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Remote Monitoring System of Heart Conditions for Elderly Persons with ECG Machine Using IOT Platform

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Abstract

These days, heart illnesses are viewed as the essential purposes behind unforeseen passing. Along these lines, different clinical gadgets have been created by designers to analyze and examine different infections. Clinical consideration has gotten one of the main issues for the two individuals and government considering enthusiastic advancement in human people and clinical use. Numerous patients experience the ill effects of heart issues making some basic dangers their life, consequently they need ceaseless observing by a conventional checking framework for example, Electrocardiographic (ECG) which is the main procedure utilized in estimating the electrical movement of the heart, this method is accessible just in the emergency clinic which is exorbitant and far for distant patients. The improvement of far-off advancements enables to develop an association of related devices by methods for the web. The proposed ECG checking framework comprises of AD8382 ECG sensor to peruse patient's information, Arduino Uno, ESP8266 Wi-Fi module, and site page. The usage of the proposed ECG medical care framework empowers the specialist to screen the patient's distantly utilizing IoT http application library utilized in Arduino ide compiler to such an extent that it can send that information to website page made, on imagining the patient's ECG signal without human presence site page itself can book arrangement for that persistent, if it is anomalous. The observing cycle should be possible at whenever and anyplace without the requirement for the emergency clinic.

Keywords: IOT; AD8232; Arduino ide; ESP8266; ECG.

1- Introduction

The heart ailments are the basic clarification behind the unexpected passing and causes a high mortality around the world yearly. Amazingly, heart diseases patients are resolved to stay at their home without making any potential that pressure the heart. Nevertheless, an enormous part of the patients fails miserably before they get any treatment since they do not feel crippled until the ailment become at an essential stage. Along these lines, the doctor must screen the actual status of the patient's heart consistently to forestall any dire backslide in heart status and afterward diminishing the passing [1]. It is difficult to keep all heart patients in the facility to screen their status. All things being equal, growing continuous checking medical care framework dependent on remote innovation is a compelling answer for the doctor to screen their patients distantly.

The Electrocardiogram is physiological wave signal that depicts the electrical development of the heart. It is produced because of siphoning and pressing blood between the atria what is more, chamber inside the heart [2]. ECG enables the specialists to choose the clinical state of the heart by assessing the time needed for the electrical sign to be experienced the heart. ECG signal is estimated utilizing a set of cathodes that are put non-carefully on the body surface to acquire data about the electrical action delivered by the heart. The expression "Web of Things" IoT was utilized for the first time in 1999 by Kevin Ashton during his works at MIT's Media Centre. This idea is utilized to communicate the association between the machines and PCs through sensors and utilizing the web as an intend to acknowledge control orders and detailing status [3]. IoT is around for a long time however without a name, machine-to-machine (M2M) was accessible for a long time and is the closest idea to IoT.

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There are numerous different names for IoT, for example, Ubiquitous figuring and web of everything. For the most part, the term (IoT) alludes to a dynamic and worldwide organization foundation which comprises of an enormous number of organization associations and processing abilities reach out to objects, sensors and ordinary things not ordinarily considered PCs [4]. These devices are allowed to create, eat up, and exchange data with a little human intervention. The gigantic degree use of IoT changes various points to the things, for instance, home computerization, energy the board contraptions, orchestrated vehicles, vigilant traffic besides, prosperity noticing devices. IoT carries inconceivable solace to the clinical administrations field, especially for persevering noticing and following organization. Enlivened improvement of the web disseminated processing and Internet compromise of clinical noticing and the board stage gives new events to the crisis centres and care centres to improve access and interconnection of devices used in clinical administrations [5]. Installed innovations have a significant part in conveying medical care to individuals in isolated and far areas by giving them a checking framework which presents a persistent stream of precise information for better medical services choices. As the innovation is to gather, examine and send information, IoT keeps on improving the IoT-driven medical services applications and frameworks arise. This paper used the IoT to introduce a financially savvy, distantly utilized, effectively prepared, and continuous medical services framework for checking the ECG of the heart patients utilizing ECG sensor and Node MCU. This framework gives ideal answers for heart patients that are living in far off areas and having restricted pay. The remainder of the paper is coordinated as follow [6]. Segment two centres around the connected works, and Section three depicts the framework from three angles: the framework segments, its information obtaining, information preparing, transmission and information representation parts. In Section Four, we present the execution steps and result perception. Segment five talks about the acquired outcomes and examination with a few related works. Segment Six gives the ends and future works.

