Using Blockchain Technology for Design of Telemedicine System Based on Mobile Terminal

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Abstract – The objective of this article is to design and construct a secure data exchange on mobile terminal using the Android platform and General Packets Radio Service (GPRS) technology based on a cryptographic approach for mobile telemedicine system. It uses the methods of constructing an Android operation system C platform and used GPRS network for remote wireless transmission of data and program by C for terminal's user interface. The results of ECG tests show that the terminal can realize functions such as ECG data acquisition, storage, and wireless data transmission, message, and phone communication, abnormality detection to trigger wireless data transmission. The doctor and monitoring center can receive the test results and ECG data via GPRS wireless network then send over to draw the corresponding ECG waveform and diagnose timely to provide medical advice. For transferring and receiving data without any changing in the system we are using cryptography approach. Nowadays blockchain is promising security challenges while technology suffering from security issues. We bring the blockchain to the telemedicine system to boot up its security. The terminal quite meets the demands of mobile telemedicine system and makes the foundation of community and family health care system.

Index Terms – Android based systems, General Packets Radio Service, Transmission Control Protocol / Internet Protocol, C program, Electrocardiogram.

1. INTRODUCTION

Recently communication and Information technologies are going to the next level, world are expected to experience massive demands from mobile telemedicine application[1].Mobile telemedicine targets at delivering allows healthcare services nevertheless of any mobility constraints, overcoming geographical, temporal, and logistic barriers[2].This study researcher propose the mobile medical system using blockchain technology which will be able to remote and records the biological signals continuously anytime and anywhere while patients continue doing their daily actives[3] .Transmission time and security data it should be given a higher consideration the important and sensitive of data transmitted. Transmission Control Protocol (TCP) [4] is used to this design for data transmission at minimum delay because Internet model is introduced to develop the argument to support packet data networking for local and wide area networks that include the Internet.

Our system design we start putting a consideration that e-health may be improved with respect to security and healthcare data management thanks to blockchain technology [5]. In the last few years, there has been increased interest in blockchain technology as a new model of data sharing in several domains such as medical research or in smart city contexts. Blockchain technology is an innately secure way to share data, using automatic cryptographic checking of data consistency [6]. In particular, data is stored in a digital ledger composed of a linked block of transactions. A blockchain is usually a decentralized and peer-to-peer based system.

Main requirement is mobile terminal that set signal acquisition, processing and analysis functions as one of the mobile platform. The research of mobile medical system, they use the universal GPRS network to achieve Wireless data transmission, to the doctor Hospital care platform for analysis and then sent to the doctor[7], this model to some extent the combination of medical data records improves the regional limitations of medical information exchange in mobile healthcare different effort was done in medical algorithms by developing in current telemedicine studies patient's diagnosis and very early detection of cardiovascular diseases along with human vital signals, pulse assessment has long been a research area of importance in the physiology field, for the reason that the pulse reflects a person's state of health[8]. Various investigations have proposed monitoring systems that can measure a variety of bio signals and provide QRS detection and arrhythmia classification, real-time ECG classification algorithm and heart rate variability measurement [9]. Compared to this designed model GPRS is going to improve the access and connection than existing models because the coverage area is larger and the operation speed is higher than other, also performance is high no delay and this model system was designed and security of the data transmission and other important information was considered and its secure and safe system to use for anyone[10].Terminal can make full use of existing domestic network resources to help patients in remote areas to timely treatment, the pre-data analysis and treatment can also be a quick diagnosis for the doctor Provide support, have broad application prospects.

Healthcare is always considered a vital by the society [11]. Nowadays healthcare records and data are important to every patient. Exchanging physical records between patient and doctor should be in secure way that avoids any misunderstanding. Since Internet of Things have been enhancing every area of industry as well healthcare, the cloud service seems a reliable for data storage and exchange information [10]. However the cloud service has been making an immense of amount effort to supply suitable data exchanging service. Fortunately, since 2008, the new technology has been becoming ubiquitous many fields which is called blockchain [12].

