Implementation of Health Monitoring using Verilog

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Abstract - *As of late, wellbeing has gotten a mainstream subject. Having a decent and sound way of life alongside a decent body viewed as one of the boundaries for good wellbeing. For assessing our body status, BMI (body mass index), BFP (muscle versus fat ratio), BMD (basal metabolic rate), RMF (relative fat mass), BMR (basal metabolic rate) can be utilized a marker. In this paper, we have structured BMI, BFP, BMD, RMF, BMR utilizing fundamental boundaries like stature, weight, age, sexual orientation, abdomen circuit and so forth. BMI shows that the individuals' hold up is straightforwardly connected to build, BFP demonstrates the fat rate in the body, BMD shows the minerals present in the body, RFM is viewed as obviously superior to BMI as it doesn't demonstrate about the fat mass, BMR shows the digestion pace of the body when the body is perfect mode. All the above-mentioned parameters are designed in Verilog language (RTL code) and it has been stimulated using XILINX 14.7 ISE.*

Key Words: **Health, BMI, BMR, BFP, BMD, RFM, Verilog, IOT.**

1. INTRODUCTION

The wellbeing awareness has become an expanding focus with current individuals. Being excessively overweight or too slim shows up as an issue of appearance as well as wellbeing [1]. Overweight and weight are characterized as sporadic or unnecessary fat assembling in the body that may debilitate the wellbeing. Overwhelming and heftiness are considered as one of the significant hazard factors for noncontagious sicknesses, for example, cardiovascular maladies that are one of the principle driving reason for death, diabetes, musculoskeletal clutters, and some cancer [2]. The nearness of overweight and corpulence suggests unfriendly metabolic consequences for circulatory strain, cholesterol, triglycerides, and insulin opposition. Ailments, for example, metabolic condition diabetes mellitus, cardiovascular ailment, non-alcoholic steatohepatitis (fattyliver), gallbladder ailment, gastroesophageal reflux, obstructive rest apnea, regenerative framework issue, numerous diseases, and osteoarthritis just as social and mental issues are related with weight. Numerous investigations indicated that high level of diabetes hazard can be credited to abundance weight [3].

BMI is utilized as valuable occupants level proportion of overweight and weight. It is normal strategy for both genders and for all ages. The BMI marker gauges the extent of body weight to the square of body tallness of a person. As indicated by the BMI esteem, individuals can tell whether they are under-weight, legitimate weight, over-weight or hefty, and perceive how much their weight leaves from the perfect load for their tallness. BMI has been utilized to order too thin and fat [4] and utilized along with material action to analyze constant vitality deficiency. Likewise, BMI has been applied in adolescence and pubescence (normalized by age and sex) to characterize hunger and corpulence [5]. BPF can be determined utilizing BMI. BFP of an individual is entire mass of fat isolated by whole weight, duplicated by 100. Muscle versus fat incorporates indispensable full and capacity cadaver fat. Basic muscle versus fat is required to keep up life and conceptive capacity. A direct condition portrayed as RFM was proposed by Woolcott and Bergman. RFM is estimation of overweight or weight in people that requires just computations dependent on the proportion of stature and midriff estimations. Furthermore, fat mass was determined utilizing two anthropometric estimations: tallness and abdomen boundary. In view of its straightforwardness and viable introduction than BMI, RFM could be used in consistently clinical practice as an undeniable limit in assessing the body association [5].

There is an astounding job in restoring the significance of utilizing (BMR) to anticipate human vitality request. The term 'basal' was utilized to decide between the vitality expended while performing physical action and being very still. BMR speaks to the joining of irrelevant measure of the considerable number of tissues in the body under stable state condition. It is normally communicated as oxygen utilization per unit body size. BMR is the everyday pace of vitality digestion person needs to keep up so as to defend the uprightness of indispensable organs of the body.

Capacity BMR relies upon body synthesis is given as far as without fat mass (FFM) and fat mass (FM) and on sexual orientation, age, physical

movement, and wholesome status [6]. BMR has regularly been the principle main focus in the investigations on the extension and treatment of fullness. Their impacts of weight and BMI on body mineral thickness in people. A BMD test estimates amount of calcium and other sort of minerals are in a zone of your bone. In this venture, we attempt to discover the connection between BMI, BMR, BMD, BFP, RFM regarding weight, stature, sex, age and we attempt to discover the precision rate between the relations.

