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RESEARCH AND IMPLEMENTATION OF IOT TEMPERATURE AUTOMATED METERING PROJECT BASED ON TELECOMMUNICATION SYSTEMS INSTITUTE

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Дослідження та реалізація IoT проекту для автоматизованого вимірювання температури на базі інституту телекомунікаційних систем

В роботі представлено результат дослідження та практичної реалізації проекту Інтернету речей для автоматизованого збору телеметрії, а саме – температури, що реалізований на кафедрі телекомунікаційних систем інституту телекомунікаційних систем, з можливістю доступу до зібраних даних з будь-якої точки Землі в мережі Інтернет та можливістю кастомізації їх представлення.

The paper presents a research and practical implementation result of the Internet of Things (IoT) [1,2] project for temperature values automated collection. The project is implemented at Telecommunication Systems department of Telecommunication Systems Institute. It aims the possibility to access the collected data from anywhere on the Internet and to customize data representation.

One of good **definitions** for **Internet of Things** is the following. IoT is a network of physical devices equipped with sensors, electronics, software, communication technologies, *with purpose to interact* with one another or with external environment, that is *designed and built* for purpose of restructuring economic and social processes, and eliminating the need of human participation which leads to *increased efficiency and reduced human workloads*.

The officially approved **students' circle of interests** "Researchers of wireless technologies for information transmission in the Internet of Things systems" operates in the Telecommunication Systems Department of Telecommunication Systems Institute since it was established in 2018. This students' circle covers both ***research*** of building IoT systems theoretical aspects and relevant information transfer technologies, as well as ***practical implementation*** of IoT projects.

The **problem solved** in this work is *the need to involve significant human resources to measure and record information on a regular basis about temperature in the lecture rooms of Telecommunication Systems Institute educational building* for the purpose of further data analysis and temperature control.

The **task solved** for mentioned problem above is the *IoT solution implementation for automated temperature data collection in the educational building* for the purpose of its further analysis and temperature control.

Since the automated temperature data collection had to be implemented in the educational building with **220V power supply** and with the ability to connect via WiFi **IEEE 802.11** access points to Internet, the decision was made to use these available resources to build a cost-effective solution, i.e. less expensive and without

involving to the solution any additional power sources and without any additional information transfer technologies.

The data from these temperature sensors are transmitted to the **MySQL database** hosted on the Internet. The scheme of the implemented solution with two temperature sensors is shown on Fig. 1.

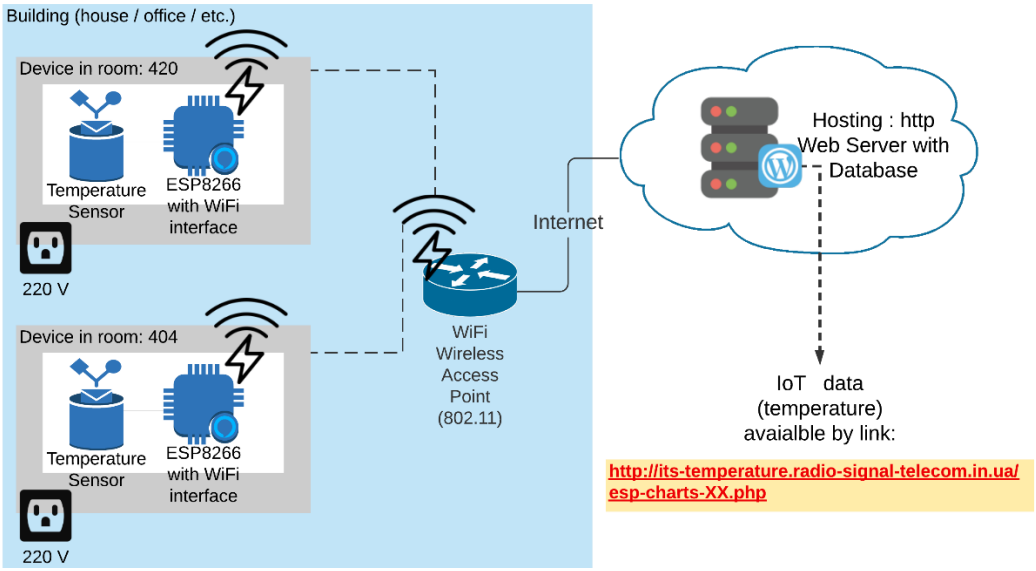

Fig. 1. Scheme of IoT project for automated temperature data collection.

The hardware of the solution is based on temperature sensors **DHT11**, **DHT21**, **DHT22**. These sensors connect to the NodeMCU V3 **ESP8266** (CP2102) transceivers. The ESP8266 have integrated wireless WiFi module (**IEEE 802.11**). The DHT temperature sensor with the ESP8266 board are mounted to a **plastic box** with intentionally made **holes** for ventilation and precise temperature measurement.

The sensors, **transceivers** boards, designed and developed **device** for measuring and transmitting temperature values are shown on Fig. 2.

