

## EXERCISE ORIENTED SMARTBAND IN HEALTH AND FITNESS

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**Abstract** - Exercise helps us to lose weight and lower the risk of some diseases. Physical exercise is important for maintaining weight, regulating the digestive system, building, and maintaining healthy bone density, muscle strength etc. Pushups are the most fundamental exercise type. Here to maintain ourselves in shape, pushups are the best motion exercise that require specific technique to avoid major injury. The smart band will support general exercise development for the same reason. The band "BE FIT SMART BAND" is a brand new, cutting edge, precise and user-friendly smart band that enables the user to exercise properly and to daily track their progress. In addition to measuring the user's BPM, this band forces them to perform pushups and pullups properly. The proposed system upholds accuracy and superior product. Future fitness tools are being provided via fundamental innovation.

**Key Words:** Pushes, Health, Exercise, Technology, SoC- System on Chip, Innovation, Smart band.

### I. INTRODUCTION



Figure 1 Fitness Band

The fast-transferring era, allow the great smart watches hold at pace with you. Smartwatches are right here, whether you want to exercise or relaxation. Smartwatches are prepared with a couple of energetic sports activities modes, like biking, workout, walking, taking walks, mountaineering, and others — making staying match smooth. Not simply bodily health, the ideal smartwatches additionally assist you maintain a check to your intellectual health with guided

meditation. Companies like Boat, Xiaomi, Apple, Fitbit, Noise, etc. are some of the leading manufacturers of fitness smart bands.

These fine of fine clever watches may even help you always live linked with smart notifications for texts, calls, reminders, and alarms. Experience faraway track and camera control out of your health watch. Within the field of wearables, additionally got here up with the exceptional clever watches for ladies This health smartwatch comes with a menstrual cycle tracking feature that allows you to live on pinnacle of your periods cycle, and log on your bodily and emotional symptoms. Its battery existence of up to ten days will maintain you always alert with smart notifications from your smartphone and vibration signals for calls, texts, timetable reminders, alarms, & extra. While other fitness bands emphasize activities that need a lot of heart rate, including walking, jogging, cycling, swimming, etc. The motion warm-up activities that are helpful for muscle growth and having correct training with crisp accuracy are the emphasis of this proposed system.[1]

### II. LITERATURE SURVEY

The market is full of many fitness bands now. However, a Japanese scientist named 'Dr. Yoshiro Hatano' developed the first fitness band in 1965. The smart band initially just included a timer and a pedometer, which tracked the user's steps and computed how many calories were burned. His main aims were to reduce weight and maintain track of his daily fitness. But now, smart watches have the potential to support health in everyday living by enabling self-monitoring of personal activity; obtaining feedback based on activity measures; allowing for in-situ surveys to identify patterns of behavior; and supporting bi-directional communication with health care providers and family members. However, smart watches are an emerging technology and research with these devices is at a nascent stage.[9] Studying various smart bands and their features, these smart bands work on calorie measurement technique and step count which helps the user to keep track on his calorie burn and fitness activity. These

bands work with couple of sensors like Accelerometer, Optical Heart rate sensor, Gyroscope sensor and have the compatibility feature which helps them to easily connect with Android and iOS devices of some desired versions using Bluetooth. These

smartwatches come with Lithium polymer battery which makes them to perform continuously up to 6-7 days. These features are easily available in modern smart bands. But there are some extra features like Call and SMS notification, Camera, Memory card reading, GPS, built in AI like Alexa or Siri (for Apple watches only) which are specifically installed in high end smart bands like Apple watch series 7, Fitbit pro, Boat Xtend band, Noise Color fit pro, etc. These features are required for outdoor workout or cardio based exercise activities.[3]

Health and fitness are most fundamental aspects of human life. But due to Covid-19 pandemic and regular stressful lifestyle people are ignoring their personal physical as well as mental health. This is causing a huge adverse effect on every individual's lifestyle. Considering these factors, every individual must exercise to keep himself/herself fit and healthy. There are some bands like "Corona Warrior Smart Bands" which measures the health parameters such as pulse rate, temperature, and oxygen content present in blood of the user. [19]

Some motion exercises like pushups can be easily done at home without any heavy equipment. But performing these kinds of motion exercises requires proper technique and attention or else it might get you a serious injury. To avoid this, there should be some tracker to monitor our exercise. But designing something which would be used in house, which would be certain exercise based and which would be pocket friendly for the users. For this, we have designed a system which will make the users workout easy and focused based on proper exercise. This band will aid the user to do his/her Pushups neatly without getting any injury or muscle pain.

