# Healthcare Monitoring Based on Cloud Computing: Case Study (Corona Virus)

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## ABSTRACT

COVID-19 (Corona Virus) is a very transmissible infection that has the world's attention lastly. This virus can be transmitted from any patient to other people by direct contact,it could be spread if the person sneezes or coughs. It is also spread by touching a surface that contains a virus.In this paper, the intelligent healthcare system is proposed, that integrates cloud computing technologies. Its architecture utilizes smart sensors, microcontrollers, C ++ and the Php programming languages to program the Arduino and cluad. The temperature sensor, with an accuracy of 0.5 degrees, and the sound sensor are used in this paper. These sensors will send the data of the patient to the SQL database and cloud after encryption it by RSA algorithm. Finally the data transport to the monitor and the doctor or nurse can monitor the patients from web browser from any device such as smart phones, ipads, or PC computers from any place remotely without touching the patients. This architecture can reduce the transmission of infections by touch, in addition to monitoring all cases in a hospital without potential. The system tracks the state of patients and delivers timely, reliable, and high quality healthcare with minimum cost. The presented architecture will be useful in diagnosis research and healthcare systems.The computing cloud is necessary for highly challenging architectures like intelligent healthcare. The concept of intelligent architecture healthcare systems was to provide patient surveillance at all times, in addition to real time connectivity. In addition, the sensors are required for this architecture to be applied to any patient afflicted with any disease. Therefore, by adding the sensors are required.



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## 1. INTRODUCTION

The World Health Organization's report World Aging & Health Survey 2015, the global population among those aged 60 and up more will grow 900 million people in 2015 to around 2 billion in 2050 years. This substantial growth in number of aged individuals. in addition to increasing patient reliance, chronic illnesses, and disability [1,2,3,] the huge financial restrictions that the economies of the countries involved would face as hospital spending grows.

Given the significant rise in the no. of elderly human who ache from the chronic diseases plus frequently require hospitalization, besides the quick spread of the new corona virus (COVID-19), we consider governments should adopt home hospitalization to limit the spread of a new corona virus (COVID-19) and keep up a health of the patients who need to be admitted to the hospital. According to the World Health Organization's World Aging & Health Survey 2015, by 2050, the total number of persons aged 60 and older would have risen from 900 million to about 2 billion. As well as the huge financial costs which will be carried by economies of all the countries involved as hospital costs rises [4,] this large rise in the no. of elderly people rises patient disability, dependency , and chronic diseases [3].

We believe that governments should adopt home hospitalization to limit the spread of corona virus (COVID-19) and keep health of the patients who need to stay in hospital , given the rapid spread of the novel coronavirus COVID-19, and the large growth in the no. of older persons who ache from chronic conditions and regularly require hospitalization. Hospitalization at home is a forward-thinking and innovative health-care model. The second consideration is cost, particularly because hospital costs have risen significantly, but home hospitalization significantly lowers health-care costs. The patient must follow the doctor's advice for the home hospitalization process to be successful, and his or her health must be monitored on the systematic basis used for medical support in the event of health unpredictability.

Also, the hospitalization room's environmental elements souled be monitored as these conditions of environmental can delay the patient's recovery and attitude the health risk. The temperature is one of these environmental factors that must be watched, as a large or low rise can cause a variety of problems, It canister affect the heart, brain , respiratory, and circulatory systems, which is especially dangerous for the elderly, as well as cause mortality in some situations [9]. With the rapid advancement of cloud computing, many smart objects and gadgets are predicted to have a significant ability to acquire and share data among themselves [10].

Clouding has been used in a variety of Its numerous technologies give a solid attitude to increasing human health, safety, and well-being [13,14], and it has received general acceptance in practically all industries, including healthcare, wherever it is frequently employed in remotely monitoring the health of patient[11,12]. In latest years, cloud computing has providing several of resources needed to use cloud computing for ubiquitous computation, storage , and processing, as well as to distribute these resources in a simple and straightforward manner [15].

Cloud computing is a novel business model that allows businesses to outsource IT infrastructure (data storage, processing, etc.) and other services to the cloud. It is expected to benefit organizations, particularly small enterprises, by lowering costs by eliminating the need to purchase expensive hardware to keep data on their premises. However, how can firms who have already spent a significant amount of money on IT infrastructure benefit from cloud computing? Users, even enterprises that have invested in IT infrastructure, are affected by the constant advancement of technology. The rapid advancement of technology brings with it a slew of security issues that must never be disregarded; as a result, security updates to secure existing infrastructure are a constant requirement. As a result, firms that have invested in IT infrastructure will gain if security can be delivered as a cloud service.

