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SMART PATIENT'S HEALTH CARE SYSTEM

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1. INTRODUCTION

The fourth Industrial Revolution is ongoing automation of traditional manufacturing and industrial practices, using modern smart technology. Large-scale machine-to-machine communication(M2M) and the Internet of Things are integrated for increased automation, improved communication and self-monitoring, and production of smart machines that can analyze and diagnose issues without the need for human intervention.

Smart IOT based technologies can be employed for the efficient monitoring of a patient in the ICU. A smart IOT based ICU patient monitoring project is proposed for this purpose. The IOT connectivity and the digital controller are used to create a smart patient monitoring system. They system utilizes temperature, heart rates and blood pressure sensors to monitor the vital signs of a patient. Diastolic pressure, systolic pressure and heart rate can be measured using the blood pressure sensor. If any of these vital signs go beyond a certain limit, an alarm buzzer is turned in to notify the concerned personnel.

Cloud computing is on-demand access, via the internet, to computing resources—applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more—hosted at a remote data center managed by a cloud services provider (or CSP). The CSP makes these resources available for a monthly subscription fee or bills them according to usage.

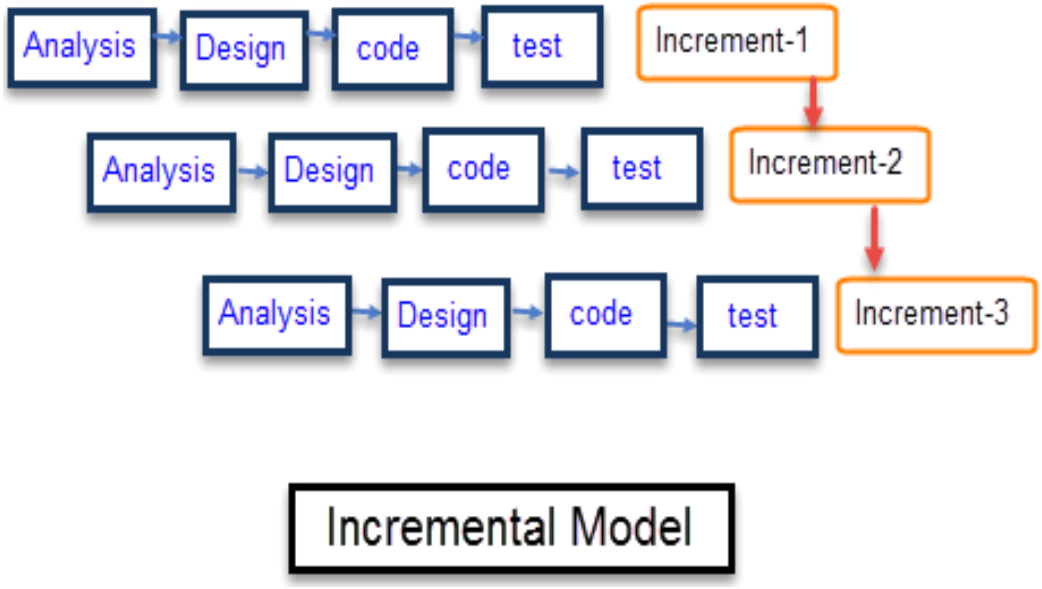
The objective of this paper is as follows:

- The main aim of Smart Patient's Health Care System is to give warning of early or dangerous deterioration.

2. METHODOLOGY OF PROJECT

Following are the steps:

1. Arduino is a brain of a system. It works or gives input/output instructions to respected hardware and software.
2. ECG stands for Electro Cardiography. It counts the heart beats of patient.
3. EMG stands for Electro MyoGraphy. It counts the muscle power of patient.
4. Cloud Computing with Google Firebase is the delivery of computing services including servers, storage, database, networking, software, analytics and intelligence over the internet.



Incremental Model

3. IMPLEMENTATION

3.1 Software Implementation

1. **Arduino with Embedded C: -** The Arduino programming language is based on a very simple hardware programming language called processing, which is similar to the C language. After the sketch is written in the Arduino IDE, it should be uploaded on the Arduino board for execution. ... The open-source Arduino IDE runs on Windows, Mac OS X, and Linux.