Nowadays many people have started to become interested in blockchain technology because this can be applied to other scenarios. Since 2009 bitcoin has been attracting and absorbing many interests the entire world [13]. Many business establishment is coping with e-cash system. Bitcoin was implemented by group of anonymous people and also known Satoshi Nakamoto. Bitcoin is digital money can transfer and receive a coins by blockchain system which is heart of bitcoin. Nowadays blockchain is proven that nobody can hack it [14]. Blockchain is technology that enables moving digital coins or assets from one individual to another individual [15]. It is a decentralized distributed ledger which is per to per all nodes associating in the network

A Blockchain is the chain which contains and adds information continuously in the blocks [16]. A blockchain copies and archives among the users of the system [17]. Blockchain owes three notable features which are distributed ledger, immutable and non – reputability [18]. The distributed ledger is shared by among the network which is peer – to – peer network. The second feature is an immutable which is hard and impossible to rectify, information and transaction in the system. Transactions are duplicated by an enormous of users since they are non – reputable[19].

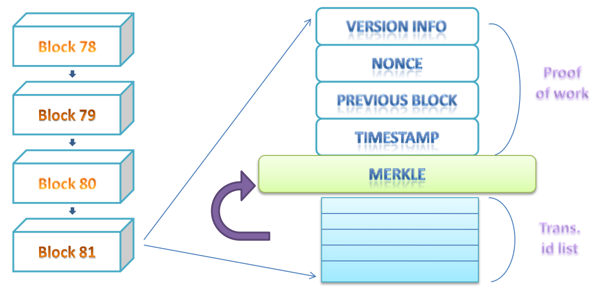

Figure 1: Block structure of the blockchain

Generally, blockchain is secured by using SHA – 256 hash function and linked chain of blocks. As illustrated in Figure 1. Every block embraces mainly three functions, block header, version info, and transactions id list. The header contains service data which is included version info, nonce, previous block id and time stamp [20]. The Merkle hash tree is built summary block's transactions [21]. Transaction Id list includes a list of transaction's identifications hashes, that was involved into the block's Merkle tree. The previous hash is pointed to the following block of hash. Blockchain has a unique property which distributed ledger consensus.

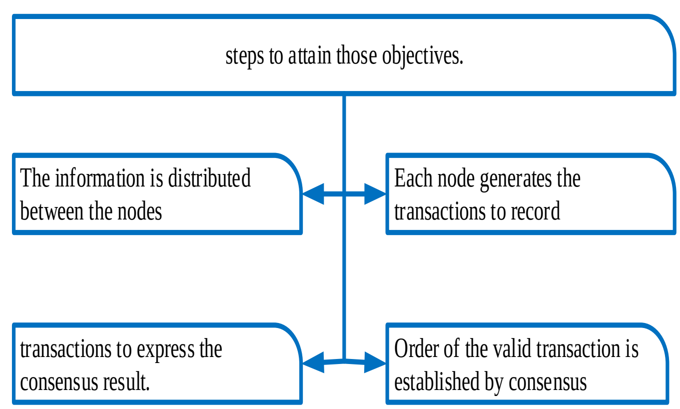

Figure 2: Mainly four steps to attain blockchain objectives.

A consensus holds a duplication of the written transactions wherein the blockchain. Nodes validate the invalidated transactions across a network remain in synchronization, immutable, and averts the system from many types of malicious attacks. The main function of the blockchain is proof of work that ensures the whole system a secure which is a consensus protocol. Validators are called nodes or miners where compete to calculate the next block's hash function by solving an overcomplicated mathematical puzzle. Once miners reach the right hash function they are rewarded by the system. In the blockchain, there are other protocols Proof of Stake and Proof of Burn Consensus follows mainly four steps to attain those objectives as it shows in figure -2.

2. RELATED WORK

Conceptually, telemedicine started around 1960s [22], after the invention of the telephony systems and the fax machine as a mean of communication. According to Yamada et al., information technology has improved healthcare to the patient at "anytime" and "anywhere" to provide emergency health services to the patient's point-of-care [23]. The emergency ambulances are used to transport the patient to the hospital under the care of the nurse on emergency duty. However, currently, modem wireless telecommunication such as GPRS and satellite technologies, offers a flexible operation of wireless telemedicine systems, liberating the medical attendants or the subject observed from being bound to stationary locations [24].

Telemedicine has been applied in various scenarios with understaffed medical practitioner to utilized the availability of manpower, minimized the cost of patient transportation to hospital and also to shorten the delay time of consultations to the patient [25]. To increase the mobility of the doctors, the global system for mobile (GSM) communication mobile telephony network was cast-off for connecting the server. But here the main challenge was the coverage network area and speed of the data transmission was below 3.4kps minimum transfer rate.

