Health Science Future Robodoctor : AI-based Heart Monitoring System for People with Disabilities.

1th Milon Biswas
Bangladesh University of
Business and Technology
Computer Science and Engineering
Dhaka, Bangladesh
milonbiswas4702@gmail.com

***Abstract*—All the surroundings of this world is human oriented. What we design, plan and implement is just for the ease of life of human being. And a remarkable part of these are the disabled persons. Keeping this in mind an artificial intelligent robodoctor has been designed and implemented partially for health monitoring of disabled persons. It is capable of collecting versatile data (like Electro Cardiogram, temperature, humidity, gas and alcohol, Blood pressure etc.) from the patient continuously and take action (like display the heart condition, inform patient condition to remote relatives, internet of things (IoT) based reporting system to remote doctor or for emergency ambulance calling etc.) accordingly. An embedded system is introduced to process all the data and give expected output on the display. The display output can be observed by using camera module from anywhere through the internet.**

***Index Terms*—robodoctor, electro cardiogram, internet of things.**

I. Introduction

The number of people is increasing day by day in Bangladesh and worldwide as well. And this is placing increased demand on healthcare services [9]–[11]. Due to being a rural area, maybe the experienced doctor isn't available at everywhere. Again the increasing number of disabled person [12], [13] is also of great concern. Hence people are thinking about e-healthcare system [14]–[17] that will solve the problem of less number of doctors. In this study a low cost system (we named robodoctor) has been built with a software which have the ability to support the target user as a personal assistant and some medical support. This device will be equipped with ECG sensor (which will measure the heart rate of the user and make primary decision what kind of diseases is affected in users heart), MQ2 sensor (which is detect what kind of gas particle present in that environment), MQ3 sensor (which will detect isn't user alcoholic or not), GPS sensor (provide the user location which will access any one), BP sensor (portable), LM35 (which is capable to detect body temperature and the environment temperature), Personal Assistance (which will directly communicate with patient in both Bangla, English languages and control the home appliance). Hence this device can be very useful for various kind of heath care application. The diagnosis system of this device comprising the followings:

- Firstly, instant diagnosis which is a system for people living in remote district and physical-disable people. In this mode, robot will be controlled remotely through the internet. Through stream, signals will be sent. For example: doctor can remote control the robot to use tools like electronic sensors.
- Secondly, information diagnosis which is used while doctor is busy. The robot will detect the parts using sensors and save it after processing. The robot can give the data to for user's medical record .At the same time, robot will send the medical record to doctor and let doctor analyze the patient's condition.
- And thirdly, the robot can send different environmental parameter like temperature, humidity, gas in air and, it also detect the alcohol level of human body. This robot can give the decision about whether those parameters are in normal condition or not. Robot also can give the decisions if any increment or decrement is needed for the given environment, and user can control their home appliance.

In short, an artificial intelligent robodoctor has been designed and implemented as prototype for health monitoring of disabled persons. It is capable of collecting versatile data (like Electro Cardiogram, temperature, humidity, gas and alcohol, Blood pressure etc.) from the patient continuously and take action (like display the heart condition, inform patient condition to remote relatives, internet of things (IoT) based reporting system to remote doctor or for emergency ambulance calling etc.) accordingly.

II. Related Work

Nowadays technology has enriched each and every sector in many ways.In this recent world everything is automated like E-voting [1], [2], supply chain management [3],robotics [4], vehicle registration [5],national identity card management [6],sentiment analysis [7],applications for own security [8] and so more.On the other hand , a paper [18] shows the full implementation of the importance of artificial intelligence (AI) and autonomous robotic surgery in the field of robotics. This current [19] trend of technology has given one of the most important opportunities for the application of AI-driven

technology by revolutionizing various medical mediums or education.As a result, people's lives are moving from better to better, and people are being freed from various harms along with the massive expansion of infrastructure.This AI technology [20]–[22] is helping a lot to avoid the catastrophe that can happen to human life due to strong population growth.Although there are various robotic devices made for health care, there are many flaws in the various robots for health care. However, the paper reveals that it is possible to take health care one step further by pushing robotics to a higher level of human health care.There have been significant advances in robotics to provide health care for people with certain disabilities, such as autism, as well as care for children, young people and the elderly.Consider the help and improvement of this instructive innovation by highlighting the developing application. Social advanced mechanics characterizes issues of strategy, human-robot relationship, agreeableness and client focused plan, social effect and self-governance and control.

