Online experiment concept explained

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Internet of things – new reality
Market (McKinsey & Company)

in 2025, businesses based on the Internet of things will bring from $ 3.9 trillion to $ 11.1 trillion.

the maximum score, which takes into account all user applications, 11% of global GDP (according to the forecast of the World Bank, GDP in 2025 will reach $ 99.5 trillion).

Key Applications:

- optimization of production ($ 1,2-3,7 trillion)
- improving living conditions in the city ($ 930 billion - $ 1.7 trillion)
- addressing traffic to support a healthy lifestyle of citizens
- retail ($ 410 billion - $ 1.2 trillion),
- health and medicine ($ 410 billion - $ 1.6 trillion) .

A little less in security, logistics, unmanned vehicles, comfortable life in the office and at home.

Technology is in Moore's Law trend

"The power of micro processor doubles each 18 months":

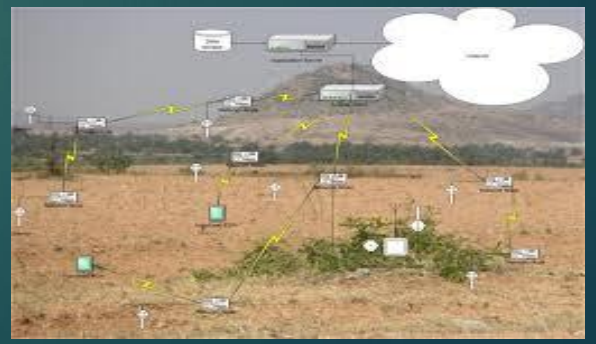
Computers

Mainframe --> Personal computer --> Smartphone -->

Smart things

Meteorology

Full size weather station --> Professional automatic weather station --> home weather station --> **distributed weather wireless sensor network**



IoT concept (Gartner+)

- Smart material objects
- Virtual (digital) objects
- Embedded software
- Communication services
- Big data analytics
- Services available anywhere in the world

