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MONITORING AND TRACKING OVERWEIGHT & OBESITY USING IOT

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Abstract:

Obesity and obese are stated as an international issue. It has been linked to each cutting-edge and a greater danger of creating a variety of persistent diseases, such as the generic cardiovascular ailment (CVD). Body Mass Index (BMI) calculates a person's physique weight in relation to their peak and also predicts their chance of growing obese. BMI monitoring is consequently crucial for monitoring and controlling obesity. Existing strategies for estimating BMI that predict weight problems are both pricey and want a lot of processing energy or they are no longer cloud-based. This find out about goals to create an Internet og Things IoT (IoT) machine that can apprehend and normalize things to do that amplify a person's chance of obesity or ingesting problems. We would supply a textile for estimating BMI the use of IoT with weight problems prediction. Based on records gathered from wearable tools, this gadget will make pointers on what to consume and how to exercising to forestall obese and weight problems.

Keywords: Smart health monitoring system, Wearable tools, obesity, smart scale.

1. INTRODUCTION

The two essential motives of obesity are immoderate consuming and inadequate exercise. Your physique will save a massive element of the more energy you consume, specifically fats and sugar, as fats if you do not burn them off thru exercising and different types of exercise [1].

Calories can be described as tools of size of the quantity of power in food. In order to preserve a in shape and toned body, a bodily perfect man wishes about 2,500 energy for the duration of the day and a bodily energetic girl wishes about 2,000 energy per day. This quantity of energy may also appear like a lot, however if you eat sure foods, it can be effortless to attain them. Taking a big takeout hamburger, for instance, 1,500 energy can be located in a dinner of fries and a milkshake. Another hassle for some human beings to be lazy, energy is transformed into fat that are saved in the body. Obesity does no longer appear suddenly.

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Rather, it varieties progressively over time due to terrible consuming habits and life-style decisions, including: eating a lot of processed or fast food.

- Overindulging in alcohol.
- Dining out frequently.
- Consuming excessive amounts of sugary beverages.
- And comfort eating.

The grasp layer is separated into two sub-layers: the first is for perceiving the bodily world, gathering and processing data, and the 2d sub-layer is for speaking with bodily entities with the community layer and the software layer. The community layer is viewed as a get admission to layer in the IoT architecture. [2].

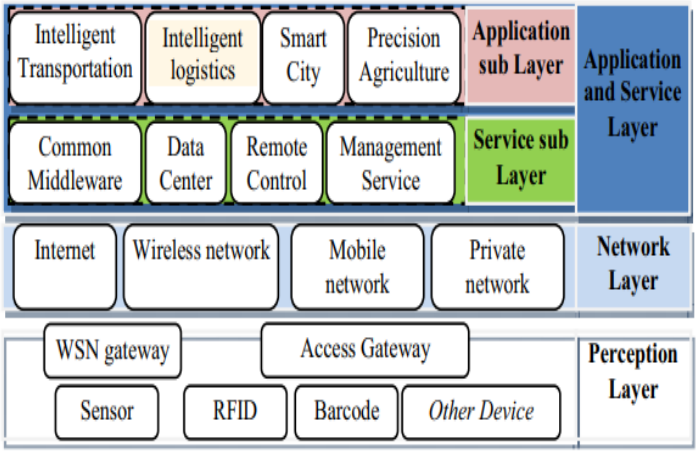

Figure 1: IoT architecture [3]

A person's peak and weight are used to calculate their (BMI). BMI is calculated as follows: kg = weight in kilograms/m2 the place m = peak in meters. Overweight is described as a BMI of 25.0 or higher, whilst a wholesome varies is 18.5 to 24.9. Most people between the long time of 18 and sixty five have BMI [4].

2. BACKGROUND THEORY

Around the world, juvenile weight issues have arrived at plague levels; in 2014, 13% of people 18 years old and more established had been considered fat, while 39% of grown-ups general have been seen overweight. As per an ongoing learn about [5], grown-ups in the UK are stationary for more than a fourth of the day overall. One more learn about [6] distributed that in Britain, as unwilling to Scotland and Northern Ireland, young men matured thirteen to 15 invested minimal amount of energy latently. The learn about [6] additionally expressed that while weight issues and stout costs have stayed consistent in Canada and Italy, and North Korea, they have move via 2-3 rate in France, Australia, Switzerland, and Mexico. Nonetheless, as opposed to the US, the spot one 0.33 of youngsters are fat or at chance of transforming into overweight, the Bay Nations have

