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IOT-SYSTEM DEVELOPMENT FOR ENERGY METERS DATA TRANSFER AND PROCESSING

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РОЗРОБКА IOT-СИСТЕМИ ПЕРЕДАВАННЯ ТА ОБРОБКИ ДАНИХ ПРО ВИКОРИСТАНІ ЕНЕРГОРЕСУРСИ

В роботі представлено результат практичної реалізації проекту Інтернету речей для автоматизованого збору телеметрії, а саме – збору і обробки показників приладів обліку енергоресурсів (води, газу, тепла, електрики, тощо), які по замовчуванню не оснащені інтерфейсом для передавання даних в телекомунікаційну мережу. Зібрані дані доступні в мережі Інтернет.

The paper presents the result of IoT automated telemetry collection project practical implementation, namely – data collection and processing from energy meter devices (water, gas, heat, electricity, etc.). The energy meters in focus of this work are not equipped by default with the data transmission interface. Collected data from such energy meters are available in the Internet.

Problem statement. There is a large number of homes and enterprises where IoT data collection, specifically – from various energy meters (**EM**), – is not automated and requires manual data pulling from those EMs (water, gas, heat, electricity, etc.), because such EMs are not equipped with an interface for data transmission to telecommunication network. As a result, the data transfer process from EMs to data collection centers requires regular and significant human resources involvement, while this process is pretty out of sync with time, and involves the errors likelihood due to the human factor presence in the data collection process. In current work, one of the options for solving this problem is presented, namely – implementation of custom data transmission system for EMs that are not equipped with any data transmission interface by default.

It is important to note that an alternative solution to this problem is to replace the EM with a more modern EM that has a telecommunication interface by design, e.g. pulse type – for data collection and transmission from that EM to data center. However, replacing EM which doesn't have a telecommunication interface, with another EM which is equipped with some telecommunication interface by design, requires both significant material resources and bureaucratic efforts to reissue documents for EM. Therefore, a large number of people are not ready for such costly EM upgrade.

Therefore, in scope of this work, the decision was made to analyze possible solutions for this problem, develop a cost-effective solution and implement a testbed

system that can automatically collect data from EMs which don't have telecommunication interface by default and require human visual look for data collection, and transmit values to data center via telecommunications network, without replacing existing EMs with a new one. First steps of this effort were done in [1] and continued in this work.

Data collection and transmission system. The telecommunication device with photocamera (**TCPC**) was developed in the work for the use with EMs, which is a supplement to EM. Such TCPC does not require intervention in the design of EM and is installed as a nozzle on top of EM. TCPC is based on a telecommunication module with a photocamera (model ESP32Cam [2]), which performs the function of photographing the visual appearance of EM and sending photos to the data center via WiFi / Internet. The TCPC fastening to EM is designed and manufactured on a 3D printer for suitable attachment TCPC on some EM. To obtain a better quality photo by TCPC, the additional lighting is used based on LED. In this work, experiments with TCPC were performed on two experimental meters, cold and hot water (Fig. 1).

Fig. 1. Photos of EM before (a) and after (b) TCPC installation on EM.

The TCPC work principle is shown on diagram (Fig. 2): photos taking of EM values with a certain time interval, photos transferring through a WiFi network to data center, and their placement to web server. In this experiment, the data center is represented by a computer unit with a properly configured software that accepts images when they are sent from TCPC; then it stores photos on a storage and web-server shows them on the website [3]. Accordingly, each EM has its own data set on a website.

Web page has the following functionality: the main page displays a list of all EMs from which data are sent by TCPC (Fig. 2,a), and through the link in the list you can go to any of the EMs to view the EMs values from photos (Fig. 2,b). Images from EMs are sorted sequentially by creation date.

It is important to highlight that the WiFi telecommunication interface used in TCPC can be replaced by any other wireless (preferably high-speed for photo transmission) or wired interface. The system can also be easily scaled to a large EMs number, so can suit both personal and industrial needs.