2. Cloud Computing with Google Firebase: - Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development.

3. Android Application with MIT Inventor 2.: - MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software(apps) for two operating systems (OS): Android, and iOS, which, as of 8 July 2019, is in final beta testing. It is free and open-source software released under dual licensing: a Creative Commons Attribution ShareAlike 3.0 Unported license, and an Apache License 2.0 for the source code

3.2 Hardware Implementation

1. **Arduino + ESP 8266 (ESP32):** - ESP32 is an open-source firmware for which open-source prototyping board designs are available. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson and SPIFFS.

2. **Power Supply: - It provides Supply to your system.**

3. **ECG (Electro Cardiography) Sensor**:- ECG electrodes are typically wet sensors, meaning that they require the use of a conductive gel to increase conductivity between skin and electrodes. How does an ECG sensor work?

   The electrodes are connected to an ECG machine by lead wires. The electrical activity of the heart is then measured, interpreted, and printed out. No electricity is sent into the body. Natural electrical impulses coordinate contractions of the different parts of the heart to keep blood flowing the way it should.

4. **EMG (Electro Myography) Sensor:**- Electromyography is a technique used to pick up signals produced by the nerves in target skeletal muscles. These signals are captured by electrodes and sensors and then converted into a digital signal by an encoder. This signal is then processed and displayed by a computer program.

   Measuring muscle activation via electric potential, referred to as electromyography (EMG), has traditionally been used for medical research and diagnosis of neuromuscular disorders. However, with the advent of ever shrinking yet more powerful microcontrollers and integrated circuits, EMG circuits and sensors have found their way into prosthetics, robotics and other control systems.

FEATURES: -

- NEW: - Wearable Design.
- NEW: - Single Supply (+3.1V to +5.9V).

Polarity reversal protection

- NEW Two Output Modes: -

EMG Envelope.

Raw EMG

- NEW - Expandable via Shields
- NEW - LED Indicators
- Specially Designed for Microcontrollers
- Adjustable Gain

APPLICATIONS: -

- Video games
- Robotics
- Medical Devices
- Wearable/Mobile Electronics

- Prosthetics/Orthotics

5. **Electro pad:**- Transcutaneous electrical nerve stimulation (TENS) is a method of pain relief involving the use of a mild electrical current. A TENS machine is a small, battery-operated device that has leads connected to sticky pads called electrodes. Credit: You attach the pads directly to your skin.

4. TESTING

4.1 Unit Testing:

This is a type of testing which is done by software developers in which the smallest testable module of an application - like functions, procedures or interfaces - are tested to ascertain if they are fit to use.

4.2 Integration Testing:

Integration testing is a type of testing meant to check the combinations of different units, their interactions, the way subsystems unite into one common system, and code compliance with the requirements

4.3 Validation Testing:

Validation testing is the process of ensuring if the tested and developed software satisfies the client /user needs. The business requirement logic or scenarios have to be tested in detail. All the critical functionalities of an application must be tested here.

4.4 System Testing:

System testing is defined as testing of a complete and fully integrated software product. This testing falls in black-box testing wherein knowledge of the inner design of the code is not a pre-requisite and is done by the testing team.

4.5 Test Result

Steps	Description	Expected Results	Actual Results	Status
Step1	Assembly of electronic equipments	Successfully assembled	Successfully assembled	PASS
Step2	Checking program compile or not	Compile successfully	Yes its compiled	PASS

Step3	Selection of Port number and Buderate	Select the Port number and Buderate	Selected	PASS
Step4	Uploading the program in ESP32	Program uploaded	Done uploading	PASS
Step4	Connecting to internet	Successfully connected	Connected	PASS
Step5	Read from Heardbeat sensor	Successfully read	Successfully read	PASS
Step6	Read from Muscle sensor	Successfully read	Successfully read	PASS
Step7	Displaying the reading of Heartbeat and Muscle Power on serial monitor	Successfully displayed	Successfully displayed	PASS
Step8	Uploading sensor value to cloud	Successfully uploading	Successfully uploading	PASS
Step9	Receiving sensor value on Android Application via Cloud Service	Successfully Receiving	Successfully Receiving	PASS
Step 10	Showing graph on android application according to sensor value received via cloud service	Successfully showing	Its showing	PASS
Step11	Giving alert according to limits	Alert successful	Alert successful	PASS

Patient's Data Displaying on Mobile App

Conclusion

This technology definitely stands out with perfection, when transfer of data is fast, feasible and more importantly reliable. So, in few years from now everything is going to fall under this super technology. Smart patient monitoring system enables clinicians to collect health data via vital sign sensors from patients at location A and electronically transfer this information to location B, where specialists access the data and give health care providers at location A recommendations for managing their patients.

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