

## DESIGN AND IMPLEMENTATION OF A SMART PHONE APPLICATION FOR HEALTH MONITORING AND LIFESTYLE MANAGEMENT

<sup>1</sup>Mgbeafulike I.J  
[Ike.mgbeafulike@gmail.com](mailto:Ike.mgbeafulike@gmail.com)

<sup>2</sup>Akpan U. S  
[ukeme\\_kpn@yahoo.com](mailto:ukeme_kpn@yahoo.com)  
Tel: 08063298481

<sup>1,2</sup>Department of Computer Science, Chukwuemeka Odumegwu Ojukwu University

### ABSTRACT

*This paper presents the design and development of an integrated system for measuring heart rate using pulse sensor to monitor the heart condition of a patients who may be discharge from the hospital. As heart related diseases are increasing day by day, the need for an accurate and affordable heart rate measuring device or heart monitor is essential to ensure quality of health. However, most heart rate measuring tools and environments are expensive and do not follow ergonomics. Our proposed Heart Rate Measuring (HRM) device is economical and user friendly and uses optical technology to detect the flow of blood through index finger. This work adopted the Structured System Analysis and Design Methodology (SSADM) to examine and explain the step-by- step procedure for accomplishing the analysis and development of this proposed system. It considers and discusses the impact of Cardiovascular related diseases as the leading cause of death in the world. Hence, deployment of resources for early detection and treatment of heart disease has a higher potential of reducing fatality associated with cardiac disease. Hence, this statistic was the main motive in embarking on the research. This research work was implemented using Microsoft Visual C#, PHP and MySQL for the health monitoring system and lifestyle management. The result obtained shows that the device meets diverse and conflicting requirements, including reliability, acceptability, affordable and low power consumption when compared to the existing systems.*

**Keywords:** integrated device, heart rate, pulse sensor, patients, health

### 1.0 INTRODUCTION

Over the past years, heart rate has been becoming an essential parameter which is linked with the cardiovascular system of the human beings. There are several ways of measuring the heart conditions of the people; i.e. through the ECG waveform or pulse generated from different body parts. The basic theory behind the cardiovascular system is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart. Heart rate, which is also known as pulse, is the number of times a person heart beats per minute. The heart rate is dependent on the condition of one's heart, size of the body, age, the person doing any activity or being at rest etc. Any of these actions would cause the variability of heart beat rate. Result shows the average adult heart beat ranges from 60-100 bpm. However, researchers are making an extensive effort to find the best solution for the monitoring of the heart. Moreover, wireless heart rate monitors based on the photoplethysmography (PPG) have been immensely contributing in diagnostic of health, as an important asset in hospitals, clinics and homes. The following (PPG) technology have an advantage in the detection of heart disorders and for the treatment of the people who

suffers from various types of diseases. These include, diabetes, arrhythmia, and blood pressure.

The Study “Health Monitoring and Lifestyle Management” was motivated by problems associated with heart rate abnormality, that most of our elders is facing today. The traditional medical test instruments Electro Cardiogram (ECG) in large sizes and their maintenance and cost pose a hurdle. Vital sign monitoring is becoming increasingly important for securing independent lives as the population of aged people increases. Online, continuous monitoring allows us to detect emergencies and abrupt changes in the patient’s condition. Especially for cardiac patients, online, long-term monitoring plays a pivotal role. It provides critical information for long-term assessment and preventive diagnosis for which long-term trends and signal patterns are of special importance. Such trends and patterns can hardly be identified by traditional examinations. Those cardiac problems that occur frequently during normal daily activities may disappear the moment the patient is hospitalized, causing diagnostic difficulties and consequently possible therapeutic errors. In this sense, continuous and ambulatory monitoring systems are needed to detect the traits, Sokwoo, (2001).

