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PUSLE DATA ACQUISATION AND DISPLAY USING IOT TECHNOLOGY

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ABSTRACT

Health monitoring is the major problem in today’s world. Owing to late diagnosis of deadly conditions like heart attack, we are inadequate to save the lives of many humans. With IoT rapidly revolutionizing the healthcare industry monitoring and diagnosing can be made much easier. Hence here, we concentrate on system that will detect heart pulse by monitoring the heart rate based on IoT (Internet of Things). For a healthy adult, ordinary heartrate is 60 to 100 bpm (beats per minute). If a person’s heart rate is constantly over 100 beats per minute then the person I s said to be having higher heart rate, which is also notorious as tachyarrhythmia. It can diminution the efficiency of heart by let-down the amount of blood pumped through the body can result in chest pain and light-headedness. With the advancement in technology, it is easy to monitor the patient’s heart rate even at home. In this project, we will made an IoT based Health Monitoring System, which records the patient pulse rate using Arduino UNO. Pulse rate generated is acquired from the sensor and is driven to micro-controller which has satisfactory pathway for those pulse signals which can get their way to server for Personal Health Record (PHR) via ESP8266 (Wi-Fi module) .

Keywords: Pulse sensor, Atmega328p micro-controller, Arduino UNO, IOT, Detect, Personal Health Record

INTRODUCTION

HEART RATE:

The number of heartbeats per unit of time, usually per minute. The heart rate is based on the number of contractions of the ventricles (the lower chambers of the heart). The American Heart Association states the normal resting adult human heart rate is 60–100 bpm. Tachycardia is a fast heart rate, defined as above 100 bpm at rest Bradycardia is a slow heart rate, defined as below 60 bpm at rest. During sleep a slow heartbeat with rates around 40–50 bpm is common and is considered normal. When the heart is not beating in a regular pattern, this is referred to as an arrhythmia. Abnormalities of heart rate sometimes indicate disease .The pulse is a bulge of an artery from waves of blood that course through the blood vessels each time the heart beats.

Fig 1.1(Heart rate graph)

SOURCES OF PULSE:

The best places to find your pulse are the:

- Wrists
- Elbow fold
- Side of neck
- Top of the foot

The pulse is often taken at the wrist to estimate the heart rate. Sensor is placed over the wrist and a minimum time of 60 seconds is given to calculate the required heart rate.

FACTORS AFFECTING HEART RATE:

- **Air temperature:** When temperatures (and the humidity) soar, the heart pumps a little more blood; pulse rate may increase, but usually no more than five to 10 beats a minute.
- **Body position:** Resting, sitting or standing, your pulse is usually the same. Sometimes as you stand for the first 15 to 20 seconds, your pulse may go up a little bit, but after a couple of minutes, it should settle down.
- **Emotions:** Stress, anxiety, extreme emotional state can raise pulse rate.
- **Body size:** Obesity might cause higher resting pulse than normal, but usually not more than 100.
- **Medication use:** Meds that block your adrenaline (Beta-blockers) tend to slow your pulse, while too much thyroid medication or too high of a dosage will raise it.

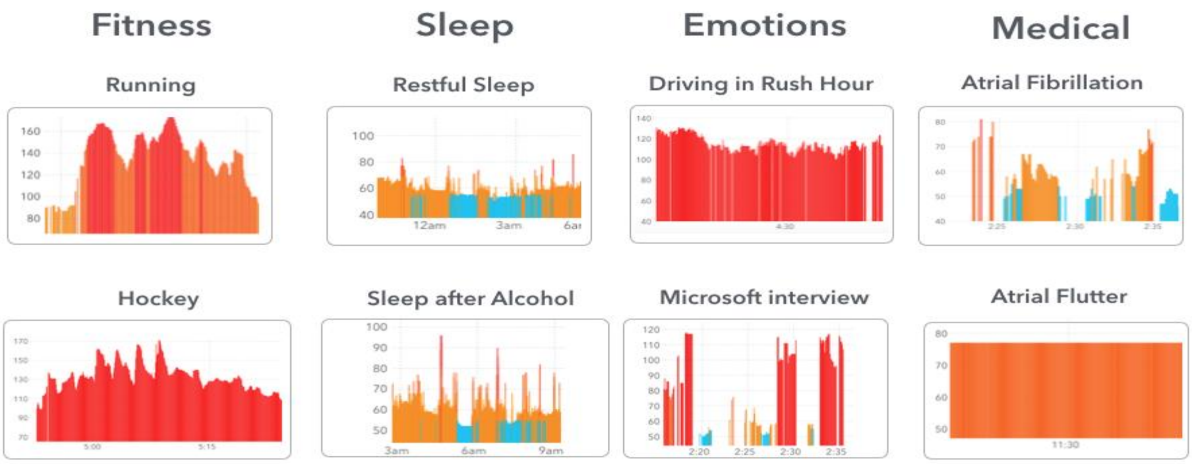


Fig 2. Abnormal heart rate (Time vs BPM)

NEED FOR THE PROJECT

Portal monitoring has become an essential means of healthcare, but portal monitoring facilities are of very high cost, which is not affordable for everyone. This project emphasis on using low cost technology with high efficiency and transferring data through IOT(Internet of Things) for efficient monitoring by various healthcare providers and by the user themselves. There by enabling the use of technology even in rural region.

