Divination of Abdominal Aortic Aneurysm by Deploying Ultrasonic Transducer Sensor

A. K. Nivetha,[1] [1]Asst. Professor,
Department of Biomedical Engineering,
Dhanalakshmi Srinivasan Engineering College,
Perambalur.

Raja Rajeswari M, [2] Sindhumathi C,
[3] Vaishnavi J, [4] Vishnu Priya S [5]
[2] - [5]UG Scholars,
Department of Biomedical Engineering,
Dhanalakshmi Srinivasan Engineering College,
Perambalur.

***Abstract* - Abdominal Aortic Aneurysm(AAA) is a dilatation of aorta at the abdominal level, carrying a substantial risk of expansion, tearing or dissection within the aortic wall which is the life threatening complication. The most common location for an aortic aneurysm is the infrarenal segment where a diameter that exceeds 3cm.The factors associated with the development of AAA are aged people, coronary heart disease, high cholesterol level, hypertension, smoking etc., Often an AAA is diagnosed by using CT, MRI, PET etc., To get rid of the radiation exposure, AAA can be detected using ultrasonic transducer sensor. Currently, theaortic diameter is the only feature that is used to predict the risk of rupture.**

Keywords: Abdominal Aortic Aneurysm (AAA),infrarenal segment, radiation exposure, ultrasonic transducer sensor

I.INTRODUCTION

The aorta is the largest artery in the body, carrying oxygenated blood from the heart and eventually to all parts of the body through systemic circulation. The abdominal portion of the aorta may become dilated, weakened, and place stress on the aortic wall. AAA is a disease that is often asymptomatic and has up to90% risk of mortality if the aneurysm ruptures. It originates just after the aortic valve connected to left side of the heart and extends through the entire chest and abdomen. The portion of the aorta that lies deep inside the abdomen, right in front of the spine is called the abdominal aorta. Overtime, artery walls may becomeweak and widen. The pressure of blood pumping through the aorta may then cause this weakarea to bulge outward, like a balloon (called an aneurysm). AAA is localized displacement of the abdominal aorta that is 50% larger than the proximal normal 2segment at healthy subject. The enlargement is induced by progressively decrease in the elasticity of the wall of abdominal aorta due to acute inflammation. The degradation of aorta tissue does not include complete aorta, but only intermediate layer which become weaker and susceptible by stress produced by aortic wall. The aneurysm is usually in the form of the bulge produced by the blood pumped under heart pressure. An aneurysm on the wall may contain deposits of cholesterol, calcium, or small blood clots.

II. RELATED VIEW

An aortic aneurysm develops when the wall of your aorta weakens and bulges outward. This can be life- threatening, especially if the aneurysm bursts. The two types of aortic aneurysm are Thoracic Aortic Aneurysm (TAA) and Abdominal Aortic Aneurysm (AAA)

TYPES

Thoracic Aortic Aneurysm

TAA, which happens in the part of aorta in your chest. This can include the ascending aorta (the short stem of the cane), the aortic arch (the cane handle), the descending aorta (longer stem of the cane).

Symptoms: Jaw pain, Back pain, Shortness of breathe

Abdominal Aortic Aneurysm

AAA, which happens in the part of aorta in your abdomen.

Symptoms: Severe pain in abdomen

III.PROPOSED SYSTEM

Ultrasonic transducer sensor detects the diameter of the abdominal aorta to diagnose the range of aneurysm. It consists of transmitters, receivers and transceivers. By measuring the time and distance between sending a signal to the abdomen and receiving an echo from the abdomen can be calculated. The output will be digitally displayed in Liquid Crystal Display (LCD). The diagnosed report of AAA can be transmitted from one place to another place by using wireless transmission such as General Packet Radio Services (GPRS)/ Global System for Mobile communications.

