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Design and Performance Evaluation of An Arduino Based Activity Tracker

An arduino based fitness and health tracker

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Abstract - Fitness band is an activity tracker that monitors the overall health of the wearer and helps us to predict the fitness plan to be followed on the basis of the number of footstep of the wearer over span of time. The band is connected to an android app where it can show user the various stats monitored by the band and the possible health plan which can be used to achieve the necessary health goals. The fitness band will also help in informing family members in case of some medical emergency.

Keywords—*Activity Trackers, Android, Sensors, Bluetooth, Arduino Nano, Wearable technology*

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I. INTRODUCTION

Today most of the people are concerned about their health and they want to monitor their heartbeat count, how many steps they have taken in past hours or so. The Arduino based fitness band is an intelligent activity tracker that has the capability of measuring the heartbeat and the footsteps of the wearer [1]. A good heartbeat counts results in an active, fit, and healthy body. So our fitness tracker helps the wearer to monitor his heartbeats at real time. Constant monitoring of the heartbeat would allow user to maintain his heartbeat like, if the heartbeat is fast he could take necessary steps to bring it down to normal levels [2]. Similarly, the step count monitoring encourages the wearer to manages the health by walking more if he feels that he has not walked enough. Our band would help to create an awareness among users for a healthy and fit body.

II. CURRENT TECHNOLOGIES

The current fitness band are expensive and are not built using the open source software. The current band requires us to subscribe to yearly package for fitness plan [2]

A. *Advantages*

1) Step counting – Current fitness band can calculate the no. of steps that user has travelled throughout the day.

2) Heartbeat calculation- The current fitness bandcan calculate the heartbeat of the wearer [4].

3) Activity tracking – The current fitness band which are available in the market tracks activity of the user and can be referred by the user at any time [5][6].

4) Wearable – The current fitness band are wearable in nature which help in eliminating the hassle of carrying it around [7].

Disadvantages

1) Water resistance property –The bands are not fully water resistant and will not work in water.

2) Accuracy – The accuracy of the sensor used in the current activity tracker is upto 80%.

3) Power consumption- The power consumption of the band is very high and the power can only last for 5 days on single charge[3].

III. PROPOSED SYSTEM

Our band uses Arduino Nano band which is a cheap alternative and is easily available and configurable. The small size of Arduino Nano board enables it to be easily wear on the hand.

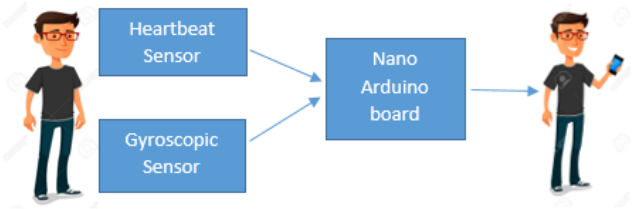

Fig 1: Basic Flow Diagram.

The Arduino Nano board is connected to a small sized breadboard on which the sensors like heartbeat sensor and gyroscopic sensor is connected. The sensor provides the connectivity to the band and is using the HC-06 Bluetooth module for communication with the Android app. The Bluetooth module will provide the connectivity with the android based application.

The proposed system keeps check on the stress level of the individual on the basis of the heartbeat. The app provided with

the band even suggests proper remedy by implementing which the stress level can be lowered substantially.

The proposed system makes use of the Bluetooth technology to report values to the controlling app which helps us in predicting the fitness routine which needs to be followed to achieve the desired results or goals.
The system also keeps track of the time for which you are sitting idle and reminds you when the idle time reaches the desired threshold.
This Confusion matrix describes the performance of the proposed arduino based fitness band in the step calculation process. Formula: One cell contains the True Positive rate(TP): Predicted Number of Steps/Actual Number of Steps *100 depicted in confusion matric below fig 2.

