A VARIANT SYSTEM FOR PATIENT MONITORING USING INTERNET OF THINGS

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***Abstract*-E-health services can take advantage of technological achievements and advancements, one such technology that is currently in the roll is the Internet of Things. This technique offers scope for monitoring data using the variety of aids, wearable sensors, mobile-applications, etc. Due to heterogeneity of connecting devices and vast human life patterns in the IoT environment, life logging personal information consists of huge uncertainty and hardly used for health care studies. It is for this reason A variant system is proposed where the foremost goal is to design and demonstrate an innovative web based remote health care diagnostic system.**

Keywords—3-channel ECG, Blood pressure, Pulse rate, Respiration rate, Body temperature, Body position

I. INTRODUCTION

One of the key challenges India is facing today is: *Rural versus Urban divide in Healthcare*. World Health Organization ranks India's healthcare system at 112 out of 190 countries. For those living in urban areas, high quality healthcare is readily available. But a staggering 70% of our population lives in rural India and don't get the same healthcare facilities as their urban counterpart. In contrast urban centers have specialist doctors and high quality clinics to provide quality healthcare. In this scenario, how the country should transform its healthcare system is the biggest question that needs to be answered. This project aims to design and demonstrate an innovative web based remote health monitoring system which provides vital medical data and live video images of a patient situated in rural area accessible to a health professional available elsewhere in urban centres resulting in better diagnosis and treatment of that patient.

Generally E-health services use data acquired by the home ambient sensors, wearable sensors, home automation devices, and medical devices to offer health related added value services and products. Research in this field has been on the way for more than a decade [1] now that it has given the ease to measure different physical body parameters like temperature, pressure, sound, humidity etc.

Also E-health oriented IoT based applications, thanks to the reduced development and production costs, that have the potentials to significantly expand the market of health monitoring systems.[2].In addition the ascending growth of wearable devices and mobile applications[4]-[8],It had become evidently possible for remote monitoring of a patient's health by connecting those diverse devices using IoT environment[9]-[11].Technically and operationally complex wearable devices and mobile applications [12]-[14] enable accounting of variety of life logging exclusive health datas, such as, physical activity, heart rate, blood pressure ,etc. Large number of research proposals [3]-[10] and commercial products have attempted to precisely monitor physical data and by using either dedicated wearable sensors [12]-[14]and by many advanced machine learning algorithms [4]-[7],But these investigations primarily depend on performance surge of various sensors or by combining GPS and accelerometers by studying raw sensor signals .In an IoT sustained med-care ecology, human sensing data can be independently analyzed using third party globalized devices.[15].

II. LITERATURE SURVEY

The Internet of Things (IoT) is a cumilative term for any of the large number of networks of sensors, actuators, processors, and computers that are linked with the Internet. Healthcare applications for the IoT can probably deliver all-inclusive patient care in various types, including acute, long-term, and

community-based .[16] The IoT is capable of precise tracking of people, equipments, samples, supplies, or even service animals and analyze the data collected. With patients linked to sensors for measurement of vital signals and other bio telemetric data, ailments could be diagnosed in a faster and better quality of care can be provided, and resources can be served more effectively. [17]

Remote health surveillance system with medical decision support system as a key component can advantageously fasten the pace of response of specialists for critical health emergencies of their patients. A monitoring system, solely designed for cardiac care with electrocardiogram (ECG) signal study as the core diagnostic technique, could play a important role in early detection of a broad range of cardiac diseases, from a plain arrhythmia to dangerous conditions like myocardial infarction. A system of this kind is supposed to have wide range of applications from tracking wellness/fitness to detection of symptoms leading to fatal cardiac ailments.[18]

