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IoT Based Environment Monitoring and Disease Prediction Using Geometric Progression

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Abstract: ***For the last few years, challenges of monitoring and control of distant environmental parameters accurately have emerged as a new field of research. The concept of the Internet of Things (IoT) is also emerging very fast where everything around us comes with internet connectivity for monitoring and control. Monitoring the environmental parameters and initiating a control action from the internet is also part of this concept. In our proposed work, we design an environment monitoring system, capable of monitoring and control of environmental parameters like temperature, pressure, and humidity. The modern approach to healthcare is to prevent the disease with early mediation rather than go for treatment after diagnosis. Traditionally, physicians or doctors use a risk calculator to predict the possibility of disease development. These calculators use Basic information such as demographics, medical conditions, life routines, and more to calculate the probability of developing a certain disease. In this approach, we are predicting disease outbreak according to the environmental condition.***

Keywords: Geometric progression, disease prediction, machine learning, Raspberry Pi

1. Introduction

Prediction of disease outbreaks, or disease forecasting, provides warning that a certain amount of disease may occur at a particular time in the future. The 'amount of disease' may be qualitative (e.g. there will be a lot of diseases) or quantitative (e.9. 35o/o of leaves will be infected). Prediction of disease occurrence ensures that control measures, especially the application of chemical treatments or biological control agents, are used more effectively. The prediction of disease outbreaks, combined with knowledge of the biological basis of disease development, allows sprays to be applied at times when they are most effective. It may allow the number of sprays to be decreased, reducing the cost of crop production and the environmental impact of pesticides. In commercial agriculture, the prediction of disease is also important for predicting crop yields. This knowledge is used to predict the long term prices of a commodity in the market place. The significance of weather monitoring exists in many aspects. By using the sensors for monitoring the weather states, the results will be accurate, and the whole system will be faster and less power consuming. The system monitors the weather states and updates the information to the web page. The cause behind sending the data to the web page is to maintain the weather conditions of a particular place that can get to know anywhere in the world. The system consists of a temperature sensor, a Co2 sensor, humidity sensor. All these sensors can measure the corresponding weather parameter. The system is intended to use in hospital premises mainly public hospitals where the number of patients on a daily basis is very high. The proposed system will predict the weather in the hospital's vicinity and predict the possible disease that may occur soon

2. Literature Survey

Climate change results in variations in weather conditions and patterns of extreme weather events. The health effects of weather change (including changes in climate variables and extreme weather events) on human infectious diseases are forced through impacts on pathogens, hosts/vectors, and disease transmission. First, a series of infectious diseases is spatially and temporally restricted by climatic variables. Changes of climate variables in spatial and/or temporal scales will affect the development, survival, reproduction, and liability of disease pathogens, hosts, and their interaction with human beings. Second, sudden and dramatic changes in weather conditions due to extreme weather events and meteorological hazards have profound effects on many infectious diseases. Due to our incomplete knowledge of some of these extreme weather events, being able to accurately predict their patterns and their health impacts remains challenging. Last, extreme weather, including large-scale extreme weather events and meteorological hazards, often involves combined shifts of several climate variables, making it more complicated to predict the implications for disease pathogens, hosts, and transmission [1]

Deepesh K Rathore and et al survey the hospitals and patient's care unit and therefore propose a system which can be very useful for biomedical applications, where doctors can monitor the subject(s) condition from the place where they are sitting and hence proper and timely care to the patient can be given. This will help in curbing deaths due to delay in timely care. Further, in case of emergency, the doctor is also informed about the patient via SMS, thus even when the doctor is not in his chamber; he will be immediately informed about the patients' condition. It will be of great help for the patients, as in any case of emergency, they can get immediate treatment. [2]

Ajinkya and et al conclude that generally in critical case patients are assumed to be monitored continuously for their heart rate, oxygen saturation level, blood pressure, body temperature, pulse oximetry (SPO2) and ECG, etc. In the last methods, the physician needs to be present physically on sight, so that the real-time health monitoring system is used every field such as hospital, home care unit, sports using a

wireless sensor network. This health monitoring system used for chronicle disease patients who have daily check-up. So, researchers design a system as a portable device. The researcher designed a different health monitoring systems based on the requirement. A different platform like Microcontroller, ASIC, PIC microcontroller and embedded systems are used to design the system based on this performance and in recent years cloud-based e-healthcare systems have emerged. In future FPGA based or using IoT, we can develop a system that will help to monitor different health parameters. [3]

The author of this paper discussed the performance of the wireless Health monitoring system has to be increased so that Patient Data can be transmitted securely and easily, where the prime components are Packet Loss Ratio and Energy consumption. The biomedical wireless sensors work at a cycle with low energy consumption for increasing the life expectancy of the network. Whereas from the results it can be inferred that the Packet Loss Ratio and Energy Consumption is small for LEACH Protocol [4]

Neha and et al concluded that paper provides or proposed a new IoT based patient's health parameter recording system which can be accessible by the physicians of an organization. The system works by sensing the heartbeat rate, the temperature of the patient and constantly saves the updated data to the server of the system. This system is proposed in order to reduce the burden of the patients when they visit the physician but the concerned physician is not able to attend the patient, hence patient has to move to another physician then the new physician can start the treatment of the patient by accessing the related data or records from the server. [5]

The current hospital-centric healthcare system is failed to treat conditions that demand immediate treatment such as heart strokes. So, the goal is to be tilting from hospital-centric treatment to patient-centric treatment. Project [6] proposes a health monitoring system that monitors crucial parameters of the patient such as temperature and heart rate using sensors as well as a fit bit that is connected to a raspberry pi board. The project contains alerting the doctor through SMS if any vital parameter of the patient deviates from the normal value. Apart from helping the physician monitor the patient's basic health parameters this health monitoring system also provides that the patient takes the prescribed medication at the right times. The raspberry pi acts like a private server that logs the details of the patient's medication. The patient is sent reminders to take medicines through SMS according to his prescription.

