IoT based smart healthcare monitoring system

A PROJECT REPORT

submitted by

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14BCE0848

In partial fulfilment for the award

of the

B. Tech

degree in

Computer Science and Engineering

School of Computer Science and Engineering

VIT®

Vellore Institute of Technology

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School of Computer Science and Engineering

DECLARATION

I hereby declare that the project entitled **"IoT based smart healthcare monitoring system"** submitted by me to the School of Computer Science and Engineering, Vellore Institute of Technology, Vellore-14 towards the partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out by me under the supervision of **Prof Anand M., Associate professor, SCOPE.** I further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma of this institute or of any other institute or university.

Signature

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CERTIFICATE

The project report entitled "**IoT based smart healthcare monitoring system**" is prepared and submitted by **Mayank Jaggi (Register No: 14BCE0848)**, has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Computer Science and Engineering** in Vellore Institute of Technology, Vellore-14, India.

Guide
(Name & Signature)

Internal Examiner
(Name & Signature)

External Examiner
(Name & Signature)

ACKNOWLEDGEMENT

Firstly, I would like to thank my faculty in – charge **Prof. Anand M.** for allowing me to take this project under his expert supervision. I have learnt a lot from him and his guidance in learning about my academics and his constant guidance has helped me to overcome the difficulties I went through during my project and to make my project unique and more valuable. I would like to express deep gratitude for **Prof. Santhi V.** (Head of Department) for her timely suggestions regarding the project dynamics and how the project is to be carried out.

My sincere thanks to **Dr. R. Saravanan** (Dean, SCOPE) for giving me the opportunity to work with professors of Computing Science and making my journey in SCOPE all these years interesting and challenging.

It has been my privilege to be part of VIT. The ample opportunities that I received here will help in my career, enhance my future and make me a better person in life. I offer my sincere thanks to the college, faculties and staff.

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LIST OF ABBREVIATIONS

Abbreviation	Expansion
IoT	Internet of Things
ECG	Elecro Cardio Gram
BP	Blood Pressure
WSN	Wireless Sensor Network
LCD	Liquid Crystal Display
OS	Operating System
TCP	Transmission Control Protocol
ICU	Intensive Care Unit
SQL	Structured Query Language

ABSTRACT

The recent innovations and expansion of Internet has made it possible to connect various devices to the internet in such a way that they can communicate with each other and share data. The Internet of Things (IoT) is another idea that allows users to connect different sensors and actuators to each other to gather data and interact with the environment. Today, the broad advancements in Smart phones and Tablets has determined a wide availability of software applications for numerous purposes. The presence of powerful processing units, embedded sensors as well as the availability of many standard communication interfaces has recently attracted the interest of the scientific community. With the help of IoT we can provide communication with sensors and smart phones.

The patients do not like to stay in hospital for too many days and also the doctor has to check and observe the condition of the patients repeatedly. The main drawback in traditional method is time consuming and difficult for the doctor to monitor the condition of the patient continuously. This application helps the patient to go out without the help of caretakers. It is very useful for the patients like pregnant ladies and old age people if they faint.
It has been observed that a comprehensive stage is yet missing in the e-Health and m-Health designs to utilize sensors to detect and transmit critical information identified with a patient's wellbeing.

In this project, I propose a semantic model for monitoring patients' e-Health. The proposed model uses sensors to take in critical information about a patient to observe his/her wellbeing which can be shared with anyone connected to the internet to monitor the patient's health by doctors, emergency services, relatives etc. The patient health can be monitored even though the doctor is not in the hospital. The doctor can do his work normally. This information can be accessed even on the go using mobile phones and reduces time and money used to go to a hospital or a clinic.

***Keywords**: Iot, Sensors, Health Care, Internet, Mobile*

1.Introduction

1.1 Theoretical Background

The **Internet of things** (**IoT**) is the interconnected network of physical devices (also referred to as "connected" or "smart" devices"), buildings, and other items embedded with electronics, sensors, actuators, software (including database systems), and network connectivity that enable the devices to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) also referred to IoT as "the infrastructure of the information society". The IoT architecture allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of data and information from the physical world into computer-based systems, in turn resulting in improved efficiency, accuracy and economic benefit along with reduced human intervention. The internet of things has numerous applications in healthcare, from remote monitoring to smart sensors and medical device integration. It has the potential to efficiently track health status for patients, but also to improve how physicians deliver care as well. Healthcare IoT can also boost patient engagement and satisfaction by allowing patients to spend more time interacting with their doctors. But healthcare IoT isn't without its shortcomings. The number of connected devices and the tremendous amount of data they collect can be a challenge for a typical hospital IT to manage. Another question that arises is how to keep all that data secure, especially if it is being exchanged with other devices.

1.2 Motivation

m-Health and e-Health are providing huge administrations remotely, like, counteractive action and conclusion against ailment, hazard appraisal, checking tolerant wellbeing, instruction and treatment to clients. This is the reason e-Health and m-Health is by and large broadly acknowledged in the general public. The developing of best in class devices and advancements in the field can be truly advantageous for e-Health and m-Health. Distinctive e-Health and m-Health designs for IoT have been created which are capable of handling crisis circumstance efficiently productively. But even with that, the current e-Health and m-Health structures don't utilize advanced cell sensors to detect and transmit critical information identified with the patients' wellbeing. I have proposed an effective and efficient system for e-Health and m-Health which makes utilization of advanced cell sensors and body sensors to acquire, create and transmit

wellbeing related information to bring together capacity in the cloud. This stored information can easily be recovered by patients and different partners later. This proposed model gives effective putting away, handling and recovering of crucial information.