### 1.1 Statement of the Problems

The following problem motivated the development of the system;

- i. The traditional medical test instruments in large sizes and their maintenance and cost pose a hurdle.
- ii. Patient could not be found in time & helped in time.
- iii. Regular monitoring of patient is not possible once he/she is discharged from hospitals
- iv. Human attention is required for each patient.
- v. Limited availability of medical instruments.
- vi. Most of the patient died due to lack of experts & machines.
- vii. Most of the Existing systems use wired communication which is too tedious for long distance communications.

### 1.2 Aim and Objectives of the Study

The aim of this research is to develop an Arduino device based system for health monitoring and lifestyle management to achieve the following objectives:

- i. To design a low-cost device which measures the heartbeat per minute BPM and analyze rate signals in real-time using photoplethysmography (PPG) Techniques.
- ii. To implement data monitoring over internet of a thing (IOT) i.e machine to infrastructure techniques.
- iii. To implement self-stabilized Tachycardia process (SSTP) algorithm i.e for every rise in heart beat rate it shall automatically recommend solutions.
- iv. Develop a common platform to provide a means of communication between the doctor and patient, where the doctor can see the patient's daily records.

Several studies and reviews in Empirical framework have been discussed extensively on the working of heart monitors. Besides, the research work on “Design and implementation of a smart phone application for health Monitoring and Lifestyle Management” is distinguished from the reviewed work in the area of incorporating the lifestyle modification aspect, where the patient or the user will be guided on the danger of cardiovascular related diseases.

## 2.0 Literature Reviews

Patient health monitoring is the continuous observation of conditions or several medical parameters (vital signs) of a patient over time by a doctor or nurse. It is a very important process which helps doctors and other medical workers to offer various assistance, such as emergency services to patients when their health is deteriorating. Furthermore, lifestyle diseases such as asthma, cancer, diabetes, heart diseases, stroke, appear to become ever more widespread as countries become more industrialized, therefore, lifestyle diseases are different from other diseases because these are potentially preventable through lifestyle modification or management such as changes in diet, lifestyle and environment. In particular, an unhealthy and irregular life pattern may increase the risk of lifestyle diseases in the later part of life. Oguma et al., (2004).

Arduino is an open source electronics prototyping platform based on flexible, easy-to-use hardware and software. In simple word, Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as light sensor, motors, relays, diodes etc. Arduino was basically designs to make the process of using electronics in multidisciplinary project more accessible. It is intended for Artists, designers, hobbyists and anyone interested in creating interactive objects or environment

### 2.1 Related works

**Some authors have written on patients monitoring using other means.** In Sridevi et al., (2010), a system is presented that monitors and delivers patient's physiological readings to the hospitals and provides an alert mechanism triggered by the patient's vital signs which is linked to a medical practitioner's mobile device. Minutolo et al., (2011) presented "A Smart Context-Aware Mobile Monitoring System for Heart Patients"; Patient context awareness is an important concept for application services in mHealth environments. In general, patient context means patient posture, movement, breath, temperature etc. Shatabd et al., (2017) proposed GSM Based ECG Tele-Alert System Using LabVIEW to Measure Various Physiological Parameters. The study explains that LabVIEW is a graphical programming tool which uses icons instead of using text and also displays the result in the waveforms. Bandana, (2016) presented "heart rate monitoring system using fingertip through arduino and processing software". This paper describes a technique of measuring the heart rate through a fingertip and Arduino. It is based on the principal of photophelthysmography (PPG) which is non-invasive method of measuring the variation in blood volume in tissue using a light source and detector. Mohammad et al., (2016), in their research paper, the design and development of a microcontroller based heartbeat and body temperature monitor using fingertip and temperature sensor was shown. The device involves use of optical technology to detect the flow of blood through the finger and offers the advantage of portability over conventional recording systems. Singh (2016) Proposed a system with artificial neural fuzzy that work as a smart monitoring system, the system measure three factors for the patient which are: temperature, heart rate, and the position of the patients to detect if he was walking, sitting, sleeping and so on. Abbas (2019) presented a hospital physiological monitoring system. In this work, physiological parameters such as pulse rate, Temperature of human are measure through the proposed system. The system was designed using Arduino, heart rate sensor, temperature sensor, and LCD and the heart beat rates of patients and temperature are calculated by utilizing sensors as an easy methodology. Nabeena (2015) presented a "Review on Cloud Based Patient Monitoring" Thus, the proposal presents an innovative solution that

