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Telehealth Patient Monitoring System

Pamarthi Kanakaraja, K.Krishna vamsi, I.Pratyush, M.Rama Krishna, B.Sai mohan

Abstract: ***Health-care Environment has now established science and knowledge based on technology-oriented wireless-sensing node. Patients face an unexpected mortality is worried due to the specific cause of health problems and mainly heart problems or attack that is due to the deficiency of good medical treatment for patients at the in time. This is to track the patients of the old age in general and to train physicians and loved ones. They are therefore proposing a motivated plan to reduce these unexpected death rates through the use of Patient Health Care Monitoring, using sensor network technologies and using the web Application to connect with loved ones when problems occurs. This system uses Heart Rate, Body Temperature and ECG sensor Modules to monitor the wellbeing of patients. The project Implementation using Raspberry Pi, Arduino Mega and MCP3008 ADC converter is used. In addition, the Camera Interface and Wi-Fi link are interfaced to track the patient's health using Raspberry Pi controller to send the data to the UbiDots web server (Cloud Computing Analysis) platform. Hence are there any one Patient Health parameter changes its threshold values it gives alerts to the Doctors with time stamp and patient live video also they can streaming their mobiles.***

Keywords: ***UbiDots Cloud Server platform, Healthcare Services, Applications, Raspberry Pi, Arduino Mega, AD8232 ECG Module, LM35 Body Temperature Sensor.***

I. INTRODUCTION

Doctor facilities need outstanding administration on an ongoing basis. Every last bit of patient's records should be helpful enough. Be that as well, there should be an opportunity to avoid details. Likewise, the accommodating data should be kept private in the event. The largest vital issue for alleging various nations in the world may be social insurance. Improving the current patients particularly in the weaker parts of the particular social order which include the aged, physically even rationally handicapped and, in addition, chronically sick patients may be the main consideration would make progress. On the current system, By requesting documentation and looking at a general stockpiling database, this data is registered in the manifestation. By and wide, however, this knowledge will be open to every last one of the workers. Subsequently, we need support proposing another route to the place tolerant What's more doctors fit to suit by flexible requisition In addition to internet requisition.

For doctors ' services, the procuring of help from alleging patients requires non-stop screening. Their heartbeats require support that is constantly monitored. There may be no procurement for test these requirements The exchange point will be home. What's more, there's a chance that the ailment could come back again. Data from patient-health (high temperature, cardiac rate, position) will be measured and transmitted over the net-server over and over again. Time to send could be an opportunity to be placed. Human screening requires specific edge resistant. Approximately 37 is a tolerant standard body temperature? While lone persnickety senses warm the temperature of the body is 37 degree Centigrade. By using ordinary techno babble, eyewitness can take these levels for patients in a moderately long period. Using the same rule previously, the advanced mobile phone of the nurse, the specialist would look at the well-being condition of as many patients as possible. At any of the parameter dives past the edge esteem he will get an caution notice.

II. RELATED WORK

The first device that the researchers made with the Wireless Body part Sensing-Network (WBPSN) using the Atmega-8 microcontroller for patient health monitoring.

The sensors used here are Temperature Sensor, BPM Sensor, and Heart Beat Sensor. A no. of assessments on the concept of Wireless-Sensors approaches were performed beforehand as task reports or as research papers on the Patient Health Monitoring System based on IoT.

III. PROPOSED METHODOLOGY

The proposed model's block diagram is shown in Fig. 1. This shows all the components of the hardware connected to the raspberry pi, which is linked to the processor. The components used in the process can be divided into two parts: the components of hardware and software.

A. Hardware Components

It shows the hardware components used in the system, starting with Raspberry Pi 3 Model B, Raspberry Pi Camera Module, Arduino Uno and single lead heart rate monitor (AD8232). The Raspberry Pi acts as a small computer and consists of 40 GPIO pins that can be used for connecting with input and output devices. Furthermore, it also has wireless LAN connection and Bluetooth which can be used to transfer data to and from other devices and websites. The Raspberry Pi Camera Module is used to monitor the patient continuously.

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* Correspondence Author
P. Kanakaraja*, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, .A.P, India
K. Krishna vamsi, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram A.P, India.
I. Pratyush, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, A.P, India
B. Sai mohan, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, A.P, India.
M.Rama Krishna, Department of ECE, Koneru Lakshmaiah Educatio Foundation, Vaddeswaram, A.P, India.