1.3 Aim of the proposed work

IOT based Smart Health care system will help the elderly to monitor themselves using the sensors such as Temperature, Heart Beat Sensor, ECG, and using the system, the monitoring can be done smartly without going to the hospital. This implementation will be beneficial for the elderly people who can't travel to the hospital. Apart from that, it can monitor patients admitted in the hospital when 24 hours monitoring by a nurse is not possible, the project will help develop a system from which the doctor or any person in the world can monitor the sensor captured details. The main objective is to monitor the patients without physical presence of doctor using a hardware in which sensors are connected such as Heart Beat Sensor, ECG sensor, Temperature sensor.

1.4 Objectives of the proposed work

The goal of this project is to make health monitoring easy for both, the hospitals and the general public, especially the Elderly people who find it difficult to go to the Hospital for health checkup and emergency situations. I worked with Internet of Things technology using Arduino board embedded with a mobile app in the front end to view information. The health monitoring is done through sensors attached to the microcontroller such as pulse rate sensor, Temperature Sensor, ECG sensor. This system will also be helpful in ICU's when patient monitoring can't be done every minute so the readings from sensors are displayed to the doctor. Similarly, for the elderly, health checkup can be done at home itself as doctor can monitor the patient by checking the sensors outputs and providing consultation on the phone.

1.5 Report Organization

In the first section, the overall project introduction is done. All the groundwork has been laid in which the basic elements of the project have been described such as the aims and objectives of the project as well as the motivation behind choosing this project for my final year.

The second section details the literature surveys that have been undertaken to provide basis for the project that is being done. Alternate and similar methods that already exist in the world are studied, documented and compared with the techniques being used in this project. Those are further checked for any gaps that may exist in their system and how they can be overcome by methods being implemented in this report.

Starting with the third section, the content is strictly technical. The basic framework and architecture of the methods that will be implemented in making the Smart Health Care System have been explained both by using text as well as with the help of Architectural diagrams and flow charts to show a step by step and organized view of the project.

We study this in greater depth in the fourth section where the methodology is further dissected and explained by determining and listing the function and non-functional requirements that are to be met in the creation of this report. Detailed software and hardware constraints as well as requirements to be met to achieve the appreciable engineering standards are further enlisted and understood in detail in the entailing sections.

The fifth section consists of the results and test cases that have been used to provide basis for the accuracy and correctness of the project as well as enlisting a brief summary based on the results that were obtained.

2. Literature Survey

2.1 Survey of the existing models

As specified in past area, the IoT takes essential put in e-Health and restorative care by utilizing distinctive detecting gadgets and remote sensor systems (WSNs). Much research on this point has been done, which can be further ordered what's more, specified. A. Engineering Computerizing outline procedure (ADM) in view of philosophy is introduced for savvy restoration framework in IoT. This design utilizes RFID, Wi-Fi, Bluetooth and link arrange with Ethernet and TCP/IP. A few elements of Artificial Insight are likewise connected to upgrade the self-learning strategy for recovery framework. Nonetheless, the restriction is this approach is that the records are entered physically while era of restoration system.

Jara et al have conferred a model for Remote watching supported IoT, integration of a number of different system like hospital system, services provider system, Context Management Framework, knowledge domain Systems and environment Integration Platform. Their design uses RFID, wireless personal devices, embedded systems. The explain an instance of k-Healthcare model Movital hardware with 6LoWPAN, HDP and, the foremost necessary, a unique protocol known as YOAPY. The planned system features great potentials, however it's unable to handle emergency things.

Jin et al have given a model/ framework to implement smart cities with the use of IoT. Their framework is made round the complete UIS (Urban data System), from structure to support networks and sensory level to Cloud based integration and knowledge management. The design primarily has three parts (Network- centrical IoT, Cloud-Centric IoT, and Data-Centric IoT), using different standards, protocols and devices. RFID, WSN, crowd sourcing, IPv6, TCP/IP design, QoS mechanism, Crossbow's iMote, IRIS, Crossbow's XMesh are used and prompted.

Boyi et al projected a semantic data model to store and obtain the IoT data. On top of that, they briefly explain a method known as UDA-IoT to acquire and manage the IoT data. This style will bolster the crisis restorative administrations. They make use of distinctive advancements moreover, instruments like RFID, GPS, XML, philosophy, NOSQL, EoR,

cEoR, call Support Systems and quiet net administrations. The model fails to elucidate in what capability of the knowledge that can be gathered and the way the model is secure.

Weihua et al analyse on the e-Health record storage standards, the way to access and show the info shared by organizations. They conjointly style the interface between the platform and medical establishment's w.r.t. network construction. The design uses HL7/XML, DICOM (Digital Imaging Communication-in), ADSL, WLAN, 3G, WCDMA, MASP, UMMP and UAAP standards and internet Services. Their planned model doesn't specify the potential to handle emergency things. Also, they didn't implement their model to check its correctness and accuracy.

