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Implementing and Exploring the WSN Based Smart Home Weather Monitoring System Using IOT

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Abstract: Aim of this paper is to implement an IoT based weather monitoring system for smart home, also explore the various technologies that exists and can be used for the low-cost smart home IoT system. Here the humidity and the room temperature is monitored using the DHT11 sensor and ESP32 microcontroller. The data collected from sensor is transmitted to ThinkSpeak cloud, where the monitoring and visualization can be done on real time. The paper also discuss various technologies related to the Smart Home weather monitoring, highlights the application of such low –cost system.

Keywords: IoT, WSN, ESP32, DHT11, Smart Home, ThinkSpeak, Weather, Monitoring, Station.

I. INTRODUCTION:

IoT been a revolutionary technology, where facility like collection of data through sensors and processing show wide spread and acceptance. The Smart Home is an important IoT application, showing the significant work in monitoring the environment and its real time data gathering and analysis. Humidity and temperature as parameters in weather monitoring are crucial and they have widely used in open areas like agriculture, meteorology and closed are like smart home and industry. Our paper presents a low cost smart home weather monitoring system based on IoT. The system consist of the technologies discussed in the section II, and developed for monitoring the room temperature and humidity using the DHT11 and ESP32.

II. RELATED WORK:

The advancements and the significance of the weather monitoring systems are reviewed in this sections. Here the systems offering the collection of the data in real time, accuracy in collection of data, energy efficiency are discussed.

Paper	Review
[1]	A novel approach is shown in the study, here the devices was implemented in open, where it worked. The author has provided the datasheet for the data, using the dashboard in the graphical and tabular form also allowing the data retrieval in excel.
[2]	Author proposed the ESP-32 microcontroller based system integrating with GISMO and provided prototype of the system, here ThingSpeak is to store the data. For better visualization of data in real time the author used the ThingSpeak.
[3]	It has been observed that the proposed system is a solution for monitoring the different weather conditions. The author integrated the microcontroller with the GSM module to send the data, the database is used to store the data.
[4]	The author used multiple sensors for efficient input in developing the system, it was developed focusing on lightweight scalable for monitoring weather,
[5]	The paper explores and discussed an interface and accessibility of the data for the proposed system.
[6]	A comprehensive system for monitoring weather is discussed for more reliability and accuracy in various conditions to work.

[7]	Author developed the weather station system with embedded approach, highlighting efficient in collecting data and its potential to be used in various fields is also discussed.
[8]	Here the innovative technologies required for smart station to monitor the weather are discussed along with challenges in implementation and direction for future research.
[9]	A hybrid model is presented in the paper for the air quality and weather monitoring, also the need of such systems is discussed.
[10]	Here the focus of study was on optimizing consumption of energy, require by the system to monitor the weather, the proposed method enhance the sustainability along with the performance.
[11]	Focusing on the controlling the temperature, quality of the air and efficiency of the system, the author presents mechanism for fan controlling, with real time data for the indoor conditions in which the system is working.
[12]	The research discuss a remote monitoring system for environment on different parameters, highlighting the potential in different areas of implementations.
[13]	The study explores the different solutions in detecting and air pollution monitoring. Various sensors were integrated for monitoring the pollution for the safety and public health. The author also highlights the strategies for response and awareness for enhancing the environment monitoring using IoT.
[14]	Here the author reviewed Indoor air and its quality monitoring system focusing on the performance, effectiveness, and research gaps for good health in urban environment.
[15]	Author presents, a system with accurate data collection and analysis for weather station and forecast.
[16]	Paper focus on Wireless IoT device for air quality monitoring with the integration of sensors, processing capabilities in real time. The system works on LoRaWAN, the strength of the system are the energy efficiency, long range Communication.
[17]	Here the author highlights and discuss the advancements in system for monitoring environment, along with new emerging technologies, potential, challenges.
[18]	The author focused on development of real-time CO_2 monitoring system, also discussing the environment health, role of IoT in it.
[19]	The paper introduced a robotic model for indoor quality detection of air, the capabilities of such system is discussed. The author has discussed data sorting process depending on the axes and simple linear regression. According to the author the error rate of 5.56% was there due to the sensor.
[20]	The study conducted, discuss the smart weather station. The author emphasize user friendly interface for the system along with data visualization.
[21]	The author focus on “triple bottom line” theory in developing the system, secondary data method of collection is used.
[22]	A comprehensive air quality monitoring system is presented along with the architecture, potential applications and data processing is discussed from aspect of urban planning. The proposed system is 84% accurate and its comparative analysis is provided.
[23]	The paper outlines the advancement in weather station systems, the author has provided extensive reviews, recommendations for improvement and highlights the water, air quality monitoring with waste management systems.