2. LITERATURE SURVEY

BMI is considered to be the important part of health monitoring. BMI measures the portion of the body by using weight and height parameter. Though BMI value, people can predict about the size of the body in terms of underweight, normal weight, Overweight or obesity. Because of its simplicity, BMI is widely used for decades [1]. BMI is used as a popular measuring tool. BPF also depends on BMI. And BFP varies in terms of age and gender. BMI, age and gender were taken as independent variable and body fat as dependent variable. BMI was noted to increase in young people, remain constant in middle age, decrease in old people. The mean difference between BFP was also increased with age where as female gain more weight than male when they become old [2]. BMI don't recognize body slender mass and muscle versus fat mass. Like individuals can have high BMI and have low fat mass and the other way around. The reason for stoutness is worried to be the new way of life here the work connected with PCs prompting less in physical action. Breathing trouble is normal for individuals who are fat. BMI disadvantage is that it doesn't reflect muscle to fat ratio dispersion (focal trunk versus hips and thighs) which is related with metabolic aggravations and cardiovascular dangers. [3]. The expression "Basal" was utilized to recognize the vitality utilized like performing work and when stayed perfect. It was typically communicated as warmth creation or vitality devoured by the body BMR is a pace of vitality digestion an individual need to support so as to keep up the uprightness of essential capacities every day [4]. RFM was proposed by Woolcott and Bergman This condition generally computes FM% utilizing dual boundaries tallness and abdomen boundary. RFM gives

better consequences of FM% dictated by every one of the body piece strategies contrasted with BMI. The formula is given by, RFM = 64 – [20 x (tallness/midsection circuit) both in meters] + (12 x sex). Sex is characterized as 0 for male and 1 for female. This can likewise be deciphered as RFM (female)=64-[20 x (height/abdomen circumference)], and for male=72-[20 x (height/abdomen circumference)]. This outside endorsement showed that the display of the RFM condition used in this examination to measure FM% was more solid than BMI [5]. Vitality consumption is a determinant of vitality balance and a body structure. Consequently, BMR is likewise mostly center around the investigations and advancement of treatment of Obesity. It mostly relies upon the mass and digestion pace of the tissues and organs. So BMR can be gotten with some precision by knowing the body structure. Sex was a huge determinant of BMR in stout kids and young people [6]. BMD can be estimated by utilizing a few procedures. BMD connotes the bones mass and through that we can become acquainted with how much calcium lack may be there which thusly can distinguish osteoporosis [7]. A significant strategy utilized are through x-beam. The bone mineral thickness and bone mineral substance estimation depends on double vitality x-beam absorptiometry [8].

3. METHODOLOGY

The methodology explains about the flow of the proposed work. The overall implementation is based on the flow chart shown below. The flow diagram explains how BMI, BMR, BMD, BFP, RMF are related to the formula. Based on the formula design is created
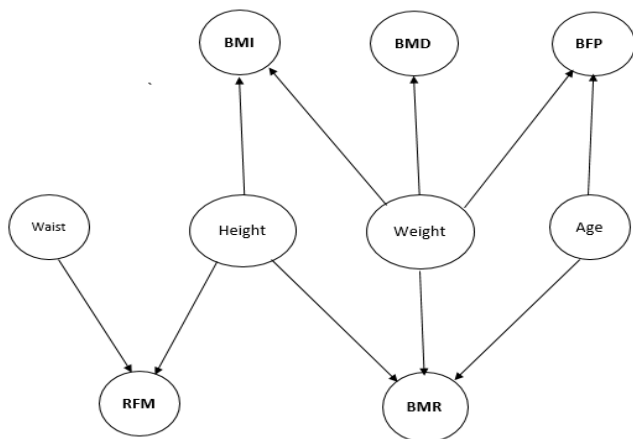
Fig-1: flow diagram of methodology

Table -1: BMI-Chart

Category	BMI Range
<18kg	Under weight
b/w 18kg-25kg	Normal weight
over 25kg	Over weight

4. PROPOSED WORK

Health monitoring system can help people to undergo the study of their individual bodies/ gain knowledge about the basic concepts of health monitoring. When we think about health the first thought comes to our mind is pulse rate, blood pressure, body temperature. But these parameters cannot be calculated by using basic concepts like height, weight, age etc. Basic concepts of health monitoring can be considered to be BMI, BMI, BMD, BFP, RFM and these parameters can be calculated using height, weight, age, gender.

