Iot Based Heart Rate Monitoring Using Arduino

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***Abstract*- In this project we are implementing a heart beat monitoring and heart attack detection system using the Internet of things. These days we have an increased number of heart diseases including increased risk of heart attacks. The sensor is then interfaced t o a microcontroller that allows checking heart rate readings and transmitting them over internet. The user may set the high as well as low levels of heart beat limit. After setting these limits, the system starts monitoring and as soon as patient heart beat go es above a certain limit, the system sends an alert to the controller which then transmits this over the internet and alerts the doctors as well as concerned users. Also the system alerts for lower heartbeats. Whenever the user logs on for monitoring, the system also displays the live heart rate of the patient. Thus concerned ones may monitor heart rate as well get an alert of heart attack to the patient immediately from anywhere and the person can be saved on time.**

***Index Terms*- Heart beat sensing – Heart attack detection-Internet of Things.**

I. INTRODUCTION

Cardiovascular disease is one of the main causes of death in many countries and thus it accounts for the over 15 million deaths worldwide. In addition, several million people are disabled by cardiovascular disease . The delay between the first symptom of any cardiac ailment and the call for medical assistance has a large variation among different patients and can have fatal consequences. One critical inference drawn from epidemiological data is that deployment of resources for early detection and treatment of heart disease has a higher potential of reducing fatality associated with cardiac disease than improved care after hospitalization. Hence new strategies are needed in order to reduce time before treatment. Monitoring of patients is one possible solution. Also, the trend towards an independent lifestyle has also increased the demand for personalized non-hospital based care. Cardiovascular disease has shown that heart beat rate plays a key role in the risk of heart attack. Heart disease such as heart attack, coronary heart disease, congestive heart failure, and congenital heart disease is the leading cause of death for men and women in many countries. Most of the time, heart disease problems harm the elderly person. Very frequently, they live with their own and no one is willing to monitor them for 24 hours a day.The use of IoT based framework makes the system get connected to the internet and so it is now more generalised and cost effective. As most of the devices including the android smart phone of doctor are connected to the internet it now becomes easier to implement the complete solution. Arduino platform by itself has no capability to get connected to the Internet. Here this capability is added to the system by using IoT device. Here IoT device gets serially interfaced to Arduino and in also to the local Wi-Fi network router.

In the new era of communication and technology, the explosive growth of electronic devices, smart phones and tablets which can be communicated physically or wirelessly has become the fundamental tool of daily life. The next generation of connected world is Internet of Things (IoT) which connects devices, sensors, appliances, vehicles and other “things”. The things or objects may include the radio-frequency identification (RFID) tag, mobile phones, sensors, actuators and much more. W ith the help of IoT, we connect anything, access from anywhere and anytime, efficiently access any service and information about any object. The aim of IoT is to extend the benefits of Internet with remote control ability, data sharing, constant connectivity and so on. Using an embedded sensor which is always on and collecting data, all the devices would be tied to local and global networks. The term IoT, often called Internet of everything, was 1st introduced by Kevin Ashton in 1999 who dreams a system where every physical object is connected using the Internet via ubiquitous sensors. The IoT technology can provide a