III. SYSTEM MODEL

The system is designed to determine the Electro Cardiogram (ECG), Gas and Alcohol sensor, Temperature and Humidity of environment. The electro cardiogram sensor output can give the primary decision of the subject. An embedded system is introduced to process all the data and give expected output on the display. The display output can be observed by using camera module from anywhere through the internet. Furthermore it can be used as a remote to control the home appliances or as a security system. The total system block diagram is given below (Fig. 1):

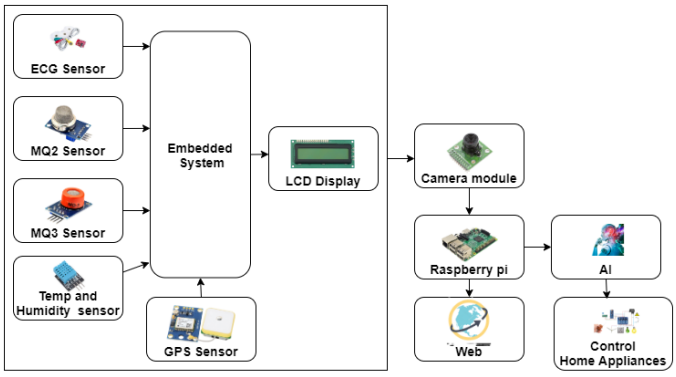


Fig. 1: Block Diagram of the system

IV. SYSTEM APPARATUS

The following apparatus has been used to complete the system implementation in small scale:

ECG Sensor:

ECG sensor (Fig. 2 (a)) is the pathway for recording electrical signal through the heart muscle. This recorded signal provides the heart information and response to physical situation.

Pulse sensor:

Pulse sensor (Fig. 2 (b)) measures the heart rate in beats per minute (BPM) by using an optical light source and an LED light sensor which is noninvasive in nature.

MQ2 Sensor:

This sensor (Fig. 2 (c)) mostly used as smoke or combustible gas detector. The detection range of MQ2 sensor is 300 10000ppm (flammable gas).

MQ3 Sensor:

MQ3 sensor (Fig. 2 (d)) is highly sensitive to alcohol and less sensitive to Benzene. This sensor is more stable, fast response and simple drive circuit.

DHT11:

DHT11 is a temperature detecting sensor (Fig. 2 (e)). Resolution of this sensor is humidity 1%RH Temperature 1degC. Measurement range of this circuit is 20-90RH and temperature 0-50degC.

GPS Sensor:

This circuit in (Fig. 2 (f)) transmits the position of current position and back to the controller. This sensor update the clock using automatic time provided by the GPS.

RASPBERRY PI:

It's a small size computer (Fig. 2 (g)) that plugs into a computer monitor, uses keyboard and mouse. It's a small computer in which everyone explores computing, and learn how to program in different languages like python.

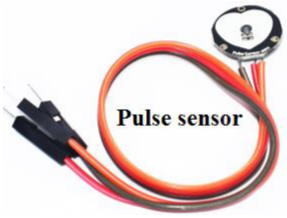
V. OUTPUT SIGNALS AND DATA OBTAINED

A small portion of total flowchart is given in Fig. 9 to visualize how the system (robodoctor) works. This part denotes whether the personnel heart rate is in normal, bradycardia or tachycardia state. For this the ECG signal is collected from electrode first. Then the heart rate will be converted into digital signal by ADC converter and fed to embedded system to make decision. If the rate is greater than 50 BPM and less than 100 BPM, then it is considered a normal heart rate. If the rate is less than 50 BPM the system will display sinus bradycardia and if the rate is in the range of 100 – 220 the system will display sinus tachycardia.

ECG signal is obtained after placing the sensor on the subject personnel, the output result found on our prototype display is as like in Fig. 10. We have also designed a display that will be placed in the robodoctor and show the analysis. Fig. 11 is the screenshot of our designed display. Pulse sensor determine the heart rate of the subject in beats per minute. After successful placing the sensor, the output signal as well as different BPM shown in the display. After analyzing the ECG signal, the robodoctor is giving primary decision about the situation of the heart. This decision is shown on the designed screen (Fig. 12, Fig. 13 and Fig. 14).