RASPBERRY PIAND ITS SPECIFICATIONS:

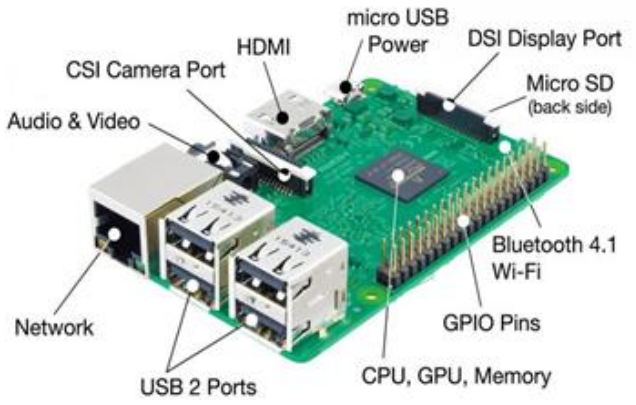

Fig.1: Raspberry Pi-3

Source:
https://www.silverlineelectronics.in/raspberry-pi-3-model-b-armv8-with-1gb-ram.html

The Raspberry pi is a small computer that normally works on NOOBS or Raspbian code. The Raspberry Pi consists of three generations: Pi-1,Pi-2 andPi-3, where each version is divided into two models: Model A and Model B. The latest work is based on Raspberry Pi-3, which consists of 40 GPIO (general input and output) pins for which various home appliances such as lights, fans, engines, air conditioners etc. are connected to each other. Generally speaking, Raspberry Pi has both a 2.4GHz and 5GHz wireless LAN (local area network) Ethernet and WIFI provision.

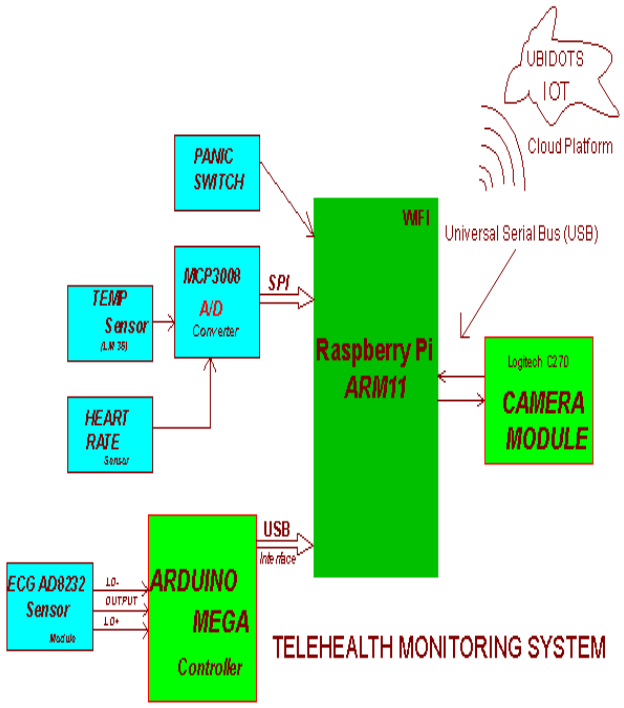

Fig.2: Block Diagram of Patient Monitoring System

In addition, the Raspberry Pi Camera Module also broadcasts a clip of the patient's current physical state. The key sensor used is the single lead heart rate monitor which monitors the signal from the ECG. An Arduino Uno is used to pass cardiac monitor information to the Pi of Raspberry. A temperature sensor is also used to measure the temperature of the skin. The existing values of the patient's control variables are reflected in a screen at the same time. There is also a push switch to send notifications; to run the Raspberry Pi with a laptop and power supply. A laptop is connected via an Ethernet cable to the Raspberry Pi by which the device code is executed.

