

Heart Detection System Using Hybrid Internet of Things Based on Pulse Sensor

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Heart Detection System Using Hybrid Internet of Things Based on Pulse Sensor

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Abstract. The advance of modern internet technology era, humans have many activities so they are constrained by cost problem and time to check the real time condition of their heartbeat. Therefore, it is necessary to have an alternative system that can monitor condition of the heartbeat so that the body's health can be monitored by personal or family side. This article proposes a heart rate detection system (HERDES) with an internet of things based on pulse sensor to monitor the heart rate health condition in real time. The research method use combining of simulation and design plan. The Arduino IDE software for simulations in running a system that was used along with a design plan that would produce a heart rate condition using IOT based on pulse sensors. The design monitoring applies several ways such as via Bluetooth smartphone, short message service and internet which can be accessed whenever and wherever. This article also presents a comprehensive result, via Bluetooth smartphone, short message service as well as internet for six objects testing various activities. The validity of HERDES is proven by closely matching the stethoscope measurements with error rate smaller than 2%.

1. Introduction

Health is the most important thing in human life. The advance of modern internet technology era, humans have many activities so they are constrained by cost problem and time to check the real time condition of their heartbeat. The author of [1] present a method that combine noise cancellation and adaptive matching method and those are applied to extract the fetal heart rate effectively. Clinical trials are carried out on pregnant women, and the comparison of fetal heart rates given by the proposed system with those given by the Doppler monitor is given to show the accuracy. In [2], the authors develop an unconstrained monitoring system that can monitor patients' heart rates continuously so that it gives physical therapist early warning in real time if necessary. The authors of [3] proposed a method of a remote blood pressure and heart rate monitoring system, based on wireless devices, capable to measure and transmit patient's arterial blood pressure and heart rate. The use of the proposed system is suitable for continuous long-time patient monitoring, as a part of a diagnostic procedure. However, all of the abovementioned models only consider for separate system.

The authors of [4] present a wireless healthcare system architecture which can prevent the damage to human bodies by those diagnosis instruments with active energy transmission such as X-ray detection and ultrasonic monitoring. The system uses a wearable smart sensor to record the body sounds for health monitoring and diagnosis. In [5], the authors present a synchronized intelligent sensor network for heart rate monitoring. The stochastic resonance method was utilized to process the sensor network data and monitor the cardiac status continually during. The authors of [6] present a



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system that wirelessly obtains the oxygen saturation and heart rate from patients using a pulse oximeter. The measurement will be sent to hospital. The authors of [7] describe the realization of a wireless oxygen saturation and heart rate system for patient monitoring in a limited area. The system can be used for long-time continuous patient monitoring, as medical assistance of a chronic condition, as part of a diagnostic procedure, or recovery from an acute event. The blood oxygen saturation level (SpO₂) and heart rate (HR) are continuously measured using commercially available pulse oximeters and then transferred to a central monitoring station via a wireless sensor network (WSN). The authors of [8] have been proposed a wireless and mobile system for concurrent non-invasive monitoring of fetal heart rate and uterine contractions. However, all of the abovementioned models still not worked yet in integrated monitoring system

The authors of [9] have been presented XBEE modules which are based on the IEEE 802.15.4 standards used in this system to build a low-power, low maintenance and selforganizing WSNs. The authors of [10] have presented quick assistance and cure to heart patients and to have advanced technology in the health sector and to bring revolutionary advancement in the health sector. The authors of [11] have been presented a design and development of remote monitoring device using Microcontroller and can be shown on laptop. The system uses several phases such as integrated pulse and signal extraction. A personal emergency response system using the wireless technique based on remote for monitoring of the heart rate of the elderly in home care have been presented by [12]. The authors of [13] have been presented A ring sensor, which attach to the finger and its 24-hour can be shown about heart rate. However, all of abovementioned systems talk about sensor that was use partially sensor not integrated yet monitoring system.