LITERATURE REVIEW

Sinan S. Mohammedsheet and Mothanna Sh. Aziz, of Northern technical university, Iraq proposed a paper ,which using LED, Infra-red Sensor with microcontroller 8051 and seven segment display for acquisition and display of heart rate, but does not confess information on data transfer. The purpose of this article, is how to design a low cost and mobile heart-rate counting system based on the microcontroller for monitoring heart health. The heart pulse was acquired by using IR finger-tip sensor, based on this biomedical signal a conditioning circuit was designed for filtering these signal and processing it. As well, the processed signal was countered using a microcontroller and displayed on seven segment display. The results of this study are expected to let the physician team to monitor and easily reading heart rate. Based on the test results, the designed system gave a good response and an accurate heart rate counting with accepted low percentage error comparison to manual measurement. The designed system can be interface with personal computers. This will give opportunities to perform further analysis to distinguish and predict any other heart disease. [1]

Soham Kanti Bishnu, Pritam Shankar, of IIT, Kolkata on their proposal stated heart rate measurement by sensing the change in blood volume in a finger artery. It consists of an infrared LED that transmits an IR signal through the fingertip of the person and the blood cells reflect a part of IR signal, which is detected by a photo diode sensor. The photo diode is used to detect the changing blood volume with heartbeat that is too small to be detected directly by a microcontroller. Therefore, a two-stage high gain, active low pass filter is designed using two Operational Amplifiers (OPAMPs) in order to filter and amplify the signal with appropriate voltage level so that a microcontroller can count the pulses. A three-digit seven-segment display is used to monitor the heart rate. The microcontroller used in this work is PIC16F628A.[2]

Sayan Banerjee and Souptik Paul, of IIT Kolkata, designed a system that has three parts to it. Its first part consists of all the sensors and verifies the identity of the patient. The second part is responsible for analysing the data and storing the data in a database obtained by the sensors of the first part. The third part is mainly responsible for displaying the analysed and processed data. This is also responsible for alerting medical authorities and concerned ones in case of any abnormalities found in the data that requires immediate medical attention.[3]

Jun-Quan Gou, Yu Pang Jing Wang, in this work, a wearable, intelligent testing device based on nRF52832 microcontroller is designed to monitor the changes of life signs parameters of patients with depression and cardiovascular disease and determine disease seriousness and mood stability. The proposed device uses the ADS1292R chip and conductive silica gel for collection and preconditioning the electrocardiogram (ECG) and respiratory signals, which and then filtered by nRF52832. Since nRF52832 is a Bluetooth chip, it transmits the life signs signals to the mobile phone APP through Bluetooth to be displayed on a device screen. The wearable, intelligent detection devices have the advantages of small size, low power consumption, low cost, and convenience to be wearable. [4]

Dhanurdhar Murali, Deepthi R Rao, Swathi R Rao,In this project, embedded Systems & IoT based solution for continuous and non-invasive measuring of the cardiac values using an upcoming technology known as pulse-oximetry. This technology uses a medical sensor creating a photoplethsmogram from which we can detect the oxygen saturation level and variations in blood volume in the tissues. This analog waveform is further processed using hardware filters to obtain heart rate and Sp02 values. These values are digitized using the A2D converters in the ATmega32 based SoC and are constantly stored and uploaded to the cloud. In case the cardiac values are found to deviate away from the set thresholds, an automated emergency alert system is triggered which uses GSM for automated SOS calls, GPS to track the patient's location and GPRS to make the system truly mobile and wireless. In addition, a patient can self-trigger the same alert system by using Google voice assistant on their smart-phone. The end goal of this project is to make a wearable cardiac monitoring and alert system, which can be generic or patient specific, and help reduce heart-related accidents.[5]

METHODOLOGY

WORK FLOW

The process of the whole project can be divided into three major parts,

- Data acquisition from pulse sensor.
- Converting Analog data into digital data.
- Displaying acquired data with help of IOT.

