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# WEATHER PREDICTION USING MULTIPLE IoT BASED WIRELESS SENSORS

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**Abstract:** Environmental monitoring is extremely important due to recent changes in climate, for ensuring a safe and wealthy life of both humans and artifacts. This field is based on remote sensing and wireless sensor networks for gathering data about the environment. Recent advancements, such as the vision of the internet of Things (IoT), the cloud computing model, and cyber-physical systems, give support for the transmission and management of huge amounts of data relating to the trends determined in environmental parameters. In this context, the paper presents three different IoT-based wireless sensors for weather prediction and environmental monitoring: one employing User Datagram Protocol (UDP)-based Wi-Fi communication, second communicating through Wi-Fi and Hypertext Transfer Protocol (HTTP), and third one using Bluetooth communication. The System consists of three different wireless sensor nodes based on Node MCU wifi module or Arduino microcontroller that is connected to the internet, and a firebase cloud server which provides information storage and delivery to remote clients. In addition, to view the result output in effective and user friendly manner MIT App Inventor is used to develop applications for Android phones using a web browser and either an associated phone or an on-screen phone person. The System conducts a look up table which contains the values of temperature, humidity, real time rain and level of carbon monoxide is used to predict the current environmental conditions by comparison of data.

**Keywords:** Wireless Sensor Network, IoT, weather predictions, cloud server, environmental Monitoring

## INTRODUCTION

The environmental care has become one of the biggest concerns for almost every country in the last few years. The industrialization level has been increasing without any control in the last decades. So, there is a growing concern over environmental issues like global warming, energy conservation, efficient energy usage, radiation, etc; the current situation is clearly changing towards more environmentally friendly solutions.

Wireless Sensor Networks (WSN) has given a viable solution to these issues. This is the field where wireless sensor networks (WSNs) have been 1st used, their primary purpose consisting in the observation of the physical world and the recording of physical quantities of the atmosphere and organizing the collected info at a central location.

WSN consists of a large number of low-cost, low-power; small size and multifunctional wireless sensor nodes, with sensing, gathering and computation capabilities which can be communicated over a short distance via a wireless medium and collaborate to finish a standard task. WSN is generally deployed in unattended and harsh environments.

However, some constraints limit their application to some extent. These constraints include restricted amount of energy, limited communication range, low bandwidth, limited processing ability and storage in each node. Performance of a sensor node is highly dependent on the effective and efficient usage of these available limited resources that leads to maximum lifetime of the WSN.

One primary concern on wireless transmission is that the power consumption. WSNs measure environmental conditions like temperature, humidity, sound, pollution (such as CO, CO2, SOx) levels, wind pressure, rainfall, light intensity etc. These are similar to wireless ad hoc networks wireless ad hoc networks in the sense that they rely on wireless connectivity and spontaneous formation of networks so that sensor data can be transported wirelessly.

Water and air quality are essential thing to maintain the equilibrium between human development and a healthy environment. In this context, environmental monitoring represents a fundamental instrument for gathering relevant information about the ecosystem, leading to new knowledge and understanding, and for ultimately implementing adaptation and mitigation actions that address the degradation of the biosphere. Weather prediction is that the perform of science and technology to predict the conditions of the atmosphere for a given location and time. People have tried to predict the weather informally for millennia and formally since the nineteenth century. Weather forecasts are created by grouping quantitative information regarding the present state of the atmosphere at a given place and using meteorology to project how the atmosphere will change.

This paper presents the design details, the development, and the analysis of three different techniques that enable the achievement of Internet connected solutions for monitoring and prediction of environment at remote locations: one employing UDP-based Wi-Fi communication second based on the HTTP protocol, and third one consisting Bluetooth. Being provided with Internet connection capabilities, the developed techniques represent a part of the Internet of Things (IoT), the vision that "allows people and things to be connected Anytime, Anyplace, with something and anyone, ideally using Any path/network and Any service".

The Internet of things (IoT) is that the system of physical gadgets, vehicles, home apparatuses, and elective thing implanted with gadgets, programming, equipment, sensors, actuators and availability that these things to join, gather and trade data, making open doors for more straightforward combination of the physical world into PC based frameworks, bringing about effectiveness enhancements, monetary preferences, and diminished human exertions.