This article proposes a heart detection system using hybrid internet of things based on pulse sensor, Called HERDES. HERDES is expected to effectively monitor human's heart rate in real timewith several ways such as via Bluetooth smartphone, short message service and internet. The performance of HERDES is presented for 6 samples testing various activities and matching will be proven by the stethoscope measurements

2. The Research Method and Description of HERDES

The research method use combiningof simulation and design plan. The Arduino IDE software for simulations in running a system that was used along with a design plan that would produce a heart rate condition using IOT based on pulse sensors.The data collection instrument used a laptop (PC) or smartphone, Arduino IDE software version 1.8.3, inventor and thingspeak which were used to analyse data from sensor output. The quantitative data can be obtained from monitoring on IOT (Internet of Thing) in term of graphs and numbers of result heart rate.

The description of HERDES scheme have been created byseveral hardware and software, while monitoring can be shown in several ways such as smartphone via Bluetooth, short message service and internet. For more detail can be described as following: data will be taken by pulse sensor, data from pulse sensor will be proceed by Arduino. In this article, using Arduino mega 2560. The processing result from Arduino will be sent to ESP8266 for internet monitoring, Android via Bluetooth for smartphone and Sim800L for short message service. All of that can be shown in figure 1.

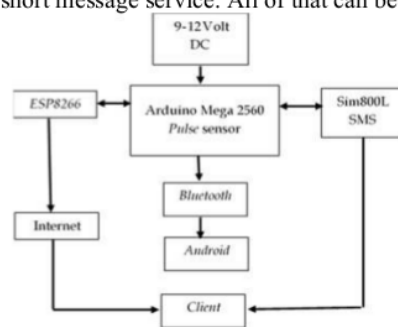


Figure 1. Diagram block for HERDES

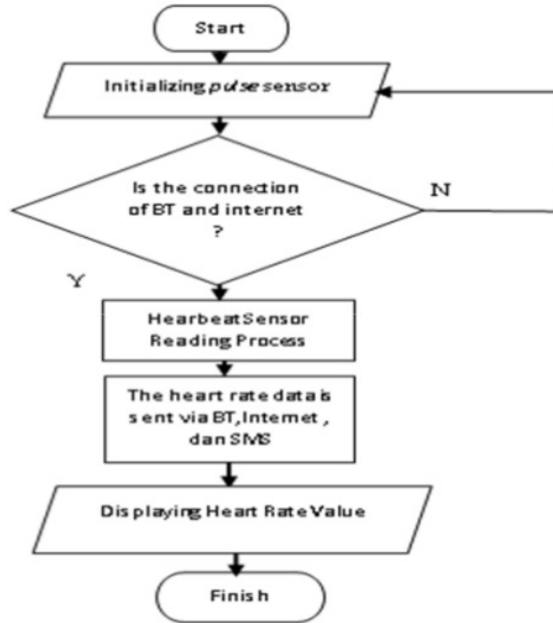


Figure 2. Flowchart for HERDES

Figure 2 shows the flow diagram of the research stages. Beginning with an initializing pulse sensor then to make sure connect to Bluetooth and internet. After that, will conduct to heartbeat sensor reading process, then the heart rate data is sent via Bluetooth, internet as well as short message service (SMS). Finally, the result can be shown in hybrid system such as smartphone, internet and short message service.



Figure 3a. An example display on ThingSpeak based on internet

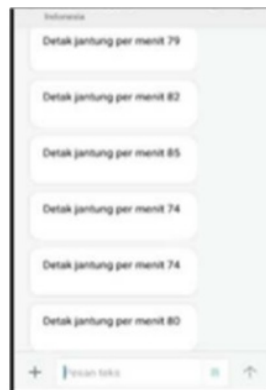


Figure 3b. An example display on SMS based GSM



Figure 3c. An example display on smartphone based on Bluetooth

An example display can be shown on figure 3a for ThingSpeak based on internet, figure 3b for SMS based on GSM model and figure 3c for smartphone based on Bluetooth, respectively.