2.2 Summary/Gaps identified in the survey

The above reported models are undoubtedly very useful but lack some part of efficiency at some level. My project model gives a simplified base to these works.

The most basic thing in these models was the lack of simplicity and usability, that is, these models are quite complex and a user needs to have a lot of knowledge of the device and the model. Also, the usage is not very easy for a layman to learn. My project model, on the other hand, is very simple to learn, understand and use, hence making it convenient for the end user. Also, the proposed models are very expensive and can be purchased by very less percentage of people in the world, whereas my model is quite inexpensive and can be afforded by a much larger group of people.
Further, these models take a lot of time and effort to develop while my model is very easy to build and to implement. It does not require a lot of space and time. Also, it is very user-friendly and the user can easily get acquainted to it. It works on similar lines as the other models and serves the same purpose and can have various dimensions and purposes in its utility.

The earlier discussed models are without doubt very helpful but at the same time lack some potency at some levels. My project model offers a simplified base to these works.

The most basic factor in all of these designs is the shortage of usability and simplicity, that is, these models are quite advanced and a user has to have plenty of information of the device and the model. Also, the usage isn't very straightforward for a layman to be told. My project model,

on the other hand, is extremely easy to be told, perceive and use, thus making it very convenient for the user. Also, the planned models are quite pricey and may be purchased by a very small share of individuals in the world, whereas my model is sort of cheap and may be afforded by a larger group of individuals.

Further, these models take plenty of your time and energy to develop whereas my model is extremely simple to make and to implement. It doesn't need plenty of space and time. Also, it's very easy and also the user can very easily get used to it. It works on similar lines to the different models and is able to serve an equivalent purpose and may have numerous dimensions and functions in its utility.

3. Overview of the Proposed System

3.1 Introduction

In the planned system, I have used the ARDUINO microcontroller and interfaced it with Pulse rate sensor, ECG sensor and Temperature sensor. In traditional models, the devices are expensive and can't be embedded with a user's mobile. Hence, I planned a wise health care observance in medical field. In this system, the patient heath care is monitored by the sensors. Here pulse rate sensor and ECG sensor sense the specified information and sends it to the microcontroller. Finally, this standing is distributed to a mobile device via Bluetooth and also the information will from there be uploaded to the web. m-Health and e-Health are providing large administrations remotely, like, opposing action and conclusion against disorder, hazard appraisal, checking tolerant welfare, instruction and treatment to patients. This is often the explanation e-Health and m-Health is by and enormous generally acknowledged within the general public. The developing of best in class devices and advancements within the field may be really advantageous for e-Health and m-Health. Distinctive e-Health and m-Health styles for IoT are created that are capable of handling crisis circumstances with efficiency fruitfully. However even therewith, these e-Health and m-Health structures do not utilize advanced cell sensors to observe and transmit crucial data known with the patients' welfare. I have planned a unique system for e-Health and m-Health that makes utilization of advanced cell sensors and body sensors to amass, prepare and transmit quiet welfare connected data to gather capability within the cloud. This data may be recovered by patients and different partners later. I have given a clear examination of various models that use IoT, which can be used as a part of managing health by means of e-Health and m-Health. The progressing work is focused on the real improvement and arrangement of m-Healthcare and e-Healthcare. One way could be the outline of a product or cell phone application which will get the information specifically from the sensors and process it naturally, or fetch stored information.