For the study of new methods of telemedicine usage as emergency medical services, researchers need to synthesize integrated telemedicine systems. The research prototypes benefits by the usage of web technologies and common device interfaces, as the product development for a manufacturer and integration efforts for future research is made simple. Gripping to this approach of the development of new medical devices eases the difficulty in usage of off-the-shelf products for research trials investigating innovative use of telemedicine.[19]
For the last five years, a system *Table1* to manage and coordinate the pre-hospital health emergency has been in consistent use as the Emergency Coordination system has been carefully tested and is now in daily use. [20]

SNO	DESCRIPTION	PREVIOUSLY USED	PROPOSED MODULE
1	MICROCONTROLLER MEMORY	192 KB	256 KB
2	STORAGE	1MB	2MB
3	SECURITY	NOT SURE	CONVINSING
4	SENSOR SYSTEMS	SAPHOSTICATED	NON INVASIVE AND CONVINIENT
5	DATA LOG	ANALOG	DIGITAL
6	SMARTNESS	LOW(SCALABLITY)	CONSIDERABLY HIGH (ALGORITHIUMS)

Table 1.Performance comparison

III. EXPERIMENTAL DESIGN PROPOSED

Figure 1.experimental setup

Internet based Patient Monitoring and Diagnosis System aims to bring High Quality Healthcare in Rural Clinics that can Stream Live Video Feed along with Vital Health Sensor Data such as ECG, Blood Pressure, Pulse rate, Respiration, Body Temperature and Orientation
This project aims to design and demonstrate an innovative web based remote healthcare diagnostic system that provides vital medical data and live video images of a patient situated in rural area accessible to a health professional available elsewhere in urban centres resulting in better diagnosis and treatment of that patient. Various medical sensors are used to collect patient medical data and sent to the monitoring station for interpretation.

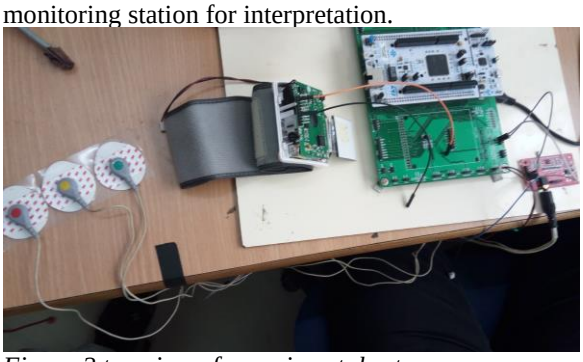


Figure 2 top view of experimental set up

The system does include an advanced camera sensor to provide live video images of the patient.

A. *Embedded Web Server*

The project uses an ARM Cortex-M4 based microcontroller that acts as a web server that sends data to the client side application. Any device with an Internet browser such as smartphone or PC/Laptop can be used to monitor the data feed. The client side user is authenticated with a unique user name and password before accessing streaming content. The web server is responsible for serving the web pages, servicing the client request and for maintaining the TCP/IP connection until the user ends the session. Web pages are constructed with HTML language. The device uses the LwIP open source TCP/IP protocol stack for its internet connectivity.

B. Medical Sensors

Figure 3 medical sensors

A 3-channel analog signal conditioning circuitry based on AD8232 is used to measure ECG signal. ECG represents the electrical activity of the heart and helps to diagnose various heart conditions. The circuitry is designed to extract, amplify, and filter the very small bio-potential signals generated from the heart. Three pins RA (Right Arm), LA (Left Arm), and RL (Right Leg) are used to attach the sensor leads to the patient body.

A digital blood pressure sensor is used to measure patient blood pressure. It consists of an inflatable cuff and an analog pressure sensor circuitry. Pulse rate is measured from the ECG signal. Respiration rate sensor calculates a patient's breathing rate by detecting changes in temperature when the patient breathes in and out. A 3-axis MEMS accelerometer sensor measures the body position and an analog temperature sensor measures body temperature.

C. Live Video Feed

Figure 4 camera sensor OV2640

This system consists of a camera sensor to stream a live video feed. When request is made the onboard microcontroller captures the JPEG images from the camera using the built-in DCMI peripheral and starts to stream it over the web in MJPEG compression format at an acceptable rate between. The image resolution is fixed at 470 x 272. The microcontroller has a large RAM memory area, about 256KB, which is a must for this kind of application.