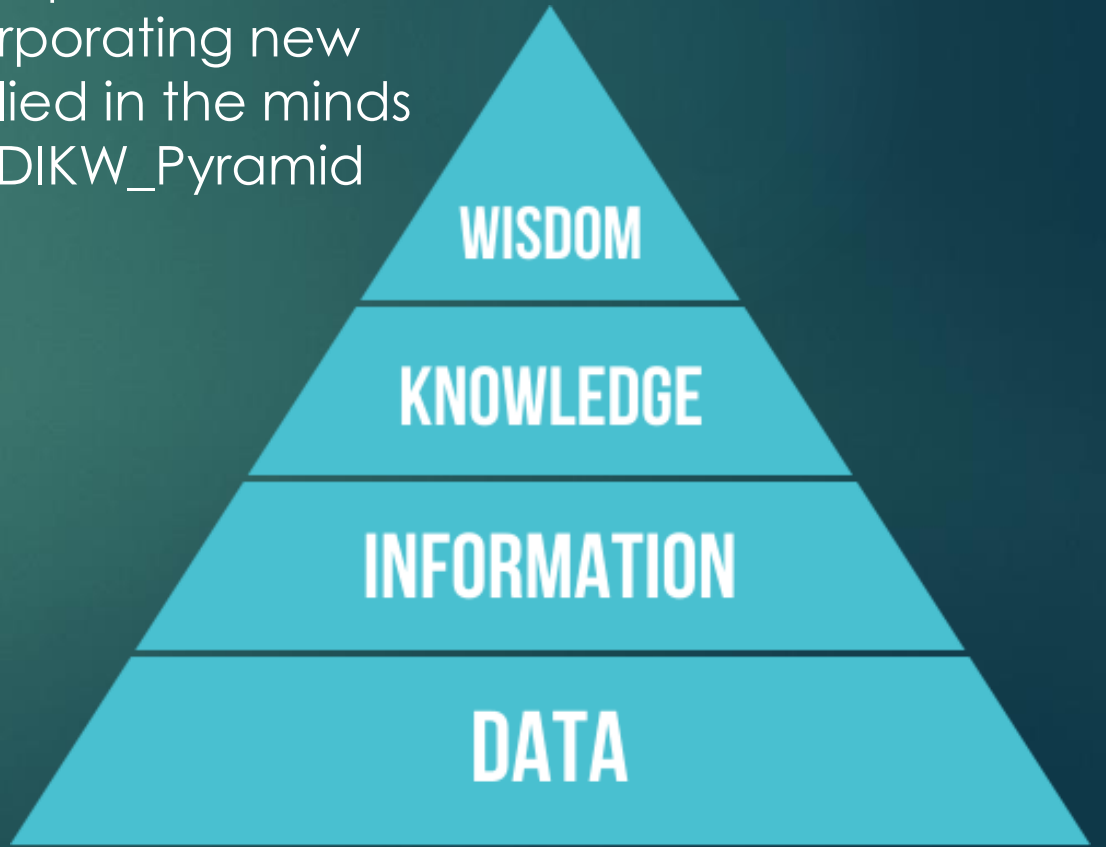
Challenges in Education

- New capabilities of IoT - technologies create a new "hybrid system" that combines: human, natural environment, technical environment and the social environment into an integrated system.
- The system is new. Its properties are not known in many aspects. It is necessary to understand the system main features and to have adequate methods for teaching students.
- IoT – technologies integrate the real world and the world of virtual objects (texts, images, video, virtual reality…) so training should be built with the tools that able to demonstrate this .
- Experiments – absolutely necessary part of education.

DIKW Pyramid

Only complex personal activity could convert information into knowledge and wisdom.

“Knowledge is a fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers.” Wikipedia https://en.wikipedia.org/wiki/DIKW_Pyramid



The basic ideas

- Basic IoT principles should be demonstrated:

smart things (sensing, local data processing, wireless and wired communications abilities), internet infrastructure, cloud services, data mining etc.

- **Offline** and **online** education materials should be combined:

- **offline** provides the skills of experimental work with real things,
- **online** provides access to a pool of spatially distributed instruments remote from the experimenters, access to educational materials and tutors support

- Most importantly, personal activity of students should be stimulated.

The basic ideas (continued)

- Education should take place in a personal learning environment (PLE) that provides accumulation of knowledge in personal knowledge base and personal portfolios.
- PLE should provide work with virtual materials and data from measurement devices (local and remote).
- The student should work on the project. The result of the project should be placed in a personal knowledge base and personal portfolio.
- The project should be supported by basic instructions and templates, developed by tutor and available online (in a cloud). Sample of remote controllable experimental setup should be available.
- The student must be able to take initiative.
- Students should have physical access to the kit which allows establishing a laboratory setting (something using Arduino type constructor + 3D printer and other prototyping tools)
- The personal learning environment should have the tools to: collect and organize information from various sources to form a multimedia document in a mash up style that integrates data and information from various sources.
- The student should be able to save intermediate results of their actions (in the form of photographs, notes, answers to questions, stored experimental data, etc.)

Online template – an algorithm and a storage of experimental results and analysis in PLE

Template consists of:

- Name of an experiment
- Aim of an experiment
- Short description of theory
- Description of an experimental laboratory setup
- Algorithm of a laboratory setup building
- Instruction how a laboratory setup should be programmed and how setup interfaces should be incorporated into template
- Instructions how a setup can be connected to cloud services and how cloud interfaces could be incorporated into template
- Instruction how data should be analyzed
- Instructions about summary/conclusions

How to use template

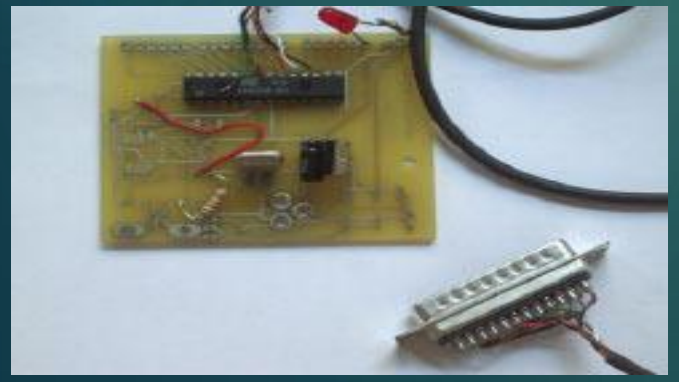
Student must:

- Download template from a cloud to PLE (personal cloud and personal app which is synchronized with personal cloud)
- Do actions (according to instructions)
- Save results of actions in the template
- Publish template (completed) for tutor and for other students
- Add template (completed) into personal portfolio.

