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The Non-Invasive PPG Method of Heart Rate Monitoring in Smart Phone Device

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ABSTRACT: A new method is introduced in this project called Finger Photoplethysmography which defines the volume of blood and health monitoring process is crucial for the survival of the vicious and frangible people admitted at the intensive care unit (ICU) in hospitality. Photoplethysmogram (PPG) have simultaneous process and pulse transducer signals from the same finger is acquired and between the AC section of the PPG and the quantity changes are estimated in high correlation is obtained (after normalization). It shows that the fact of while resting the fingertip and PPG signal variations are only due to the change of volume. There is no contribution so the blood density is not changed. The PPG is simple way to get the functions about heart and the measuring process is based on the density of blood quantity with the help of blood revolution. The amount of the blood in the different fingers with respect time which in turn on to send the SMS by using the hardware module is GSM. This concept is simple and also low cost method to assess cardiovascular related frameworks such as the heartbeat, pulse transit timing and saturation for blood oxygen.

KEYWORDS: Message, Mobile, PPG, GSM

1. INTRODUCTION

Photoplethysmography(PPG) is a simple and low-cost optical technique that can be used to detect blood volume changes in the micro-vascular the bed of tissue. It is often to use non-invasively device to make measurements at the skin surface.

Plethysmographs measures to change the volume. The method is to measure the absolute changes in blood volume accurately in the extremities by using chamber -plethysmography. The changes of volume is converted into blood flow by using $F = dV/dt$. However, in some cases, we are only interested in the respective volume, for example to see that the pulsation rate of the heart. In that, the information is in timing and not in the amplitude or shape of the signal. If that we can use an electric impedance - plethysmography or photo-plethysmography(PPG). This detail's are on the background of plethysmography can be found in the book of Webster.

A PPG sensor can be used in reflection mode (for example on the finger) or in transmission mode (for example on the ear). Normally, a wavelength is in nearby infrared is used because there we have the strongest modulation of the signal due to light absorption in the haemoglobin in the blood.

The absence of volume changes such as in rigid tube, PPG signal can be observed by using pulsated blood. Thus, the following questions remains incompletely answered: what effect(s) may have blood density changes on PPG in the fingertip, where a wide network of capillaries exists? The aim of this study is to investigate the respective roles of blood volume and density changes in the genesis of the PPG signal in this particular anatomical location. To this end, first a simple geometrical model is proposed. The simultaneous PPG and volume-related data are recorded from the same finger. Finally, the relative volume changes obtained through both optical and mechanical methods are compared.

Functions of photoplethysmography

This process is based on the principle of photoplethysmography (PPG) which is non-invasive method of measuring the variation in blood volume in tissues using a light source and a detector. Since changes in the blood volume of synchronous to the heart beat, this type of technique can be used to calculate the heart rate. Transmit and reflect are

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two basic types of photoplethysmography. For the transmit PPG, a light source is emitted in to the tissue and a light detector is placed in the opposite side of the tissue to measure the resultant light. Because the limited penetration have depth of the light through organ tissues, the transmit PPG is applicable to restrict the body part, such as the finger or the ear flap. However, the reflect PPG have the light source and the light detector are both placed on the same side of a body part. The light is emitted into the tissues and the reflected light is measured by the detector. In this, the light doesn't have to penetrate the body, the reflect PPG can be applied to any parts of human body. In either case, the detected light reflected from or transmitted through the body part will fluctuate according to the pulsatile blood flow caused by the beating of the heart.

The following picture shows a basic reflectance PPG probe to extract the pulse signal from the fingertip. Subject's fingers are illuminated by an infrared light emitting diode. More or less lights are absorbed by depending on the tissue blood volume. Consequently, the reflected light intensity vary with the pulsing of the blood with heart beat. A plot variation against time is referred to be a photoplethysmographic. The PPG signal have two components, frequently referred to as AC and DC.

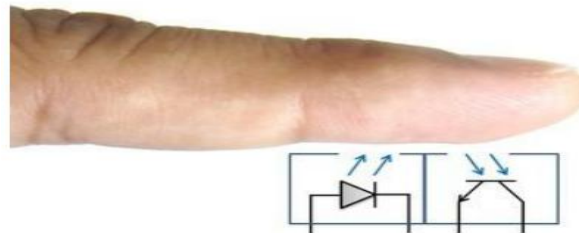


Figure1. Finger Plethysmography

The AC component is mainly caused by pulsatile changes in arterial blood volume it is synchronous with the heart beat. So, the AC component can be use the source of heart rate information. This AC component is super imposed onto a large DC component that relates to the tissues and to the average blood volume. The DC 3 component must be removed, to measure the AC waveform with a high signal-tonoise ratio. Since the useful AC signal is only a very small portion of the whole signal, it is an effective amplification circuit also required to extract desired information from it.

II.LITERATURE REVIEW

The physiological control of heart rate and blood pressure is very important in maintaining blood pressure homeostasis, and is often characterized by the bar reflex sensitivity (BRS, unit ms/mmHg). BRS can be attenuated in cardiovascular disease. Its non-invasive assessment is possible using beat-to-beat peripheral arterial blood pressure waveforms measured using finger-pressure cuff/PPG technology. It has already been stated in the section on blood pressure measurement that there are several devices that can be used for this purpose. The value of simple and low cost PPG surrogate measures of arterial blood pressure have also been explored for BRS type studies, including the PTT.

