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Microcontroller based fitness analysis using IOT

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Abstract
This works aims to measure the number of steps and the distance walked by the person and Heart Beat. The design problem is to design and fabricate a small mechanical Pedometer which can at least measure two kilometers on a dial or counter. The size of the pedometer is to be about 50×50×25 mm. Assuming the average stride of a person is 0.33 m, the pedometer must measure about 6000 steps approximately. This can be achieved by using a 3 digit counter which can measure till 999 and a gear reduction of 1:10. Thus the pedometer will be able to measure 9990 steps which is more than the required specification.
It is generally used by people who do measured exercise every day. The device counts the number of steps taken by the person and multiplies it by the average step length fed to give the distance walked by the person. In the present works, we are measuring the number of steps the person takes. This has to be appropriately multiplied by the stride length of the person to calculate the actual distance traveled by the person using IOT Device. IOT Device gets a number of steps walking by a person from Smartphone using android application and also checks the Heart Beat rate of a person by using microcontroller and interact the data from microcontroller to Smartphone. Android Apps developed by using eclipse software supported android development kit.

Keywords: Microcontroller, Heart Beat Sensor, IoT, Android Application

1. Introduction

1.1. Wi Fi

Wi-Fi or Wi Fi is a technology that allows electronic devices to connect to a wireless LAN (WLAN), mainly using the 2.4 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands. A WLAN is usually password protected, but may be open, which allows any device within its range to access the resources of the WLAN network. Wi-Fi is less secure than wired connections, such as Ethernet, precisely because an intruder does not need a physical connection. Web pages that use TLS are secure, but unencrypted Internet access can easily be detected by intruders. Because of this, Wi-Fi has adopted various encryption technologies.

1.2 IOT (Internet of Things)

The Internet of things is the internetworking of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

1.3 Android

World is contracting with the growth of mobile phone technology. As the number of users is increasing day by day, facilities are also increasing. Starting with simple regular handsets which were used just for making phone calls, mobiles have changed our lives and have become part of it. Now they are not used just for making calls but they have innumerable uses and can be used as a Camera, Music player, Tablet PC, T.V, Web browser etc. And with the new technologies, new software and operating systems are required. Android is a powerful Operating System supporting a large number of applications in Smart Phones. These applications make life more comfortable and advanced for the users.

1.4 Pedometer

Pedometers use many different mechanisms to measure the number of steps taken by the person while walking. The basic principle behind the counting mechanism is that when a person moves, he bends a little, so his center of gravity goes down. For every step first the center of gravity goes down and then up, this to and fro motion continues throughout walking. Different types of mechanism are Mechanical systems, Pendulum Mechanism, Electronic Systems, Counting Mechanism, Ratchet Wheel and Free wheel Mechanism

Proposed Work & Technical Description

The mechanical pedometer approximately met the design specifications for size. It was also able to measure more than the specified distance of 2 km and can actually measure about 21 km. The disadvantage of this high range is that the accuracy gets reduced. It can measure only multiples of 22 m as this the digit number changes by 1 number only after 22 m or 66 steps. This can be solved by using a freewheel with less number of ratchet pegs. This reduces the least count but also reduces the range. Hence a balance between range and accuracy has to be reached based on the person's requirements. Another method to increase sensitivity is to increase the angle of oscillation of the pendulum. The main difference is that Bluetooth is primarily used to connect devices without using cables, while Wi-Fi provides high-speed access to the Internet. Bluetooth is a wireless technology standard that is used to exchange data over short distances, usually between personal mobile devices. Wi-Fi, ZigBee, and Bluetooth are different protocols for wireless communication. Wi-Fi gives a higher data rate, whereas Bluetooth and ZigBee give lower ones. Wi-Fi operates with either a 2.4GHz or 5GHz frequency band and supports devices with a substantial power supply. In this work Wi-Fi device i.e. IOT device is used. AT89S52 Microcontroller used to read the pulse from heart beat sensor. ESP8266-07 IOT device for communicate with microcontroller and Smartphone through wireless at the frequency of 2.4GHz. Android app is developed by using android IDE with eclipse. Accelerometer measure the 3 axis used to calculate the number of steps walked by a person. Then calculate the calorie value by using weight and height of a person with the help of calorie formula.

