A CYBER-PHYSICAL SYSTEM FOR ENVIRONMENTAL MONITORING

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Abstract: This paper presents the improvement of a cyber physical framework which screens the ecological states alternately the encompassing states for example, temperature, pressure in indoor spaces in remote areas. The correspondences between Transmitters and Receivers are performed towards remote foundation which is dependent upon the IEEE 802.11 b/g standards. The resulted solution gives likelihood about logging estimations from areas throughout the world and for visualizing and examining this assembled information from the device associated with Internet. This work includes the complete solution, A cyber-physical system, beginning with physical level, comprising from claiming sensors, processor and the correspondence protocol, and arriving at information management and stockpiling at the digital level. The test outcomes indicate that the suggested framework represents a feasible and straightforward solution for economical monitoring applications.

Keywords: Cyber Physical System, IEEE 802.11 standards, Internet of Things, Wireless Communication.

I. INTRODUCTION

The vitality from claiming natural screening will be undoubted for our age. This will be the field the place remote sensor networks (WSNs) need been initial used, their basic role comprising in the perception of the physical reality and the recording of physical amounts characterizing it[1]. The constant attempts of social and economic bodies for the improvement of technologies to develop energy efficiency and to reduce pollution and for the more efficient use of national infrastructure along with the needs of decreasing the cost of computation, networking, and sensing had lead to the emergence of a new era of advanced systems, called cyber-physical systems (CPSs), less than a decade ago. These include embedded systems, sensor networks, actuators, communication and management processes, and services to collect physical information and to work on the physical environment, all integrated under an intelligent decision system [2,3]. This paper presents a system for environmental and ambient parameter monitoring using low-power wireless sensors connected to the Microcontroller, which send their measurements to a central server using the IEEE 802.11 b/g standards. Finally, data from all over the world, stored on the base station, can be remotely visualized from every device connected to the Internet. This overcomes the problem of system integration and interoperability, providing a well-defined architecture that simplifies the transmission of data from sensors with different measurement capabilities and increases supervisory efficiency.

II. SURVEY OF WORKDONE

The document includes a development of monitoring solutions that credited from the advantages provided by wireless sensing technology. Reference [1] in June 2016 George Mois presented the development of a cyber physical system that monitors the environmental conditions or the ambient conditions in indoor spaces at remote locations. The resulted solution provides the possibility of taking measurements from locations all over the world and of visualizing and examining the gathered data from any device connected to the framework. This work encompasses the complete solution, a cyber-physical system, starting from the physical level, consisting of sensors and the communication protocol, and reaching data management and storage at the cyber level. The experimental results show that the proposed system represents a viable and straightforward solution for environmental and ambient monitoring applications.

Reference [5] defines an automated irrigation system based on a distributed wireless framework of soil wetness and temperature sensors that results water savings of 90% compared with classical implementations. Reference [15] presents a smart monitoring solution for the assessment of possible causes of power inefficiency at the photovoltaic panel level based on WSNs [15]. The work presented here leads to a ubiquitous network architecture, where the sensors are part of the Internet [7]. The developed monitoring solution, a CPS that incorporates all the developed Wi-Fi sensors and a cloud platform, allows the acquisition of data from every place where a wireless IEEE 802.11 network exists and the visualization of recorded data from every terminal connected to the Internet, without any additional hardware and software application other that an Internet browser.

III. STATE OF ART

Table 1: Comparisons of Methods, used for monitoring and controlling of environmental things.

Ref No	Methodology	Advantages	Limitations
[1].	A Beaglebone black embedded processor with programmable system on chip (PSOC3).	Faster response in transmission with low data loss.	Expensive hardware, number of sent packages increases, the losses also increase.
[2].	Average Slope Multiplication(ASM) to classify odors using dynamic response of sensors.	The ASM transferred data shows better separation among different cluster of test gases.	Expensive method.
[14].	Multiplayer Perceptron (MLP) Neural for pattern recognition algorithm.	Better superiorities for quantifying multiple kinds of chemicals.	Large size Algorithms.
[16].	Data fusion and aggregations based on self organised map (SOM) algorithms.	Aggregations and data fusions are good solutions.	Trade-off between the amount of transmitted data and energy consumption.
[17].	Real time air quality monitoring using WLAN, WSN, Embedded Systems.	Developed smoothing algorithm to reduce temporary errors.	Energy consumption issue.

IV. WIRELESS COMMUNICATION SYSTEM

A graphical representational of the whole cps utilized for observing natural conditions in indoor or open air spaces, the place IEEE 802. 11 b/g organize scope exist, is introduced over figure.