As health care services are an important part of our society, automating these services lessen the burden on humans and ease the measuring process. Also, the clarity of this system helps patients to trust it. When the threshold value is reached, the alarm system that consists of buzzer and LED alerts the doctors and he can act more quickly. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedures. The GSM technology helps the server to update the patient data on the website. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors. The biometric data of the patient which is stored and published online can be given to scientists and researchers of medical fields to analyze the value and find patterns or for other research work. [7]

There are several places on the Internet of Things (IoT) is used Such as smart environment, smart home, smart city, smart parking, agriculture fields, and medical fields. In the medical field also, there are several processes are used the internet. In [8], monitor a patient's heart rate, body temperature, respiration rate and body movements using Raspberry Pi. After connecting the Internet to the Raspberry Pi board it acts as a server. Then the server is automatically sending data to the web server. Then these parameters are monitor using webpage anywhere in the world using laptops, smart phones, etc. If these parameters are going to abnormal, it will automatically send an alert message to the doctor.

As we know that it is very difficult to screen the patient for 24 hours. So here the status of patient health i.e Pulse rate, Body Temperature, Position of the body, ECG, and Blood pressure and so on. All of these parameters can be measured by utilizing some sensors. The collected data through the sensors is then transferred to the internet. And Via internet this information is transferred to computers which are registered to the server of the database as well as the smartphone of the doctors. After analyzing the data doctors can then prescribe the medication based on the data results shown by the system. The presented prototype will minimize the burden on patients to visit the doctors every time for monitoring of these health parameters. [9]

A wireless healthcare monitoring system using mobile devices and sensors can be implemented in a global network with the help of Arduino and Raspberry Pi. The devices and IoT collect and share data with each other, making it possible to collect, analyze and monitor data more accurately. Thus IoT can be used for monitoring the patient and gives services in a timely manner. The proposed system [10] can be enhanced and extended by using other invasive as well as non-invasive sensors for picking up essential medical potentials of a patient. This can be further analyzed, stored and transferred on a global platform. Mega Arduino can also be used that is capable of interfacing many sensors at the same time. This will help to show results parallel so that ease of connection and time saving can be facilitated. [10]

3. Proposed System

In WSN various Environment monitoring sensors are placed inside the field, sensors include CO sensor, moisture sensor, temperature sensor & humidity sensor. Using this information, Environment monitoring parameters calculated remotely at control system and display on the remote station android mobile wirelessly. This Unit consists of a Wi-Fi module, sensors, a microcontroller, and power sources.

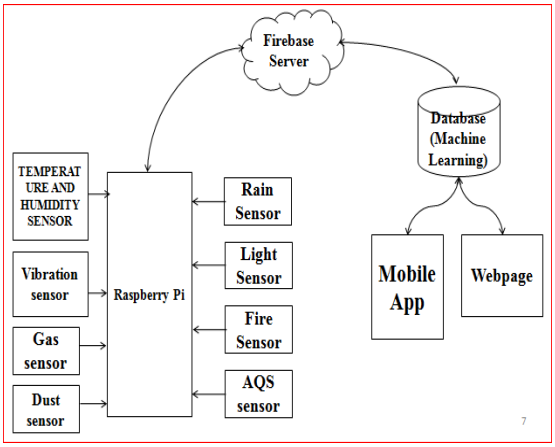

Figure 1: Block Diagram of Proposed System

In WSN various Environment monitoring sensors are placed inside the field, sensors include CO sensor, moisture sensor, temperature sensor & humidity sensor. Using this data, Environment monitoring parameters calculated remotely at the control system and display on the remote station android mobile wirelessly. This Unit consists of a Wi-Fi module, sensors, a microcontroller, and power sources. This setup measures the temperature of the atmosphere and humidity level using temperature and humidity sensor (DHT11), moisture in the air and CO Gas (in the air) related information using CO sensor. Each unit is based on the microcontroller that controls the Wi-Fi module and processes information that came from all sensors. We are using Raspberry Pi as a controlling unit and as a Wi-Fi module. Values of CO, Moisture, Temperature, and humidity are updated on firebase. Users can access data via Android App and webpage (designed in PHP). Real-time values are updated on the firebase server.

Disease prediction is performed in Python using a geometric progression algorithm. The diseases are predicted according to a particular temperature, humidity and air quality of that year and the previous one.

A geometric sequence is a sequence such that any element after the first is got by multiplying the previous element by a constant called the common ratio which is shown by **R**. The common ratio (**R**) is got by dividing any term by the previous term, i.e,

$$R = \frac{a2}{a1} = \frac{a3}{a2} = \ldots\ldots\ldots \frac{an}{an-1}$$

Where R common ratio
a_1 first term
a_2 second term
a_3 third term
a_{n-1} the term before the n^{th} term
a_n the n^{th} term

The geometric sequence has its sequence formation: $a_1, a_1r_1, a_1r^2, \ldots\ldots\ldots a_1r^{n-1}, a_1r^n$.

To find the nth term of a geometric sequence we use the formula:

$$a_n = a_1 r^{n-1}$$

Where R common ratio
a_1 first term
a_{n-1} the term before the n^{th} term
a_n the n^{th} term

4. Conclusion

The proposed system helps in determining the presence of environment changes with a low cost hardware and providing a real time fast solution. It helps users to quickly respond to the situations based on results obtained. Prediction of disease occurrence ensures that control measures, especially the application of chemical treatments or biological control agents, are used more effectively. The prediction of disease outbreaks, combined with knowledge of the biological basis of disease development, allows diagnosis of particular disease before it costs someone's life.

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