HARDWARE REQUIREMENTS:

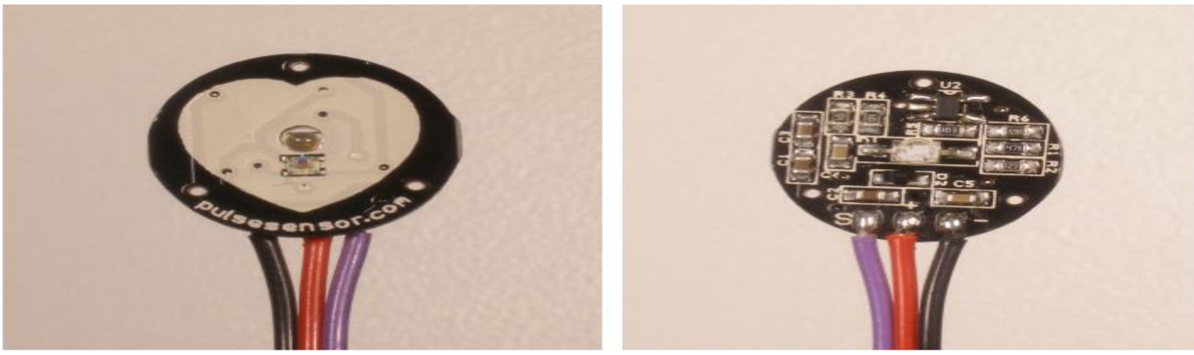
- ATMEGA328p[microcontroller]
- ARDUINO UNO board.
- ESP8266-01[Wi-Fi module]
- ADC0804[Analog to digital converter]
- L1117 3.3v regulator
- Transformer supply of 12 v
- 7805 5v regulator
- Power supply circuit
- Program burner circuit. Etc.

Software requirements:

- Atmel studio 7.1 or Genuino Uno
- Proteus 8.1

DATA ACQUISATION FROM PULSE SENSOR

Pulse Sensor is a well-designed plug-and-play heart-rate sensor,which has infrared and LED light source for detection and provides analog output , Fig 3. Pulse sensor [front and back view]



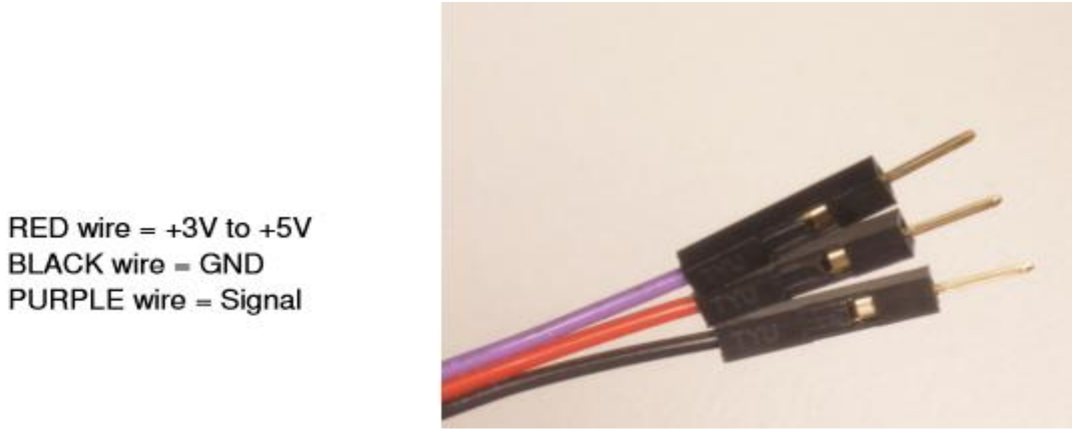


Fig 4. Pulse sensor pins

Analog signal collected from the pulse sensor is directly given as input to the analog to digital converter.

CONVERTION OF ANALOG DATA INTO DIGITAL DATA

ADC0804 CMOS 8-bit successive approximation converters (ADC) that use a differential potentiometric ladder — similar to the 256R products These converters are designed to allow operation with the NSC800 and INS8080A derivative control bus with Tri-state output latches directly driving the data bus. These ADCs appear like memory or I/O ports to the microprocessor and no interfacing logic is needed. Differential analog voltage inputs allow increasing the common-mode rejection and offsetting the analog zero input voltage. In addition, the voltage reference input can be adjusted to allow encoding any smaller analog voltage span to the full 8 bits of resolution.

CONVERSION USING ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328p. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

CONVERSION USING AVR ATMEGA 8515

The high-performance, low-power Microchip 8-bit AVR RISC-based microcontroller combines 8KB of programmable flash memory, 544B internal memory, up to 64KB external SRAM, and 512B EEPROM. The device supports a throughput of 16 MIPS at 16MHz and operates between 2.7-5.5 volts.

