Pavithra B, et. al. International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 10, Issue 8, (Series-V) August 2020, pp. 25-32

RESEARCH ARTICLE OPEN ACCESS

An IoT Based Automatic Patient Health Monitoring System

[1]Pavithra B. , [2]Sangeetha K.
[1]*Student, SNS College of Engineering*
[2]*Assistant Professor, SNS College of Engineering*

ABSTRACT
Moving into a replacement era of healthcare, new tools and devices are developed to extend and improve health services, such as remote patient monitoring and risk during this concept Internet of Things (IoT) present great advantages by
providing remote and efficient services. In India many patients are dying due to heart attacks and reason behind that they're not getting timely and proper help. To give them timely and proper help first we would like to continuous monitoring of patient health. The fixed monitoring system are often used only when the patient is on the bed and this technique is merely available in hospitals. The system is developed for home use by patients that aren't in critical condition but got to be constant or periodically monitored by clinician or family. During this paper, a prototype of a wireless health monitoring system capable of sending SMS associated with the health status of the patient is developed. During this project, the temperature, blood pressure and heart rate of the patient is measured. The collected data is shipped to the server using IoT. When the info recorded is found to be abnormal, a buzzer is about on to point the critical condition.
***Keywords*:** IoT, Wireless Health Monitoring System

Date of Submission: 15-08-2020 Date of Acceptance: 01-09-2020

I. INTRODUCTION

Health care monitoring system are an emerging technology that permits continuous ambulatory monitoring of human vital signs during daily lifestyle (during work, at home, during sport activities, etc.) or during a clinical environment, with the advantage of minimizing discomfort and interference with normal human activities.

Health devices are a part of personal health systems, an idea introduced within the late 1990s, with the aim of placing the individual citizen within the center of the healthcare delivery process, managing its own health and interacting with care providers and concept that's commonly mentioned as "patient empowerment. The aim was to boost the people interest about their health status, improving the standard of care and making use of the new technology capabilities. These devices create asynergybetweenmultiplescience domains like biomedical technologies, micro and nanotechnologies, materials engineering, electronic engineering knowledge and information and communication technologies.

According to Statista, the wearable devices market is currently having a worldwide revenue of around $26 billion, and is predicted to succeed in almost $34 billion in 2019. Regarding healthcare and medical environments, it is expected to grow almost to $15 billion worldwide value in 2019. This review aims to collect recent information on HDs and better evaluate the present situation of such devices, foreseeing their evolution in the coming years. The main focus will be in vital signs and in textile embedded WHDs.

In a hospital health care monitoring system it is necessary to constantly monitor the patient's physiological parameters. For example a pregnant woman parameters like vital sign blood pressure (BP) and heart rate of the lady and pulse rate and fetal movement to regulate their health condition. This paper presents a monitoring system that has the potential to monitor physiological parameters from multiple patient bodies. Within the proposed system, a coordinator node has attached on patient body to gather all the signals from the wireless sensors and sends them to the base station. The attached sensors on patient's body form a wireless body sensor network (WBSN) and that they are ready to sense the pulse rate, blood pressure and so on. This system detects the abnormal conditions, sends an alarm to the patient and also a SMS/E-mail to the physician. Also, the proposed system consists of several wireless relay nodes which are liable for relaying the data sent by the coordinator node and forward them to the base station. The most important advantage of this techniqueiscompared to previous systems is to

scale back the energy consumption to prolong the network lifetime, speed up and extend the communication coverage to extend the liberty for enhancing patient quality of life. We've developed this technique in multi-patient architecture for hospital healthcare and compared it with the opposite existing networks supported multi-hop relay node in terms of coverage, energy consumption and speed.

The rest of this paper is organized as follows. Section II discusses related work on the projected health monitoring system. In Section III, proposed structure is explained, while Section IV describes the planningof proposed structure.Results are discussed in Section V. Finally, the conclusion is given in section VI.