Placing the MQ2 sensor at the normal place, the output data is shown in a display (Fig.15). It can show the output data as numerical value. The output data is given below: In the same system, placing the MQ3 sensor the output data also shown in another display (Fig. 16 and Fig. 17). It can show output as same as MQ2 sensor (mg/L).The output data

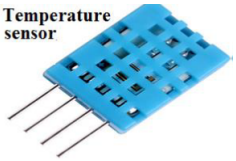
(a) ECG sensor



(b) Pulse sensor

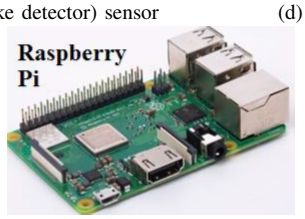
(c) MQ2 (smoke detector) sensor

(d) MQ3 Sensor



(e) DHT11 (temperature) sensor

(f) GPS Sensor



(g) Raspberry Pi

Fig. 2: Usable Apparatus of Proposed System

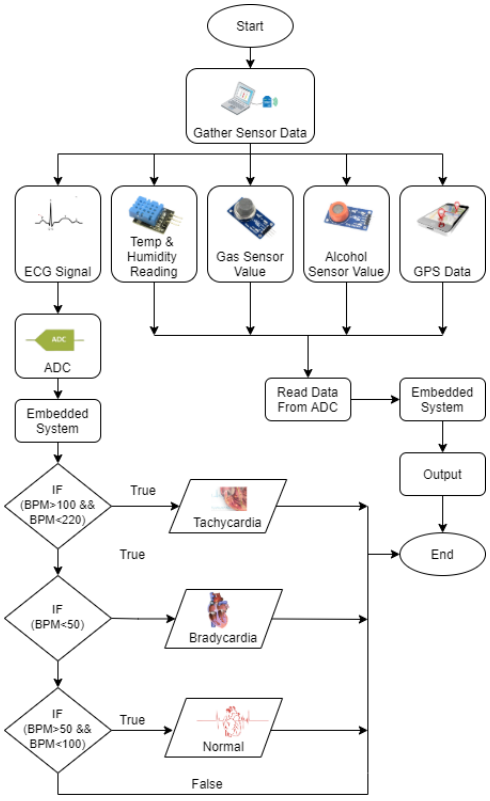


Fig. 3: Flowchart for determining heart state

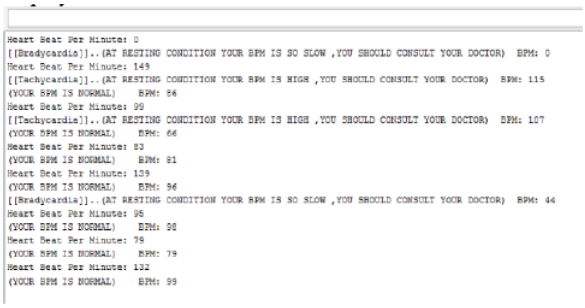


Fig. 5: Output data on screen

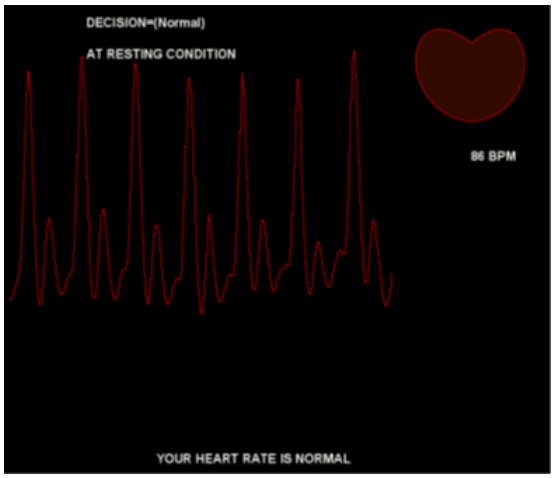


Fig. 6: Output data on screen (Normal)

Fig. 4: Obtained ECG signal

shown in display is given below:

After initialization of this sensor, temperature and humidity was shown in a display (Fig. 18 and Fig. 19).Temperature will be shown in both Centigrade and Fahrenheit scale and humidity will be shown in percentage.

