# Multiutility & Customizable Environment Monitoring System with the Healthcare Utilities

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**Abstract:**
In the current scenario the Internet has been evolving expeditiously and is unravelling millions of new possibilities. While exploring the capabilities of this giant communication channel we came up with an IoT based approach of the Remote Monitoring System (RMS). To serve data to the user over long distances wirelessly, Chatbots, web servers and cloud storage could be the best alternative of all and to make the device which satisfies the user's needs we have combined all of them to create a multi utility environmental parameters monitoring and recording system. The device is capable of broadcasting real-time sensor data over the cloud server, social media and a local host web server with the speed depending upon the internet. Integration of API has enabled the device to connect with social media and cloud storage services.

**Keywords:** RMS, Local Host, web server, cloud storage, API.

## Introduction:

The monitoring of environmental conditions is a crucial aspect of ensuring the health and safety of individuals. As concerns continue to grow over the quality of air and other environmental factors, the need for intelligent monitoring devices capable of gathering and analysing real-time data is becoming increasingly evident. This research paper seeks to introduce a device that utilizes an ESP-32 microcontroller, DHT-22 module, BMP-180 sensor, MQ135 gas sensor, and IR sensor to gather pertinent environmental data, including temperature, humidity, heat index, altitude, pressure, air quality, and fire alert. The collected data is then seamlessly transmitted to a telegram chatbot, providing easy access and monitoring, while also streaming to a Blynk IoT application, enabling real-time monitoring with cloud storage capabilities. Furthermore, it features the capability of Over-The-Air (OTA) updates, facilitating facile maintenance and continual enhancement.

The device's true value lies in its potential applications within hospital settings, where the monitoring of environmental conditions is critical for maintaining patient safety and well-being. With accurate and timely information concerning factors such as temperature, humidity, air quality, and more, healthcare professionals can ensure that their patients are being cared for in a secure and healthy environment.

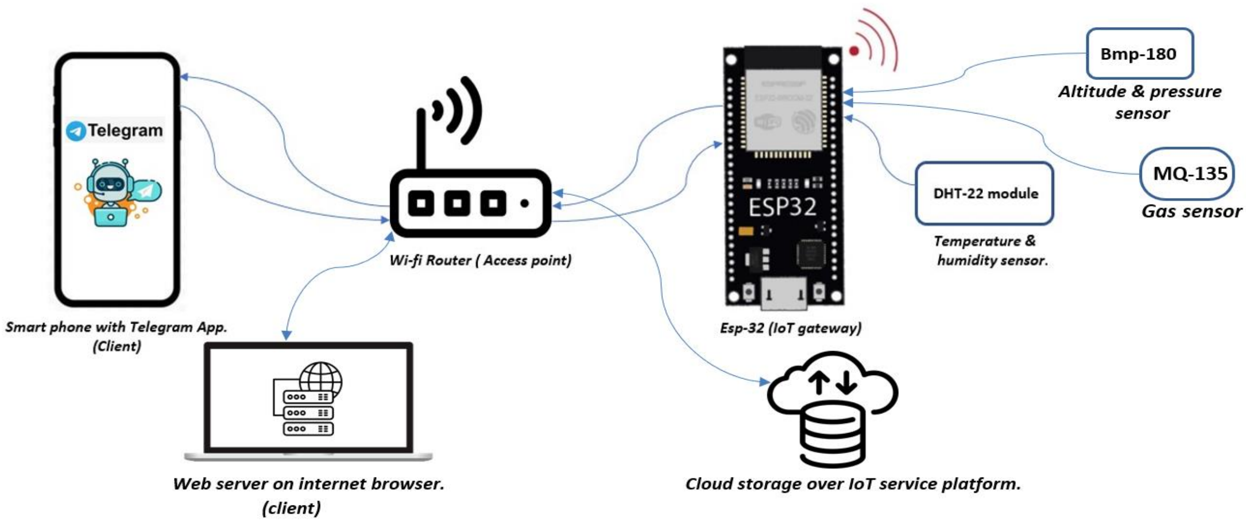
This research paper shall delve into the device's design, encompassing its various hardware and software components, along with its data collection and transmission processes. Additionally, the study will present the experiment's results, while exploring the device's possible applications within the healthcare industry.