CIRCUIT DIAGRAM:

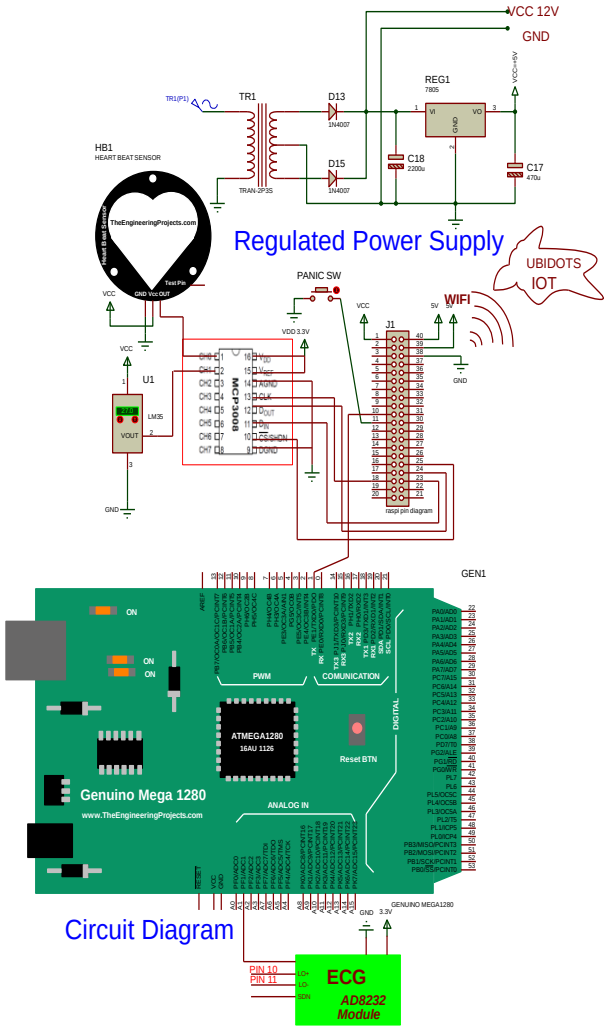

Fig.3: Circuit Diagram

B. Software Components

In terms of application, python is used to code in the Raspberry Pi as the main programming language. The version of python 2 is used as more tools and libraries are available. For the processing and visualization of data, modules such as pandas, numpy, biosppy, urllib and etc. Arduino programming language is used for the arduino and HTML, CSS, together with python, PHP is used to build the website. The ThingSpeak IoT platform is used for continuous data processing. RPi-Cam-Web-Interface, a web interface for the raspberry pi camera module, is used for the video streaming service.

IV. ARCHITECTURE AND COMPARISONS

1.) Architecture

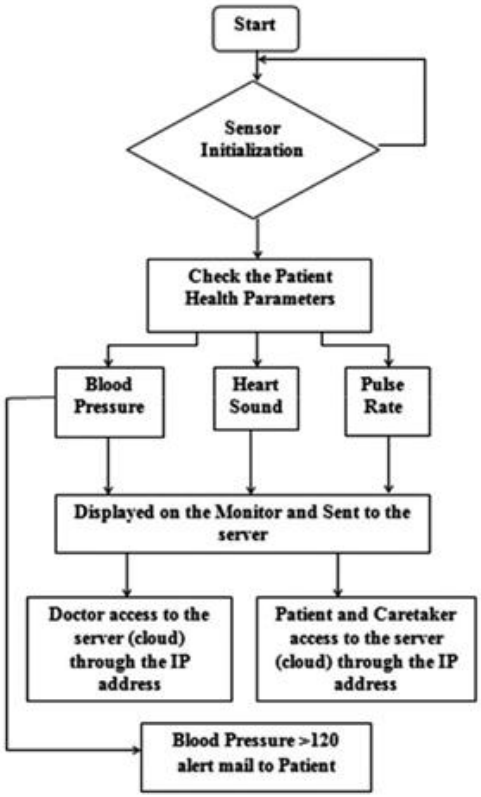

Fig.4: Flow diagram
Source:
http://www.computerscijournal.org/wp-content/uploads/2019/03/Vol_121_hea_gan_Fig_2.jpg

a.) Processing Unit

For this reason, an Arduino Uno with Atmega controller is required. Different device units in the module will be associated with the greater part. This system takes basic parameters from the endurance, technique and advanced yield of the joined sensors. Additionally, this module contains a Wifi networking gadget that sends changed sensors over advanced mobile phone data.

b.) Temperature-Sensor

The Lm-35 arrangement is accuracy-based knowledge preparing Lm-35 thermal sensors whose volt-age yield will be directly related to the Celsius scale temperature. Those sensing nodeLm-35 Alongside these outlines require favourable component above straight body-temperature sensors, tuned to ° kel-vin(K), Similarly as the consumer is not obliged to subtract an extensive stable volt-age from their products in order to obtain useful quantification of centigrade. The sensing node Lm-35 does not assist in any external configuration or modification during normal room temperature to provide ordinary precisions of ±1⁄4 ° C. In contrast, ±3⁄4 ° C should be+ 150 ° C over a total -55. The short output of the Lm-35 produces resistance, straight output, and also strict critical orientation aggravates inter-facing is meandering mostly modest data or controls. Similarly, it pulls fairly 60-62 µA from its source, requiring exceptionally little self-heating, under 0.1 ° C at present midair.

