напряжение и сжатые границы времени требуют максимальной концентрации и включенности, что, несомненно, отражается на настроении и общем состоянии личности.

Обобщая вышеизложенное, отметим, что магистранты заочной формы обучения аграрного технического университета имеют среднюю степень удовлетворенности своей жизнью. В наибольшей степени они довольны последовательностью в достижении жизненных и профессиональных целей, что можно рассматривать как внешний фактор формирования удовлетворенности, в наименьшей степени выражен общий фон настроения, являющийся внутренним фактором. Данные показатели свидетельствуют о достаточно гармоничном общем психологическом состоянии респондентов. В то же время для улучшения их внутреннего состояния, которое является определяющим для ощущения удовлетворения жизнью, требуются определенные усилия и целенаправленная внутренняя работа.

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УДК 621.313.11

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MECHATRONICS IN ENGINEERING SYSTEMS

Ключевые слова: мехатроника, инженерные системы, интеллектуальная сельскохозяйственная техника, умные роботы, технологические решения

Key words: mechatronics, engineering systems, intelligent farm machinery, smart robots, technological solutions.

Аннотация: статья посвящена мехатронике как междисциплинарному предмету, объединяющему три технических направления – механику, электротехнику и вычислительную технику. Показана роль мехатроники в инженерных системах сельского хозяйства. В статье описаны некоторые инновационные инженерные системы земледелия, основанные на мехатронике.

Summary: the article is devoted to mechatronics as a multi-disciplinary subject combining three technical fields of mechanical, electrical and computer engineering. It is shown the role of mechatronics in farming engineering sys-

tems. Some of innovative mechatronics based farming engineering systems are described in the article.

Technological innovations such as artificial intelligence, cloud computing, robotics, Industry 4.0 and the Internet of Things are fundamentally changing the way we live, think and work. Our physical world is quickly transitioning into a cyber-world. Mechatronics, as a multi-disciplinary subject combining three technical fields of mechanical, electrical and computer engineering, will provide the critical connection between the cyber and physical worlds through the advancement of sensing, actuation, and intelligence technologies.

The term “mechatronics” was derived from the two words “mecha” from mechanics and “tronics” from electronics. A highly integrated approach to mechatronic in engineering systems provides intelligent, innovative and sustainable technological solutions, such as drones, robots, autonomous vehicles, sensors for space exploration, intelligent healthcare devices, smart manufacturing, additive manufacturing, fuel cell systems, thermal and electrical microgrids and agro-technology.

Mechatronics plays a vital role in transforming the agricultural sector. Modern agriculture has been completely revolutionized by technological innovations ranging from robotics and drones to computer vision software. Farmers now have access to tools to help them meet the growing needs of our planet's population. Since automated agriculture is such a broad topic at the moment, here we will focus on the latest developments and their approvals.

As mechatronics and autonomous systems have developed, it has become possible to design a new range of agricultural equipment based on small, intelligent technologies that reduce waste, reduce environmental impact, increase economic opportunities and contribute to food sustainability. Intelligent machines can help humans to carry out more efficient operations. We will consider several areas where mechatronic systems have been introduced.

A number of innovative mechatronic based farming engineering systems have been introduced to help in decision making, particularly concerning management, feeding strategies, animal health and animal fecundity. In addition, electronic systems have been developed to manage relevant variables and to provide tools and alerts to the farmer. Thanks to advances in mechatronics, biosensor technology has great potential to improve animal welfare, health and production efficiency.

Sowing is one of the basic agricultural procedures for crop production. The appropriate choice of seed, the sowing process and the correct agronomic dates have a significant influence on the final yield. Nowadays, with the help of mechatronics, automated tillage and seeding machines are available to do the labor-intensive work. The machine can perform both ploughing and minimum tillage as well as the drilling of cereals and intercrops at the same time. In order to enable intelligent farm machinery to perform automated field operations, it is necessary to ensure that machines are capable of recognizing actual working

conditions, identify adaptive corrections suitable for constantly changing conditions and implement these corrections during field operations when supported by an appropriate mechanical system. The basis for achieving this capability is often provided by models controlling intelligent machines, ranging from simple logical rules managing basic tasks to sophisticated artificial intelligence algorithms for complex operations.