IoT is spreading to whole world to change the world with wireless system. However, the security is the most challenge for IoT. Nowadays many researchers are working on the IoT's security problem. Today Medical service is enhanced and revolutionized by Internet of Things. Huawei Technologies Co.Ltd and The Hong Kong Polytechnic University cooperated together and published an extraordinary paper. The paper is proposed new system which is called BlockHIE that aims to exchange healthcare data. They provided two types of medical information which are Electronic medical records (EMR) and Personal healthcare data (PHD). Generally, they also analyzed the distinct demands to share and store them. According to the analysis, they designed BlocHIE on two kinds of loosely – coupled blockchains, first one is electronic medical records which is called EMR – Chain, second on is Personal healthcare data is called PHD – Chain. In EMR-Chain, they aggregated techniques of on – chain verification and off – chain storage to look after of authenticability and privacy [15]. In addition, they proposed transaction packing algorithms to boost up the system and the balanced all users. Eventually, they implemented their work by using the GRPC – python.

3. PORPOSED MODELLING

This section explain the components used during the design of the proposed model which consist of the following units patient's terminal, the remote monitoring (central remote server) , the management unit and the network module as shown in Figure 3.

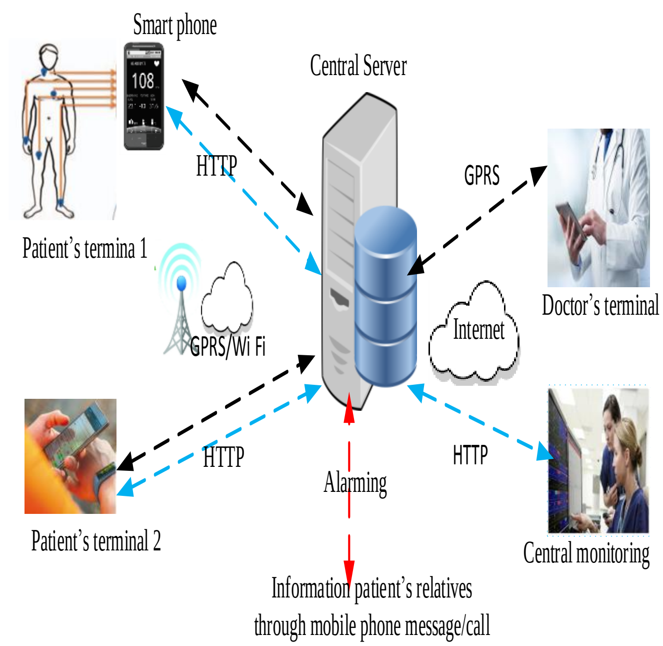

Figure 3: Architecture of the proposed telemedicine system.

A.System description

First, the sensors collect physiology data from the human body; then, the data, after being processed by the intelligent control module, is connected onto the GPRS communication module in the serial mode(RS232) in the form of data stream, and transmitted through the communication with the GPRS base station; after this, the base station SGSN(Serving GPRS Support Node) carries on the correspondence with GGSN(Gateway of GPRS Supporting Node), while GGSN does some processing to the grouped information, which is then transmitted to Internet through GSN(GPRS service node) ; finally, GSN finds the monitoring center server on the Internet according to an assigned IP address, and saves the information into the monitoring center server. The patient wears the WPR wireless ECG-sensor which transmit the signals to the smart phone using automatic arrhythmia detection algorithm and the smart phone transmit the ECG signals via GPRS to the base for the mobile. The data is made available in two forms either as a real time data mode or stored in the cloud based server as a store-and-forward data mode. The doctor will then receive the recorded ECG signal and make diagnosis evaluations for the precise patient.

B. Mobile terminals

Although most processing workload takes place in the communication centre, mobile terminals require specific programming, too. Nowadays, different languages and operating systems have been developed specifically adapted for mobile devices, such as Symbian and those based on Java. Patient terminals are specially complicated, because of the communication with biometric sensors [26]. To achieve an efficient transmission of the signal samples towards the communication centre, they are compressed by means of a specific algorithm, depending on the type of signal. Biologic registers will always be transmitted after a compression stage [27]. Wavelet Transform-based methods provide very good results, both about compression rate and reconstruction quality, with complex signals, such as ECG, FECG and EEG.

