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Cloud based Smart Healthcare Management System Using Blue Eyes Technology

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***Abstract*— In today's modern world, health care management system is becoming as an emerging research area. In health care, still manual work take a lot of time to measure multiple parameters of a patient. Also, in recent days there is an extensive demand for skilled workers in the field of health care. To reduce the manual work, a solution is proposed to automate all the patient monitoring activities through Blue Eyes Technology. The main idea is to use the BET for the betterment in health care management system and to monitor a patient with the help of BET. It measures various parameters that include emotions, mood variations, blood pressure, heart rate, skin temperature, and electrocardiogram. The major steps involved are process of giving sensing capacity to a device, so that it can sense some basic metrics of a human being, then, human emotion detection involves the process of observing different emotions of a human which includes happiness, sadness, fear, anger, surprise and disgust and finally, respond appropriately and properly if any critical situation occur**

Keywords: Blue Eyes Technology, Health care management, IoT, Cloud

I. INTRODUCTION

In most of the countries, the patient monitoring is done manually by a nurse or a care taker who has to perform continuous measurement of patient parameters such as heart rate, blood pressure, temperature, ECG, etc [1-2]. Also, these work gets delayed if done manually. The Health care systems are facing various issues that includes lack of public health care knowledge, shortage of employees in the hospitals, extreme costs for advanced degrees, etc. Nowadays, more people need health care support [3-4].

In many hospitals, Health monitoring requires additional custom healthcare software and there prevails a doubtful reliability due to variations of accuracy [13]. Moreover, Real-Time Health Monitoring Equipment's deployment is highly dependent on an extensive wireless telecommunications framework, which may not be available or feasible in rural areas [5]. To surmount these issues, an automated patient monitoring system is proposed to provide an excellent care to the patients.

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II. LITERATURE REVIEW

With the advancements in various technologies, there is a notable increase in process automation. Some of the technologies that will be helpful for implementing automation in the field of heath care are as follows:

a) Blue Eyes Technology

International Business Machines conducted a research on Blue Eyes Technology at Almaden Research Center (ARC) in California since the year 1997. The technology provides user-friendly facilities. It enables a machine to understand a human being and react appropriately [12]. The system comprises of two important devices namely, the emotion mouse and the expression glass. It also includes AI speech recognitionto gather physiological data; MAGIC (Manual and Gaze Input Cascaded) for the selection of a target and reduce the cursor movement; SUITOR (Simple User Interest Tracker) for tracking a user's behaviour and an eye movement sensor to measure the eye movement [2]. The main feature of BET is to impart human power to a computer.

b) Internet of Things

Internet of Things – IoT is a platform through which data transfer is made reliable. IoT devices has the ability to generate a huge amount of data which can be then used by

Artificial Intelligence [8]. Using IoT the following benefits are achieved:

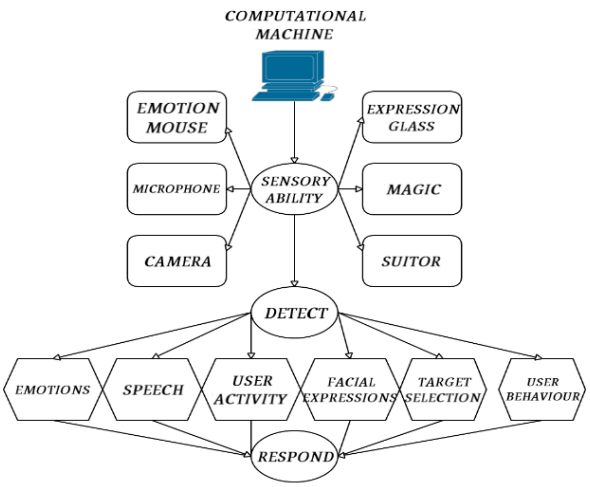

Fig 1. Basic architecture of Blue Eyes Technology

- Easier data transmission.
- Communication and control are simplified.
- Cost effective, saves time