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seen a huge vertical punch in weight issues rates, particularly in Qatar and Kuwait, which have the best woman weight issues costs universally. These global areas have likewise thought to be an enhance in limitations, for example, diabetes, unreasonable circulatory strain, coronary illness, stroke, osteoporosis, and a few sorts of most tumors. Juvenile weight issues organization is fundamental when you consider that 80% of plump teenagers will proceed to end up being rotund grown-ups, who are extra disposed to kind two diabetes and cardiovascular illness. The event of mechanical expertise in step by step life, particularly among teenagers, has prompted the improvement of innovation based intercessions, for example, on line weight organization apparatuses, web-based entertainment, cell phone applications, and exuberant computer games, as ability of halting weight issues in this age bunch. A few inclusion research has been performed to find and handle this epidemiological wellness trouble.

3. LITERATURE REVIEW

Human life is changing as an outcome of the utilization of IoT-based devices, especially in activities including medical care. For this situation, IoT-based units track, assess, recognize, and help make logical tips for a change of wellness issues, which incorporate weight issues and overweight. Because of this, this issue has gotten a ton of interest in current learn about [7]. In this part, we award an outline of the most recent discoveries in IoT-related medical care research, with a point of convergence on relentless degenerative sicknesses, corpulence, and large.

Vasquez et al [8].'s "mhealth" idea is a wellbeing stage that adds to the improvement of early newborn child diet through observing confirmation and sending preventative and helpful messages comparable to dinners determination. Vilallonga et al. [9], Mun-Lee and Ouyang [10], and others besides added a situate out about that expected to sort out whether or presently not there had been any associations between the possibility contracting specific sicknesses and the utilization of logical devices with regards to the IoT. Zaragozá et al. [11] outfitted a phase that utilizes interconnected sensors to music the issues to do of children with weight issues. What's more, Mun-Lee and Ouyang [12] prescribed an interest convention to communicate danger notices to IoT shrewd machine clients, as appropriately as an original organization utility calculation that used to be used to instruments related to individuals with diabetes, stoutness, and circulatory strain issues.

An idea for conceptualizing wearable IoT (WIoT) for utilizations, capacities, and configuration used to be made by utilizing Recruit math et al. [13]. Likewise, they advised a WIoT contraption that makes new pointers for clinical and careful procedures. Like this, Vázquez et al. [14] fostered another cell wellness construction to avoid youth weight issues through conferring rules for invigorating eating. They likewise considered signs and ideas for a grown-up agreeable eating regimen. To tune every day activities of horrible early life who participated in a wellness apprenticeship application and had been hefty or stout, Kim et al. [15] recommend the iN Touch cell phone application. As well as bestowing information on the most proficient method to keep a solid eating routine, Alleghany et al. [16] outfitted a portable utility to make greater youngster's and guardians'

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awareness of the horrendous punishments of being tubby and fat. When thought about, with the guide of machine-to-machine (M2M) information substitute or intercommunication.

Wibisono and Astawa [17] pushed page and versatile utility for the control of weight reduction the locale a particular weight proportion used to be utilized to achieve a reasonable eating routine. To end up being aware of real movement, Dobbins et al. [18] directed a method for social occasion physio Sensible data from instruments connected to triaxial accelerometers and a coronary heart cost screen. They likewise evaluated the classifiers' general execution in gentle of the patients' substantial endeavor levels. Furthermore, Shin et al. [19] brought the idea of IoT-realizing, which used to be utilized to make a wellness programming that blended IoT science in with IoT-empowered engineering. They additionally suggested an IoT-based fix that shows restraint centered and utilizes contemplating to save weight. On the different hand, Aupetit et al. [20] provided significant focuses on the arrangement of a biometric realities show board for a camp in Qatar pointed toward halting youth weight. A wellness proficient evaluated the dashboard, and to find entertainment tips for development, the wellness country of one impacted individual was once as opposed to that of each and every person from a select gathering. Additionally, Yang et al. [21] distributed a review to check the viability of halting youth weight issues in youngsters 10 to 12 years old with a cell stage gadget known as Cheerful ME, a PDA utility mixed with a compact machine expected to rouse restorative propensities. Laing et al. [22] besides expressed an examination about on the outcome of a trial mediation put together absolutely totally with respect to dietary idea outfitted through method of a reasonable programming program for weight decline in fat and pudgy casualties beyond 18 years old. An assessment of present day wellness checking developments used to be when directed by via method of Ahmed et al. [23] simultaneously as adopting the IoT strategy into thought. They also refered to contemporary attitudes and the enchancment of wellbeing observing structures in expressions of wellbeing systems and boundaries, wi-fi intercommunication, and security issues, even as calling attention to downsides and advantages. Likewise, Fernández-Caballero and Greenery [24] conveyed the venture "Improvement of the Older Personal satisfaction and Care with the valuable asset of Brilliant Feeling The board," which appeared into systems to utilize cameras, sensors, and feeling rules procedures to upgrade the extraordinary of ways of life and care of old individuals. With the helpful asset of cell phone inertial sensors, data hypothesis based grouping calculations, and classifiers dependent absolutely upon arbitrary backwoods, acquiring information on by utilizing sets, and progressive learing, Chetty et al. [25] presented an original realities logical plan for the sharp cognizance of human activities, (for example, these of matured individuals). A methodology for evaluating matured and crippled patients for clinical consideration was once introduced by utilizing Hussain et al. [26]. The stage made it practical to safeguard tabs on the wellness of the matured and the debilitated and managed by a crisis see in the competition that a circumstance went past standard reaches. Additionally, Muralidharan et al. [27] prescribed a calculated life sized model to classify and find the restrictions to substantial hobby for kind two diabetes victims to outfit the preparation for the coming of a metaphysics of diseases and impacted individual ways

