IOT based Wearable Smart Health Band Assistance

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Abstract—: **Web is a significant piece of our life. It has empowered various gadgets to be checked, examined and control absent a lot of human mediation utilizing Internet of Things (IOT) Technology. IOT is a blend of sensors, controllers, remote gadgets for information correspondence. Wellbeing applications are drawing in much consideration and have become a quickly developing part with the expanded prerequisite for self-wellbeing observing. This research paper is an effort to present a measuring device that collects information about physical parameters of human body like heart rate, body temperature, alcohol amount etc. using wearable sensors and helps to analyze and monitor parameters by sending them to android interface using Wi-Fi. The information will be continuously stored on the cloud. This information can be obtained by using a smart health band and a smartphone app. The wearable estimating gadget permits a person to be portable in their own social condition, self-observing and permitting them to live their lives in certainty. The remote prosperity watching system can be applied in the accompanying circumstances:**

- **Critical body organ circumstance.**
- **The circumstance prompting the improvement of a dangerous perilous condition. This is for individuals at a propelled age and possibly having bombing wellbeing conditions.**

Keywords— *BPM, IOT, Smart health, Temperature, Wearable sensors, Wi-Fi.*

I. INTRODUCTION

In the ongoing years remote innovation has expanding for the need of maintaining different parts. In these ongoing years IoT fussed a large portion of mechanical zone extraordinarily robotization and control. Biomedical is one of ongoing pattern to give better medicinal services. In medical clinics as well as the individual wellbeing caring offices are opened by the IoT innovation. For checking procedure and documentation at hospital it requires a ton of time for enrolment, arrangement and afterward check-up. Likewise, reports are produced later. Because of this long procedure working individuals will in general disregard the exams or delay it. This cutting-edge approach diminishes time utilization all the while. Wearable wellbeing observing innovations, including shrewd watches and wellness trackers, have pulled in significant customer enthusiasm in the course of last not many years. Currently, present day wearable gadgets are not, presently just dependent on clear wellbeing following estimations, for example, the measure of steps taken in a day, they also screen immense physiological assessments, for example, Heart Rate Variability (HRV), glucose measures, circulatory strain readings, and much extra success related information. Among the diverse fundamental signs surveyed, the beat (HR) count has been one of the most noteworthy parameters. For a long time, record Electrocardiogram (ECG) has been utilized as a commanding cardiovascular watching framework to perceive cardiovascular anomalies and to see abnormalities in heart rhythms. For example, for the ECG to work viably, a couple bioelectrodes must be set at certain body domains; this system extraordinarily confines the moving adaptability and transportability of the clients.

II. MATERIALS AND METHODS

Different parameters, for example, Heart rate, internal heat level which are viewed as significant markers of wellbeing status, have an enormous analytic worth. These days, constant and effectively checking of these wellbeing parameters has been conceivable outside the medical clinic condition. With the headway of wearable innovation, these parameters can be observed precisely, ceaselessly and continuously.

Photoplethysmography

Heart beat is the sound of valves that powers the blood starting with one area then onto the next. The occasions heart pulsates every moment (BPM) is the pulse. Heartbeat is the weight of blood pushing against the dividers of a supply route as heart thumps. Heartbeat felt in the arteries that untruth near the skin. Photoplethysmography (PPG) is a basic optical estimation technique. It is frequently utilized for pulse checking purposes. PPG is an innovation that utilizes an optical force variety as light is dissipated or ingested during its way through the blood as the heart beat changes. It utilizes light source (LED) and a photodetector at the outside of skin to quantify the volumetric varieties of blood course. An infrared light transmitting diode (IR-LED) or a green LED are utilized as the principle light source in most normal PPG sensors. IR-LEDs are for the most part utilized for estimating the progression of blood IR-LEDs are for the most part utilized for estimating the progression of blood which is all the more profoundly amassed in certain pieces of body like the muscles. This is on the grounds that it all the more profoundly enters into tissue and henceforth can give increasingly precise estimations. PPG sensors likewise utilize a photodetector to gauge the power of reflected light from the tissue. In view of the measure of the distinguished light, the blood volume changes can be estimated (calculated). Wearable PPG sensors must be put at certain body areas as appeared in Fig-1.
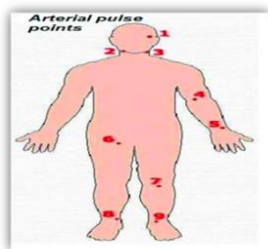
Fig-1: Pulse points in a human body

The PPG's ability to measure blood assortments in different bits of the body and its potential ability to distinguish physiological parameters that are associated with the cardiovascular and respiratory structures has continued convincing standard analysts to become progressively unassuming and significantly exact wearable PPG-based contraptions for checking step by step plan works out.