DISPLAYING ACQUIRED DATA WITH IOT

IOT

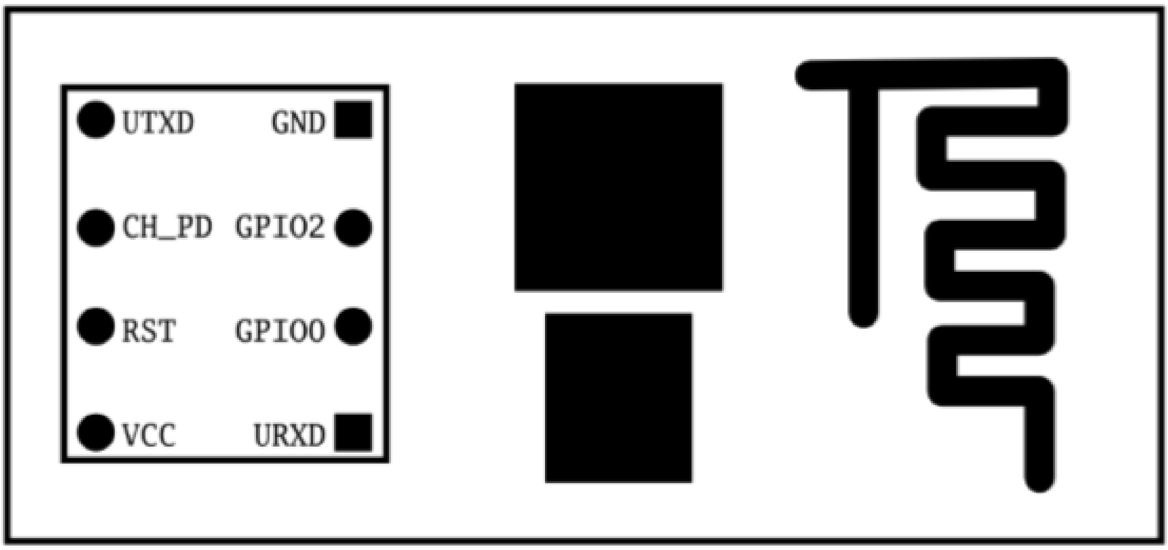
The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

ESP8266-01

ESP8622-01 Wi-Fi module is being used for data transmission . ESP8266 is a complete and self-contained Wi-Fi network solutions that can carry software applications, or through Another application processor uninstall all Wi-Fi networking capabilities. ESP8266 when the device is mounted and as the only application of the application processor, the flash memory can be started directly from an external Move. Built-in cache memory will help improve system performance and reduce memory requirements. Another situation is when wireless Internet access assume the task of Wi-Fi adapter, you can add it to any microcontroller-based design, the connection is simple, just by SPI / SDIO interface or central processor AHB bridge interface. Processing and storage capacity on ESP8266 powerful piece, it can be integrated via GPIO ports sensors and other applications specific equipment to achieve the lowest early in the development and operation of at least occupy system resources. The ESP8266 highly integrated chip, including antenna switch balun, power management converter, so with minimal external circuitry, and includes front-end module, including the entire solution designed to minimize the space occupied by PCB. The system is equipped with ESP8266 manifested leading features are: energy saving VoIP quickly switch between the sleep / wake patterns, with low-power operation adaptive radio bias, front-end signal processing functions, troubleshooting and radio systems coexist characteristics eliminate cellular / Bluetooth / DDR / LVDS / LCD interference

ESP8266-01 requires an power supply of 3.3 v which is taken from the regulator L1117 3.3 v regulator

Fig 6.ESP8266-01 pin out



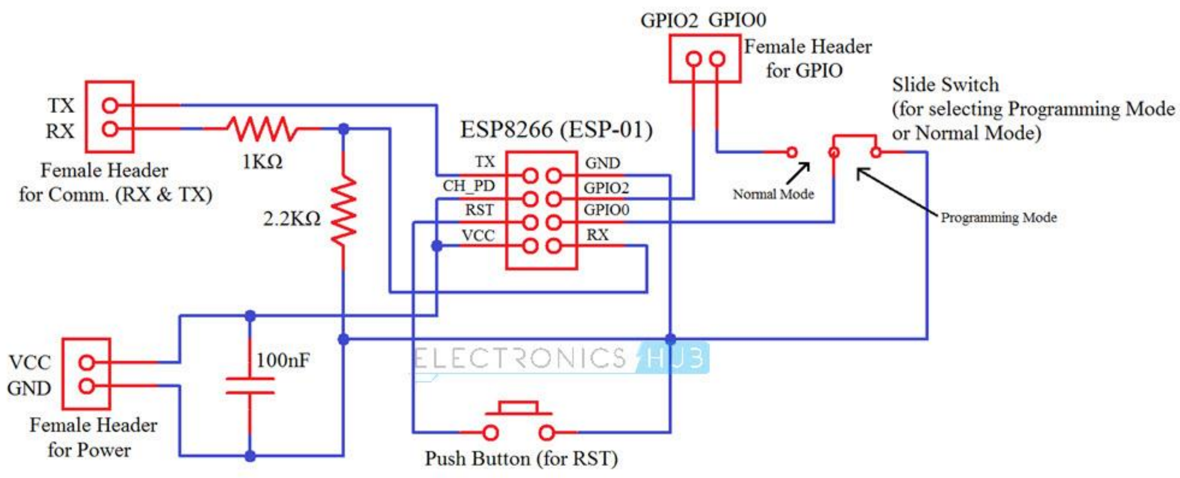
ESP8266 WiFi Pinout

VCC - 3.3v

Gnd - common ground

UTXD – to the RXD pin

URXD – a receiver circuit with 3.3 v tolerance is made and is connected to TXD pin .