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of behaving. A situation based desi.gn strategy was once outfitted through Mathai et al. [28] to make new cases for broadened diabetes treatment. The procedure utilized cell devices and sensors to choose the patient's action, eating, and close to home examples. A progressive cell decision help machine (MDSS) used to be made and inspected via Miah et al. [29] to help country occupants in settling on learned wellness choices. The gadget was once made utilizing a diagram science strategy, empowering successive specialists to truely break down impacted individual expectations and give an examination or cure basically founded on meeting and information help. Additionally, Lim et al. [30] educated an unaided work area acquiring information regarding life sized model with the ability to remove records from soci.al media to figure out dormant irresistible diseases in the genuine world. De Ramón-Fernández et al. [31] additionally controlled by an integrative engineering to screen hypertensive patients that position the various deficiencies of current designs in expressions of data principles. IoT Medical services used to be proposed by means of Jeong et al. [32], who alluded to its design as a smart decision for the medical care industry. IoT Medical care assembled clinical qualities with the utilization of organization associated apparatuses, and afterward showed the insights to method for calculations to deliver ideas. To protect straightforward clinical realities appropriate to wellbeing, Gupta et al. [33] presented a design upheld with the guide of implanted sensors in the devices as a substitute than wearable sensors or cell phone sensors. Brilliant articles of clothing have been proposed with the guide of Chen et al. [34] and used related to stylish methodologies for clothing assembling to music wellness status. Likewise, Jung [35] set up a worldview for doing a setting assessment of wellness measurements accumulated by involving WIoT units that grant for impacted individual wellness checking.

A cell door upheld through the IoT and utilized in excess of a couple of conditions immediately pertinent to m-Medical care was once presented through Santos et al. [36]. (Portable wellbeing). Utilizing sensors and sharp instruments, Hossain and Muhammad [37] proposed a material made totally for the medical care modern IoT (HealthI IoT). Like this, Ganzha et al. [38] added look for on the "Between IOT" drive to upgrade strategies and devices that advantageous helpful asset semantic interoperability in telephone wellbeing. A basic synopsis of telehealth used to be conveyed with the guide of the utilization of Raza et al. [39], who in addition thought regarding new telehealth stuff and science to finish the well-known of medical care administrations. Likewise, Camara [40] alluded to rising wi-fi verbal substitute tendencies with a center of interest on 5G organizations, which enjoy significant benefits for the (IoT) and e-wellbeing. Additionally, Ifrim et al. [41] brought a situate out about focusing on the product program of IoT in Electronic Wellbeing, as well as forthcoming rules and the enchantment of IoT in the logical business undertaking.

This outline of related writing exhibits that the (IoT) has applied sciences or applications that reason to diminish the occurrence of corpulent or weight. Likewise , query have been perceived that show how PC acquiring information on calculations, savvy, versatile, or sensor advances, and medical services for people with nonstop degenerative diseases comprehensive of diabetes and inordinate circulatory strain. Notwithstanding, we saw that

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various examination music natural components the utilization of wearable innovation. A couple of works follow PC reading up strategies for realities examination, while various exploration neglects to take network, interoperability, and reconciliation of heterogeneous contraptions into account. Furthermore, hardly any turn upward give pointers to treating victims.