addresses problems of integration, such as medical staff from one institution being able to monitor patients located at another. Punit et al., (2016), proposed a system that has enough intelligent to monitor the health parameters of patient. Aboobacker et al., (2007), in their research paper implementation of heartbeat monitoring and heart attack detection system using Internet of things was shown. The sensor is interfaced to a microcontroller that allows checking heart rate readings and transmitting them over internet.

### 3.0 Proposed System and Implementation

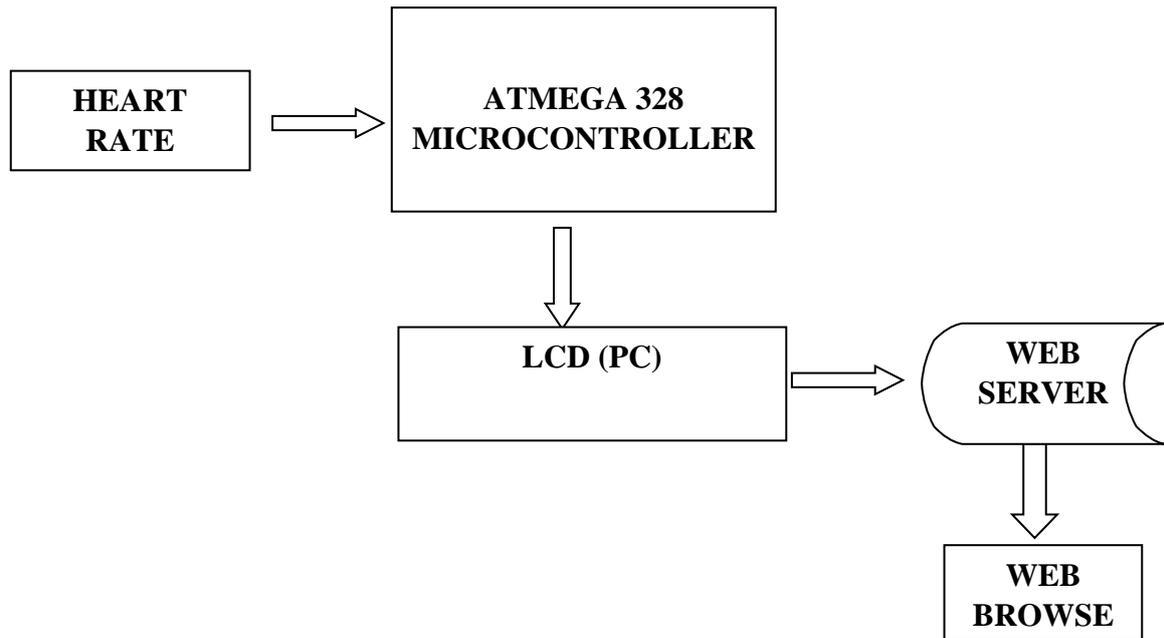


Figure 1: Data flow diagram of the proposed health monitoring system

The above diagram is the general architecture of our health monitoring system. Our system Patient Health Monitoring and lifestyle Management System consists of three main components such as data sensing module, data processing module and data communication module. The data sensing module consists of heart beat sensor which senses the changes in the physiological parameters. The information is then conveyed to the microcontroller of data processing module. The data processing module analyzes the input signals and displays the data on a Personal Computer (PC) using a serial port so that measured heartbeat can be sent to web server for further online monitoring by the healthcare professional accessible through a web browser with a smartphone. The proposed system equally provides its user with a lifestyle management guideline to prevent cardiovascular related diseases.

### 3.1 Methodology Used

The Methodology employed during the course of the work is Structured System Analysis and Design Methodology (SSADM). SSADM is a set of standards for systems analysis and application design. An open methodology based on the waterfall model with the following

attributes; requirements analysis, analysis of the old system, system and software design, implementation of the new system and testing/maintenance.