3.2 Architecture of the Proposed System

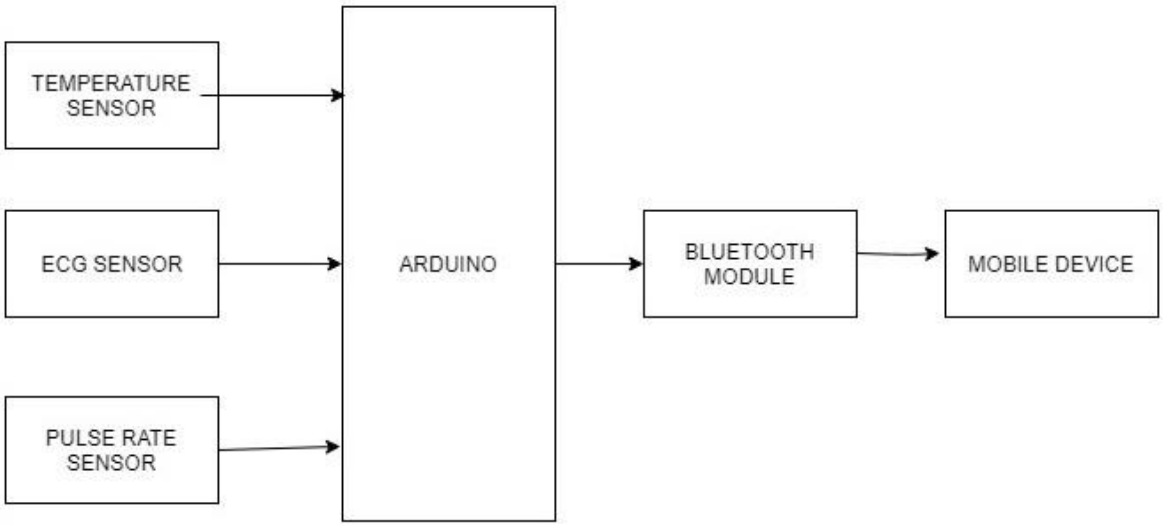

Figure 3.1 Patient Section

Figure 3.2 Monitoring Section

3.3 Proposed System Model

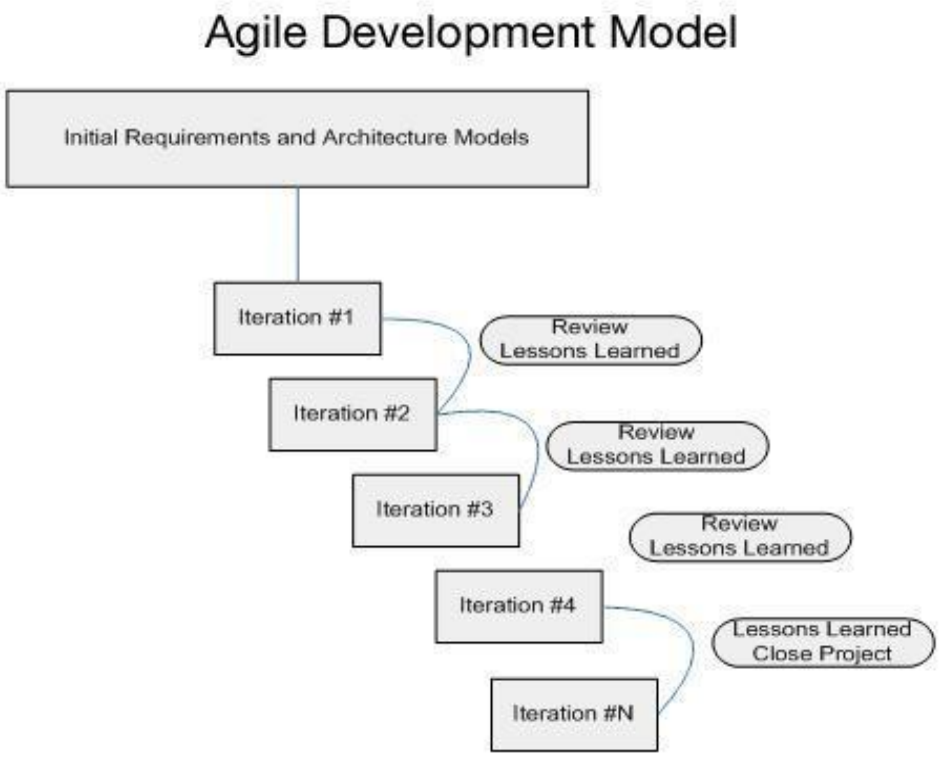

Figure 3.4 Agile Model

The software system model that's the simplest for the given project is the agile development model. Above shown is a basic diagram describing the steps concerned in implementing the agile development model.

In agile development model, the complete project is split into varied builds. Multiple development cycles happen here, creating the life cycle a "multi waterfall cycle". Cycles are cut out into smaller, additional simply managed modules. Every module passes through the requirement, design, implementation and testing phases. A working version of the model is created throughout the primary module, therefore you've got operating package timely throughout the package life cycle. Every future unleash of the module adds performance to the previous unleash. The method continues until the entire system is achieved. These steps are recurrent in a loop as long as a final refined version of the output that is to be expected is obtained.

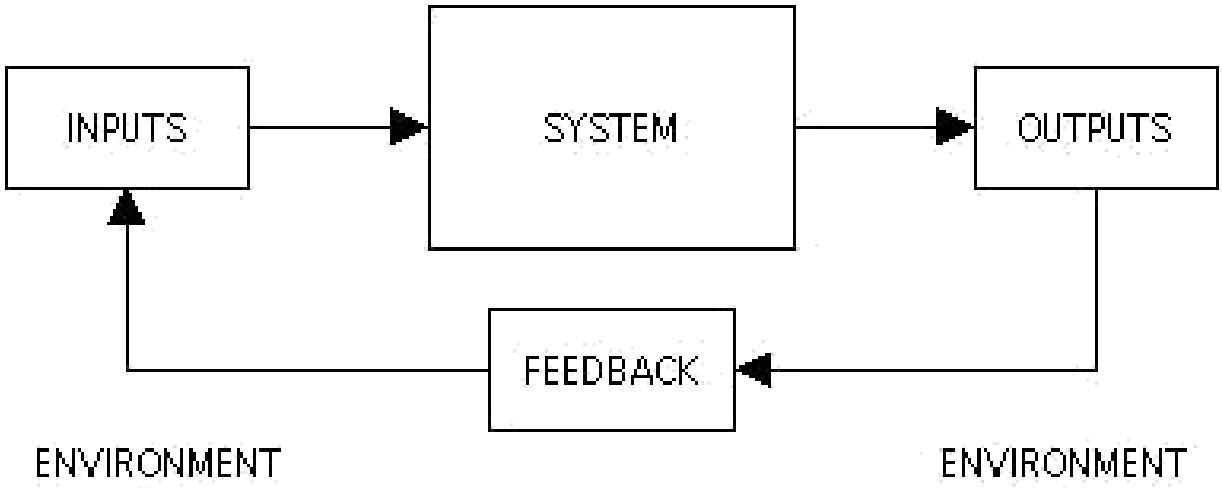

Figure 3.5 System Model

As the project is a real time monitoring system, this new output is fed back to the initial input system to relinquish a correct description of all the remaining free slots. This is never-ending cyclic method that is undertaken whenever a patient is monitored through the system.

