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Real time ARM Controller based Patient Monitoring System using android App

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Abstract –

In this paper we present an electronic system to perform a non-invasive measurement of the blood pressure based on the oscillometric method, which does not suffer from the limitations of the well-known auscultatory one. With reference to other similar devices, a great improvement of our measurement system is achieved since it performs the transmission of the systolic and diastolic pressure values to a remote computer. This aspect is very important when the simultaneous monitoring of multi-patients is required. Blood pressure readings with help of developed algorithm has been calculated and transmitted via Bluetooth kit to the stationary computer. Numerical reading values of systolic and diastolic blood pressure remotely recorded and displayed with help of LCD as well stationary computer.

Index Terms - continuous blood pressure; monitoring system; wireless; Biosensors; Bioelectronics

INTRODUCTION

The most recent developments of electronics, informatics and telecommunications let consider applications in the biomedical engineering field to improve the healthcare quality. In particular a number of systems has been developed in the telemedicine and home care sectors which could guarantee an efficient and reliable home assistance allowing a highly better quality of life in terms of prophylaxis, treatment and reduction of discomfort connected to periodic out–patient controls and/or hospitalization for the patients afflicted by pathologies, such as hypertension, and allowing considerable savings on sanitary expenses.

In particular hypertension is defined as elevated blood pressure (BP) above 140 mm Hg systolic and 90 mm Hg diastolic when measured under standardized conditions. Hypertension can be a separate chronic medical condition estimated to affect a quarter of the world's adult population, as well as a risk factor for other chronic and non-chronic patients. Traditional high-risk patients include all patients afflicted by pathologies such as cardiac decomposition, ischemic heart disease, kidney disease, diabetes. Persistent hypertension is one of the key risk factors for strokes, heart attacks and increased mortality. In particular in pregnant women with gestational diabetic, known as preeclampsia, hypertension is the most common cause of maternal and fatal death. For all the previous cases blood pressure should be kept below 130 mmHg systolic and 80 mm Hg diastolic to protect the kidneys from BP-induced damage.

Therefore, in particular for high-risk patients, it is very important to employ a system for monitoring blood pressure over a long period (for example, of twenty-four hours), without compromising the ordinary day activities.

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A person's blood pressure is usually expressed in terms of the systolic pressure over diastolic pressure and is measured in millimetres of mercury (mmHg). Normal resting blood pressure for an adult is approximately120/80 mm hg. Blood pressure varies depending on situation, activity and disease states, and is regulated by the nervous and endocrine systems. Blood pressure that is pathologically low is called hypotension, and pressure that is pathologically high is hypertension. Both have many causes and can range from mild to severe, with both acute and chronic forms. Hypotension can cause the blood supply to the brain, heart and other tissues to be too low and hypertension is strongly correlated with higher risk for cerebral stroke and heart infarct.

In this paper we propose an electronic system to perform a non-invasive measurement of the blood pressure based on the oscillometric method and able to evaluate both the systolic and diastolic blood pressure values. With reference to other similar devices, a great improvement of our measurement system has been achieved since it performs the transmission of the systolic and diastolic pressure values to a remote computer. This aspect is very important when the simultaneous monitoring of multi-patients is required.

PHOTO PLETHYSMO GRAPHIC TECHNIQUE (PPG)

PPG is a simple non-invasive method used to measure relative changes in pulse blood volume in the tissues. It utilizes the use of reflectance sensor that contains an infrared light source. The light source illuminates a part of the tissue (fingertip, toe, ear lope, etc.) and a photo-detector receives the returning light. The waveform obtained from this technique represents the blood volume pulse which can be used to measure blood pressure.

SYSTEM DESCRIPTION

The block diagram of the developed system is shown in fig. 1. The system mainly consists of three stages: the sensing measurement circuit, signal amplification circuit, microcontroller and transmission unit.

The proposed system is also able to inform the healthcare professionals about any unusual health conditions of a patient. The doctors can also use the publishing system incorporated with the system. When the measured data exceeds the allowable normal range, the system can send an alarm message to the concerned healthcare professionals. The system can facilitate healthcare professionals to perform immediate medical diagnosis and to administer the medical treatment if needed

In the sensing stage, the PPG basic form utilizes two components: a light source to illuminates a part of the tissue (e.g. fingertip) and a photo detector to receive the light. Transparency of living tissue to light makes it possible for some part of the light from the source to pass through the tissue to the photo-detector.

