Temperature Humidity Monitoring and Control Application Using Concepts of Internet of Things

Felipe Muhamed-Ávila, Thallyson Silva, Tania Tronco and Luis Fernando de Avila

Abstract- In this paper, we present an application of Internet of Things (IoT) using Cloud concepts. The main idea of this application is monitoring and control of temperature and humidity of a room without human intervention. The application runs in real time and can be used anyplace where with internet access. For this, a sensor and an Arduino microcontroller card are employed, as well a remote database is built to store the collected information. The IBM IoT platform, that includes a cloud interface, is used to create a graphic view of this application.

Keywords: **Internet of Things, M2M, Sensors, IBM IoT, Cloud**

I. Introduction

In recent years, the automation of machines and electronics has grown rapidly and the implementation of technologies is becoming more complex, making the search for new technologies increasingly common. With this growth of automation, the concept of M2M (Machine to Machine) has been much discussed. The M2M concept is based on the communication from one machine to another machine without any human intervention, thereby increasing system autonomy [1]. M2M application examples are since the communication between cars, sending information among them, thus reducing the rate of accidents, until the temperature monitoring in a greenhouse to prevent the death of the flora. A well-aimed concept nowadays implementing M2M technology is the IoT. It includes sensors to collect data, a communication network, to send data to remote location, and a platform to treat the data and take autonomic decisions.

II. Development of the Application

The basic idea of this work is to develop an autonomic temperature and humidity monitoring and control application for a room, using the concepts of IoT. The components of this application are: (1) a sensor, to collect data of temperature and humidity from the room and (2) an Arduino microcontroller to obtain the data from the sensor to process and send them, via internet, to a remote cloud service. At a remote place, a graphic visualization is created and displayed to the user anywhere [2][3].

A. Temperature Humidity Sensor

The temperature and humidity sensor is a DHT11 module from the company Keyes, shown in Fig. 1. Which has the function of obtaining environmental data, store and send them to Arduino card.

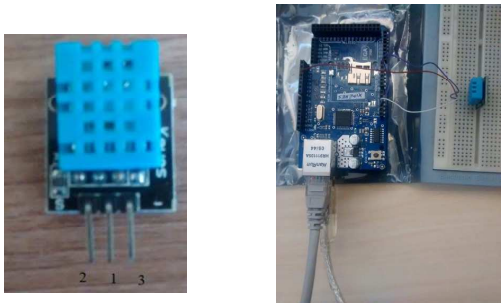

Fig. 1. Sensor (a) and Microcontroller card (b)

The response time of the sensor is lower than 20 ms, providing fast response, the signal transmission range is 20 m, the temperature range is 0 to 50^{o}C and humidity range is 20 to 90%.

B. The Microcontroller

Regarding the microcontroller, we propose to use Arduino Mega 2560 from Atmel, shown in Fig. 1(b). This card is responsible for collecting all the data sent by the sensor. To process the data, was used an algorithm detailed in Fig. 2. For the transmission of data, a network module of shield with RJ 45 connection is installed directly to Arduino board.

C. Cloud Storage

To perform the storage of data obtained from the sensors, was used the IBM IoT Foundation Platform [4] as a framework. The IBM IoT includes a simple and innovative interface named IBM Bluemix, which is considered as a

Felipe M. Ávila, Thallyson P. da Silva Melo, Luis Fernando de Avila, Engenharia de Telecomunicações Faculdade de Tecnologia - FT, Universidade Estadual de Campinas - UNICAMP, Limeira – SP, Brasil. E-mails: femuhamed@hotmail.com thallysonpaulino@yahoo.com.br, and lfavila@ft.unicamp.br. Tania Regina Tronco, Fundação CPqD, Diretoria de Gestão da Inovação, Campinas-SP,Brasil, E-mail: tania@cpqd.com.br.

cloud interfaces for IoT [5]. This interface is used to generate the database and the HTTP services, enabling the access to the data anytime, anywhere. The database stores, in real time, every data transmitted by the network. For the connection between Arduino and this database, it is necessary to configure a MAC address in the the Arduino card and connect it, via internet, with the Bluemix interface. The structure used to create this connection is called NodeRed [4], which is also offered by IBM IoT platform.

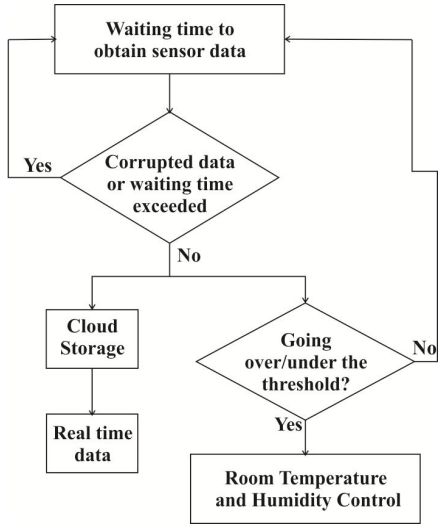

Fig. 2. Steps of the Algorithm.

III. Results

When the cloud storage starts, the collected data are being displayed in a graphic view, as shown in Figure 3 and Figure 4. The IBM IoT platform enables this kind of view, in real-time, through any device with Internet access.

Fig. 3. Temperature versus time graph.

As shown in Fig.3, when the temperature is lower than the threshold (25 °C), the system automatically sends commands to the air conditioning to correct it.

In the same way, when the humidity is higher than the threshold (50%), the system automatically corrects it.

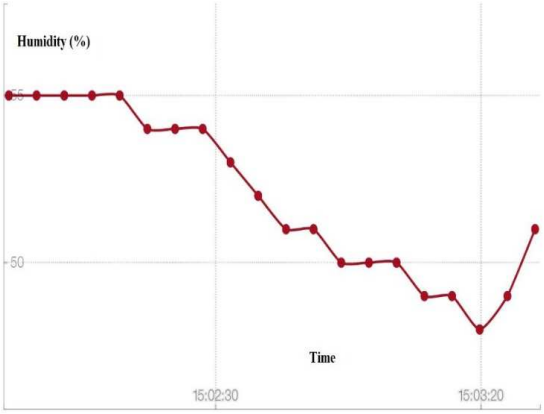

Fig. 4. Humidity versus time graph.

IV. Conclusions

We shown that the combination of sensors, Arduino platform, internet and the concepts of IoT and Cloud enables the creation of an IoT system that collect, analyze data and take actions to monitoring and control temperature and humidity of a room. This system can be extended to include others applications, for example, related to smart cities, to help solving problems in an efficient and sustainable way.

Acknowledgements

The authors are grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Serviço de Apoio ao Estudante SAE from Pro-Reitoria de Graduação of UNICAMP for financial support.

REFERENCES

[1] L. Atzori, A. Iera, and G. Morabito, “The Internet of things: A survey,” Comput. Netw., vol. 54, no. 15, pp. 2787–2805, 2010**.**

[2] W. T. Sung and M. H. Tsai, “Data fusion of multi-sensor for IOT precise measurement based on improved PSO algorithms,” Comput. Math. Appl., vol. 64, no. 5, pp. 1450–1461, 2012.

[3] M.Paschou,E.Sakkopoulos,E.Sourla,andA.Tsakalidis, “Health Internet of Things: Metrics and methods for efficient data transfer,” Simul. Model. Pract. Theory, vol. 34, pp. 186–199, 2013.

[4] https://internetofthings.ibmcloud.com/

[5] C. Wang, Z. Bi, and L. D. Xu, “IoT and cloud computing in automation of assembly modeling systems,” IEEE Trans. Ind. Informat., vol. 10, no. 2, pp. 1426–1434, 2014.