2- Related Works

G. Xu [6], The rising Internet of Things (IoT) framework permits us to layout small gadgets which could be ready to sense, processing and communicating, permitting sensors, embedding gadgets and other ' things ' to be created in order that you'll assist to apprehend the environment. during this paper, the IoT assisted electrocardiogram (ECG) tracking framework with stable records transmission has been proposed for non-stop cardiovascular fitness tracking. the development and implementation of a light-weight ECG Signal Strength Analysis has been proposed for computerized category and realtime implementation, the utilization of ECG sensors, Arduino, Android phones, Bluetooth and cloud servers with the proposed IoT-assisted ECG tracking system. For stable records transmission, the Lightweight Secure IoT (LS-IoT) and light-weight Access Control (LAC) has been proposed. The ECG alerts taken from the MIT-BIH and Physio Net Challenges databases and ECG alerts for varied bodily sports are analyzed and checked in real-time. The proposed IoT assisted ECG tracking framework has extraordinary capability to make a decision the medical attractiveness of ECG alerts to reinforce the efficiency, accuracy and reliability of an unsupervised diagnostic system.

B. M. Lee and J. Ouyang planned a wise assistance model for medical care [7]. A joint effort convention has been proposed to send and get the elements identified with the dangers between IoT medical care gadgets. The coordinated effort convention is an application convention comprising of numerous occasions which are applied to arrange the progression of information between IoT's gadgets, the boot occasion instates all the IoT's gadgets in the framework by communicating join message.

G. Ismaeel and E. K. Jabar expected to arrive at m-wellbeing by planning a medical care framework for pregnant ladies utilizing Mobile GIS [8]. This framework empowers the pregnant lady which needs exhortation, update and supporting (from their home) to enlist in maternity care focus through the web interface by sending SMS to the framework worker including her ID, telephone number, name, age, just as finding the position utilizing a versatile underlying GPRS method.

B. Padmavathi and S. T. Rana planned and actualized a system for IoT put together medical services arrangement based with respect to distributed computing [9]. This system incorporates five layers. Information preparing layer recognizes and finds the information from sensor-based innovation by utilizing RFID, ZigBee, NFC, Barcode advances and computerized cameras.

A. Ahamed et al. executed a minimal effort ECG observing framework [10]. This framework comprises of four units, an ECG securing unit detects the patient's ECG information signal by utilizing the Bio Protech T716 terminal, this information is moved to the intensifier input. Signal molding unit utilizes the AD620 intensifier just as numerous different methods to get an unadulterated information signal by enhancing the information sign and diminishing the clamor.

The ECG records the electrical activity generated by the depolarization of the heart muscle, which propagates it in response to electrical waves reaching the skin. Although the amount of electricity is actually very small, it can be taken reliably with ECG electrodes connected to the skin. The three major types of ECG are:

2-1- Resting ECG

You lie down, no move is allowed during the test, as electrical impulses developed by other muscles may intrude with those generated by your heart. This usually takes 5 to 10 minutes.

2-2- Ambulatory ECG

If you have an ambulatory, you wear a portable recording device for at least 24 hours. You are free to move around normally while the monitor is attached. This type of ECG is used for people whose syndromes are intermittent and may not show up on a resting ECG, and for people recovering from heart attack to ensure that their heart is functioning properly. You record your syndromes in a note and note when they occur so that your own experience can be compared with the ECG.

2-3- Cardiac stress test

This test is used to record your ECG while you ride on an exercise walk on a treadmill. This type of ECG takes about 10 to 25 minutes to complete [10].