C. Remote Diagnosis

Remote diagnostic module including hospitals guidance, department's guidance, disease guidance, medical imaging diagnostic, and certificate of illness Diagnosis issued [28]. After logging in the system, community physicians can apply for remote diagnosis for patients; experts can download medical image from the server and issue a medical certificate (patient report). The effect of remote diagnosis with smart handheld devices is shown in Figure 3.In order to ensure the reliability of patient report, electronic signature technology is used. Taking into account the smart device memory and screen resolution limit, the system provides some simple image processing functions, such as magnification, the window

D. Central Remote Server

It receives and stores the vital signs in the central patient's database and exhibits the body processes signals to the doctor's terminal's via application program for analysis and evaluations. Also, it permits remote access for nurses and physicians to obtain vital signs via a web based application interface over internet to observe these data using their own devices. After diagnosing the vital signs information, the doctor can respond by MMS message to the patient. The message has medical instruction and/or a list of control commands to the mobile-care device for resending the abnormal case's vital signs data. Likewise, the central remote server may alert the family member in case of abnormal analysis and call the mobile care center to offer transport to the patient with emergency attention to be taken to the nearby rural center for medication as per the doctor's report [29].

E. Central monitoring

Guardianship section mainly refers to the hospital's custody center, which acts as mobile medical terminal End of the data receiving end. Terminal to receive abnormal ECG data by the doctor to make a diagnosis and then feedback to the patient [30], at the same time can at any time by SMS GPRS module or telephone contact Patients make some medical advice, in order to achieve the custody and treatment of patients with out-of-hospital mobility.

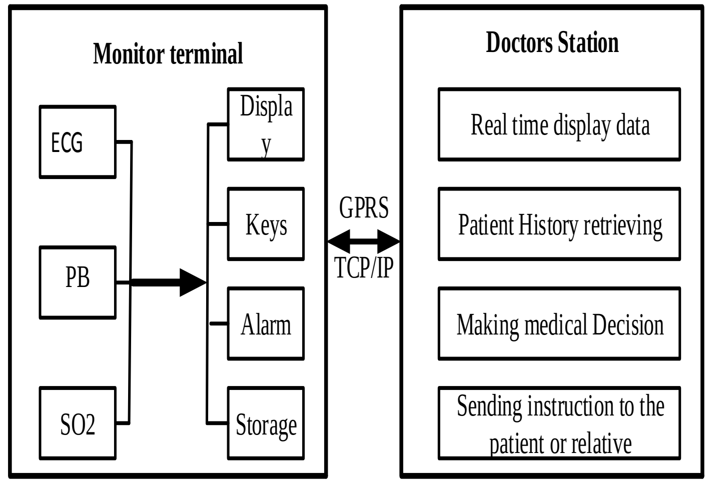

Figure 4: Monitoring System Centre.

From the figure 4 above show how monitoring terminal system is a multi-tasking system, at the same time there may be a number of tasks concurrent Implementation, due to the introduction of human-computer interaction, according to the different requirements of patients, different task of concurrent execution will be different[31]. For multi-tasking management Better support, transplant Android operating system is the best choice. At the same time, due to department the design used in the Data transmission is done using the TCP/IP network protocol [32]. Transmitting data over TCP/IP is a trivial and easy task when using networks, which have high bandwidth and low error rate.

In order to transmit a buffer of n bytes through TCP/IP a header of about 55 bytes is added, this will add a great amount of data especially in cases that we transmit small buffers (e.g. when transmitting a buffer of 10 bytes the network protocol will increase this buffer to 65 bytes). When transmitting a buffer that has size larger than the Maximum Transfer Unit (MTU) this buffer will be fragmented in to smaller packets that each one has the size of the MTU, all small packets will be reconnected when arriving at the destination site; this case will cause problems when one of the fragmentation packets is lost.

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3.1The Blockchain Structures.

First and foremost participants register their identity, once they complete their registration, they can send a data to the doctor through the blockchain technology. Our structure is controlled by three nodes in the system. First node stores medical records, second one manages it, third one holds medical records in the history as show in figure 5 a and b.