A} BMI: BMI is determined dependent on tallness and weight that holds great to grown-up people. It is widely utilized as generally useful pointer of whether an individual has a sound weight and for their stature. solely, the worth acquired from the gauge of BMI is utilized to characterize whether an individual is thin, ordinary weight, stout, or hefty relying upon what go the worth falls between. These scopes of BMI fluctuate dependent on variables, for example, stature, weight and are here and there additionally partitioned into subcategories, for example, seriously underweight or seriously stout. Being stout or thin can have significant wellbeing impacts, so while BMI is a blemished proportion of sound weight, it is a helpful pointer of whether any advantageous testing or activity is required.
Formula:

Metric BMI=weight(kg)/[height(m)]2
Imperial BMI=702*weight(ibs)/[height(inchs)]2

B} BMR: The vitality required while resting in a calm situation when the stomach related framework is idle is characterized as BMR. In such a condition, vitality will be utilized distinctly to maintain fundamental organs, which incorporate the heart, lungs, kidneys, sensory system, digestion tracts, liver, lungs, sex organs, muscles, and skin. Mifflin-St Jear equation:

BMR =10W+6.25H-5A+5 //for men

BMR= 10W+6.25H-5A-161 //for women
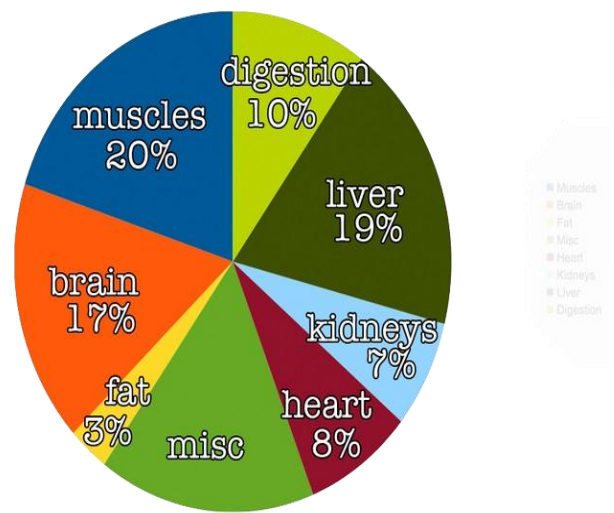Where w: body weight, H: body height, A: age F: body fat percentage

Chart -1: percentage of BMR

C} BMD: A BMD test estimates amount of calcium and other kind of minerals are in a region of your bone. A BMD test is can give a preview of your bone wellbeing. The test can distinguish osteoporosis,

discover your hazard for breaks (broken bones), and decide your reaction to osteoporosis recuperating.

Table -2: BMD Chart for Females:

Female Weight	Bone Mass Weight
<50kg	1.95kg
b/w 50kg-75kg	2.40kg
over 75kg	2.95kg

Male Weight	Bone Mass Weight
<65kg	2.65kg
b/w 65kg-95kg	3.29kg
over 95kg	3.69kg

Table -3: BMD Chart for males

D} BFP: It is determined by isolating the complete load of the fat separated by the body weight. Each individual needs to have a specific amount of fundamental fat. The basic fat percent shifts colossally among ladies and men. underneath is an outline of muscle versus fat percent go for ladies and men equation:

BFP= (1.20 * BMI) + (0.23 * Age) – (10.8 * S) – 5.4

S = 1 for male and 0 for female. BMI = Body Mass Index, Age= Age in years.

Table -4: BFP Chart:

Description	Male	Female
Essential fat	2-5%	10-13%
Athletes	6-13%	14-20%
Fitness	14-17%	21-24%
Average	18-24%	25-31%
Obese	25%+	32%+

E} RFM: It is a straightforward recipe for the estimation of overweight or corpulence in people that requires just a figuring dependent on a proportion of stature and midriff estimations. High muscle to fat ratio is connected with expanded dangers of denied wellbeing and untimely fleetingness. RFM is a straightforward anthropometric technique that is professed to be more advantageous than BFP and more exact than the customary BMI. The extent of the patient's tallness and abdomen estimation, both in meters, is increased by 20 sooner than being deducted from a number (appeared in intense beneath) that modifies for contrasts in sexual orientation and stature:

- RFM for grown-up guys: 64 – 20 × (tallness/abdomen circumference)

- RFM for grown-up females: 76 – 20 × (tallness/ abdomen circumference)