4. Proposed System Analysis and Design

4.1 Introduction

REQUIREMENT ANALYSIS

HARDWARE

- Arduino Microcontroller and power supply
- ECG Sensor
- Temperature Sensor
- Pulse rate sensor
- Mobile device
- Bluetooth module
- Connecting wires

SOFTWARE:

- Sublime text IDE
- Arduino IDE

4.2 Requirement Analysis

4.2.1 Functional Requirements

Functional requirements could be calculations, technical details, data manipulation and processing and any other specific practicality that outlines what a system is meant to do. Activity needs describing all the cases wherever the system uses the useful needs are described in use cases. Functional requirements are complimented by nonfunctional requirements (also called quality requirements), that impose constraints on the design or implementation (such as performance needs, security, or reliability). Generally, functional requirements are expressed within the type "system should do ", whereas non-functional requirements define what "system shall be ". The plan for implementing functional requirements is elaborate within the system design. The arrange for implementing nonfunctional needs is elaborate within the system architecture.

The primary functional requirements of the smart healthcare monitoring system are listed below:

1. The system should be able to figure out whether the conditions are accurate for processing output.
2. The device must recognize all type of bodies.
3. The system should have an authorization system.
4. There must be a user interface which will be used to display the appropriate information to the user.
5. The system should be able to upload all data to the cloud server.

4.2.1.1. Product Perspective

The smart healthcare monitoring system could be a system for creating regular checkups and economical motion of many patients who feel it is troublesome to travel to the hospital. Initially, the sensors acquire data that outline the patient's health and may predict that immediate admit is needed or not.

The good thing about the system is that anyone within the world having access to the system will read the information and measures of the patients.

It additionally makes the operating of hospitals sensible as no frequent meetings of nurses and doctors is needed as all the continual and concurrent readings are shown continuously on the screen outside the ICU/ Patient space and in the doctor's office.

4.2.1.2. Product features

The below mentioned product features are expected in the Smart Health Care:

- Sensors calibration should permit it to sense changes considerably
- The data retrieved by the sensors should be noticeable and measurable.
- It should be attainable to send the data to devices and database placed on the web.

4.2.1.3. User characteristics

The following user characteristics are enforced within the creating of the Smart Health Care:

- The smart healthcare monitoring system should not be broken by external force.
- The system should be able to establish problems concerning the parts
- The system should report the problems back to the device.

4.2.1.4. Assumption & Dependencies

As is that the case with any software system, some dependencies and assumptions are set beforehand to convey a sensible understanding:

- Need good and proper condition sensors
- All the sensors should be in a pattern and shape to be attached to the patient's body.
- The bluetooth module should be in range with the server bluetooth Android mobile phone.
- More number of sensors and functionalities can be added.
- The server Android phone must have internet access.

4.2.1.5. Domain Requirements

- The system must be accessible for the data.
- The system must update the database whenever required.
- The system must be accessible from anywhere.

4.2.1.6. User Requirements

- Users are expected to have basic operational knowledge of a computer
- Users must know how to operate an Android phone.
- Users must have access to the Mobile Application

4.2.2. Non-Functional Requirements

In systems engineering and requirements engineering, a non-functional requirement could be a demand that specifies criteria that may be required to decide the operation of a system, instead of specific behaviors. They're different from functional requirements that outline particular behavior or functions. The arrange for implementing purposeful needs is elaborated within the system design. The arrange for implementing non-functional needs is elaborated within the system architecture, as they're typically architecturally significant needs.

Some non-functional requirements that are required for the Smart Healthcare system include:

1. The sensors and display should be updated in realtime.
2. The hardware that will be used for this project is Arduino Uno and sensors based on Health.
3. The softwares used for this project are Arduino and any text editing IDE.
4. The project will be developed on a Windows Operating System and Android Phone shall be used to display the readings, outputs and stored information.
5. The system should be light.
6. The system app should not require a lot of storage space.
7. The system should not use up a lot of CPU resources.
8. The system should be portable and should work across a number of devices.

4.2.2.1. Efficiency

- The system shall improve the accuracy of the patient health readings.
- The system shall be able to output emergency situations with a better UI design.
- The system shall be able to collect data efficiently.

4.2.2.2. Reliability

- The system shall be able to provide data online and locally
- The system shall be able to analyse data to a very high accuracy point
- The system shall be able to perform collection, storage, analysis efficiently

4.2.2.3. Portability

- The system is a virtual one and hence has no portability issues. It depends on the size of the computer device on which it is operating
- The mobile application can be installed on to any mobile phone running on Android OS.