As per the standard assignment from Figure 1, the ECG arrangement comprises of in any event four anodes on the chest or at the four closures. In any case, there are varieties of this setting to take into consideration more adaptable and meddlesome accounts. Terminals are joined to the wrists and lower legs. ECG anodes ordinarily require wet sensors and a conductive gel to build the conductivity between the skin and the cathodes [11].

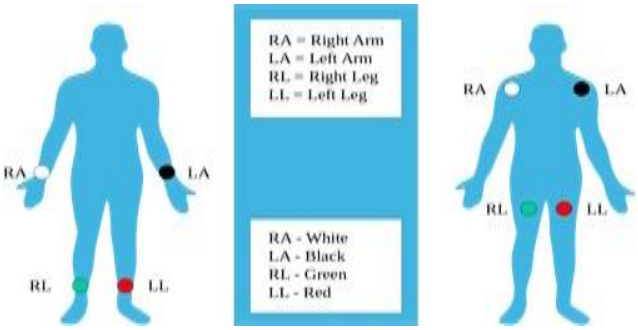

Fig. 1 Says that standard nomenclature (RA = right arm; LA = left arm; RL = right leg; LL = left leg).

Typical range is 120 - 200 ms. Figure 2 shows the QRS length up to 120 ms. The abnormal value of the heart rate is 60 to 100 beats / min. Indicates the heart rate is slower than 60 beats / min, which is called bradycardia. A heart rate of more than 100 beats / min is called a tachycardia [13].

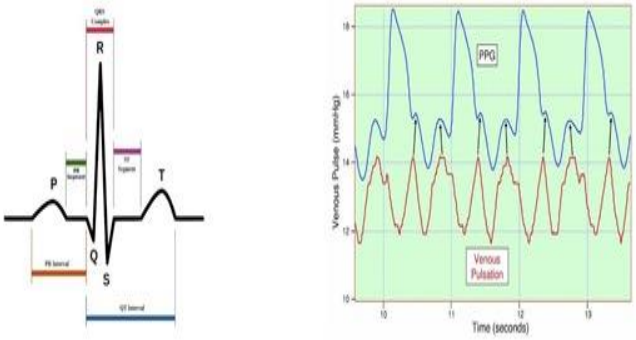

Fig. 2 Measured from first deflection of QRS complex to end of QRS complex at isoelectric line

In rundown, the connected works talked about already do not present an ECG medical care framework that has the four fundamental highlights: continuous, minimal effort, simple prepared and distantly arrangement situated utilized. Any medical care with these four highlights will be fulfilled for the low-pay and distant living heart patients. The proposed medical services framework helps the doctors to follow the actual status of their patients at whenever and anyplace.

3- Materials and Methods

The proposed framework comprises of a bunch of equipment and programming parts that are cooperated to construct the general framework as shown in figure 3. These parts can be partitioned into four units, the information gathering unit that is liable for perusing heart action signals from the human body, the got information from ECG test, ESP Wi-Fi module that sends the created data to the distant page, lastly, investigate the readings and continue as indicated by it [14].

