A NOVEL CYBER-PHYSICAL SYSTEM FOR ENVIRONMENTAL MONITORING AND CONTROLLING THE TASKS

[1] Yelle Kavya, PG Schloar, [2] Dr. T Jagannadha Swamy

[1]M.Tech Embedded Systems Student, Dept of ECE, GRIET, Hyderabad

[2]Professor, Dept of ECE, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

ABSTRACT

Development of a Cyber Physical System (CPS) that monitors the environmental conditions in indoor spaces or remote locations is required for various important applications. The communication between the system's components is performed using the existent wireless infrastructure based on the IEEE 802.11 b/g standards. By visualizing and analyzing the gathered data from any device connected to the Internet, we can have information of environmental conditions. 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.

Index: Cyber Physical System, Sensors, WSN, ICT, ARM7TDMI, GPS, GPRS

I INTRODUCTION

Cyber-Physical System is the one of the new development task for the various monitoring conditions and applications. The communication between the system's components is performed using the existent wireless infrastructure based on the IEEE standards [1]. By analyzing and visualizing the gathered data from any device connected to the Internet, receives various information of environmental conditions. 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 [2].

A real-time Cyber-Physical system for environmental monitoring based on WSNs and cloud computing is proposed in this paper. The architecture is designed according CPSs paradigm, and restful API are used to distribute sensor data for upper application. Wireless Sensor Network (WSN) has sensors to detect the physical parameters and they are interconnected wirelessly to trade information[3, 4]. It has a central monitoring system that is associated with the web to access the information remotely.

A few sensors are equipped in each remote area to measure environmental parameters and these measurements are sent to the focal office for capacity and analysis reason. Likewise, the focal office can offer charge to remote area for yield control execution [5, 6]. These elements offer an approach to keep up condition and permit acquiring alert on event of any abnormal conditions like parameters exceeding. A WSN permits organization of number of sensor hubs which design themselves depending on the system topology and neighborhood circumstance [7,8]. After sensing their physical condition and processing the acquired information locally, nodes communicate their information towards a network sink, where information is further handled and accessible [9,10].

II SYSTEM MODEL

The embedded systems and communication techniques and technologies advancements, led to the development of sensors. Sensors are getting more powerful, smaller, and cheaper. These offer a range of advances over traditional wired sensor applications, the most important consisting in the cost reduction and minimization of deployment through the elimination of wires [1]. All the aforementioned facts encourage the adoption of wireless sensor networks at a scale never encountered before and it is expected that in the future, this trend will not only continue but also become even more accentuated [6]. Furthermore, the development of CPSs brought new demands and opportunities for the use of WSNs, the combination of advanced sensing, measurement and process control having applicability across a wide range of domains, such as environmental monitoring, defense, smart buildings, transportation, energy, civil infrastructure, manufacturing and production, and others. Computations and physical processes, and not their union.

Fig 1: Cyber Physical System

As per complex definition of CPSs that a CPS integrates computing, communication, and storage capabilities with monitoring and control of entities in the physical world, and must do so dependably, safety, securely, efficiently, and in real time. Fig 1 gives the functionality of CPS.In addition, CPSs can be defined as follows: CPSs refer to Information and Communications Technology (ICT) systems (sensing, actuating, computing, communication, and others) embedded in physical objects, interconnected including through Internet, and providing citizens and businesses with a wide range of innovative applications and services. All of the definitions in the literature emphasize a strong relationship between computational (cybernetic) and physical resources in order to exceed the nowadays ICT systems in terms of autonomy, efficiency, functionality, adaptability, dependability, and usability. According to these statements, the system presented in this paper represents a CPS that employs wireless sensors for gathering and presenting data about the environmental conditions[4,5,6]. Fig 2 shows the complete block diagram of the system design.