Arduino

decision-making for prototyping IoT

Carnegie Mellon University and Stanford already using Arduino, $ 1 billion in 2015 (with the clones)



The first board of the prototype, created in 2005, had a simple design and was not called Arduino.

"Arduino philosophy: if you want to learn electronics, you can learn it from the first day instead of having to learn algebra first"

Our vision is based on

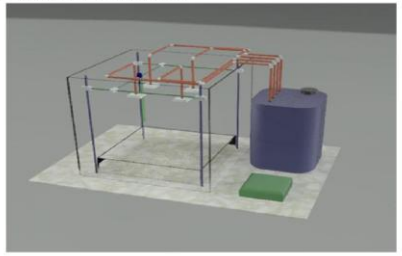
- 14 years of experience in the Laboratory of wireless communication technologies (Wireless Lab), created in the Nizhny Novgorod State University with the support from Intel.

- Experience of 22 short-term (2-3 weeks) schools "Technology + Business"
- The development of personal knowledge management environment "Alterozoom" and PLE based on it.
- Experience in establishing university spin-off companies (12 companies in 14 years). 3 companies operating in the field of IoT.

“LOCALMET” – building the laboratory setup and template https://alterozoom.com/ru/documents/31452

Laboratory Setup Development

We have developed and assembled the layout of the laboratory setup. Within ECOIMPACT project, students studying meteorology may use the setup to simulate the soil moisture regime and humidity mode (using the contact made irrigation system) can record changes of meteorological variables

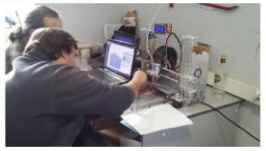


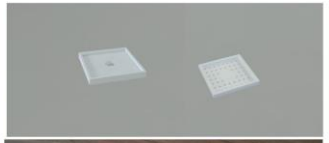
Laboratory Setup Development: Setup Building

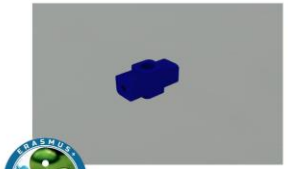
Firstly, laboratory setup was built

Laboratory Setup Development: 3D Design

We got the skills to work with 3D printer and made a part of the items with it





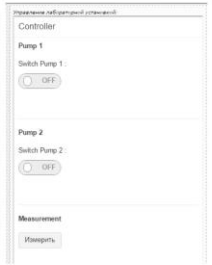


Laboratory Setup Development: Web Programming

Also, we have developed a web interface that allows users to receive measurement data (including in the form of graphs) and manage the intensity of irrigation

Demonstration display in the web interface of the installation

Buttons of enable irrigation and measurements

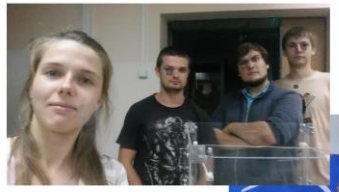


Main Result

The result of our work was the layout of the laboratory setup, managed via the Internet and ready for experiments on local meteorology. If necessary, the setup can be supplemented with other sensors (for example, pressure sensor, light sensor and etc.) and thus to expand functionality

Our team

During the Summer School, each of us has gained important and useful in the further study skills. For two weeks we have become a close-knit team!



Internet links

- DEMO MATERIALS FOR CALMET: https://alterozoom.com/documents/31450.html

- Internet of Things (IoT): A vision, architectural elements, and future directions: http://www.sciencedirect.com/science/article/pii/S0167739X13000241

- IoT (Coursera): https://www.coursera.org/specializations/internet-of-things