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A Model of an Automatic Blood Pressure Monitoring and Triggering System for Hospital

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Abstract: Blood pressure (BP) monitoring is not yet practically available for daily use. Challenges include making the system easily wearable, reducing noise level and improving accuracy. Variations in each person's physical characteristics, as well as the possibility of different postures, increase the complexity of continuous BP monitoring, especially outside the hospital. This work attempts to provide an easily wearable solution and proposes training to specific posture and individual for further improving accuracy. The wrist watch based system we developed can measure electrocardiogram (ECG). From these two signals we measure pulse transit time (PTT) through which we can obtain systolic and diastolic blood pressure through regression techniques. We proposed Automatic Blood Pressure Monitoring and Triggering System for Hospital, which is focused on the development of a convenient device for continuous blood pressure (BP) monitoring with wireless communication interface. The reliability of long-term automatically monitoring is the main focus for current paper. 18 healthy subjects were tested with the continuous BP monitor against a brand of community-based BP monitor. Accuracy assessment of the monitor has been accomplished.

Keywords: Blood Pressure, Electrocardiogram, Photoplethysmogram, Pulse transit time.

I. INTRODUCTION

The most few decades have witnessed an unfaltering increase in life time of people in many parts of the earth leading to a steep rise in the number of senior citizens. A recent report from United Nations foretold that there will be 2 billion (22% of the world population) older people by 2050. Also, research indicates that about 89% of the senior citizens will possibly live freely. In any case, medical research studies understood that about 80% of the aged people older than 65 suffers from at least one chronic disease causing many aged people to have difficulty in taking care of themselves. Accordingly, providing a decent quality of life for aged people has become a serious social challenge at that moment. The rapid proliferation of information and communication technologies is enabling innovative healthcare solutions and tools that show promise in addressing the aforesaid challenges. Presently, Internet of Things (IoT) has become one of the most dominating communication ideas of the 21th century[4]. In the IoT environment, all things in our day to day life become part of the internet due to their communication and processing abilities (including micro controllers, transceivers for digital communication). IoT spreads the concept of the Internet and makes it more unavoidable. IoT allows seamless communication among different types of devices such as medical sensor, monitoring cameras, home appliances so on[5]. Due to this reason IoT has become more beneficial in several fields such as healthcare system. In healthcare system, IoT includes many kinds of low cost sensors (wearable, implanted, and environment) that enable the elderly to enjoy modern medical healthcare services at any place, any time. Further, it also greatly improves aged peoples quality of life. It is fundamentally a set of low-power and mobile wireless sensor nodes that are used to observe the human body's functioning and surrounding climate. We give an overview of a project, which is focused on the development of a convenient device for continuous blood pressure (BP) monitoring with wireless communication interface. The reliability of long-term automatically monitoring is the main focus for current paper. 18healthy subjects were tested with the continuous BP monitor against a brand of community-based BP monitor.

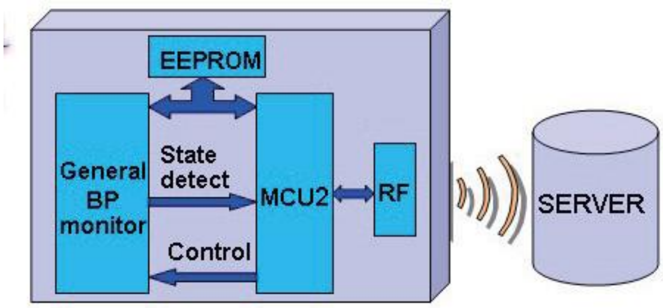

Fig. 1 Block Diagram of the continuous BP monitor [1]

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II. LITERATURE SURVEY

COMPARATIVE ANALYSIS
Comparative study of techniques of blood pressure monitoring system

1. Continuous Blood Pressure Monitor with Wireless Interface.[1]
This technique is focused on the development of a convenient device for continuous blood pressure (BP) monitoring with wireless communication interface. The reliability of long-term automatically monitoring is the main focus for current paper. 18 healthy subjects were tested with the continuous BP monitor against a brand of community-based BP monitor. Accuracy assessment of the monitor has been accomplished. As a result of current study, it can be used to self-monitoring in home.

Technology Uses and Technique: Wireless Communication Interface
Limitation: Realization of communication between continuous blood pressure monitor and compute engines.

