



М. ҚОЗЫБАЕВ АТЫНДАҒЫ
СӨЛТҮСТІК ҚАЗАҚСТАН МЕМЛЕКЕТТІК УНИВЕРСИТЕТІ
СЕВЕРО-КАЗАХСТАНСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
ИМЕНИ М. КОЗЫБАЕВА

М. KOZYBAYEV
NORTH KAZAKHSTAN STATE UNIVERSITY



Индекс 74935

ХАБАРШЫ

ТЕХНИКАЛЫҚ СЕРИЯСЫ

ВЕСТНИК

СЕРИЯ ТЕХНИЧЕСКАЯ

BULLETIN

TECHNICAL SERIES



№ 4 (33)

Петропавл, 2016

**М.ҚОЗЫБАЕВ АТЫНДАҒЫ
СОЛТҮСТІК ҚАЗАҚСТАН МЕМЛЕКЕТТІК УНИВЕРСИТЕТІ
СЕВЕРО-КАЗАХСТАНСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
ИМЕНИ М.КОЗЫБАЕВА**

**М.KOZYBAYEV
NORTH KAZAKHSTAN STATE UNIVERSITY**

ХАБАРШЫ

Техникалық сериясы

ВЕСТНИК

Серия техническая

BULLETIN

Technical series

№ 4 (33)

**Петропавл
2016**

**М.Қозыбаев атындағы
Солтүстік Қазақстан мемлекеттік университетінің хабаршысы**

**Вестник Северо-Казахстанского государственного
университета им. М.Козыбаева**

Bulletin of M.Kozybayev North-Kazakhstan State University

**Басылымы IV (XXXIII)
Выпуск IV (XXXIII)
Volume IV (XXXIII)**

**Жылына 4 рет басылып шығарылады
Выходит 4 раза в год
Published 4 times a year**

Редакционная коллегия серии:

Омирбаев С.М., ректор, д.э.н., профессор - главный редактор.

Ивель В.П., д.т.н., профессор - заместитель гл. редактора.

Члены коллегии:

Демьяненко А.В. - к.т.н.;

Косых А.В. - д.т.н., профессор (Россия);

Попов А.Ю. - д.т.н., профессор (Россия);

Машеков С.А. - д.т.н., профессор (Казахстан, КазНКТУ им.К.И.Сагпаева);

Кошеков К.Т. - д.т.н., доцент;

Савинкин В.В. - к.т.н.;

Dr.-Ing. Arnold Sterenharz, Managing Director, ECM space technologies GmbH, Berlin (Германия);

Кузнецова В.Н. - д.т.н., доцент ФГБОУ ВО «Сибирская государственная автомобильно-дорожная академия (СибАДИ)» (Россия, г.Омск).

М.Қозыбаев атындағы Солтүстік Қазақстан мемлекеттік университетінің хабаршысы / Вестник Северо-Казахстанского государственного университета им. М.Козыбаева / Bulletin of M.Kozybayev North Kazakhstan State University. Выпуск №4(33). - Петропавловск: СКГУ им. М.Козыбаева, 2016. – 162 с.

© Северо-Казахстанский государственный университет
им. М.Козыбаева, 2016, г. Петропавловск