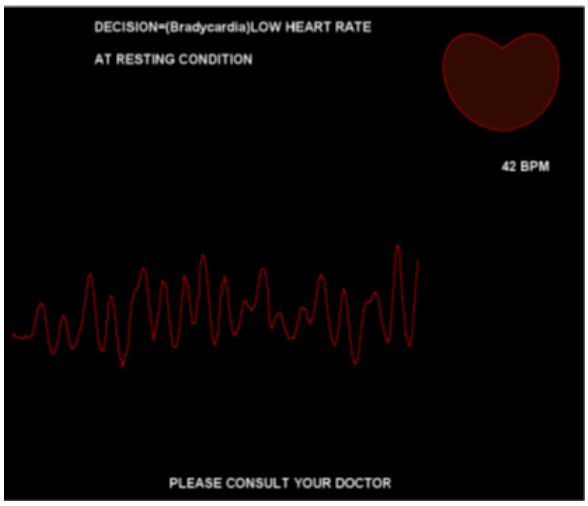


Fig. 7: Output data on screen (Bradycardia)

Fig. 8: Output data on screen (Tachycardia)

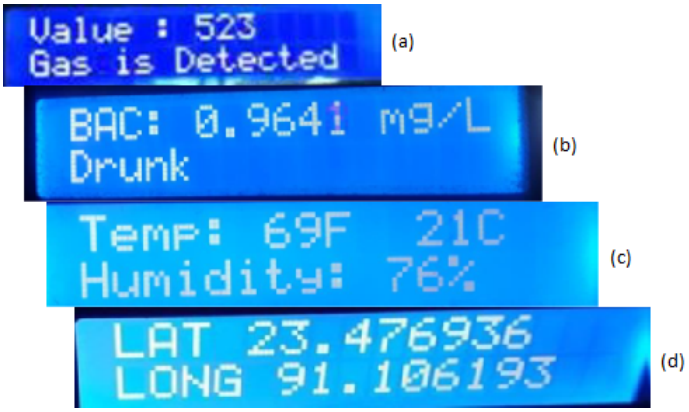


Fig. 9: (a) MQ2 output data on display, (b) MQ3 output data on display, (c) DHT11 output data on display, (d) GPS system output coordinates

After successful enabling GPS sensor, it displayed (Fig. 20) the following coordinate. By this coordinate, user can easily find the location from map.

By using a camera module all output signals and data will be seen from anywhere in the world via the internet. Also as a personal assistant disable user can easily control their home appliance.

VI. CONCLUSION

An artificial intelligent robodoctor has been designed and implemented as prototype for health monitoring of disabled persons. It is capable of collecting versatile data (like Electro Cardiogram, temperature, humidity, gas and alcohol, Blood pressure etc.) from the patient continuously and take action (like display the heart condition, inform patient condition to remote relatives, internet of things (IoT) based reporting system to remote doctor or for emergency ambulance calling etc.) accordingly. An embedded system is introduced to process all the data and give expected output on the display. The display output can be observed by using camera module from anywhere through the internet.

REFERENCES

[1] Biswas M, Mahi M, Nayeen J, Hossen R, Acharjee UK, Md W. BUVOTS: A Blockchain based Unmanipulated Voting Scheme. Rakib and Acharjee, Uzzal Kumar and Md, Whaiduzzaman, BUVOTS: A Blockchain Based Unmanipulated Voting Scheme (November 23, 2020). 2020 Nov 23.

[2] Mukherjee PP, Boshra AA, Ashraf MM, Biswas M. A Hyper-ledger Fabric Framework as a Service for Improved Quality E-voting System. In2020 IEEE Region 10 Symposium (TENSYMP) 2020 Jun 5 (pp. 394-397). IEEE.

[3] Al-Amin S, Sharkar SR, Kaiser MS, Biswas M. Towards a Blockchain-Based Supply Chain Management for E-Agro Business System. InProceedings of International Conference on Trends in Computational and Cognitive Engineering 2021 (pp. 329-339). Springer, Singapore.

[4] Akib AA, Ferdous MF, Biswas M, Khondokar HM. Artificial Intelligence Humanoid BONGO Robot in Bangladesh. In2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT) 2019 May 3 (pp. 1-6). IEEE.