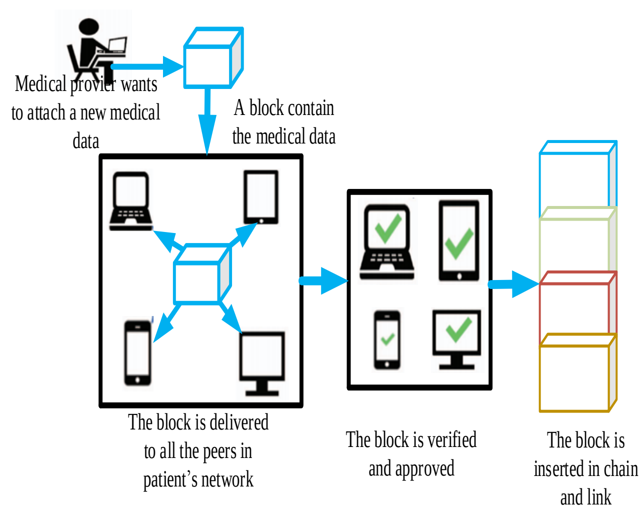

Figure 5a: Blockchain for health and medical records.

Figure 5b: Blockchain for health and medical records.

The system users consist patients and hospital stuff for instance doctors and nurses. The system manages to record data about patients such as address, name, age, next.etc., consultations from doctor for example prescription, date, doctor seen, etc., treatments and conditions. The system generates reports at frequently intervals for patient, clinic staff and health authority. Generally, all reports is placed in history of blockchain which is immutable and provides both sides with medical information. Basically, the system includes three features which are:

1. Personal care management. Records are created by the system by doctor and able to view patient's history. The system provides summarized information which aims doctors can get information and learn about patient's illness and treatment history.

2. Monitoring patient. Records of patients are monitored by the system always when as soon as possible problems are detected in treatment and problems warnings. Moreover, a warning will notify a doctor if a patient has not checked data for some time. Most priority of monitoring patient is to keep track patients health continually and check medical records.

3. System reporting. Weekly management reports is generated by the system that shows the amount of users treated at each hospital, the amount of users who have accessed and exited the healthcare system, the medicine is prescribed and their prices, etc.

Privacy is vital in all medical systems that patient's data is confidential and can be seen only patient themselves and authorized hospital members such as doctors and nurses. The figure illustrates sending data by cryptography way where can work off line and online in the system. A patient encrypts medical data (MD) and sends it to the doctor. Doctor already is provided a secret key that can decrypt the medical information and check the patient's condition. Adversary is not able to get medical information is a readable unless he has a secret key of patients. The figure 6 shows the algorithm:

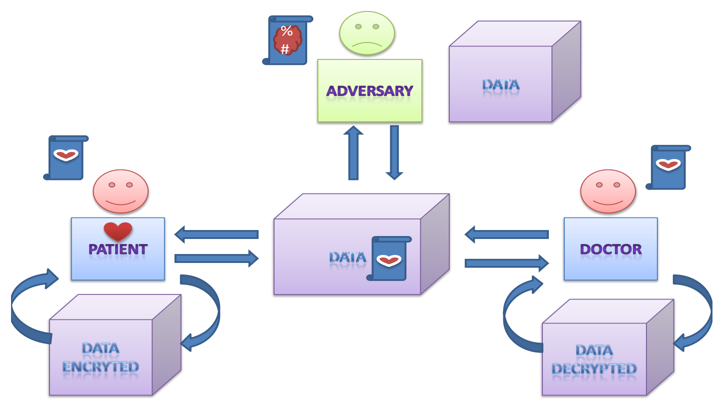

Figure 6: Sending data by cryptography way.

MD = (MD.Setup, MD Key-Gen, MD Encrypt, MD Put-Key & MD Decrypt);

First parameter of algorithm: MD Setup(1µ) > ppmd. µ is security parameter on input, MD Setup outputs patient parameters ppmdfor scheme which is plaintext.

Second parameter of algorithm: MD Key-Gen(ppmd)> (pkmd,skmd). ppmdis patient parameter on input, Key-Gen outputs a public key pkmd and secret key skmd.

Third parameter of algorithm: MD Encrypt (ppmd,pkmd) >c. for input patient parameter ppmd, a public key pkmd. Encryption provides an output which is a cipher text c.

Fourth parameter of algorithm: MD Put-Key & MD Decrypt(ppmd, skmd) >m. For input patient parameters ppmd and a secret key skmd, MD Put-Key & MD Decrypt provides an output a massage m which is readable for decryptor.

