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Cuffless Blood Pressure Monitoring System Including GSM

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ABSTRACT:
A lot have been invented in the field of bio-medical in order to reach the goal of finding the most efficient blood pressure monitoring instrument, but still the goal has been not achieved yet. The current paper includes the survey of some of that inventions and how that methods were inefficient in fulfilling the goal which our method does, just by the analysis of the lacking features in the previously done works and at the same time fulfilling those.

Keywords: Blood pressure, Photoplethysmograph, Arduino, GSM

I. INTRODUCTION

The paper mainly discusses the way to eliminate the increasing problems leading due to abnormal blood pressure which leads to serious issues like heart attacks, loss of kidney function, seizures in pregnant women, damage to eyes, sexual dysfunction, bone loss, problems in brain, etc. [1] It's a fact that whenever any advancement is done in any field, it is very necessary that the already done work should be surveyed and various conclusions must be derived from them. Conclusions includes the features which are useful should again be added in the future work while the features which are missing should be fixed at their correct place, which we have done and summarized in our work. We have sequentially mentioned some patents we read before initializing our work and also mentioned the key features we are going to carry in our work while even those which we are going to replace to reach our destination to serve the mankind.

II. A BRIEF COMPARISON WITH PREVIOUS BP MONITORING SYSTEMS

A. A Wearable Blood Pressure Monitor Using Adaptive Calibration Of Peripheral Pulse Transit Time Measurement

This is a Non Invasive Blood Pressure (NIBP) measurement method which estimates BP using calibrated pulse wave velocity measurements. This passive method not only eliminates the need for an actuated cuff during measurement but also has the capability of providing continuous beat to beat estimates. But difficulties associated with using pulse wave velocity to estimate BP can be divided into two categories (1) Inaccurate measurement of PWV using non-invasive sensors and (2) Employing static calibration equations to map the PWV measurements to BP [2]. Both this limitations are eliminated by the use of Arduino Uno, a microcontroller board based on ATmega368. In this, the calculations are pre-programmed which provides quick and accurate readings unlike the method based on Pulse Transit Time. In addition to it, the device is even made cost efficient by the use of a single in-line photoplethysmograph sensor which is two in number in the case of PPT based method.

B. Noninvasive Continuous Blood Pressure Meter

This invention relates to an instrument for the non-invasive continuous measurement of arterial blood pressure in which the actual blood pressure waveform is reproduced. This is achieved by means of an inflatable flexible finger cuff which incorporates a photoelectric infrared transmitter and receiver, electronic circuitry connected to the transmitter and receiver and controlling an electro-pneumatic transducer which, in turn, is connected to the inflatable cuff by a flexible tube to which is also attached an electronic pressure transducer. Such a cuff is virtually a miniaturized version of the conventional sphygmomanometer cuff, but incorporating an infrared light source and sensor [3]. Though this method has removed the discomfort to a great extent which is found in the conventional method still hasn't eliminated the use of inflatable cuff which completely disappears in our invention in which the BP of the patient can be known just by wearing the gadget and having a look on the LCD display.

C. Cuffless Continuous Blood Pressure Monitor

A device for noninvasive, continuous monitoring of arterial blood pressure for advanced cardiovascular diagnoses. Most of the current noninvasive, continuous blood pressure measurement devices are mechanically intrusive and, therefore, cannot be used for long-term ambulatory monitoring. This new approach requires only simple, noninvasive monitoring devices such as finger photoplethysmographs and an electrical impedance photoplethysmograph (EIP) to monitor the dynamic behavior of the arterial blood flow. In this approach, measured signals from these noninvasive sensors on an arterial segment are integrated to estimate the blood pressure in the segment based on a hemodynamic model. A mathematical model of the arterial blood flow is derived and transformed into a state-space representation [4]. This method doesn't possess any major limitation accept the use of more than one photoplethysmograph sensor so we thought of carrying forward its advantages in our own style by making changes in the components used in the above method a little bit while keeping the core idea unchanged and at the same time giving it a key feature by the inclusion of GSM technology through which the doctor will be well updated about the health of his patients and can suggest immediate prescriptions if required eliminating the conditions of emergencies in the future.

III. BLOCK DIAGRAM

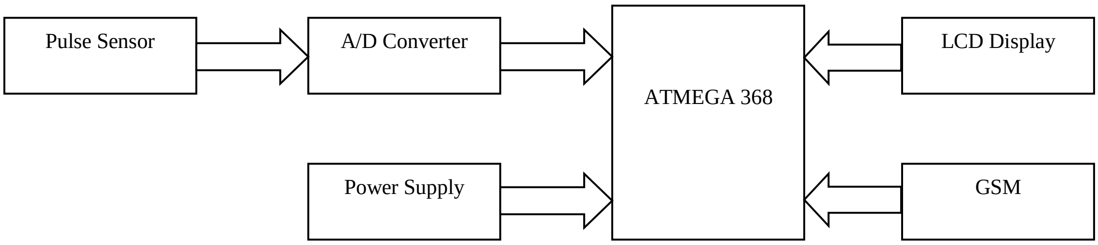

Figure 1. Block diagram of Cuffless Blood Pressure Monitoring System

Based on various studies a simplified block diagram of the Wearable Blood Pressure Measuring System employing GSM for transmitting information was designed. As shown in the block diagram the pulse sensor named photoplethysmograph is used which will sense the pulses and the calculations will be made accordingly to measure the blood pressure. The reading from the pulse sensor is usually in analog form, thus an AD converter is used to convert the analog data into digital form. The digital data is send to atmega 368 microprocessor in which processing of the received signal is done so as to obtain blood pressure value. The GSM module and LCD display are also connected to atmega. The instantaneous value of blood pressure will be displayed on the LCD display and the same would be sent to doctor via GSM module.

IV. CONCLUSIONS

After all the survey conducted as mentioned above, we finally were able to conclude our topic of invention and what all should be included in it for ex: the components so as to help patients economically by providing them an inexpensive instrument and the procedure of monitoring so as to make our device an easy to access instrument for the patient and for the doctor as well. The components include Arduino Uno Board, Photoplethsymograph sensor, LCD display and GSM SIM900 Modem. While the procedure is as follows: In this instrument, the pulse sensor as mentioned above gives a PPG waveform through which Pulse Transit Time (PTT), the time required for the pressure pulse to travel between two different locations along the arterial tree is recorded from ulnar artery at the wrist or from the common palmar digital artery on the outside of little finger. There are some mathematical calculations in which the recorded value is placed to obtain the BP of a patient who is wearing this device. All these calculations are pre-programmed in the Arduino Uno. It performs all the calculations as well as converts the analog readings obtained from the pulse sensor into digital so that it can be later displayed on a LCD display. To display the readings, LCD display needs to be interfaced to Arduino Uno board. This is how the patients can continuously monitor their blood pressure. Further the doctor of respective patient can have a record of BP of his patient irrelevant of where he is through the message which will be received by him on his cellphone, every time when the patient monitors his BP. The message is send through the GSM SIM900 Modem which is interfaced to the Arduino Uno board and further programmed through the use of AT command. Thus, we conclude that Wearable blood pressure monitoring with GSM technology overcomes the drawbacks of existing BP monitors in three ways. Firstly, it eliminates the need of an actuated cuff during measurement. Secondly, regular monitoring as a source of feedback improves patient compliance with prescribed treatments [5, 6]. Thirdly, it eliminates consultancies to a doctor frequently which saves lot of human energy and time.

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