II. EXISTING SYSTEM

Body sensor network systems can help people by providing healthcare services like medical monitoring, memory enhancement, medical data access, and communication with the healthcare provider in emergency situations through the SMS or GPRS. Continuous health monitoring with wearable or clothing-embedded transducers and implantable body sensor networks will increase detection of emergency conditions in in danger patients. Not only the patient, but also their families will enjoy the benefit from these. Also, these systems provide useful methods to remotely acquire and monitor the physiological signals without the necessity of interruption of the patient's normal life, thus improving life quality. Now days, heart diseases are exceeds up to dangerous level which result in death of human being. Monitoring the patient constantly is difficult or doctors also are unable to watch the particular patient for total working hours. In many critical conditions such as patient is located far away from hospitals or also in case of old patient who suffering with heart diseases and physical disorders. This module consists of pulse rate sensor and temperature sensor which measures the pulse rate and body temperature and sends SMS through GSM module to the medical advisory for the preliminary precautions in order that patient can be prevented from serious situations before reaching to the hospital. The data are stored in the cloud for the physician reference.

2.1 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega 328.The Arduino Uno are also powered via the USB connection or with an external power supply. The facility source is chosen automatically. The Arduino Uno features a number of facilities for communicating with a computer, another arduino or other microcontrollers. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the arduino board. The Arduino Uno are often programmed with the arduino software.

2.2 LM35 TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit LM35 temperature sensors, whose output voltage is linearly proportional to Celsius temperature. The LM35 sensor thus has anplus over linear temperature sensors calibrated in ° Kelvin, because the user isn't required to subtract an outsided constant voltage from its output to get convenient Centigrade scaling. The LM35 sensor doesn't require any external calibration or trimming to supply typical accuracies of ±¼°C at temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

2.3 HEARTBEAT SENSOR

The sensor has a super bright red LED and light detector. The necessity for LED to be super bright is for the maximum light passed is to spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and due to that less light is reached at the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified through an amplifier which outputs analog voltage between 0 to +5V logic level signal. It works on the principle of light modulation by blood flow through finger at each pulse.

2.4 GSM MODULE

GSM module is used to establish communication between a computer and a GSM system. GSM module has a GSM modem assembled together with power supply circuit and communication interfaces (like RS- 232, USB, etc) for computer. GSM MODEM is a class of wireless MODEM devices that are designed for communication of a the system with the GSM network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network.

2.5 ARDUINO IDE

Arduino consist of a physical programmable circuit board (microcontroller) and a

piece of software, or IDE (Integrated Development Environment) that runs on the computer, used to write and upload computer code to the physical board.The arduino software (IDE) contains a text editor for writing code, a message area, a text console, a tool bar with buttons for common functions andseries of menus.

2.6 CLOUD

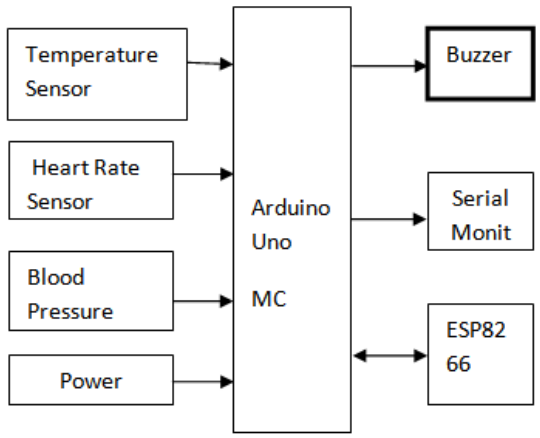
The information from the sensors are received by the Arduino board and from Arduino the data is transferred to the cloud. The data's are sent to the cloud continuously by which doctors are able to view the patient details. Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining a record on printed paper. The digital records are kept in a particular computer or memory device like pen-drive because there are chances that these devicescan get corrupt and data might be lost. In case of IoT, the cloud storage is more dependable and has less chances of data loss.

2.7 CONCLUSION

Modern technologies have developed that promotes comfortable and better life which is disease free. This paper provides the low-cost solution to increase the remote monitoring capability of existing health care system by using arduino, wi-fi and GSM modem. It uses two sensors such as pulse rate and body temperature. The sensors are operated and important information is transmitted to the microcontroller. By using this prototype circuit the messages can be transmitted in case the value of any parameter falls below or above a predetermined value to the corresponding medical expert so that necessary treatment can be given to the patient.

III. PROPOSED SYSTEM

3.1 BLOCK DIAGRAM



3.2 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega 328.The Arduino Uno is powered using the USB connection or an external power supply. The power source is selected automatically. The Arduino Uno has a number of modes for communicating with a computer, another arduino or other microcontrollers. The Arduino software consists of a serial monitor which allows simple textual data to be sent to and from the arduino board. The Arduino Uno is programmed with the arduino software.