[5] Hossain, M.P., Khaled, M., Saju, S.A., Roy, S., Biswas, M.: Vehicle registra-tion and information management using blockchain based distributed ledger frombangladesh perspective. In: 2020 IEEE Region 10 Symposium (TENSYMP). IEEE

[6] Datta P, Bhowmik A, Shome A, Biswas M. A Secured Smart National Identity Card Management Design using Blockchain. In2020 2nd International Conference on Advanced Information and Communication Technology (ICAICT) 2020 Nov 28 (pp. 291-296). IEEE.

[7] Mahi MJ, Hossain KM, Biswas M, Whaiduzzaman M. SENTRAC: A Novel Real Time Sentiment Analysis Approach Through Twitter Cloud Environment. InAdvances in Electrical and Computer Technologies 2020 (pp. 21-32). Springer, Singapore.

[8] Khatun S, Sarkar S, Biswas M. SecureIT–A weapon to protect you. Available at SSRN 3568797. 2020 Feb 25.

[9] Platis, C., Reklitis, P. and Zimeras, S., 2015. Relation between job satisfaction and job performance in healthcare services. PROCEDIA-Social and behavioral sciences, 175, pp.480-487.

[10] Acharya, B., Maru, D., Schwarz, R., Citrin, D., Tenpa, J., Hirachan, S., Basnet, M., Thapa, P., Swar, S., Halliday, S. and Kohrt, B., 2017. Partnerships in mental healthcare service delivery in low-resource settings: developing an innovative network in rural Nepal. Globalization and health, 13(1), pp.1-7.

[11] Robert, G., Cornwell, J., Locock, L., Purushotham, A., Sturmey, G. and Gager, M., 2015. Patients and staff as codesigners of healthcare services. Bmj, 350.

[12] Maulik, P.K. and Darmstadt, G.L., 2007. Childhood disability in low-and middle-income countries: overview of screening, prevention, services, legislation, and epidemiology. Pediatrics, 120(Supplement 1), pp.S1-S55.

[13] Yeo, R. and Moore, K., 2003. Including disabled people in poverty reduction work:"Nothing about us, without us". World Development, 31(3), pp.571-590.

[14] Saleem, K., Derhab, A., Al-Muhtadi, J. and Shahzad, B., 2015. Human-oriented design of secure Machine-to-Machine communication system for e-Healthcare society. Computers in Human Behavior, 51, pp.977-985.

[15] Guo, C., Zhuang, R., Jie, Y., Ren, Y., Wu, T. and Choo, K.K.R., 2016. Fine-grained database field search using attribute-based encryption for e-healthcare clouds. Journal of medical systems, 40(11), pp.1-8.

[16] Firouzi, F., Rahmani, A.M., Mankodiya, K., Badaroglu, M., Merrett, G.V., Wong, P. and Farahani, B., 2018. Internet-of-Things and big data for smarter healthcare: From device to architecture, applications and analytics.

[17] Zhou, J., Lin, X., Dong, X. and Cao, Z., 2014. PSMPA: Patient self-controllable and multi-level privacy-preserving cooperative authentication in distributedm-healthcare cloud computing system. IEEE Transactions on Parallel and Distributed Systems, 26(6), pp.1693-1703.

[18] O'Sullivan, S., Nevejans, N., Allen, C., Blyth, A., Leonard, S., Pagallo, U., Holzinger, K., Holzinger, A., Sajid, M.I. and Ashrafian, H., 2019. Legal, regulatory, and ethical frameworks for development of standards in artificial intelligence (AI) and autonomous robotic surgery. The International Journal of Medical Robotics and Computer Assisted Surgery, 15(1), p.e1968.

[19] Dhanabalan, T. and Sathish, A., 2018. Transforming Indian industries through artificial intelligence and robotics in industry 4.0. International Journal of Mechanical Engineering and Technology, 9(10), pp.835-845.

[20] Broadbent, E., Stafford, R. and MacDonald, B., 2009. Acceptance of healthcare robots for the older population: review and future directions. International journal of social robotics, 1(4), p.319.

[21] Share, P. and Pender, J., 2018. Preparing for a robot future? Social professions, social robotics and the challenges ahead. Irish Journal of Applied Social Studies, 18(1), p.4.

[22] Khan, Z.H., Siddique, A. and Lee, C.W., 2020. Robotics utilization for healthcare digitization in global COVID-19 management. International journal of environmental research and public health, 17(11), p.3819.