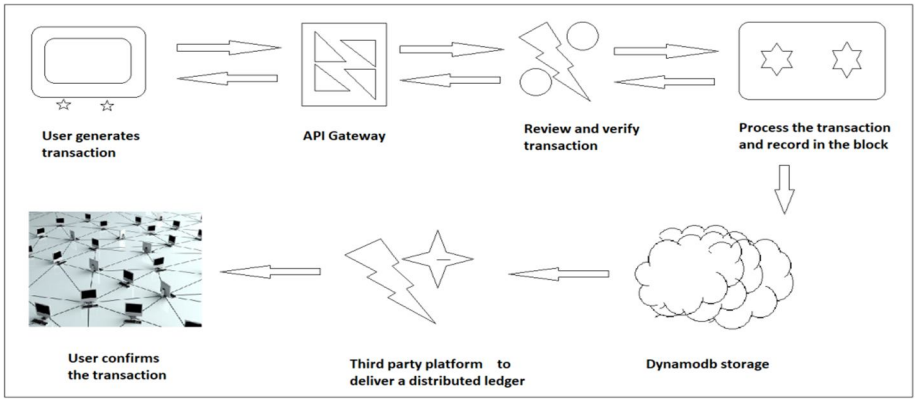


Fig. 1. Architectural model of Blockchain building to record dynamic patient data

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In the proposed system of blockchain development, the end user or the patient is the initiator of transactions. It is recommended that all the human beings hold on to such a blockchain so that their health can be tracked with ease and provide the analysist system with sufficient and precise data leading to good diagnosis or prediction. This would mean that each and every person would need a digital wallet that would help store this blockchain [13] [14]. Digital wallets like the "Digi Locker" play an important templet in implementing such wallets. Digital signatures, hash function, proof of work in digital library and consensus are utilized for additional data protection and integrity of blockchain. Authorized to read using consortium read explorer is needed where the owner of the blockchain provides for read access. The patient needing help from a medical practitioner may grant permission of the blockchain. This blockchain is read and examined for the patients history and may be sought for various tests, which are again updated to the blockchain. This updated blockchain is allowed access to the diagnostic center, which on diagnosis would upload the test reports. Once this upload is approved and updated in the blockchain, it is visible to the Doctor. The Doctor based on the report would prescribe the medicine in the form of prescription, which is again uploaded to the blockchain. The process is continued till the patient closes the transaction or after a limited amount of time after which it will be closed. Any manipulations would be based on the principles of blockchain making it get consensus from a minimum of three fourth stakeholders. The model would also accommodate to store the lifestyle changes of a person, which is a good practice to record once in a fortnight. This includes about 30 parameters which are listed as "Traditional risk factors" and "Emerging risk factors" [7]. These factors listed are used to build a system of prediction based on the standard measuring methods of the industry and this leads to supervised learning. On successful identification and grading we plan to lead the system of prediction into semi-supervised and then into unsupervised learning of system. Advantages of the system are vivid. This provides the Doctor with the lifestyle changes of the patient along with historical data for diagnosis. If the person is hospitalized for any reason anytime, the Doctor also gets to see the discharge summaries of previous admissions, which could have vital information of the current state of the patient.