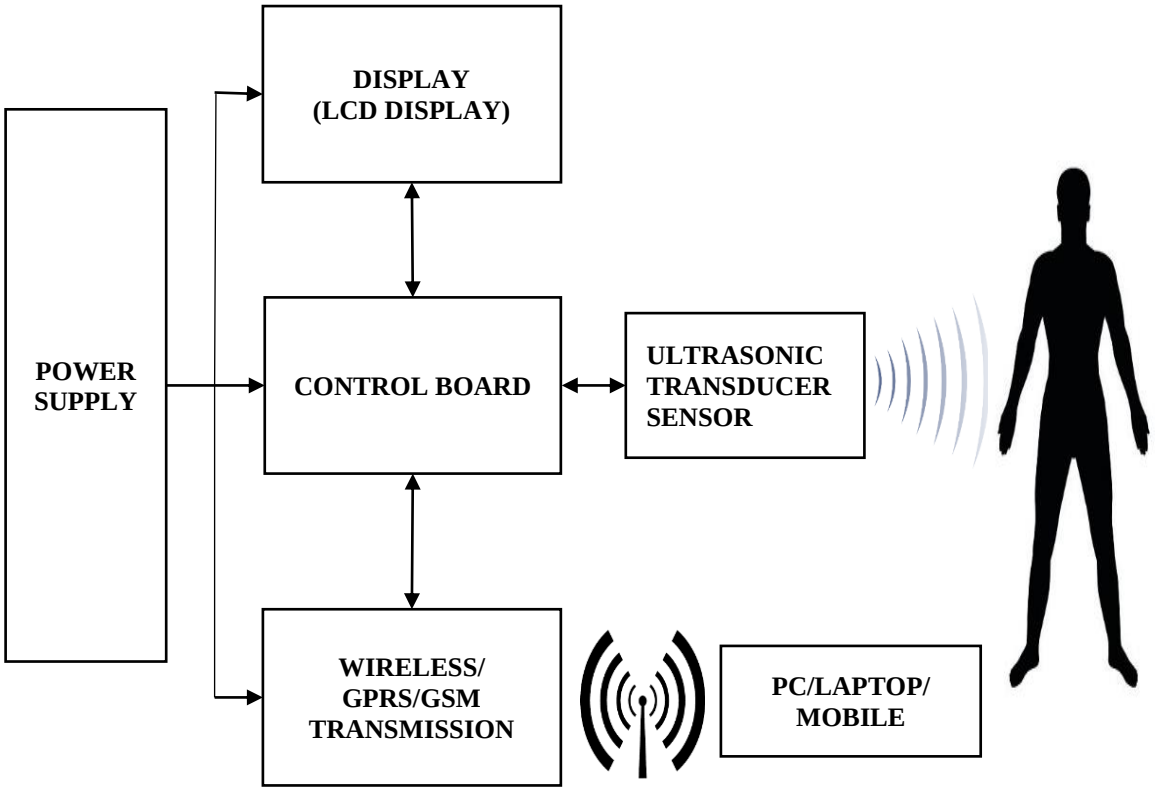

Fig. 1 Block Diagram

DESCRIPTION

We coded the program in the kit to find the distance between the transducer and the abdomen. In this transducer, Piezoelectric crystals are used for this conversion process.The power supply produces (0-5-12V) by using step-down transformer in the kit as shown in Fig.1.Arduino is the advanced version of embedded system. Display unit is connected to the Arduino kit used to display the diameter of abdominalaorta. The diagnosed report which is transmitted from one place to another can be viewed by either laptop or mobile.

IV.HARDWARE DESCRIPTION

POWERSUPPLY UNIT

Power supply is the important part in an electronic circuit. A step-down transformer is used in this unit, which converts high voltage, low current power (primary side) into low voltage,high current power (secondary side).It is a multiple output transformer.It converts AC power into DC power by using rectifier.A rectifier diode (1N4007) is used as one-way check valve. This diode allows an electrical current to flow in only one direction, they are used to convert AC power into DC power. This diode is electrically compatible.

CONTROL BOARD

The PIC microcontroller PIC16f877a is one of the most renowned microcontroller. The main use of this controller is to burn the program easily for the measurement of abdominal aortic diameter. The time interval and distance values were already fixed in the controller to operate in an established manner. The coded program can be write-erase as many as possible based on our convenient. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies. The programmed PIC microcontroller is interfaced with the arduino board to control all the blocks as shown in Fig .1

ULTRASONIC SENSOR

HCSR04 arduino ultrasonic transducer sensor plays a vital role in this circuit. It is able to measure distances from 2cm to 400cm with an accuracy of about 3mm.It works on a principle similar to radar or sonar which evaluate the attributes of a target by interpreting the echoes from radio or sound waves respectively. It is a device that converts energy into ultrasound or sound waves above the normal range of human hearing. It generates sound waves in the ultrasonic range, of 40 kHz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed in Liquid Crystal Display (LCD).

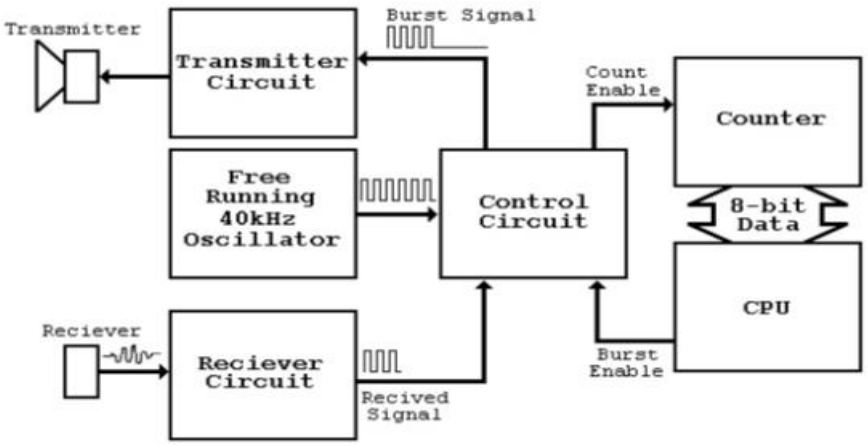

Fig. 2 Block Diagram of Ultrasonic Sensor

HC-SR04 module has 4 pins:

VCC – 5V, +ive of the power supply

TRIG – Trigger Pin

ECHO – Echo Pin

GND – -ive of the power supply

Ultrasonic sensor generate high frequency sound waves by the transmitter to the abdomen and evaluate the echo which is received back by the sensor from the aorta. Sensors calculate the time interval and distance between sending the signal and receiving the echo from an aortic wall. At the same time, it measures the diameter of an aorta.

LCD DISPLAY

Liquid Crystal Display (LCD) is an Alphabetic Display it means that it can display Alphabets, Numbers as well as special symbols thus LCD is a user friendly Display device which can be used for displaying various messages unlike seven segment display which can display only numbers and some of the alphabets. The time and distance calculated from the sensor and to the abdomen were displayed. The only disadvantage of LCD over seven segment display is that seven segment is robust display and can be visualized from a longer distance as compared to LCD. Here we have used 16 x 2 alphanumeric displays.

WIRELESS GPRS/GSM TRANSMISSION

The diameter of aorta which is displayed in Liquid Crystal Display (LCD) can be transmitted from one place to another with the help of wireless transmission such as GPRS/GSM. General Packet Radio Service (GPRS) is a wireless service channels can be used for the purpose of data transmission, but they only provide a maximum transmission speed of around 9.6 Kbps. Global System for Mobile communications (GSM) have several extra upgrades to cope with GPRS traffic. The transmitted diagnosed result of patient can be viewed by either personal computer, laptop or mobile.

V.RESULT & DISCUSSION

The diameter of abdominal aorta is measured and the report is analyzed on its own, whether the range of abdominal aortic diameter is normal/ abnormal. It can be transferred from one clinician to other medical practitioner by using wireless transmission service.

VI.CONCLUSION

This project is intended to detect the aneurysm that occurs in abdominal aorta, without any radiationexposure. It is the simplest method and it can be handle without any medical practitioner.

VII.REFERENCES

[1] Fleming C, Whitlock EP, Beil TL, Lederle F. Screening for abdominal aortic aneurysm. A best-evidence systematic review for the US Preventive Services Task Force. Ann Intern Med. 2005; 142: 203±211. PMID: 15684209

[2] Lim LS, Haq N, Mahmood S, Hoeksema L; ACPM Prevention Practice Committee. Atherosclerotic cardiovascular disease screening in adults. American College of Preventive Medicine position statement on preventive practice. Am J Prev Med. 2011; 40: 381.e1±10.

[3] Forsdahl SH, Singh K, Solberg S, Jacobsen BK. Risk factors for abdominal aortic aneurysms: a 7-year prospective study: the Tromsø Study, 1994±2001. Circulation. 2009; 119: 2202±2208. https://doi.org/10.1161/CIRCULATIONAHA.108.817619 PMID: 19364978

[4] Wanhainen A, Bergqvist D, Boman K, Nilsson TK, Rutegård J, BjoÈrck M. Risk factors associated with abdominal aortic aneurysm: a population-based study with historical and current data. J Vasc Surg. 2005; 41: 390±396. https://doi.org/10.1016/j.jvs.2005.01.002 PMID: 15838468

[5] Sakalihasan N, Defraigne JO, Kerstenne MA, Cheramy-Bien JP, Smelser DT, Tromp G, et al. Family members of patients with abdominal aortic aneurysms are at increased risk for aneurysms: analysis of 618 probands and their families from the Liège AAA Family Study. Ann Vasc Surg. 2014; 28: 787±797. https://doi.org/10.1016/j.avsg.2013.11.005 PMID: 24365082

[6] Akai A, Watanabe Y, Hoshina K, Obitsu Y, Deguchi J, Sato O, et al. Family history of aortic aneurysm is an independent risk factor for more rapid growth of small abdominal aortic aneurysms in Japan. J Vasc Surg. 2015; 61: 287±290. https://doi.org/10.1016/j.jvs.2014.07.007 PMID: 25175636

[7] Scott RA, Wilson NM, Ashton HA, Kay DN. Influence of screening on the incidence of ruptured abdominal aortic aneurysm: 5-year results of a randomized controlled study. Br J Surg. 1995; 82: 1066±1070. PMID: 7648155

