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Implementation of IOT based Student Healthcare Monitoring and Automation Booth Testing Centre in the School/University/College Zone

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Abstract - *In healthcare, the Internet of Things (IOT) plays a critical role in connecting patients and healthcare clinics for diagnosis, health monitoring, tracking, and updating medical information. During the current pandemic, IOT-based health monitoring solutions could be extremely beneficial to COVID-19 patients. Regular patient monitoring is a specialization of IOT in the healthcare system, which involves examining numerous parameters monitored and relayed by sensors attached to the patient's body. Many researchers introduced a variety of healthcare techniques ranging from diagnosis to treatment and prevention on an effective e-health monitoring system. In the existing techniques, accuracy was not improved, and time consumption was not reduced. The smart healthcare system for students has been developed in the current project using various diagnostic plans and the IOT medical system. The major purpose of this work is to create an IOT-based health care system that determines the severity of a student's sickness by forecasting possible disease using health metrics extracted and derived from medical equipment as well as other IOT devices. This proposed system has a lot of potential for analyzing health care data and helping students avoid dangerous health conditions.*

Key Words: Internet of Things, e-health monitoring system, Patient data, Raspberry-pi, RFID technology, cloud, Big-data Pre-processing.

1. INTRODUCTION

The Internet of Things (IoT) is becoming more popular in the medical field as a method of offering better health care in today's environment. The Internet of Things (IoT) is a critical player in healthcare, supporting physicians and hospitals as well as providing improved medical facilities to patients. The internet of things (IoT) is a network of networked devices, software, and sensors that enhances a system's capacity to collect and share data. The frequent monitoring of a patient by checking multiple parameters measured and sent by sensors connected to the patient's body is the speciality of IoT [5], [10], [20] in the healthcare system. Despite the fact that many gadgets with sensors can be found in hospitals in traditional medical systems. In areas where the virus has spread, it is always preferable to keep track of these individuals through remote health monitoring [12]. The Internet of Things (IoT) is a new ecosystem in which every connected node connects with other nodes in the network to send vital data for accurate and timely decision-making. The Internet of Things is a highly efficient ecosystem in critical scenarios such as medical applications [4], [25], [26].The internet has become an integral component of our daily lives [24].

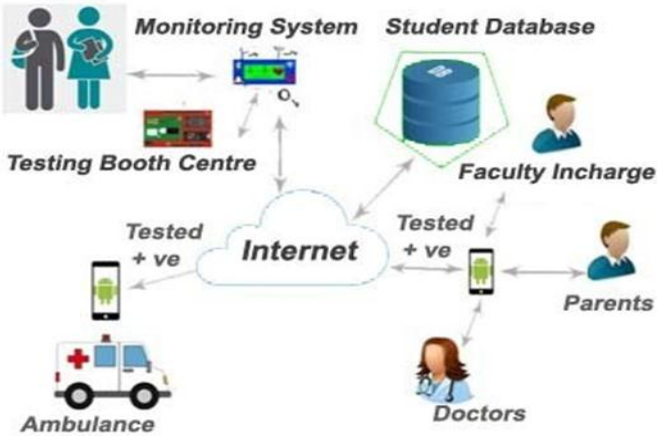

Fig. 1. Process Involved in the Proposed System

The Internet of Things (IoT) is a network that connects all things that are considered new technology [2], [6], [8]. With the support of new technologies, the healthcare sector has enhanced its performance. Health problems such as heart failure, lung failure, and cardiovascular disorders are on the rise. From time to time, the health monitoring system is required. Without any direct interaction, a doctor kept track of the patient's health [27]. With the use of technology such as wearable gadgets, wireless channels, and extra distant equipment, health specialists developed healthcare monitoring systems for a variety of disorders.

Health is always a major concern as the human race progresses in terms of technology. The recent Corona virus outbreak, which has harmed China's economy in some ways, is an example of how health care has become more

important. In areas where the pandemic is widespread, it is always preferable to monitor these individuals using remote health monitoring equipment [1], [17], [21]. The COVID-19 pandemic [11], [13] is currently one of the world's most serious health threats. The total number of persons confirmed to have been infected with SARS-COV-2 as of November 19, 2020 is over 56.4 million, with over 1.35 million deaths from the coronavirus, suggesting that COVID-19 infections are on the rise globally [15].The system's primary goal is to predict the seriousness of a student's condition using health data from medical equipment and other IoT devices to detect probable illnesses.

2. EXISTING SYSTEM

In the traditional method, healthcare practitioners play a crucial role. To acquire the necessary diagnostic and advice, go to the patient's ward. There are two major problems with this strategy. First and foremost, healthcare professionals must remain on the patient's side at all times. Second, the patient is admitted to a hospital and is monitored by bedside biomedical instruments for an extended period of time.