## LITERATURE SURVEY

Several solutions for monitoring different environmental parameters which is based on wireless nodes have been proposed earlier. In this paper the solution described particular attention to the data storage and safety, even though conceived with a similar approach. The architecture proposed in [1] by Luca Lombardo et al., relies on a multiple-level data storage, which provides a strong data safety. In particular, it gives the possibility to retrieve the whole measurement history of the monitored site, avoiding any issue connected with cabling and network connection break. In paper named as "Wireless Sensor Network application for water quality monitoring in India" [2], aim of author Dr.Seema Verma and Prachi is to discuss requirement and suitability of WSN for water quality surveillance. Paper [3] presents the development of a real time wireless sensor network for any environmental data prediction using naïve prediction model. The developed system was imposed on intranet; Low forecast metric error result obtained shows the accuracy of the naïve model.

I.F. Akyildiz et al., describes the concept of sensor networks in their paper "Wireless sensor networks: a survey" [4] which has been made viable by the convergence of micro electro-mechanical systems technology, wireless communications and digital electronics. First, the sensing tasks and also the potential sensing element networks applications are explored, and a review of things influencing the planning of sensing element networks is provided. Then, the communication design for sensing element networks is made public, and also the algorithms and protocols developed for every layer within the literature are explored Open analysis problems for the conclusion of sensor networks are also discussed. Wireless small sensing element networks are known mutually of the foremost necessary technologies for the twenty first century. Paper [5] traces the history of study in the field of sensing networks over the past several decades, including two important programs of the Defence Advanced Research Projects Agency (DARPA) spanning this period: the Distributed sensor Networks (DSN) and the sensor info Technology (SensIT) programs. Technology trends that impact the event of sensing element networks area unit reviewed and new applications like infrastructure security, surroundings watching, and control area unit introduced. The technical challenges continue sensing element network development involve network discovery, management and routing, cooperative signal and knowledge process, tasking and querying, and security.

This paper presents the design details, the development, and the analysis of three different sensors that enables the achievement of Internet connected solutions for monitoring the environment or the ambient at remote locations: one employing UDP-based Wi-Fi communication [6], one based on the HTTP protocol, and one consisting in power harvesting Bluetooth Smart. Being provided with Internet connection capabilities, the developed sensors represent a part of the Internet of Things (IoT), the vision that "allows people and things to be connected Anytime, Anyplace, with Something and Anyone, ideally using Any path/network and Any service" [7]. Donno et al., [8] propose a solution where self-powered Radio-frequency identification tags, equipped with temperature, light, and acceleration sensors, are used. The device has the power to reap RF energy and its operation has been valid through two real-world experiments, within which the no inheritable knowledge area unit collected a number computer with the assistance of a reader antenna. The design achieved a transmission range of up to 10 and 20 m in fully passive and battery-assisted-passive modes, respectively.

The proposed system can be used for monitoring the ambient or outside weather parameters, and, if the host PC is provided with an Internet connection, can be part of an IoT-based solution. In [9] we reported the development of Wi-Fi sensors sending temperature and relative humidity measurements to a base station using UDP. A battery lifetime of two years with a twenty min measurement cycle was achieved. This encouraged the development of a device using HTTP, for investigating the power efficiency of this more reliable solution, from the communication point of view. J. Ramprabul describes a low cost and holistic approach to the water quality monitoring problem for drinking water distribution systems as well as for consumer sites in their paper [10]. Their approach is to develop sensing element nodes for real time and in-pipe watching, assessment of water quality on the fly and to calculate the number of water delivered.

Wireless sensor Networks (WSNs) are achieved widespread relevancy in water quality observance. However, existing WSN-based observance systems aren't adequate for Observance Lake and lake water, town water distribution and water reservoir. Moreover, these frameworks can't be reused in alternative observance applications since they use static and application specific detector nodes and aren't dynamic to the ever-changing needs. Thus, author of paper [11] introduce a reusable, self-configurable, and energy economical WSN-based water quality watching system that integrates a Web-based info portal and a sleep planning mechanism of sensing element nodes. The workplace and simulation results show that the framework will monitor the water quality in period and therefore the sleep programing mechanism will increase the network time period, severally. Finding patterns in giant, real, spatio/ temporal data continues to draw in high interest (e.g., sales of merchandise over house and time, patterns in mobile users; sensor networks aggregation operational info from vehicles or perhaps from humans with wearable computers). In paper [12], Anastassia Ailamaki et al., describe an interdisciplinary research effort to couple knowledge discovery in large environmental databases with biological and chemical sensor networks so as to revolutionize drink quality and security deciding. They describe a distribution and operation protocol for the placement and utilization of in place environmental sensors by combining (i) new algorithms for spatial temporal processing, (ii) new ways to represent water quality and security dynamics, and (iii) a classy decision-analysis framework.