Furthermore, as mobile technology advances, security problems will not go away very soon; rather, more security procedures will be necessary to complement the technology[4,8]. To handle security challenges in cloud computing, a security management framework is required. Organizations will be compelled to utilize cloud computing if a successful security management mechanism is implemented. [16,17] proposes a number of Cloud and clouding-based solutions, which contribute to the several benefits of the Cloud Computing in supporting ever growing data volumes. On the other hand, moving to the cloud is not a straightforward Cloud computing application.

With artificial intelligence (AI) and deep learning (DL) approaches, the incorporation of human-like intelligence into intelligent health frameworks is timely. Clouding and cloud technology have recently made major advancements, allowing intelligent healthcare services to be delivered in real time. A large need for a smart and intelligent healthcare system delivers a seamless and speedy reaction with clouding-cloud integration. Cognitive behavior and decision-making can be improved using DL and AI. Smart city stakeholders have access to advanced electronic applications and technologies in addition to smart sensor equipment. Nonetheless, in a smart city setting, finding and accessing medical experts and hospitals can be difficult. Critical patients frequently require immediate attention and care to save their lives. As a result, patient data must be transferred and interpreted as quickly as possible, and the results must be exact enough for medical experts to use for first evaluation. As a result, an intelligent healthcare system is required that can address the aforementioned difficulties by utilizing the technology and services accessible in a smart city context. Fog computing [18] is a new computing idea that is gaining traction in comparison to Cloud computing because of its capacity to solve requirements that Cloud computing has yet to address. Fog computing is extended the Cloud's computational resources to the cloud's grid edge, allowing a large number of linked devices to deliver services for instance processing and data storage to its customers. Its architecture also offers real time data study for all the geographically scattered devices with restricted processing and data storage capability, decreasing data transfer between the devices and a Cloud [19].

This project goals to give to the development of healthcare systems by developing a reliable, low cost , and safe healthcare system depend on significant modern technologies, for instance clouding, fog computing, and cloud computing, in focus of the problems knowledgeable by most. finally of the fast distribution of the COVID_19, healthcare facilities experienced delays and a lack of resources during this time. as a result of the quick proliferation of the new COVID_19 through the improvement of a low cost, safe, and dependable healthcare system depend on key current technologies

This technique permits patients to be able to recover and be treated in the privacy of their own homes, away from the risk of the infection from the new corona virus. This is especially essential for the elderly, who typically suffer from the chronic conditions and low immunity, making hospital visits difficult. In the mobile cloud computing paradigm, sensors and mobile devices play an important role. The ability of sensors and actuators to work together effectively. Storage, analytics, and visualization are the three primary components of Cloud Processing. The system is intended for long-term archiving of patient biomedical data as well as providing diagnostic information to health providers. The research on cloud-based medical data storage and the initial issues has been vast. Analytics that combine sensor data with the increasingly common e-Health records can aid in the diagnosis and prognosis of a variety of health issues and diseases. Furthermore, because it is impracticable to ask clinicians to pore over the vast data or analysis from wearable sensors, visualization is a critical component for any such system. If wearable sensors are to have an impact on clinical practice, visualization methods that make data and analysis accessible to them in an easily digestible format are critical. Cloud computing encompasses both the applications supplied as services via the Internet as well as the hardware and software in the data centers that support those services. We refer to the services as Software as a Service (SaaS) because that is how they have been referred to for a long time. We'll refer to the hardware and software in data centers as a Cloud.

As a result, cloud computing can be viewed as an infinite resource that can be accessed at any time and from any location on the planet. This is in stark contrast to having servers running apps on the grounds of a company. Despite various objections to cloud computing, it is envisioned as a solution to the dilemma of whether mobile devices can perform as well as desktop computers [4]. One of the applications that can profit from the combination of mobile and cloud computing technology is mobile health care. This study aims to boost mobile health monitoring services by constructing a converged and trusted network infrastructure and methodology for mobile cloud computing.

When it comes to multimedia services using ubiquitous mobile devices, there are a variety of computationally heavy tasks that can be offloaded to the cloud. Multimedia sensor signal processing and security management operations are two of these, which have received little attention in the mobile cloud computing research field.