III MODEL FOR THE DESIGN

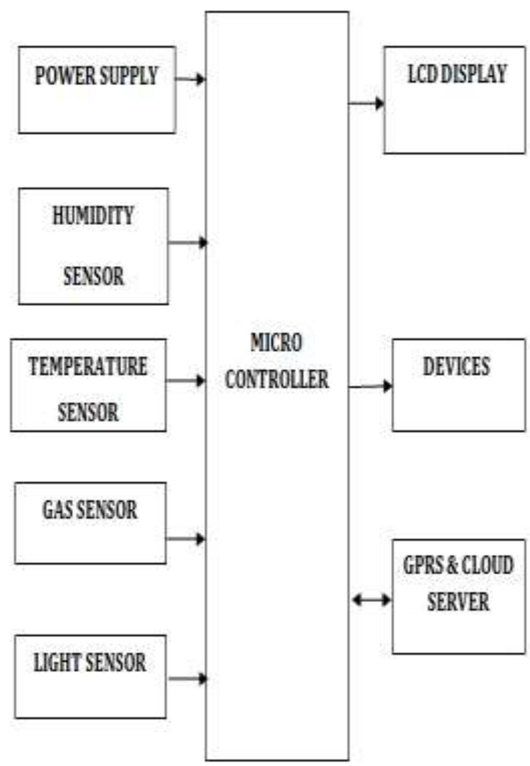

Fig 2: Block Diagram

a) Micro controller: This is the control unit of the project. It consists of a Microcontroller and circuitry like Crystal with passive elements, Reset circuitry, Pull up resistors and so on. As it controls the devices being interfaced and communicates with the devices according to the program being written, microcontroller is the heart of the proposed model.

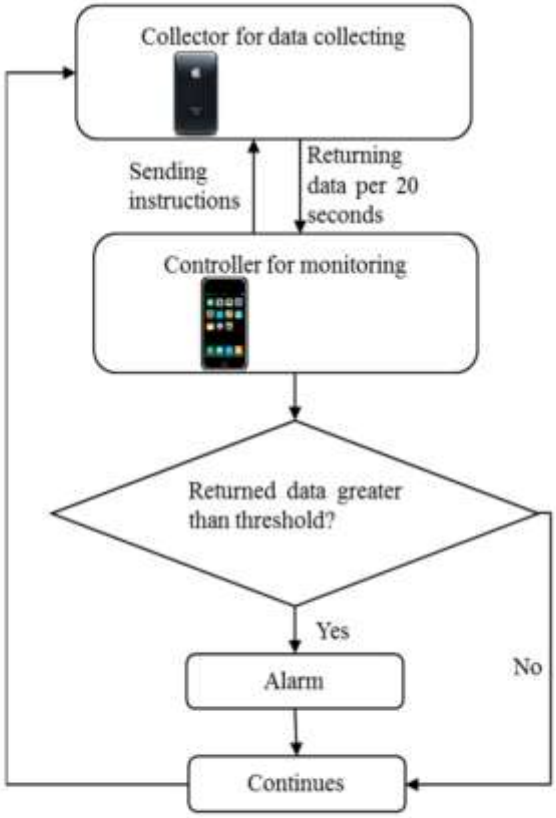

Fig 3: Flow Chart

b) ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines. It is the name of a class of processors and is the name of a kind technology as well. The RISC instruction set and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

c) Temperature Sensor (TMP103): Up to an accuracy of 1°C can be measured by TMP103. The TMP103 consists of two-wire interface which is compatible with both I^2C and SMBus interfaces. And also, the interface supports multiple device access (MDA) commands that allows the master to communicate with multiple devices on the bus concurrently. The TMP103 is suitable for indoor, low power applications with more temperature measurement zones should be calculated. The TMP103 can calculate temperature from –40°C to +125°C. Light Dependent Resistors are helpful significantly in light/dark sensor circuits. Normally the resistance of an LDR is very high. But when light incident on LDR, resistance drops instantly.

d) Gas Sensor: Effective smoke sensors are ionization and photoelectric detectors. These two detectors must pass the similar test for being certified as good smoke detectors. For smaller fire particles, Ionization detectors will get responded whereas for smoldering fires, photoelectric detectors respond. In both detectors, steam will lead to condensation on the circuit board and sensor, which causes alarm to sound.

Ionization detectors are of low cost than photoelectric detectors, but some users purposely put them out of action because they sound an alarm because of their sensitivity to minute smoke particles. However, ionization detectors have a degree of built-in security not inherent to photoelectric detectors. When the battery seems to fail in an ionization detector, the ion current reduces and the alarm sounds. That is it warns to change battery before the detector becomes of no use. Back-up batteries may be used for photoelectric detectors.

Sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, as the gas concentration increases, sensor's conductance also increases. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapour. The sensor is used to detect different concentration levels of alcohol; it is with low cost and suitable for different application.

e) Humidity sensor: A device that measures the relative humidity in a given area is called humidity sensor. A humidity sensor can be used in both indoors and outdoors. In both analog and digital forms humidity sensors are available. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. Usually the sensor is made of glass or ceramics. The insulator absorbs the water. This insulator is made out of a polymer which takes in and releases out water based on the relative humidity of the given area. This changes the level of charge in the capacitor of the on board electrical circuit. A digital humidity sensor works using two micro sensors which are calibrated using the relative humidity of the given area. The values are then converted into the digital format using analog to digital converter which is located in the same circuit. A machine made electrode based system protects the sensor from user interface.

d)**GPRS:**GPRS is based on using GSM communication. It will have services like mobile connections and Short Message Service (SMS).

