International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

CYBER PHYSICAL SYSTEM BASED HEALTH MONITORING SYSTEM

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Abstract - *Today the information technology has provided its great service to various fields including healthcare. Healthcare data is not only huge but also hard to handle and process. This healthcare data is created in a very small span of time at a rapid rate which can regarded as a big data problem. The healthcare data can be flexibly handled using health CPS, assisted by cloud. This system consists of data collection layer, data management layer and application service layer. Using cloud and big data we can enhance the performance of the healthcare data. This paper provides a solution to big data problem via health CPS.*

***Key Words*: Cyber physical system, EMR(Electronic medical record), UNO ATMEGA328, Heartbeat sensor and temperature sensor.**

1.INTRODUCTION

At present, information technology is considered a "strategic necessity" by world class organizations instead of just a supporting tool. Information technology (IT) is rapidly becoming integrated with healthcare to improve processes and communications, support decision making, reduce inaccuracies, and improve patient safety. The advancement of medical science through the years has made possible the use of more expensive equipment and the latest technology. This will allow healthcare providers and patients to gain access to health information easily and thus has the potential to improve the quality, safety, and efficiency of health care [1].

Electronic medical record (EMR) stores patient's medical information through IT to enable sharing across healthcare institutions. It can be made more secure through appropriate IT access and security safeguards. Electronic health records (EHRs), biomedical database, and public health have been enhanced not only on the availability and traceability but also on the liquidity of data [2].

Healthcare organizations are facing increased security threats by [3]:

• The adoption of digital patient records and the automation of clinical systems.

•The use of antiquated EMR and clinical applications that are not designed to securely operate in today's networked environment and software vendors who push that problem to the provider.

• The ease of distributing ePHI both internally (laptops, mobile devices, thumb drives) and externally (third parties, Cloud services).

• The heterogeneous nature of networked systems and applications (i.e. network-enabled respirator pumps on the same network as registration systems that can browse the Internet).

• The evolving threat landscape, where cyber-attacks today are more sophisticated and well-funded given the increased value of the compromised data on the black market.

According to researches, cyber-physical systems are the result of M2M (machine-to machine) application and modernization. M2M refers to the communications between computers, smart sensors, embedded processors, and other devices minimizing human participation. M2M systems have many important characteristics for modern cyber-physical systems [5].

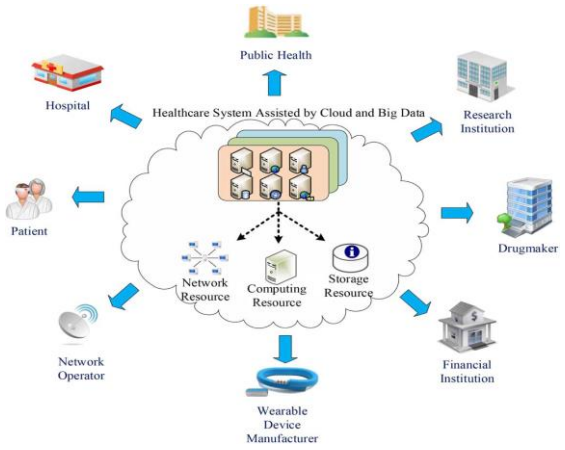

Fig.1. Illustration for the extended healthcare ecosystem [4].

2. SYSTEM ARCHITECTURE

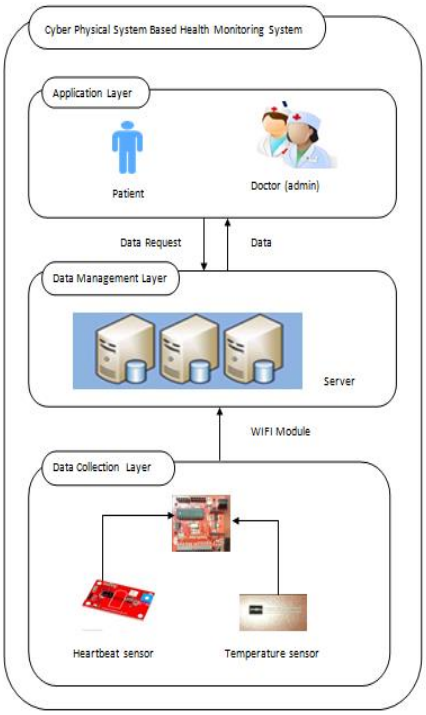

Fig.2Architecture of cyber physical system based health monitoring system.

Cyber Physical System Based Health Monitoring System mainly consists of three layers: Data collection layer, Data management layer, Application layer.