## 2. Literature Survey

Many researchers propose healthcare by using cloud computing lastly, can be presented the following:-

[20] Kocabas O., and other, Financial and regulatory pressures have created tremendous incentives to increase illness prevention, patient monitoring, and drive healthcare in the United States into the digital era. This transformation necessitates the protection of digital health data's privacy in three stages: acquisition, storage, and calculation. In terms of effective implementation and privacy, each level presents its own set of issues. While existing AES encryption solutions can provide data privacy in phases (acquisition) and (storage), phase (computation) must also enable data privacy to enable healthcare businesses to take advantage of cloud computing employing resources such as Amazon Web Services. There is currently no technology in place that allows direct computing in the cloud while maintaining data privacy. FHE (Fully Homomorphic Encryption) is a new cryptographic system that allows you to compute on encrypted data in the cloud without transferring it back to your PC. However, this innovative technique is plagued by significant performance and storage difficulties. While true FHE will take years to gain traction, we offer a feasibility study for its application in a simple long-term patient ECG data monitoring system.

[21] Yang Li and others demonstrate key features of the WikiHealth Analysis system, that enables developers, scientists , and professionals to publish their data analysis models as cloud utilities, allowing anybody to access and use sensor data without requiring expert knowledge. To support the feasibility of this strategy, an ECG-based health monitoring service application has been created in addition to the Wiki-Health platform. The volume and diversity of sensor data collected and analyzed is growing all the time.

[22] Huang Lin, and others present design To preserve the privacy of the interested persons and their data, A privacy-preserving mobile health monitoring system was developed with the help of the cloud. In addition, the outsourcing decryption technique and a newly proposed key private proxy re-encryption have been developed to move the computing complexity of the involved parties to the cloud without affecting client privacy or service provider intellectual property. Finally, our security and performance analysis demonstrates the success of our proposed solution. In this study, they offer a cloud-assisted mHealth monitoring system (CAM).They start by identifying the design flaws that impair privacy, and then they suggest solutions. We'll start with the most basic method to make things clearer and to identify any potential privacy infractions. Then, by resolving the privacy concerns raised, we propose a better approach. The new approach allows the mHealth service provider (the company) to be offline and deliver data after the setup stage.

[23] A. Roshandeh1 presents A layered big data and real-time decision-making architecture has been designed for bridge data management and health monitoring. Due to unforeseen circumstances, the bridge will not be fixed in a timely manner. In these situations, road users should be the ones to make the decisions, and they should be informed immediately about the bridge's condition. Using this technique, sensors placed on bridges might be programmed to send warning messages to Variable Message Signs and cell phones within a specific radius. Big data and cloud computing are emerging technologies that could be utilized





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to address challenges of real-time communication with road users and/or experts in the central management office. Bridge data collection and storage, as well as making timely decisions to address bridge structural degradation and avoid catastrophic incidents, remain a challenge that needs the use of more sophisticated technologies.

[24] Li, W. and others, present categories and service models of cloud computing were discussed, as well as its technology intelligence, various applications in medical services and healthcare, and biometrics-based authentication for information security. Privacy, security, application hurdles, and compliance with laws in the healthcare industry were also discussed.

[25] Moeen Hassanalieragh and others, Analyze the current state of integration of remote health monitoring technology into clinical care, as well as expected future directions. Wearable sensors, especially those with IoT intelligence, provide appealing possibilities for observing and recording data in home and work contexts for considerably longer periods of time than is now possible during office and laboratory visits. When examined and presented to clinicians in easy-to-understand visuals, this treasure trove of data has the potential to dramatically improve healthcare while also lowering costs. Before systems can be created for seamless integration into clinical practice, various obstacles in sensing, analytics, and visualization must be overcome. In this paper, they discussed the current state of remote health monitoring technology integration in clinical practice and forecasted future developments. Wearable sensors, especially those with IoT intelligence, provide appealing possibilities for observing and recording data in home and work contexts for considerably longer periods of time than is now possible during office and laboratory visits. When examined and presented to clinicians in easy-to-understand visuals, this treasure trove of data has the potential to dramatically improve healthcare while also lowering costs.

[26] M. Shamim Hossain & Ghulam. M. present a geriatric health monitoring system that uses cloud assisted speech and the face recognition, in which video cameras or handheld devices collect speech and facial images, which are subsequently transferred to a cloud server for analysis and categorization. Based on a patient's voice and facial images, the framework recognizes a patient's case, for instance discomfort, tensing, and so on. The patient case recognition system citations local information from texture descriptors and speech from face pictures. The data is subsequently classified utilizing support vector machine. The standard state is directed to the care center remotely, healthcare specialists, and suppliers for necessary services so that provide smooth health monitoring. Experimentations were conducted to confirm the procedure and determine the framework's applicability in terms of a accuracy and timeliness. The results suggest that the proposed method is effective at analyzing faces and speech.

[27] Park, S. and others propose the primary goal of this study will be to look at ambient assisted living concerns in order to successfully identify and generate alarms in cases of stroke beginning, allowing for timely medical intervention and mitigating the long-term repercussions of these attacks.



