

Sažetak rada

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**OD PODATAKA DO DOBROBITI: DIGITALNE TEHNOLOGIJE U FUNKCIJI
ZDRAVLJA, ZAŠTITE I ODRŽIVOG UNAPREĐENJA DOBROBITI ŽIVOTINJA**

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Kratak sadržaj

Usled intenziviranja stočarske proizvodnje i globalnih klimatskih izazova, sposobnost pravovremenog prepoznavanja narušavanja zdravstvenog statusa i komfora životinja postaje ključni preduslov održivog menadžmenta farme. Ovaj rad analizira transformativni put od prikupljanja sirovih podataka do donošenja odluka u funkciji zdravlja, zaštite i održivog unapređenja dobrobiti životinja. Fokus je na prelasku sa tradicionalnog, reaktivnog posmatranja na kontinuirani, neinvazivni monitoring u realnom vremenu primenom tehnologija preciznog stočarstva (PLF) i Interneta stvari (IoT), čime se prevazilaze ograničenja ljudskog rada i nepovoljnog odnosa broja farmera i jedinki.

Sinergija različitih digitalnih sistema omogućava prikupljanje visokofrekventnih podataka i njihovo prevođenje u objektivnu evaluaciju fizioloških i bihejvioralnih potreba životinja. Implementacija elektronske identifikacije (RFID) i satelitskog pozicioniranja (GPS/GNSS) postavlja osnovu za individualizovani pristup nezi, optimizaciju korišćenja prostora i rano detektovanje anomalija u kretanju i ispaši. Podaci sa nosivih biosenzora (akcelerometri, pedometri i mikrofoni) i podloga sa senzorima pritiska omogućavaju kontinuiran nadzor nad aktivnošću, odmorom i vokalizacijom, čime se obezbeđuje rano otkrivanje stresa, bola i hromosti. Poseban doprinos zaštiti zdravlja pružaju infracrvene termalne kamere i ugradni temperaturni senzori koji beskontaktno i neinvazivno prate promene telesne temperature, uspešno identifikujući inflamatorne procese (poput mastitisa), estrus i toplotni stres, bez izazivanja manipulativnog stresa karakterističnog za konvencionalnu rektalnu termometriju. Istovremeno, IoT senzori mikroklimе (temperatura, vlažnost, nivo buke i koncentracija štetnih gasova) u kombinaciji sa automatskim sistemima za hranjenje (AFS) i inteligentnim integrisanim sistemima za pranje i dezinfekciju, koriste prikupljene ekološke parametre za automatsko prilagođavanje ambijentalnih uslova, čime se direktno redukuju toplotni stres, kompeticija, agresivno ponašanje i prisustvo patogena u okruženju.

Zaključuje se da digitalne tehnologije uspešno prevode podatke u direktne i precizne mere zaštite, minimizirajući bol, stres i povrede. Automatizacija i inteligentno upravljanje na osnovu podataka u realnom vremenu omogućavaju donošenje pravovremenih odluka, što postavlja temelj za dugoročno, ekonomski isplativo i održivo unapređenje zdravlja i opšte dobrobiti životinja u savremenoj pametnoj poljoprivredi.

Ključne reči: analiza podataka, digitalni sistemi, neinvazivni monitoring, održiva dobrobit, precizno stočarstvo (PLF), zdravlje životinja

Zahvalnica

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FROM DATA TO WELFARE: DIGITAL TECHNOLOGIES IN THE FUNCTION OF HEALTH, PROTECTION, AND SUSTAINABLE IMPROVEMENT OF ANIMAL WELFARE

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Summary

Due to the intensification of livestock production and global climate challenges, the ability to timely recognize disruptions in animal health status and comfort is becoming a key prerequisite for sustainable farm management. This paper analyzes the transformative path from raw data collection to decision-making in the function of health, protection, and sustainable improvement of animal welfare. The focus is on transitioning from traditional, reactive observation to continuous, non-invasive real-time monitoring through the application of Precision Livestock Farming (PLF) technologies and the Internet of Things (IoT), thereby overcoming the limitations of human labor and the unfavorable farmer-to-animal ratio.

The synergy of various digital systems enables the collection of high-frequency data and its translation into an objective evaluation of the physiological and behavioral needs of animals. The implementation of electronic identification (RFID) and global navigation satellite positioning (GPS/GNSS) establishes the foundation for an individualized approach to care, optimization of space utilization, and early detection of anomalies in movement and grazing. Data from wearable biosensors (accelerometers, pedometers, and microphones) and pressure-sensing mats allow for continuous monitoring of activity, rest, and vocalization, ensuring the early

detection of stress, pain, and lameness. A specific contribution to health protection is provided by infrared thermal cameras and embedded temperature sensors, which monitor body temperature fluctuations in a contactless and non-invasive manner, successfully identifying inflammatory processes (such as mastitis), estrus, and heat stress, without inducing the handling stress characteristic of conventional rectal thermometry. Simultaneously, environmental IoT sensors (temperature, humidity, noise levels, and harmful gas concentrations) combined with automated feeding systems (AFS) and intelligent integrated washing and disinfection systems, utilize the collected environmental parameters to automatically adjust ambient conditions, directly reducing heat stress, competition, aggressive behavior, and the presence of pathogens in the environment.

It is concluded that digital technologies successfully translate data into direct and precise protection measures, minimizing pain, stress, and injuries. Automation and intelligent management based on real-time data enable timely decision-making, which sets the foundation for long-term, economically viable, and sustainable improvements in the health and overall welfare of animals in modern smart agriculture.

Key words: animal health, data analysis, digital systems, non-invasive monitoring, precision livestock farming (PLF), sustainable welfare

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