Data Collection Layer: In this layer data is collected from various data nodes, such as temperature sensor, heartbeat sensor etc. Collected data is then passed to the adapter where the noise in the data is removed and it is even converted to understandable format using AES (Advanced Encryption Standard) algorithm.

Data Management Layer: Encrypted data is then sent to the cloud via WIFI module. This layer consists of Distributed File Storage (DFS) which provide data storage.

Application Layer: In this layer decrypted data can be accessed by the patients and the doctors by successful authentication process. Doctors can even prescribe medication to the patients via the web pages.

3. DATA COLLECTION LAYER

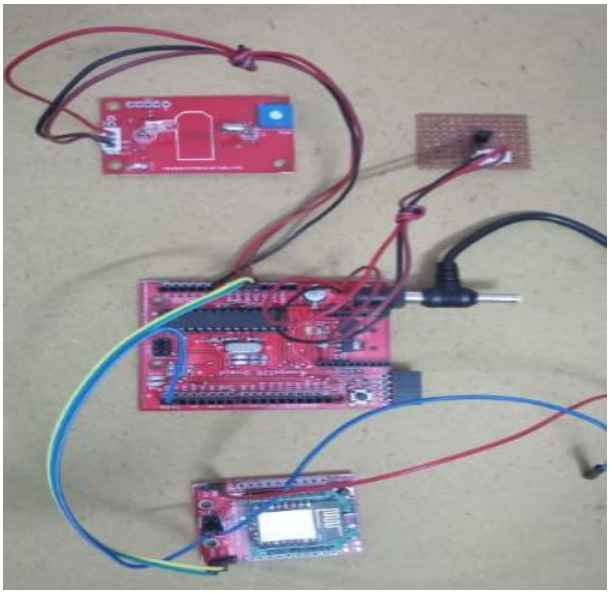

Fig.3.Connection of various sensors to the controller.

3.1 UNO ATMEGA328

We use UNO ATMEGA328 as a controller. This board also has inbuilt Xbee footprint with memory card interface in a single compact board without the need of doing external connections. The UNO Atmega 328 also includes 6 analog inputs, 14 digital I/O pins (6 amongst these could be used as PWM outputs), a crystal oscillator with 16MHz frequency, a 5 pin female connector to connect FT232 plugin, a power jack, a reset button and an ICSP header. to load the program we have given common interface through FT232 breakthrough board where we can connect to a computer and load the codes into the UNO Atmega 328.

3.2 HEARTBEAT SENSOR

The Heart Beat Sensor is designed to provide analog output of heart beat when a finger is placed on it. When the Heart detector starts working, the top most LED will starts flashing with every heart beat. The output of this sensor is connected to Micro Controller (UNO ATMEGA328) directly to measure the heart beat. It functions on the principle of light modulation by blood flow through the nerves of the finger at every pulse. The module output mode, analog output mode is simple

3.3 TEMPERATURE SENSOR

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 ^{o}C temperature rise in still air.

3.4 WIFI MODULE

We have used ESP8266 wifi module in our project. It is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors with minimal development up-front and minimal loading during runtime. In our project the data from the sensors are hosted to the server this Wifi module and it is connected to the arduino UNO.

3.5 AES ALGORITHM

In present day cryptography, AES is widely adopted and supported in both hardware and software. Till date, no practical cryptanalytic attacks against AES has been discovered. In this project for encrypting and decrypting the data we use AES algorithm. The data which is collected from the sensors are hosted to the cloud. Before the data gets stored in the cloud the data is encrypted via AES algorithm.

4. DATA MANAGEMENT LAYER

We are using cpanel server from Microsoft azure to implement the cloud. The data that is hosted will be stored here in the encypted format. cPanel is an online Linux-based web hosting control panel that provides a graphical interface and automation tools designed to simplify the process of hosting a web site. cPanel is designed to function either as a dedicated server or virtual private server.

5. APPLICATION LAYER

The patients can access their data and even doctors can view their patients details via respective webpages. When either a patient or a doctor wishes to view the required data he/she will request for the OTP which is used as a key for decryption, this OTP is sent to the registered mobile number through SMS LANE ,upon entering this OTP in the textbox the data is decrypted and can be viewed.

6. CONCLUSIONS

This paper has presented a smart health system assisted by cyber physical system, which includes 1) a data collection layer for the personal health devices, 2) a cloud-enabled platform for multisource heterogeneous healthcare data storage and analysis, and 3) a unified interface for the doctors and the patients. In future we can improvise this project by including even the public medical resources.

ACKNOWLEDGEMENT

This proposed project in the paper is funded by the project members under the curriculum of Visvesvaraya Technological University.We would like to thank our guide Ms.Swarna H.R, Lecturer, Dept.of Computer Science and Engineering, Srinivas School of Engineering for her constant support.

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