Cyber-physical systems: realities and perspectives
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Abstract
The analysis of cyber-physical systems made and their main components are defined. The conceptual model of cyber-physical system and its levels are considered. The applications of cyber-physical systems and the technologies used in them also indicated. Then perspectives of improvements for industrial cyber physical systems are given.
Keywords: Cyber physical system, Internet of Things, Industry 4.0
Cyber-Physical Systems (CPS) are on the priority list of innovations in many countries of the world. The term Cyber-Physical Systems (CPS) was coined in 2006 by Helen Gill - Director of Embedded and Hybrid Systems at the US National Science Foundation.A cyber-physicalplatform can be visualised from the following three types of networks (Figure 1), as stated by the German academy Acatech:
- Internet of People (iop);
- Internet of Things (iot);
- Internet of Services (ios).

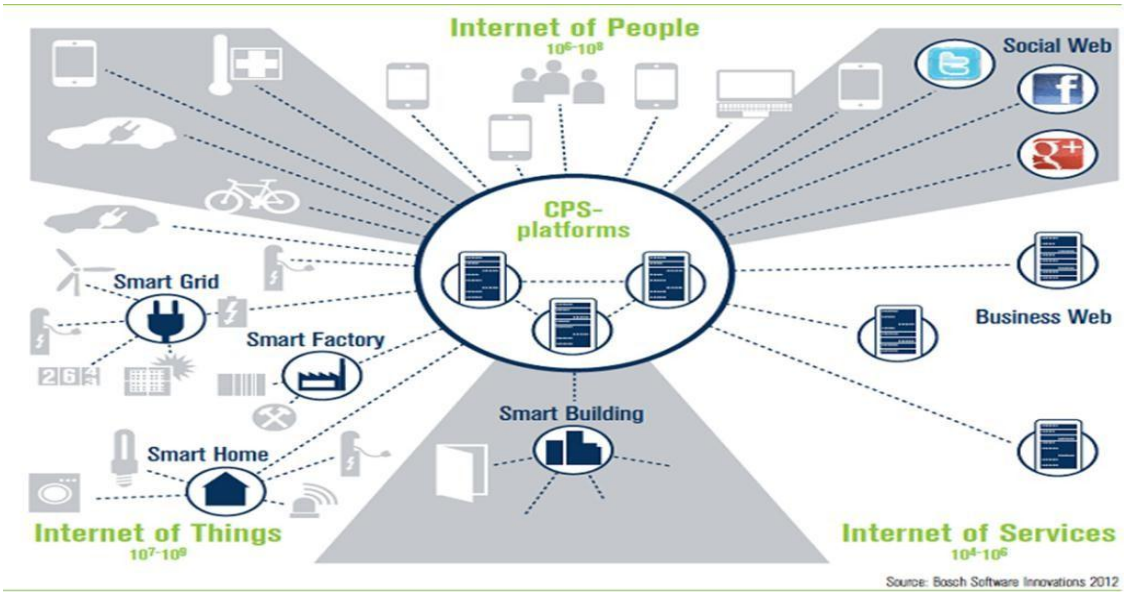

Figure 1. Cyberphysical platform

According to some scientists and specialists, the emergence of CPS and Industry 4.0 will affect the interests of the whole society; will change the relationship of people with the outside world [1].
Areas of application of CPS will extend to almost all kinds of human activities. In cyber-physical systems, the computing component as its carrier distributed throughout the physical system and strongly linked with other constituent elements [2, 7].
CPS is not a new technology, but use and combine existing technologies, techniques, means and methods such as:
- Innovative IT industry;
- Communication technologies;
- Hardware;

- Software;
- Secure data storage and transmission, etc.

One of the main prerequisites for the implementation of the CPS concept can considered the integration of individual industrial elements into global systems: iot, global sensor networks, future defense systems. The CPS should combine models and methods for the controlled object, which also characterized by a wide range of aspects and innovative technologies. CPS and iot both fit the trend of integrating digital capabilities [3, 4, 5].

The conceptual model of CPS shown in Fig. 2.Thisconceptual model of CPS consists of the following five levels:

1. Physical layer.
2. Network level.
3. Data storage layer.
4. Processing and analytics layer.
5. Application layer.

At the physical layer, sensors, actuators, controllers, tracking devices and computational elements. Controllers collect sensor data from production and process it locally and/or transfer it to cloud storage for further processing. Controllers (adapters) provide hardware connectivity to computing elements.