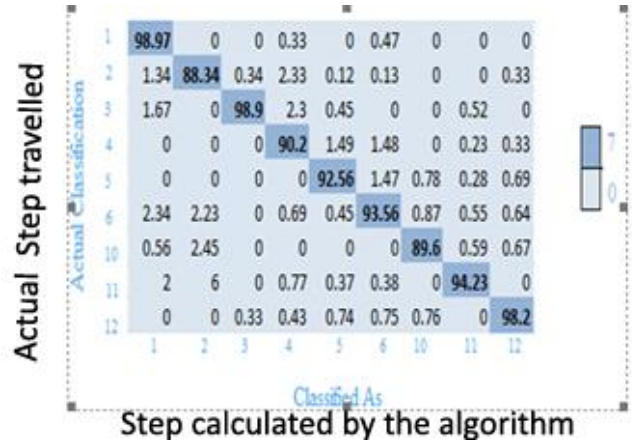

Fig 2: Confusion Matrix

The *accuracy* (*AC*) is the proportion of the total number of steps that were correct. It is determined using the equation (1):

$$AC = \frac{a+d}{a+b+c+d} \quad (1)$$

The *recall* or *true positive rate* (*TP*) is the proportion of positive cases that were correctly identified, as calculated using the equation (2):

$$TP = \frac{d}{c+d} \quad (2)$$

a is the number of correct steps that an instance is negative,
b is the number of incorrect steps that an instance is positive,
c is the number of incorrect steps that an instance is negative,
andd is the number of correct steps that an instance is positive.

A. MPU 6050

The MPU-6050 sensor contains a MEMS accelerometer which has to be combined with a MEMS gyroscope and embedded onto a single chip. It is very accurate, as it contains 16-bits analog to digital conversion hardware for each channel. Therefor it can capture the x, y, and z channel at the same time. The sensor uses the I2C-bus to interface with the Arduino[5].

MPU 6050 is a motion tracking sensor that works on low power. It is very cost effective and has high performance.
It is a combination of 3 axis gyroscope and 3 axis accelerometer on the same silicon chip. It is an IMU (Inertia Measurement Unit) sensor that is compatible with Arduino Nano board. IMU sensors are used to get the altitude of the object to which it is connected.

An accelerometer works on the principle of piezo electric effect. Gyroscopic sensors work on the principle of Coriolis acceleration.

MPU 6050 works on 2.37 V (Volts) – 3.46 V. The Temperature sensitivity ranges from +85 °C to -40 °C.

B. Heartbeat Sensor

Heartbeat is used to measure the pulse count of the wearer. The sensor can be mounted on the breadboard and connected to the Arduino Nano board to provide output in the form of pulse rate count. The power supply voltage is between 3.5 V to 5 V.

C. HC 06 Bluetooth module

Bluetooth is a wireless communication technology used for exchange of data over short distances. It is found in many devices ranging from mobile phones and computers. Bluetooth technology is a combination of both hardware and software. It operates at the band of 2.4 to 2.485 GHz. HC 06 is an Arduino based Bluetooth module that provide the connectivity to the Arduino over Bluetooth. It works at the voltage of 3.3 V. Its working temperature range is -20 to +75 centigrade.

D. Arduino Nano board

Arduino Nano in open source based compact, complete, can be used on any available breadboard. It runs on the ATmega328 microcontroller. Its operating voltage is 5V. It runs on 32 Kilobyte flash memory. It has clock speed of 16MHz. Its size is 18 X 45 millimeter.
It has 22 digital Input/output pins, 8 analog Input/output pins and 6 (PWM) Pulse Wave Modulation pins.

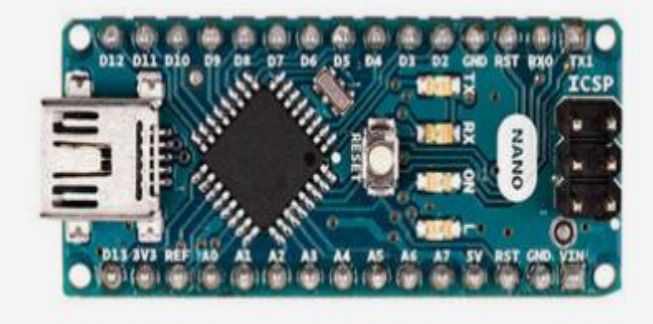

Fig 4: Arduino Nano Board.