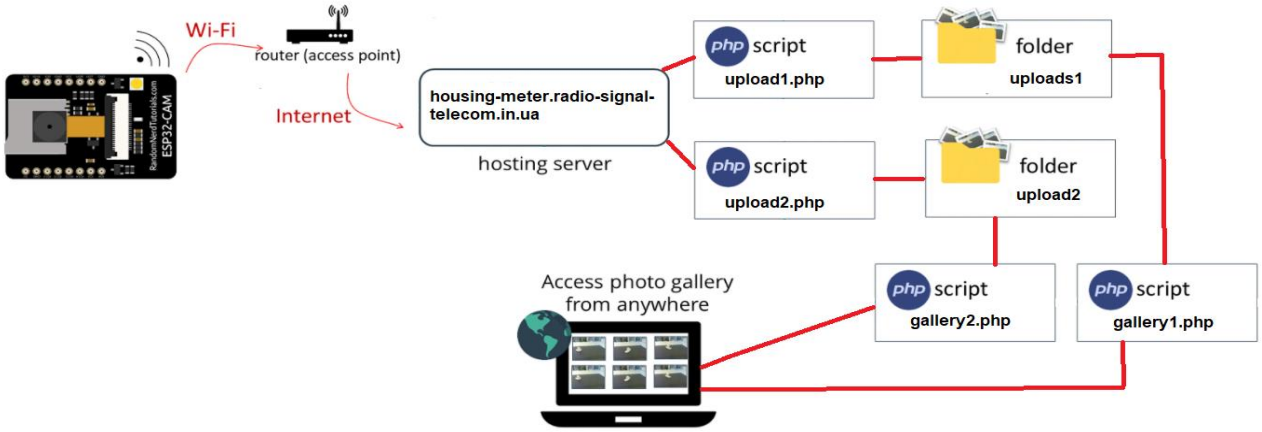
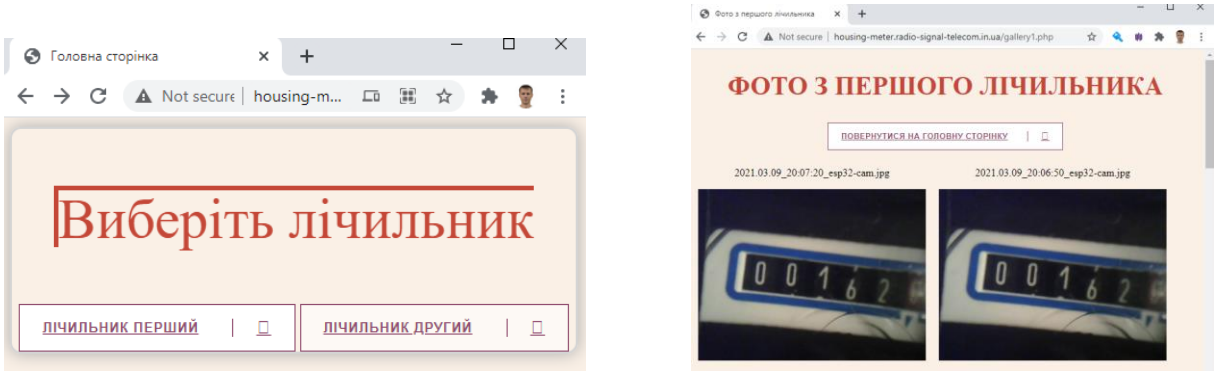


Fig. 2. The TCPC solution work principle: automated data collection from EMs to data center and its web presentation.



a) b)

Fig. 3. Web page with EMs list (a) and web page with data available on the Internet from first EM.

Thus, the testbed of automatic data collection and transmission to data center on the basis of TCPC, from EMs without the built-in telecommunication interface, is developed and demonstrated. The advantage of this proposed solution is ~50-70% lower cost of implementation compared to the replacement by new EMs with a telecommunication interface, and the need absence to reissue documents on new EM. The disadvantage of propose solution is the need in a custom configuring TCPC for a given EM in each case.

References

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2. Telecommunication device with camera, model ESP32Cam – https://randomnerdtutorials.com/esp32-cam-video-streaming-face-recognition-arduino-ide/.
3. Web-page for tested energy meters in scope of this work – http://housing-meter.radio-signal-telecom.in.ua/.