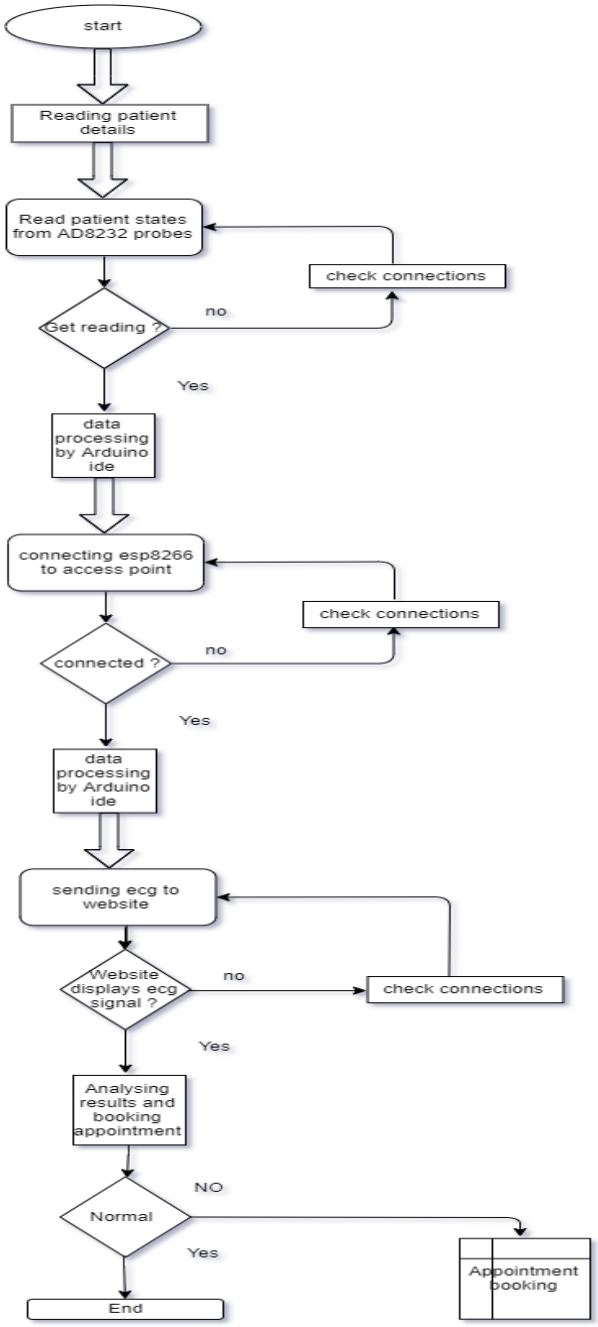

Fig. 3 Flowchart showing framework

The major pieces of the data making sure about unit are AD8232 chip and three paste cathodes terminals pointed as R for the right side, L for the left side and COM as shoreward the key endeavor of the AD8232 chip is removing, upgrading, and filtering the little signals of the heart electrical activity when a boisterous condition happens in view of development or distant anode plan. Signal trim is cultivated using a bipolar point high pass channel which is joined with the instrument speaker structure.

The AD8232 chip contains a non-operational speaker that makes a three-post low pass channel similarly as decreasing the additional uproar. As shown in figure 4, AD8232 contains a brisk recovery work, we can diminish the long high leave channel to work behind the long tail wonder. If the enhancer rail voltage signal change, (for instance, the lead out of the case), AD8232 worked in an enhancer for the right-side driver (RLD) and other drive lead applications [15]. AD8232 will thus adjust to a higher direct cut-off state.

This incorporate license the AD8232 to achieve quick recovery, and accordingly the lead relationship with the assessment of the article can be cultivated at the soonest opportunity after the assessment of the value. AD8232 is related with the esp8266. The pin specifications are shown in Table 1.

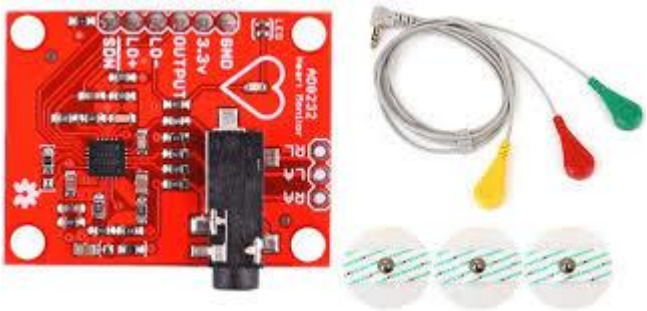

Fig. 4 AD8232 ECG sensor.

Table 1 Pins specifications of AD8232

Board label	***Pin function***	***Node MCU connection (figure 5)***
GND	Ground	GND
3.3V	3.3V power supply	3.3V
OUTPUT	Output signal	A0
LO-	LEADS-OFF detect-	D3
LO+	LEADS-OFF detect+	D2
SDN	Shut down	Not used

Fig 5: Node MCU

The ESP8266 Wi-Fi module which is utilized to send the information from an Arduino from which it can access by the client. Wi-Fi module integrated with TCP/IP protocol and has self-contained SOC. ESP 8266 module can easily provide Wi-Fi when it gets attached to an Arduino [16] – [18].