4.2.2.4. Usability

- The system is user-friendly.
- The system can be run offline but cannot store information.
- The system can get the stored data easily.
- The system is accessible in any Android device having the application installed

4.2.2. Engineering Standard Requirements

ECONOMIC

- The trade-off is accuracy over cost
- The making of the smart healthcare monitoring system is not very expensive.

ENVIRONMENTAL

- The device poses no threat to the environment
- The device does not take-in nor release any harmful substance to the environment.

SOCIAL

- The device has a big social impact since it will keep the elderly people healthy and updated.
- People will be able to save time.

POLITICAL

- The device will help in political stability
- There will not be chaos during times of crisis since people will know beforehand their conditions.

ETHICAL

- It is an open source system that is available to everyone charging a nominal license fee

HEALTH & SAFETY

- Smart Health Care will not cause any health issues
- Smart Health Care is completely safe to use without causing any harm to the user.

SUSTAINABILITY

- The device is a one-time product
- The device will not be replaced since it will be properly calibrated and installed

- The device will only incur a one-time cost except in the case of anything breqaki

LEGALITY

- The device will transfer data to the online servers
- Smart Health Care designed in adherence to all the legal safeguards
- All software will be a standard license issue and not a pirated copy

INSPECTABILITY

- There is no need for inspection as there will be no change in the Smart Health Care as long as there is no change in the initial idea.
- One time installation effort after which software can be used effortlessly
- If by any chance the device gives wrong data, it will be inspected as soon as possible to not give wrong error into the database.

4.2.3. System Requirements

4.2.3.1. H/W Requirements

Temperature Sensor

The LM35 is an integrated circuit sensor that may be used to observe temperature by an associated electrical output proportional to the temperature (in ºC) We can observe temperature a lot more accurately than by employing a thermistor. The sensing element is sealed and free from oxidation etc. The LM35 produces a higher output voltage than thermocouples and should not need that the output voltage be amplified.

Figure 4.1 Temperature Sensor

ECG Sensor

The electrocardiogram sensor measures the electrical pulses generated during a heartbeat. To measure the classic PQRST wave, the sensor's the electrodes may be attached up to the skin of the user's forearms using disposable electrocardiogram patches. The sensing element is supported with a comprehensive user guide. Because the average heart cycle is often 0.7 to 0.8 seconds this sensing element is best used with an Easy Sense logger capable of fast logging like simple Sense VISION, QAdvanced, 3Link, 1Link. A logger that can capture solely 10-bit resolution (e.g. Q3+, Q5+ or Flash Logger) might not be able to record enough detail.

Figure 4.2 ECG Sensor

Pulse rate sensor

Pulse rate sensor is be a well-designed plug-and-play pulse rate detector specially designed for Arduino. It is often utilized by students, artists, athletes, makers, and game & mobile developers who simply wish to include live pulse information into their projects. The detector is held between the fingers and plugged into the Arduino microcontroller.

The Pulse Rate sensor may be plugged directly to the arduino, or connected to a bread board. The front of the detector is that the pretty side with the heart picture. This is the face ofd the sensior that is supposed to be in contact with the skin and read the pulse. On the front, you see a little spherical depression, that is where the LED shines through the rear, and there's conjointly a little square just below the LED. The square is an ambient light detector, precisely like the one employed in cellphones, tablets, and laptops, to regulate the screen brightness in several light conditions. The LED shines lightweight into the fingertip, or different capillary tissue, and detector reads the sunshine that bounces back. The rear of the detector is where the remainder of the elements area unit mounted.

Figure 4.3 Pulse Rate Sensor

Bluetooth module

HC-05 module is a simple to use Bluetooth SPP (Serial Port Protocol) module, build for clear wireless serial association setup. The HC-05 Bluetooth Module is employed in a Master or Slave configuration, creating it an excellent answer to wireless communication problems.This interface bluetooth module is completely qualified Bluetooth V2.0+EDR (Enhanced knowledge Rate) 3Mbps Modulation with complete a pair of.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Figure 4.4 Bluetooth module

Arduino UNO

Arduino Uno is, typically, a microcontroller board supported by the ATmega328P. it's fourteen digital input/output pins (of that 6 are used as PWM outputs), half-dozen analog inputs, a 16 MHz quartz, a USB association, an power jack, an ICSP header and a reset button. It contains everything required to support the microcontroller; just connect it to a laptop with a USB cable or power it with a AC-to-DC adapter or battery to urge started. You'll be able to tinker with your UNO without any concern. Worst case state of affairs you'll be able to replace the chip for a small price and begin once again.

"Uno" means one in Italian and was chosen to pronounce the release of Arduino code (IDE) one.0. The Uno board and version 1.0 of Arduino code (IDE) were the reference versions of Arduino, currently evolved to newer releases. The Uno board is that the 1st in a very series of USB Arduino boards, and therefore the reference model for the Arduino platform;

The Arduino Uno features a resettable polyfuse that protects your computer's USB ports from shortcircuits and overloading. Though most computers offer their own internal protection, the fuse provides an additional layer of protection. If greater than 500 mA is applied to the USB port, the fuse can mechanically break the affiliation till the shortcircuit or overload is removed.

Differences with other boards

The Uno is different from all previous versions of the boards in the sense that it does not use the FTDI USB-to-serial driver chip. Instead, it has the Atmega16U2 (Atmega8U2 up to version R2) incorporated as a USB-to-serial converter.