III. REVIEW OF LITERATURE

Bhasker Pandey et al [1] delineates that it is profitable for more seasoned people and steady patients who require relentless checking. This structure performs fundamental prosperity enlistment by evaluating the body parameters typically and report the data to the experts. The result data are then appeared as verbalizations in a web application where pros and patients can team up with each other.

Dimitrov et al [2] Internet of Things (IoT) and appropriated registering expect a crucial activity in the present Tele-watching prosperity system. This structure screens patient's physiological parameters through arrangement of body sensors' data using Arduino Lilypad board. The patient's prosperity card appeared on a site page where authorities and patients can get to and bestow each other without physical closeness.

Zois et al [3] Using appropriated processing, the data can be taken care of, revived and got to from wherever on the planet. It is genuinely sensible for provincial districts where clinical workplaces are not available.

Hassanalieragh et al [4] Being long range remote headway, crisis circumstance of the patient's success is immediately perceived and great intercession prompts spare the life of the patient. This structure amasses information of different body parameters through Biosensors, wearable gadgets and speedy materials and it transmits the information to focal focus point server safely. As needs be, the server shares the gathered information to the offices for additional treatment.

Hamrioui et al [5] the server rings alarm to the salvage vehicle during emergency condition. Evaluation is of two segments: 1) Qualitative gathering and 2) Quantitative Survey. The standard test is to make seniors outfitted with for growing new advances and to become acknowledgment towards Smartphone, PC, etc. IoT based Smart restorative administrations with the help of quick devices and things improves the social protection watching system satisfactorily.

Hamrioui et al [6] IoT nearby wise contraptions decline multifaceted nature and ensnarement in the social protection system. The invasion of compact advances and smart contraptions over social protection system cause enormous impact on the world.

Ahouandjinou et al [7] In remote versatile prosperity watching structure, the patient prosperity parameters are recorded by a propelled cell phone by clearing out an additional hardware and transmit data through a web interface.

S. Lorenz et al [8] It urges from beginning to end watching screen through three phases. At first, the consistent prosperity parameters are evaluated through wearable sensors and transmitted to a propelled cell which shows the patient prosperity status in graphical interface. Likewise, this structure gives a data to relative and master through web interface for extra checking.

Wan. J et al [9] Secondly, the huge test is of the precision, authenticity and decency of estimation data with various devices. Thirdly, the convenience and the experiences of the customer with the contraption and its kind supporting programming expect crucial employment in continuing with standard and broad stretch use of wearable GPS guides.

Sahu S et al [10] Various systems strategies that are used in IoT in the review with good conditions and shortcomings that ought to be kept an eye on later on for development of the social protection checking structure.

IV. BLOCK DIAGRAM & WORKING

System is designed to serve the purpose of helping people to monitor their own health parameters like heartrate, body temperature and activeness based on blood alcohol content. In this system, pulse sensor is used for calculating heart beats as BPM (beats per minute). Temperature sensor LM35 is used to collect body temperature data in Celsius degrees and MQ-3 alcohol sensor have application in determining the alcohol estimation in a body, based on which response of body is shown. Arduino nano is used as a controller. Bolt IoT Wi-Fi module is used for communication.

A] Input Unit
Sensors are surrounding us; these are the gadgets that identify physical and natural signals and give an approach to such motions toward be estimated and recorded. Sensors act as an input unit to collect raw data and these are connected to analog pins of Arduino i.e. to controller unit.

B] Controlling Unit
This is the unit on which calculations are performed to extract meaningful information about health parameters which is done using Arduino programming. Arduino nano is a controller of choice for this project. Necessary computations are performed to get appropriate data.