The work planned in [13] by S. KaviPriya et al., is the event of low price fuzzy based mostly water quality watching system victimisation wireless sensing element networks that is capable of measurement physio chemical parameters of water quality like hydrogen ion concentration, temperature, conductivity, oxidation reduction potential and turbidity. Recent advancement in wireless communications and physical science has enabled the event of cheap detector networks. The detector networks will be used for

varied application areas (e.g., health, military, home). For different application areas, there are different technical problems that researchers are currently resolving. The current state of the art of detector networks is captured during this article, wherever solutions area unit mentioned underneath their connected protocol stack layer sections. The article presented in [14] also points out the open research issues and intends to spark new interests and developments in this field.

One of the immediate benefits brought by the acquisition of such physical proprieties, like soil moisture, temperature, and salinity, can be seen in agriculture, where significant water resource savings can be achieved [15]-[17]. Wireless sensing elements and sensor networks are with success utilized in the implementation of solutions happiness to numerous fields, together with environmental watching [18]–[19], natural disaster bar , current consumption watching in large buildings , monitoring systems for the dosimetry of radiology operators in healthcare applications [20]-[21].

## PROBLEM STATEMENT & OBJECTIVE

- Environmental monitoring and prediction is extremely important due to recent changes in climate, for ensuring a safe and wealthy life of both humans and artifacts.
- The sudden change in climate impacts on environment in the form of pollution, temperature, humidity, rain, and heavy thunderstorm etc these are greatly affected to thousands of people, causes critical diseases and frowzled their life.
- In this context the proposed system having three IoT based solutions and providing environmental monitoring and weather prediction.
- The earlier system limits their monitoring region.
- This system is simpler and less costly as compared to earlier system.

## OBJECTIVE

- To monitor environmental conditions like temperature, humidity, real time rainfall and level of carbon monoxide gas using three different IoT based wireless communication.
- To predict the weather conditions and update along with sensor value on the cloud server.

## METHODOLOGY

The proposed system is simpler and uses advanced technology. It is based on sensor data collection and that uploaded to cloud server by three different technologies (UDP, HTTP and Bluetooth) and result is shown in mobile app taken from cloud server. The block diagram of the proposed system is shown below in figure 1.

The block diagram consists of three different nodes. Each node contains four sensors (such as Temperature, Humidity, Rain and CO sensors) and communicated to cloud server through three different protocols. Google Firebase is using as cloud server which stores the data collected by the sensors and displays in mobile app. For determining temperature and humidity of atmosphere we are using temperature and humidity sensor (DHT11) which will help in predicting environmental conditions. CO sensor (MQ-7) is used for determining level of Carbon Monoxide in environment, whereas rain sensor is used for detection of rain. The system is placed in 3 different locations and data from each location is collected by the server as shown in figure1.

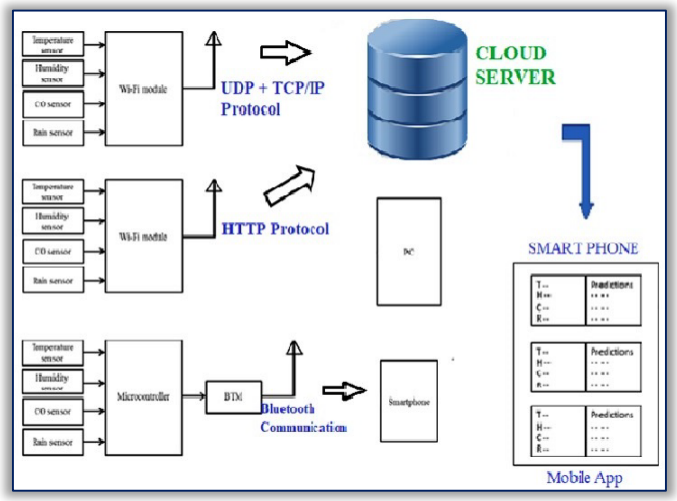


Figure 1. Block Diagram Of Proposed System

The server stores and displays the current values of all 4 parameters. A look up table is generated which contains the values of temperature and humidity and is used for predicting the current environmental conditions by comparing the data. These two data are only used because these are the basic and important constituents of environment, For example, if humidity is more and temperature is less then chances of rain is more, if humidity is less and temperature is more then chances of rain is less, if humidity is moderate and temperature is also moderate then weather is clear etc. Presence and absent of real time rain is determined by rain sensor.