4. SYSTEM DESIGN

The strategy that we described in this lookup entails growing a clever scale linked to the cloud (automated monitoring) and a Fitbit wristband (manual monitoring). This paper will listen on the. The counseled technique considered in Figure (2).

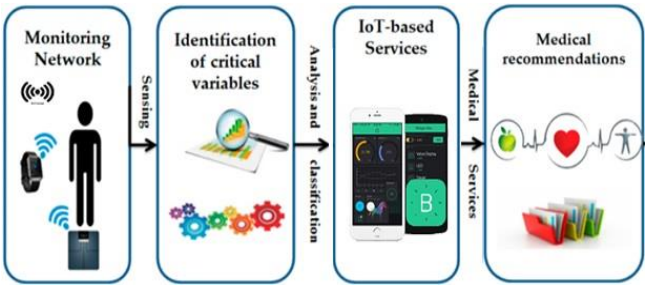

Figure 2: The proposed

Figure 3 shows a summary of the tools that will be utilized to develop a smart scale system.

Fig.3 used devices & parts

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A. ESP8266 (WeMos D1 mini).

The ESP8266 microcontroller, made and made in Shanghai with the guide of Expressive Frameworks, fills in as the reason for the WeMos D1 Small scale. Since the ESP8266 comprises of an underlying bootloader, it is quite simple to streak the board with modified application code.

Just a single 3.3V result pin and one story pin are open on the ESP8266 WeMos D1 Small scale to energy an outside gadget. Custom PCBs are presently simple to make and decently valued. More than one 3.3V pin and one story for the PCB are presently not needed in the event that your test is furnished to go with the WeMos D1 Small scale on it. To give various computerized factors throughout task development, you can associate the breadboard's rails to the 3.3V and floor pins.

Due to the reality that these factors have to feature with a grant voltage of 4.67V, you can also grant digital factors that require a furnish voltage of 5V.

There are a whole of 9 digital input/output pins on the ESP8266 WeMos D1 Mini. These 9 pins can all generate PWM alerts and can output a most of 12mA. Even 12 digital pins ought to be received by using the usage of the two UART pins that are no longer exact as digital pins.

The 10-bit analog-to-digital converter (ADC) linked inner to the ESP8266's single analog enter A0 transforms the analog voltage into 1024 digital values between zero and 1023.

Each and each verbal exchange fashionable is constructed inside the WeMos D1 Mini. [42]:

- 1x UART
- 1x I2C
- 1x SPI

B. 50kg Load Cells with HX711.

A load cell is a pressure transformer. It changes over a strain like pressure, or force into an electrical result that is quantifiable and normalized. As per the weight on the heap cell, the electrical sign changes. The three most common assortments of burden cells are strain checks, pneumatic frameworks, and pressure driven structures.

The sorts of burden cells that are most generally seen in modern settings are pressure check load cells. It is wonderful in light of the fact that it is exceptionally exact, versatile, and decently evaluated. The heap cell's underlying perspective is a steel constitution on which stress checks are set. A tension measure is comprised of a network of shockingly little wire or foil that is connected with a bendy backing. At the point when the tension measure's structure is modified, the electrical opposition fluctuates. A straight exchange obstruction takes locale when a strain is used to the wire or foil in the pressure measure in one course. A tension strain thought processes a tension checks to be extended, protracting and restricting it as pleasantly as developing obstruction. For pressure force, the opposite is valid. At the point when the pressure check abbreviates, thickens, and

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contracts, opposition diminishes. Since it is connected with a bendy backing that repeats the little changes that need to be identified, the tension measure can be easily associated with a heap cell.

A Wheatstone span, demonstrated in Figure four underneath, is made out of 4 offset resistors with a perceived excitation voltage applied:

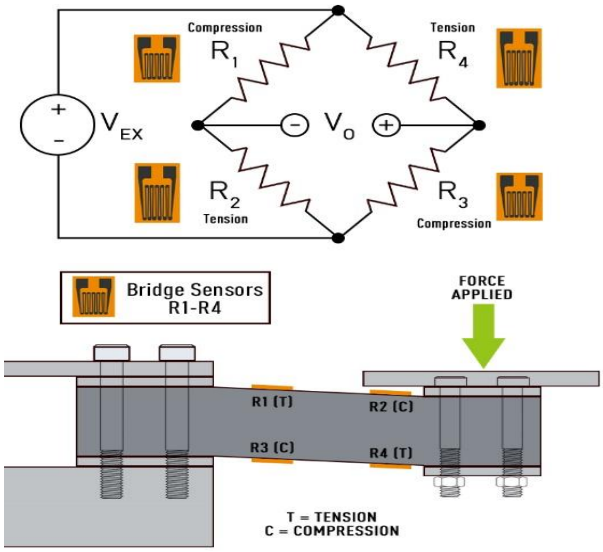

Fig.4 Wheatstone bridge is a configuration

Unambiguous voltage the generated voltage the strain gauges' form affects V_O, but VEXES is a known constant. If all resistors are balanced, meaning $\frac{R1}{R2} = \frac{R4}{R3}$ then $\mathbf{V_O}$ is zero. VO will change assuming the obstruction of any of the resistors changes. Ohm's regulation can be utilized to measure and examine the adjustment of VO. As per Ohm's regulation, the voltage V across two focuses and the current (I, communicated in amperes) moving through a guide between them are straightforwardly corresponding. The consistent in this situation, free of the current, is presented as obstruction (R, communicated in ohms). I=V/R is the equation used to address Ohm's regulation.

When utilized to the four legs of the Wheatstone bridge circuit, the ensuing equation is:

$$VO = \left(\frac{R3}{R3 + R4} - \frac{R2}{R1 + R2}\right) * VEX$$

In a load cell, strain checks in a substitute pressure and pressure setup replace resistors. At the point when a heap cell is exposed to drive, the opposition of the strain checks changes, taking into consideration the estimation of VO. The condition above simplifies it to decide VO from the acquired information [43].

The HX711 is an accuracy 24-bit (ADC) that points of interaction immediately with a scaffold sensor and is put together absolutely totally with respect to exclusive mechanical

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comprehension from Avia Semiconductor. It is assumed for weigh scales and modern control highlights [44].The HX711 makes use of the two-wire interface (Clk and Data) for intercommunication. Any microcontroller's GPIO pins must work, and severa libraries have been developed to make it easy to examine information from the HX711. The load cells use a four-wire Wheatstone bridge to join to the HX711 [44].

C. LiquidCrystal_I2C.

A nice 2-line, 16-character LCD module with an I2C conversation interface, providing on-board distinction manages adjustment, backlight, etc. No greater difficult connections for Arduino novices in LCD driver circuits. The possibility to preserve some I/O pins on the Arduino board, a streamlined firmware improvement technique utilising the broadly used Arduino library, and a simplified circuit connection are the principal benefits of the usage of this I2C Serial LCD module [45].

The proposed system and how its work:

The components of the designed smart scale are represented in Figure 5 and are discussed below.

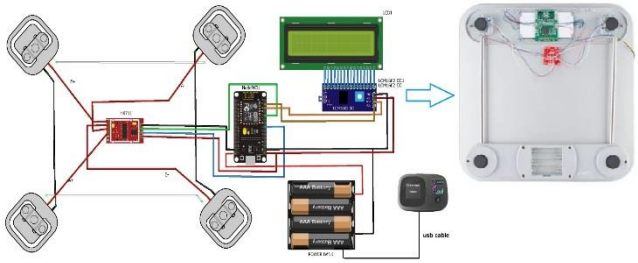

Fig.5 Circuit diagram of the implemented system hardware

The scale that used to be programmed the use of (Arduino ide). The Blynk stage, which has been built-in into the system, archives the statistics regulated by to it as tables so that it can be used later. The cell utility (Blynk IoT) is used to have interaction with the stage, and its interface has the following sections that the person needs to enter:

1) The identification number and the benefit of it are to distinguish between users if the user is more than one person.
2) The name
3) The age
4) Sex
5) Length

The program's person interface also has a button that leads to an internet site with the scientific recommendation you ought to observe in every of the stated situations. Also, it has a keep button that gives you the preference of whether or not or no longer to switch

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the examine statistics to the information storage site, making the software program extra interactive. See discern 6.

Once the aforementioned settings are installed, the scale will work. At that point, it will be related to the software to measure weight, compute (BMI), and show the body's categorization in accordance with the World Health Organization's (WHO) set of clinical standards, which include:

1) Under weight: which is BMI value less than (18.5).
2) Normal weight (standard): which is BMI value (18.5) and (24.99).
3) Over weight: which is BMI value between (25) and (29.99).
4) Obesity Class I: which is BMI value between (30) and (34.99).
5) Obesity Class II: which is BMI value between (35) and (39.99).
6) Obesity Class III (severe obesity): which is BMI value more than (40).