C] Output unit

Health parameters are displayed on a TFT display to user. As the system is designed to be wearable, it should be compact as possible & hence 1.8-inch TFT display is a choice.
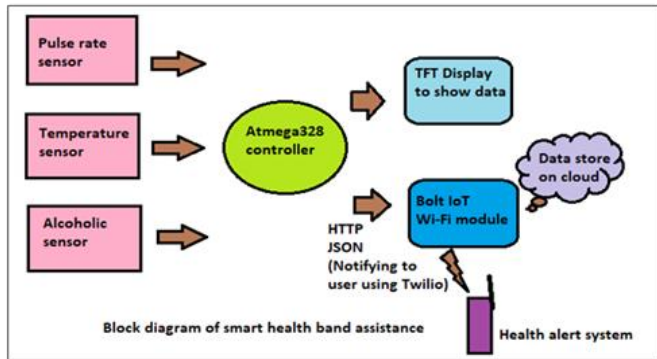

Fig-2: Block diagram of health monitoring system

D] Web connectivity

For communication, Bolt IoT Wi-Fi module is used. Health parameter body temperature is monitored and stored on a cloud. Progress of health conditions can also be monitored. Bolt Android application is used for monitoring body temperature time to time. It also shows the data over long period i.e. 10-12 days and hence can help doctors to make treatments for patients. For creating health alert system, Bolt IoT Wi-Fi module is linked to a Twilio service provider platform. Twilio provides SMS services. After linking credentials of Wi-Fi module and Twilio, a code is written using python to notify user. In a python code, moderate health parameters and actual health parameters are compared. If they are not matched, a request is made by Twilio to notify user with his/her health conditions. Users get notified after certain intervals, which helps them to continuously keep track of their health conditions.
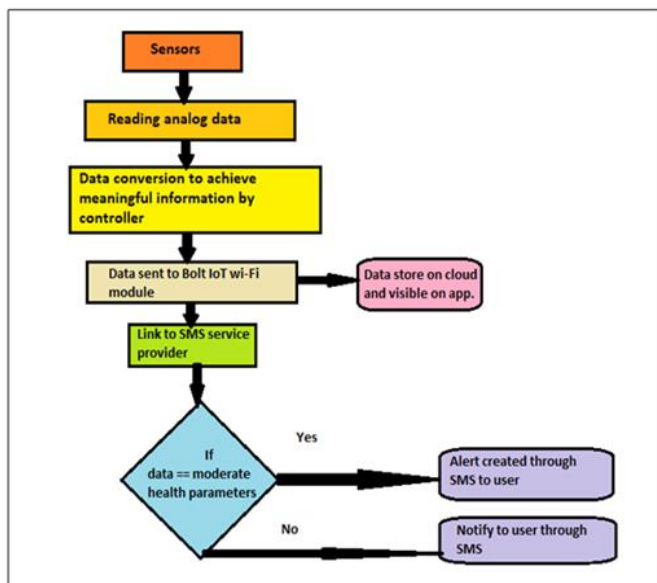
V. FLOW CHART

Fig3: Flowchart for smart health band assistance

VI. HARDWARE REQUIREMENTS

A] Pulse sensor

Heartbeat Sensor is a basic sensor used to quantify pulse. This sensor utilizes optical strategy for estimating pulse. In which with each heartbeat, there is a spike in blood vessel (oxygenated) blood, which is identified as an adjustment in the absorbance and additionally reflectance of red or potentially infrared light.
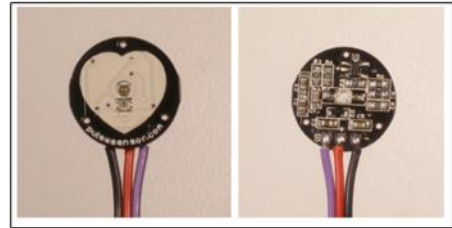

Fig-4: Pulse sensor

Optical heartbeat sensors utilize a framework called photoplethysmography (PPG) to gauge beat. PPG is a specific term for shining light into the skin and assessing the extent of light that is scattered by flow framework. There are two sorts of photoplethysmography:

1.Transmission: Light transmitted from the light radiating device is transmitted through any vascular region of the body like ear ligament and got by the discoverer.

2.Reflection: Light released from the light emanating contraption is reflected by the regions.

B] LM35 temperature sensor

LM35 is an exactness incorporated circuit simple sensor. It creates simple voltage, corresponding to temperature of human body detected by it. The yield voltage produced by sensor is relative to the Celsius or centigrade temperature. The sensors working base is the voltage that is perused. The temperature rises at whatever point voltage increments.

