무선 센서 네트워크를 사용하여 물 수준 모니터링

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Cold Storage monitoring of Pharmaceutical Products using Near Field Communication, ZigBee and Sensor Cloud

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ABSTRACT

This paper proposes a system composed of wireless sensor network and cloud to monitor storage environment of pharmaceutical products. Integration of sensor networks to cloud is an emerging architecture offering the benefits of internet for monitoring to be done easily and remotely from anywhere and anytime and at the same time freeing the sensor network from processing, analysis, computational and storage of sensor data.

I. Introduction

Wireless sensor networks (WSN) have been a focus for research for several years [1]. There are many applications of WSN and among them is environmental monitoring. Cold storage monitoring of pharmaceutical products is one of the applications categorized under environmental monitoring. The monitoring is a crucial part in pharmaceutical supply chain to ensure its quality is not compromised.

Medicinal products require controlled storage conditions in order to ensure that their quality is maintained. This applies to low-risk products as well as high-risk products such as vaccines, insulin and blood products. All Storage Personnel of drug products are required to record essential storage environmental parameters such as temperature and humidity [2,3]. The World Health Organization's working documents on Good Distribution Practices (GDP) is applicable to all persons and companies such as brokers, suppliers, distributors, wholesalers, traders, etc, who are involved in product storage [4].

It is a requirement by the regularity bodies to the involved persons and companies to monitor and record the conditions of storage environments.

Counterfeit pharmaceutical products are a real threat to public health and safety[5]. The monitoring of storage environments through cloud is proposed

in this work. The architecture of sensor-cloud platform includes the sensor data storage, visualization and remote management. As the cloud computing offers plenty of storage capacity and processing capabilities, collection of sensor data from the pharmaceutical storage facilities will allow efficient and reliable monitoring.

II. System Architecture

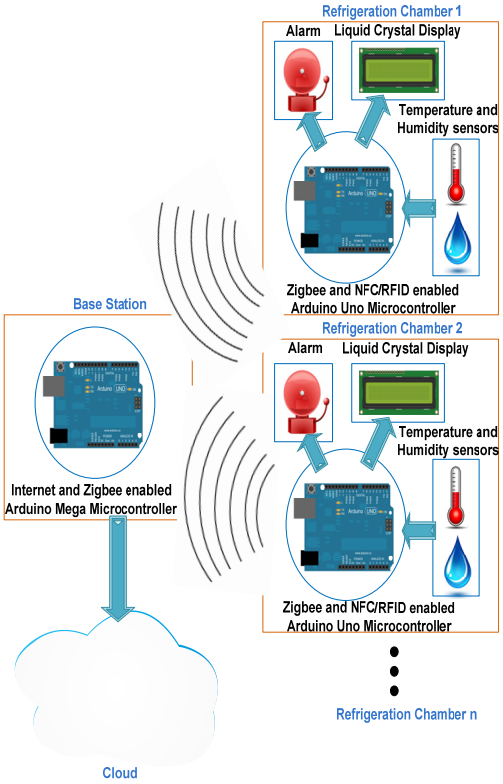

Fig.1 Pharmaceutical product cold storage monitoring block diagram

The monitoring system constitutes of one base station and a number of nodes. The platform used is Arduino. The base station is composed of Arduino Mega 2560 microcontroller, Arduino Xbee shield and Arduino Ethernet shield with removable memory card. The nodes are composed of Arduino Uno microcontroller, Arduino Xbee shield and NFC/RFID shield. Batteries are used to power up the nodes while the base station is powered by an adapter.

Each node in the network is independent of the base station and surrounding nodes in the sense that they have no physical connection and possess its own processor and power supply. This architecture averts using of wires for data transfer from nodes to base station which is impractical and allows easy setup and deployment of nodes and hence maintaining of the overall network.

III. System Operation

Continuous monitoring of the Chamber environment is carried out through a set of temperature and humidity sensors and latest values are displayed on a LCD display. This data is sent over to base station every 5 minutes via Zigbee. To ensure that nodes are powered up all the time, battery level is read and included in the data packet sent to base station. All products entering and leaving the chamber are read through NFC/RFID shield which are then incorporated into the data packet with sensor information and transmitted to base station. So a packet sent from node to base station constitutes of humidity & temperature readings, battery level at the node, and NFC/RFID readings. The nodes also consist of an alarm bell which becomes activate when abnormal sensor reading is taken.

At the base station, the transmitted data packets from the nodes are received and are prepared for upload to the sensor cloud through Ethernet connection. Data packets received from the nodes are compared with old packets to extract information regarding NFC/RFID tag movements in and out of the chamber (this is important for tracking chamber inventory). Memory card also play important role in storing data during times the internet connection is down. The inventory information is emailed to respective personnel and the rest of the data i.e. temperature, humidity and battery level are uploaded to ThingSpeak sensor cloud.

Fig.2 ThingSpeak Sensor Cloud interface

On the sensor cloud, data are arranged and displayed in notable and remarkable way for easy and effective monitoring. Each refrigeration chamber has its own channel in ThingSpeak and within each channel are 3 different fields for data visualization. These are humidity reading, temperature reading and finally the battery level reading. Different means of alert and notification are configured, such as Twitter and email and are triggered when the preset threshold values of sensor reading and battery level are exploited.

IV. Conclusion

To conclude, the proposed system offers many benefits over the traditional means of monitoring and recording which was initially done by hand and sensor networks where data was only accessible and analyzable locally. The system enables monitoring over internet resulting in effective and reliable monitoring due to data accessibility and monitoring system's update availability anywhere.

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