2. Overview of Concepts

The aim is easily helps to monitors the fitness of athletes, senior citizen and common peoples. By providing these facilities to use for monitoring the calories burnt and heart beat rate. The main objective of this work was to build an android application in the healthcare domain using the idea of Microcontroller and IOT device. Microcontroller measures the Heart Beat rate and then communicates to Smart Phone through IOT device. Microcontroller reads the heart beats using IR sensor. In Microcontroller based application, IOT is a technology that is having major impacts in many different domains. Time Savings in hospital due to avoid senior citizen waiting in a queue. This technology is also easily used in home by common people. To calculate the calorie value from number of steps walked by a person and then measures the heart beat rate.

3. Design and Implement

The ned-to-end system architecture of Microcontroller using IoT for analyzing the fitness to reads calories burnt by steps walked and the heart beats using IR sensor. Every 10 ms, microcontroller scans their sensor output. If switch is pressed, microcontroller scans their sensor output until one minute timeout. Then again switch is pressed, the beats per minute send to Smartphone through IOT. Microcontroller communicates to IOT with the help of RS232 signal through AT commands. Microcontroller set the ssid and password to IOT device.

Circuit Diagram

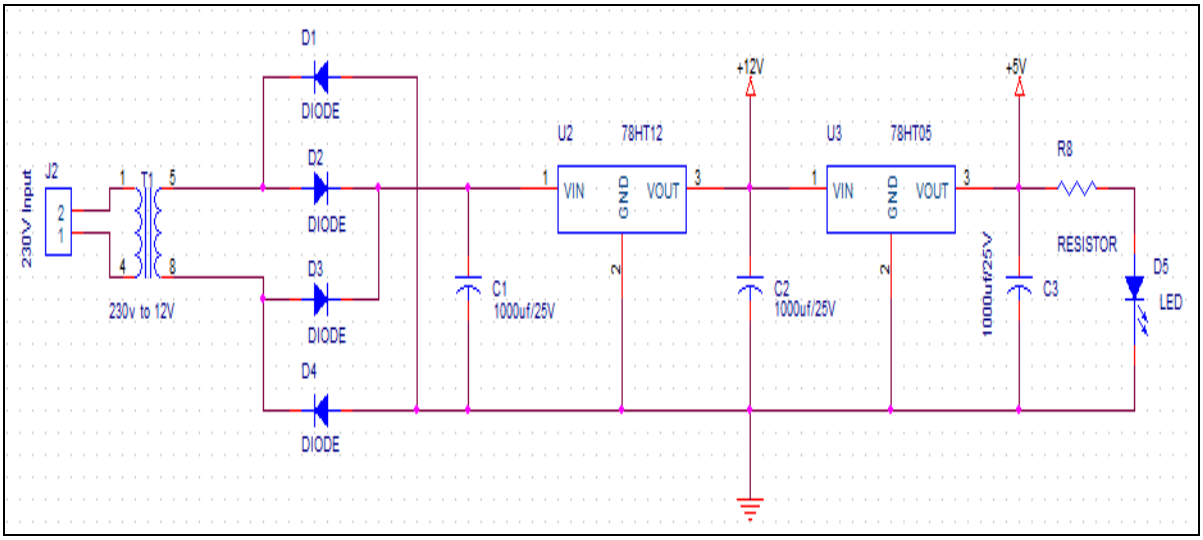

Fig 5.3: Power Supply Circuit

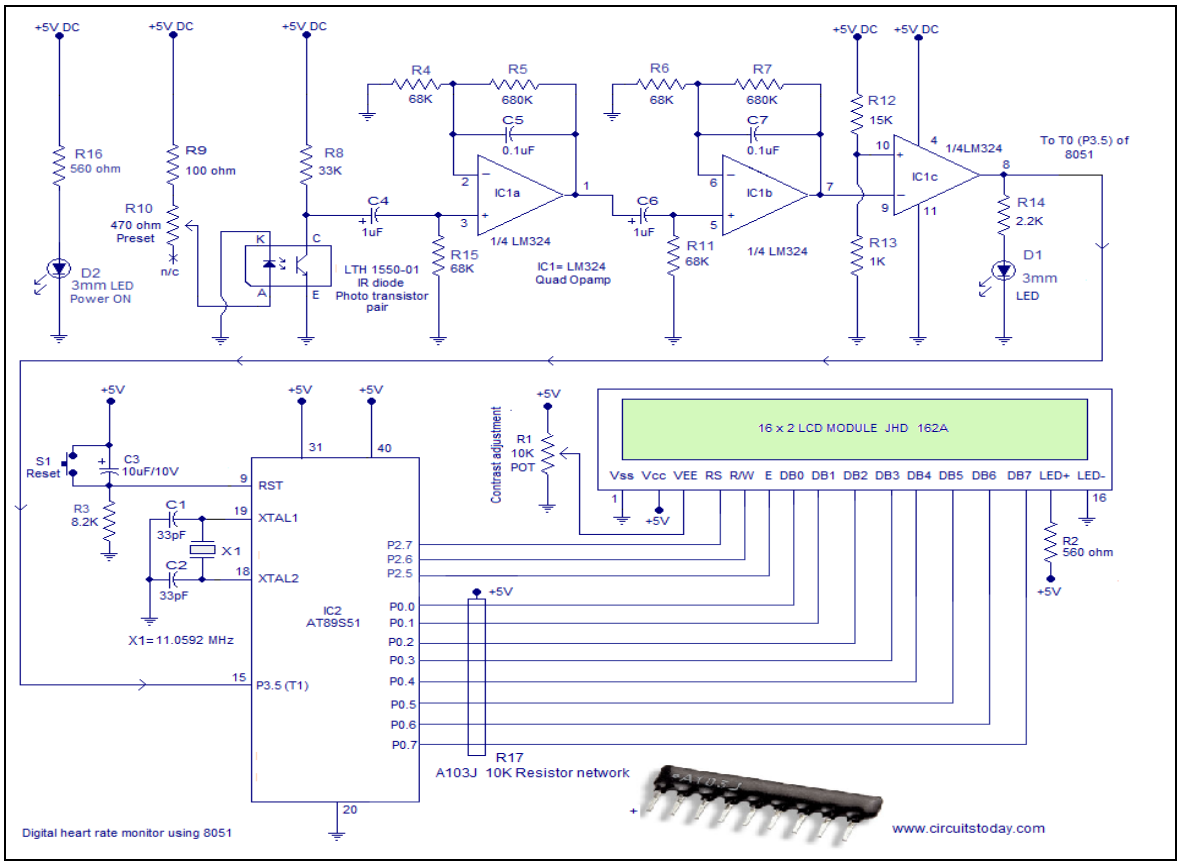

Fig 5.5: Heart Beat Sensor Circuit

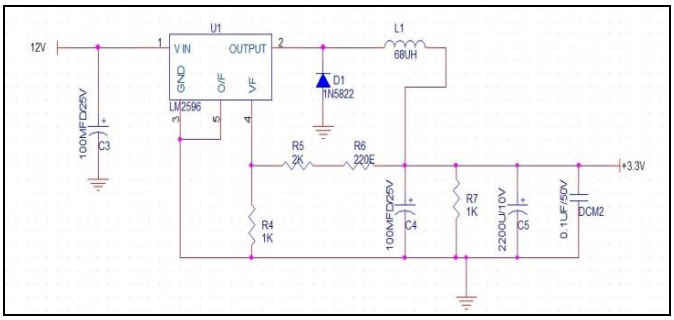

Fig 5.4: IOT Power Supply Circuit

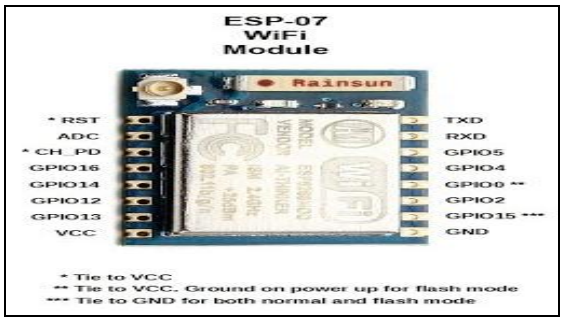

Fig 6.2: Front image of ESP 8266-07

IoT ESP8266 in smaller sizes of the module encapsulates Ten silica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash.

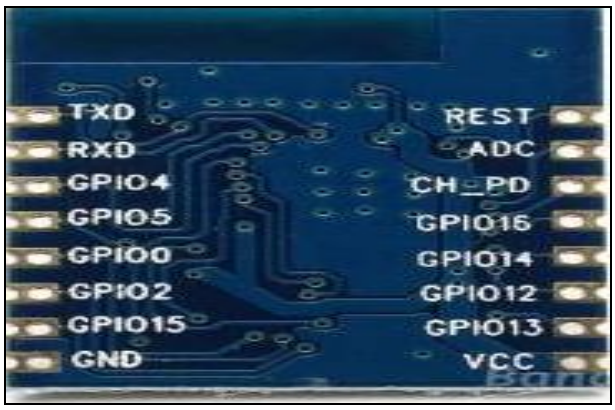

Fig 6.3: Back Image of ESP 8266-07

Frequencies of crystal oscillators supported include 40MHz, 26MHz and 24MHz. The accuracy of crystal oscillators applied should be ±10PPM, and the operating temperature range should be between -20°C and 85°C.

