Microcontroller Module for Wearable Health Monitor Device

Introduction

The majority of patients in the hospital are ambulatory and would benefit significantly from personalized predictive monitoring systems since hospital staff cannot be present all the time. [2] Embedded system is the best answer to personalized health monitoring system. An embedded system is a microprocessor-based system that is built to perform a certain function, to run custom dedicated programs and connected to specialized hardware and to perform a dedicated set of functions. [6] Utilizing the most fashionable embedded system, wearable devices are small and require less power than general purpose computer. This technical review briefly summarizes some commercially available microcontroller-based wearable devices, explains the advances in the technology, and provides a method for implementation of wearable health monitor device with possible variations on some components.

Commercial Solution of wearable device

Most important factors that contribute to the portable feature of wearable devices include low power consumption, small size and extensible hardware. Low power consumption, small size, and extensible hardware are the most important factors in wearable device design. There are several designs available in the market right now. The Arduino project is an open-source project, so all plans for the modules are published under a Creative Commons license. The Arduino Uno is a microcontroller-based Atmel 8-bit AVR that only has 16 MHz clock Speed. In the Arduino community, a lot of circuit designers and manufacturers can make the modules inexpensive, which means most modules and accessories cost less than 50 dollars each. [1] Adafruit's Arduino module family is marketed approximately 150K pieces as of February 2011. [7]

Another alternative design is Freescale Semiconductor, Inc WaRP board, known as Wearables Reference Platform. Freescale launched WaRP board for 149 dollars in January 2014 on CES 2014. [4] Unlike the Arduino, WaRP provides a well-developed solution to wearable device. WaRP includes a single-core ARM Cortex-A9 processor and Kinetis KL 16 MCU that handles sensor aggregation and wireless charging. [3] Freescale optimizes component and board design for low power consumption and reduced size. Murata Wi-Fi and Bluetooth wireless modules are integrated inside the board. Another advantage of this solution is a full-featured Android 4.3 Operating system on the board. Developers can use standard Android SDK to develop wearable applications on board.

Technology inside wearable microcontroller module

Components of microcontroller module for wearable device include a processor, a wireless module, communication bus, and programming environment. The processor operates instructions on the program. A wireless module transfers data from device to user device or cloud. A Communication bus, which typically refers to I2C bus, transfers data from sensor applications to memory or processor. Programming environment includes the language and integrated development environment (IDE) for writing and compiling and uploading programs to the board. High speed processor provides the ability to solve complicated problems quickly, but powerful processor will drain more energy and shorten the time the device lasts. Wearable device designs almost always guarantees less power consumption than other embedded devices. In the wireless module, wearable device uses newest Bluetooth standard, which is Bluetooth 4.0 low energy. Bluetooth low energy only costs 10mW and lasts 15000 days, assuming sending a report every minute. [5] Due to low consideration on user experience, C or assembly language is used on the embedded device. Wearable device needs high level language to develop applications, like C++ and Java. Additionally, a feature-rich library or SDK eases development effort for software developers and supports extensible UI to optimize user experience.

Integration of Microcontroller Module into Health Monitor Device

Microcontroller module is the core part in the wearable health monitor device. It is an important trade-off between integrated microcontroller and open-source assemble microcontroller like Arduino. Using Freescale WaRP solution, program runs on a microcontroller, and then transfers result to User-end device, which is user's phone or computer. By using Arduino solution, microcontroller collects data from sensor and transfers raw data to User-end device and analyzes the result. Both solutions, however, pedometer, gyroscope, accelerometer and smell sensors connect to analog input, and process the data. Microcontroller encapsulates this data to the necessary format. I2C bus can transport this data to different modules in the microcontroller. Wireless module is connected to microcontroller and transfers data to User-end device through network protocol.

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