Linear scale factor of LM 35:

LM 35 gives straight yield. It has scale factor of +10 factories volt for each degree centigrade. It implies that with the expansion in yield voltage of sensor by Vout pin by 10 factories, the temperature esteem increments by one. The equation to change over the voltage to centigrade temperature for LM35 is:

Centigrade Temperature = Voltage Read by ADC/10 mV

C] MQ-3 alcoholic sensor

Alcohol Sensor Module is made utilizing Alcohol Gas Sensor MQ3. It is semiconductor sensor, which has high affectability to liquor. Module has radiator on it. The radiator gives important work conditions to work of touchy segments on module. Radiator set aside some effort for consuming. The heater is appeared as in Fig-5.

Fig-5: MQ-3 alcoholic sensor

The wrapped MQ-3 have pins, used to get signals, and for giving warming current.

• Relation between blood alcohol content and sleep deprivation:

An investigation shows that moderate lack of sleep produces debilitations comparable to those of liquor inebriation. Moderate absence of rest produces crippling in mental and motor execution equivalent to legally suggested degrees of liquor intoxication. Studies show lack of sleep execution resembles being influenced by alcohol. These discoveries fortify evidence that the unfriendly effects of absence of rest are a critical factor in execution of speed and accuracy required for prosperity - this join driving.

Goal of study: To analyze the relative consequences for execution of lack of sleep and blood alcohol content.

Discoveries:

1. After 17 to 19 hours without rest, execution was equal or more terrible than that of a blood liquor fixation (BAC) level of 0.05 percent. After longer periods without rest, execution arrived at levels proportional to a BAC of 0.1 percent.

2. Response speeds were up to half slower for certain tests and exactness measures were altogether less fortunate than at this degree of liquor.

By missing one day's rest as of now makes you legitimately unequipped for driving. By contrasting the adjustment in execution due with liquor utilization at focuses generally assented to be perilous (0.05% blood liquor fixation (BAC)) with the comparative conduct after lack of sleep, it should be conceivable to survey the measure of lack of sleep at which identical shortfalls happen. We utilized MQ3 alcoholic sensor to gauge liquor content in a body approx. what's more, rely upon the convergence of liquor, client will get a thought regarding his/her states of being in stages, for example,

- Awake, Slow response, Need some sleep, Drunk.

D] Controller

The Arduino Nano is a little, reduced, adaptable and breadboard-accommodating board, which depends on ATmega328microcontroller. It just differs from Arduino UNO in a size. It's small size and breadboard neighborly nature makes it ideal for greater part of uses where a size of the electronic sections is of amazing concern.

E] Display Unit

The 1.8 TFT is a colorful display with 128 x 160 color pixels. This Display is the best way to add a small, colorful and bright display to any project.

- It has 128×160 shading pixels.
- Its TFT driver (ST7735R) can show full 18-piece shading (262,144 shades)
- 1.8-inch TFT LCD utilizes 4 wire SPI to convey.
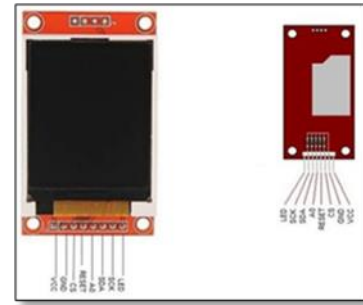- Able to compose content, draw shapes and show pictures on the screen.

Fig-6: TFT display

- **Library:**

The Arduino TFT library broadens the Adafruit GFX, and Adafruit ST7735 libraries that it depends on. The GFX library is liable for the drawing schedules, while the ST7735 library is explicit to the screen on the Arduino screen. The TFT library depends on the SPI library, which must be remembered for any sketch that uses the screen. For utilizing the SD card, we have to incorporate the SD library also.

- **Programming of TFT:**

After making essential connections for SPI communication between Arduino and TFT, we need to include libraries such as TFT, SPI, SD card etc. Flow of program consist of including libraries, defining pins of TFT, Instantiating a named instance of the TFT library, and programming of void setup () and void loop () functions. TFT can be used to draw shapes, show text and images.

- **Graphics Primitives**

Pixels: picture components, the squares involving a computerized picture — are tended to by their even (X) and vertical (Y) arranges. The arrange framework puts the inception (0,0) at the upper left corner, with positive X expanding to one side and positive Y expanding descending.
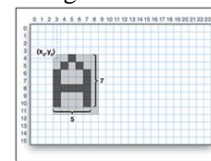

Fig-7: Pixels format

VII. SOFTWARE REQUIREMENTS

A] Bolt IOT Platform and Bolt IOT app for Android
1.Setting Up Bolt device:

Here comes the job of Bolt IoT versatile App and introducing it in the cell phone.