We setup a reconfigurable developed mobile sensor application device that extracts data collection, processing, and wired or remote transmission together. The device might a chance to be broadly utilized within large portions requisition regions of the IoT and WSN should gather multiple sorts from claiming sensor information progressively.

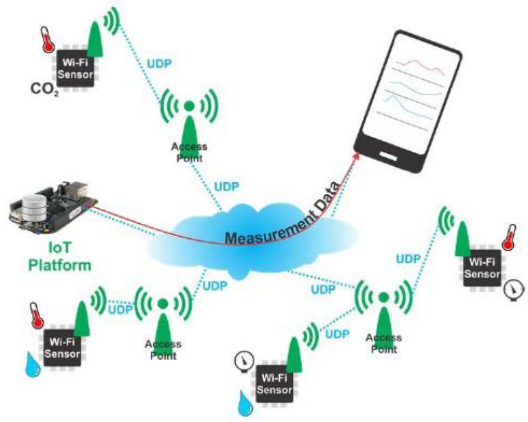

Figure.1. CPS for environmental monitoring[1].

Hardware Interface:

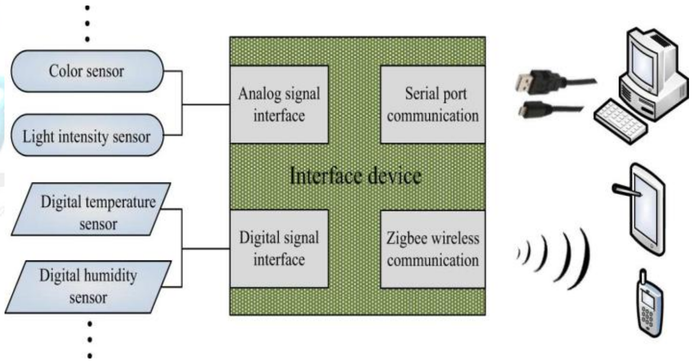

Figure.2. Application and Block diagram of the reconfigurable smart sensor interface device[8].

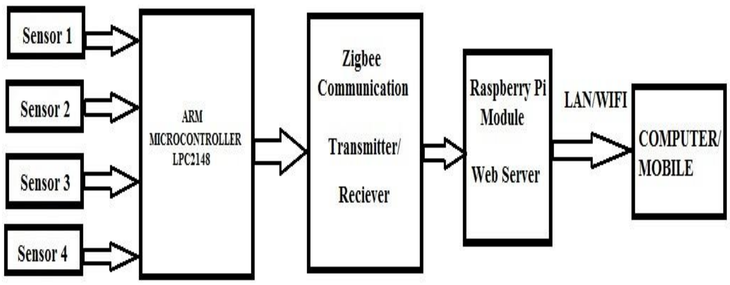

Figure.3. Basic Communication Hardware Block Diagram

The Microcontroller in this experiment can measure CO2(carbon dioxide) levels, temperatures, and the relative humidity in the air, the absolute pressure, and the light intensity using the mentioned digital sensors: a Cozir ambient sensor [10], a DHT22, an MPL115A2 barometer

[11] and a TSL2561 [12], respectively. These sensors can appear in any combination attached to a Wi-Fi device, with or without a LCD for the local visualization of the measured values. The communication with each one of the components is carried through using different protocols as follows: Serial data transmission for the carbon dioxide sensor and for the Wi-Fi module, a proprietary protocol for the DHT22 sensor, and I2C with the barometric pressure and light sensors. Being a wireless sensing node, with constraints regarding its power supply, the device stays most of the time in sleep mode and wakes up only when measurements and result transmissions have to be performed. This is one of the most efficient strategies for minimizing energy consumption in these kinds of systems [6]. Furthermore, because the power consumption of all the attached transducers in sleep mode does not allow long battery lifetimes, a separate power supply was developed and included in this second design. It uses a chip that provides high efficiency while using small amounts of power, consuming less than 1 μA in shutdown mode. These, coupled with the use of a high capacity (1500 mAh) battery, only slightly influenced by temperature variations and loads, lead to periods of continuous operation of up to three years without its replacement.

IOT Stage: The IoT platform is, in fact, a LPC2148 Processor and Raspberry Pi singleboard computer running at 1 GHz [9]. This choice was motivated by the advantages provided by this device when the development of a reliable stand-alone low-cost platform is targeted. Moreover, the use of the ARM as part of the proposed solution leads to low power consumption and to a reduced TCO. A server application runs on the IoT platform. This listens to the UDP port, interprets the messages received from the sensors, and saves the data in a database in the device's internal memory or on a microSD card. A Web server is installed on the platform for providing access to the data requested by authenticated users for further analysis.