Figure 3.1 UNO Processor

3.3 CK101 BLOOD PRESSURE MONITOR

CK101 is a hand held blood pressure monitor powered by 2xAAA batteries. CK101 has a built-in LCD display and an inflatable wristband. User can wear it at his wrist, and then press the power switch to start the pressure measurement.

CK101 consist of a semiconductor pressure sensor to measure the high pressure (SYS), the low pressure (DIA), and the heart rate, pulse. CK101 have built-in memory space to store the measured readings. User can use the memory button to retrieve the previous readings. Small in size, light in weight are other features of CK101.

A sphygmomanometer consists of an inflatable cuff, a measuring unit (the mercury manometer, or aneroid gauge), and a mechanism for inflation which may be a manually operated bulb and valve or a pump operated electrically. It is a device to measure blood pressure, composed of an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner and a

mercury or mechanical manometer to measure the pressure. It is always used in conjunction with a means to determine at what pressure blood flow is just starting, and at what pressure it is unimpeded.

Figure 3.2 CK101 Pressure monitor

3.3 Heart Rate Sensor

Heart Rate Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by anyonewho want to easily incorporate live heart rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time. Heart Rate sensor includes a 24-inch Color-Coded Cable, with (male) header connectors. One can find easy to embed the sensor into your project, and connect to an Arduino. No soldering is required. The clip can be hot glued to the back of the sensor and easily worn on the earlobe. These are 'hook' side and are also perfectly sized to the sensor. We'll find the Velcro dots very useful if you want to make a fabric strap to wrap around a fingertip. Velcro strap to wrap the Pulse Sensor around your finger. Transparent Stickers are used on the front of the Pulse Sensor to protect it from oily fingers and sweaty earlobes. The Pulse Sensor has 3 holes around the outside edge which make it easy to sew it into almost anything. The front of the sensor is with the Heart logo.

This is the side that makes contact with the skin. On the front you see a small round hole, which is where the LED shines through and there is also a little square just under the LED. The square is anlight sensor, exactly like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the amount of light that bounces back. The other side of the sensor is where the rest of the parts are mounted.

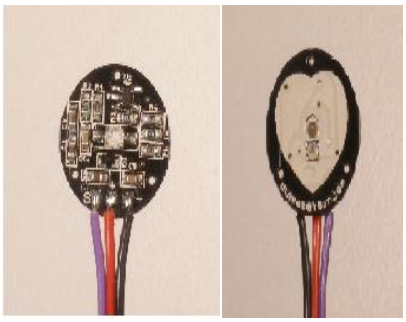


Figure 3.3 Heart rate sensor

3.4 Temperature Sensor

Melexis MLX90614ESF-BAA is an infrared thermometer designed for non-contact temperature sensing. An internal 17-bit ADC and a powerful DSP contribute to the MLX90614's high accuracy and resolution. It has a large number of applications including body temperature measurement and movement detection.

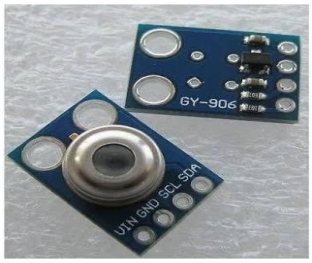


Figure 3.4 Temperature sensor

3.5 MQTT (MQ Telemetry Transport)

MQTT (MQ Telemetry Transport) is a lightweight messaging protocol that provides resource-constrained network clients with a simple way to distribute telemetry information. This protocol uses a publish/subscribe communication pattern, that is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT).

MQTT enables resource-constrained IoT devices to send or publish information about a given topic to a server that functions as an message broker. The broker pushes the information out to those clients that have previously subscribed to the client's topic.

The MQTT protocol is the best choice for wireless networks that experience varying levels of delay due to periodic bandwidth constraints or unreliable connections. Should the connection from a subscribing client to a broker get broken, the broker will buffer messages and push them out to the subscriber when it is back online. If the connection from the publishing client to the broker is disconnected without notice, the broker can close

the connection and send subscribers a cached message with instructions from the publisher.

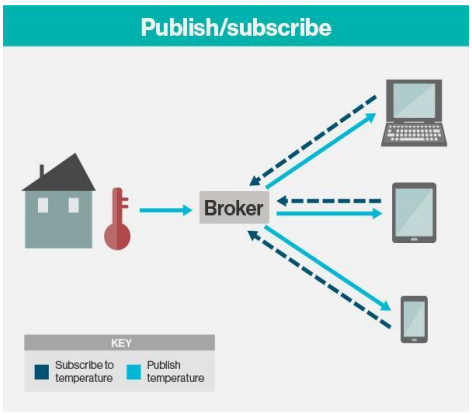


Figure 4.5 MQTT'S publish/subscribe model

3.6 MQTT DASHBOARD APP

With the app we can create dashboards for our MQTT enabled automation systems.

