International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

# FPGA Based Health Monitoring System

**Fazal Noorbasha, Bevara Kishore, Koushik Reddy, Kongara Srinivas**

***Abstract*: In present days, Health issues are occurring more frequently. Because of climatic changes, industrialization and technical advancement which led to reduced physical activity. Saving lives requires monitoring the health conditions of people who have chronic diseases or heart related problems. Decrease in morbidity from disease and extend lives can be achieved by earlier detection of problems. When we reach a certain age we have to keep monitoring the three vital signs of the body to extend our lives. In this paper, we are designing a healthcare monitoring system which can either monitor or measure three vital signs i.e. heart rate, respiratory rate and body temperature of human body. The developed system uses wearable sensors to measure body temperature, heart rate and breathing rate. In order to minimize human involvement and respond at an appropriate time a health monitoring designed FGPA system will take the data from the sensors and analyze the date. It will give the health report, health status and alerts the concerned whenrequired.***

***Keywords: FPGA, Health, Heart Rate, Body Temperature, Respiratory Rate.***

## I. INTRODUCTION

This paper is mainly used to track heart conditions, respiratory system and body conditions by monitoring heart rate, breathe rate and body temperature. All the data that is tracked by various sensors are integrated into the system to process of health data. When the patient is at home, it is not possible for doctors and nurses to take care of him all the time so when we get the health report from the system we can take necessary measures or consult a relevant doctor based on emergencies. We analyze the data from sensors using an algorithm where the age of the patient is considered and determines whether vital parameters are in the specified range for the mentioned age. This device helps to monitor the health conditions of patients who are having memory related problems. The device measures the vital parameters continuously and gives a processed report irrespective of what they are doing.

Manuscript published on January 30, 2020.
* Correspondence Author
**Fazal Noorbasha** Associate Professor, Department of Electronics and Communication Engineering Koneru Lakshma iah Education Foundation (K L Deemed to University), Guntur, Andhra Pradesh, India,
**Bevara Kishore,** UG Student, Department of Electronics a nd Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, AP, India – 522502.
**Koushik Re ddy,** UG Student, Department of Electronics a nd Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswa ram, Guntur, AP, India – 522502.
**Kongara srinivas,** UG Student, Department of Electronics and Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswa ram, Guntur, AP, India – 522502.



## II. SYSTEM MONITORING PROCESS

### A. Heart Rate

Heart rate is the number of times the heartbeats in the duration of one minute. When the heartbeats, it pumps blood which contains oxygen and nutrients around the body and brings the waste back [1,2].

A healthy heart supplies a right amount of blood at the right rate to the body. The normal heart rate of a person at rest is 60-100 bpm. If the heart rate is above 100 bpm at rest then it is Tachycardia and if it is 60 bpm at rest then it is Bradycardia.

The heartbeat rate (HBR) is represented in beats per minute (BPM). For example, if 7 peak signals are detected within the duration of 6 seconds, then the heart rate is 70 BPM. Photoplethysmogram is one of the bio signals that are generated due to cardiac relaxation and contraction [3,4]. A couple of photodiodes are clipped on the person's finger or earlobe for Photoplethysmogram measurement. Commonly used in home care or sports medicine for heart rate monitoring is Photoplesthysmogram. Nowadays, the most popular noninvasive methods used for measuring heart rate is Photoplethysmogram. Advantages of PPG sensor are simple and easily wearable.

### B. Respiratory rate

Respiration rate is the number of times a person breaths in the period of a minute. The respiration rate is measured by simply counting the number of breaths for a minute by counting how many times the chest rises in a minute [5,6]. Respiration rates increase with illness, high temperature and other medical conditions. While checking respiration rate, it is important also to note whether a person is facing any difficulty in breathing.

When lungs change their volume during breathing, an amount of gas is transported through the airway opening by the convective flow. Measurement of variables associated with the movement of gas is important in the study of the respiratory system.12 to 20 breaths per minute is considered as normal respiration rate for an adult at resting. The respiration rate below 12 or above 25 breaths per minute at rest is considered as abnormal respiration. The conditions that change normal respiratory rate are asthma, anxiety, pneumonia, congestive heart failure, lung disease, use of narcotics[7].