RST – active low reset circuit

Fig 7.AVR setup

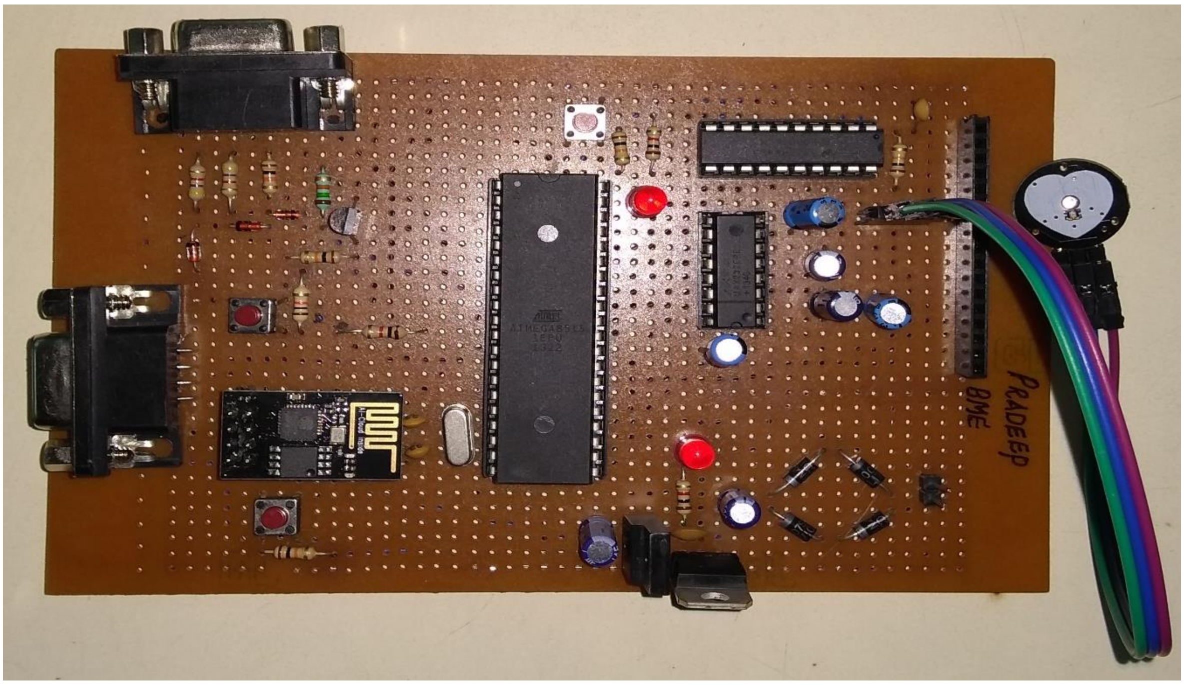


Fig 8 Arduino setup

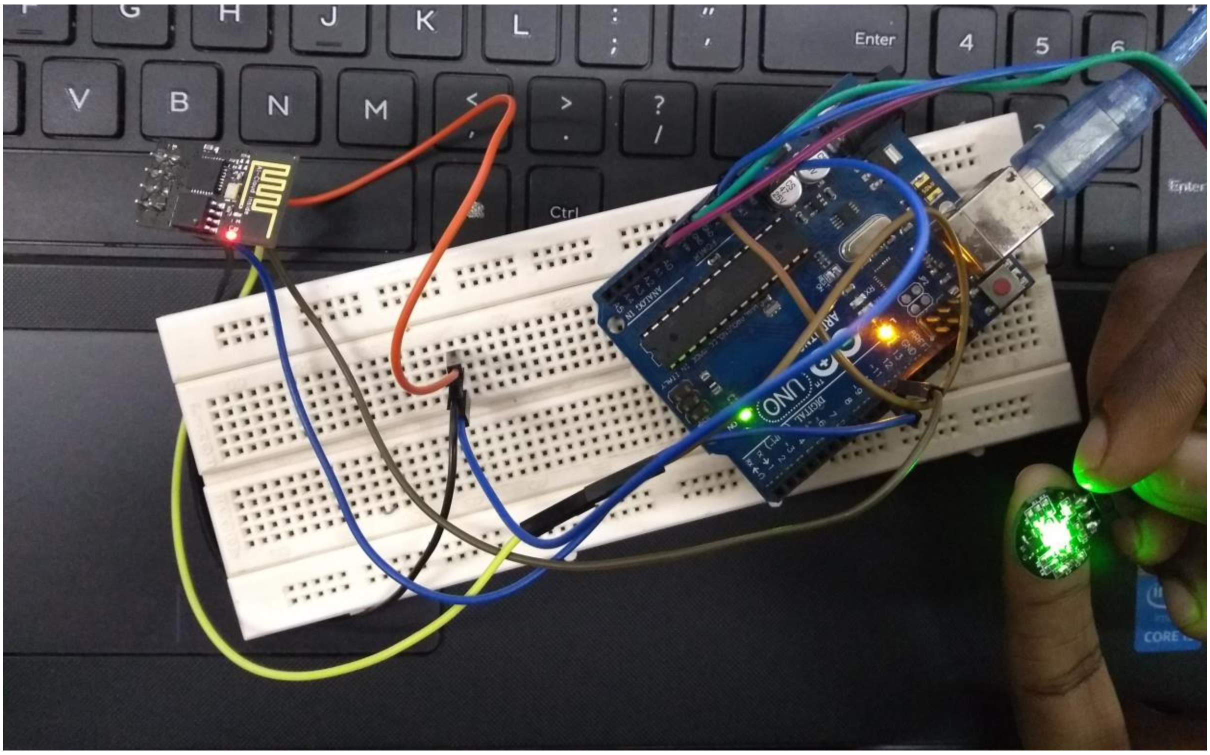
