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Information systems: Characteristics of an IIoT concept implementation at a fish processing enterprise

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Abstract. This research focuses on relevant questions of the Industrial Internet of Things (IIoT) concept development and implementation at the enterprise. Lately IIoT has been widely publicized as a part of Industry 4.0. In this article the features of the information system development are presented, including SOA telecommunications that allow the remote access and control of the ongoing technological process with mobile devices. The capacity of the developed system is shown. The realization of the data exchange between developed telecommunications is highlighted. The practice of using the telecommunications, developed within the IIoT, has shown positive results and become the basics of implementation of an integrated information system that would link the other enterprise's objects.

1. Introduction

Information technology has become one of the key factors in social development in the twenty-first century. More people are involved with the production, storage, processing and realization of information. The term "information society" is moving from its theoretical background to a more applied meaning and is becoming widespread. Information technologies cover all the spheres of human activity including industry [1]. For example, ever greater demands have been made on automation systems as the part of informational and intellectual support of the ongoing technological process and the option of remote control of parameters and management of the pocess. In this case, there is no wonder that lately the Industrial Internet of Things concept has been widely publicized as a part of Industry 4.0 [2].

Nowadays many large organizations are organized into associations such as MESA (Manufacturing enterprise system association), IIC (Industrial Internet Consortium) and SMLC (Smart Manufacturing Leadership Coalition) for technologies coordination, aiming at the realization of the IIoT potential, improving technological processes [3] and leading to the development of "smart production" [4].

Within this project, the task of implementation of the main principles and ideas of IIoT to the ongoing production in a training production shop of Murmansk State Technical university (MSTU) was solved. The dryer [5] for smoked, dried and stockfish production was the object of the study.

2. Materials and methods

In the project, it was decided to develop an information system and create a fully functional server that would support the basic provisions of the IIoT concept using a regular office computer. The information system must provide automated technological process management, and support the

working capacity telecommunications that are part of it according to the principles of SOA (service-oriented architecture), [6] including:

- facility for remote mobile access for the technological process control with mobile devices;
- facility for remote workstation of the dryer's operator;
- technological process visualization with Web-camera;
- Web-access based on the server operating mode.

An inexpensive office computer with quite low by modern standards characteristics (Intel Celeron, 2G DDR3, Intel HD Graphics, 200G HDD) has been chosen as the server. However, for stated purposes a Micro PC Intel Compute Stick or tablets with Windows OS would also be suitable. At the same time there are many open-source systems that allow IIoT implementation [7].

Taking into account the main patterns of external and internal mass transfer of moisture within capillary-porous colloidal matter and after finishing the processes of relaxation in dehydrated fish surface, the dryer's work has been optimized [8]. It should be noted that automatic machinery by the Russian company "Owen" has been used in the project. The control of transmission signals to actuating mechanisms, information reading from the sensors, and video stream reception from the Web-camera are implemented by the server enabled by AC4 interface converters and based on the OWEN_IO.lib library driver. The software "SAU MSU" has been used as a driver [5].

3. IIoT implementation at the enterprise

To solve the task, it was decided to equip the dryer with the information system performed within a Web-application using IIS (Internet Information Services).

The convenience of the Web-application is that it operates in a browser and does not depend on the operation system on the device that is used. Web-applications could be launched on a PC, a smartphone, a laptop or tablet. The main condition is availability of an Internet connection.

The typical pattern of users' work with the Web-applcation is shown in figure 1, part "A". With an Internet connection the user is connected to the remote Web application and forms queries to the database. The Web-server, to be more exact one of its services, processes users' queries interacting with the database management system. This pattern is also typical for most internet-based resources: on-line shops, banks, libraries, etc. The main idea of our work within the concept of IIoT is ensuring Web-server interaction not only with the users, but also with automatic control system of a small-sized dryer. In fact, in accordance with the figure 1 part "B" , the automatic control system is both a user of the developed Web-application and a part of its information space.