МАЗМҰНЫ / СОДЕРЖАНИЕ

Абильмажинова А.С. (магистрант, СКГУ им. М.Козыбаева, г. Петропавловск), Томашец А.К. (профессор, к.т.н., СКГУ им. М.Козыбаева, г. Петропавловск) <i>Качество моторного масла как фактор обеспечивающий снижение потерь энергии на трение.....</i>	6
Абдураимов Е.К. (студенттер, М.Қозыбаев атындағы СҚМУ, қ. Петропавл), Екентай І.М. (студенттер, М.Қозыбаев атындағы СҚМУ, қ. Петропавл) <i>Газ – дизельді қондырғының сығылған табиғи газбен жұмыс істеуі.....</i>	9
Абраменков Д.Э. (д.т.н., профессор, заведующий кафедрой «Здания, строительные конструкции и материалы», ФГБОУ ВО Сибирский государственный университет путей сообщения, г.Новосибирск, РФ), Абраменков Э.А. (д.т.н., профессор, кафедра «Строительные машины автоматика и электротехника» ФГБОУ ВО Новосибирский государственный архитектурно-строительный университет, г.Новосибирск, РФ), Савинкин В.В. (доцент, к.т.н., заведующий кафедрой «Транспорт и машиностроение» РГПП ПХВ СКГУ им. М.Козыбаева, г. Петропавловск, РК) <i>Воздухораспределительные системы и перспективы применения дроссельных пневмоударных механизмов и перспективы их применения в машинах нового поколения на их основе.....</i>	11
Адилбеков А.Е. (магистрант, СКГУ им. М.Козыбаева, г. Петропавловск), Кошеков К.Т. (профессор, д.т.н., СКГУ им. М.Козыбаева, г. Петропавловск) <i>Вибродиагностика насосного оборудования.....</i>	21
Айтулина А.М. (аға-оқытушы, М.Қозыбаев атындағы СҚМУ, қ. Петропавл), Кожяхметова Д.Е. (студент М.Қозыбаев атындағы СҚМУ, қ. Петропавл), Секенов Е.Е. (студент М.Қозыбаев атындағы СҚМУ, қ. Петропавл) <i>Мобильдік байланыс желілерінің болашағы.....</i>	25
Голодова И.В. (доцент, к.х.н., СКГУ им. М.Козыбаева, г. Петропавловск) <i>Исследование многокомпонентных систем, содержащих 3-d элементы методом фурьордта с привлечением большого числа аналитических длин волн.....</i>	29
Демьяненко А.В. (декан, к.т.н., СКГУ им. М.Козыбаева, г. Петропавловск), Исаева И.Н. (докторант, КазНИТУ им. К. Сатпаева, г.Алматы), Ахметова Д.А. (магистрант, СКГУ им. М.Козыбаева, г. Петропавловск) <i>Исследование искусственного отражателя типа «Пропил» в тонкостенной стальной пластине методом ультразвуковой дефектоскопии.....</i>	37
Demyanenko A.V. (Dean of Engineering and Technology Faculty, NKZU named after M. Kozybaev) <i>Internet of things and operator training simulators.....</i>	48
Зорин А.Ю. (студент СКГУ им. М.Козыбаева, г. Петропавловск) <i>Анализ преимущества применения композитных опор.....</i>	51
Ивель В.П. (профессор, д.т.н., СКГУ им. М.Козыбаева, г. Петропавловск), Герасимова Ю.В. (доцент, к.т.н., СКГУ им. М.Козыбаева, г. Петропавловск) <i>Принципы построения цифро-аналоговых преобразователей для многопараметрических систем управления на базе платформы ARDUINO MEGA 2560.....</i>	58
Ивель В.П. (профессор, д.т.н., СКГУ им. М.Козыбаева, г. Петропавловск), Герасимова Ю.В. (доцент, к.т.н., СКГУ им. М.Козыбаева, г. Петропавловск), Сыздыков Д.Т. (магистрант, СКГУ им. М.Козыбаева, г. Петропавловск) <i>Моделирование многопараметрической системы управления электрохимическим формообразованием на базе платформы ARDUINO MEGA 2560 в реальном формате времени.....</i>	62

М.Қозыбаев атындағы Солтүстік Қазақстан мемлекеттік университетінің хабаршысы

Меншік иесі: ҚР Білім және ғылым министрлігінің «Манаш Қозыбаев атындағы Солтүстік Қазақстан мемлекеттік университеті» ШЖҚ РМК. №13405-Ж есепке алу туралы күәлігін 2013 жылдың 25 ақпанында ҚР Мәдениет және ақпарат министрлігі берген.

Басылуға 11.11.2016 ж. қол қойылды. Пішімі 60×90 1/8. Times гарнитурасы.

Кілемі 20,25 б.т. Таралымы 60 дана. Кітап-журнал қағазы. Тапсырыс №221.

М.Қозыбаев атындағы СҚМУ баспаханасында басылды. 150000, Петропавл қ., Пушкин к., 86.

Вестник Северо-Казахстанского государственного университета им. М.Козыбаева

Собственник: РГП на ПХВ «Северо-Казахстанский государственный университет имени Манаша Козыбаева» МОН РК. Свидетельство о постановке на учет №13405-Ж от 25 февраля 2013 г. выдано Министерством культуры и информации РК.

Подписано в печать 11.11.2016 г. Формат 60×90 1/8. Гарнитура Times.