### 3.2 Implementation and Result

The implementation was done by dividing the whole project into small parts; regarding the hardware parts each one has passed through the following steps:

- Real hardware implementation and testing.
- Integration with other parts.

With respect to the software part, also it has been divided into small parts each part performs a certain job, thus each one has passed through the following steps:

- Algorithm design.
- Real implementation and testing.
- Integration with other parts.

In overview, the proposed health Monitoring and lifestyle Management System is implemented using Aduino Micro controller board, pulse sensor and a PC connected through a com port.

We also use C# programming language for reading of data to the database through my sql connector and PHP for web development (figure 2).

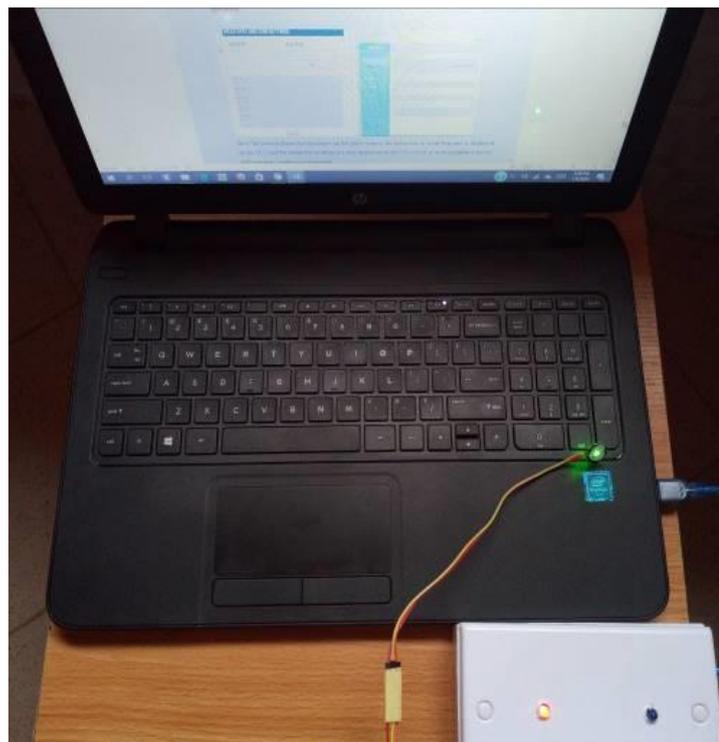
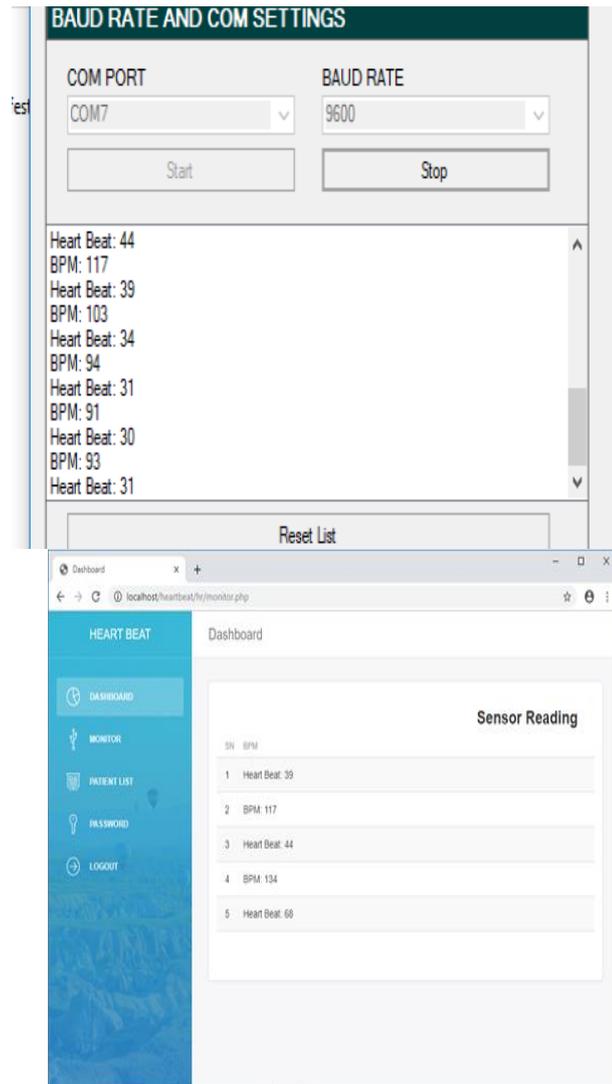