2. BioWatch: A Non-invasive Wrist-based Blood Pressure Monitor that Incorporates Training Techniques for Posture and Subject Variability[3]
Noninvasive continuous blood pressure (BP) monitoring is not yet practically available for daily use. Challenges include making the system easily wearable, reducing noise level and improving accuracy. Variations in each person's physical characteristics, as well as the possibility of different postures, increases the complexity of continuous BP monitoring, especially outside the hospital. This work attempts to provide an easily wearable solution and proposes training to specific posture and individual for further improving accuracy. The wrist watch based system we developed can measure electrocardiogram (ECG) and photoplethysmogram (PPG). From these two signals we measure pulse transit time (PTT) through which we can obtain systolic and diastolic blood pressure through regression techniques. In this work, we investigate various functions to perform the training to obtain blood pressure. We validate measurements on different postures and subjects, and show the value of training the device to each posture and each subject. We observed that the average RMSE between the measured actual systolic BP and calculated systolic BP is between 7.83mmHg to 9.37mmHg across 11 subjects. The corresponding range of error for diastolic BP is 5.77 to 6.90mmHg. The system can also automatically detect the arm position of the user using an accelerometer with an average accuracy of 98%, to make sure that the sensor is kept at the proper height. This system, called BioWatch, can potentially be a unified solution for heart rate, SPO2 and continuous BP monitoring.

Technology Uses and Technique : Pulse Transit Time to measure Systolic and Diastolic BP
Limitation : Limited for specific arm movement

3. Reliability of home blood pressure monitoring devices in pregnancy[2]
Home blood pressure monitors are freely available and used for women during pregnancy. The exact role of home blood pressure monitoring in pregnancy remains uncertain, and few such monitors have been validated for use in pregnancy. As it has been our Unit's policy to test these devices against sphygmomanometer (as the gold standard) before clinical use for some years now, we undertook this study to ascertain the degree of accuracy or inaccuracy of these devices in usual clinical practice. We analyzed 9 consecutive blood pressures (BP) alternately using an automated home BP device and sphygmomanometer in 127 pregnant women with hypertension using two different methods: a) a modified version of the British Hypertension Society's guidelines for analyzing automated devices, and b) examining the difference between the mean of blood pressure readings by the device and sphygmomanometer for each patient. 87 devices (69%) had systolic BP within 5 mmHg or less and 98 (77%) were within 5 mmHg for diastolic BP. The frequency of systolic BPs within 5 mmHg was similar for non-validated vs. validated devices

(75 vs. 60%; p = 0.23). Similarly, diastolic BP within 5 mmHg was similar for non-validated vs. validated devices (86 vs. 68%, p = 0.06). Our findings showed that a wide variety of devices are used and few if any have been formally validated for use in pregnancy. As a group the devices provide accurate BP in the majority of women, but up to a quarter will have a BP difference of at least 5 mmHg, and this is not related to the absolute BP. Furthermore using a home BP device validated for general use in non-pregnant subjects appeared as reliable as using other non-validated devices. On the basis of these data we recommended clinicians always perform their own analysis of a patient's home BP machine accuracy prior to home use using a simple protocol as described here, even if the machine has been validated for general use.

Technology Uses and Technique : Sphygmomanometer
Limitation : Same assessment for all the age group

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III. EXISTING SYSTEM

Noninvasive continuous blood pressure (BP) monitoring is not yet practically available for daily use. Challenges include making the system easily wearable, reducing noise level and improving accuracy. Variations in each person's physical characteristics, as well as the possibility of different postures, increase the complexity of continuous BP monitoring, especially outside the hospital. With the increased interest in personal health monitoring products and development of new wearable sensors, a continuous non-invasive wearable BP device would be a great asset for a health enthusiast or someone who is diagnosed with heart related ailments. Even though different studies have proposed noninvasive solutions like measuring BP from the pulse transit time (PTT) or from the radial artery, an easily wearable product for this purpose is still not available in the market.

IV. PROPOSED SYSTEM

This paper attempts to provide an easily wearable solution and proposes training to specific posture and individual for further improving accuracy. The wrist watch based system we developed can measure electrocardiogram (ECG). From these two signals we measure pulse transit time (PTT) through which we can obtain systolic and diastolic blood pressure through regression techniques. We proposed Automatic Blood Pressure Monitoring and Triggering System for Hospital, which is focused on the development of a convenient device for continuous blood pressure (BP) monitoring with wireless communication interface. The reliability of long-term automatically monitoring is the main focus for current paper. 18 healthy subjects were tested with the continuous BP monitor against a brand of community-based BP monitor. Accuracy assessment of the monitor has been accomplished.