[8] Lindholt JS, Sørensen J, Søgaard R, Henneberg EW. Long-term benefit and cost-effectiveness analysis of screening for abdominal aortic aneurysms from a randomized controlled trial. Br J Surg. 2010; 97: 826±834. https://doi.org/10.1002/bjs.7001 PMID: 20473995

[9] Norman PE, Jamrozik K, Lawrence-Brown MM, Le MT, Spencer CA, Tuohy RJ, et al. Population based randomised controlled trial on impact of screening on mortality from abdominal aortic aneurysm. BMJ. 2004; 329: 1259. https://doi.org/10.1136/bmj.38272.478438.55 PMID: 15545293

[10] Guirguis-Blake JM, Beil TL, Senger CA, Whitlock EP. Ultrasonography screening for abdominal aortic aneurysms: a systematic evidence review for the U.S. Preventive Services Task Force. Ann Int Med. 2014; 160: 321±329. https://doi.org/10.7326/M13-1844 PMID: 24473919

[11] Olchanski N, Winn A, Cohen JT, Neumann PJ. Abdominal aortic aneurysm screening: how many life years lost from underuse of the medicare screening benefit? J Gen Intern Med. 2014; 29: 1155±1161. https://doi.org/10.1007/s11606-014-2831-z PMID: 24715406

[12] Reichmann WM, Walensky RP, Case A, Novais A, Arbelaez C, Katz JN, et al. Estimation of the Prevalence of Undiagnosed and Diagnosed HIV in an Urban Emergency Department. Plos One. 2011; 6: e27701. https://doi.org/10.1371/journal.pone.0027701 PMID: 22110730

[13] R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 2016.

[14] Jamrozik K, Spencer CA, Lawrence-Brown MM, Norman PE. Does the Mediterranean paradox extend to abdominal aortic aneurysm? Int J Epidemiol. 2001; 30: 1071±1075. PMID: 11689524

[15] Ashton HA, Buxton MJ, Day NE, Kim LG, Marteau TM, Scott RA, et al. Multicentre Aneurysm Screening Study Group (MASS). Lancet. 2002; 360: 1531±1539.

[16] Thompson SG, Ashton HA, Gao L, Buxton MJ, Scott RA; Multicentre Aneurysm Screening Study (MASS) Group. Final follow-up of the Multicentre Aneurysm Screening Study (MASS) randomized trial of abdominal aortic aneurysm screening. Br J Surg. 2012; 99: 1649±1656. https://doi.org/10.1002/bjs. 8897 PMID: 23034729

[17] Lindholt JS, Juul S, Fasting H, Henneberg EW. Screening for abdominal aortic aneurysms: single centre randomised controlled trial. BMJ. 2005; 330: 750±755. https://doi.org/10.1136/bmj.38369.620162.82 PMID: 15757960

[18] Palombo D, Lucertini G, Pane B, Mazzei R, Spinella G, Brasesco PC. District-based abdominal aortic aneurysm screening in population aged 65 years and older. J Cardiovasc Surg (Torino). 2010; 51: 777±782.

[19] Pleumeekers HJ, Hoes AW, van der Does E, van Urk H, Hofman A, de Jong PT, et al. Aneurysms of the abdominal aorta in older adults. The Rotterdam Study. Am J Epidemiol. 1995; 142: 1291±1299. PMID: 7503049

[20] United Kingdom EVAR Trial Investigators, Greenhalgh RM, Brown LC, Powell JT, Thompson SG, Epstein D, Sculpher MJ. Endovascular versus open repair of abdominal aortic aneurysm. N Engl J Med. 2010; 362: 1863±1871. https://doi.org/10.1056/NEJMoa0909305 PMID: 20382983

[21] Ehlers L, Overvad K, Sorensen J, Christensen S, Bech M, Kjolby M. Analysis of cost effectiveness of screening Danish men aged 65 for abdominal aortic aneurysm. BMJ. 2009; 338: b2243. https://doi.org/10.1136/bmj.b2243 PMID: 19553267

[22] Sidloff D, Stather P, Dattani N, Bown M, Thompson J, Sayers R, et al. Aneurysm global epidemiology study: public health measures can further reduce abdominal aortic aneurysm mortality, Circulation. 2014; 129: 747±753. https://doi.org/10.1161/CIRCULATIONAHA.113.005457 PMID: 24249717

[23] Eaton J, Reed D, Angstman KB, Thomas K, North F, Stroebel R, et al. Effect of visit length and a clinical decision support tool on abdominal aortic aneurysm screening rates in a primary care practice. J Eval Clin Pract. 2012; 18: 593±598. https://doi.org/10.1111/j.1365-2753.2010.01625.x PMID: 21210902