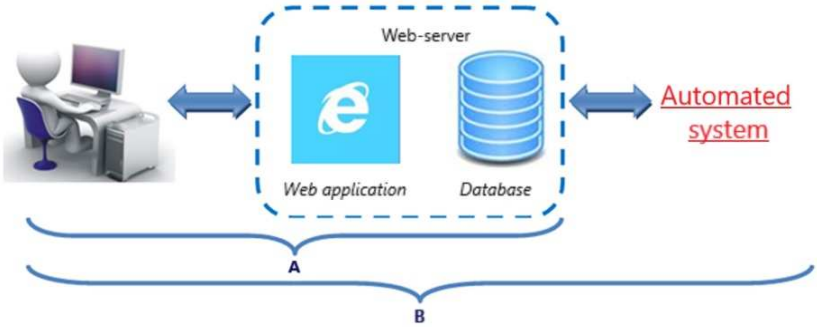


Figure 1. A typical pattern of users' work with the Web-application

The developed information system with the typical structure [9] is a result of IIoT concept implementation to the ongoing technological process. The structural scheme of the system is shown in figure 2.

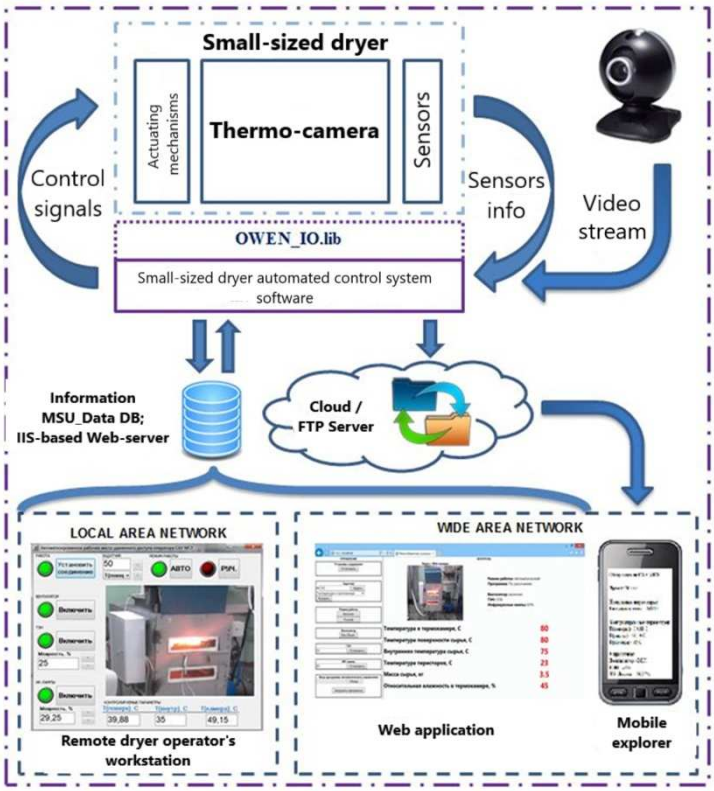
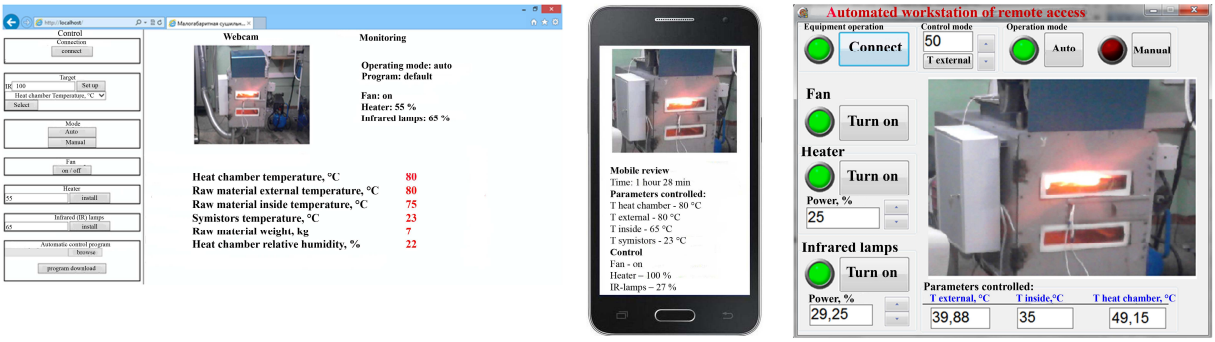


Figure 2. The structural scheme of the information system

The information system's core is the MSSQLServer_MSU_Data database, which synchronizes all the apps' work. A multi-user regime of the database and authentication allows error reduction when connecting to the shared recources and using them.