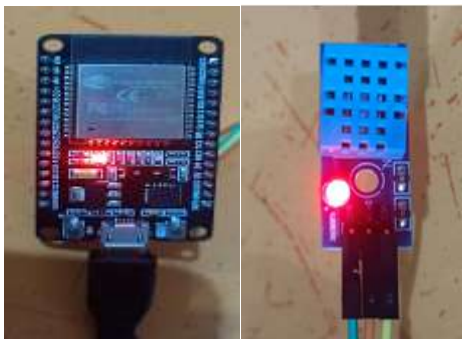
III. PROPOSED SYSTEM AND TECHNOLOGIES:

The following technologies were used in implementing the system, the complete programming was done in the ARDUINO IDE. The connection are as shown in the following fig. 1. Using the female to female jumper wires the sensor was connected to the microcontroller, the microcontroller was connected to the wireless network.

i. **WSN:** Wireless Sensor Network enables the IoT system to be connected to the Internet and communicate. This network consist of the DHT11 sensor and ESP32 that collects the data and transmit it wirelessly. Through home gateway this data is then transferred to the cloud i.e. ThinkSpeak for monitoring.

ii. **ESP32:** Fig 1. (a), this is a microcontroller which work on low power and comes with built-in Wi-Fi and Bluetooth connectivity support. This is one of the low cost and widely used microcontroller, it is reliable with efficient power consumption and strong connectivity. The microcontroller works on 240 MHz frequency and comes with 4MB Flash.

Fig 1. (a) Fig 1. (b)



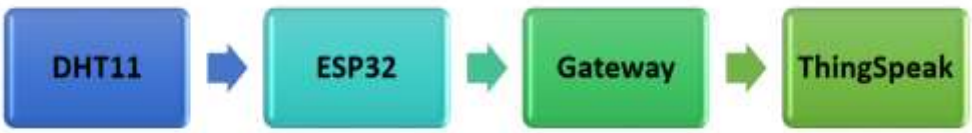
iii. **DHT11:** Fig 1 (b), it is a sensor which collects the humidity and temperature, it comes with easy connectivity and helps in monitoring the environment on real time basis.

iv. **ThinkSpeak Platform:** This platform collects the data and give the real time monitoring facility. Here data collection and monitoring is more secure, it provides the advanced security feature of using the API key that can be generated and used for the secure system communication. It support API key generation and the visualization of the data can be made private or public as per the requirement. This platform provides data visualization and pre designed various types of representations can be used for this.

IV. SYSTEM FLOW:

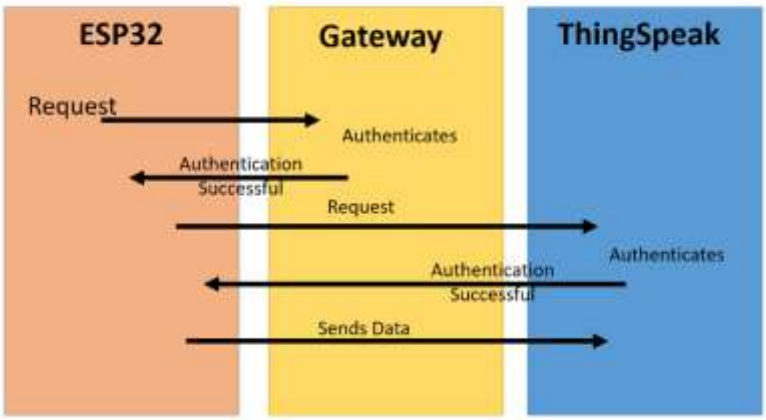
Fig 2, represents the flow of data and system as well. The DHT11 is a digital sensor which collects the values for the humidity and temperature. Then it transfer them to microcontroller, which then sends them to the cloud through the gateway. Here the gateway is the Wi-Fi router.