large amount of data about human, objects, time and space. While combining the current Internet technology and IoT provides a large amount of space and innovative service based on low-cost sensors and wireless communication. IPv6 and Cloud computing promote the development of integration of Internet and IoT. It is providing more possibilities of data collecting, data processing, port management and other new services. Every object which connects to IoT requires a unique address or identification with IPv6. There are so many people in the world whose health may suffer because they do not have proper access to hospitals and health monitoring. Due to the latest technology, small wireless solutions which are connected to IoT can make it possible to monitor patients remotely instead of visiting the physical hospital. A variety of sensors which are attached to the body of a patient can be used to get health data securely, and the collected data can be analyzed (by applying some relevant algorithms) and sent to the server using different transmission media (3G/4G with base stations or Wi-Fi which is connected to the Internet). All the medical professionals can access and view the data, take decision accordingly to provide services remotely with the passage of time and development of society; people recognize that health is the basic condition of promoting economic development. Some people say that existing public health service and its supportability have been greatly challenged with respect to time. Worldwide the Government and industry are investing billions of dollars for development of IoT computing, and some of these projects include China's National IoT Plan by Ministry of Industry and IT, European Research Cluster on IoT (IERC), Japan's u-Strategy, UK's Future Internet Initiatives and Italian National Project of Netergit . The IoT applications in the field of medical and healthcare will benefit patients to use the best medical assistance, shortest treatment time, low medical costs and most satisfactory service. Health monitoring is important to be checked regularly in order to make sure our body constantly maintain in healthiness and excellent condition. Generally the vital parameters observed for health monitoring such as Heart Rate (HR), temperature, weight, blood pressure, glucose and ECG. Such services can be used to supplement the use of visiting nurses or to get medical consult from the doctor In a time where hospital error is the 6th leading cause of preventable death, having sensors imbedded in equipment could serve as a line of defense and reliability. With the variety of wireless monitoring services now available, devices can work together to create a comprehensive information network. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities

II. INTERNET OF THINGS

The Internet of things (stylised Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M)

communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to the areas such as smart cities . "Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices environmental/food/pathogen monitoring or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest looking at "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like s mart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring.

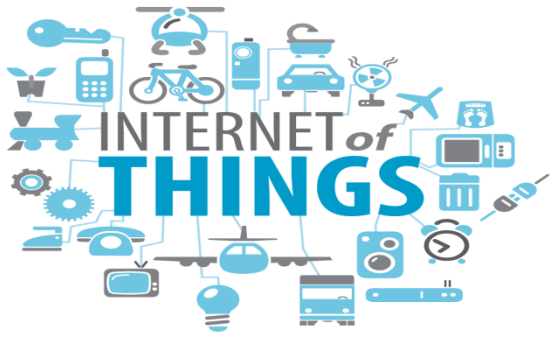

Figure.1. Internet of Things

According to Gartner, Inc. (a technology research and advisory corporation), there will be nearly 20.8 billion devices on the Internet of things by 2020. ABI Research estimates that more than 30 billion devices will be wirelessly connected to the Internet of things by 2020. As per a 2014 s urvey and study done by Pew Research Internet Project, a large majority of the technology experts and engaged Internet users who responded—83 percent—agreed with the notion that the Internet/Cloud of Things, embedded and wearable computing (and the corresponding dynamic systems) will have widespread and beneficial effects by 2025. As such, it is clear that the IoT will consist of a very large number of devices being connected to the Internet. In an active move to accommodate new and emerging technological innovation, the UK Government, in their 2015 budget, allocated £40,000,000 towards research into the Internet of things. The former British Chancellor of the Exchequer George Osborne, posited that the Internet of things is the next stage of the information revolution and referenced the inter-connectivity of everything from urban transport to medical devices to household appliance Network control and management of manufacturing equipment, asset and situation management, or manufacturing process control bring the IoT within the realm on industrial applications and smart manufacturing as well. The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands, and real-time optimization of manufacturing production and supply chain networks, by networking machinery, sensors and control systems together.

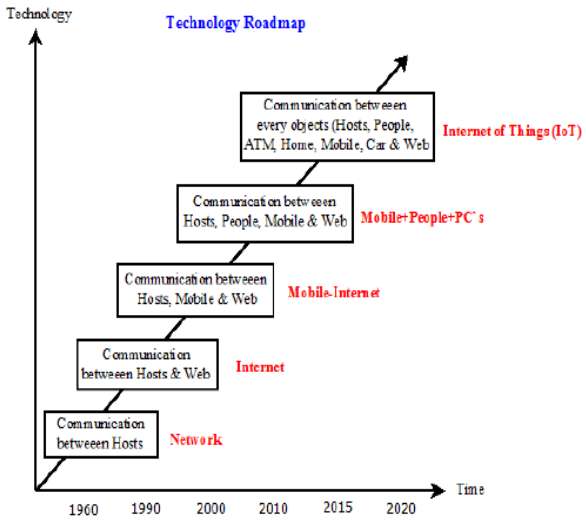

Figure.2. Technology roadmap

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT. But it also extends itself to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Smart industrial management systems can also be integrated with the Smart Grid, thereby