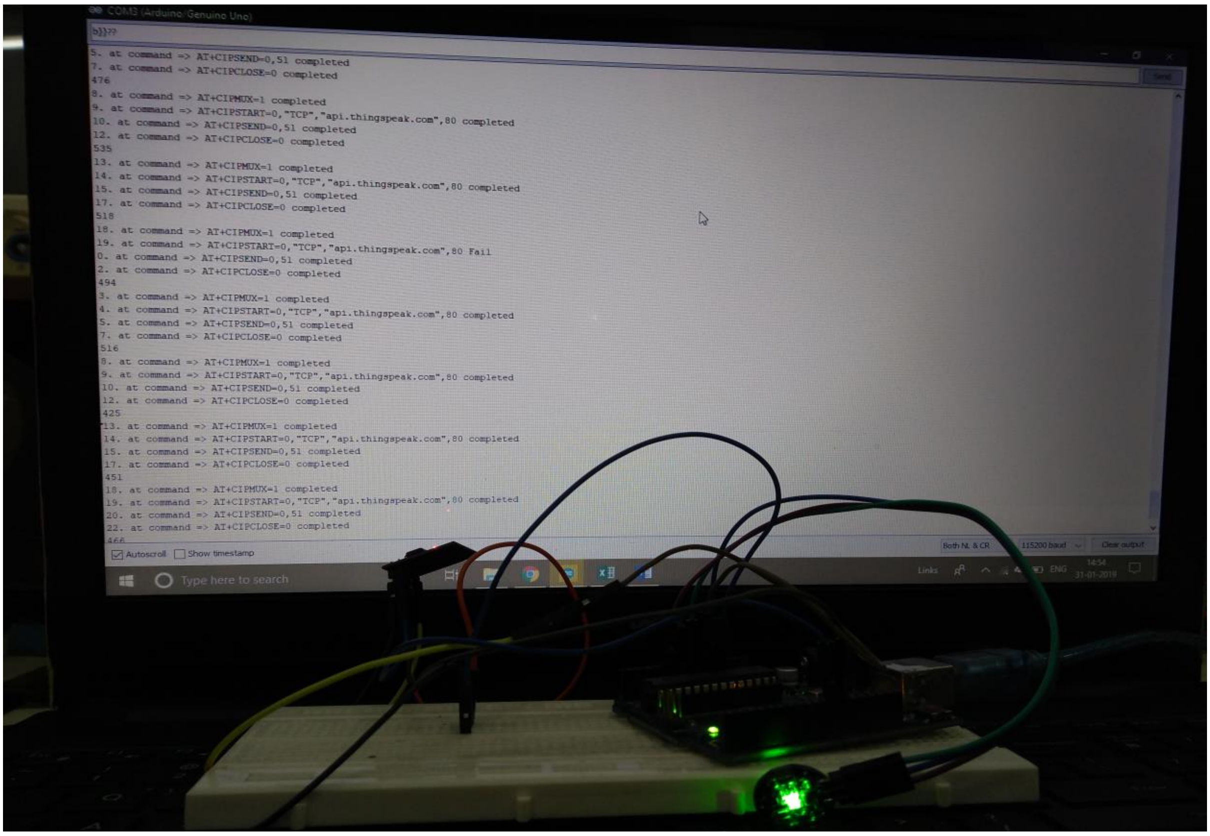


Fig8.1Aquiring data using Arduino



RESULT AND OBSERVATION

Pulse sensor measurements that are made are as follows:

Fig 9. Normalized pulse rate visualization

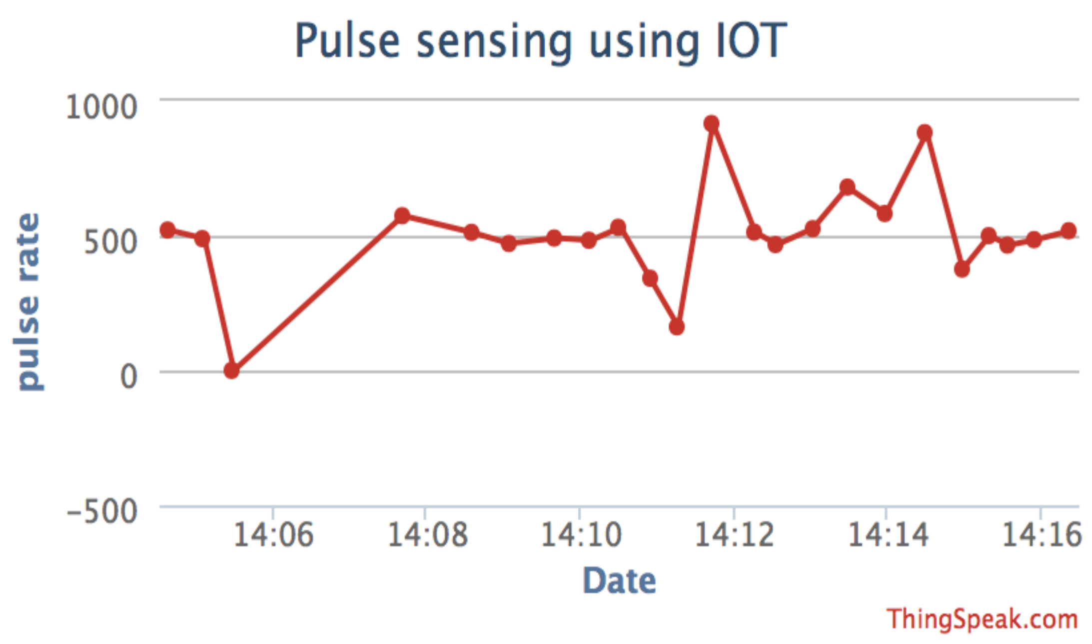


Fig 10. Pulse rate visualization (300 samples)