- Phones and tablets are supported in both orientations
- Share metrics among devices via shared topic
- Simple and easy to use dashboard-like UI
- Designed to run 24/7 (memory efficient, reconnects automatically)
- Scripting support (JavaScript)
- Unique to the app: Image metric and custom URLs to open
- Unlike Blynk, this app uses industry standard protocol (MQTT) instead of custom one, so it's much easier to connect all of your smart devices together
- Support for M2M, Sonoff, Electrodragon, esp8266, Arduino, Raspberry Pi, Microcontrollers (MCU), sensors, computers, pumps, thermostats, remote control and other things.

3.7 SOFTWARE REQUIREMENTS

3.7.1 ARDUINO IDE

The Arduino project provides the Arduino integrated development environment (IDE), which is a application written in the programming language Java. It evolved from the IDE for the languages Processing and Wiring. It includes a editor with features such as text cutting and pasting, searching and replacing text, brace matching, and syntax highlighting, and provides simple one- click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the file extension .ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

The Arduino IDE supports the languages C and C++ using special rules of code structuring.The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

3.7.2 Embedded C Language

Embedded C programming requires non-standard extensions to the C language in order to support features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee published a report extending the C language to address the issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

Syntax

C has a formal grammar specified by the C standard line endings are generally not significant in C; however, line boundaries do have significance during the preprocessing phase. Comments may appear either between the delimiters /* and */, or (since C99) following // until the end of the line. Comments delimited by /* and */ do not nest, and these sequences of characters are not interpreted as comment delimiters if they appear inside string or character literals.

C source files contain declarations and function definitions. Function definitions contain declarations and statements. Declarations define new types using keywords such as struct, union, and enum. Keywords such as char and int specify built-in types. Sections of code are enclosed in braces ({ and }, sometimes called "curly brackets") to limit the scope of declarations and to act as a single statement for control structures.

As an imperative language, C uses statements to specify actions. The most common statement is an expression statement, consisting of an expression to be evaluated, followed by a semicolon; as a side effect of the evaluation, functions may be called and variables may be assigned new values. To modify the normal sequential execution of statements, C provides several control-flow statements identified by reserved keywords. Structured programming is supported by if (-else) conditional execution and by do-while, while, and for iterative execution (looping). The for statement has separate initialization, testing, and re-initialization expressions, any or all of which can be omitted. Break and continue can be used to leave the innermost enclosing loop statement or skip to its re-initialization. There is also a non-structured go to statement which branches directly to the designated label within the function. Switch selects a case to be executed based on the value of an integer expression.

Expressions can use a variety of built-in operators and may contain function calls. The order in which arguments to functions and operands to most operators are evaluated is unspecified. The evaluations may even be interleaved. However, all side effects (including storage to variables) will occur before the next "sequence point"; sequence points include the end of each expression statement, and the entry to and return from each function call. Sequence points also occur during evaluation of expressions containing certain operators (&&, ||, ?: and the comma operator). This permits a high degree of object code optimization by the compiler, but requires C programmers to take more care to obtain reliable results than is needed for other programming languages.

IV. WORKING PRINCIPLE

4.1 Temperature Sensor working:

The function of temperature sensor is to measure the body temperature.MLX90614 thermometer is the temperature sensor used to measure the temperature. The MLX90614 is built from 2 chips developed and manufactured by Melexis. The MLX90614 is factory calibrated in wide temperature ranges: -40 to 125 °C for the ambient temperature and -70 to 382.2 °C for the object temperature. The 10-bit PWM is as a standard used to transmit continuously the measured object temperature. The various temperature ranges are given in the tabular column below.

^{o}C	F	CONDITION
30.56	90.40	NORMAL
35.08	95.14	NORMAL
36.22	97.19	NORMAL
37.64	99.75	ABNORMAL
40.54	104.97	ABNORMAL

4.2 Heart Rate Sensor working:

Heart Rate Sensor is a well-designed sensor for Arduino. It can be used by anyone who want to easily incorporate live heartrate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino.