enabling realtime energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by a large number of networked sensors An IoT-enabled intelligent system of such cases has been demonstrated by the NSF Industry/University Collaborative Research Center for Intelligent Maintenance Systems (IMS) at University of Cincinnati on a band saw machine in IMTS 2014 in Chicago. Band saw machines are not necessarily expensive, but the band saw belt expenses are enormous since they degrade much faster. However, without sensing and intelligent analytics, it can be only determined by experience when the band saw belt will actually break. The developed prognostics system will be able to recognize and monitor the degradation of band saw belts even if the condition is changing, so that users will know in near real time when is the best time to replace band saw. This will significantly improve user experience and operator safety, and save costs on replacing band saw belts before they actually break. The developed analytical algorithm was realized on a cloud server, and was made accessible via the Internet and on mobile devices. The system will likely be an example of eventdriven architecture, bottom-up made (based on the context of processes and operations, in real-time) and will consider any subsidiary level. Therefore, model driven and functional approaches will coexist with new ones able to treat exceptions and unusual evolution of processes (multi-agent systems, BADSc, etc.). Integration with the Internet implies that devices will use an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows billion unique addresses), objects in the IoT will have to use IPv6 to accommodate the extremely large address space required. Objects in the IoT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet).To a large extent, the future of the Internet of things will not be possible without the support of IPv6; and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IoT in the future.

III. RESULT AND ANALYSIS

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse. The cardiac cycle refers to a complete heartbeat from its generation to the beginning of the next beat, and so includes the diastole, the systole, and the intervening pause. The frequency of the cardiac cycle is described by the heart rate, which is typically expressed as beats per minute. Each beat of the heart involves five major stages. The first two stages, often considered together as the "ventricular filling" stage, involve the movement of blood from the atria into the ventricles. The next three stages involve the movement of blood from the ventricles to the pulmonary artery (in the case of the right ventricle) and the aorta (in the case of the left ventricle). The first stage, "diastole," is when the semilunar valves (the pulmonary valve and the aortic valve) close, the atrioventricular (AV) valves (the mitral valve and the tricuspid valve) open, and the whole heart is relaxed. The second stage, "atrial systole," is when the atrium contracts and blood flows from atrium to the ventricle. The third stage, "isovolumic contraction" is when the ventricles begin to contract, the AV and semilunar valves close, and there is no change in volume. The fourth stage, "ventricular ejection," is when the ventricles are contracting and emptying and the semilunar valves are open. During the fifth stage, "isovolumic relaxation time", pressure decreases, no blood enters the ventricles, the ventricles stop contracting and begin to relax, and the semilunar valves close due to the pressure of blood in the aorta. Throughout the cardiac cycle, blood pressure increases and decreases. This works presents a lot of considerations and improvements that were incorporated in to the functionality of the device so as to reflect desired features such as cost, design complexity, size, software development, weight, lack of portability etc. This design uses a miniaturized pulse sensor (IC sensor) which has been optimized for very accurate sensing and measurement of changes in the heartbeat rate. The system calculates the heartbeat rate in beat per minute (BPM) with the help of the microcontroller, displays the measured heart rate on a 16X2 character LCD and sends the result to the pc which is interfaced with the Arduino

board by using the compile r, each time the heart rate goes above or below a fixed threshold, the result is displayed in the pc and from the pc the result can be trans mitted to the android devices via internet.