### III. PROPOSED SYSTEM

The proposed system presented is an upcoming innovative smart band which helps the user to perform pushups neatly with proper technique and preventing the risk of muscle injury to the user. As it is focused to a particular exercise, it performs on its full potential while the user exercises. It measures the distance between the user and the ground and when a satisfactory distance is achieved it generates a count of pushups performed. Also, it measures the speed of the user while exercising to maintain a track record of his/ her exercise consistency. Unlike other smart bands, it is easy to use. Its performance speaks more than its features.[2]

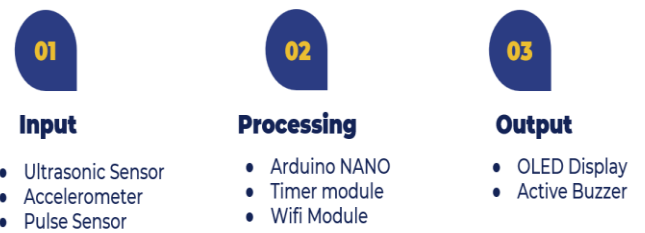


Figure 2 Technical Implementation of the proposed system

At the input stage we have used an Ultrasonic sensor, an Accelerometer, and a Pulse Oximeter sensor. At the processing stage we have used an Arduino Nano as our main microcontroller board, a timer module, and a Wi-Fi module. At the output stage, we have installed an OLED display and an active buzzer. We have used Arduino IDE and Things Speak software platforms.[2]

#### A. Input

1. Ultrasonic sensor (HC-SR04)

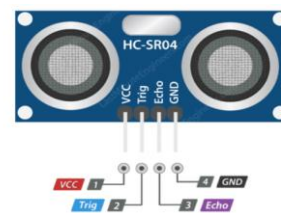


Figure 3 Ultrasonic sensor

Distance measurement becomes easier using Ultrasonic sensors. It is used to measure the distance between body and ground. It is tied at the chest level. When the distance between body and ground crosses 10cm, it generates a count. [8]

2. Accelerometer (ADXL 335)



Figure 4 Accelerometer

It is used to measure the speed of the body of the user while exercising. This speed is monitored to keep a track record of his/her daily exercise performance.[3]

3. Pulse Oximeter sensor (MAX 30100)



Figure 5 Pulse and Oximeter sensor

A sensor system with just an embedded pulse oximeter & cardiac monitor is named MAX30100. It is used to measure pulse rate and oxygen level in the user's body before exercising, during exercising and after exercising. This data helps the user to keep an eye on his health as well as to plan his exercise routine.[21]

**B. Processing**

1. Arduino Nano (ATMEGA 328P)



Figure 6 Arduino NANO

Arduino Nano is used as our main microcontroller board. Its miniature size makes it easy and suitable for making compact and light weight circuit designs. The user-friendly design and light weight factors won't disturb the user while performing his/her exercise activity.[9]

2. Timer Module (DS3231)



Figure 7 Timer module

The DS3231 is an I2C real-time clock with an embedded crystal oscillator and crystal that is low-cost and high precision. RTC keeps a record of seconds, minutes, hours,

days of the week, dates, months, and years. This is used to display time and date to the user. This increases specificity in keeping the track record of exercise activity.[6]

3. Wi-Fi Module (ESP8266)



Figure 8 Wi-Fi module

Using the Wi-Fi module, the system prohibits any third-party software to transfer or maintain data.[15]

4. Li-Ion battery (RYX-NX9)



Figure 9 Li-ion rechargeable battery

Li-ion battery is used as power source for our band. Its 380MAH power storage allows the Band to operate 6 days easily. It is rechargeable in nature, so there's never a problem of battery replacement.

**C. Output**

1. OLED display screen (SSD1306)

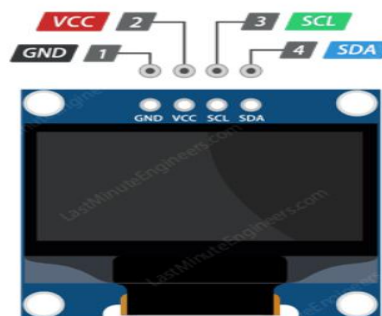


Figure 10 OLED display screen

It is one of the most attractive displays of a microcontroller. The OLED display will display exercise count, pulse rate and oxygen level of the user. The clarity of the OLED display is better than others.[1]

2. Active Buzzer



Figure 11 Active buzzer

In the proposed system, an active buzzer can turn it ON and OFF to make various sounds. It indicates when a person halts for more time while exercising to indicate to him/her to complete the exercise quickly. After completion of exercise the buzzer blows continuously for a minimum of 10 second. If the buzzer beeps, it indicates the user to complete his/her set exercise. [2]