Bolt IoT App: It helps in setting up Bolt module and monitoring data on cloud after linking.

Stage 1: Downloading the App.

Stage 2: Creating the Account. To making and actuating the record we have to add gadget to account.

Stage 3: Adding Bolt to account.

Stage 4: A green dab will show up next to the Bolt's gadget ID in the event that it is effectively associated with Wi-Fi system and cloud. Hence, it shows that your device is online.

Fig-8: a) Bolt setup is complete b) Device is online

2. Communication of Bolt devices with Bolt Cloud

By visiting Bolt Cloud (cloud.boltiot.com), and signing in to your enrolled account, you will see your Bolt gadget with status as 'On the web' on your record on the dashboard as follows:
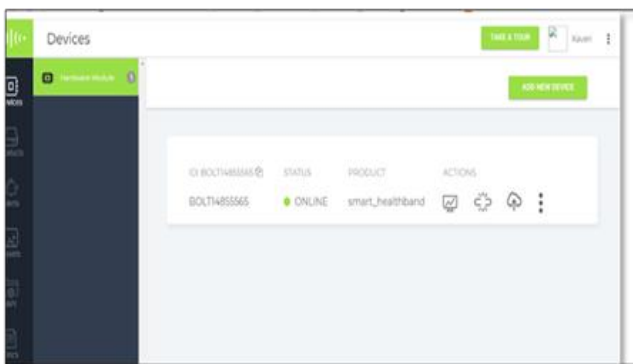

Fig-9: Bolt cloud Dashboard

3. Visualizing the Data (Plotting Graph) on the Bolt cloud

To visualize the body temperature data on a bolt cloud, we need to create a product, here named "smart_healthband" and configure it. We will show the body temperature data using a line graph. After linking the product with the bolt device is done, we need to deploy configuration and to see the data on a cloud, click "view this device "icon. The

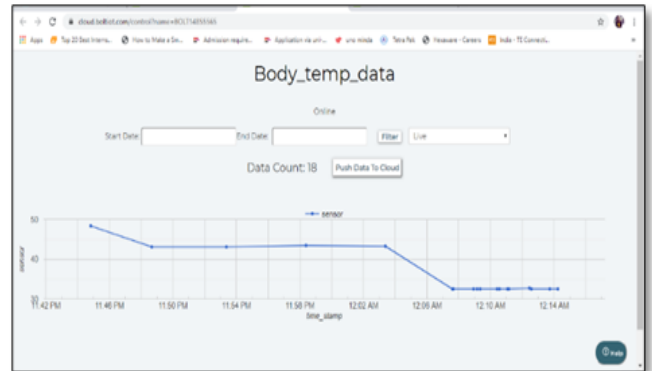body temperature variations using several data points is shown over a bolt cloud as follows:

Fig-10: Data monitoring on Cloud

4. Use of Bolt app to visualize data:

We can continuously monitor our own body temperature using this app. Wearing smart health band with internet connectivity, provides us necessary information about body parameters time to time. This data can also be shown to doctors and in hospitals as a health record and can help doctors by indicating variations in health parameters. Subsequently it can support clinical offices and experts to deal with patient's medicinal services better. Body temperature data over particular time is shown below:

Fig-11: Data monitoring through Bolt android app

B] Twilio

Twilio is a cloud communications platform that provides SMS functionality. We can send and receive messages and make phone calls using web services API's of Twilio. Twilio works between the two systems for example Web and communication. It starts with the telephone number. A Twilio phone number gives a virtual closeness on the physical correspondence arrange. Client needs to buy a number and it is relegated by Twilio. Same number can be designed by client for informing interchanges. In this health alert system, we are notifying user with his/her current body temperature. He/she will receive a normal

text message when having body temperature within range 33-37 degrees, which is a moderate temperature range. Other parameters like heart beat and alcohol content-based activeness can also be implemented in a same way. After successfully signing into Twilio account, we have to

- Verify a number to which message will be sent.
- Create a product and link it with your Bolt IoT dashboard.
- Choose "Programmable SMS" and click on Get Started button to generate phone number.
- Now, creating SMS alert system.