B. Conclusion

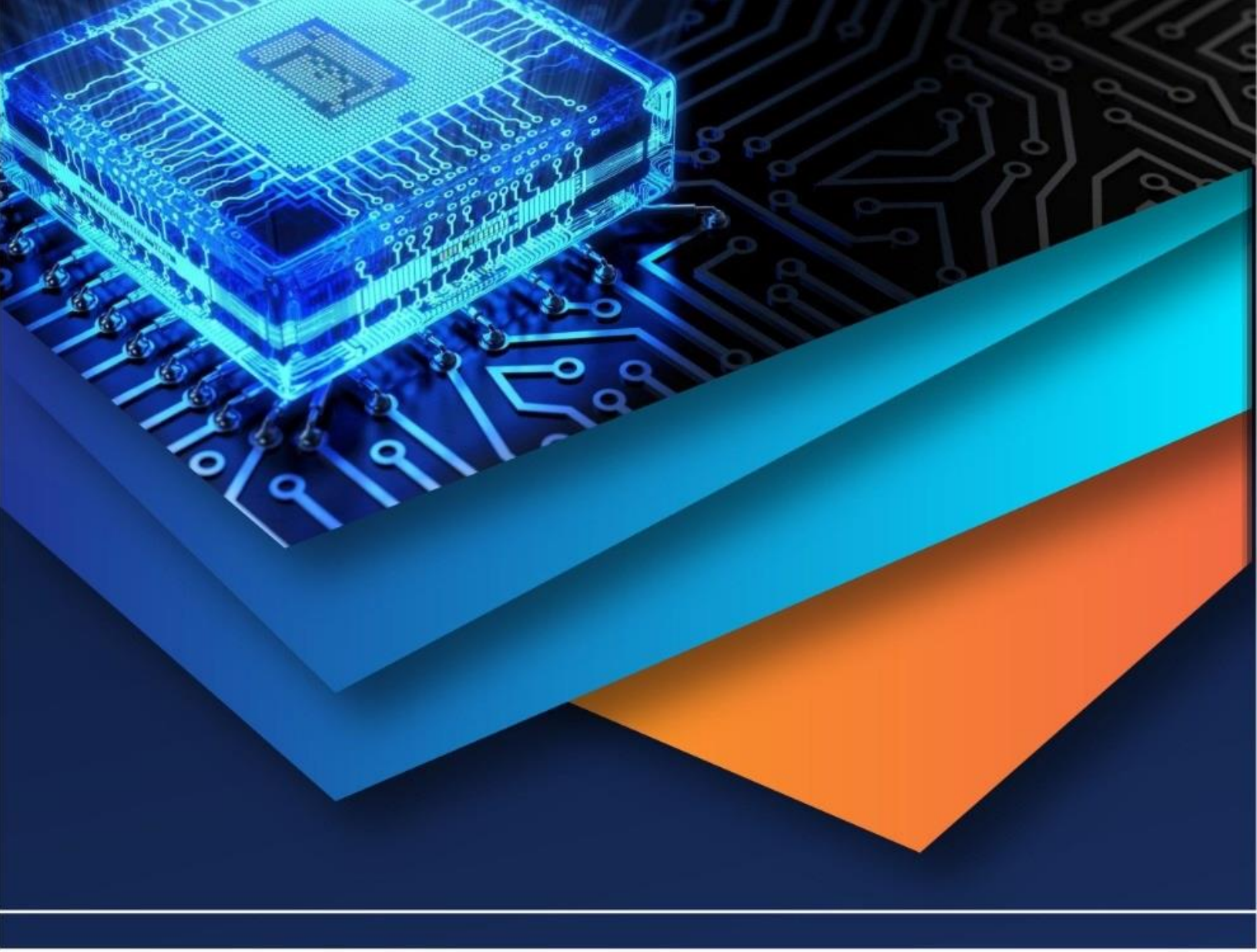
The paper attempts to acquire all the life style details of an individual from himself and also store information of his medical condition based on the other stakeholder's entry viz., Doctor, diagnostic center, consultant doctor, hospital staff, in-charge nurse and duty doctor or intensivist. The priority set for these entry into blockchain is in a hierarchical manner that would need other stake holders to agree for insertion and would ensure no deletion or manipulation until there is consensus. The degree is consensus is set accordingly as to not disturb the specific group of stakeholders. The method is a novel idea to record all the details and create an ideal environment for further work like supervised and unsupervised learning and development of Decision Support System(DSS).

1) *Future Enhancements:* The paper currently has exclusive work on gathering data and presenting it to the doctor for diagnosis. The main aim of this research is to build a system which would deduce reasons and analyze the percentage of risk the patient is in wrt CVD. The future work would concentrate on building a system of prediction that would use supervised learning to predict CVD and there after become independent base on unsupervised learning or semi-supervised learning technique.

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