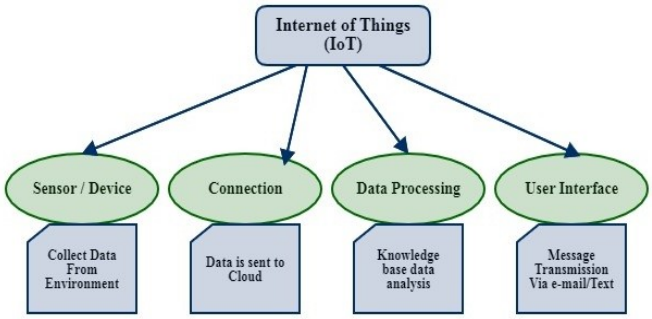

Fig 2. IoT Platform

c) Cloud Computing

In simple terms, cloud computing offers a variety of computing services, including servers, storage, databases, networking, software, analytics, and intelligence over the Internet [11]. In the health care industry, cloud computing enables better storage at a minimal cost, use of big data to enhance the patients' treatment, improved collaboration, effective data security and many other related benefits [9-10].

III. PROPOSED SYSTEM

On a complete analysis on the existing patient monitoring system, the following solution that involves implementation of BET in patient monitoring system is addressed. The proposed system observes a patient's heart rate, blood pressure, temperature, emotion level and ECG. The objective is to ensure 24/7 monitoring for patients and reduce manual work. Here, in this system, a specialized automated care can be implemented. The aim of Blue Eyes Technology is to give human power or abilities to a machine. IoT is an emerging interconnection technology that facilitates communication between devices. Here, the amalgamation of Blue Eyes Technology with Internet of Things creates a tremendous change by assuring best personalized care. The system comprises of three major units. They are:

1. Data Acquisition Unit (DAU)
2. Central System Unit (CSU)
3. The software unit.(SU)

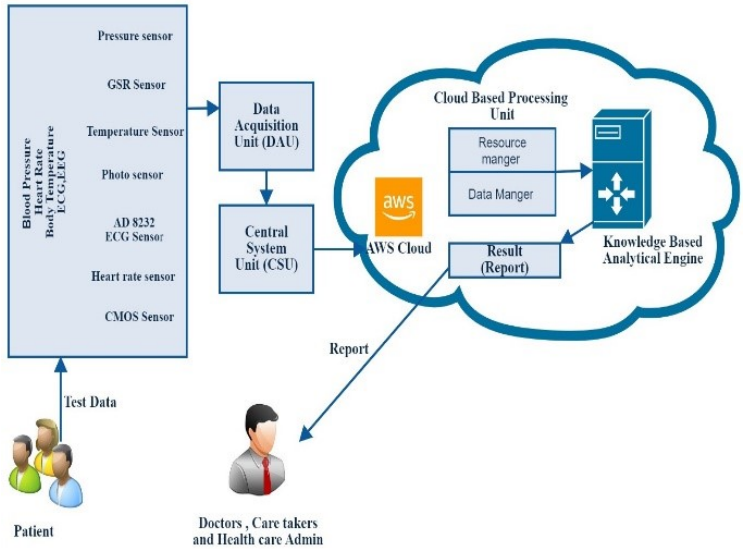

Fig 3. Overview of proposed system

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A. DAU – Used to gather physiological information and forward the gathered information to Central System Unit for data processing and verification purpose.

PIN - Personal Identification Number codes and Identity cards are generated to the entire operator's authentication purpose [4]. The Bluetooth module of DAU provides a wireless interface between the CSU and the operator.