- Even however for the most part approved on database of somewhere in the range of 12,000 grown-ups, RFM has not yet been assessed in investigations of enormous populaces to distinguish ordinary or anomalous RFM according to corpulence related medical issues
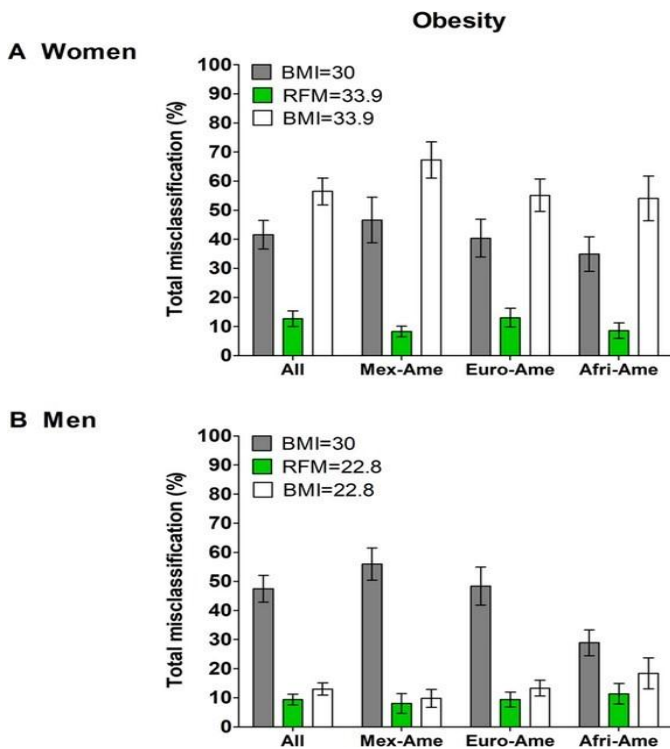
Chart -2: RFM data chart

Fig 2: Verilog flow of proposed work

The parameters mentioned above are designed and implemented using VERILOG language. The code is constructed using the formula mentioned above along the specified chart. The RTL code and test bench are verified for certain values. The Verilog code written here is synthesizable one and certain testcases are verified. The RTL code and test bench are verified for certain values. The Verilog code written here is synthesizable one and certain test bench is verified.
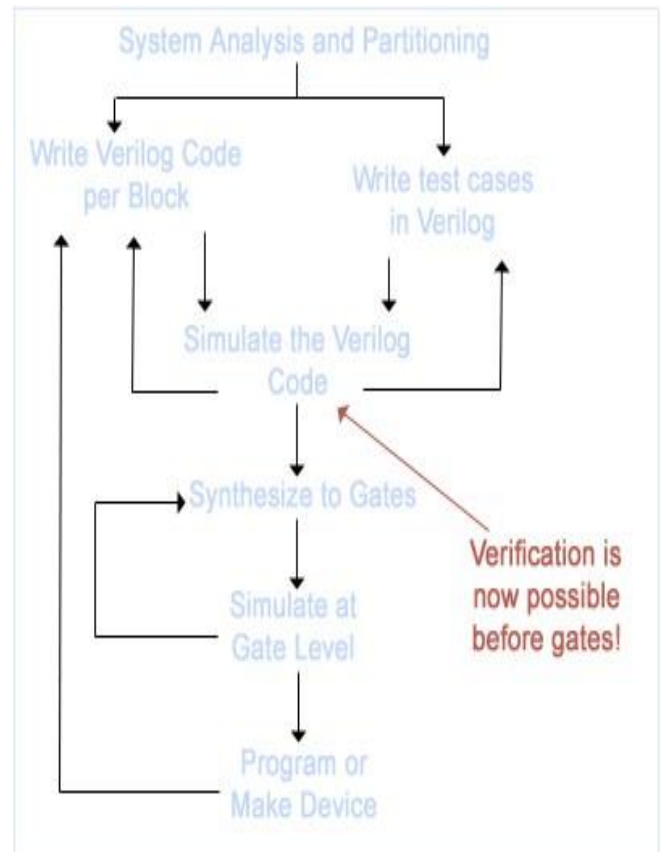
5. RTL SCHEMATIC:

Variable "a" is utilized to determine the sexual orientation, on the off chance that a=0, at that point it is female or, in all likelihood it is viewed as male. The input is taken as 8-bit, where w[7:0]=weight of the body(kg),h[7:0]=height in cm , [7:0]age= age of the individual in number, waist[7:0]=waist of the periphery. Along these lines yield got is additionally 8-bit,where [7:0] BMI=(w/h), [7:0] BFP=((1.20 * BMI)+ (0.23 * Age) – (10.8 * S) – 5.4)). [7:0] RFM=(for male:64 – 20 × (tallness/abdomen circumference), for female:76 – 20 × (tallness/abdomen circumference)BMD is planned distinctly from the weight boundary from the predefined diagram.
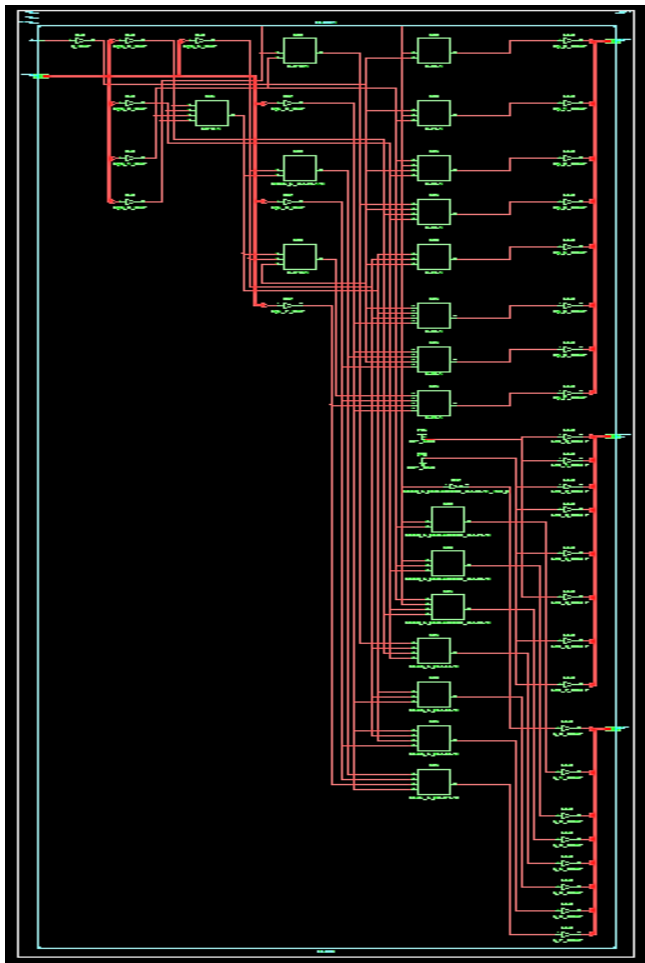
Fig 3: RTL schematic

generally changing readings and that regularly vary from the standard techniques for fat estimations.
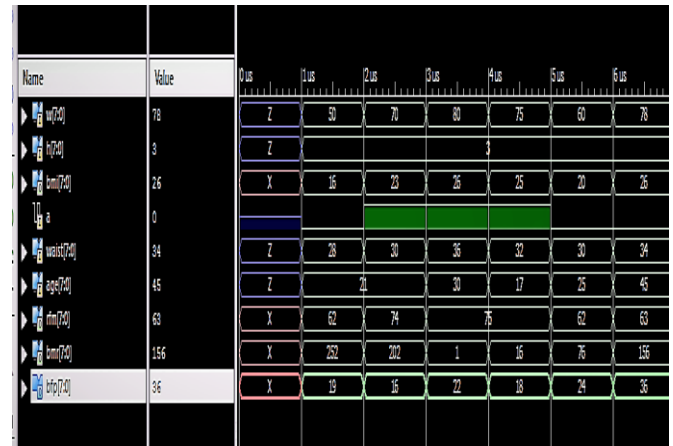
Fig 4: output waveform

Table -5: RTL Analysis

Logical utilization	Used	Utilization
Number of 4 input LUT	19	1%
Number of occupied slices	10	1%
Number of Slices containing only related logic	10	100%
Number of Slices containing unrelated logic	0	0%
Number of bonded IOBs	33	19%
Average Fanout of Non-Clock Nets	2.82	