3. Results

3.1 Bluetooth Testing

In order to test the Bluetooth of this system, the data will send from pulse sensor to smartphone via Bluetooth. Then, response can be shown on status in term of sent or not. The status of the heart rate data from pulse sensor to smartphone via Bluetooth can be obtained. The results of data transfer testing via Bluetooth can be shown on table 3.1:

Table3.1. The results of data transfer testing via *Bluetooth*

No.	Distance	Data from pulse sensor (BPM)	Data received smartphone (BPM)	Status
1.	1 meter	88	88	Sent
2.	2 meters	90	90	Sent
3.	3 meters	91	91	Sent
4.	4 meters	89	89	Sent
5.	5 meters	90	90	Sent
6.	6 meters	85	85	Sent
7.	7 meters	87	87	Sent
8.	8 meters	88	88	Sent
9.	9 meters	90	90	Sent
10.	10 meters	85	85	Sent

The IEEE 802.15.1 which task group one is based on Bluetooth technology. It defines physical layer (PHY) and Media Access Control (MAC) specification for wireless connectivity with fixed, portable and moving devices within or entering personal operating space. This standard is a formalization of Bluetooth wireless technology, a short-range communications system intended to replace the cable(s) connecting portable and/or fixed electronic devices. Key features are robustness, low power, and low cost. Many features of the core specification are optional, allowing product differentiation [15].

According to IEEE 802.15.1 that transfer data maximum is 10 meters and table 3.1 shows the data transfer testing via Bluetooth can be proven that a good data transfer is between 1 and 10 meters. The status have given information sent as normally in accordance with standardization.

3.2. Entire objects testing

In this article consist of six objects to test using pulse sensor and can be shown on hybrid internet of things, that is mean display result from object's testing can be shown on three devices such as smartphone, SMS and internet, respectively. The all of result from HERDES system will be compared with stethoscope measuring and also give error rate for each object. Totally numbers data were taken 600 data and 100 data taken for each object. Let us denote A, E and F be 20 years old object of E24 years old and object of F37 years old, respectively.

Let us also denote C, D and X be object of C25 years old, object of D29 years old and object of X70 years old, respectively.

In the system testing process, some objects have different responses to the value of sensor because they are influenced by gender, age and object's activity. Table 3.2 summarizes results of entire objects testing in 100 data for each object retrieval.

Table 3.2 The results of the entire objectstest

Object	M/F	Age	Activity	Condition	Averagepulse sensor (BPM)	Averagestethoscope (BPM)	Erorr (%)
A	F	20	Waking Up	Good	79.19	78.04	1.4
E	M	24	Sitting	Good	85.97	84.55	1.6
F	F	37	Sitting	Good	76.02	74.94	1.4
C	M	24	After playing badminton	Moderate activity	105.26	104.46	1.1
D	F	29	Jogging	Moderate activity	110.49	109.32	1.2
X	M	70	Jumping jack	Fat burn	100.35	99.04	1.35

Table 3.2 also shows kind of object, gender, age, activity and condition, respectively. In addition also value of average pulse sensor, average stethoscope and error, respectively. The result of error between value of average pulse sensor and average stethoscope smaller than 2%. For more detail based on graph can be shown on figure 4.

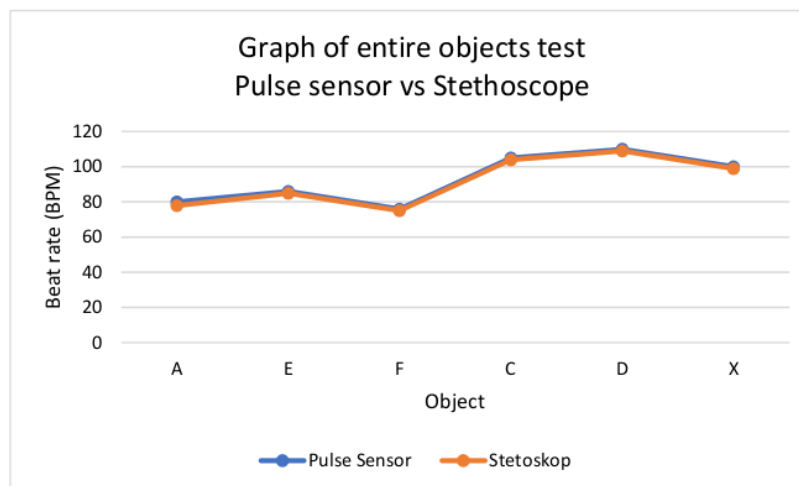


Figure 4.Graph of entire objects test

Figure 4 shows the average pulse sensor against stethoscope. The average pulse sensor obtained by measurement is very close to that obtained by stethoscope. It is obvious HERDES have proven result of six objects in various activities very accurate in measuring heart rate with error rate smaller than 2% and very matching with stethoscope measurement.