[28]Shanmugasundaram G. and others present in order to have a good monitoring system BSN is used by the cloud to keep track of the patient's health. Here, the cloud serves as a virtual server, storing patient data on a third-party server, posing major security and privacy risks. Various approaches have been utilized to monitor healthcare information in a cloud environment at the healthcare center. The purpose of this research is to discuss various strategies and taxonomies related to contemporary cloud computing methodologies utilized in hospital healthcare monitoring systems. Furthermore, the advantages and disadvantages of various healthcare monitoring system approaches are explored.

[29] Vermaand, P. and others Using the notion of fog computing at the smart gateway, propose remote patient health monitoring in smart homes. At the network's edge, the suggested architecture employs advanced techniques embedded data mining, distributed storage, and alerting systems, among others. The patient's real-time data is processed at the Fog Layer using a data transfer mechanism based on event triggering. By computing the patient's temporal health index, the temporal mining concept is utilized to assess bad occurrences (THI). To test the system's validity, health data from 67 patients was systematically generated for 30 days in an IoT-based smart home setting. When compared to previous classification methods, the suggested BBN classifier-based model has a high accuracy and response time in determining the status of an event. Furthermore, decision-making based on real-time healthcare data boosts the suggested system's utility.

[30] WANG, X. and Jin,Z 2019 explain how MCC approaches have been widely used in a variety of healthcare applications, and describe the broad architectural and design concerns that should be considered when creating an MCC for healthcare scenarios. This study discusses state-of-the-art optimization approaches on the MCC for satisfying varied priorities and achieving the optimal tradeoff among many objectives, given a huge number of factors that may affect the MCC's performance and potentially result in disastrous effects in healthcare. Finally, the MCC's security and privacy concerns in healthcare are examined.

[31] Gaoa, F. & Sunyaev, A. provide a conceptual framework for cloud computing adoption studies in healthcare, as well as seven study recommendations. Their study adds to the theory by offering a thorough list of industry-specific elements that influence cloud computing adoption decisions in healthcare, as well as an explanation of the industry's specificities. The discovered characteristics can be used by practitioners as a checklist to help healthcare companies make decisions about cloud computing adoption.

[32] Abd Ali1 & AL-Askery, A. To provide comfort to the patient, create a gadget that can be worn for a reasonable cost and is compact in size. In comparison to the benchmark, this gadget should have a high level of accuracy. This research also considers real-time remote monitoring based on a wireless sensor network and cloud computing, where cloud computing and the Internet of Things are integrated to solve the data flow problem. The Wearable Remote Vital Signs Monitoring System (WRVSMS) was built using a printed circuit board that contained the ESP01, MAX30100, NTC, OLED, and Li-ion battery. The data was stored and processed on a cloud server connected to the WRVSMS via the HTTP protocol. The WRVSMS is based on combining vital sign data and allocating stakeholders to whom the alert is conveyed, depending on the patient's circumstance. When the patient's vital signs are outside the threshold, this is a quick communication to the stakeholders who are crucial in rescuing the patient. The device was found to be 99.37 percent accurate, and the error was determined using statistical analysis. The recommended device's goal is to read and monitor some of the patient's vital signs remotely. The device monitors a variety of vital signs, including heart rate, body temperature, and blood oxygen saturation., to keep track of the patient's health (SpO2).

[33]Kaur, H.& Chauhan. R. Currently, the goal of a successful IoT healthcare device is to offer real-time data in order to track patient medical status, avoid catastrophic circumstances, and increase the comfort of the smart IoT environment. The Internet of Healthcare Things (IoHT), one of the most remarkable technological advancements, combines technological knowledge and electronics. Despite the fact that the Internet of Things' impact on health care was still ubiquitous in its early stages. This research seeks to examine and comprehend IoHT programs in order to obtain excellent healthcare.

[34] SADIA ALI and others offer paper to improve the rate of defect detection,

provide a design pattern-based framework for selecting and ranking test cases. They identify test cases for commonly accessed components using observer patterns first, and then rank test cases based on the strategies they utilize. The proposed framework was validated by an experiment, and it was compared to alternative approaches (previous faults based and random priority). As a result, as indicated by the experimental data, the proposed framework successfully verified changes. As a result, the proposed framework outperforms earlier fault-based and random priority frameworks in terms of fault identification (by more than 90%). (i.e., more than 80 percent respectively). Due to ongoing integration and innovation in health care features and services, component-based devices leveraging cloud platforms improve reliability analysis. It has become increasingly difficult and time-consuming to increase the rate of fault identification in the cloud environment for dependability analysis. As a result, the proposed method can be utilized to aid reliability testing of redesigned components with no redundant defects or test cases. As a result, the proposed approach was developed to address regression testing concerns in C.B. healthcare cloud-enabled systems while also aiding modern software development teams with decision and implementation operations for continuous dynamic change. The current approach failed to boost fault detection rate and component change verifications due to redundant faults or irrelevant test cases, as well as frequent revisions.