We have used Ubuntu operating system with the help of VM virtual box. Using python files to store credentials of Bolt IoT account and a file containing main code to collect the data from the cloud and SMS. Twilio is linked to Bolt IoT account. Body temperature is sensed in a real time and now the event of sending messages to customer starts with Twilio's Programmable SMS Interface. Twilio's API take incoming HTTP request and starts performing requested action of sending messages as shown:

```
Reading sensor value
Sensor value is: 333
Reading sensor value
Sensor value is: 2
Making request to Twilio to send a SMS
Response received from Twilio is: <Twilio.Api.V2010.MessageInstance account_sid
=AC60234f4c4b05ba62acdbed5ebe74d7d7 sid=SM25c8fc20dabb42cbba263f87c4707274>
Status of SMS at Twilio is :queued
Reading sensor value
Sensor value is: 328
Reading sensor value
Sensor value is: 328
```

Fig-12: Output of body temperature on terminal window

The wellbeing ready framework can send a HTTP solicitation to Twilio's API to send an instant message from the application's telephone number to a client telephone number, with a message containing the clients current internal heat level. Inside Twilio, that message is added to a line where messages are sent successively in a first in first out manner. After Twilio lines the message for conveyance, the message is gotten by the organization obligated for sending outbound message. There, it is given further to transporter through SMPP and internal heat level is sent to client's cellphone as appeared as Outcome:
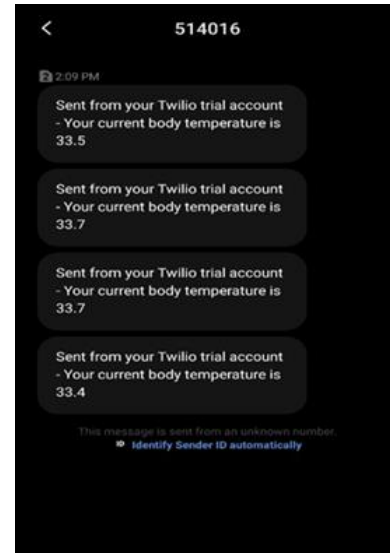
Fig-13: Health alert SMS

VIII. OUTCOMES

interruptSetup() is an ISR function. ISR (Interrupt Service Routine) is used for health monitoring system to work in a real time. When external interrupt occurs processor first executes the code in ISR and then returns back to state, where it left the normal execution.
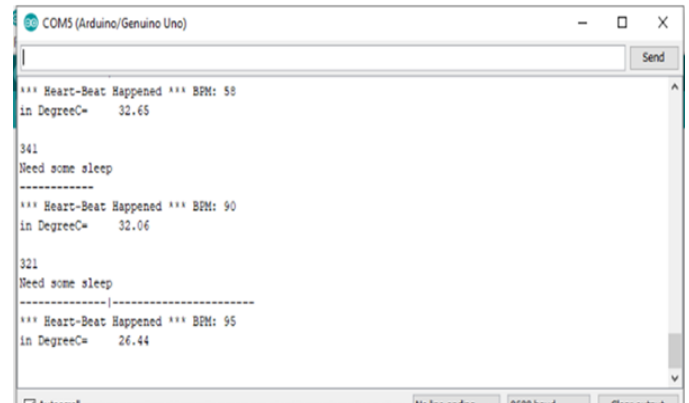
Fig-14: Output of heart rate, body temperature and response of the body

Health parameters can be visualized on a serial monitor by setting proper baud rate. As shown in output Fig-14, whenever heartbeat happens, Interrupt in enabled and ISR function works. Heartbeat data is provided in a BPM term. Body temperature is shown in degree Celsius and response of a body is shown as "Need some sleep" based on a blood alcohol content.

IX. RESULT AND DISCUSSION

This whole structure will be fused into a compact wearable band, blending this development reliably into the patient's life. The utilization of IOT in health care systems is expanding step by step because of the sensors engaged with it. That permits remote wellbeing observing, older consideration and numerous physical projects. The small, amazing, improved sensors and their ability in health band related by methods for IoT, empowers the checking system to push toward the patient instead of the patients advancing toward the expert for observing their health. The sensors inside health band sense health data & further

this information is sent to individual's cell phone for analyzing one's health status. The data can also be stored on a cloud and can be used for future refer.

X. CONCLUSION

This paper revolves around the beat rate, internal heat level and blood liquor content checking and making ready which can screen patients internal heat level condition. The system chooses the wellbeing information each second and a while later sends short message organization (SMS) caution to the Phone. This IOT based wearable health band is compact and practical. It is an effective framework and exceptionally simple to deal with. In this manner it gives incredible adaptability and fills in as an extraordinary improvement over other traditional checking and ready frameworks.

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Conflict of Interest: The authors declare no conflict of interest.

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