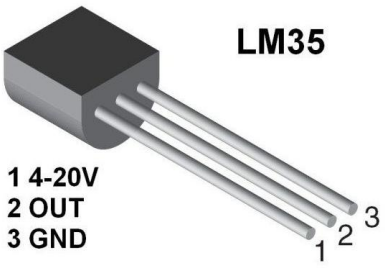

Fig.5: Temperature Sensor

Source:
https://crelectrons.com/product/lm35-sensor-de-temperatura/

c.) ECG Sensor Data Notation

Here clearly mention the ECG stands for and how we can deal with it. The ECG Signal is divided into three fundamental intervals, the PR interval, ST and the QT interval mentioned below.

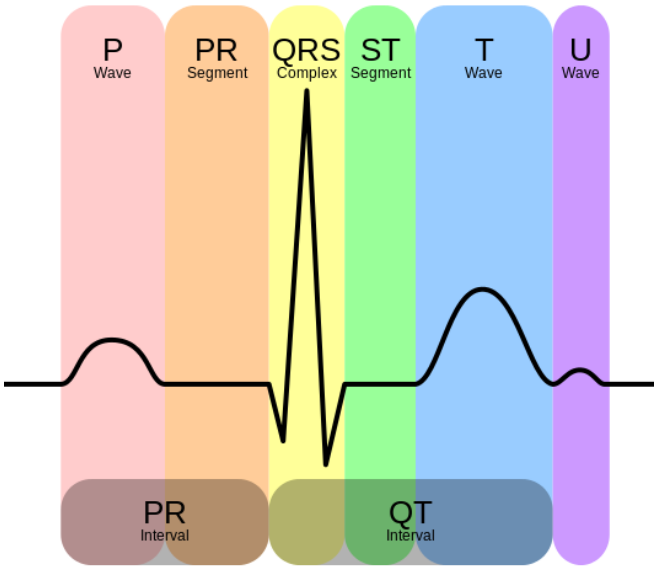

Fig.6: ECG waves and Heart interval Time Slots Notation
Source:
https://learn.sparkfun.com/tutorials/ad8232-heart-rate-monitor-hookup-guide/all

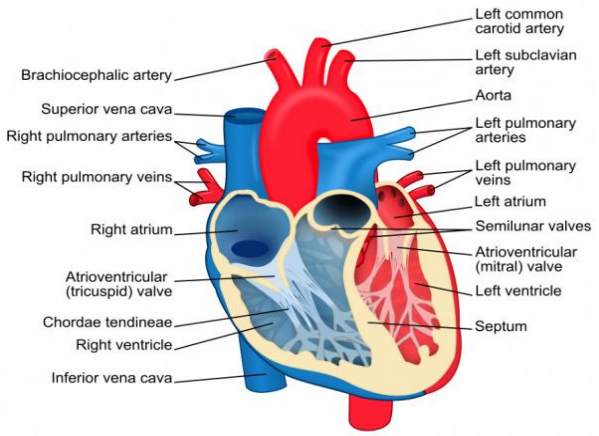

Fig.7: Internal Cross Sectional View of heart
Source:
https://learn.sparkfun.com/tutorials/ad8232-heart-rate-monitor-hookup-guide/all

1). PR interval Notation

The PR time period is the underlying fundamental electrical drive wave that movements from the correct chamber to one side chamber. The correct chamber is the known as the main chamber to see electrical motivation Response. The chambers were 'depolarized' by this electrical signal shock. It leads to forces it to contract, pumping de-oxygenated blood from the upper and lower vena cava into the whole right ventricle. It then antecedent the left atrium to contract over the edge of the brain as the electrical impulse is passes.

CONNECTING THE HARDWARE

In this, we will Interface an Arduino MEGA controller Board to the AD8232 Sensor Module. We will create a simple ECG monitor to allow you to measure your heart's electrical activity in real time and upload it into a **UbiDots** Cloud Platform with the Help of Raspberry Pi inbuilt Wi-Fi Module.