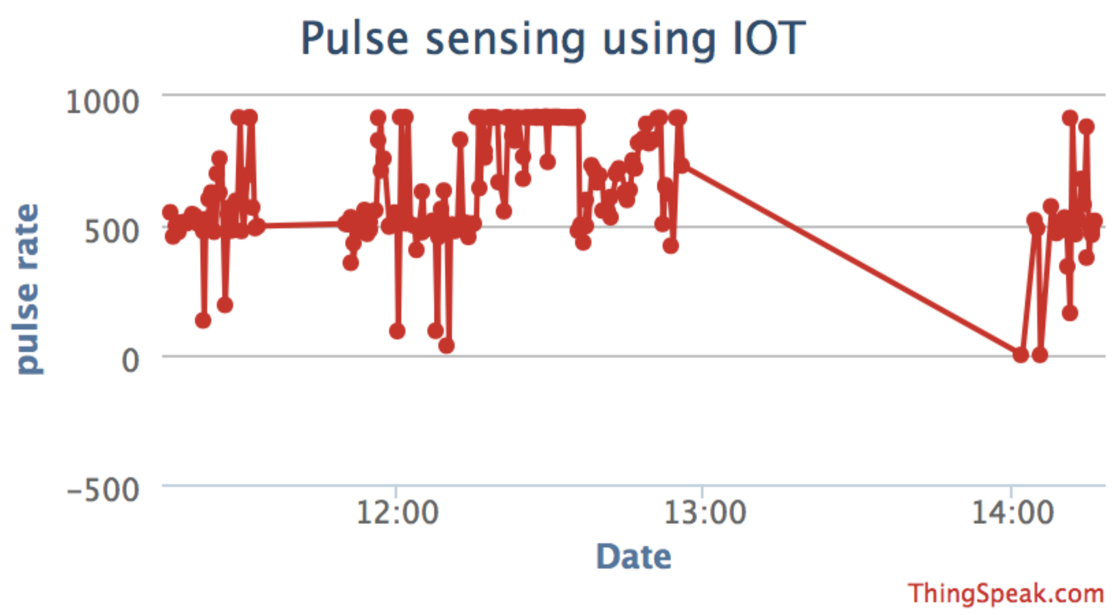


Fig 11. Sample amplitude visualization

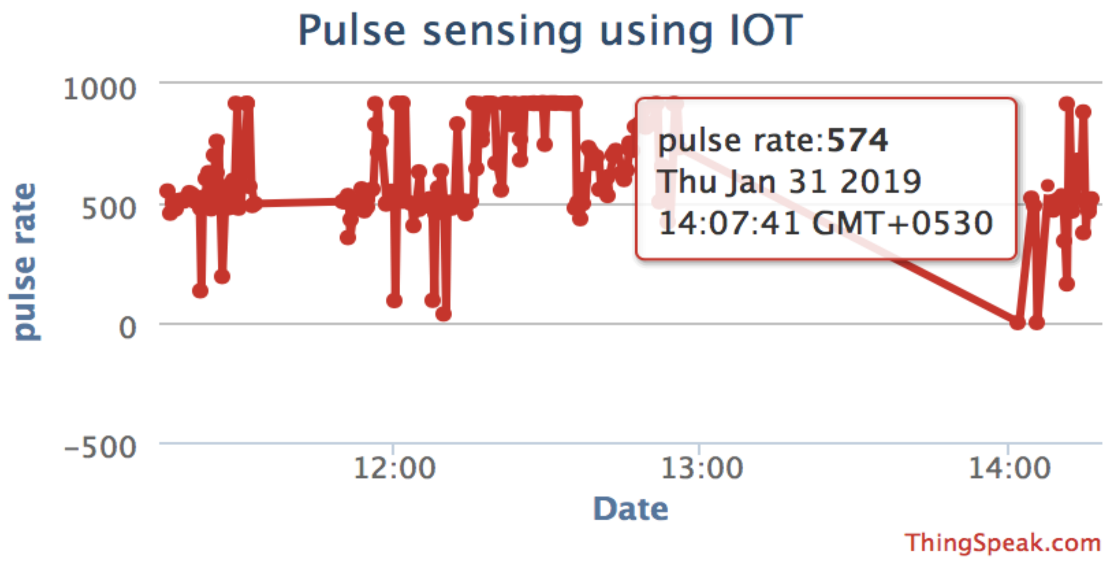
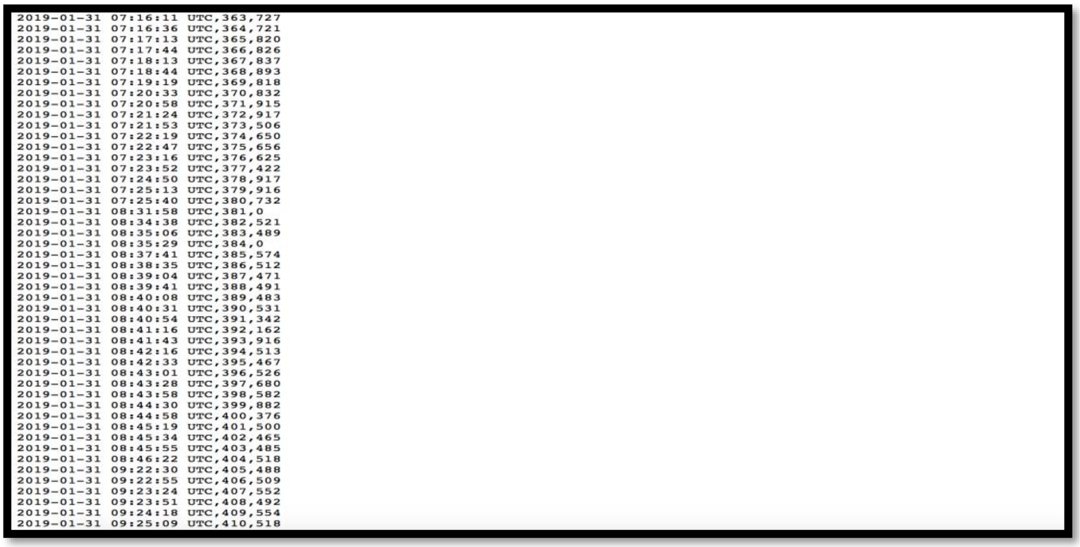


Fig 12 Acquired data in CSV format



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2019-01-31 07:16:36 UTC,364,721
2019-01-31 07:17:13 UTC,365,820
2019-01-31 07:17:44 UTC,366,826
2019-01-31 07:18:13 UTC,367,837
2019-01-31 07:18:44 UTC,368,893
2019-01-31 07:19:19 UTC,369,818
2019-01-31 07:20:33 UTC,370,832
2019-01-31 07:20:58 UTC,371,915
2019-01-31 07:21:24 UTC,372,917
2019-01-31 07:21:53 UTC,373,506
2019-01-31 07:22:19 UTC,374,650
2019-01-31 07:22:47 UTC,375,656
2019-01-31 07:23:16 UTC,376,625
2019-01-31 07:23:52 UTC,377,422
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2019-01-31 07:25:13 UTC,379,916
2019-01-31 07:25:40 UTC,380,732
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2019-01-31 08:34:38 UTC,382,521
2019-01-31 08:35:06 UTC,383,489
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FUTURE WORK

With adapting various types of ADC ICs various sensors can be used and multiple parameter can be measured, portable advanced microcontrollers like AVR can be used to enhance the efficiency of the prototype. Further the protype can be extended to an Android application which can be used to view and monitor the parameter by the user and share the same with healthcare providers.

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