**Methodology:**

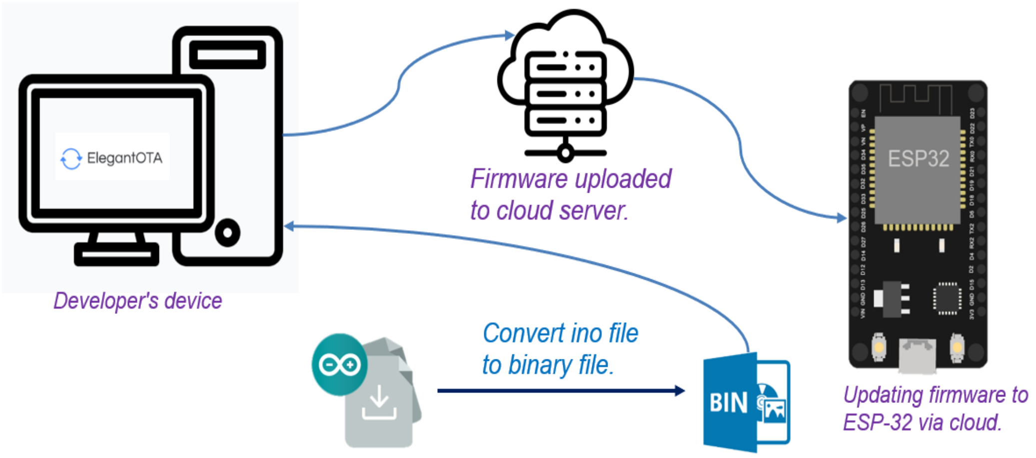
The technical methodology of working for this device is as follows:

1. **Sensor selection and integration:** The selection of the sensors was based on their ability to provide accurate and reliable data on environmental conditions. Each sensor was calibrated and integrated into the device's circuit using appropriate hardware connections.
2. **Programming:** The device's programming involved developing a firmware using the Arduino Integrated Development Environment (IDE) to control the sensors and perform data collection, analysis, and processing. The programming was written in C++ using libraries and modules suitable for each sensor, such as the Adafruit sensor libraries for the BMP-180 and DHT-22 sensors
3. **Testing**: The device was tested in various environmental conditions to ensure that the sensors and firmware were functioning optimally. Testing involved subjecting the device to varying temperatures, humidity levels, and altitudes, as well as exposing it to different gases and pollutants. Test results were analysed to optimize the device's performance and improve its accuracy and reliability.
4. **Real-world deployment and evaluation:** The device was deployed for use in some closed environments, where it underwent extensive evaluation under real-world conditions. User feedback was collected to improve the device's functionality and ease of use.
5. **OTA updates:** The device's firmware was designed to allow for OTA updates. This involved developing a system that could remotely update the firmware, including security features, to address any potential vulnerabilities or functionality issues that might arise.

Overall, the technical methodology of working for this device involved selecting, calibrating, and integrating sensors into a single device, developing optimized firmware using the Arduino IDE, extensive testing, real-world deployment and evaluation, and incorporating OTA updates to ensure continuous optimization and improvement of the device's functionality and reliability.




*Graphical representation of system architecture.*




*Graphical Representation of over-the-air (OTA) firmware update.*

**Working Mechanism:**

1. **Data Collection:** The device continuously collects data from each of its sensors. The DHT-22 module collects data on temperature and humidity, the BMP-180 sensor collects data on pressure and altitude, the MQ135 sensor collects data on air quality, and the IR sensor detects any presence of fire.
2. **Data Processing**: The device processes the collected data using algorithms programmed into its firmware. These algorithms convert the raw sensor data into meaningful and accurate environmental parameters, such as heat index and air quality index.
3. **Data Transmission**: Once the data is processed, the device transmits it to a Telegram chat bot and Blynk IoT platform in real-time. The Telegram chat bot allows users to access the device's environmental data, receive alerts, and control the device remotely. The Blynk IoT platform enables users to monitor the device's environmental data on a dashboard and store the data in the cloud.
4. **Fire Alert System**: In the event of a fire, the device's IR sensor detects the heat and sends an alert to the Telegram chat bot, notifying users of the potential danger.
5. **OTA Updates**: The device is designed to receive OTA updates, which allows for remote maintenance and updates to the firmware, including security features and improvements to the device's functionality.

In summary, the device works by continuously collecting data from its sensors, processing the data using programmed algorithms, transmitting the data in real-time to a Telegram chat bot and Blynk IoT platform, detecting any presence of fire using its IR sensor, and allowing for OTA updates for continuous improvement and maintenance of the device's firmware.

**Software Required:**

- Arduino IDE
- Telegram App
- Web Browser
- Blynk IoT platform or Thing speak.