PIN CONNECTIONS

The AD8232 ECG Module Monitor breaks out of nine IC links. The module consisting of three ECG Pads Those is Black Acts as a Common Node, Blue acts as a LA (Left Arm) and Red Acts as RL (Right Leg).

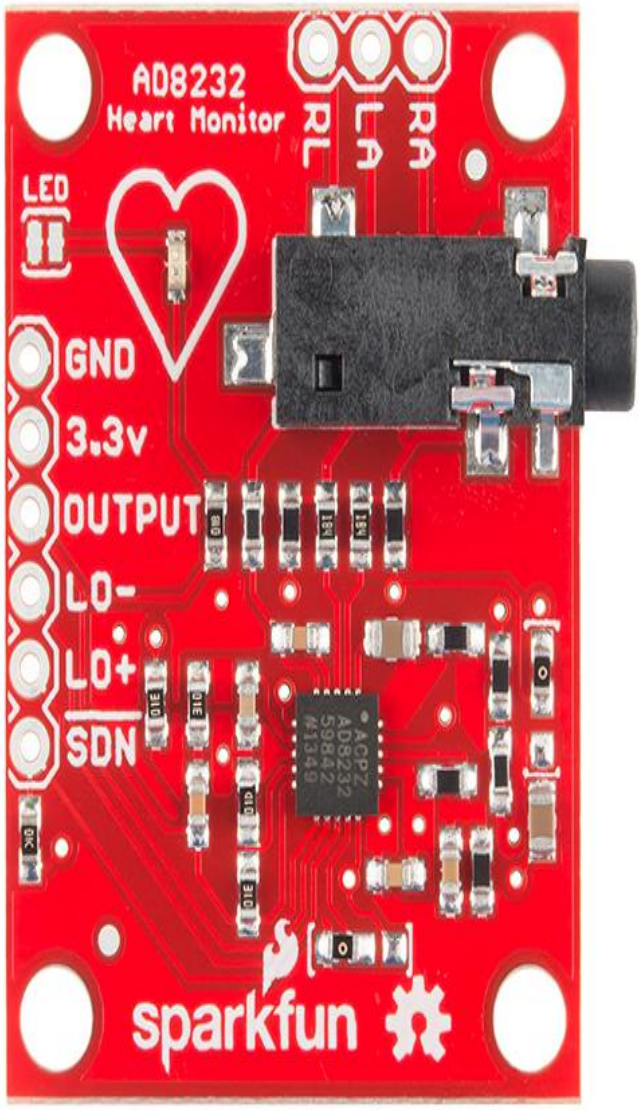

Fig.8: pin configuration of AD8232 ECG Module

Table-1: Pin Connection Configuration Notations

IC AD8232 ECG	*Pinouts*	*Pin Connection with Arduino*
GND	Ground	GND
3.3 Volts	3.3V Power Supply	3.3Volts
OUTPUT Pin	Output Signal	A0
LO (minus)	Leads off Detect minus	11
LO(plus)	Leads off Detect plus	10
SDN	Shut down	Not used

The very closer the chest pads are, the better the measurement is possible moreover to use the jelly for body quick respond purpose. The cables were color coded to give determine the correct orientation based on Einthoven's triangle as shown in the above table-1. And they can be placed on the chest very closer to the arms and above the lower right abdomen, as shown on the below figure on the right side image in the below diagram.

Table-2: sensor placement details.

Cable Color	Signal
Black	RA (Right Arm)
Blue	LA (Left Arm)
Red	RL (Right Leg)

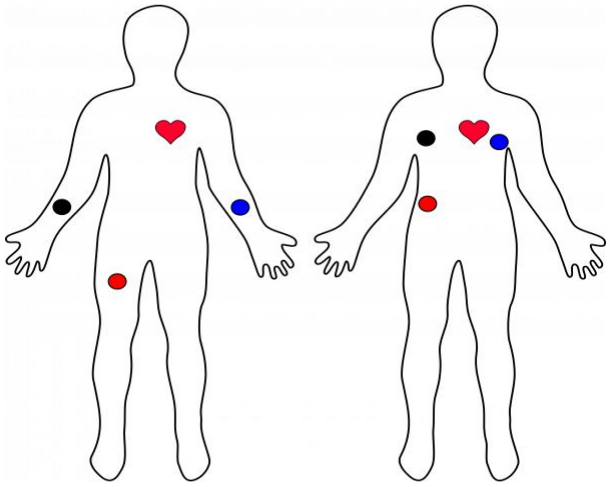

Fig.9: ECG Pads placements.