1.Network Access - once a GPRS mobile station is switched on, it 'introduces' itself to the network by sending a 'GPRS attach' request. Network access can be achieved from either the fixed side or the mobile side of the GPRS network - point-to-point, point-to-multi-point or anonymous connections are then available.

2.Routing and Data Transfer **-** once a mobile station begins data transmission, routing is performed by the GSNs on a hop-by-hop basis through the mobile network using the destination address in the message header.

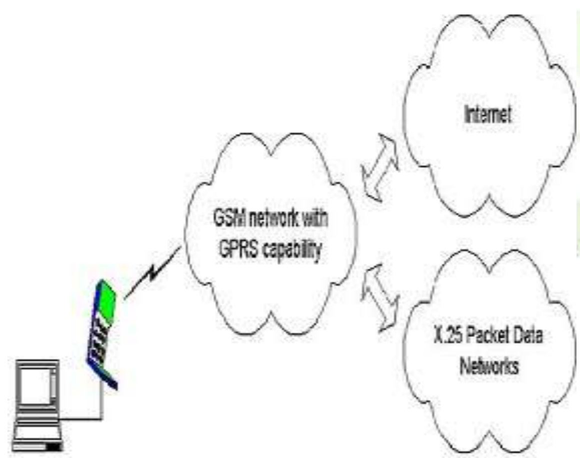

Fig 4: GPRS Network

Routing tables are maintained by the GSNs which will use the GTP layer which will carry translation and mapping functions to convert the external PDN (public data network) addresses to an address which is used for routing in PLMNs. The data itself will go through several transformations as it travels through the network

3.Mobility Management - as a mobile station moves from one area to another, mobility management functions are used to track its location within each PLMN. SGSNs communicate with each other and update the user location. VLRs that are accessible to SGSNs via the local MSC (mobile services switching centre) preserves the mobile station's profile. A logical link is formed and maintained between the mobile station and the SGSN. At the end of transmission or when a mobile station moves out of the area of a specific SGSN, the logical link is released and the resources associated with it can be reallocated Fig 3 shows the complete flow diagram of the process involved in this proposals. Fig 4. Explains the GPRS Network structure.

IV SIMULATION RESULTS

Here we have tested the proposed system with various environmental parameters like humidity, temperature and gas using the respective sensors, and the values are compared with the threshold values. If the obtained values are less than the and threshold values, then "Alert" indicator indicates the false or true results.

	A	B	C	D	E
1	Test	Humidity	Temperature	Gas	Alert
2	Test 1	35.3609	26.78	No	FALSE
3	Test 2	35.3938	26.65	No	FALSE
4	Test 3	36.3608	26.12	No	FALSE
5	Test 4	36.8112	26.01	No	FALSE
6	Test 6	35.9887	26.92	No	FALSE
7	Test 7	35.8786	26.76	No	FALSE
8	Test 8	35.4112	26.88	No	FALSE
9	Test 9	35.3439	26.67	No	FALSE
10	Test 10	35.2187	26.89	No	FALSE

Table 1: Results as per test conditions

And also we had drawn a graph according to the above table by taking out the values of humidity and temperature.

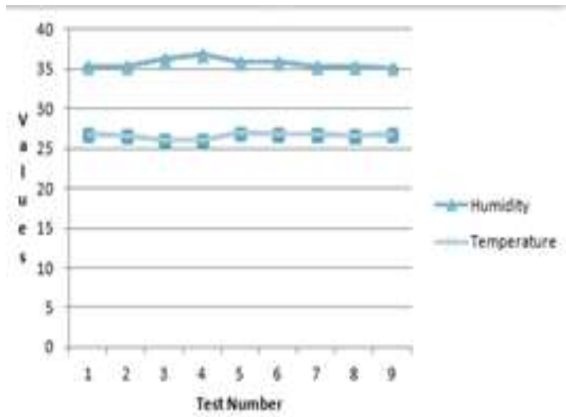

Fig5: Simulation Results

V CONCLUSION

Among recent technologies, cyber-physical systems (CPS) are an ever-growing terminology representing the integration of computation and physical capabilities. The development of a CPS, which will monitor environmental parameters based on the existent IEEE 802.11 infrastructure, was presented. It uses sensors which calculate the environmental conditions, sends alerts to an IoT platform using UDP. The system provides the possibility of saving data where Wi-Fi network In this real time Cyber-Physical system for environmental monitoring based on WSNs, the sensor hub is relatively centralized table 1 and fig5 shows the results based on the various conditional and parameters. Fig 5 represents the Humidity and temperature values are graphed with respect to values and test numbers. It is not so good for device management when numbers of devices are connected to the system. A distributed strategy will be developed in the future work.

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