The new weed-killing, spraying and controlling robot is now available. This robot uses vision systems: a color vision system and a grey vision system. A multifunctional intelligent automatic weeding machine allows flexible regulation of irrigation rates. This system makes it possible to remove weeds without damaging crops. Pesticide spraying and eliminating weeds from fields can be wasteful and harmful to the environment. Intelligent sprayers must automatically adapt to the properties of the pesticide by means of global and local positioning in the field or cultivated crop. Maps of soil parameters (moisture, organic matter, nutrients) as well as vegetation (vigor, stress, weeds, temperature) can be useful for fertilizers. Many modern sprayers need to monitor the pressure and flow of the applied media (liquid or gaseous) to facilitate automatic control and to achieve an accurate application rate.

Controllers calculate the optimum application rate on the fly and provide the intelligence of the mechatronic system. They consist of microcontrollers that take readings from sensors or loaded maps to calculate the instantaneous rate of application based on internal algorithms. This speed is continuously transmitted to actuators for the physical application of the product. Controllers can include small monitoring displays or switches for manual operation from the operator's cab if required. Electromechanical or electrohydraulic devices (actuators) receive electrical signals from the controllers to regulate the amount of product applied.

A wireless sensor network is proposed to create an agricultural remote monitoring and control system. The main purpose is to control and monitor the environmental particular plant requirements. Sensors are important components in mechatronic engineering systems because they provide the information needed to support automated operations. In modern agricultural technology sensor output signals are converted into a digital format and can thus be displayed on an LCD screen or fed to a computer. The sensor network consists of small autonomous devices called sensor nodes. Each node observes, senses and periodically collects data and then sends this information to the base station. The system is based on Zigbee, which is a low-powered wireless communication device. The sensor data collected by robotic platforms on the farm is also providing valuable information and insight into yield optimization, advanced planning, required resource levels, and when and where resources are required to reduce waste and improve yields.

Smart robots can also be used to determine the position of surrounding objects during agricultural operations such as special plants or potential obstacles. Ultrasonic range finders are sensor devices used successfully for this purpose.

Because they measure the distance to target objects based on the speed of sound, these sensors are also known as sonar sensors.

Vision is one of the important elements of human intelligence that gives farmers the ability to perceive visually. Machine vision is a computerized version of a farmer's vision; cameras work like eyes and computers work like brains. The output of machine vision systems are digital images. A digital image is made up of small squares called pixels that carry information about the level of light intensity.

While the agricultural robot market has been dominated by robots for milking and dairy management over the past decade, crop robots are expected to increase their commercial presence and dominate the market in the coming years, especially for special crops (e.g. tree fruits, grapes, melons, nuts and vegetables). This transformation of the farmer from worker to manager of the digital age can play an important role in attracting the younger generation to careers in agricultural production.

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УДК 331.45

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САМОКОНТРОЛЬ, ВЗАИМНЫЙ КОНТРОЛЬ И ВИДЕОКОНТРОЛЬ – ВАЖНЫЕ ЗВЕНЬЯ В ОБЕСПЕЧЕНИИ БЕЗОПАСНОСТИ ТРУДА РАБОТНИКОВ СЕЛЬСКОХОЗЯЙСТВЕННОЙ ОТРАСЛИ

Ключевые слова: опасность, безопасность, риск, самоконтроль, взаимный контроль, видеоконтроль.

Key words: danger, safety, risk, self-control, mutual control, video control.

Аннотация: рассмотрены базовые понятия опасности, безопасности, риска. Обоснована важность самоконтроля, взаимного контроля и ви-