3. PROPOSED SYSTEM

The goal of this system is to automate a contactless student testing booth in real time. Raspberry Pi, RFID technology, Cloud, and Big-Data Pre-processing are all used in this project. It is used to verify student information such as name, Aadhaar scan, and mobile number. Specific information that allows the system to separate the test subject from the rest of the user while also making the process quick and error-free. When the Raspberry-pi gets data from the RFID reader, the person's information, as well as the details of the sample collection and test results, are transmitted via SMS to their designated caretaker mobile number. As a result, the Omicron booth testing procedure has been totally automated, refining this process in a safe and error-free manner, allowing us to tackle the pandemic.

3.1Hardware Components

- Raspberry-pi: The Raspberry Pi 4 Model B is the latest addition to the Raspberry Pi series of computers. It outperforms the previous Raspberry Pi 3 model B+ in terms of speed, multimedia capabilities, memory, and connectivity. It has a low power consumption and is compatible with other devices. This new model provides users with desktop performance that is comparable to that of an entry-level x86 PC machine. It also features a high- performance 64-bit quad-core processor with dual display support up to 4K through micro-HDMI ports and 8GB RAM, as well as wireless LAB (2.4/5.0 GHz), Bluetooth 5.0, Gigabyte Ethernet, USB 3.0, and POE capability. The dual-band wireless LAN and Bluetooth compliance certification on the board is modular, allowing it to be incorporated into end products with much reduced compliance testing, cutting costs and shortening time to market. It works like a little computer that may be utilized in a variety of settings to do a variety of tasks [9].

- RFID Tags and RFID Reader: RFID is an abbreviation for radio frequency identification, and it refers to digital data stored in smart tags and acquired by radio waves by a reader. An RFID tag is made up of two pieces. 1. Antenna for data transmission, 2.An integrated circuit (IC) chip used to store data on the tag. RFID tags are applied to retail store items so that the reader can track them. RFID tags receive energy from an antenna, which activates the chip and sends a signal back to the antenna. Depending on the memory bank selected, each chip has memory banks that hold information about the tagged item or the tag itself.

- Wi-Fi ESP8266 module: Espressif invented the ESP8266 Wi-Fi enabled system on chip (SoC) module. It's most commonly used to create integrated Internet of Things (IoT) apps. It is powered by a Tensilica Xtensa L106 32-bit RISC CPU and runs at 80 MHz. The system has 64KB of startup memory, 64KB of command memory, and 96KB of data random-access memory. External flash drives may be accessed via SPI. This Wi-Fi module is a low-cost wireless transceiver that's perfect for Internet of Things (IoT) end-point applications. The microcontroller should use a series of AT instructions to communicate with the ESP8266 (Wi-Fi module). A UART with a fixed Baud rate connects the ESP8266-01 device to the microcontroller.

- GSM modem (SIM900A):SIM900A GSM Module is the tiniest and most affordable GPRS/GSM module on the market. In most embedded applications, Arduino and microcontroller are used. The module communicates with a mobile sim card through GPRS/GSM technology. It uses the 900 and 1800 MHz frequency bands to allow users to make and receive phone calls as well as send and receive SMS messages. Developers can create customized applications using the keypad and display interface. In addition, it has two modes: command mode and data mode. GPRS/GSM and various protocols/frequencies are used in each country. Developers can use command mode to change the default settings to meet their needs.

- Power supply: Low-current power supply, such as 5V at 1A, can be used with the Raspberry Pi. Excessive usage of USB ports, as well as intense CPU/GPU loads, might result in voltage drops and instability while in operation. A "low power indication icon" is included in the newest versions of the Raspberry Pi B+/A+/2 to notify the user if there is a power issue.

3.2 Block Diagram

In this Block Diagram, the Raspberry Pi receives sensory data from the SPO2 sensor for measuring the pulse rate, the temperature sensor for measuring blood pressure, and the Booth testing known as SWAB testing, which aids in the identification of COVID-19. This information is updated in a cloud database based on RFID tags that contain student information and is displayed on an LCD display. Finally, it will send a text message to the student caretaker's phone as well as the health care clinic.