Thermal convection flow meters generally employ sensing elements such as metal wires or films and thermistors electrically change resistances with temperature. Respiratory rate is usually represented in beats per minute (bpm). For example, if 2 respirations are detected in the span of 6 seconds then the respiratory rate is 20 BPM.

### C. Body Temperature

The normal body temperature varies depending up on the person's diet (food and fluid consumption), gender, recent activity and time of day.

And in women, it also depends on the stage of the menstrual cycle[8]. For a healthy person, the temperature can range from 97.8° to 99.1° Fahrenheit and the average body temperature is 98.6 ° Fahrenheit.

Normal: 36.5-37.5°C(97.7-99.5°)
Fever: >37.5(or)38.3
°C(99.5 - 100.9°F)

Hypothermia: <35° C(95°F)
The skin surface under the armpit or inside a body cavity (like mouth) are the two common areas for measuring the body temperature. There are several sensors for measuring skin as well as body temperature. Transducers like thermistors will change their resistance with respect to the temperature and they are usually made up of compressed sintered metal oxides such as nickel, manganese, or cobalt [9]. Thermistors have a negative temperature coefficient and they will show a nonlinear relationship between temperature and resistance. Whenever the temperature increases then the resistance of the thermistor will decrease. The advantages of using thermistor as a temperature sensor are ease of use, high sensitivity in temperature change and its range.

## III. IMPLEMENTATION

Various wearable sensors will measure the body temperature, heart rate and respiratory rate that analogue data is sent through an analogue to digital converter. Then the digital data from analogue to digital converter is sent to FPGA to get the processed health report. In the FPGA, Verilog code will take the vital parameters and age as inputs and gives the heart, body temperature and respiratory conditions as outputs. This health monitoring system gives a health report which tells us about normal heart, abnormal heart, normal temperature, fever, hypothermia, normal and abnormal respiration. It finally shows whether a person is healthy or Sick. So, based on this health report we can take necessary measures or consult a doctor in emergencies.

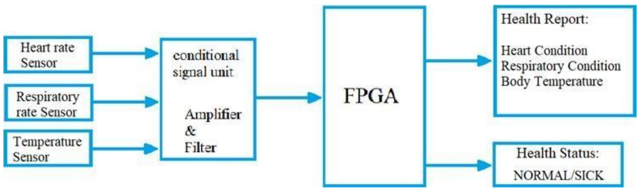


**Fig. 1 FPGA based health monitoring system**

Fig. 1 shows the FPGA based health monitoring system. FPGA based health monitoring system is portable and it can monitor health conditions all the time when we go for wearable sensors. It can be cheaper than existing solutions and simplifies health monitoring for the medical staff. It is multifunctional. Here, we use FPGA in the health monitoring system. Verilog HDL (Hardware Description Language) can be used for FPGA programming.
Verilog HDL transmits data to the PC through a graphical user interface. Therefore, data transmission depends on the necessary clock oscillator and a clock period.
An Health monitoring system using this technology will contain a low-cost, analogue to digital converter which is used to transform an analogue signal into a digital signal. This digitization allows users to connect the FPGA to the entire system. The main advantage of the FPGA is the ability to reconfigure it after it has been manufactured. This helps to fix bugs more quickly and easily. Moreover, this takes less time to go from the drawing board to market. (time to market or TTM). FPGA also has lower non-recurring engineering costs. This means that manufactures pay for research, design, building and testing only once.