4. Conclusions

This article proposes a heart rate detection system (HERDES) with an internet of things based on pulse sensor to monitor the heart rate health condition in real time. The design method applies several ways such as via Bluetooth smartphone, short message service and internet which can be accessed whenever and wherever. This article also presents a comprehensive result, via Bluetooth smartphone, short message service as well as internet for six objects testing various activities. The validity of HERDES is proven by closely matching the stethoscope measurements with error rate smaller than 2%.

References

- [1] W. Yang, K. Yang, H. Jiang, Z. Wang, Q. Lin and W. Jia, "Fetal heart rate monitoring system with mobile internet", *2014 IEEE International Symposium on Circuits and Systems (ISCAS)*, Australia, 2014
- [2] J. Park, J. Cho, J. Choi and T. Nam, "A Zigbee network-based multi-channel heart rate monitoring system for exercising rehabilitation patients", *TENCON 2007 - 2007 IEEE Region 10 Conference*, Taipei, 2007
- [3] C. Rotariu, A. Pasarica, H. Costin, F. Adochiei and R. Ciobotariu, "Telemedicine system for remote blood pressure and heart rate monitoring", *2011 E-Health and Bioengineering Conference (EHB)*, Romania, 2011.
- [4] Z. Wang, K. Yang, W. Wang, H. Jiang, S. Wu, Q. Lin and Wen Jia, "Sound monitoring based wireless healthcare and a typical implementation for heart rate monitoring", *2013 IEEE International Conference of Electron Devices and Solid-state Circuits*, Hongkong, 2013.
- [5] G. Hui, "Real-time human heart rate monitoring using a wireless sensor network based on stochastic resonance", *2010 International Conference on E-Health Networking Digital Ecosystems and Technologies (EDT)*, China, 2010.
- [6] S. Alshorman, F.T. Jaber and F. Bensaali, "A Wireless Oxygen Saturation and Heart Rate Monitoring and Alarming System Based on the Qatar Early Warning Scoring System", *2015 International Conference on Computational Science and Computational Intelligence (CSCI)*, Las Vegas, 2015.
- [7] C. Rotariu, V. Manta, "Wireless system for remote monitoring of oxygen saturation and heart rate", *2012 Federated Conference on Computer Science and Information Systems (FedCSIS)*, Poland, 2012.
- [8] M. Roham, E. Saldivar, S. Raghavan, M. Zurcher, J. Mack and M. Mehreg, "A mobile wearable wireless fetal heart monitoring system", *2011 5th International Symposium on Medical Information and Communication Technology*, Switzerland, 2015.
- [9] N.S.A. Zulkifli, F.K. Che Harun and N.S. Azahar, "XBEE wireless sensor networks for Heart Rate Monitoring in sport training", *2012 International Conference on Biomedical Engineering (ICoBE)*, Malaysia, 2012.
- [10] A. Hodge, H. Humnabadkar and A. Bidwai, "Wireless Heart Rate Monitoring and Vigilant System", *2018 3rd International Conference for Convergence in Technology (I2CT)*, India, 2018.
- [11] B. A. Izneid, I. Sukar, M. Ali, M. Souiyah, "Development of wireless Bluetooth heart rate remote monitoring system", *IET International Conference on Wireless Communications and Applications (ICWCA 2012)*, Malaysia, 2012.
- [12] D. L. Larkai, R. Wu, "Wireless Heart Rate Monitor in Personal Emergency Response System", *2015 IEEE 18th International Symposium on Design and Diagnostics of Electronic Circuits & Systems*, Serbia, 2015.
- [13] I.-H. Jang, H.-G. Yeom and K.-B. Sim, "Ring sensor and heart rate monitoring system for sensor network applications", *ELECTRONICS LETTERS* 20th November 2008 Vol. 44 No. 24.
- [14] American Heart Association. (2016, October 12). Target Heart Rate. 2017

- [15] IEEE 802.15.1. Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)". IEEE Standards Association. doi:10.1109/IEEESTD.2005.96290. ISBN 0-7381-4707-9. 2011.

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