Fig. 2. System Flow



Here the microcontroller sends the request to the gateway, to get connected to internet. The authentication and authorization mechanism takes place here, depending on this the microcontroller either gets connected successfully or shows disconnected status. This phase of authentication is as shown in the following fig 3.

Fig. 3 Authentication Phase



After the successful authentication from the gateway, then same phase is repeated with microcontroller and ThingSpeak. Then only the humidity and temperature data can be stored and visualized. Here the authentication is done using the API key which can be regenerated.

V. CHALLENGES & SOLUTIONS:

Here during the implementation various challenges were faced like authentication failure if the correct required credentials are not matched. Another challenge is that the platform accepts the data only after specific time interval.

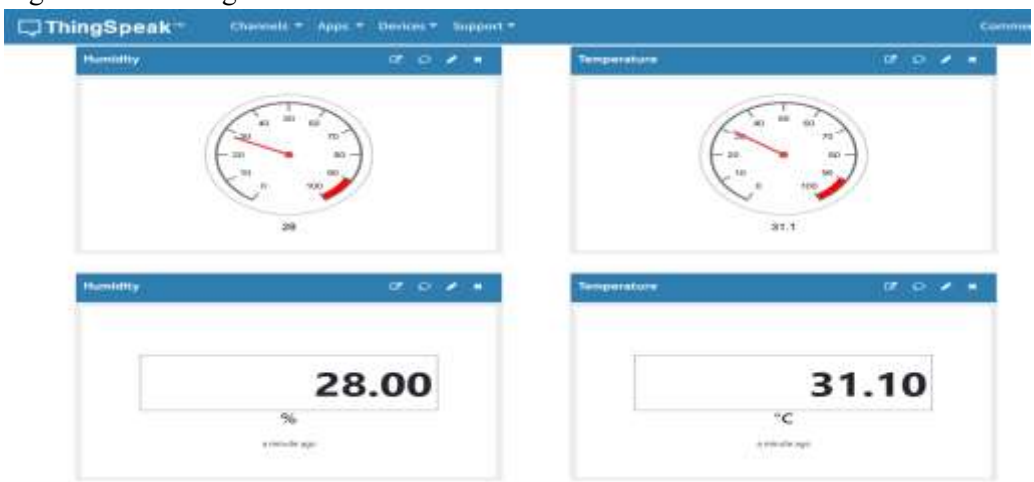
VI. RESULT:

The following fig 4, represents the system, fig 5 and fig 6 shows the humidity and temperature data on the platform.

Fig 4. System Connection

Fig 5. Humidity & Temperature Data Visualization

Fig 6. Data in Widgets



The embedded system works well in terms of monitoring the temperature and humidity. The System completes the authentication phase and connected to the ThingSpeak, where the data is successfully uploaded. Using the widgets and other features provided by the ThingSpeak, the data can be monitored and visualized.

VII. FUTURE SCOPE:

Depending upon the requirements for the system the data can be store on the system server and other cloud platforms like the Xampp Server, Firebase. If the proposed system is used with the AI, its application can even perform for predicting environment changes, different patterns for research and management, monitoring pollution and air quality. This proposed system can be used as the base system for implementing in various fields to be applied. Using various sensors the system can monitor the environment in different conditions it can perform well. It can be used as application in agriculture, green house, health care center as it has the potential and provide accessibilti and data visualization.

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