Source:
https://learn.sparkfun.com/tutorials/ad8232-heart-rate-monitor-hookup-guide/all

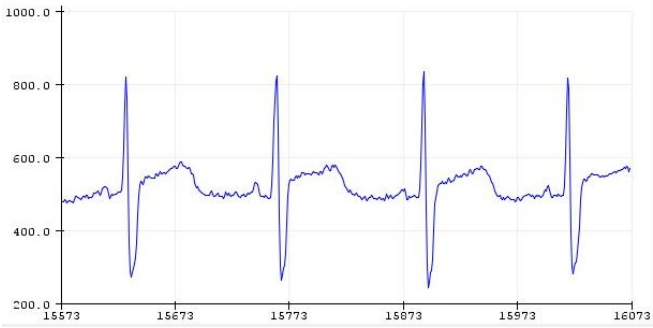

Fig.10: processing Model of ECG Waveforms

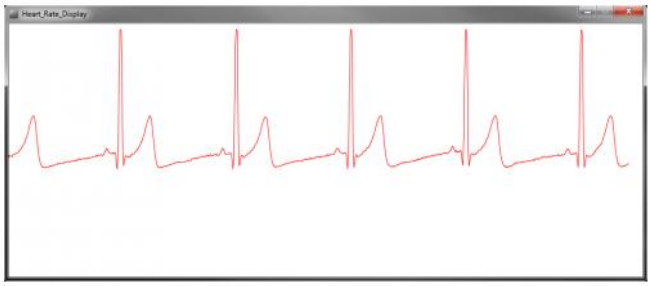

Fig.11: The Normal heart rate of an SFE Model schematic model

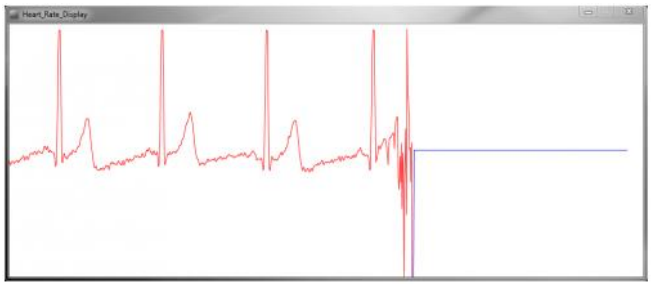

Fig.12: The Output Sensor is Blind state.

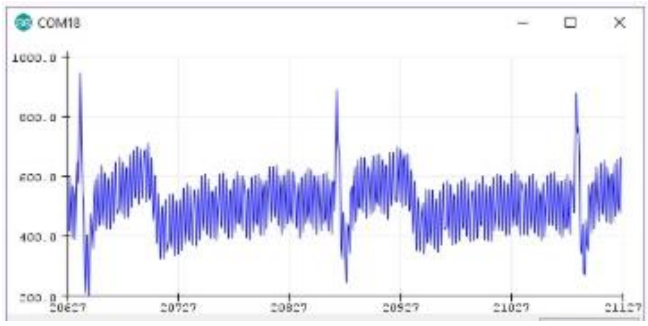

Fig.13: Noises in the waveform between QT time intervals

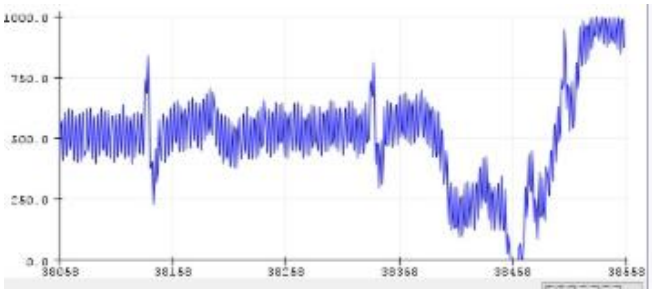

Figure.14: Showing a noisy waveform of clear-cut QT intervals and Motion Artifacts using UbiDots Platform.