4. RESULTS AND DISCUSSIONS

To test and verify the designed telemedicine system including the GPRS network communication platform, electrocardiography (ECG) was chosen as the monitored medical parameter. A system composed of a patient unit, public mobile communication network, a Protocol Interpreter, and a Central Monitoring Station was designed.

4.1TCP/IP client

Internet Protocol (IP) client is responsible for addressing, routing, segmentation, and reassembling of IP-packets. The Transport Control Protocol (TCP) is a reliable connection-oriented protocol that allows a byte stream originating on one machine to be delivered without error on any other machine in the internet. The TCP client is in control for control of the data flow regulator.

4.2Software

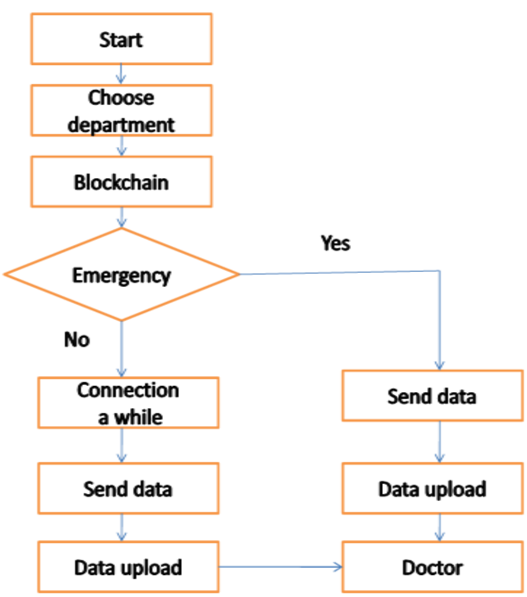

Figure 7: System main program flow chart.

As Figure 7 show below the flow chart of the received patient's data through an application program developed using C# language. The interface design provides most of the general as well as functional first of all user registered in the database, which includes all lists of patients and personal information about patients then displays patients' vital signals and sets edges for each measurable parameter. Abnormal cases if appear it alerts healthcare providers and the assign family member The researchers show why this system is the best and they recommend for both health services providers and patients to use it because It shows past medical records for all patients including diseases, past surgeries, clinical findings, past medication, allergies, and images. Furthermore it sends messages including instructions for patients and drug prescription. Lastly Sensor data will be automatically reloaded at predefined time intervals to keep the view updated.

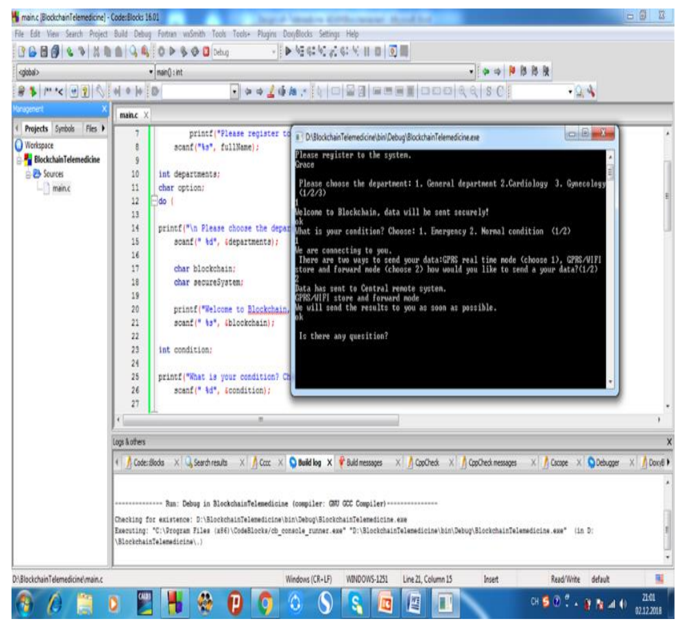

Figure 8: Result of the output.