4- System Implementation

In this segment, the segments of the proposed framework are associated, as shown in figure 6. The execution starts with instating site tolerant subtleties, the initial step is to fill structure, the following stage is to make a record utilizing a substantial email address to get a validation code information field where the information can be shown as a chart so variety of the ECG information sign of the patients can be envisioned. The product is intended for playing out this undertaking.

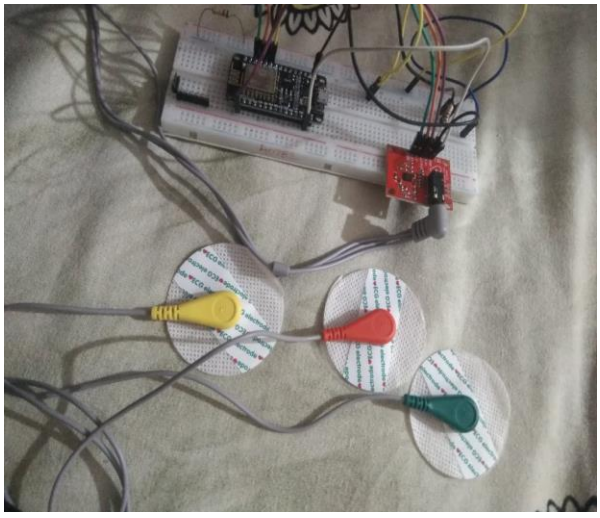

Fig. 6 Proposed Work

The program code is composed utilizing Arduino IDE 1.8.5 climate, this code beginning to set up the essential library for ESP8266 module and web application. Figure 7 shows the circuit diagram of the Arduino connections. The ECG simple signs from the test's terminals are perused Node MCU A0. The test terminals must be set appropriately at the predetermined piece of the human body the information by changing the simple information over to advanced data utilizing Analog to computerized transformation. The yield information will be passed to the ESP8266 module through pin 2 and pin 3. ESP8266 Module is associated with the web hotspot utilizing the name of the hotspot (SSID) and (PASSWORD) and afterward sending the information to site page stage.

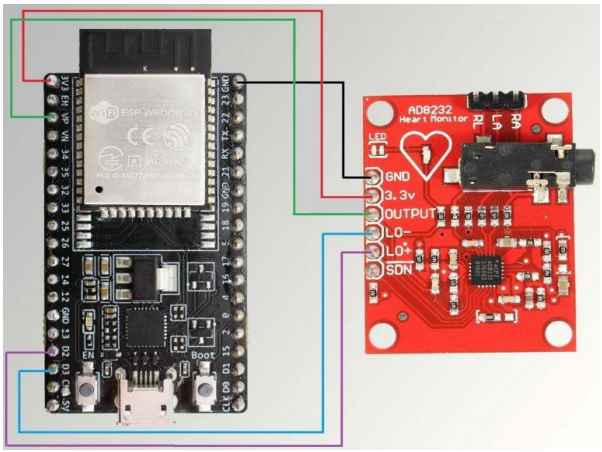

Fig. 7 Circuit Diagram

5- Results and discussions

The basic point of the proposed framework is limiting the time between the snapshot of getting patient's information and showing the outcomes through application on the PC. In this section, the pieces of the proposed structure are related. The execution begins with presenting page, the underlying advance is to sign in to point of arrival or make a record using a real email address where the data can be appeared as a chart and plain. With the objective that assortment of the ECG data indication of the patients can be envisioned. The website page is intended for playing out this errand. Figure 8 shows the data from the monitor of the system of the proposed framework segments.

We have,
(Inter beat internal let take) x (ml in one minute)
= 60*1000 m/s = 60000 m/s

IBI=60000/x BPM
BPM=60000/inter beat internal

Table 2 shows the ECG data generated from the proposed device and table 3 shows the comparison of the proposed work with the related works.