Power

The Arduino Uno board can be powered via a USB connection or through an external power supply. The power source is chosen automatically.

External (non-USB) power come either from an AC-to-DC adapter (wall-wart) or a battery. The adapter can be connected by inserting a 2.1mm center-positive plug into the board's power jack. Leads from the battery are inserted within the GND and Vin pin headers of the POWER connector.

The board will operate on an external supply from 6 - 20 volts. If furnished with less than 7V, however, the 5V pin may provide less than 5 volts and also the board might become unstable. If mistreatment over 12V, the transformer might overheat and cause damage to the board. The preferred vary is from seven to twelve volts.

The power pins are as follows:

- Vin. The input voltage to the Arduino board once it's getting power from an external power supply (as against 5 volts from the USB association or any other regulated power source). you'll be able to offer voltage through this pin, or, if activity voltage via the power jack, access it through this pin.
- 5V. This pin outputs a regulated 5V from the regulator on the board. The board will be furnished power either from the DC power jack (7 - 12V), the USB connective (5V), or the VIN pin of the board (7-12V). activity voltage via the 5V or three.3V pins bypasses the regulator, and might harm your board.
- 3V3. A 3.3-volt supply generated by the on-board regulator. Maximum current that can be drawn by the board is 50 mA.
- GND. Ground pins.
- IOREF. This pin provides the voltage reference for microcontroller to operate. A properly organized shield will scan the IOREF pin voltage and choose the

acceptable power supply or alter voltage translators on the outputs to figure with the 5V or 3.3V

Memory

The ATmega328 has 32 KB (with 0.5 KB used up by the bootloader). It also has additionally 2 KB of SRAM and 1 KB of EEPROM (that can be read and written using the EEPROM library).

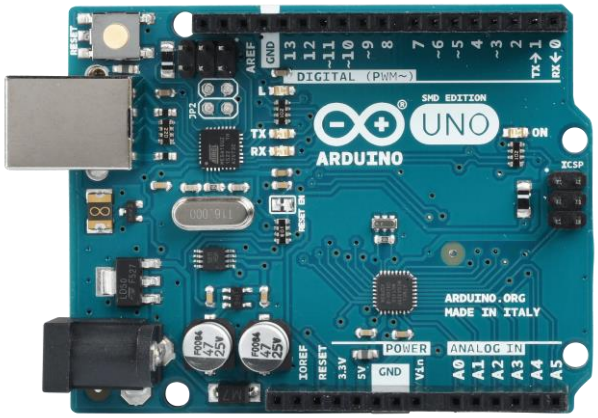

Figure 4.5 Arduino UNO microprocessor

4.2.3.2. S/W Requirements

1. Arduino IDE: The Arduino Uno is programmed using the Arduino (IDE). Choose "Arduino Uno" from the Tools > Board menu (based on the microcontroller that you have). The ATmega328 on the Arduino Uno is already programmed with a bootloader that enables you to transfer new code to it without using any external hardware compiler. It communicates using the original STK500 protocol.