The front side makes contact with the skin. On the front you see a small round hole, where the LED shines through from the back, and there is also a little square just under the LED. The square is an light sensor, like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or capillary tissues, and sensor reads the amount of light that bounces back. The other side of the sensor is where the rest of the parts are mounted. The Pulse Sensor can be connected to Arduino, or plugged into a breadboard.

4.3 CK101 BLOOD PRESSURE SENSOR working:

Figure 4.1 Blood Pressure sensor

CK101 is a personal hand held blood pressure monitor powered by 2xAAA batteries. CK101 has a built-in LCD display and an RT inflatable wristband. User can wear CK101 at his wrist, and then press the power switch to start the blood pressure measurement.

4.4 NODEMCU ESP8266

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It

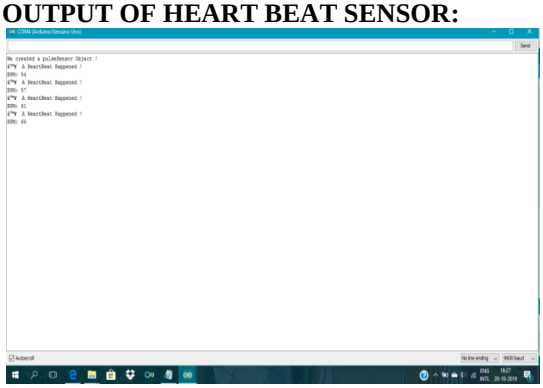
provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Finetworking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller-based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated Wi-Fi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area. ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the Wi-Fi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK).

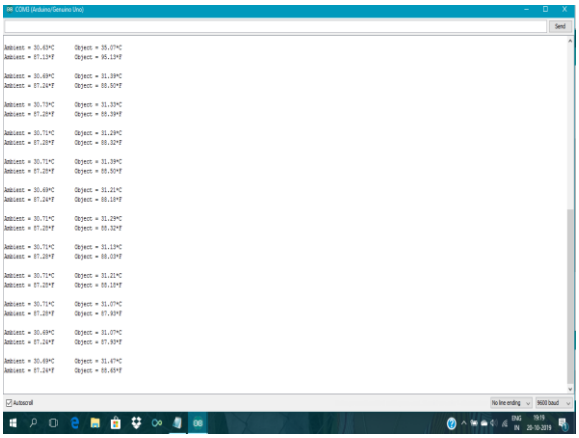
Figure 4.2 NodeMCU

V. RESULTS

OUTPUT OF HEART BEAT SENSOR:



OUTPUT OF TEMPERATURE SENSOR:



If the temperature is above 90 Fahrenheit the buzzer is turned on automatically.

OUTPUT OF BLOOD PRESSURE SENSOR:

VI. CONCLUSION

Modern technologies have developed that promotes comfortable and better life which is disease free. The project provides the low-cost solution to enhance the remote monitoring capability of existing health care system by using Arduino and wifi module. It uses sensors such as pulse rate, blood pressure and body temperature. The sensors are operated and vital information is transmitted to the microcontroller. By using this prototype circuit the hardwares circuit the messages can be transmitted in case the value of any parameter falls below a predetermined value to the corresponding medical expert so that necessary medications can be given to the patient.

The datas are collected from the sensors and sent to the server by using IoT. ESP8266 module is used which acts as IoT. The existing model uses zigbee protocol which is applicable only within respected range. An advancement in the existing system has been made using IoT. MQTT dashboard app is used to which the data is pushed and this acts as server.

The proposed system can be used at home and hospital. This system can be further used to monitor more than one patient's health information

REFERENCES

[1]. S. Jaiswal, R. Katake, B. Kute, S. Ranjane, and P. D. Mehetre, "Survey of Health Monitoring Management Using Internet of Things (IOT)," Int. J. Sci. Res., vol. 5, no. 11, pp. 2243–2246, 2017.

[2]. D. Kajaree and R. Behera, "A Survey on Healthcare Monitoring System Using Body Sensor Network," Int. J. Innov. Res. Comput. Commun. Eng., vol. 5, no. 2, pp. 1302–1309, 2017.

[3]. R. S. Pramila, "A Survey on Effective in-Home Health Monitoring System," Int. J. Comput. Appl., vol. 68, no. 7, pp. 15–19, 2013.

Pavithra B, et. al. "An IoT Based Automatic Patient Health Monitoring System." *International Journal of Engineering Research and Applications (IJERA)*, vol.10 (08), 2020, pp 25-32.