[35] Dang, H. & others offer a Digital Twin architecture based on cloud computing and deep knowledge for essential health-monitoring is presented to efficiently conduct real time monitoring and preventative keep. The structure comprises of structural elements, digital models, and device measurements developed by combining several sub models such as machine learning, mathematical, and finite element models. The data connection between the physical structure, digital model, and human interventions is improved via cloud computing infrastructure and the user friendly web application. The proposed framework's viability is proved by case readings of loss detection of the model and a real bridge structures utilizing deep learning Algorithms, which have a great accuracy of 92%. The ultimate goal of this research area is to provide a SHM solution that can monitor structures in real time or near real time with high precision while staying within a fair development/operation budget and ensuring long-term performance.

[36] George, A.M. and Others show a wireless healthcare system that uses sensors to detect patients' vital signs, sends data to the cloud, and uses machine learning techniques to forecast approximate life expectancy. The Internet of Things (IoT) is a concept that connects gadgets and provides patients with excellent health care services. The IoT architecture collects sensor data and sends it to the cloud, where it is processed and analyzed. Feedback inputs are supplied back to the clinician based on the studied data, and utilizing the patient's current pulse rate, a nominal or approximate value of life expectancy is estimated using machine learning algorithms.

[37] G. Yamini and G. Ganapathy suggest an IoT-based healthcare information system with a focus on dependability in the design process. The inclusion of future user viewpoints is a distinguishing characteristic of our planned effort. The proposed reliability-driven design paradigm addresses real-world issues.

[38] H. Chang1 and T. Lin2 show the proposed system's software architecture and emphasize on the technologies used, such as client-side scripting, NoSql databases, and socket connectivity. We also discuss the difficulties of portraying the 3D structural model's general movement and shape alteration. Thus, the rotations and translations of each internal linked element are calculated by converting the monitoring results of each sensor device observed in a global coordinate system. We devised the inverted movement calculation approach to address this issue. To show system function

and validate the inverted movement computation approach, a simple 3D two-level structure model and simulated sensor displacements are used. Structural Health Monitoring (SHM) is a project that intends to create a system that can continuously monitor a structure, offer current structural responses, and even issue an alert when the structure crosses the design domain. A more effective SHM should deliver real-time and online monitoring findings, allowing for instant intervention.

## 3. METHOD

### 1. Proposed system's architecture

The novel COVID-19 is sweeping the globe, with thousands of infected cases and deaths as a result of the epidemic in several nations. COVID-19 sickness is communicated by direct touch, therefore people can become infected by other persons who have the virus. The elderly and people with chronic conditions like increased blood pressure, heart disease, or diabetes are particularly vulnerable to this virus Most hospitals throughout the world are having trouble tolerating a large number of sick persons as a result of the recent coronavirus outbreak, since the virus has begun to be spreading among these institutions' medical and para-medical employees, posing a serious risk to healthy of hospitalized patients. Aside from the spread of the virus, the human is seeing a significant growth increase in the elderly population individuals.

The first step in Fig. 1 is that the sensors will be put on the body of the patient. The temperature sensor is the first to sense the temperature and will process it and transmit the data to the cloud. The sound sensor is the second. This sensor will sense the sound and process it to detect if the sound is a cough or not. After distinguishing, it will send the data to the cloud.



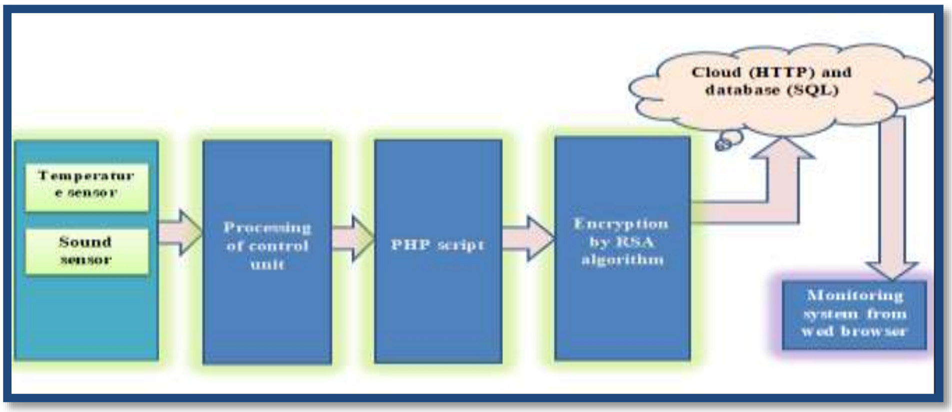



Fig.(1) block diagram of the architecture

The cloud will send the data to the doctor or any person monitoring the case as shown in fig (2), which will show the connection, public network, head sensor, cloud and monitoring.