In fact, the combination of the latest suitable telecommunication solutions (GPRS and Bluetooth) with new algorithms and solutions for automatic real-time diagnosis, cost-effectiveness (both in terms of purchase expenses and data transmission/analysis) and simplicity of use (the patient will be able to wear it) can give the designed system useful for remote monitoring, allowing real-time rescue operations in case of emergency without the necessity for data to be constantly monitored. For this purpose the proposed system has been equipped with properly developed firmware, which enables automated functioning and complex decision-making. It is indeed able to prevent lethal risks thanks to an automatic warning system. All this occurs automatically without any intervention of the user.

The heart beat sensor used to measure the heartbeat of the patient. This sensor monitors the flow of blood through a clip that is attached with

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a fingertip. The sensor has a laser that emits light through the skin and measures the reflection of the laser due to the flow of the blood. The heart beat rate of an individual may vary. At rest, an adult man has an average pulse rate of 72 beats per minute. Athletes normally have a lower pulse rate compared to that of a less active people. On the other hand children have a higher pulse rate (approx. 90 beats per minute). We set the critical pulse rate at 120 beats per minute. The sensor measures the heart beats and converts them into electrical signals.

The circuit of ARM7 microprocessor and peripheral equipment includes a ARM7 chip, a clock circuit, a reset circuit, a 32MB flash memory. All of these make up the control and process core of the system. The on chip features can significantly reduce the total system cost to design network devices. It has 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory, so it can execute longer programming code and has larger RAM to store more data.

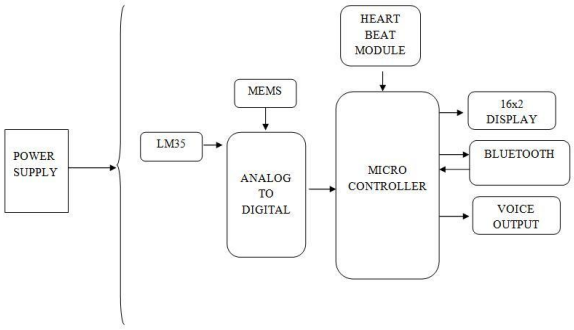

Fig: 1 Block Diagram

The temperature sensor chosen for this project is LM35. It is a standard semiconductor transducer suitable for the temperature range of -50^{o}C to +150^{o}C. It is fastened to the person's body and it produces 10mV/0C of body temperature. This signal is suitably amplified and fed to the ADC.

Blood pressure (BP), sometimes referred to as arterial blood pressure, is the pressure exerted by circulating blood upon the walls of blood vessels, and is one of the principal vital signs. When used without further specification, "blood pressure" usually refers to the arterial pressure of the systemic circulation. During each heartbeat, blood pressure varies between a maximum (systolic) and a minimum (diastolic) pressure.

The blood pressure in the circulation is principally due to the pumping action of the heart. Blood pressure without further specification usually refers to the systemic arterial pressure measured at a person's upper arm and is a measure of the pressure in the brachial artery, the major artery in the upper arm. A person's blood pressure is usually expressed in terms of the systolic pressure over diastolic pressure and is measured in millimetres of mercury (mmHg), for example 120/80. Creation of any abnormalities in the blood pressure on human subject is very difficult. Hence, simulated blood pressure circuit is proposed in this system. Non Invasive Blood Pressure (NIBP) measurement method is adopted by this system to measure the Systole and Diastole pressure values

The Bluetooth technology used in this system is acquired by using Bluetooth (SKKCA-21) Remote Control. SKKCA-21 module offers simple yet compact Bluetooth platform for embedded applications. It has a surface mount layout which makes the process of development and application easier.

The microcontroller then finds the highest peak of the signal and the lowest peak of the signal and then displays them as systolic and diastolic readings respectively in the LCD and Parallel serial terminal software via Bluetooth transmission kit.

CONCLUSION

With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The small embedded system can display the systolic and diastolic blood pressure on a mini LCD as well stationary computer which is a Bluetooth

enabled device though Bluetooth wireless technology. In case of any abnormal changes in the blood pressure readings, the system alerts using a buzzer and it also send a message to the predefined number(i.e. a physician number) using GSM. Furthermore, the obtained results will be compared with existing devices data like a sphygmomanometer to verify the accuracy of the developed instrument. This system provides users an easy-to-use interface and simple BP management environment. The Bluetooth interface provides a convenient and low-power consumption method for data transmission. This work may further be extended in future to include more number of physiological parameters like heart rate, oxygen saturation etc. to be monitored for a long period of time. GPS system can be used to spot the exact position of the patient and thus can provide immediate help if required.

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