The program code is composed utilizing Arduino IDE climate, this code beginning to set up the fundamental library for ESP8266. The ECG simple signs from the test's terminals are perused Node MCU pin A0. The test terminals must be put appropriately at the predetermined piece of the human body.

Node MCU measures the information by changing the simple information over to advanced data utilizing Simple to modernized change. The yield data will be passed to the ESP8266 module through pin D2 and pin D3. ESP8266 Module is associated with the web hotspot utilizing the name of the Wi-Fi (SSID) and (PASSWORD) and afterward sending the information to the page.

Table 2 ECG data

Interval	***Corresponds to***	***Normal range***
PR interval	AV nodal delay	0.12-0.20 seconds
QRS duration	Ventricular depolarization	Up to 0.10 sec
QT intervals	Total duration of ventricular depolarization	Up to 0.43 sec
R-R intervals	Time between beats -is used to calculate heart rate	0.6 to 1 sec
Mean electrical axis	Net vector of ventricular depolarization	-30-+100 degree is the widest normal range

Table 3(a) Comparing the Proposed System with Related works

Parameter	***Proposed System***	***Ref. [6]***	***Ref. [3], [16]***
Data Reading	AD8232 ECG sensor	ECG sensor	AD8232 ECG sensor
Microcontroller	ESP8266	Arduino, Android phones	Arduino Uno
Transmission Technique	Wi-Fi	Bluetooth	Wi-Fi
Distance	Unlimited	10 meters	Unlimited
Displaying Results	Webpage	webpage	Blynk Application on smartphone
IoT	Yes	yes	Yes
Time	Real-time	Real-time	Real-time
Cost Effective	Yes	yes	Yes

Table 3(b) Comparing the Proposed System with Related works

Parameter	***Ref. [17]***	***Ref. [19]***	***Ref [14]***
Data Reading	Heartbeat pulse, blood pressure and heart sound sensors kits	Heart Beats sensor	AD8232 CG sensor
Microcontroller	Raspberry Pi	Raspberry Pi	Arduino Uno
Transmission Technique	Wi-Fi	GSM+Wi-Fi	Bluetooth
Distance	Unlimited	Unlimited	10 meters
Displaying Results	Web Page IP address	SMS Acknowledgment and Web page IP	Serial plotter and smartphone
IoT	Yes	Yes	No
Time	Real-time	Real-Time	Real-time
Cost Effective	Yes	Yes	Yes

Table 4 A comparison of Arduino, Raspberry Pi and ESP8266 Node MCU

	Arduino UNO	***Raspberry Pi***	***ESP8266 Node MCU***
Developer	Arduino	Raspberry Pi Foundation	ESP8266 open source community
Operating System	None	Linux	XTOS
CPU	Atmel, ARM, Intel	ARM Cortex	LXT106
Clock Speed	16 MHz	1.2GHz	26 MHz – 52 MHz
Memory	32KB	1-4GB	Upto 128MB
Storage	1KB	MicroSDHC Slot	4MB
Power	USB, Battery, Power Supply	USB, Power Supply	USB
Operating Voltage	5V	5V	3.3V

