DESIGN OF INTELIGENT SENSORY NETWORK IN ADMINISTRATIVE BUILDING

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PROBLEM STATEMENT

Internet of Things is a huge boom in home, in the administrative and also in the industrial sphere. There is a lot of reasons why to have an intelligent sensory network in an administrative building:
- greater security,
- lower cost of energy,
- better conditions for life and health (level of CO2, oxygen, temperature, humidity, etc.) & others.

Existing solutions are:
- often too expensive,
- are not suitable for existing buildings (need of a special wiring etc.),
- are focused on only one function (need of more than one specific devices).

CONTRIBUTION

Newly designed wireless sensory modules consist of:
- the **MCU – ESP8266,** a small micro-controller available in various versions of the PCB layout, which differ in the number of pins and amount of flash memory,
- WiFi antenna,
- a full TCP/IP protocol stack support,
- various sensors (the basic version PCB is using DHT-11 for monitoring humidity and temperature**,** TSL-2561 for light level).

These modules are running the **NodeMCU** firmware, which contains a Lua virtual machine. It has 40 kB of RAM, 4 MB of ROM, the CPU is running on 80 Mhz and can be overclocked to 160 MHz.

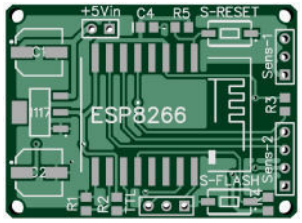

Figure 1: ESP8266 module (4x3 cm).

Modules communicate through the **MQTT protocol,** which is developed for delivering messages between devices quick and reliable. It is topic based and every topic can have various number of subscribers and publishers.

Modules are network nodes and the **Adaptor** is a gateway for collected data. Modules are co-operating with the adaptor through the **MQTT broker.**

Modules are powered by a 5V adaptor, but the ESP is running on 3.3 V, so module is equipped with the voltage regulator AMS-1117-3.3 and a couple of 47 uF capacitors.

Adaptor

Is a C# application developed to collect data messages, transform data structure of received message, add timestamp to the message and send it to the REST Api, where these data are stored to the database. The adaptor can also **warn a sensor network maintainer,** that there is an issue with a module, for example the sensor returned an error instead of the measured value. This module can be easily replaced or the sensor can be repaired and the module should work again. The adaptor can **update source code** on ESP based modules through the WiFi so if there is **a global bug** in ESP modules it **can be fixed** in a few minutes on all modules in the building or just on the selected ones.

MQTT broker

A computer running specialised software where every device of a sensory network is connected to. Modules are publishing data messages to a data topic on the MQTT broker and these data are collected by the adaptor. Communication between module and adaptor is **encrypted with the TLS** on a level of the MQTT protocol message, modules are using the **WPA2 Personal** for connection to the WiFi network. A source code on the modules is pre-compiled to a **Lua byte-code,** so it is in a human unreadable format.

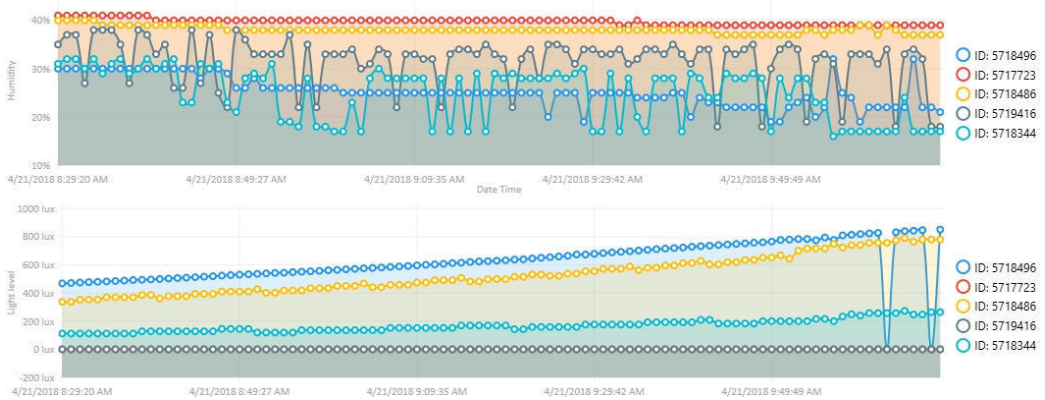

Figure 2: Humidity and light level measurements.

RESULTS & CONCLUSION

ESP modules, the adaptor and the MQTT broker are creating a secure sensory network situated in class rooms of Faculty of Business and Economics of Mendel University. This network is used for monitoring temperature, humidity and light level, while only one module can provide all of these functions.

Data from modules, which are collected by the adaptor are stored for the further use.They can be used for lower costs of energy or live control over the whole building. Also the other systems in the building can change its behavior based on the collected data. For example an air condition or lights in a room can be regulated. This network can be easily extended by modules with other functions.