Code Script

```
#include <stdio.h>

#include <stdlib.h>

int main()

{

    char fullName[60];

        printf("Please register to the system.\n");

    scanf("%s", fullName);

int departments;

char option;

do {

printf("\n Please choose the department: 1. General department 2.Cardiology  3. Gynecology (1/2/3)\n");

    scanf(" %d", &departments);
```

```
    char blockchain;

    char secureSystem;

    printf("Welcome to Blockchain, data will be sent securely!\n");

    scanf(" %s", &blockchain);

int condition;

printf("What is your condition? Choose: 1. Emergency 2. Normal condition  (1/2)\n");

    scanf(" %d", &condition);

    if (condition == 1){

        printf("We are connecting to you.\n");

    }

        if (condition == 2){

        printf("We will connect to you in while.\n");

    }

    int choose;

    char mobilePhone;

    char internet;


    printf(" There are two ways to send your data: GPRS real time mode (choose 1), GPRS/WIFI store and forward mode (choose 2) how would you like to send a your data?(1/2)\n");

    scanf(" %d", &choose);

{

    if (choose <=2){

        printf("Data has sent to Central remote system.\n");


        if (choose == 1){

            printf("GPRS real time mode\n");

        }

        if (choose == 2){

            printf("GPRS/WIFI store and forward mode\n");

    }

    }else{

    printf("Wrong number\n");}

}

{

    char results [2];

     printf("We will send the results to you as soon as possible.\n");

    scanf(" %d", &results);

}

printf(" \n Is there any quesition?\n");

option=getche();

} while ( option == 'y');


    return 0;

}
```

5. CONCLUSION

A low-cost telemedicine system has been designed and the simulation is done on C language Program software and results are shown. Monitoring, alerting, diagnosis and convenient way of communication TCP used for network connection and it was very fast with minimum delay. The blockchain improve the sharing of medical service and records management between patients and the service providers, this system was given the positive impact, transmission data is secure. This paper reaches the writer perspective. The investigation showed that the GPRS-network and the phone terminal are the a because the standard mobile phone can get 9.6 kbps uplink, and also the TCP/IP protocol it could not always fulfill the desired transmission rate. It has been shown that when the GPRS transmission's condition is good (depending on the communication traffic on the network), there has been a capacity surplus in the network, and the transmission was well performed. This condition makes the reliability of the designed system.

REFERENCES

[1] G. Aceto, V. Persico, and A. Pescapé, "The role of Information and Communication Technologies in healthcare: taxonomies, perspectives, and challenges," J. Netw. Comput. Appl., vol. 107, pp. 125–154, Apr. 2018.

[2] H. Alemdar and C. Ersoy, "Wireless sensor networks for healthcare: A survey," Comput. Networks, vol. 54, no. 15, pp. 2688–2710, Oct. 2010.

[3] P. Zhang, D. C. Schmidt, J. White, and G. Lenz, "Blockchain Technology Use Cases in Healthcare," Adv. Comput., vol. 111, pp. 1–41, Jan. 2018.

[4] P. Pandya, "Transmission Control Protocol/Internet Protocol Packet Analysis," Comput. Inf. Secur. Handb., pp. e205–e218, Jan. 2013.

[5] Y. Gu, D. Hou, X. Wu, J. Tao, and Y. Zhang, "Decentralized Transaction Mechanism Based on Smart Contract in Distributed Data Storage," Information, vol. 9, no. 11, p. 286, Nov. 2018.

[6] K. Peterson, R. Deeduvanu, P. Kanjamala, and K. Boles, "A Blockchain-Based Approach to Health Information Exchange Networks."

[7] P. Corbishley and E. Rodriguez-Villegas, "Breathing Detection: Towards a Miniaturized, Wearable, Battery-Operated Monitoring