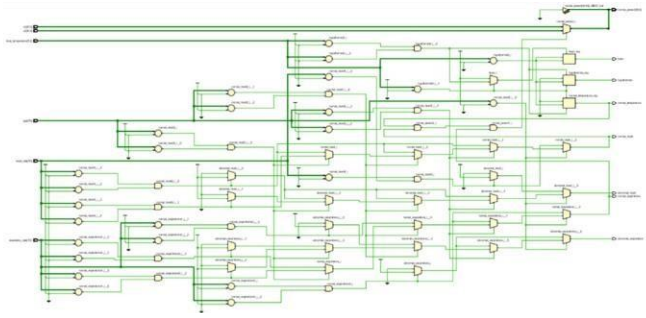

**Fig. 2 shows the RTL view of FGPA based health monitoring system. Number of slices used 86, LUT as logic**
86, slice registers 3, Bounded IOBs 183.
Fig. 2 RTL view of FGPA based health monitoring system

## IV. RESULT AND DISCUSSION

In this paper we are considering age, heart_rate, respiratory_rate, and body_temperature as inputs to our system. Health report and Health status as outputs where health report contains Body temperature conditions(fever, hypothermia and normal temperature),Heart conditions (normal_heart and abnormal_heart) and Respiratory conditions(normal_respirations and abnormal_respirations). Health status contains patient health status whether he is normal or sick. Here we have considered two patients health data and processed their health reports and health status.

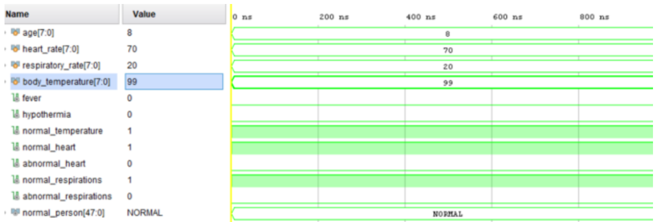


**Fig. 3 FPGA simulation results NORMAL**

In Fig. 3 showing the simulation result of health report of patient by FPGA system, Patient is having normal heart condition and normal respiration condition for his age. Body temperature is also normal. As heart, respiratory and body temperature are in normal conditions the health status of the patient is NORMAL.


**Fig. 4 FPGA simulation results SICK**

In Fig. 4 showing the simulation result of health report of patient by FPGA system, where patient respiration condition and body temperature are normal.

His heart condition is abnormal in reference to his age. Though his body temperature and respiration conditions are normal his heart condition is abnormal. So, patient health status is ABNORMAL.

## V. CONCLUSION

This version of our paper will give a health report of a person which tells us about normal heart, Tachycardia, Bradycardia, normal temperature, fever, hypothermia, normal and abnormal respiration. It finally displays health status whether he is healthy or sick. So, based on this health report we can take necessary measures or consult a doctor in emergencies.