The information system consists of the Web-application (figure 3a), needed for remote access and control of the ongoing process in the dryer, mobile managing, and viewing the information and state of all the system's sensors. The feature of the Web-interface is its efficiency regardless of operating system or browser type, and a mobile device for user's Internet access that in turn widens the possibilities of workstation arrangement of the dryer's operator and leads to improved performance of the workshop.

In should be noted that Web-application receives the video stream from the Web-camera: the user (operator) is able to visually confirm the technological process in the small-sized dryer.



a **b** **c**

Figure 3. Web-application's screens

Closed data communication protocol SSL (Secure Socket Layer) protects BIG DATA [10] sent

within the information system via the Internet. SSL also provides the connection of the automated system to the server with user's authentication [11].

A separately developed solution is a mobile observer (figure 3b) that provides the remote access and control to the technological process with mobile devices.

Mobile observer's work is implemented within a global network segment, but is based on FTP (File Transfer Protocol). By inputting the dryer's information system address in the mobile devices' browser, a user can view all the neccecary information about the technological process and visualize it by receiveing the picture from the Web-camera.

Using the mobile observer, it is only possible to watch the controlled parameters, not to control the technological process like with the Web-application. The reason is FTP itsef: it is difficult to provide data protection. The protocol is not encrypted, login and password are transmitted by an open text – which is why the develoment of remote control in addition to monitoring is unreasonable.

A part of the developed information system is the software "Automated workstation of remote access" (AWoRA, figure 3c), which implements the telecommunicaton network feature on the operator's workstation.

The automatic system works with a two second quantification step, which has been chosen due to time of all sensors polling by the system and control action on actuating mechanisms activation. Thus, every two seconds the "SAU MSU" software populates the MSU_Data database with the informaton about current temperature and humidity in a thermo-camera, temperature of the product affected by thermal treatment, and the input power level to actuating mechanisms. The informaton from the Web-camera is also transmtted to the database for technological process visualization. Updating the information in the developed software happens within the same two second step.

"SAU MSU" software continuously controls the working of all the system sensors and actuating mechanisms. Moreover, in case of an emergency situation the software is able to make a decision about either changing parameters to less critical levels for production or a full stop of the technological process.

The practice of using the developed information system has shown that the MS SQL Server provides a stable data exchange between the automated system of a small-sized dryer and the end-user. In addition to this, it is possible to work in a multi-user mode with a minimum chance of collision owing to the database management system and a quantification step of two seconds.

According to the measurements, the server resources provided to the IIS (Internet Information Services) and MS SQL Server work. The central processing unit is loaded on 10-15%, memory used on 40-45%. There are still questions about the system's efficiency with high initial processes, and additional tests are required. However, the proposed method will be efficient for users' interaction which are similar to the dryer objects (for example, with autoclaves, ovens, smoke machines, etc).

As the result, the dryer has received the information infrastructure allowing the remote control and management of the technological process, its visualization, and remote acuation mechanisms management.

4. Conclusion

Thus, there is an example of computerization of the training production shop of Murmansk State Technical University (MSTU) as a part of unification of the object of automation (dryer) and the operator's workstation into an integrated information network.

The developed system within the IIoT concept allows usage of the mobile workstation of the dryer's technologist-operator instead of the stationary one. The Web-application helps to connect to the automated control system despite the location in relation to the dryer. The technological process management is possible with any kind of mobile platform and operating system (Microsoft Windows, Android, Linux, IOS and others). Using the Internet, the system allows monitoring and visualization of the parameters of the ongoing technological process and managing the system's actuation mechanisms remotely.

The project also addresses the issues of implementation of information safety. The remote access control is implemented on the basis of SSL, which guarantees the safe connection with users' identification and authentication tools. The use of the developed information system has shown positive results. The perspective is to realize the whole potential from the IIoT elements' implementation at the enterprise level and to equip the production shop of MSTU with an integrated information environment linking other objects, such as autoclaves, smoke machines and smokers.

5. Acknowledgments

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