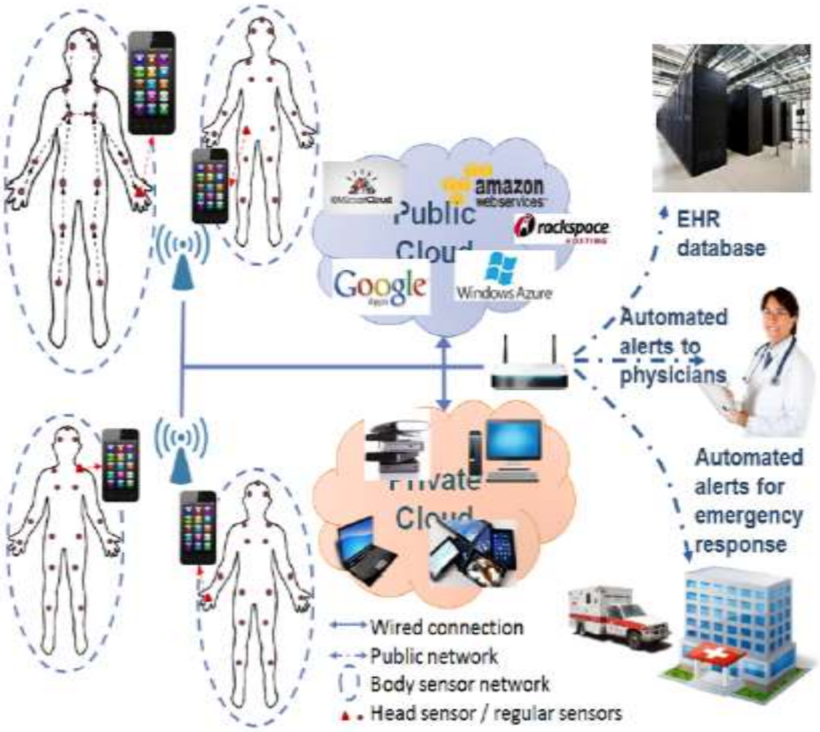



Fig (2) the architecture of project

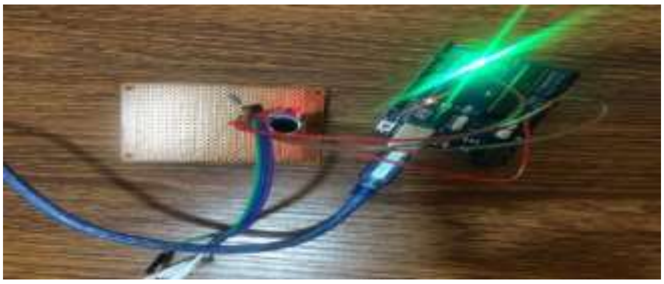
**4**

**.Practical Implemntaion**

**4.1.Hospital Room**

The idea of this project is to monitor coronavirus patients. Therefore, the first step is to sense the syndromes of the patient. Two sensors are used: a temperature sensor put on the patient's skin and a sound sensor put near the patient to catch the cough. The sound sensor will sense every sound, so we coded it with a special function. This function is a window for several levels of cough with its duration.These sensors will be connected and send the data to the microcontroller as shown in fig (2), and the microcontroller will send this data through a cable to the computer.The fog computer will transport the data which is encrypted to the cloud. The data is accumulated, which means you will not lose any data. In addition, can use the react technique to update the change of data (temperature and cough) without updating all the information on the page and without refreshing the page.





a. Sound sensor

b. Temperature sensor

Fig.(2) a&b the sensors and microcontroller

### 4.2.Coding and Flowchart

The following languages are used in this project: Firstly, the C language is used to program the microcontroller. It sends the data to the computer, and the computer is programmed with C#. The computer will send the data to the cloud.For programming the cloud, many techniques are used. The database used is SQL Server. As a backend cloud, the PHP language is used, and as a front cloud, the React technique is used. For security, the connection between the computer C# and the cloud PHP is secured by aligarthims encryption RSA.The flowchart as shown fig.(3).