System," IEEE Trans. Biomed. Eng., vol. 55, no. 1, pp. 196–204, Jan. 2008.
[8] F. Palumbo, J. Ullberg, A. Štimec, F. Furfari, L. Karlsson, and S. Coradeschi, "Sensor Network Infrastructure for a Home Care Monitoring System," Sensors, vol. 14, no. 3, pp. 3833–3860, Feb. 2014.
[9] P. Corbishley and E. Rodriguez-Villegas, "Breathing Detection: Towards a Miniaturized, Wearable, Battery-Operated Monitoring System," IEEE Trans. Biomed. Eng., vol. 55, no. 1, pp. 196–204, Jan. 2008.
[10] F. Xhafa, J. Li, G. Zhao, J. Li, X. Chen, and D. S. Wong, "Designing cloud-based electronic health record system with attribute-based encryption," Multimed. Tools Appl., vol. 74, no. 10, pp. 3441–3458, May 2015.
[11] T. Nugent, D. Upton, and M. Cimpoesu, "Improving data transparency in clinical trials using blockchain smart contracts," F1000Research, vol. 5, p. 2541, Oct. 2016.
[12] J. Yli-Huumo, D. Ko, S. Choi, S. Park, and K. Smolander, "Where Is Current Research on Blockchain Technology?—A Systematic Review," PLoS One, vol. 11, no. 10, p. e0163477, Oct. 2016.
[13] G. Irving and J. Holden, "How blockchain-timestamped protocols could improve the trustworthiness of medical science," F1000Research, vol. 5, p. 222, Mar. 2017.
[14] X. Yue, H. Wang, D. Jin, M. Li, and W. Jiang, "Healthcare Data Gateways: Found Healthcare Intelligence on Blockchain with Novel Privacy Risk Control," J. Med. Syst., vol. 40, no. 10, p. 218, Oct. 2016.
[15] Shan Jian, Jiannong Cao, Hanqing Wu, Yanni Yang, Mingyu Ma, Jianfei He, "BlocHie: a BLOCkchain-based platform for Healthcare Information Exchange" 2018.
[16] M. Niranjanamurthy, B. N. Nithya, and S. Jagannatha, "Analysis of Blockchain technology: pros, cons and SWOT," Cluster Comput., Mar. 2018.
[17] S. Angraal, H. M. Krumholz, and W. L. Schulz, "Blockchain Technology," Circ. Cardiovasc. Qual. Outcomes, vol. 10, no. 9, Sep. 2017.
[18] I. Eyal, "Blockchain Technology: Transforming Libertarian Cryptocurrency Dreams to Finance and Banking Realities," Computer (Long. Beach. Calif)., vol. 50, no. 9, pp. 38–49, 2017.
[19] D. Ichikawa, M. Kashiyama, and T. Ueno, "Tamper-Resistant Mobile Health Using Blockchain Technology.," JMIR mHealth uHealth, vol. 5, no. 7, p. e111, Jul. 2017.
[20] L. Wang and Y. Liu, "Exploring Miner Evolution in Bitcoin Network," in CONFERENCE PROCEEDINGS, 2015, pp. 290–302.
[21] S. Singh and N. Singh, "Blockchain: Future of financial and cyber security," in 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I), 2016, pp. 463–467.
[22] B. Kang et al., "Design of Life-context for User-centric Service in Mobile Environments," 2017, no. 20154030200860, pp. 30–32.
[23] B. Kumar, S. P. Singh, and A. Mohan, "Emerging Mobile Communication Technologies for Health," pp. 828–832, 2010.
[24] L. Vasquez-cevallos, J. Bobokova, E. Bautista-valarezo, and V. Dávalos-batallas, "Telemedicine in Medical Training in Ecuador," 2017.
[25] H. Ji, J. Wang, J. Gao, and X. Liu, "Research on Telemedicine Technology and Implement based on Virtual Reality," pp. 1581–1586, 2013.
[26] V. Thulasi Bai and S. K. Srivatsa, "Design and implementation of mobile telecardiac system," J. Sci. Ind. Ressearch, vol. 67, pp. 1059–1063, 2008.
[27] Y. Xiao, D. Takahashi, J. Liu, H. Deng, and J. Zhang, "Wireless telemedicine and m-health: technologies, applications and research issues," Int. J. Sens. Networks, vol. 10, no. 4, p. 202, 2011.
[28] S. Xing-Hua, Z. Xiao, and G. X. Wei, "Design and Development of Tele-Diagnosis System of Medical Image Based on Mobile Terminal," Int. Conf. Intell. Comput. Technol. Autom., p. 5, 2014.
[29] M. T and S. O, "Designing and Implementation of Mobile Terminal for Telehealth Care Life Support System," p. 7, 2014.
[30] J. Liao and C. Wen, "Telemedicine system design based on bluetooth and mobile phone network," in 2010 International Conference on Apperceiving Computing and Intelligence Analysis, ICACIA 2010 - Proceeding, 2010, pp. 183–186.
[31] S. B. Vadillo, J. D. U. Fernández, M. del M. E. Pérez, and J. M. Q. Reboul, "Design of a Remote Monitoring Platform for Telemedicine Systems Using New Generation Mobile Services," in 2008 International Conference on Complex, Intelligent and Software Intensive Systems, 2008, pp. 643–648.
[32] S. K. Yoo, K. M. Kim, S. M. Jung, K. J. Lee, and N. H. Kim, "Design of multimedia telemedicine system for inter-hospital consultation.," in Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference, 2004, vol. 5, pp. 3109–11.

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