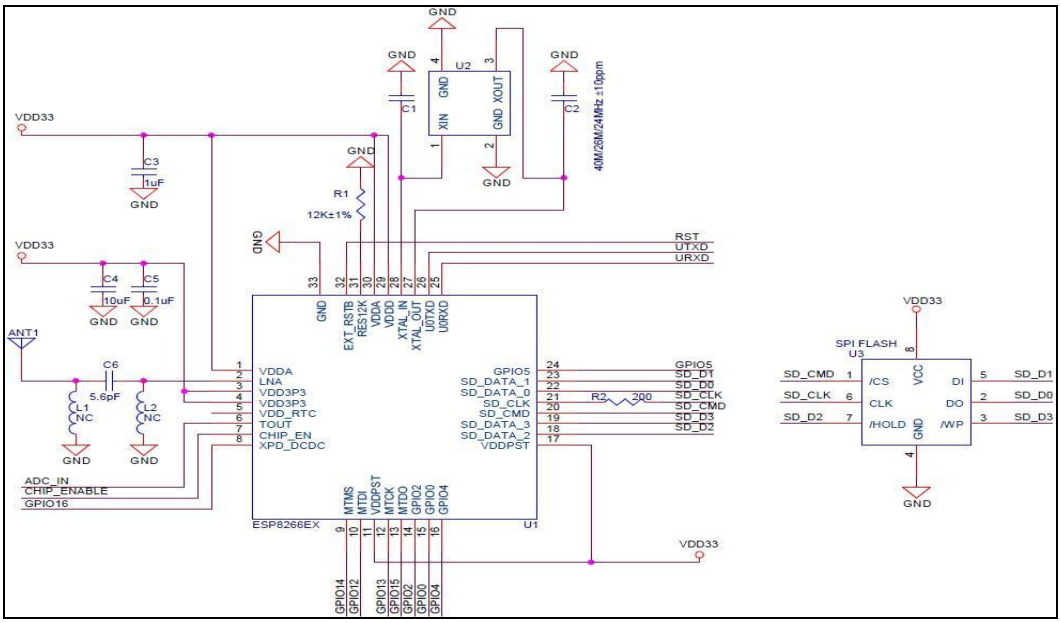

Fig 6.4: Crystal

Android application is developed by using android IDE with eclipse. In android, socket programming is used to communicate with IOT device. Before open the android application switch on the wifi in Smartphone device then connect to IOT device by entering the ssid and password set by microcontroller. Then open the android application set the ip address to communicate with IOT device. Then select the connect option from setting menu. IOT device successfully connect to Smartphone. User enter the weight and height of a person then walk a certain distance then Smartphone android application measure the number of steps. With the help of reading steps to calculate the calorie value help of accelerometer which is available in Smartphone. By entering the height and weight of a person, we calculate the calorie value by using formula. Touch the option menu in Smartphone then calculate option is showed. Touch the calculate, calorie value is displayed in LCD display of Smartphone. Microcontroller read the pulse from heart beat sensor. ESP8266-07 IOT device is communicated with microcontroller and Smartphone through wireless at the frequency of 2.4GHz.

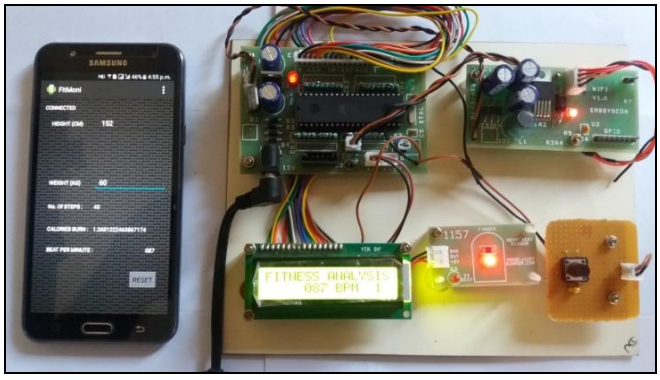

Fig 8.7: Calories Burnt and BPM