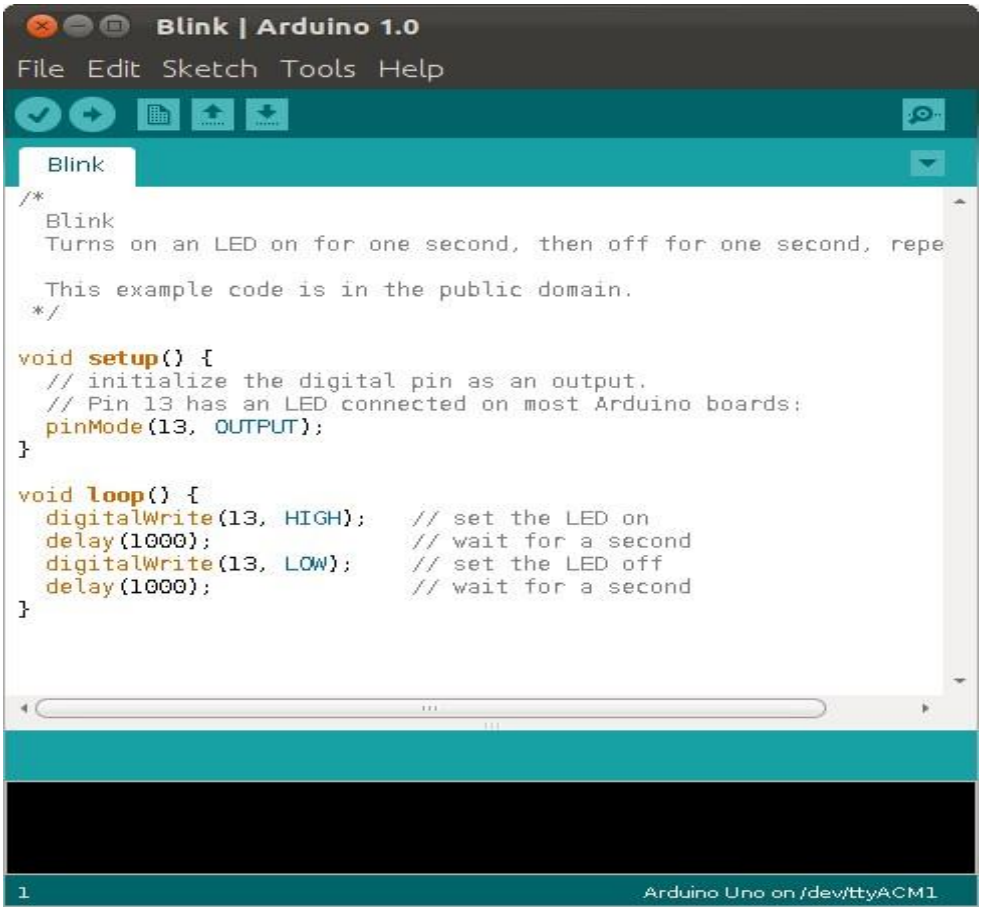

Figure 4.6 Arduino IDE

2. A text editor is required to build the APIs in the PHP to run on the application. Any IDE with PHP support works fine.

5. Result and Discussions

5.1 Test cases

Test Case 1 –

Test case Id: Product module	1	Test engineer: Testing date:	Mayank Jaggi
Product version		Testing cycle	
Revision history		status	Working
Purpose	To measure the temperature.		
Assumptions	The sensor is working fine and giving the correct temperature.		
Pre-conditions	External power to the microcontroller and correct connections.		
Steps to reproduce	Switch on the power.		
Expected results	Temperature is displayed on the mobile device.		
Actual outcome	Temperature is displayed on the mobile device.		
Post conditions			

Table 5.1

Test Case 2

Test case Id: Product module	2	Test engineer: Testing date:	Mayank Jaggi
Product version		Testing cycle	
Revision history		status	Working
Purpose	To measure the Pulse Rate.		
Assumptions	The sensor is working fine and giving the correct pulse rate.		
Pre-conditions	External power to the microcontroller and correct connections.		
Steps to reproduce	Switch on the power.		
Expected results	Pulse rate graph is displayed on the mobile device.		
Actual outcome	Pulse rate graph is displayed on the mobile device.		
Post conditions			

Table 5.2

Test Case 3

Test case Id: Product module	3	Test engineer: Testing date:	Mayank Jaggi
Product version		Testing cycle	
Revision history		status	Working
Purpose	To measure the ECG range.		
Assumptions	The sensor is working fine and giving the correct ECG.		
Pre-conditions	External power to the microcontroller and correct ECG.		
Steps to reproduce	Switch on the power.		
Expected results	ECG is displayed on the mobile device.		
Actual outcome	ECG is displayed on the mobile device.		
Post conditions			

Table 5.3

5.2 Summary of the Results

The embedded technology is the primary technology being used here, wireless being the main domain; to achieve what is required here, ARDUINO UNO is being used as the prime controller which utilizes the ATMEGA- 328 controller that is driven by 5V DC supply, the programming is performed using the ARDUINO IDE it is also dumped to the controller through the same IDE, , php is used as the coding language for building the APIs for the mobile application to run on. Arduino includes twelve digital pins, six analog pins, 1 5v, 3 ground pins and one serial pin. The digital pins may be used as the serial pins by making use of the serial communication in software, here three sensors are being used out of which the temperature sensor and pulse rate sensor is used as analog sensors and the ECG sensor is used as digital.

Each and every sensor consists of a 5v pin and ground pin which is given to the Arduino's 5v and ground pin, the input pin is given to the corresponding Arduino's input pin which is declared in the coding, since the temperature sensor must met the certain threshold so that the sensor is connected as the analog which is used to detect the patient's body temperature, the ECG sensor senses the cardio waves of the patient, and the mobile device is used for viewing the information. The Bluetooth and the mobile device are used to update the data on the cloud.

The Embedded Technology is currently in its prime and therefore the wealth of information out there is enormous. Embedded System is typically a combination of software and hardware. Embedded technology plays a serious role in integrating the varied functions related to it. This must hold up the varied sources of the system in closed loop system. This proposal greatly reduces manpower, saves time and operates expeditiously while not requiring any or very little human interference. This project puts forth the primary step in achieving the required target. With the advancement in technology, the present systems are developed to possess in engineered intelligence.

6. Conclusions Limitations and Scope for Future Work

An economically viable and efficient Smart Health Care system is engineered which has the capability to alter completely the Patient observation system being followed today and facilitate the globe in various ways. No need of regular checkups and visit to the hospital.

1. No requirement of the doctor visiting the Patient Ward or ICU. Patient's readings and health will be monitored through the data monitored on the screen of the mobile devices.
2. Remote Health Centers can be set up in villages and patients can be monitored and prescribed using video conferencing and Smart Health Care system.

The performance metrics for the project are the accuracy in the obtaining the sensor values and the time interval between the time of sending the command and receiving back the values on and from the Internet via IoT, i.e., 30 seconds.

I believe, that, in future, all hospital and clinical processes can be automated and man power and errors can be reduced to a great level. Time and energy can be saved to a large extent by exploiting new technologies like IoT. In near future, we will be able to have Smart Hospitals and Remote Health Centres that will be operated on the top end current technology with great accuracy and automation of tasks.

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