System is placed at three different positions and each position uses different protocol for transmission of data. First place uses UDP+TCP/IP protocol to communicate with server. It transfers the data to mobile using the rules setup by TCP/IP protocols. The second place's system uses HTTP protocol to communicate with the webpage. The data is automatically updated in each 5sec. a webpage is developed to receive and transmit data using this protocol. The system placed at 3rd position uses Bluetooth module to transmit data on mobile. This system uses Bluetooth protocols and communicates with mobile app according to those protocols. Smartphone transfers data to webpage or mobile app using the mobile internet.

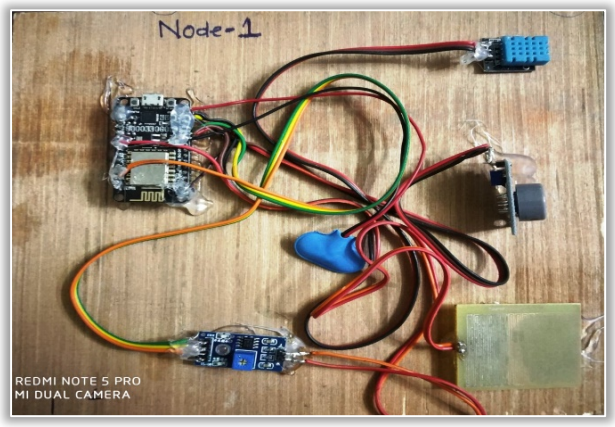


Figure 2. Node - 1 uses UDP+TCP/IP protocol

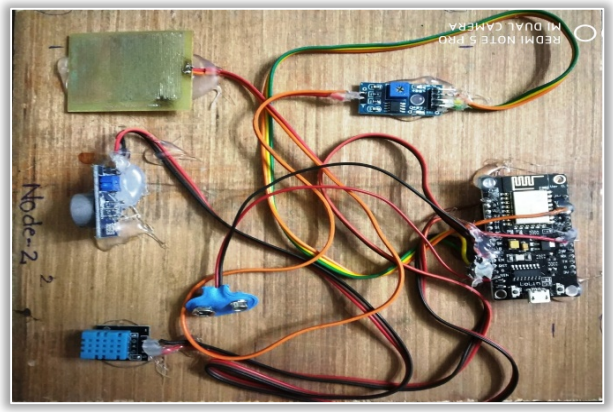


Figure 3. Node - 2 uses HTTP protocol

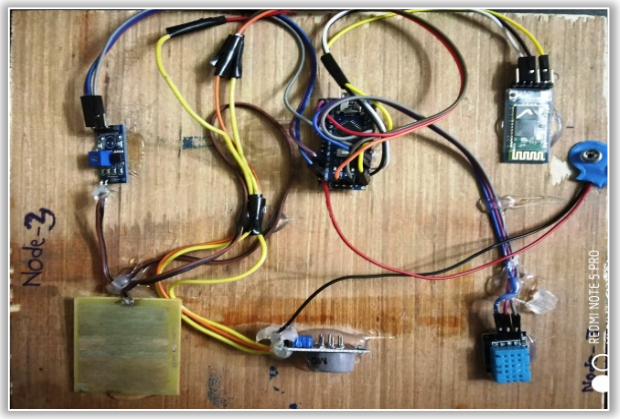


Figure 4. Node - 3 uses Bluetooth Communication

## RESULTS AND DISCUSSIONS

Sensor data recorded on different days and their predicted value are presented in Table 1.