Further research is needed though before PTT information can be included in routine clinical autonomic studies. The heart rate and its variability are much more straightforward since they can easily be extracted from PPG pulse signals. Where, the endothelium is the layer of thin specialized epithelium, comprising a single layer of cells that line the interior surface of blood vessels to form an interface between the circulating blood in the lumen and the vessel wall. These cells line the entire circulatory system, from the heart to the smallest capillary. Endothelial cells are involved in many aspects of vascular biology, including vasoconstriction and vasodilatation, blood clotting, atherosclerosis, angiogenesis, and inflammation and swelling. Endothelial dysfunction is considered to be an early event in atherosclerosis and correlates with major risk factors for cardiovascular disease. Endothelial function is often assessed non-invasively by ultrasound brachial artery diameter measurement before and after several minutes of blood flow occlusion to the arm. The change in arterial diameter gives a measure of flow mediated vasodilatation. The technique, however, is operator dependent and requires high cost ultrasound imaging

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instrumentation which could limit its usefulness for routine clinical assessments. PPG has also shown potential for the assessment of endothelial function but is much less costly than the ultrasound approach. Shape-related information can be extracted from the PPG waveform to quantify vasodilatory effects with reactive hyperemia, etc. This analysis could include comparing the height of the reflected peak relative to the systolic peak or quantifying the degree of maximal pulse damping.

It is important to monitor the perfusion of the circulation. The most important cardiopulmonary parameter is blood pressure, but monitoring it is complicated. A second important parameter is blood flow, which is related to blood pressure. We can monitor the blood perfusion in large vessels using ultrasound devices, but it is not practical to use these routinely. Several devices for monitoring blood perfusion have been developed, but, unfortunately, it is difficult to find a practical device. However, the perfusion of blood flow and blood pressure can be determined easily using a pulse rate monitor. Wearable pulse rate sensors based on photoplethysmography (PPG) have become increasingly popular, with more than ten companies producing these sensors commercially. The principle behind PPG sensors is optical detection of blood volume changes in the micro-vascular bed of the tissue. The sensor system consists of a light source and a detector, with red and infrared (IR) light-emitting diodes (LEDs) commonly used as the light source. The PPG sensor monitors changes in the light intensity via reflection from or transmission through the tissue. The changes in light intensity are associated with small variations in blood perfusion of the tissue and provide information on the cardiovascular system, in particular, the pulse rate. Due to the simplicity of this device, wearable PPG pulse rate sensors have been developed. This review describes the basic principles of PPG, previous and current developments in wearable pulse rate monitors with a light source, and the elimination of motion artifacts.

III.EXPLANATION

The microcontroller device used in this project, which is a typical PIC microcontroller produced by Atmel corporation. This Microcontroller is the most important fragment of this project as it controls all the operations of the circuit such as reading heartbeat rate pulses data from the heartbeat sensor.

Separate code and data spaces (Harvard architecture).A small number of fixed length instruction. Most instructions are single-cycle (2 clock cycles, or 4 clock cycles in 8-bit models), with one delay cycle on branches and skip One accumulator (W0), the use of which (as source operand) is implied (i.e. is not encoded in the opcode).All RAM locations function as registers as both source and/or destination of math and other functions.

A hardware stack for storing return addresses

A small amount of addressable data space (32, 128, or 256 bytes, depending on the family), extended through banking

Data-space mapped CPU, port, and peripheral registers

ALU status flags are mapped into the data space

The program counter is also mapped into the data space and writable (this is used to implement indirect jumps).

There is no distinction between memory space and register space because the RAM serves the job of both memory and registers, and the RAM is usually just referred to as the register file or simply as the registers.

IV.EXPERIMENTAL RESULTS

4.1 Heart rate monitoring kit



Figure 4.1 Heart Rate Monitoring Kit

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4.2 PIC Transplanting

For the transplanting of Embedded C code, its main task is to re-write the codes which are associated with the processor and compiler, the codes include the following: redefinition of compiler-related data type, interrupt-switching code, stack, the initialization functions for task stack, task-switching function and so on. The transplanting is completed in the following environments: the compiler tool is PIC 16F877A for PIC microcontroller.

4.3 LCD Display



Figure 4.2 LCD Display

4.4 Data Transmission

In order to transmit the data from microcontroller to GSM module, two system tasks are established in PIC. one is at the receiver end and other at the transmitting end.

4.5 Blood Volume Display



Figure 4.3 Blood Volume Display

V.CONCLUSION

Thus, PPG sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. Hence, with each cardiac cycle the heart pumps blood to the periphery. Even though this pressure pulse is somewhat damped by the time it reaches the skin, it is enough to distend the arteries and arterioles in the subcutaneous tissue. If the pulse oximeter is attached without compressing the skin, a pressure pulse can also be seen from the venous plexus, as a small secondary peak. Thus, PPG signal variations are only due to volume changes and that blood density does not change thus has no contribution. It is a simple and low cost method to assess cardiovascular related parameters such as heart rate, pulse transit time and blood oxygen saturation. The results clearly indicate that Pulse Transit Time (PTT) can be calculated using two PhotoPlethysmograph circuits,

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a wrist PPG and a finger PPG circuit which can successfully replace the utilization of Electrocardiograph(ECG)and this also avoids the complexity of measuring the distance from heart to finger. The hardware unit was successfully instrumented and software algorithm was implemented to calculate Pulse Transit Time.

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BIOGRAPHY



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