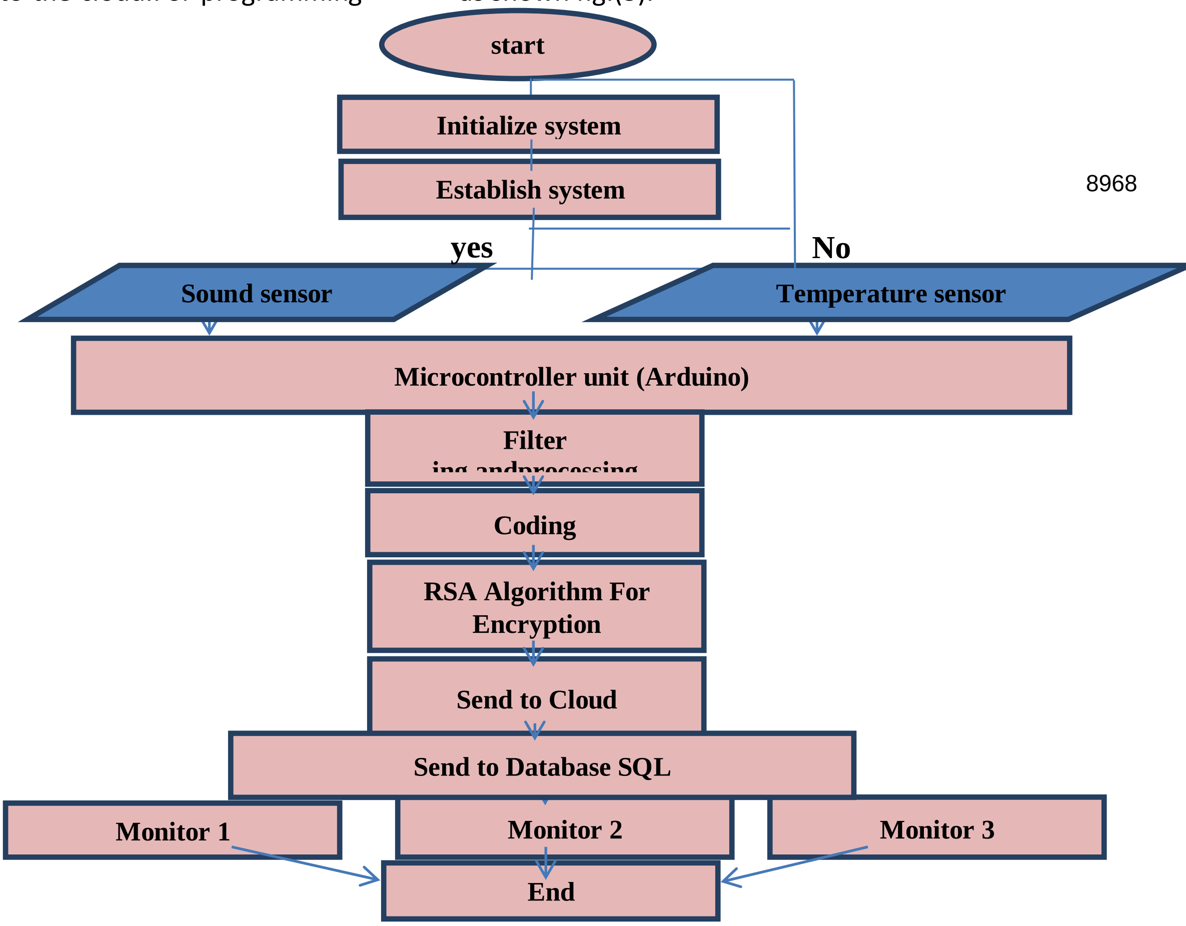



Fig.(3) the flowchart of system

### 4.3.Cloud Monitoringand Resulting

The data is transmitted from moicroprosseor to the computer will be apear in fog computer as shown fig.(4)