Table: 1. Output Result

| Date | Temp (□C) | Relative Hum (%) | Conc. of CO | Rain status (Digital Value) | Prediction |
|---|---|---|---|---|---|
| 10-Mar-19 | 32 | 54 | 115 | 0 | sunny weather |
| 11-Mar-19 | 32 | 57 | 116 | 0 | sunny weather |
| 18-Mar-19 | 33 | 43 | 109 | 0 | sunny weather |
| 19-Mar-19 | 33 | 43 | 108 | 0 | sunny weather |
| 27-Mar-19 | 27 | 95 | 115 | 1 | It's Raining |
| 28-Mar-19 | 32 | 65 | 116 | 0 | clouded |
| 29-Mar-19 | 33 | 70 | 135 | 0 | clouded |
| 31-Mar-19 | 32 | 42 | 112 | 0 | sunny weather |
| 4-Apr-19 | 31 | 43 | 109 | 0 | sunny weather |
| 5-Apr-19 | 31 | 78 | 108 | 0 | clouded |
| 10-Apr-19 | 30 | 43 | 105 | 0 | sunny weather |
| 11-Apr-19 | 32 | 34 | 106 | 0 | sunny weather |
| 12-Apr-19 | 32 | 78 | 138 | 0 | clouded |
| 13-Apr-19 | 31 | 43 | 128 | 0 | sunny weather |
| 14-Apr-19 | 31 | 43 | 116 | 0 | sunny weather |
| 15-Apr-19 | 31 | 45 | 143 | 0 | clouded |
| 16-Apr-19 | 30 | 48 | 121 | 0 | clouded |
| 17-Apr-19 | 30 | 43 | 117 | 0 | sunny weather |
| 18-Apr-19 | 30 | 60 | 110 | 0 | Partly clouded |
| 19-Apr-19 | 29 | 58 | 111 | 0 | Partly clouded |
| 22-Apr-19 | 11 | 96 | 108 | 1 | It's Raining |
| 26-Apr-19 | 30 | 60 | 109 | 0 | Partly clouded |

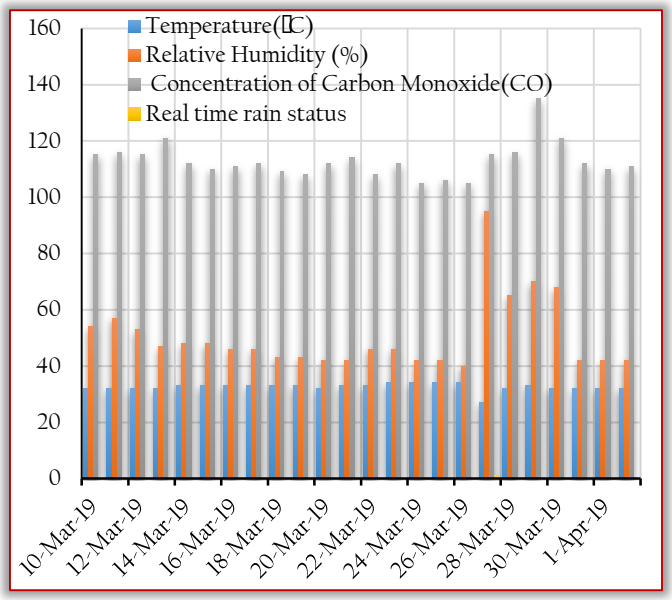


Figure 5. Graphical Representation of Output Result (sensor data on different days)

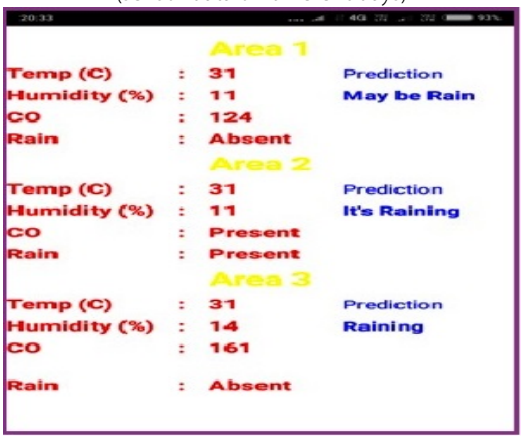


Figure 6. Result Displays in Mobile app

## FUTURE SCOPE:

With some modifications in basic system, proposed system can be used in following areas:

- industrial sensing
- infrastructure security
- traffic control
- environment and habitat monitoring

## CONCLUSIONS

This paper presents three different techniques for implementing IoT-based solutions for environmental monitoring and prediction: one employing User Datagram Protocol (UDP)-based Wi-Fi communication, second employing communicating through Wi-Fi and Hypertext Transfer Protocol (HTTP), and a third one using Bluetooth communication.

The system was designed, developed, and analysed and all of them were fabricated with discrete components and provide facile access to the Internet using a minimum of additional hardware and software resources. The analysis of the three implementations revealed the fact that all three technologies are suited for successfully environmental monitoring applications. The prediction done on the basis of sensor data collected, which experiments are done at Viman Nagar area in Pune on different environmental

conditions. The result shows in mobile application in form of data value and prediction. Employing this technology has been proved efficient and promising results which encourage for development of systems.

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