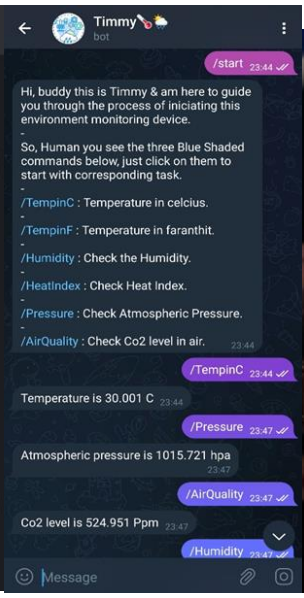
**Hardware Required:**

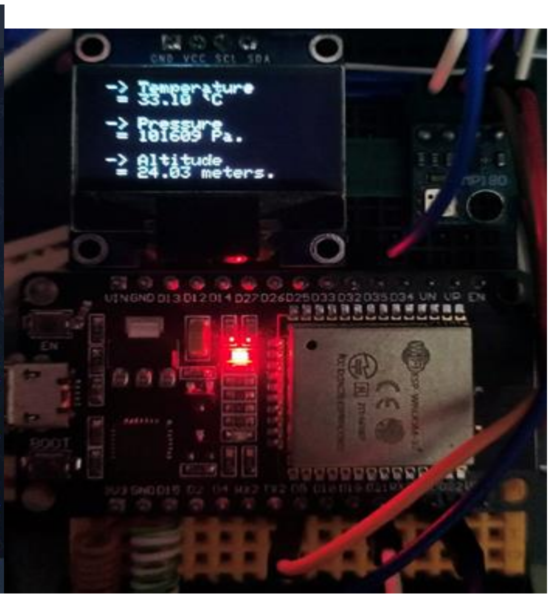
- Esp-32 Development Module. (Espresso systems)
- BMP-180 pressure and altitude sensor. (Bosch)

- DHT-22 humidity and temperature sensor. (Generic)
- MQ-135 Gas sensor (winsen)
- IR Receiver Module. (Generic)
- OLED display SSD1306 (Adafruit)

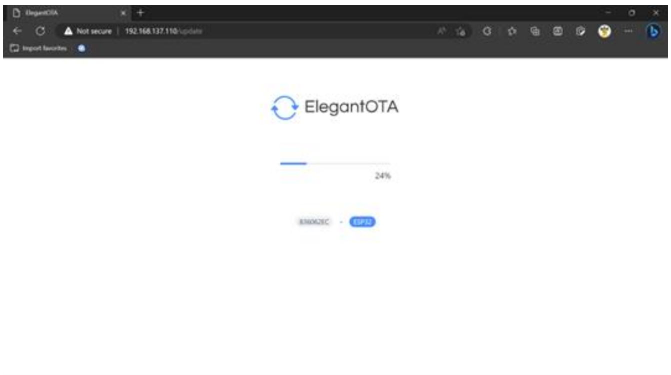
**Results:**

Here are the images of user interface to show the acquired sensor data on different Web, iOS & android based applications.

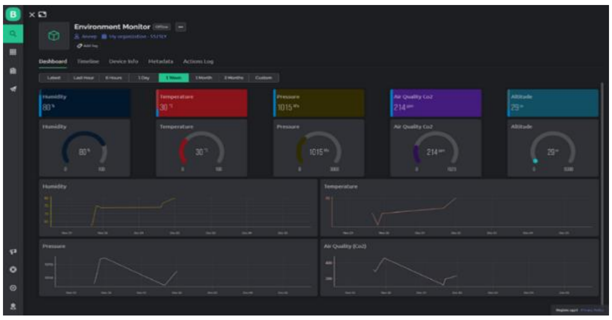




*1. Blynk app interface.* *2.Telegram Chatbot.* *3. Display onboard.*




*4. Blynk web dashboard & cloud storage.*




*5. Over-the-air (OTA) firmware update.*

**Conclusion:**

In summary, the device is a significant contribution to the field of environmental monitoring and has potential applications in other settings beyond hospitals. Its ability to provide accurate and real-time data, combined with remote monitoring and control features, makes it a valuable tool for maintaining optimal environmental conditions and improving overall healthcare outcomes.

The device's use of advanced sensors and firmware algorithms ensures that it provides highly accurate and reliable data, while its OTA update feature allows for continuous improvement and maintenance of its functionality. Additionally, its fire alert system provides an added layer of safety and security for hospital occupants, further enhancing the device's overall effectiveness.

The successful real-world deployment of the device in some environments, coupled with positive user feedback and extensive testing, confirms the effectiveness of its technical methodology and working mechanism. Future research can explore the potential for integrating additional sensors and features to enhance the device's functionality further.

Overall, this device is a highly innovative and effective solution for monitoring environmental conditions in hospitals, with potential applications in other settings that require continuous monitoring of environmental parameters.

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