D. *Security*

Before connecting with the system the user has to enter the login username and password which is a much needed security measure to prevent others from accessing the content. Once logged in, the user allowed accessing all the data including the video feed.

E. *Trust*

Information that is delivered from sensors may be correct, but might have been corrupted anywhere between origin or during transmission, or cautiously changed by malwares that gain unwanted access to the IoT through the Internet. Another form of trust relates to kind and composed care. Caring is about a relationship forged between the patient, their family and community, and nurses and other healthcare professionals. Compassionate care for the ill is an expectation for all healthcare providers, but compassion is based on trust.

F. *Embedded RTOS*

A real time operating system is necessary to handle the timely events and other multitasking requirements of the project. Here FreeRTOS is chosen to provide this ability. FreeRTOS is the number one real-time operating system in the world.

Microcontroller

A project of this sort needs a very capable microcontroller with large amount of RAM memory. Thus STM32F429 from STMicroelectronics is

chosen as the main MCU, which is one of the powerful microcontrollers currently available in the market. It is an ARM Cortex-M4 based microcontroller that can run upto 180 MHz. It has got 2MB of Flash memory and 256 KB RAM memory. More importantly it has got a DCMI (Digital Camera Interface) peripheral to interface with camera sensors.

SYSTEM FLOW DIAGRAM

As shown below the system consists of 2 portions, viz,

1. Embedded system