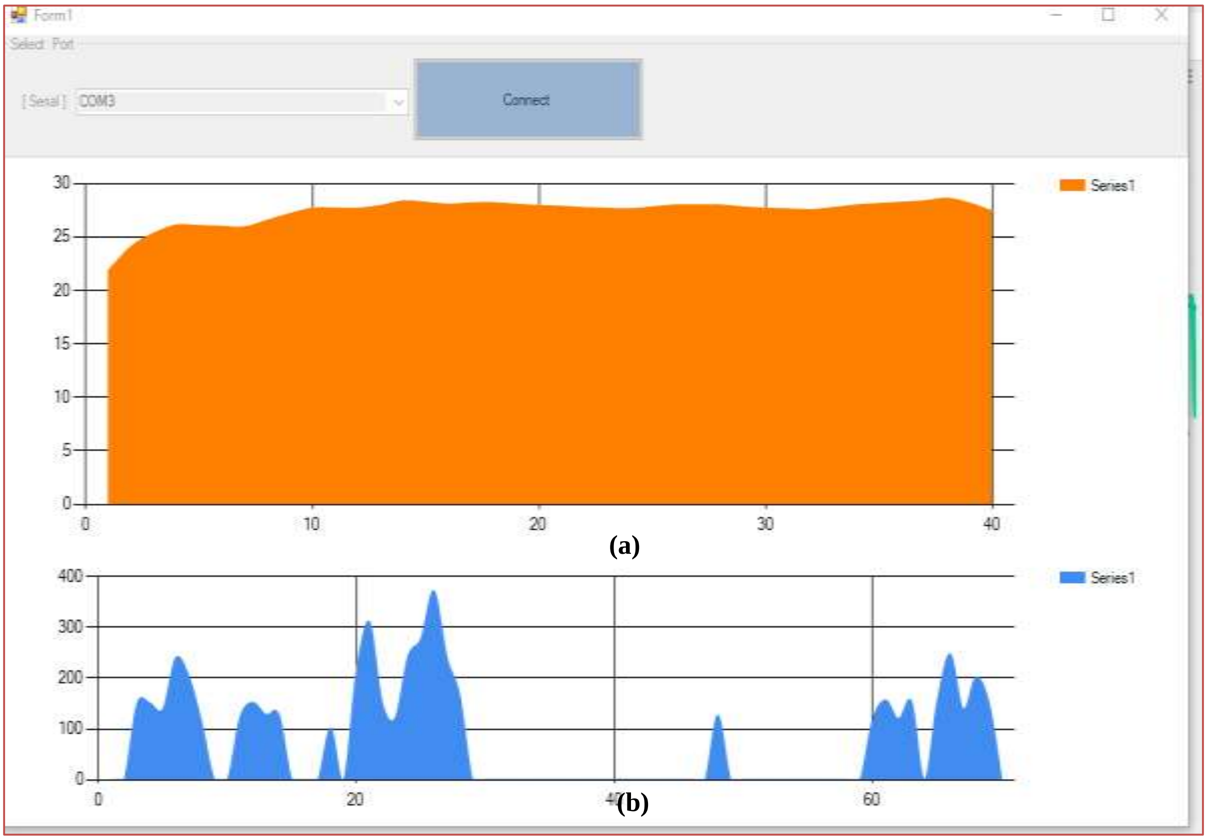



Fig.(4) the data in fog computer (a) tempereture (b) sound

This data will be transfer to the cloud and apear as shown fig.(5), and any person monitor the patiant can see this data from cloud.

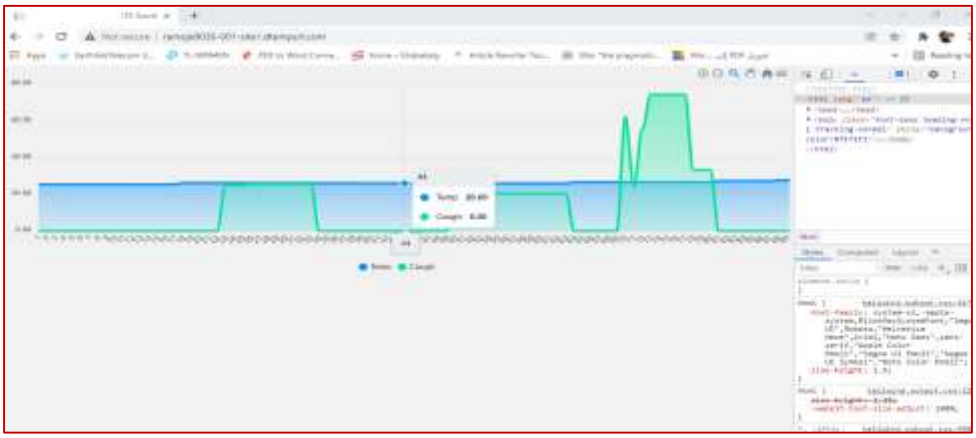


Fig.(5) the data in globle cloud

## 4. Conclusion

The main syndromes of COVID-19 are the temperature and cough. These syndromes will be monitored based on the cloud remotely without touching the patient. In addition, monitor all infected cases in the hospital from any device at any time without potential. This process will prevent the spread of the virus. The intelligent architecture healthcare systems can be applied to any disease by adding the required sensors. This processing will allow for control of all cases found in the hospital

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