

An ARM and GSM Based Global Embedded Patient Monitoring System

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Abstract: *Now days the fast development and popularization of information processing and wireless data transmission technology, the research of wireless Medical Monitoring System has become a hot topic with the help of biomedical sensors. By utilizing the wireless technique to transmit information between medical sensor and monitoring control center, the free space of patients is enlarged, and the efficiency of the modern management of hospitals is improved. The main aim of this paper is used Monitoring Terminal and it can detect the patient's real-time body temperature, heart rate and other physiological information's, and transmit them to the doctor and in the meantime to suggest the medication the patient for emergency.*

Keywords: Android application, Arduino ADK board, Heart rate, ECG simulator.

1. Introduction

People don't use their smart phones for talking as much as they used to, but they are increasingly using them to detect and monitor their health. Indeed today's telemonitoring devices are smaller and more user-friendly, and can monitor heart rate, blood pressure, oxymetry and weight. Recent studies have shown that using telemonitoring devices, together with patient communications, have a significant impact on efficiency of care and quality of life, while decreasing re-hospitalization rates. [1] Many medical centers now a days install telemonitoring devices in patients' homes to keep track of their medical condition. Although this is a major breakthrough, it still limits the patient from leaving his/her home without being telemonitored to keep track of his/her medical condition. Smartphone technology breaks that limit as the smart phone when equipped with specific accessories and application can be more than just a phone but be also "Smart" to be a "telemonitoring device". Smartphone technology is the fastest growing and most competitive field of the corporate mobile phone sector, with Apple's iPhone®, Google's Android® and Microsoft's Windows Phone 7® striving to take over from Blackberry as the smart phone of choice for both business users and individuals[2]. A substantial rise in smart phone applications would be those that are employed in the fields of health care and medicine.

There has been a significant growth for the mHealth application market in 2011, and, by the end of 2012 the market size will nearly double, reaching US\$ 1.3 billion in 2012, up from US\$ 718 million in 2011. At the end of 2012 the number of mHealth application users, mobile users who downloaded a smart phone mHealth application at least once will reach 247 million. Compared to the 124 million users who downloaded mHealth smart phone applications in 2010, this is a near doubling. However, despite this substantial growth, the mHealth market is still in an embryonic state –especially in comparison to the US\$ 6 trillion of the overall global healthcare market. Several factors especially smartphone penetration, will continue, however, to drive mHealth market growth over the next

couple of years [3]. So despite the immense evolution in the field of Health applications, progress has been limited in providing successful and reliable mobile technology to help patients manage cardiovascular diseases and other illnesses. Heart rate is an independent risk factor for patients with cardiovascular disease, in particular with arterial hypertension, myocardial infarction, coronary artery disease and heart failure. This relation is supported by a large number of animal studies as well as clinical trials [4]. Continuous monitoring of patients' heart rate is crucial in keeping track of their cardiac condition. This can be achieved by making use of today's fastest growing technology which is smart phone technology.

Many smart phone applications exist nowadays for measuring the user's heart rate. One of which is through the smart phone's camera that can be used to detect changes in heart rate in a person's finger using a technology called photoplethysmographic (PPG) measurement. PPG refers to the technology commonly used by a pulse oximeter to capture blood volume change based on a light-emitting diode (flash of the smart phone's camera) [5]. Even in hospitals where nurses view the patient's heart rate measured by both the conventional electrocardiogram (ECG) and the pulse oximeter, they always use the heart rate measured from the ECG and consider it more dependable [6]. Some of the benefits of such applications is the user friendliness and the fact that they do not require any external hardware, however accuracy is essential especially.

2. System Design Model

Now a day with the increase of biomedical sensor we are going into this process of detecting the patient's real-time body temperature, heart rate and other physiological information's. Coming to the main core of wireless medical monitoring system is the design of wireless monitoring terminal, and the development of system software. Electrical waves cause the heart muscle to pump. These waves pass through the body and can be measured at electrodes (electrical contacts) attached to the skin. Electrodes on different sides of the heart measure the activity of different

parts of the heart muscle. An ECG displays the voltage between pairs of these electrodes, called Leads, and the muscle activity that they measure, from different directions.

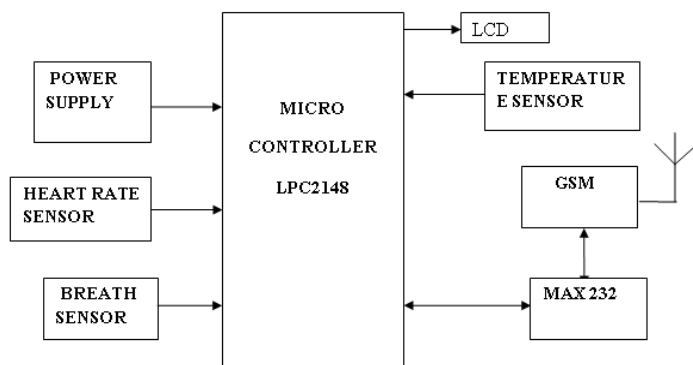


Fig: 1. Block diagram of monitoring system.