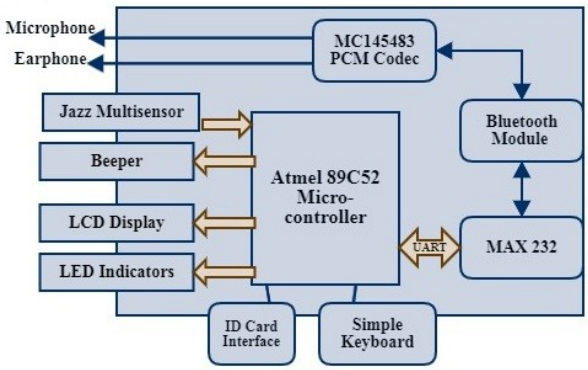

Fig 4. DAU Components

B. ***CSU*** – The main job of CSU is to process the data and react properly. The CSU mainly encompasses a codec and a wireless Bluetooth module [5].

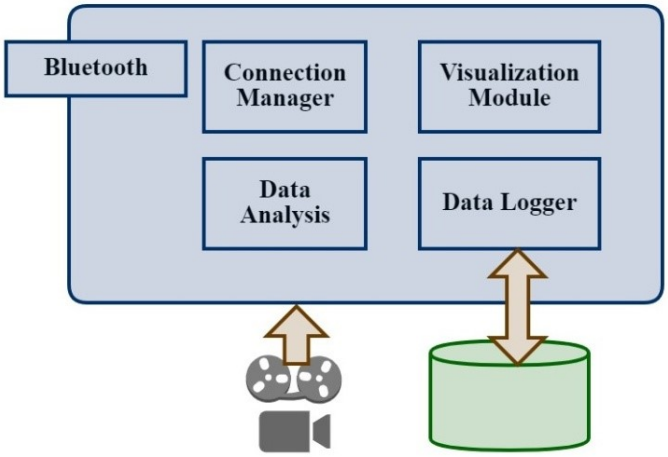

Fig 5. Central System Unit

C. Software Unit - The operator is constantly monitored by a software termed as Blue Eye Technology software. The software enables transfer of messages between the manager and the data analyzer. The software will respond in real time according to the operator's physiological changes. Here, the software acts as a supervisor.

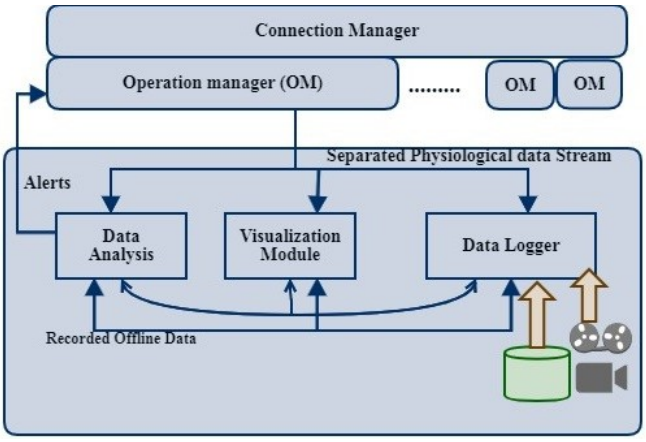

Fig 6. Software Analysis Diagram

IV. STEPS INVOLVED IN MONITORING A PATIENT

a. Process of giving sensing capacity.
b. Human Emotion detection
c. Respond appropriately and properly.

At the beginning, patient observation is done by the system using voice recognition software, high resolution cameras, biometric sensors which includes AD8232 ECG SENSOR and heart rate sensor.

In voice recognition software, an ADC translates the analog waves of the patient's voice into digital data by sampling the sound; high resolution cameras capture pictures and the incoming "picture" hits the image sensor chip, which splits it up into millions of pixels. The CMOS image sensor evaluates the brightness and colour of each pixel and records it as a unique number; AD8232 ECG Sensor measures the electrical movement of the heart by using electrodes placed on the skin and the heart rate sensor measures a patient's heart rate in Beats per Minute employing an optical LED light source and an LED light sensor.