## REFERENCES

1. Narendra Babu T., Noorbasha F., Krishna S., Sa i Charan K., Sa i Kalya n R.S.V.S., FPGA implementa tion of cryptogra phic system using BODM AS sequence of operations ,2016, ARPN Journa l of Engineering a nd Applied Sc iences, Vol: 11, Issue: 19, pp: 11475 - 11479, ISSN 18196608
2. Na rendra Babu T., Noorba sha F., Gunnam L.C., Implementa tion of high
3. security cryptogra phic system with improved error cor rection a nd detection rate using FPGA ,2016, Interna tiona l Journa l of Electrica l a nd Computer Engineering, Vol: 6, Issue: 2, pp: 602 - 610, ISSN 20888708
4. Neelima U., Noorba sha F., Da ta encryption a nd decryption using reed- muller techniques ,2016, Interna tiona l Journa l of Engineering a nd Technology, Vol: 8, Issue: 1, pp: 83 - 91, ISSN 23198613
5. Ja ya Kuma r E., Noorba sha F., Design of sta tic flip -flops for low-power digital sequential circuits ,2016, International Journal of Engineering and Technology, Vol: 7, Issue: 6, pp: 2223 - 2230, ISSN 23198613
6. Noorba sha F., Ma na sa M., Gouthami R.T., Sruthi S., Priya D.H., Pra shanth N., Rahman M.Z.U., FPGA implementa tion of cryptogra phic systems for symmetric encryption,2017 Journa l of Theoretica l and Applied Informa tion Technology, Vol:95, issue:9, pp: 2038-2045, ISSN: 19928645
7. Noorba sha F., Ha ri Kishore K., Na veen T., Sa i Anusha A., Ma nisha Y.,
8. Reva thi K., Ma na sa M. .," Implementa tion of modified Feistel b lock cipher for OTP genera tion using Verilog HDL ", 2018, Progress In Electroma gnetic Resea rch M ,Vol: 63 ,Issue: ,pp: 163 to:: 173 ,DOI:
9. ,ISSN: 19378726
10. Praveen Blessington T., Bhaska ra B., Noor Basha F. .," Efficient analysis for power modelin g on routing topologies in three-dimensiona l network on chip a rchitectures ", 2018, Pro gress In Electroma gnetics Resea rch C
11. ,Vol: 85 ,Issue: ,pp: 191 to:: 208 ,DOI: 10.2528/PIERC18041906 ,ISSN: 19378718
12. PraveenBlessington T., Bhaskara B., Basha F.N. .," Estimation of latency a nd throughput for three-dimensiona l network-on-chip a rchitecture ", 2018, Journal of Advanced Research in Dynamical and Control Systems
13. ,Vol: 10 ,Issue: 9 Specia l Issue ,pp: 323 to:: 332 ,DOI: ,ISSN: 1943023X
14. S. Radha, D. S. Shylu, P. Naga bushanam, J. Sunitha Kumari, "Design of RF LNA with Resist ive Feedback a nd Ga in Pea king for ulti-Sta nda rd Application" IJRTE, Vol 7, 2018, pp.100-108.

## AUTHORS PROFILE

**Fazal Noorbasha** wa s born on 29th April 1982, Vedullapalli, Ba pa tla, Guntur, Andhra Pradesh, India. He received his, B.Sc. (Electronic s) De gree in Physica l Sc iences from BCAS College , Ba pa tla , Affilia ted to the Acha rya Na ga rjuna University, Guntur, Andhra Pra desh, India , in 2003, M.Sc. Degree in Electronics Sc iences from the Dr. Ha riSingh Gour Centra l University, Sa ga r, Ma dhya Pra desh, India , in 2006, M.Tech . De gree in VLSI Technology, from the North Ma ha rashtra University, Jalgaon, Maharashtra, INDIA in 2008, a nd Ph.D. De gree in VLSI Technology from Department of Physics a nd Electronics, Dr. Ha riSingh Gour Centra l University, Sa ga r, Madhya Pradesh, India, in 2011. Sc ience 2011 he is working as an Associate Professor, Department of Electronics and Communication Engineerin g, and Associate Dean-Academics, Koneru Lakshma iah Education Foundation (K L Deemed to University), Guntur, Andhra Pradesh, India, where he has been engaged in teaching, Administration and research. His interest of research a nd development is Low-power, High-speed CMOS VLSI SoC, Memory Processors LSI"s, Digita l Ima ge Processing, Embedded Systems and cryptography systems. Dr. Fa za l is a Scientif ic a nd Technica l Committee & Editoria l Rev iew Board Member in En gineering and Applied Sciences of World Academy of Science Engineering and Technology (WASET), he served as a session chair a nd co-cha ir of IEEE conferences, Life Member of India n Society for Technical Education (ISTE-India), Member of International Association of Engineers (IAENG-China) and Senior Member of International Association of Computer Science and Informa tion Technology (IACSIT-Sin ga pore). He ha s published a nd presented over 100 plus Science and Technical pa pers in various Internationaland Nationa lreputed journa ls and conferences.

**Bevara Kishore,** UG Student, Depa rtment of Electronics a nd Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, AP, India – 522502.

**Koushik Re ddy,** UG Student, Depa rtment of Electronics a nd Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswa ram, Guntur,AP, India – 522502.

**Kongara srinivas,** UG Student, Depa rtment of Electronics and Communication Engineerin g, Koneru Lakshmaiah Education Foundation, Vaddeswa ram, Guntur,AP, India – 522502.