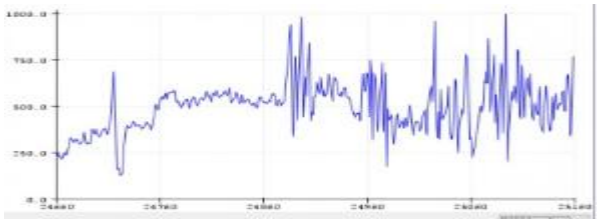

Figure.15: Serial Monitor Showing a Bright Wave-form in the Ubidots Cloud web Server.

Table-3: Compared with the different Microcontrollers.

Parameter	Ardulno Uno	Raspberry Pi Model B+	Intel Edison
Price	$30	$35	550 (board not included)
Size	7.6 x 1.9 x 6.4 cm	8.5 x 5.6 x 107 cm	3.55 x 2.5 x .39 cm
Memory	0.002M8	5412MB	1 GB
GPIO	14	40	40
Clock Speed	16 MHz	700 MHz	500 MHz, 100 MHz
On Board Network	None	10/100 Base T Ethernet socket	Wi-Fi, Bluetooth 4.0
Multitasking	No	Yes	Yes
input voltage	7 to 12 V	5 V	3.3 to 4.5 V
Flash memory	32KB	micro SD card	4 GB eMMC
USB	One, input only	Four, peripherals OK	One, peripherals OK
Operating System	None	Linux distributions	Yocto Linux v1.6
Integrated Development Environment	Scratch. IDLE, anything Arduino IDE	Arduino IDE. Eclipse, with Linux support	Intel XDK

Arduino Uno remains the cheapest of all these micros. Beagle-Board is one of the best micro-Boards used in the monitoring system for Wi-Fi Patient Health, but it is expensive compared to Arduino. The price of Beagle-bone varies from $199-250.

Raspberry Pi is a good one and has a comparable rate with Arduino and in future works can move to Raspberry pi. As existing IoT Health monitoring Raspberry devices are efficient and their prices are only 5-10 $ higher but it is suitable to interface cloud web server and Night vision high definition camera is possible. In this project implementation we are using Arduino MEGA ATmega 1280 Powerful controller to decode the ECG signals and these ECG Signals are transmitted to Ubidots Web Server through the Raspberry Pi by interfacing the Raspberry Pi and Arduino MEGA using Serial Protocol.

IV. RESULTS AND DISCUSSIONS

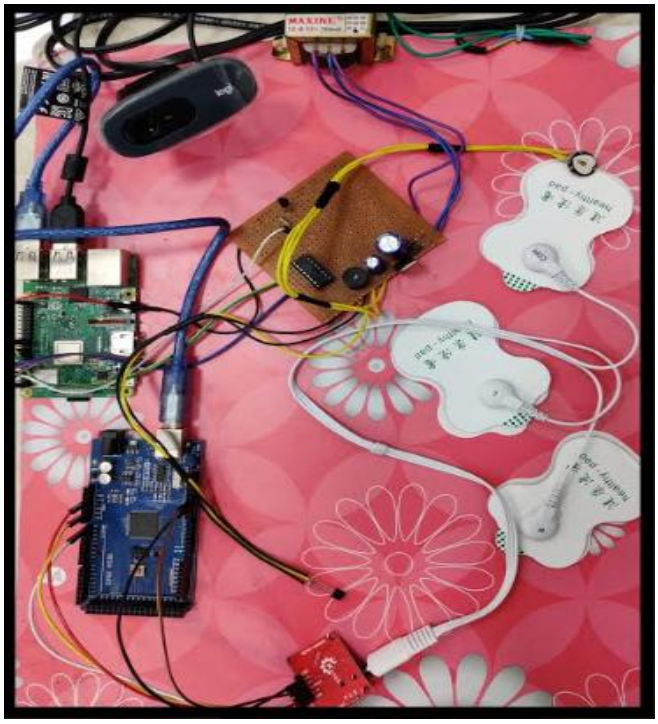

Fig.16: Project Practical Hands on Hardware Prototype

This System is implemented and the results have been verified practically. It helps the user to monitor and control the home appliances connected through message.

Fig.17: ECG Practical Measurement Procedure.

Results are as follows:

The results have been obtained through Ubidots. After signing into the Ubidots account and producing the required fields, an API (Application Programming Interface) key has been generated and through this we get the message.