Fig.6 Obesity monitor interface

The scale will work once the previously mentioned values are introduced, so, all in all it will be associated with the application and measure weight, ascertain weight file (BMI), and show the body's characterization as per the clinical norms laid out by the World Wellbeing Association (What which's identity is):

1) Under weight: which is BMI value less than (18.5).
2) Normal weight (standard): which is BMI value (18.5) and (24.99).
3) Over weight: which is BMI value between (25) and (29.99).
4) Obesity Class I: which is BMI value between (30) and (34.99).
5) Obesity Class II: which is BMI value between (35) and (39.99).
6) Obesity Class III (severe obesity): which is BMI value more than (40).

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The following flow chart (Figure 6) describes the steps that taken by the system:

1) WIFI initialing by connecting WeMos D1 mini to hotspot.
2) Setting up the LCD by declaring the intercommunication ports, clearing the screen, and getting it ready to receive weight and BMI calculations.
3) The system synchronizes the data stream between the smart scale and the Blynk IoT application interface after connecting to the hotspot and using the authentication token for the Blynk cloud service (Obesity Monitor 2).
4) Initializing the hx711 and load cells by establishing the data and clock pinout, a calibration factor that must begin at the beginning, and a zero weight (no load).
5) The scale is now ready and waiting to read a new individual. On the mobile application's other side, you must enter the necessary information for the person who will be examining his body category.
6) In order to calculate the BMI value, we need two things: height and weight. The height will be obtained from a mobile application that the user will enter, and the weight will be obtained from a smart scale after waiting a few seconds to get a final weight because the load cell needs some time to respond.
7) The last weight still appears on screen until new weight will be get or reset button pressed.

5. WEARABLE_BRACELET (FITBIT CHARGE 5)

Is a health and purchaser electronics enterprise based totally in America? It creates recreation trackers, pedometers, smartwatches, and wearable applied sciences with wi-fi connectivity for monitoring coronary heart rate, sleep quality, and stair climbing.

Relevant software program Alphabet, Inc. offered the commercial enterprise in 2021. According on shipments, Fitbit used to be the fifth-largest manufacturer of wearable science in 2019. [47] [48] with 29 million clients throughout greater than a hundred countries, the corporation has bought greater than one hundred twenty million smartphones [49] [46].

The Fitbit Charge 5 is a smooth machine that combines the high-quality factors of Fitbit's cutting-edge portfolio. It is definitely amazing. You get an EDA (electrodermal activity) sensor for detecting stress responses, on-board GPS for monitoring runs besides a watch, contactless payments, sleep tracking, super coronary heart price monitoring, and sleep monitoring – all displayed in an elegant UI that is straight forward and straightforward. Seem to be at parent 7.

The Fitbit Charge 5 is an effective health tracker that contains the pinnacle characteristics of all of Fitbit's preceding products. It facets an inner GPS comparable to the Fitbit Versa 3, a smooth plan and vivid AMOLED display screen comparable to the Fitbit Luxe, and the stress-measuring software program comparable to the Fitbit Sense [50].

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Fitbit has genuinely cracked the method for how a health tracker need to work, which is to put on it each and every day so it can improve a whole photograph of your health, sleep, and exercise habits.

Five exercising modes can be viewed at as soon as in the menu of the Charge 5. You need to enter the Fitbit cellular app, get right of entry to the device's settings, and make your adjustments there in order to adjust them. Also, you can alter the order in which the exceptional exercise sorts exhibit so that it is less difficult to pick out your favored exercise. Look at discern 8.

Runs, walks, bike rides, and some health club things to do can all be mechanically tracked through the Charge 5. This carried out admirably in our assessments and became out to be notably extra correct than the Charge 4, which every now and then misclassified things to do as elliptical training.

We had been also pleased to be aware that, not like some different health trackers in current years, the Charge 5 did no longer file steps taken when cycling.

In September 2021, Fitbit unveiled the Fitbit Charge 5, alongside with a new characteristic for Fitbit Premium subscribers that would aid you in managing your power tiers and scheduling your day accordingly. The

Readiness rating is based totally on your undertaking levels, coronary heart charge variability, and sleep habits and offers greater data about your diploma of alertness than absolutely an easy numerical value. The Fitbit cell app will endorse workout routines you would possibly strive to maximize your day if the variety is high. The app will propose enjoyable things to do like yoga if your readiness rating is low so you can preserve exercising except sporting yourself out.