The monitoring terminal generally consists of three modules: the sensor module, the control module, and the wireless communication module. The sensor module is used for acquiring medical information from the outside, and then converts them to digital signals. The control module is often compared to the brain of monitoring terminal, which is in charge of coordinating the task of different modules, controlling the sensors, processing data, and executing communication protocols. The wireless communication module mainly deals with the wireless transmission of information. Nowadays, there are various kinds of wireless communication protocols. But since the main task of a monitoring terminal is to realize the transmission of signals such as heart rate, body temperature, and calling signals the data traffic is not heavy. Moreover, because the monitoring terminal is worn on patients, which needs to be supplied by battery, it puts a high demand on the reducing of power dissipation of wireless transmission module. Having taken these comprehensive factors into consideration, this paper chooses the GSM technology as the wireless communication. This system collects the patient data and transmits them to the doctor and in the meantime to suggest the medication the patient for emergency.

3. Experimental Results

Figure.2 shows the kit. The monitoring terminal generally consists of three modules: the sensor module, the control

module, and the wireless communication module. The sensor module is used for acquiring medical information from the outside, and then converts them to digital signals.

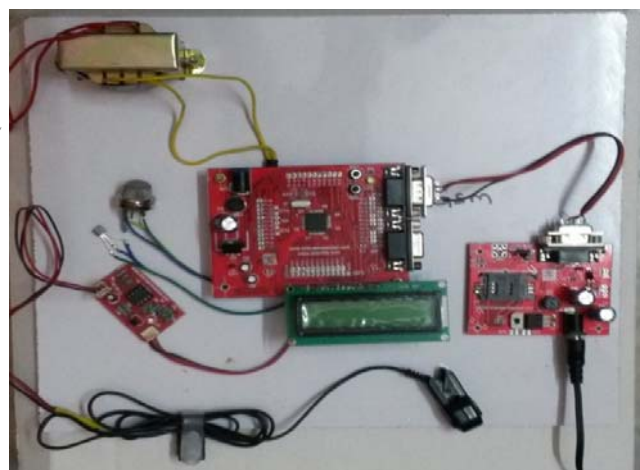


Figure2: Demonstration Kit

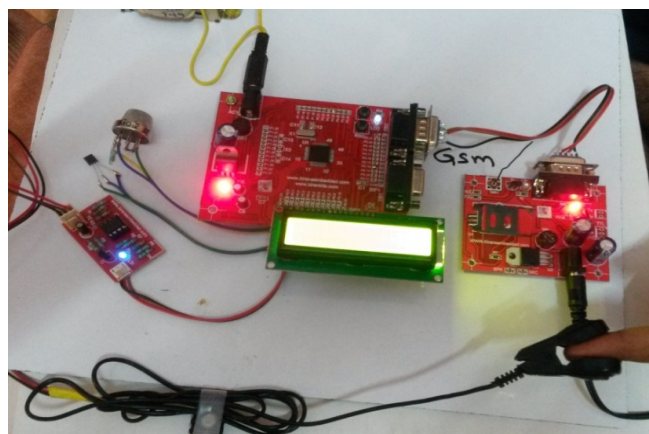


Figure 3: Giving power supply to the whole kit

The control module is often compared to the brain of monitoring terminal, which is in charge of coordinating the task of different modules, controlling the sensors, processing data, and executing communication protocols. The wireless communication module mainly deals with the wireless transmission of information



Figure 4: Output (patient information) shown in LCD

The three sensor modules detect the information from patient and shown in LED and transmit them to the doctor to seek medical advice when needed. The patient information received and shown on mobile.

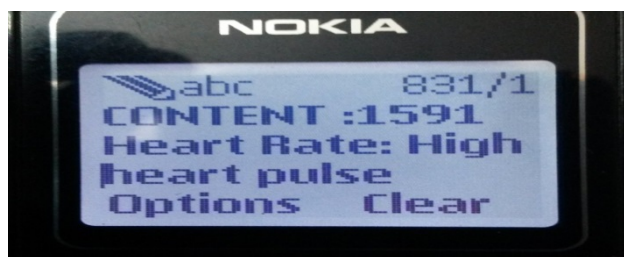
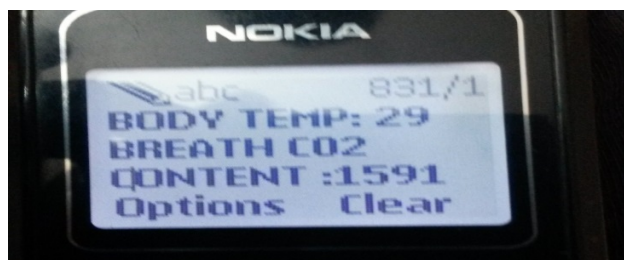


Figure 5: patient information on mobile

4. Conclusion

In this paper, we described a design for a mobile accessory that once connected via USB to the patient's Android based device displays his heart rate, calculated from his ECG extracted from two electrodes connected to his thumbs, and provides him with the option of sharing the result of his heart rate with his physician via SMS by a press of a single button. This proposed design is helpful for patients suffering from cardiac diseases as heart rate is an independent risk factor for patients with cardiovascular disease, in particular with arterial hypertension, myocardial infarction, coronary artery disease and heart failure. Studies demonstrated detrimental effects of increased heart rate on the function and structure of the cardiovascular system. Heart rate can be easily detected and therefore allows a conclusion on prognosis and efficiency of therapy.

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