E. Android Application

The android application will store and display the stats collected from the Arduino based fitness band via heartbeat sensor, acceleration and gyroscopic sensor.

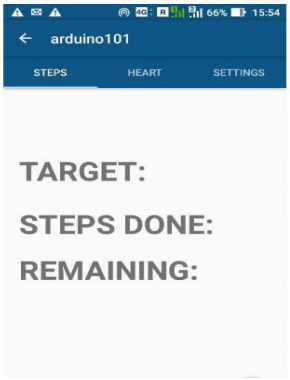

Fig 5: Sample Android App for the fitness band.

The application will consist of three panels each for steps taken, heartbeat recorded and for user settings respectively. Like in the steps panel there will be three text feature that will show the following features:

a) TARGET : The target feature would be given by the user himself. As name tells this field will store the number of steps the user wishes to take. It will always remind of his goal.

b) STEPS DONE : The steps taken feature will contain the number of steps taken by the user the whole time after setting the goal. The data in this field will come from the accelerometer and gyroscopic sensor present on proposed fitness band.

c) REMAINING : The remaining feature will contain the number of steps the user will have to take to reach his goal that was setup by him.

IV. The Application

The application for controlling and displaying the Arduino based fitness band collected stats consists of 3 parts:

A. Calorie Counter

This is the part of the application which makes use of the input from the accelerometer 6050. It implements the algorithm which determines if the number of steps being taken by the holder of the band. Then using the Steps-Calorie-age chart, the algorithm converts the counted steps into calories and helps the holder of the band get a measure of how many calories the person has burnt.

B. Heart Rate Monitoring

This part takes input from the Heart Rate Sensor in the module. The application provides the user to enter custom values for his normal heart rate. It also takes input the contact details of any loved ones of the holder of the band. In case of any steep rise in the heart rate of the holder, these people will be informed via a message on their phones.

C. Settings

This part provides all the customization to the user. It provides the user to change his heart rate settings, change his age and see the battery remaining in the device.

V. LIMITATIONS

Some of the limitations of the proposed fitness band are as follows:

1) The biggest limitation is the battery that cannot last more than 1week. We need a better power backup procedure for its usage in the market.

2) The values obtained from the accelerometer may contain a lot noise which is difficult to separate out from the original values. The same goes for the heart beat sensor. The Bluetooth only adds to noise.

3) The heart rate sensor is also very delicate to set up values as everyone as their own set of normal values for their heart rate.

4) The band is not 100 percent water resistant as the joints are still prone to moisture damage.

5) There can be a lot of work done on lowering the cost of band which includes directly using the ATmega328 instead of the complete Arduino Nano board.

6) Its design has to be modified so that it is fit for all kinds of wrists.

CONCLUSION

The fitness band which is capable of tracking multiple health parameters and overcomes the shortcomings of previous fitness band is achieved. The techniques and hardware used are good enough for practical purposes and the device can make the life of wearer easier by acting as a personal health assistant which will motivate an individual to achieve health targets or goal effectively and productively.

FUTURE SCOPE

In addition to tracking the fitness, the application should provide complete schedule to the user so as to improve his health. Also it should enroll some doctors who may keep track of the exercise of the holder and can continuously guide him upon what to do and what not to do.

1) We wish to bring the payment feature in the proposed system. That way we can use it as an e-wallet and the use of debit cards will not be required. These can also be used at Metro stations.

2) This product has been designed as a prototype and entails further developments for using it in practical life environment. It is high time that the fitness trackers improve their performance if in future they have to give some competition to the ever growing market of smart watches.

3) A button can be added which will send the location, which is detected using the Android device's GPS system, to his loved ones in case of any danger. This is especially helpful for women in case of an assault.

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