The consolidated graph in which the test has been taken from five different person with different Age, Height and Weight by walking a distance of 1000m for calculating the Steps count and Heart beat rate for the person of every 200m is shown below.

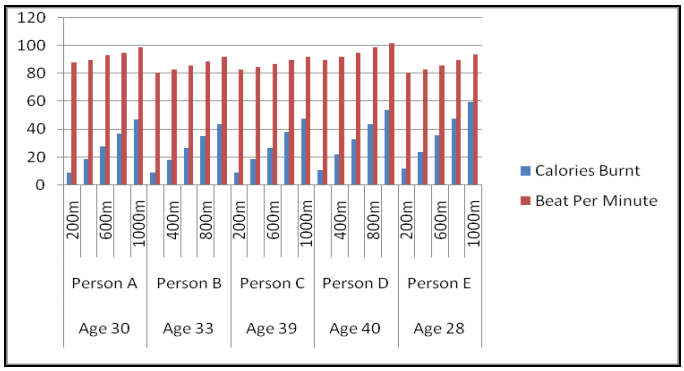

Fig 8.13: Consolidated Graph of 5 Person Conclusion

In this type of technology, easily helps to monitor the fitness of athletes, senior citizen and common peoples. By providing these facilities to use for monitoring the calories burnt and heart beat rate. The main objective of this work was to build an android application in the healthcare domain using the idea of Microcontroller and IOT device. In Microcontroller based application, IOT is a technology that is having major impacts in many different domains. Time Savings in hospital due to avoid senior citizen waiting in a queue. This technology is also easily used in home by common people.

Physicians and Trainers can make use of the data collected for a long period of time for different application for further data analysis by viewing graphs.

In Future, this work is also used to blind person by hearing the heart beat rate and calorie burnt by using Text to Speech Technology in Smartphone.

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