The next step of human emotion level detection is done using the following device:

a) *Emotion mouse:*
Emotion Mouse is used as an input device to record the emotions of a patient or a user by a simple touch on it. The Emotion Mouse is designed to evaluate and identify the user's emotions such as surprise, fear, anger, happiness, sadness, disgust etc. when he/she is interacting with computer. The main objective of the Emotion Mouse is to gather information about the user's physiological as well as physical condition by a simple touch [6,7]. This gadget also calculates the blood pressure and body temperature of a person with the appropriate built-in sensors.

b) *New sensing methodology:*
Our system aims at creation of machines that have perceptual and sensing capabilities. It employs non-obtrusive method of sensing which measures physiological quantities to identify user activities [7]. Continuous monitoring of patient activities is enabled with the use of speech recognition and facial recognition software.
Facial recognition software monitors and diagnoses a patient's genetic, medical and behavioral conditions. Deepvision AI offers a wide range of AI-enabled facial recognition services. Visual face, offered by Deepvision, is one of the best-suited facial recognition software for patient monitoring. The biometric software extracts data from the captured digital images and measures characteristic facial features.

c) *Response generation:*
Once the emotion levels, heart rate, blood pressure and other such parameters are detected, the supervisor checks whether the measured parameters are within an appropriate range. If the measured values are within a given range, the system continues its job of monitoring, else it generates a response message, also called as alert message. These alert messages [8] are sent in the form of text notification through e-mail or SMS to the care taker as well as the doctor.

V. PROTOCOLS

Bluetooth:
Bluetooth is a standard IoT protocol for wireless data transmission and it supports short range communication [9]. In our system, bluetooth enables wireless communication among the units of BET.

Advanced Message Queueing Protocol (AMQP):
AMQP Provides point-to-point connection and supports seamless and secure exchange between connected devices and cloud. It helps the servers handle immediate requests in a fast and efficient manner [10].

Message Queue Telemetry Transport (MQTT):
MQTT collects data from various electronic devices and enables remote device monitoring. This protocol helps in transfer of information between the supervisor and the care taker as well as the doctor. It reduces data congestion [11].

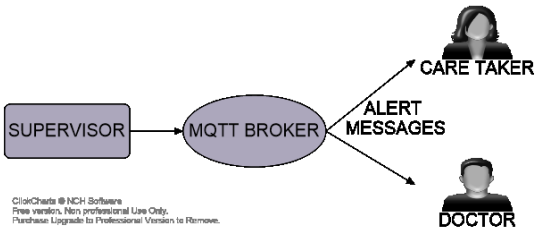

Fig 7. Working of MQTT Protocol

The above-mentioned protocols bring efficient information distribution among the system. The patient data gathered from the systems' remote devices like high resolution camera, emotion mouse, heart rate sensor, ECG Sensor and microphone is transferred to the supervisor with the ease of AMQP Protocol. At the next stage, the supervisor analyses the data and sends alert messages to the care taker and the doctor during critical conditions. These alert messages are sent using the MQTT Protocol.

VI. APIs USED

a) EmoVu

EmoVu API was produced by Eyeris. EmoVu facial detection API integrates machine learning and micro expression detection. EmoVu gathers information about the emotion of a patient by observing micro expressions using webcams. It offers wide platform assistance, including many tracking features, like head position, tilt, eye tracking, eye open/close, and more [12].

b) Nviso

NvisoAPI implements emotion recognition software to capture and analyze the emotional response and visual attention of the user. Nviso specializes in emotion video analytics, using 3D facial imaging technology to supervise many different facial data points to produce likelihoods for 7 main emotions [12].