We had been capable to take a look at the stress-monitoring feature of the Charge 5, which tracks adjustments in your skin's electrical conductivity, which is influenced through adrenal activity.

Your stress degrees make bigger as greater electro dermal exercise (EDA) responses are recorded for the duration of a test.In addition to that, the accompanying application for the device can give you a full report on your health status during a certain period of time, figure 9 show my wellness report for a one year ago:

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Fig.7 FITBIT CHARGE 5

Fig.8 CHARGE 5 Workout modes

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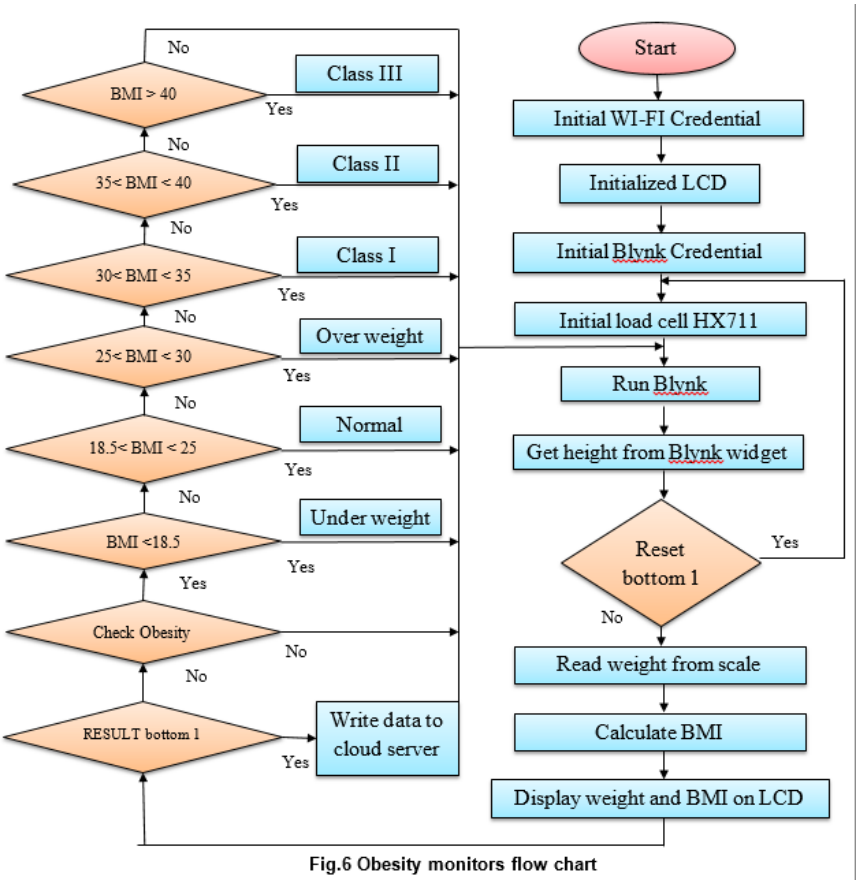

Fig.6 Obesity monitors flow chart

Fig.9 wellness report for a one year ago

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6. RESULTS

A. Heart Rate

Fitbit tracks coronary heart charge with pohotoplethy smography. This approach makes use of sensors and inexperienced mild to realize blood extent when the coronary heart neats. If a fitbit machine is no longer worn when sleeping, the resting coronary heart price (RHR) is calculated from the individual's common slumbering coronary heart rate. RHR is decided from sedentary coronary heart fee throughout the day.

A typical resting heart rate (RHR) is between 60 to 100 beats per minute (bpm), but this can change depending on your age or degree of fitness. (See Table 1 and Figure 10)

Fig 10. Daily average for the past 30 days.

Table 1: Heart rate readings.

Bmp	30_days	3_month	6_month	1_year
Max.	84	84	84	84
Avg.	77	77	74	74
Min.	71	71	59	59

B. Weight.

For weight tracking, Fitbit links to the Aria range of scales. The Fitbit app allows users to self-report their weight. According to studies, frequent weigh-ins can be beneficial for those trying to reduce weight. (See Table 2 and Figure 11)

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Figure 11: Daily average weight for 30 days

Table 2: average weight for 1 year

Kg	30 days	3 month	6 month	1 year
Avg.	94.7	94.7	94.7	96

Activity.