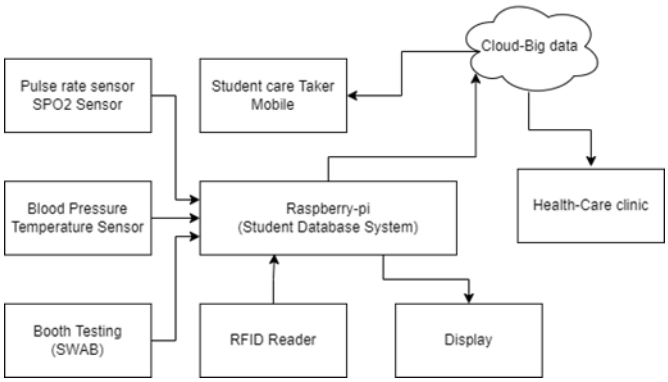

Fig. 2. Block Diagram for proposed methodology

3.3 Student Data pre-processing

Fig. 3. Data Processing and Event Classification [7]

This part receives two kinds of data: - Sensory data Personal information When recording the decisions of the different events of the sensors, it is important to remove the data is important and retrieve lost data and analysis for better results, and the importance of this part in reducing the dispersion of sensor receivers can also be used personal information of the student for more necessary actions. Consider the above aspects that are placed in the personal information required for the student [7].

4. WORKING METHODOLOGY

The proposed design can be implemented with the following as we don't require for additional registration; the system uses RFID technique which provides all necessary the information about the student. The health monitoring system records the measurements such as temperature readings, heart beat rate, oxygen levels. The IOT integrated system is used for communication between the two ends. The ends are connected to the health centre. The health centre takes the responsibility of medical treatment to the student if the student is found to be suffered or affected with the disease spread. Thus, the student health can be easily monitored with the help of proposed system.

IoT-based student healthcare monitoring and testing model is described as follows. To perform the automatic student healthcare management, the testing model consists of three subsystems namely

1. Student Database System,
2. Health Monitoring System and
3. IOT device.

4.1 Student Database System

The details of the student along with their personal data are collected and stored in the school and college database. Several databases are collected from various schools and colleges and made them as the centralized student database.

In the database, the details such as name of the student, date of birth, blood group, aadhaar number, mobile number, parents and caretaker number, address, medical history are stored for reference.

The centralized student databases are connected to the primary, state and central health care departments. The health care departments can able to monitor their health on daily basis. If any health related problems occurs for the student's, the health care workers visit the schools or colleges and take necessary steps to treat the student.

Thus, by maintaining the database the student health can be taken care with utmost priority. This database unit works along with the health monitoring system thereby making the measurement of temperature readings, pulse rate, heart beat rate and oxygen saturation levels etc., These data's are stored in the RFID tags and provided to each and every student.

4.2 Health Monitoring System

The health monitoring system comprises of IR temperature sensor, ECG Sensors, spo2 sensors. The IR Temperature sensor senses the temperature of each and every student while enter- ing the classroom. The health monitoring system checks for the normal range of body temperature which ranges between 97°F (36.1°C) and 99°F (37.2°C).

If the body temperature shows above the normal range, the system predicts the student is suffering from fever and asks to carry the medical test. This information is also provided to parents, caretaker, school or college authorities and healthcare workers. ECG Sensors is used to record the heart beat readings of the student.

This ECG sensor will be come into act when the student shows any signs of unhealthy condition. Next with the help of oximeters, the oxygen saturation level and pulse rate of the student can be identified. These data's are recorded and stored on daily basis. If any of the measured data shows the value beyond the normal range, the particular student should have to undergo medical test. These datasets are provided to the IoT system. The IoT systems are interconnected with various units to communicate with other devices [14], [18].

4.3 IOT Interconnected System

The IOT system [16], [23] consists of Raspberry-pi, GSM, attendance recorder, LCD Display, Buzzer unit, Wi-Fi module. The Raspberry-pi is the heart of the system which serves as micro-controller device. The instructions are fed to the raspberry-pi controller based on the command instructions, the microcontroller acts upon. GSM is used to send/receive SMS connect to internet with the help of GPRS and receive phone calls.

The modem may be linked directly to a PC serial port or to any microcontroller. For GSM we prefer SIM 300 modem. The attendance recorder is connected to the Raspberry-pi which monitors the attendance of the student at the entrance itself. For attendance system, we use RFID readers to read the RFID tags which are provided to the student's as ID cards. This RFID tags carry all the necessary information about the student.

LCD module displays the student temperature range, pulse rate, oxygen levels in the screen. Here we use 20x2 LCD display. Buzzer unit is used to provide alarm if there is any deviations in the normal range values. Wi-Fi module is used to connect the IOT interconnected devices to provide network communication [19]. The preferred Wi-Fi module is ESP8266 device.

With the help of networking unit, the student health monitoring [3] data can be shared with primary health care centers to monitor the student health [22]. Thus, the proposed system can be implemented in every schools and colleges to secure the student health and ensure the healthy environment in the school and college premises.

5. RESULTS

Student information is tracked using RFID technology. The data collected up to that point is promptly uploaded to the lab through the IOT Wi-Fi module before the next person arrives. The technician can monitor the number of samples examined in real time and use the Wi-Fi module to send sample test results to the IOT server. The system sends an SMS to the associated person along with the test result for each sample via GSM modem.