The network layer of cyber-physical system models can access cyberspace via various network protocols such as Wi-Fi, wimax, GPRS and 3G/4G/LTE technologies. Other protocols such as MQTT, coap, AMQP, Websocket, and Node used to transfer data from peripheral (external) devices to the cloud for further storage and processing of information.

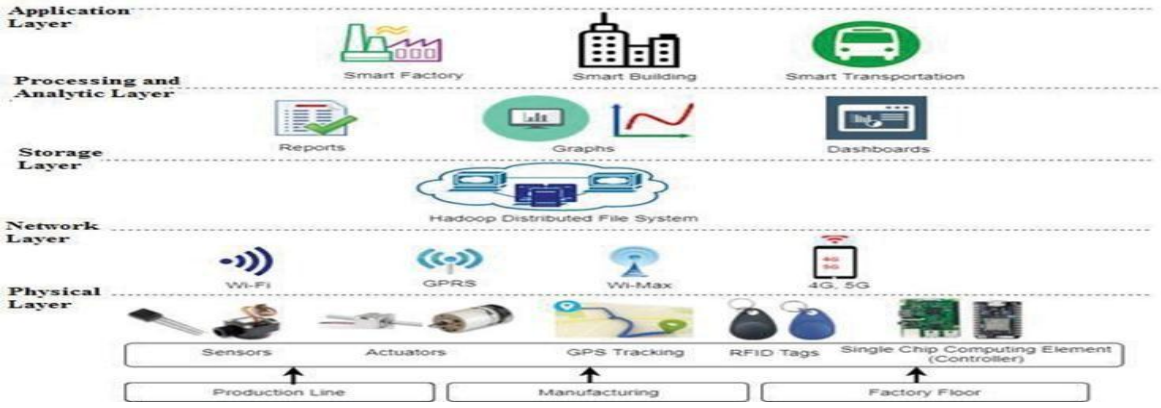

Figure 2.Conceptual model of CPS

Data storage layer of cyber-physical system after collecting data from the control object located in the physical layer ensures that the data is stored on a local server or in the cloud. For example, Hadoop, for redundancy, data can be stored in a cluster of different nodes.

The processing and analytics layer used for data processing and analysis (data mining, data clustering, data classification and regression methods, etc.) Using computer simulation models. The application layer is the user interface for end users, operators, manufacturers, third party suppliers, other service providers and other users, and provides the link between them. These applications can refer to the smart grid, smart factory, smart building, smart transport and smart healthcare. These applications also enable the interoperability of the SFC layers. The main applications of cyber-physical systems include the following:

- transport systems;
- medical technologies;

- building management;
- healthcare;
- transport;
- energy, etc.

For example, Smart Products, Smart Factories (Smart Factory), Smart City, Industrial Smart Data, etc.

The Fourth Industrial Revolution claims to connect the two worlds of manufacturing and network connectivity through the use, which are the main components, of Cyber-Physical Systems, Cyber-Physical Production Systems (CPPS) and iot. CPS and iot, as two basic elements, enable the use of Industry 4.0: Machine to Machine (M2M) with the Internet of Things. M2M provides automatic transmission and measurement of data between mechanical and electronic devices with embedded sensors or RFID wireless (Radio Frequency Identification) communication networks [8, 9].

The main components of any cyber-physical system are [2]:

- Physical layer;
- digital layer;
- the interface of interaction between the digital layer and the physical layer;
- the interface of interaction of the digital and physical layer with.

Significant security issues of CPS inherit from the Internet of Things and in general from the M2M environment. Other challenges to the development of cyber-physical systems include cyber security issues, economic issues, and systems issues. The major technologies in cyber-physical systems can considered as Internet of Things, cloud computing and big data techniques [10].

The categories of improvements for cyber-physical systems include: automation, autonomisation, human-machine interaction, decentralized computing, various digitization, Big data, pattern recognition, designing security infrastructures, etc. Industrial intelligence and others.

Conclusion

KFS is an important part of Industry 4.0 and will change the way people interact with the outside world. It will become even more challenging for businesses to attract skilled labor. Therefore, will have to consider the implications of these things in both business and human resource management.

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