Analysis of Three IoT-Based Wireless Sensors for Environmental Monitoring

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1 Summary

Analysis of Three IoT- Based Wireless Sensors for Environmental Monitoring is a paper acknowledging a major crisis faced by the current society. As the current advances in the field of technology and economy are moving at a fast pace so is the decline of the current world's environment and immediate and serious actions must be taken to monitor and analyse the effects of the development. Every invention has an after-effect and collateral damage and in order, to damage control the situation immediately before the events go beyond repair, proper measures must be taken and analysis and monitoring of the situation can help in formulating appropriate, rapid and cost-efficient responses in accordance with the situation. Recent advancements, such as the vision of the Internet of Things (IoT), the cloud computing model, and cyber-physical systems, provide support for the transmission and management of huge amounts of data regarding the trends observed in environmental parameters. In this context, the current work presents three different IoT-based wireless sensors for environmental and ambient monitoring: one employing User Datagram Protocol (UDP)-based Wi-Fi communication, one communicating through Wi-Fi and Hypertext Transfer Protocol (HTTP), and a third one using Bluetooth Smart. All the presented systems provide the possibility of recording data at remote locations and of visualizing them from every device with an Internet connection, enabling the monitoring of geographically large areas.

The first section of the paper talks about the environmental challenges faced by the current world due to various advancements in technology and ways to analyse and monitor the current situation using the collection of data. This can be done using Bluetooth and Wi-fi based technology, it talks about how the WSNs and their applications are in the monitoring phase of the system. For a more accurate grasp of the situation, it is suggested that data be collected not just from an open environment but also from indoors as it also helps in providing a comfortable ambience for the users of various products. The monitoring and analysis will include the collection of multiple data from pollutants such as CO2, CO, SOX, etc. There will be various modules set up with sensors equipped with Bluetooth and Wi-fi components in multiple sectors. The sensors based on this type of module take advantage of the existing infrastructure, have native IP-network compatibility and can use protocols such as User Datagram Protocol (UDP) and Hypertext Transfer Protocol (HTTP), eliminating the need for applications that encapsulate the data for transmitting them to the internet. There will be three different types of Zigbee-based Bluetooth IEEE devices for the purpose of monitoring and analysing the environment they are discussed in different sections.

The author has suggested two solutions devices for the problem statement:

1. Wi-fi based solution (subdivision A B)
2. BLE-based solution
3. Extensive idea of Wi-fi based solution proposed by the author. The Wi-fi based solution explains the two sensors and the protocol followed by the module.

2 Key Contributions/ Ideas from Author

First, the UDP component of the Wi-fi based module senses the temperature and relative humidity of the room and the ambient temperature of the room. It collects the data and sends it to a cloud-based storage system. It is cost-efficient and has lower power consumption and lower data packet sizes so lower

latency increases the speed of data transfer. There was also reference data given to a test conducted by the author it explained how average consumption of 25.68 mA during 13-s-long wakeup periods, for a complex device, with several sensors attached (temperature and relative humidity, CO2 concentration in the air, absolute pressure, and light intensity). Because there are several sensors attached to the device, the structure is more complex than the general one. This one includes a separate power supply for the sensors, that can be turned off and leads to the power consumption of only 10 µA during sleep periods. By setting the ratio between wake-up periods and sleep intervals, the system can reach a power consumption between 100 and 200 mW. The consumption profile of the device, in this case, is highly influenced by the sensors attached, especially by the carbon dioxide sensor, which requires the use of a digital filter for attenuating the noise, which adds time to the wakeup period. The power signature of the device during a wakeup period, with the filter of the CO2 sensor set to 2, leads to an active time duration of 7 s, a wakeup period comparable with the one of the HTTP-based solution. Next comes the HTTP component of the Wi-fi module. The results obtained by using Wi-Fi and UDP lead to the development and analysis of an HTTP-based solution. Therefore, sensors that connect to a WLAN and that send measurement data through HTTP requests were designed and manufactured. It was expected that the use of this application protocol would increase the reliability of data transmission, with the side effect of also increasing the power consumption of the devices. The operation of the wireless sensor is similar to the one presented in the previous section, the only difference consisting in the way in which data are transmitted. Here, during the wakeup period, the device interrogates the attached sensor, opens an HTTP connection, and sends the data in the form of a GET request. After receiving the response from the server, it closes the connection and goes to sleep, according to the period set by the user. For testing the device operation, a generic free public cloud service was selected, data.sparkfun.com, which provides the possibility of logging data from remote locations, according to the IoT vision. The data are posted here using GET and POST requests, based on a public key and on a private key provided by the cloud platform when creating a data stream. These can be accessed from everywhere and the related information can be retrieved in different formats (JavaScript Object Notation, comma-separated values file, Structured Query Language) and further processed, if necessary. Finally, the entire module is concluded by various graphs and analysis tests run and different pictures of test models and trials are run to bring the most appropriate and logical module-based device.

Two the BLE-based solution:

Bluetooth Smart is getting an increasing amount of attention lately, and, therefore, a solution employing this technology was also developed. However, the scenario, in this case, is a completely different one. Here, the system consists of power harvesting beacons for the acquisition of environmental data, communicating in a wireless network without dedicated infrastructure. The gateway in this case is a mobile one and can be a smartphone that receives the data when it is situated in the sensor's range. From here, the data can be sent to a server, using the mobile device's connectivity capabilities. By using the location obtained by the mobile gateway, geographical data and time can be added to the recorded values, increasing their complexity and relevance. One simple example consists of the achievement of a smart city's map showing the changes in the environmental parameters, such as temperature or air quality, over time. This would imply the deployment of large numbers of BLE sensors in different locations and a background application running on the citizen's smartphones, acting as mobile forwarders of data to the cloud. In this direction, a BLE beacon that periodically measures the temperature and relative humidity in the air, the atmospheric pressure, and the light intensity was developed. The wireless sensor polls the sensors every minute and broadcasts BLE advertisements containing the acquired data every 3 s. The application running on the mobile gateway continuously scans for BLE advertisement packets and, if in range of one of the beacons, it receives and processes them. The application can display the values measured by the attached sensors locally or is able to send them to a cloud platform in an IoT scenario. Further tests and graphs are made in order to design the most ideal module to counter the problem statement given in the present scenario.

3 My Views:

Preserving and protecting the environment should be the top priority of mankind as humans have the supreme intellect that no other species has, the prowess of our minds is strong and great enough to affect the entire world and its ecosystem as such, we should be using it to undo the unbalance

that has done by previous generations as right now our top priority must maintain the balance of our environment in order to have a stable ecosystem. The solutions suggested by the author have a creative and significant application of Bluetooth IEEE and Wi-fi based modules as the IoT-based solutions and devices have proven to be highly efficient in the past in various sectors and the transfer of data and its collection process is also swift and efficient. The author has put in an appropriate amount of time and effort to invest in and conduct various tests to bring out the most energy-efficient, cost-efficient and least time consuming, most ideal solutions available. The protocols and programming pathways taken by the modules and the data analysis system are suitable for real-world applications to counter the problem statement.