IV. METHODOLOGY

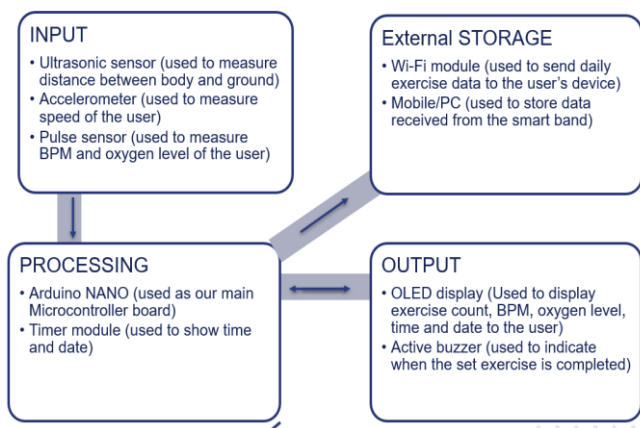


Figure 12 Working of the proposed system

In this smart band, an Ultrasonic sensor is placed at the chest level. Also, an accelerometer is placed beside the ultrasonic sensor. The user must set the count of exercise he/she wants to perform and then start the exercise. As the user starts exercising, the ultrasonic sensor measures the distance between body and ground. The accelerometer used measures the speed of the user while exercising. The pulse oximeter sensor measures the BPM (Beats Per Minute) and Oxygen level content present in the user before exercise, during exercise and after exercise. This helps to keep an eye on his/her health and avoid exertion. All the data collected

from the sensors is sent to the microcontroller board for storing and processing purposes. A timer module is also used to display Time and Date to the user. If the user halts for more than 20 sec while exercising, there's a buzzer ringing indicating the user to do his/her exercise quickly. When the user completes the set exercise count, buzzer blows indicating that the exercise is completed. Exercise count, BPM, Oxygen level and Time and Date is displayed on the OLED display.

A Wi-Fi module is used to send the exercise data to the user's smartphone or PC. This data helps the user to keep a track record on his/her exercise.[2] [4]

V. CONCLUSION

Table 1 Comparison table

Pushups Counter smart band	BE FIT SMART BAND
Uses ultrasonic sensor for pushups measurement.	Uses accelerometer and Ultrasonic sensor for pushups monitoring
Uses only pulse sensor for BPM measurement	Uses MAX30100 sensor for BPM and oxygen level monitoring.
Uses simple 16x2 LCD display Uses external power supply	Uses OLED display for clear visuals. Uses a rechargeable Li-ion battery.

Comparing some more smart watches with the proposed system model, shows that the operation of this band is quite different from other smart bands as it only focuses on a particular type of exercise.

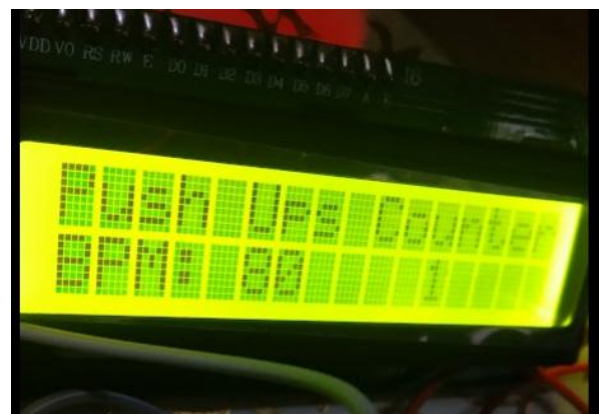


Figure 13 Output of the proposed system model

Figure 13. shows type of exercise i.e., Pushups, pulse rate (BPM) of the user and the count of pushups performed by the user using the proposed system model.

Table 2 Pushups speed monitoring

Mon	Tue	Wed	Thurs	Fri	Sat
19	18	11	15	18	20
19	19	16	15	18	20
17	19	16	18	20	20
20	20	18	17	16	18
19	20	18	17	19	18
18	20	19	19	18	17
19	18	20	19	18	15
18	19	20	20	15	19
20	18	20	19	14	19
17	18	20	18	15	14
17	18	17	15	16	15
19	20	17	16	17	14
19	20	18	15	16	17
19	17	19	12	17	10
17	15	15	10	17	15
20	18	12	10	20	16
18	11	16	15	20	18
15	16	14	14	12	19
18	18	19	18	16	16

Table 2 Working statistics

Ultrasonic count	Accelerometer count	Actual pushups
10	19	1
10	19	1
10	17	1
10	15	1
10	18	1
10	19	1
10	19	1
10	17	1
10	18	1
10	20	1