I/O Connectivity	SPI I2C UART GPIO	SPI DSI UART SDIOCSI GPIO	UART, GPIO

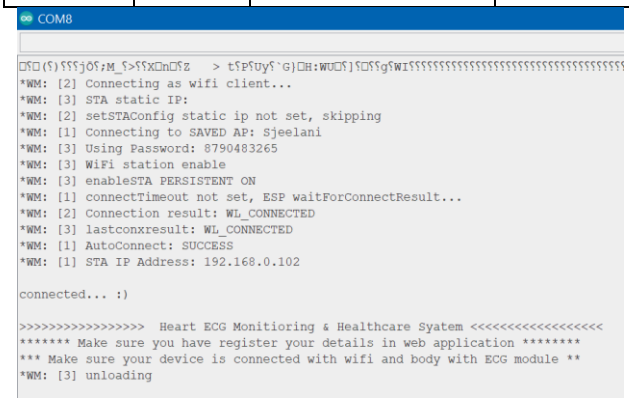

Fig. 8 Serial monitor data of uploading data to cloud

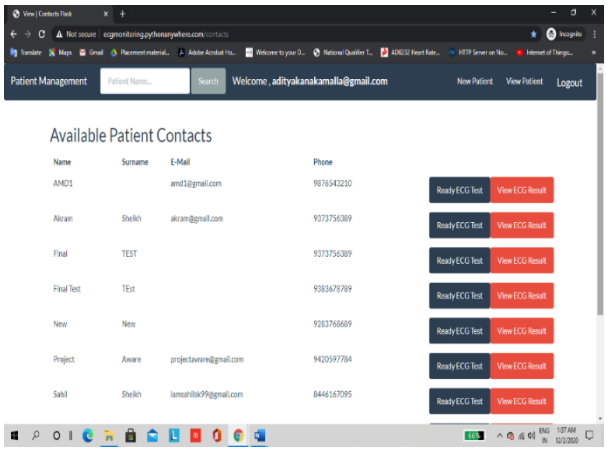

Fig. 9 Web main page.

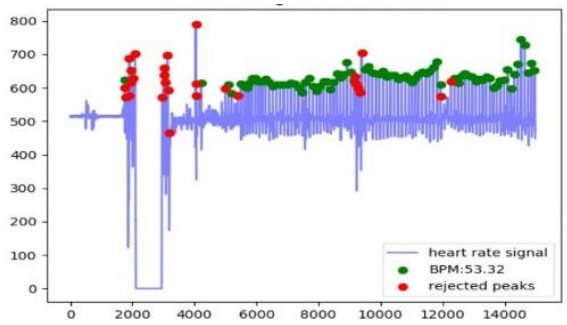

Fig. 10 ECG graph in webpage.

Patient Heart ECG Report				
Blood Per minute	Inter Beat Interval	Standard Deviation of NN Interval	Standard Deviation of RR Interval	Breathing Rate
53.31510594668489	1125.3846153846155	75.59494467720383	34.94883038199409	0.045568466621098 2
Result : Abnormal ECG Found				

Doctor Appointment : Required					
Patient Name	Patient Surname	Patient Email	Patient Mobile	Doctor Appointed	Appointment Date
Project	Aware	projectaware@gmail.com	9420597784	John Blair	2020-11-30

Fig. 11 Detailed data analysis of ECG data and generation of appointment

The whole network is framed in a system that connects the patient with the clinic and helps in getting appointment easily. Figure 9 shows the web page (main) developed. The waveform generated by the proposed device can also be observed as shown in figure 10. After observing the patient's report, appointment will be generated based on the seriousness of the patient's condition, as shown in figure 11. This proposed system provides a platform that supports any elderly heart patient to run regular check-ups in home without travelling/going to a clinic. It is mostly applicable and beneficial for the patients in rural areas and hilly regions.

6- Conclusions

This paper intends to plan an ECG medical care framework dependent on IoT for patients who are experiencing issues in heart action. The framework uses the IoT application which is a simpler to book arrangement when it is irregular and furthermore without human presence, the doctors to screen the heart condition of their patients. The fundamental strength purposes of our proposed framework are anything but difficult to associate and use by anybody, can be conveyed anyplace, distantly utilized, savvy, and effectively prepared. This framework can be created in future by expanding the quantity of the anode for ECG sensor to get more precise outcomes, additionally can be stretched out by adding more sensors for estimating different boundaries, for example, pulse and pulses. Making a cloud information base will be exceptionally powerful to store the patient's wellbeing data including patient's wellbeing history, nonetheless, in each time the specialist plays out another ECG perusing the information will be straightforwardly put away in the patient's record in the data set, at that point it could be dissected, and the specialist can send a warning report to the patient, when they came to emergency clinic.

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Conflict of Interest

This paper is not submitted or published in any journal and there is no conflict of interest.

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