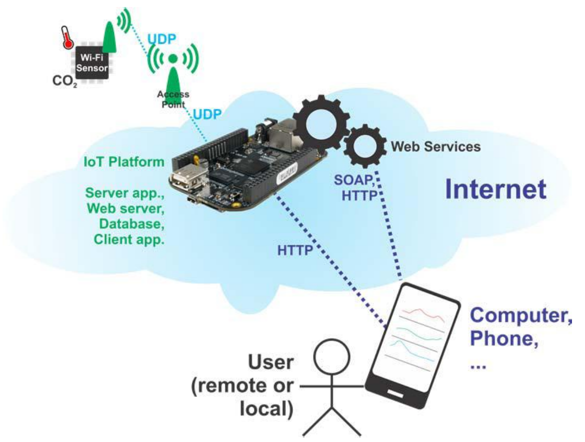

Figure.4. CPS for Surrounding monitoring[9].

Web Server: In reference[1], an accessible antecedent licensed small memory footprint Web server, namely, *lighttpd*, was installed on the IoT platform for remote data visualization (Figure. 4) [9].
Figure. 5 presents a simple Web client application in existing system displaying the temperature and humidity recordings sent by a Wi-Fi hosting the most recent eight qualities of the networking get control (MAC) address 663458D5. The data from the database can also be displayed as charts. As an example, a Web client application displaying the temperature, relative humidity, and carbon dioxide charts for the data sent by a sensor having a specific MAC address.

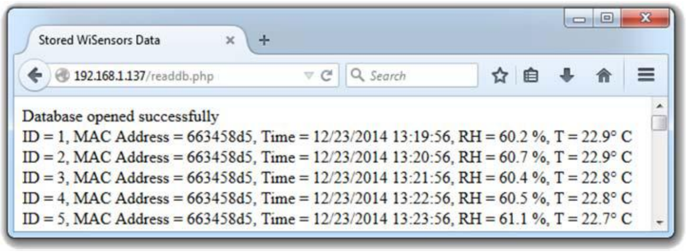

Figure.5. Server Window showing temperature and relative humidity Values[1].

V. EXPERIMENTAL RESULTS FROM LITERATURE REVIEW

A number of experiments were performed by George Moise and team to provide reliability and better performance to the data transmission from experimental setup to the host computers.

Firstly they tested for server's capabilities to process large quantity of received messages from nodes in a short time interval (window). The aim behind these test was to examine the maximum number of packages that can be evaluate in short time interval for a single IOT platform. Figure. 6 shows that the losses are reduced in this way and more data can be saved.

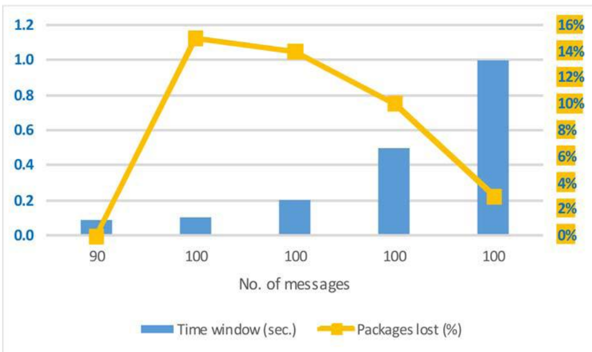

Figure. 6. Packages lost when receiving data from one source having 100 packages[1].

The second experiment by George Mois and team was with single IOT platform with 4 PCs, which was wirelessly connected. Two time windows were used to transmit one package. The result shows that if period increases, the package loss ratio decreases.

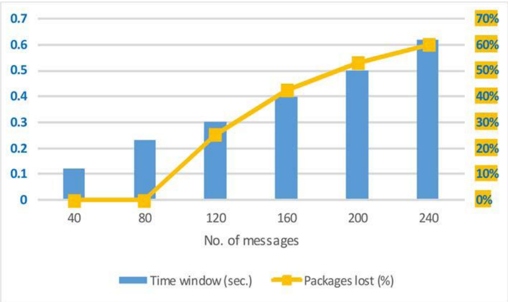

Figure. 7. Packages lost when receiving data from four sources at a time window of more than 120 ms[1].

VI.DISCUSSION AND CONCLUSION

The improvement of a CPS, which analyzes parameters of an environment dependent upon the existent IEEE 802.11 infrastructure. It utilizes sensors measuring the encompassing or the environment, which send messages to an IoT stage utilizing UDP. The correspondence protocol and the plan of the hubs help over accomplishing low power consumption, offering battery lifetimes for a long time. The framework dispenses with cumbersome solutions, gives the likelihood about logging information the place Wi-Fi organize scope exists, furthermore might be utilized within an extensive variety from claiming checking provisions. Future worth of effort means on upgrade those dependability and security of the recommended framework.

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