Fig. 4. Scanning student RFID.

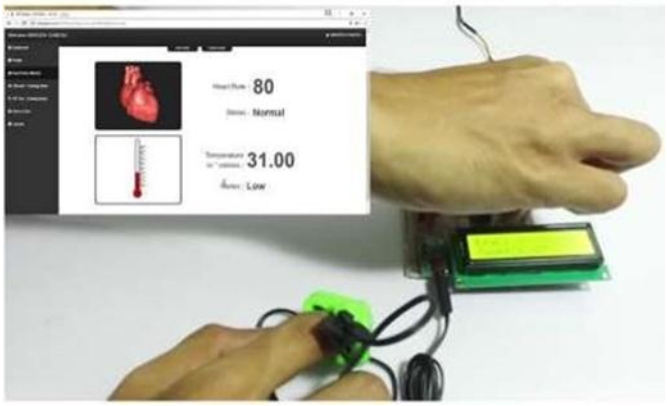

Fig. 5. Student health monitoring System.

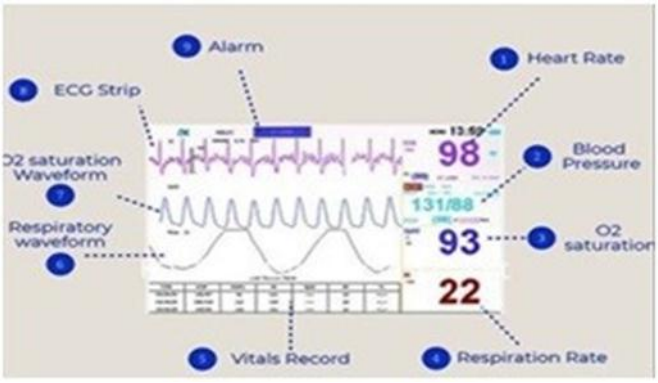

Fig. 6. Student health measurement record

Fig. 7. Student Health data collection

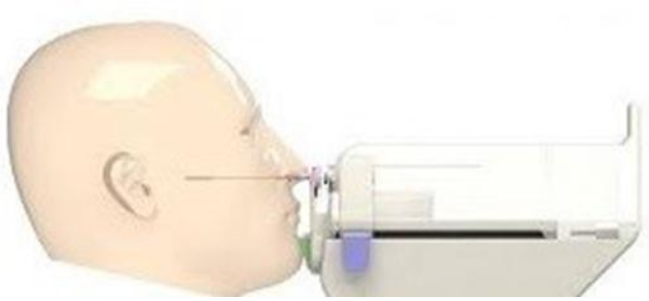

Fig. 8. Design of Automatic Swab Testing Unit

6. APPLICATIONS

The following are the list of applications that can be performed by using the proposed technique:

- Easy maintenance of student database.
- Fast access of health details report
- Automatic attendance system
- Contactless testing and instant reporting
- Avoids crowding
- Ensures safety of student community
- Provision for continuing offline education

7. CONCLUSION

The proposed system "Implementation of IOT based Student Healthcare Monitoring and Automation Booth Testing Centre" can be design for a completely automated instant contactless student health monitoring system. The student data can be collected and monitored on daily basis. The monitored details can be provided to the health care centers. With the help of IOT, an integrated system can be developed to maintain the student health details collected from the schools and colleges. This proposed system ensures the safety of the student's from being contact with the spread of the disease. In case of any affected student, the authority can inform the parents and healthcare officials, so that the affected one can be treated medically. The system in advance avoids the spread of disease further among the healthy ones. The proposed system found to be fruitful when the universities, colleges and schools adopted this technique in monitoring their student's health. Thus the healthy education can be ensured to the student community in the near future.

The proposed model incorporates all of the hardware components that have been utilized in IoT technology and built using the Raspberry Pi. Thus the system "IOT based Student Healthcare Testing Centre" can be implemented in every school, colleges and universities to ensure the safeguard of student community. The designed model enhanced the accuracy for identifying the student condition. With the incorporation of IOT systems, the student healthcare monitoring system can be transformed to proactive and preventive framework.

8. FUTURE SCOPE

The current system is dependent on the sensors attached to the body as well as the ambient conditions in which the system sensors are present. It is a contact-free health monitoring system that requires the patient to be present a few metres away from the sensors. Using smart healthcare technologies, this model checked the student's signs and identified biological and behavioural changes. The developed model improved the accuracy of determining a student's condition. In the future, e- healthcare monitoring systems can be carried out with greater accuracy and in less time by utilizing machine learning and deep learning techniques.

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