The Arduino Nano Board

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything Diecimila/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper.Nano's got the breadboard-ability of the Boarduino and the Mini+USB with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable.

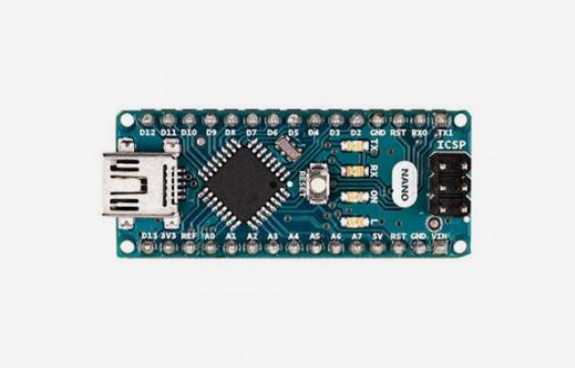

Figure.3. Arduino uno board

The Pulse Sensor Unit

A Heartbeat sensor is a monitoring device that allows one to measure his or her heart rate in real time or record the heart rate for later study. It provides a simple way to study the heart function. This sensor monitors the flow of blood through the finger and is designed to give digital output of the heartbeat when a finger is placed on it. When the sensor is working, the beat LED flashes in unis on with each heartbeat. This digital output can be connected to the microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. The Pulse Sensor is a well designed plug and play heart rate sensor for Arduino. It also includes an open source monitoring app that graphs your pulse in real time.

Figure.4. Pulse sensor

Heart rate data can be really useful whether you're designing an exercise routine, studying your activity or anxiety levels or just want your shirt to blink with your heart beat. The problem is that heart rate can be difficult to measure. Luckily, the Puls e Sensor Amped can solve that problem The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications. Simply clip the Pulse Sensor to your earlobe or finger tip and plug it into your 3 or 5 Volt Arduino and you're ready to read heart rate! The 24" cable on the Pulse Sensor is terminated with standard male headers so there's no soldering required. Of course Arduino example code is available as well as a Processing sketch for visualizing heart rate data

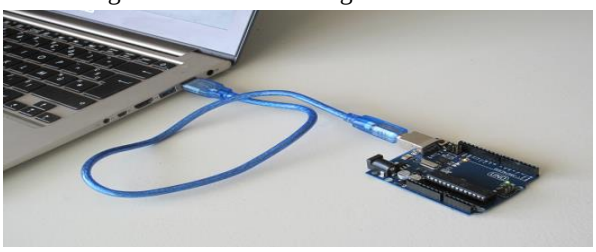

Figure.5. Arduino connected to laptop

As shown in the figure above the Arduino board is connected with the heart beat sensor, now after

completing the microcontroller and sensor setup the board has to be connected with a power source . Since here we use serial communication for displaying the result or the detected heart beat we are connecting the microcontroller with the laptop through the USB port. Now the program is compiled and uploaded into the arduino board using arduino compiler and the result is thus obtained in the serial monitor of the so called compile

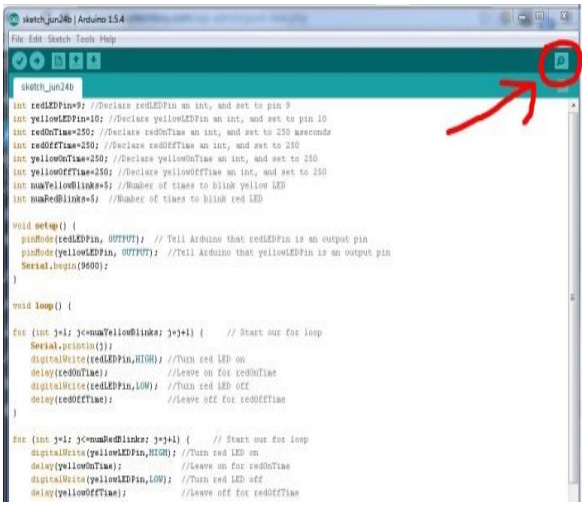

Figure.6. Screenshot of serial communication

As the part of the project we have opened a thinkspeak channel in order to track the heart beat of a particular patient and monitor it correctly and give the emergency message when there is an increase or decrease in the particular level of the heart beat.