VII. IMPLEMENTATION

The construction of the system in the hospital involves building up of isolated wards for each patient who gets admitted and seeks for an intensive supervision. The patient is surrounded by a 24/7 monitoring unit which encompasses, a high-resolution camera, which includes a CMOS Sensor[13] with high quantum efficiency – certainly important for constant observation of a patient, an emotion mouse to be kept in physical contact with the patient's hand which is used to obtain the emotion levels of the patient. The emotion mouse has a set of sensors which includes, a built-in pressure sensor – used to detect the blood pressure, a GSR sensor – measures the sweat gland activities, a temperature sensor – enables body temperature measurement and a photo sensor – confirms the absence or presence of an object. AD 8232 ECG Sensor is placed on the patient's body surface closer to heart for a regular measurement of heart rhythm [14]. Also, a heart rate sensor is strapped around the patient's chest to record the patient's heart rate in real-time. A microphone is used to enable patient's speech recognition [15].

a) Configuration of the sensors used:

Pressure sensor - Sensor Type: Load Cell, Accuracy: ±1%, Voltage – Supply: 5V, GSR Sensor – Sensor type: Temperature, pressure, Voltage – Supply: 2.5V ~ 5V, Temperature Sensor - Voltage supply: 4 to 30V, Typical operating voltage: 5V, Current drain: 60 µA, Accuracy: ±05˚C, Ranging temperature: −55˚ to +150˚C, Photo sensor – Wavelength: 1080nm, Output Type: Voltage, Working voltage :12-24VDC 24-240VAC (AC-DC power are applicable), AD 8232 ECG Sensor - Operating Voltage - 3.3V, Analog Output, Leads-Off Detection, 3.5mm Jack for Biomedical Pad Connection, Heart rate sensor - Operating Voltage: +5V or +3.3V, Current Consumption: 4Ma, CMOS Sensor - output 8/10-bit image data of various resolutions such as full frame, sub-sampling, zooming and windowing, 15 frames per second (up to 30 frames for 1080P images, 60 frames for 720P images, and 120 frames for QVGA resolution). PC Configuration: Intel core i7 processor, 16GB Ram, 240Gb SSD and Windows 10 Professional.

For activating the CMOS sensor present in the high-resolution camera, FPGAs are used [16]. All the above-mentioned sensors are programmed using JAVA, a programming language best-suited for healthcare applications. Speech recognition is done on a computer with the aid of ASR (automatic speech recognition) software programs. Many ASR programs request the user to "train" the ASR program to identify their voice so that it can more exactly convert the speech to text. The APIs involved with this system are EmoVu and Nviso. Emovu and Nviso APIs uses GPU capability for increased processing strength, returning nearly 20 unique metrics per user. In order to activate these APIs Node.js is installed on our machine and an Auth0 account is created.

Table 1 holds patient ID, gender, age, date and time of measurement of the parameters and a list of values including temperature, blood pressure, ECG, heart rate and emotion. Table 1 consists of three different set of readings per patient recorded at a time interval of 4 hours.

VIII. CONCLUSION

The paper projects that the proposed solution enhances the quality of health care services and reduces the human involvement in patient monitoring. Implementation of blue eyes technology in health care serves as a best solution for automated monitoring of patients in the health care industry. The proposed system will be able to take care and pamper a patient all by its own and will provide a great care to the patients. The day is very near, that this Blue Eyes Technology will advance the way towards health care.

Table 1. Patient Analysis Table

ID	Gender	Age	Date	Time	Temperature	Blood Pressure	ECG	Heart Rate	Emotion
1	Male	23	12/01/2020	9.00 A.M	97°F	117/77 mm Hg	Normal	72 bpm	Sadness
				1.00 P.M	97°F	120/79 mm Hg	Normal	78 bpm	Sadness
				5.00 P.M	99°F	120/81 mm Hg	Normal	81 bpm	Happiness
2	Female	63	12/01/2020	9.00 A.M	101°F	137/87 mm Hg	Normal	89 bpm	Fear
				1.00 P.M	99.5°F	139/88 mm Hg	Normal	92 bpm	Fear
				5.00 P.M	104°F	142/92 mm Hg	Abnormal	102 bpm	Fear
3	Male	65	12/01/2020	9.00 A.M	99.5 °F	82/77 mm Hg	Normal	80 bpm	Disgust
				1.00 P.M	99°F	89/70 mm Hg	Normal	78 bpm	Disgust
				5.00 P.M	97 °F	90/60 mm Hg	Normal	75 bpm	Anger

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