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Wireless Heart Rate Monitoring System using MQTT

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Abstract

This paper presents the heart rate monitoring system using ESP8266 Wi-Fi module on the Arduino microcontroller and Message Queuing Telemetry Transport (MQTT) for messaging protocol that designed for lightweight communications. The developed system is intended to remotely monitor the real-time heart rate of a patient. This design use simple infrared light and photo detector to detect and pick up the rate of heart beat signal and send measured data wirelessly to the MQTT broker where running on a Raspberry pi, a low-cost, credit-card sized computer. The preliminary result demonstrated that the system provides useful information and helpful for nursing related health care tasks.

Keywords: Heart rate monitor; Message Queuing Telemetry Transport (MQTT); Wireless sensor network

1. Introduction

The heart rate monitor can be used in several ways and applications such as in the hospitals, elderly health care, personal emergency response [1, 2] or sport training [3]. In the developing countries or rural hospitals, health care budgets are very limited and increasing expenditure is affected to the quality of service in a small hospital. Monitoring of heart rate is essential for real-time information that would allow emergency detection and for evaluating the risk of heart failure. However, commercial heart rate monitors are expensive and not every hospital can afford it. There are some researchers have demonstrating a low-cost heart rate monitor and adopting wireless technology into this kind of system using ZigBee, XBEE, Bluetooth and RF modules [1, 3-5]. However, some of those designs still required high power, time consuming and big data overhead for communication protocol. In this

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work, we aim to build inexpensive prototype of simple wireless sensor network for heart rate monitoring system based on Wi-Fi connectivity and utilize a light weight MQTT for a publish-subscribe based messaging protocol.

2. Methodology

The system mainly includes 4 parts: a heart rate sensor module, a microcontroller equipped with ESP8266 Wi-Fi, MQTT on the Raspberry pi and monitoring software. Figure 1 illustrates the block diagram of the system. Figure 2 shows the heart rate sensor and its schematic that is well built to fit over a patient's fingertips and reads the amount of infrared light reflected by the blood circulating inside of patient's body. When the heart pump, the blood pressure rises sharply and so the amount of infrared light from the emitter's LED that get increased and reflected back to the photo detector. The photo detector passes more current when it get more reflected light and then become a voltage drop. The two consecutive operational amplifiers are used to establish a signal baseline and emphasize the peaks and filter out the noise. The filtered signal will be read by analog-to-digital pin on the Arduino microcontroller board.
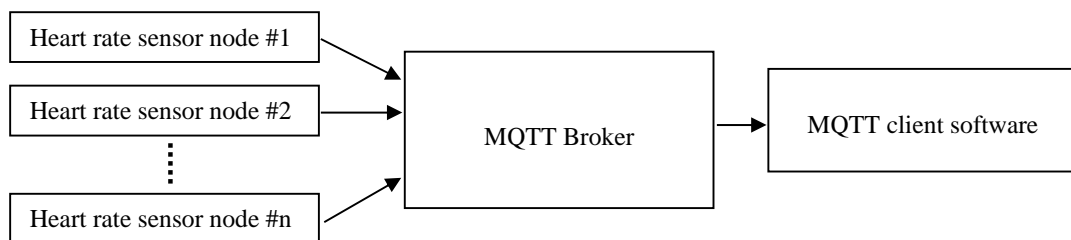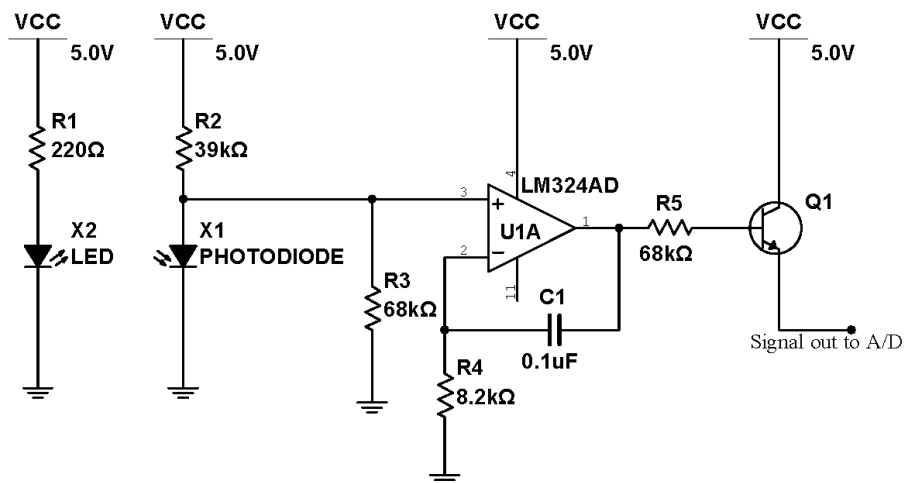

Fig. 1 Block diagram of the system

Fig. 2 Schematic of heart rate sensor

The ESP8266 is an integrated chip designed for the needs of an increasingly internet of things devices. It provides a complete self-contained Wi-Fi networking capabilities, allowing it to act as host applications or offload all Wi-Fi networking functions. This module is installed on the Arduino microcontroller board for adding the Wi-Fi functionality. In every minute, the Arduino is reading the heart rate pulse from the sensors that connected to its internal A/D and calculate the heart rate and then update to the server which is connected on the same network.