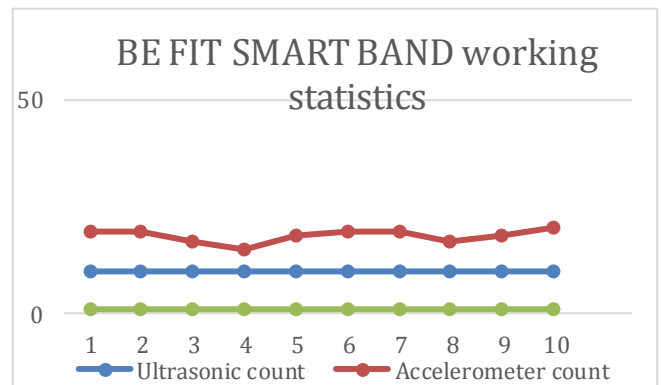


Figure 15 Working statistics of BE FIT SMART BAND

Figure 15. shows the statistical analysis of the proposed system. It is seen that while operating this band, it gives precise outputs indicating the accuracy of sensors calibration and performance. Green line indicates Actual pushups performed by the user while using this band. The Blue line indicates count generated by Ultrasonic sensor and the red line shows the speed of the user marked by the Accelerometer used.

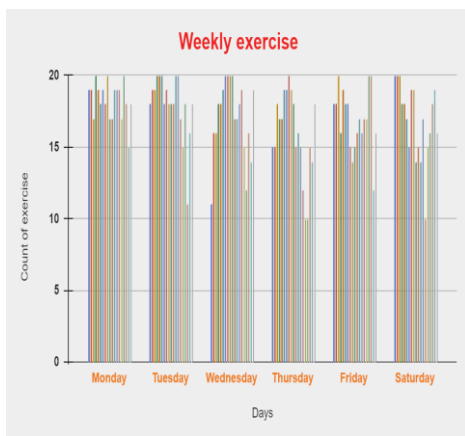


Figure 14 Weekly exercise output

Figure 14. show the consistency in exercise by the user. As the user performs exercise while using the proposed system, the accelerometer used in it measures the speed of user's body and monitors it. Also, a graph is plotted for virtual representation of consistency in user's exercise routine. The user can keep a track of exercise using such data and can develop his/her exercise routine.



Figure 16 BPM monitoring

Figure 16. show the pulse rate i.e., BPM of the user while exercising and after exercising. This data helps the user to avoid fatigue and exertion while exercising. This data is purely based on sensor’s sensitivity and user’s heart rate at the time of monitoring.

accurate. But Be Fit smart bands aren't that expensive, anyone can get it, and push-ups are counted accurately, so the accuracy is 100%. Therefore, the Be Fit smart band is cheaper and quite different compared to the smart bands already implemented.



Figure 17 Oxygen level monitoring

Figure 17 shows Oxygen level in the user while using this band. Oxygen level monitoring is done to be stable and avoid exertion. This data is also purely based on sensor’s sensitivity and user’s heart rate at the time of monitoring.

The Be Fit Smart Band works effectively and shows the exercise, count of exercise, pulse rate and oxygen level of the user on the display screen. This device helps the user to perform his/her exercise and to be in-shape. All the components work effectively and give precise readings. The table above shows the readings measured by Accelerometer while performing exercise. The BPM and Oxygen level data is displayed virtually using the ThingSpeak platform.[2] [11]

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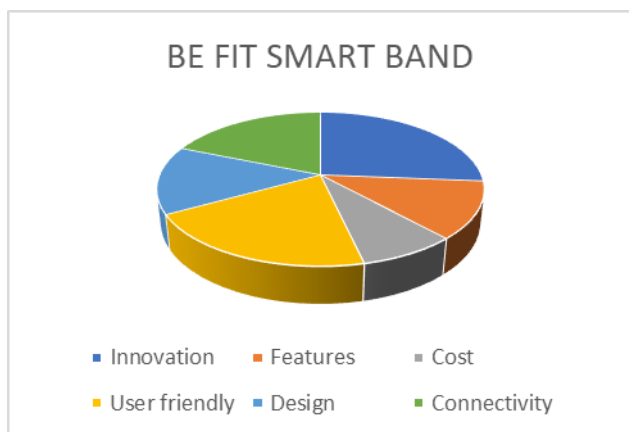


Figure 18 User's feedback

Figure 18. shows the active feedback given by the users after using BE FIT SMART BAND. The pie-chart illustrates users likeliness’ to the features of this band. As this is a prototype, its features are less compared to other smart bands. But looking to other aspects it is user friendly and pocket friendly too. The unique design and smart innovation also catch eye of the user.[2]

Other smart bands already implemented measure a variety of things that are the result of physical activity, such as steps, heart rate, calories burned, and distance travelled. But so far, no band has been implemented to count push-ups and pull-ups for users wearing Be Fit smart bands. Smart bands already implemented are very expensive. If we didn't use them, we could have spent your money on something more convenient, and these smart bands aren't 100%

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