WiFi Module ESP8266

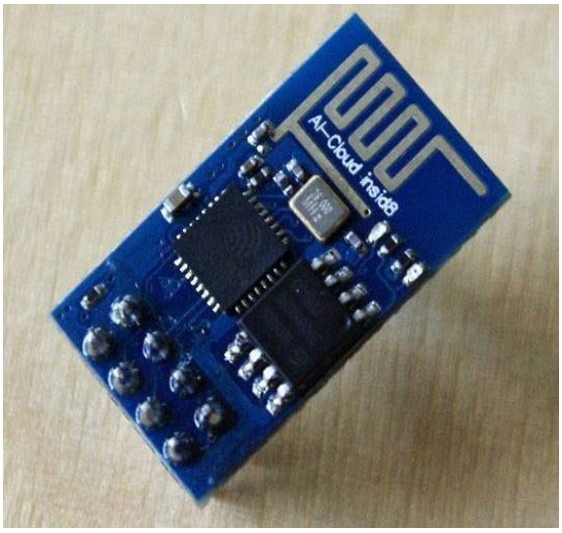

Figure.7. WiFi Module ESP8266

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor

Fig.8.Heart Rate Graph On thinkspeak

IV. CONCLUSION

In These days we have an increased number of heart diseases including increased risk of heart attacks. Our proposed system users sensors that allow to detect heart rate of a person using heartbeat sensing even if the person is at home. The sensor is then interfaced to a microcontroller that allows checking heart rate readings and transmitting them over internet. The user may set the high as well as low levels of heart beat limit. After setting these limits, the system starts monitoring and as soon as patient heart beat goes above a certain limit, the system sends an alert to the controller which then transmits this over the internet and alerts the doctors as well as concerned users. Also the system alerts for lower heartbeats. Whenever the user logs on for monitoring, the system also displays the live heart rate of the patient. Thus concerned ones may monitor heart rate as well get an alert of heart attack to the patient immediately from anywhere and the person can be saved on time. In our proposed research, we tried to propose a complete paper for detecting heart attack using two ways. However, we have some plan about this research. Time of India, a leading newspaper in India

published that "Researchers in the United States, within the next decade Heart Microeconomic Microchip will be set in blood vessel of human body. The smart phone will collect data and send the information to us". Researchers are trying to implement the requirements of Microchip for uses of the technology in smart phone. We will try to use this technology in future. If this technology will developed then we can detect heart blockage through this technology by our project.

REFERENCES

[1] Internet of Things: internet of things, https:// en. wikipedia.org/wiki/Internet_of_things.
[2] Effective Ways to Use Internet of Things in the Field of Medical and Smart Health Care: Kaleem ullah,Munam ali Shah,Sijing zhang, IEEE Journal 2016
[3] IReHMo: An Efficient IoT-Based Remote Health Monitoring System for Smart Regions, Ngo Manh Kohi, Karan Mitra , 2015 17th International Conference on E-health Networking, Application & Services (HealthCom)
[4] Mobile based Horne Automation using Internet of Things(IoT), Kumar Mandula, Ram parupalli, E.Magesh , 2015 International Conference on Control, lnstrument
[5] Heartbeat monitoring and alert system using GSM technology, Ufaraoh S.U,Oranugo C.O, International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015 ISSN 2091-2730
[6] Heart rate monitoring and heart attack detection ,Mamidi manisha, Katakan neeraja, International Journal of Innovations in Engineering and Technology (IJIET)
[7] Myocardial infarction: https://en. wikipedia. org/wiki/ Myocardial_