Fig.18: monitoring the pulse rate

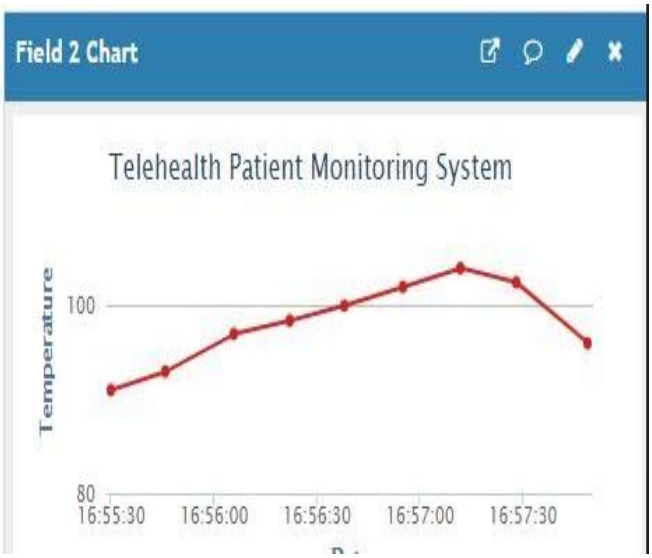

Fig.19: monitoring the temperature

created_at	entry_id	Heart Rate	Body Temp
2019-11-16 01:22:58 UTC	11	66	
2019-11-16 01:25:30 UTC	12	76	91
2019-11-16 01:25:46 UTC	13	79	93
2019-11-17 10:26:06 UTC	14	81	97
2019-11-17 10:26:22 UTC	15	84	98.4
2019-11-18 10:26:38 UTC	16	66	100
2019-11-18 10:26:55 UTC	17	72	102
2019-11-19 11:27:12 UTC	18	73	104
2019-11-19 11:27:28 UTC	19	71	102.5
2019-11-19 11:27:49 UTC	20	77	96

Fig.20: values of pulse rate and temperature

Fig.21: alert message send from the system

VI. SUMMARY

The system is set up for home use by patients who are not in a life-threatening situation but need to be monitored in a timely manner by the doctor or the family. As per the paper work, the design of the health monitoring system is based on the idea of a researcher that meets the needs of patients. As per the contemplation of the conformist system, this system is still in use from its build-up, but it is very difficult to handle individually and the size and cost are also more associated with the improved system and it also takes more than 1 minute to get the exact result. This system provides more facility for medical devices on a single on-chip platform compared to traditional systems

VII. CONCLUSION

From this paperwork, Patient Health Monitoring is beyond the accepting apple to begin analyzing assorted abstruse explanations in order to improve healthcare accounting in an address that accompanies absolute casework by assembling the IoT abeyant. Similarly as with every thought of the traditional system, even now this framework is being used from their manufacturing Be that as it is thick, as it is cumbersome with handle separately Also extent Expense also need additional aid contrasted with those propel framework What's more it detracts more than 1 minute to get the right result.

It takes less than a minute for the health monitoring system to calculate the ECG, blood pressure and temperature monitoring results. Scope also decreases due to the combination of no. of medicinal data sensors on a single piece compared to the conservative scheme. Therefore, the complication of time-cost is reduced.

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AUTHORS PROFILE

Pamarthi Kanakaraja currently working as Assistant Professor in Koneru Lakshmaiah Education Foundation (Deemed to be University). He has 8 Years working experience On Embedded Designing & Programming Concepts. He is Technical EMBEDDED DESIGNING concepts Adviser for many Engineering and Polytechnic (DIPLOMA) Students. He also published papers in various international journals. He is a Regular Contributor in EFY (Electronic for You) International Technical magazine. His area of research is Embedded Designing, Internet of Things (IoT) & Artificial Intelligence (AI).

K.Krishna Vamsi studying B.Tech in Koneru Lakshmaiah Education Foundation (Deemed to be University), Department of Electronics and Communication Engineering.

I.Pratyush studying B.Tech in Koneru Lakshmaiah Education Foundation (Deemed to be University), Department of Electronics and Communication Engineering.

M.Rama Krishna studying B.Tech in Koneru Lakshmaiah Education Foundation (Deemed to be University), Department of Electronics and Communication Engineering.

B.Sai Mohan studying B.Tech in Koneru Lakshmaiah Education Foundation (Deemed to be University), Department of Electronics and Communication Engineering.