Объём 20,25 усл.печ.л. Тираж 60 экз. Бумага книжно-журнальная. Заказ №221.

Отпечатано в СКГУ им. М. Козыбаева. 150000, г. Петропавловск, ул. Пушкина, 86.

Bulletin of M.Kozybayev North Kazakhstan State University

Owned by Republican State Enterprise «M.Kozybayev North Kazakhstan State University».
Certificate no.13405-Ж issued by Ministry of Culture and Information of the Republic of Kazakhstan
on 25 February, 2013.

Signed for publishing on 11/11/2016. Size: 60x90 1/8. Font type: Times. Volume: 20.25 conventional lists.
Number of copies: 60. Order no. 221. Printed on office paper by M. Kozybayev NKSU Press, 86, Pushkin
street, Petropavlovsk, Kazakhstan, 150000.

1. Демьяненко А.В., Исаева И.Н., Мокренский А.Б., Джамбиесова Т.С. Ультразвуковая дефектоскопия тонкостенных стальных пластин прямым совмещенным преобразователем // Материалы МНПК «Актуальные вопросы энергосбережения и новые технологии в науке и образовании Республики Казахстан», т.2, Петропавловск: СКГУ им. М.Козыбаева, 2014, с.53-58.

UDC 004.5

INTERNET OF THINGS AND OPERATOR TRAINING SIMULATORS

Demyanenko A.V.

(Dean of Engineering and Technology Faculty, NKZU named after M. Kozybaev)

Аңдатпа

Қашықтықтағы мониторинг және бақылау технологиялық үдерісі, осы үдерістерді жүзеге асыратын оператор-технологтарды дайындауға арнайы талаптарды ұсынады. Бұл дайындықта маңызды рөл "Интернет Заттар" технологиясын барынша басым пайдаланатын оқыту симуляторлары ойнау үшін шақырылды.

Аннотация

Удаленный мониторинг и контроль технологических процессов предъявляет специфические требования к подготовке операторов-технологов, которые будут осуществлять этот процесс. Важную роль в этой подготовке призваны сыграть обучающие симуляторы, максимально использующие преимущества технологии «Интернета Вещей».

Abstract

Remote monitoring and control of technological processes imposes specific requirements to training of operators-technologists who will be carried out those processes. A key role in this training must play the operator training simulators, which maximally employ the advantages of the "Internet of Things" technology.

Internet of Things (IoT) is modern and rapidly developing technology. IoT is one of the essential sources of "The Fourth Industrial Revolution" that will fundamentally alter the way we live, work, and relate to one another [1]. According to the Cisco Internet Business Solutions Group (IBSG), IoT is simply the point in time when more "things or objects" were connected to the Internet than people. Thus, Cisco IBSG estimates that IoT was "born" sometime between 2008 and 2009 [2].

Almost every day appeared one more new application of Internet of Things technology. In work [3] considered 15 most known examples of Internet of Things technology that are in use today. The stringiest among those examples (on our opinion) is "Kolibree Smart Tooothbrush". Kolibree connects to your smartphone and encourages good brushing habits for both kids and adults by turning brushing into a game and saving data on your phone about your brushing habits [4]. The most relevant to this paper is the project "Cisco's Connected Factory"[5]. As one of the leaders in IT field the Cisco is integrating IoT technologies into different spheres of industry to make technological and production processes more efficient.

Cisco provides the breadth of plant infrastructure capabilities across networking, wireless, security, physical video, computing, and communications. In this way, the

solution can flexibly support the current and future business needs of manufacturers. It meets the requirements of both business IT and operational technology in a highly secure, reliable, and integrated platform [5].

Remote monitoring and control of technological processes imposes specific requirements to training of operators-technologists who will be carried out those processes. A key role in this training must play the operator training simulators (OTS), which maximally employ the advantages of the "Internet of Things" technology.

Most of training simulators have nothing to do with IoT technology. They aimed mostly on training of operators but not on improving of control system. The following examples of training simulators illustrate that state of things.

Authors of work [6] have developed an operator's training simulator for the blast furnace plant to improve operator's operation skill. The simulator consists of a workstation with a process model, human machine interface, and plant control system. Authors approve that they have achieved such an environment as the operator can operate through human machine interface as if the operator is operating an actual plant and system is controlling the same software that controls the actual plant.