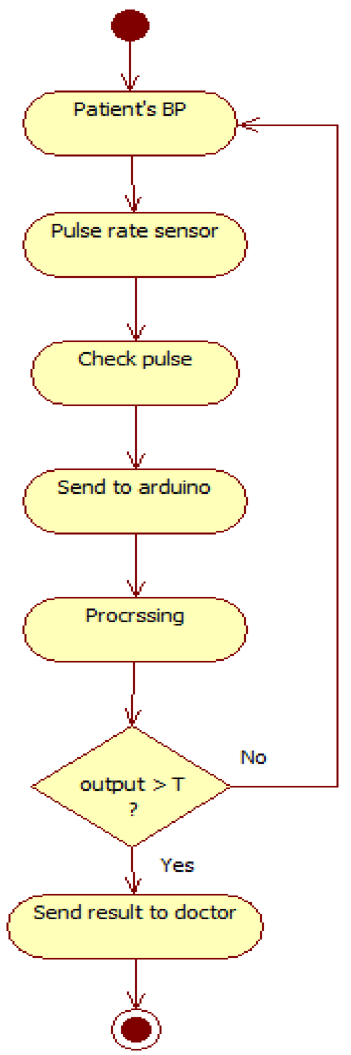

Fig. Flow diagram of blood pressure monitoring

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Above diagram depicts the flow of proposed system. It shows its working .Through flow diagram , it is shown that how blood pressure is calculated and how it is processed.

Mathematical Model :

S = {s, e, X, P,Y, Fme, DD, NDD, Mem_Shared, F, Su}

Where,

- s : Initial State.
- e : Final State.
- X : Input Given.
- Y : Output Obtained.
- P:processing component.
- Fme: Algorithm/Function-prediction algorithm.
- DD : Deterministic data- dataset of the patients.
- NDD : Non Deterministic data.
- Mem_shared : Memory Shared by the Processor.
- Su: Success State.
- F: Final State.

X ={X1, X2, X3… Xn}

Where, Xn = Different data from different source.

Y = {Y1, Y2, Y3…Yn}

Where,Yn=Different data items in different categories.

F=Complete report of current patient.

P=P is processing element.

Su=Success State.

- Input:

X1= Starting condition and Check the blood pressure.

X2= If blood pressure goes low or high then trigger will start beeping.

X3= Maintain daily diagnostic report.

- Output:

Y1=Blood pressure detection.

Y2=Processed information about patient from database.

Y3=Remote Monitoring of patient

- Success Condition:

1.Successful Blood pressure monitoring.

2.Successful data image processing and human detection.

3.Successful generation of surveillance report.

- Failure Condition:

1. Failure in Trigger .
2. Network Related Issues.
3. Failure of Wrist Band .
4. Error in Report Generation.

Algorithm:

Algorithm: Blood Pressure Monitoring with the trigger.

Input: BP measure by band.

Output: Detected the Systolic or Diastolic blood pressure.

1. The general BP monitor consist of several component continuously monitor the blood pressure.
2. The monitored blood pressure need to store in memory, for this EEPROM is used which will store the data for some time before transmitting to the server’
3. The MCU2 is motion control unit which is used to detect the state of measurement and control the other parts.
4. The RF is the radio frequency which is used for communicating with the server. (This module can be replaced by Bluetooth or any other communicating module).
5. The server are where the actual data is stored and from which it is visible to the doctor or any person who is supervising it.

Classification of blood pressure for adults (18 years and older)

	Systolic (mm Hg)	Diastolic (mm Hg)
Hypotension	< 90	< 60
Desired	90–119	60–79
Prehypertension	120–139	80–89
Stage 1 Hypertension	140–159	90–99
Stage 2 Hypertension	160–179	100–109
Hypertensive Crisis	≥ 180	≥ 110

V. CONLUSION AND FUTURE SCOPE

In this paper, we intended to reduce the response time for a medical emergency. It constantly senses the heart pulse rate. A prototype of the continuous BP monitor is presented here. In an experiment assessing the accuracy of the continuous BP monitor and after measuring the BP a report is generated. During the BP measurement, if BP goes low or high, suddenly our device will trigger a beep sound. Trigger beep will show that the BP has changed. The main objective of the project was to notify the doctor as soon as possible so that proper action can be taken in order to treat the patient. The use of internet means that the condition of the patient can be monitored through a web page or an Android app. Hence we can say that this project helps in significantly reducing the time needed to detect an emergency and act quickly. It is also affordable than most other systems due to its low cost architecture.

This project is useful for health care system which provides health monitoring of a patient at home or anywhere else. Also provide constant and consistent monitoring of the health of a patient. In this project we are monitoring the blood pressure and generate report of blood pressure using wrist band.

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