Figure 2: Architecture of the Proposed Monitoring System



Once the patient places his/her finger on the pulse sensor, the pulse rate or heart beat rate is displayed on the GUI and the parameter readings are also displayed on the web server so as to maintain a history of the patients continuous monitoring.

#### 4.0 Conclusion

The proposed system can be effectively used to monitor the heart condition of a patient when he/she is out of the hospital thereby aiding the cardiologist in making intelligent decisions. The system This system is not to rule out the job of the cardiologists, but to assist them or the physicians in handling issues of clinical decision making. The experiment shows a high degree of accuracy compared to the traditional system already in the market.

#### 5.0 REFERENCES

Abbas, S. H., & Raof, T. H. (2019). Hospital Physiological Monitoring System. Journal of Engineering and Sustainable Development (JEASD), Vol. 23(02), PP. 132 – 140.

- Aboobacker, S., Arith, K., & Sathish, K. (2007). Heart beat Sensing and Heart Attack Detection Using internet of things IOT, *International Journal of Engineering Science and Computing (IJESCE)*, April 2007.
- Bandana, M., & Ajit, K. P. (January 2016). heart rate monitoring system using fingertip through arduino and processing software. *International Journal of Science, Engineering and Technology Research (IJSETR)*, Vol. 5(1), pp. 84-89.
- Minutolo, A., Sannino, G., Esposito, M., & De Pietro, G. (2010). A rule-based mHealth system for cardiac monitoring in *Biomedical Engineering and Sciences (IECBES)*, pp. 144-149.
- Mohammad, W.A., Tanin, S., & Mohammad, S.A. (2016). A Heartbeat and Temperature Measuring System for Remote Health Monitoring using Wireless Body Area Network. *International Journal of Bio-Science and Bio-Technology*, Vol.8(1).
- Nabeena, A. (2015). A Review on Cloud Based Patient Monitoring. *International Journal of Information Technology & Systems*, Vol. 4(1), pp. 29 – 34.
- Punit, G., Deepika, A., Jasmeet, C., & Pulkit, K.D. (2016). IoT based Smart Healthcare Kit. *Jaypee University of Information Technology. Himachal Pradesh, India©2016 IEEE*.
- Shatabdi, T., Antara, T., Pooja, L., & Upasani, D.E. (2017). GSM based ECG Tele-alert system using LabVIEW to measure various physiological parameters. *International Research Journal of Engineering and Technology (IRJET)*, Vol. 04 (04), pp. 3248 – 3251.
- Singh, K., Sharma, D. & Aggarwal, S. (2016). *A Real Time Patient Monitoring System based on Artificial Neural Fuzzy Inference System (ANFIS)*. *International Journal of Computer Applications*, Vol. 146(15).
- Sokwoo, R. (2001) “design and analysis of artifact resistive finger photoplethysmographic sensors for vital sign monitoring” *Massachusetts, U.S, chapter1, P9*.
- Sridevi, S., Sayantani, B., Amutha, K.P., Mohan, C.M., & Pitchiah, R. (2010). Context Aware Health Monitoring System in 13th International conference on medical biometrics (ICMB), pp. 249–257, 2010.
- Oguma Y., Shinoda T., (2004). Physical activity decreases cardiovascular disease risk in women: Review and metaanalysis. *American Journal of Preventative Medicine*, 2004, 26(5):407–418.