The "Virtual Training System. Technological process simulator" is one of the Abiroy company products [7]. The main component of the dynamic computer simulator («Virtual Training System») is so called «virtual technological process». The virtual technological process is intended to simulate operations of the real life production facility (process unit). The Virtual Training System is used mainly to train the operational personnel, and it is also used to analyze and to improve the technological process, to design and to verify the control system, to practice skills related to Emergency Response Plans (ERP). A simulator may generate process upsets to enable training for non routine situations. Process failures or non routine situations which occurred at the plant in the past may be simulated at a simulator in order to practice skills and to transfer knowledge related to safe methods of work [7].

Richmond [8] declared that integrating of Operator Training Simulators (OTS) into corporate training programs, applying virtualization, and using 3-D virtual reality are but three examples of how operator training simulators have been adapted to meet the demands of the modern workforce. He expects these synergistic approaches and other emerging technologies (e.g., mobile computing, remote operations, workflow technology, and situational awareness graphics) to result in continued advances in the world of operator training simulation, contributing to a new generation of safe, productive, and profitable plant operation [8].

Lukec [9] formulated the following requirements for OTS:

- 1.Describing the dynamics of the process/unit,
- 2.Simulating normal operation,
- 3.Describes steady state,
- 4.Simulating start-up and shutdown,
- 5.Simulating incidents,
- 6.Ease of usage,
- 7.Simulating external disturbances (raw material qualities, utilities.)
- 8.Using realistic unit process graphics,
- 9.Using realistic unit control and safety system.
10. Robust process model: capable calculating exact solution in any situation.

Thus we can see the importance of IoT and OTS for sustainable development of modern and future industry. So applying of IoT and OTS simultaneously could lead to synergetic effect.

The basis of the OTS is a software implemented mathematical models of the control object and the control system (control program). Interaction of these models in different normal and emergency situations is studied and evaluated simultaneously on the same working station. This approach has certain disadvantages:

- a) Communication channels between the object of control and the automatic control system are simulated by computer with different simplifying assumptions. This disadvantage could be essential in the case of remote monitoring and control via mobile Internet or Wi-Fi.
- b) After the simulation studies we don't get tested and configured control computer with adjusted control program. Control program for control computer need to be developed additionally based on result of simulation and taking into account physical parameters of input-output devices. It leads to the loose of time and money. Especially in case of remote monitoring and control.

For overcoming these disadvantages we propose to use two different computing devices (computers, laptops or tablets). On the first computing device there will be running a simulation model of the control object that will handle incoming by radio channels (mobile Internet, Wi-Fi, or Bluetooth) control signals and will transmit by the same channels the signals that containing information about technological parameters of simulated control object. On the second computing device there will be loaded the real control program without any simulation. Thus, that second computing device will be operating in real mode handling signals about technological parameters of the control object (that could be either real or simulated) and producing corresponding control signals. Thus, we propose to simulate only the control object (on first computing device) and to use the real (not simulated) control program loaded on control computing device.

This will be useful for improving of control system in the process of simulating and for creating remote computing device with real control program for more efficient operator training.

References:

1. K. Schwab. The Fourth Industrial Revolution: what it means, how to respond. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond> 14 January 2016.
2. D. Evans. The Internet of Things How the Next Evolution of the Internet Is Changing Everything. <http://www.cisco.com/c/dam/global/ru ua/assets/pdf/iot-ibsg-0411final.pdf> April 2011.
3. 15 Examples of Internet of Things Technology in Use Today. <http://beeboom.com/examples-of-internet-of-things-technology/> Last Updated: September 26, 2016.
4. Kolibree Smart Toothbrush with Games. Sonic toothbrush Educates Kids with Live Feedback and Interactive App <https://www.amazon.com/Kolibree-Upgraded-Toothbrush-Bluetooth-Application/dp/B00XJOPS0G>
5. Cisco Connected Factory. <http://www.cisco.com/c/en/us/solutions/industries/manufacturing/connected-factory.html>
6. T. Izuha, T. Sato, H. Gomi, Ya. Sono, T. Hida, K. Washizu. Operator's Training Simulator for Blast Furnace Plant // Nippon Steel Technical Report No. 89, 2004. pp. 85-90.
7. Virtual Training System. Technological process simulator. <http://www.abiroy.com/en/services-en/virtual-training-system/virtual-training-system-technological-process-simulator.html>