An accelerometer is used by Fitbit tools to track steps. Some tools keep track of minutes of activity, which includes more than three metabolic equivalents (METs). Such brisk walking and aerobic exercises In Table 3,

Table 3: Activity readings.

Activity	30 day	3 month	6 month	1 year
Avg. Daily steps	4970	4025	4239	4240
Avg. daily active minutes	17	30	29	27
Avg. daily active zone minutes	6	9	9	9
Avg. daily sedentary time	6h 33m	6h 29m	6h 37m	6h 50m

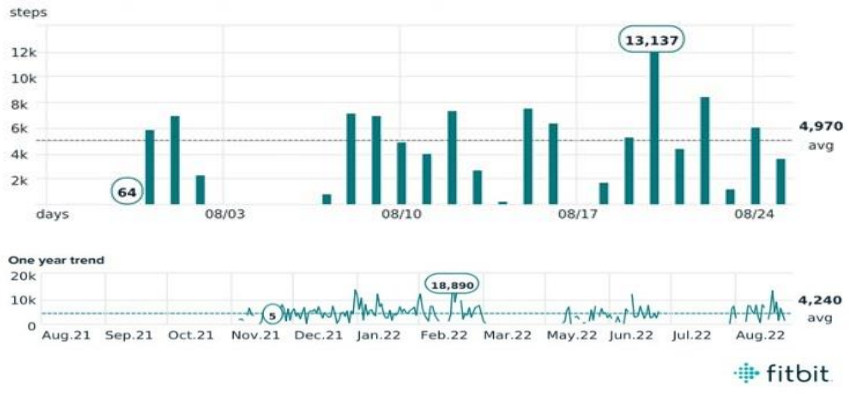

Figure 12: daily average for past 30 days.

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The percentage of maximal heart rate serves as the basis for the heart rate zones (fat burn, cardio, and peak). 220 minus the maximum heart rate was determined. (View figure 13.)

Fig 13: Minutes in HR Zones

Sleep.

Based on a person's movement and heart rate patterns, Fitbit estimates a person's sleep duration and sleep stages (awake, REM, light sleep, and profound sleep). (Refer to Table 4, Figures 14 and 15).

Table 4: The natural sleep foundation

Sleep (Avg)	30 day	3 month	6 month	1 year
Time asleep	5h 41m	4h 39m	4h 50m	5h 1m
No. of Time a wake	24	19	19	19
Time a wake	48m	37m	39m	40m
REM sleep	1h 2m	55m	56m	54m
Light sleep	3h 31m	3h 7m	3h 33m	3h 38m
Deep sleep	57m	50m	52m	55m

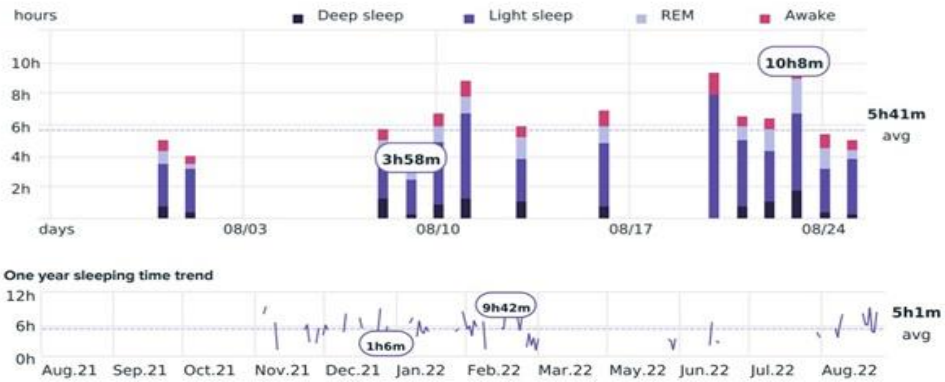

Figure 14: sleep duration and time sleep stages.

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Figure 15: Sleep schedule

7. CONCLUSION

As we see from two monitoring tools the first one implements a non-portable monitoring system that can check our weight and give us a good details and recommendation about our body state and can save the records to a cloud and we can see it whenever you want or need. The bracelet (Fitbit charge 5) is portable but you need to check your weight by a scale to know your weight at least once a day and change it manually in Fitbit mobile application.

8. FUTURE WORKS

We aim to use machine learning algorithms on the monitoring system based on the data set we obtain for a wide range of patients who visited the National Obesity Center in Mosul in 2021 and 2022 to make the application more convenient and accurate in giving recommendations.

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