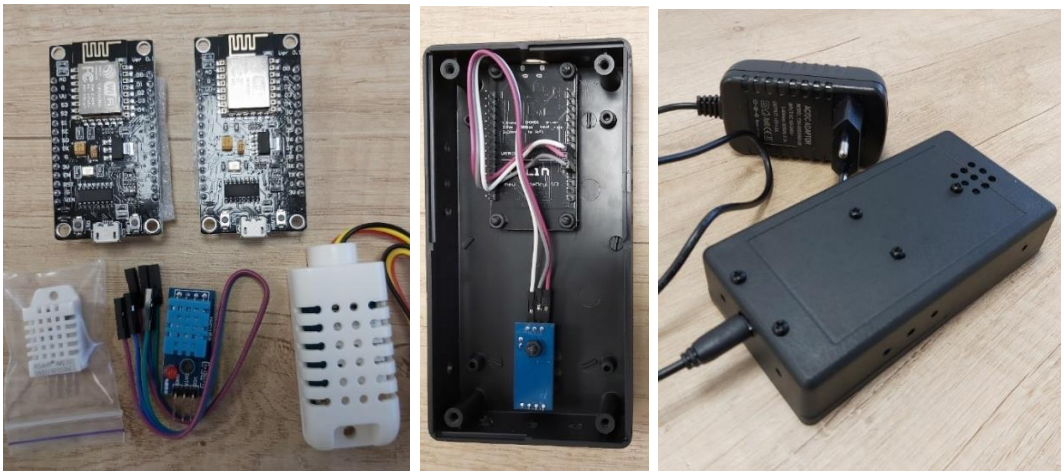

Fig. 2. Sensors, transceivers, built device for measuring and transmitting temperature.

The **DHT11** temperature sensor **characteristics** [3]: temperature determination in range of 0-50 *C with error deviation of 2*C, response frequency < 1 Hz, dimensions 15.5 x 12 x 5.5mm.

The NodeMCU V3 **ESP8266** transceiver **characteristics** [4]: protocols WiFi 802.11 b/g/n; built-in TCP/IP stack; digital and analog inputs D0-D8, SD1-SD3, AD0; power: 3.3-5V; power consumption: data exchange: 70 mA (200 mA maximum), standby time: <200 mA; board sizes 48x26mm; operating temperature -40…+125 *C.

To be able to send **temperature data** from the ESP8266 board, the necessary **program code** was created to program the ESP8266 board. Temperature data is written to relational **MySQL** to the Internet using **Web technologies** (**HTML, PHP**). A web page based on **HTML & PHP** was created [5] to read data from database and visualize it (Fig. 3). The photo with students who implemented this project is shown on Fig. 3.

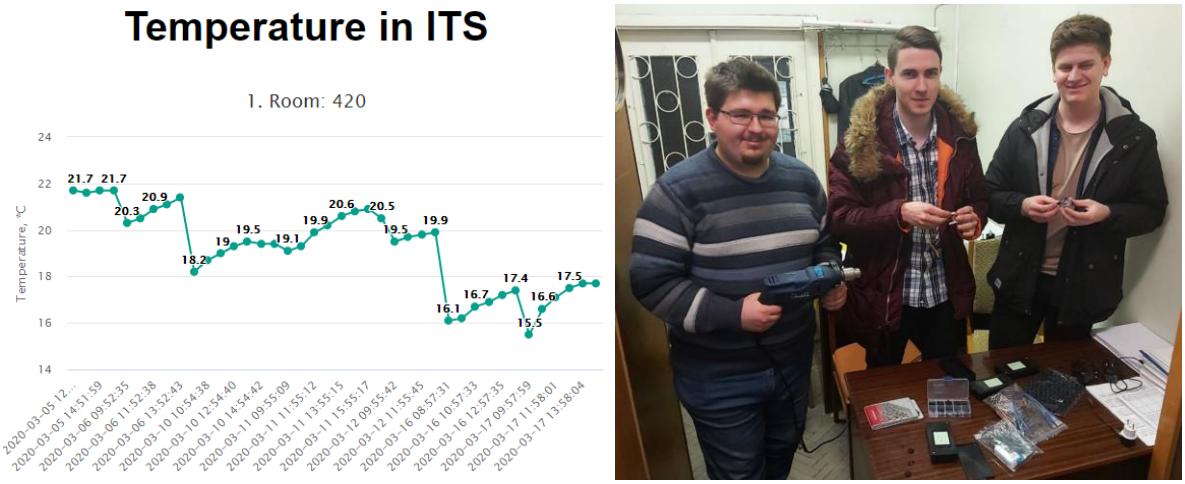

Fig. 3. The Web page with temperature data visualization in graph and students who implemented the project.

Thus, the IoT project is implemented for **automated** temperature collection, which **solves the task** of freeing human resources from **manual** temperature measurement. The 5 devices have been developed so far which are set up in the classrooms #403, 404, 406, 420, 503 of Telecommunication Systems Institute. Devices transmit temperature data values to MySQL database hourly, and data is visualized on the Web page [5]. The implemented IoT project allows a **flexible extension** of **devices number** to hundreds+, as well as allows devices extension by **other sensor types** (e.g., air quality, smoke, etc.).

References

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