2. The internet of things

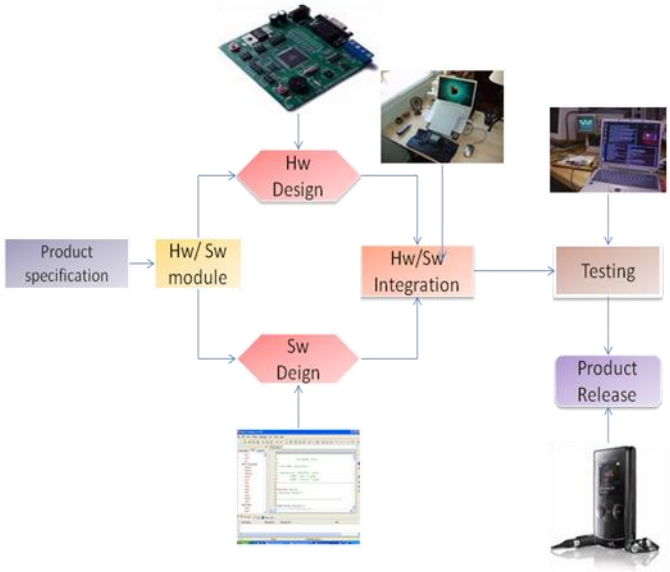


Figure 5 Above depicts the system flow required

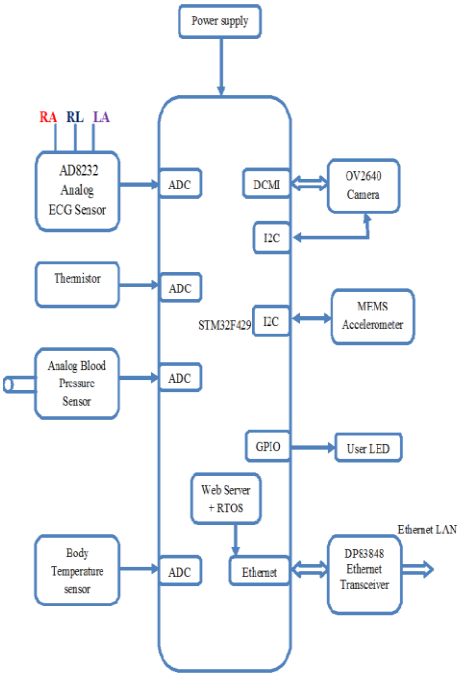


Figure 6 Embedded system module

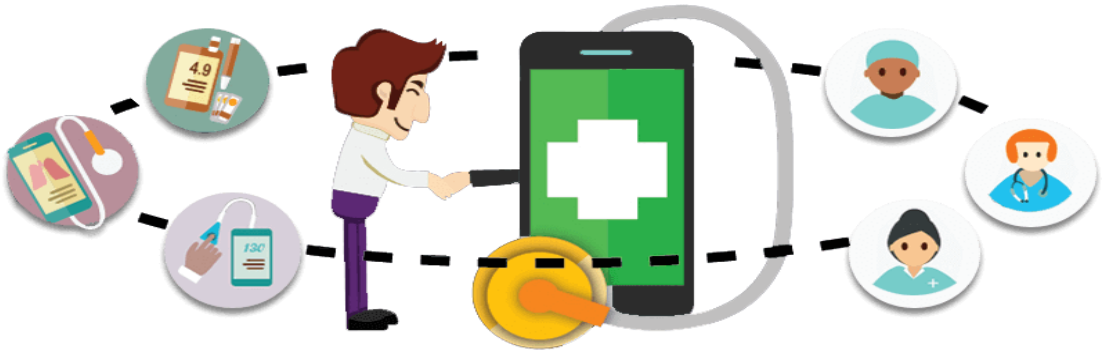
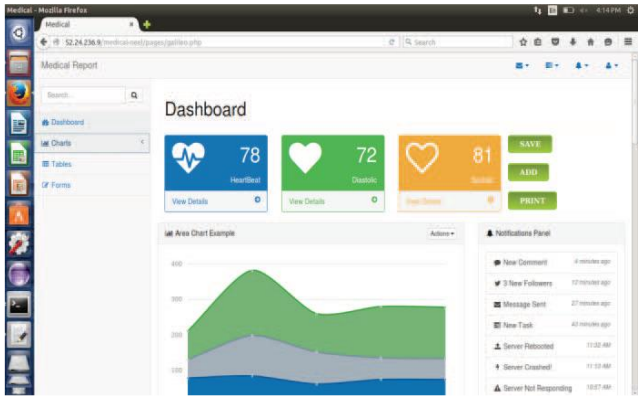


Figure 7 The internet of things replicate

IV. RESULTS AND INFERENCES

Figure below displays the web page which consists of three reading of Diastolic, Systolic and Pulse reading that is monitored. Also an alert button for alarming an emergency is provided.[21]



Also a website and an application has been created to surpass the logistical problems that are being witnessed in current systems where a protocol is not available for the clear and prolonged analysis of the patient details

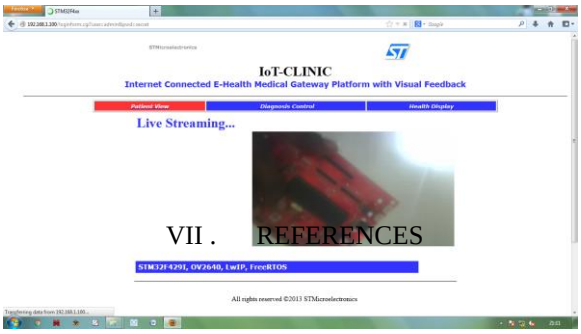
V. FUTURE SCOPE

As mentioned above the website designed can be used for marketing and improving the health care expectancies in our country. The ever-growing technological advancements in both the Embedded and VLSI field an lead to better utilization of power with high accuracy and efficiency imbibed in the system. Like usage of system of chip and cloud storage

VI. CONCLUTIONS

Remote and rural residents experience barriers to healthcare that limit their ability to get the care they need. Right medical consultation at the right time offered without delay is the difference between prosperity and poverty of a nation. This is a project designed to achieve this mission and is an effort to reduce the health disparities arising out of rural versus urban divide in our country.

Figure 8.The real-time output of our system



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