6. ACCURACY OF RESULTS

The BMI is a valuable estimation for the vast majority more than 18, and can assist with getting to if individuals are overweight or hefty. Yet, BMI may not generally be precise. From the got outcomes, we state it is roughly exact up to 95%. The primary issue of BMI is that it doesn't recognize fat mass and non-fat mass. For the count of BMR Mifflin-St Jear recipe is utilized. These equations give a rough number of calories your body consumes during physical movement. There is edge of around 10% mistake. Also, the ongoing examination has indicated that your stature and midriff boundary is placed into an equation and the subsequent number is regally equivalent to BFP which is viewed as RFM. One of the principle issues with muscle versus fat scales is that they frequently erroneous Studies have discovered that distinctive muscle to fat ratio scales produce

7. CONCLUSION

The BMI has been utilized extensively in epidemiological and logical examinations to arrange overheavy and weight. The regular World Health Organization (WHO) portrayal for body weight status is underweight (<18 kg/m 2), ordinary weight (18.5–24 kg/m 2), overweight (25–30 kg/m 2), and stoutness (>30 kg/m 2).BMI downside is that it doesn't reflect muscle to fat ratio circulation (focal trunk versus hips and thighs) which is related with

metabolic unsettling influences and cardiovascular risks[2].The RFM is structured and determined utilizing just two boundaries for example (tallness and abdomen circumference).It is Costless and furthermore Superior to BMI for prognostic purposes Cheap and it doesn't require unique gear. BFP is like RFM yet for computing we need age, weight of the body, stature in cm. Having a sound BFP give preferred position, for example, temperature rule, impartial hormone levels, upgraded conceptive wellbeing. BMD is significant as it is utilized to gauge the mineral in bones particularly calcium. From this we can become acquainted with about the individuals who are in danger for osteoporosis, particularly for more seasoned grown-ups. BMR is the regularly pace of vitality digestion an individual need to keep up so as to guard the respectability of basic capacities. In ordinary free-living people, the measure of vitality gave by their eating routine must conceal the requests of basal digestion in addition to advantageous sums required for the physical development related with essential substantial needs, and notwithstanding those forced by the physical work associated with calling, in taking part in social co-operations and in recreation exercises.

8. FUTURE WORK

The future work of this task can be further improving the idea by including bp, beat rate and ascertaining the internal heat level by utilizing sensors and connecting this over all idea to IOT by interfacing it to cloud. At that point the significant point will be to comprehend and get the yield continuously condition with precision by means of IOT. The way toward putting away information can be utilized from numerous points of view, for example, anticipating the sicknesses, dissecting and so forth.

REFERENCES

1) Chih-Hua Tai Daw-Tung Lin "A Framework for Healthcare Everywhere:16th IEEE International Conference on Mobile Data Management.
2) Chathuranga Ranasinghe, Prasanna Gamage , Prasad Katulanda , Nalinda Andraweera, Sithira Thilakarathne and Praveen Tharanga.
3) Maali Said Mohammed, Sandra Sendra, Jaime Lloret and Ignacio Bosch.
4) CJK Henry School of Biological and Molecular Sciences, Oxford Brookes University.
5) Alan E. Guzmán-León,Ana G. Velarde , Milca Vidal-Salas , Lucıa G. Urquijo-Ruiz , Luz A. Caraveo-Gutiérrez , Mauro E. Valencia.
6) Stefano Lazzer, Giorgio Bedogni , Claudio L. Lafortuna , Nicoletta Marazzi , Carlo Busti ,Raffaela Galli , Alessandra De Col, Fiorenza Agosti and Alessandro Sartorio.
7) An image processing algorithm to estimate bone mineral density using digital X-ray images Shiyana Sherief Khan; Archana S. Jayan ; Sharmila Nageswaran
8) Development of bone mineral density and bone mineral content measurements system using a dual energy x-ray "Y. Promworn ; C. Pintavirooj
9) Smart health monitoring system using IoT based smart fitness mirror Amgad Muneer1, Suliman Mohamed Fati2, Saddam Fuddah3.
10) Internet of Thing Based Health Care Monitoring System, Shreyaasha Chaudhury, Debasmita Paul.
11) IOT Based Smart Health Monitoring Alert Device, K Hari Kishore, K.V.Surendra Nath, K V N Hari Krishna, D.Pavan Kumar, V.Manikanta, Fazal Noor Basha.
12) A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis Alexandros Pantelopoulos and Nikolaos G. Bourbakis.
13) Healthcare monitoring system based on IoT, Krishna C S, Nalini Sampath.
14) An IoT based Patient Health Monitoring System 1D. Shiva Rama Krishnan, 2Subhash Chand Gupta, 3Tanupriyam Choudhury