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Artificial Intelligence for General Appearance Evaluation: A New Era in Dairy Animal Selection

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Selecting a superior dairy animal is one of the most important decisions for every dairy farmer. A good dairy cow or buffalo is valued for more than just high milk production. Its body conformation, structural soundness, health, mobility, and breed characteristics are equally important. Together, these traits influence productivity, longevity, and farm profitability. For many years, experienced livestock judges have assessed these traits through careful visual observation and practical experience. This approach has served the dairy industry well. However, it is often subjective, and evaluation scores may differ from one judge to another. Such variation can affect the consistency and reliability of animal selection. Today, artificial intelligence (AI) is bringing a new dimension to dairy animal evaluation. Computer vision, smartphone technology, and digital image analysis make it possible to assess animals more objectively and consistently. These technologies improve the accuracy, repeatability, and standardization of evaluations. A modern General Appearance Score Card provides a scientific and practical framework for evaluating dairy animals. It assesses their physical, structural, behavioral, and functional characteristics in a systematic manner. When combined with AI-assisted phenotyping, it supports more accurate selection and precision breeding for future dairy herds.

Why General Appearance is Important

The general appearance of a dairy animal is more than an indicator of beauty or breed type. It provides valuable information about the animal's health, productivity, reproductive efficiency, longevity, and adaptability. These traits are essential for sustainable dairy production. An animal with sound structural conformation and balanced body proportions is usually more productive. Well-developed dairy character further reflects its functional

efficiency. Such animals convert feed into milk more efficiently. They maintain higher milk production over multiple lactations. They also experience fewer health and locomotion problems. Proper body structure supports easier calving and better mobility. It also improves reproductive performance and helps animals cope with environmental stress. As a result, these animals remain productive in the herd for a longer period. This reduces replacement costs and increases overall farm profitability. For these reasons, the evaluation of general appearance is a key component of dairy animal selection. It is widely used in breed improvement programs, livestock exhibitions, dairy farms, and genetic evaluation. Accurate assessment helps identify animals with superior functional and productive traits. Recent advances in artificial intelligence (AI), computer vision, and digital phenotyping have transformed dairy animal evaluation. General appearance can now be assessed using standardized and objective methods. These technologies reduce subjectivity and improve the consistency of evaluations. They also support data-driven identification of genetically superior and functionally efficient dairy animals for precision breeding.

A Scientific General Appearance Score Card

Modern dairy animal evaluation extends beyond body size and milk production. It considers the animal's overall structure, functionality, health, and breed characteristics. A comprehensive assessment provides a more accurate measure of dairy merit. The proposed General Appearance Score Card includes 60 scientifically important parameters. It evaluates structural correctness, dairy character, health, welfare, and breed conformity. Together, these parameters provide a comprehensive and objective assessment of dairy animals. They also support accurate selection, genetic improvement, and precision dairy breeding.

These parameters can be grouped into several functional categories.

1. Breed Character and Identity

Every dairy breed has unique physical characteristics. These features distinguish one breed from another. They also help identify breed purity and genetic identity. Important breed characteristics include coat colour, horn shape, ear orientation, facial profile, hump, dewlap, and body conformation. Careful evaluation of these traits supports accurate breed identification. Artificial intelligence (AI) can now recognize these breed-specific characteristics from digital images. This approach is faster and more consistent than conventional visual inspection. It also improves the accuracy and reliability of breed identification.

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2. Body Development and Growth

Body measurements provide valuable information about growth and production potential. They reflect skeletal development, body capacity, and nutritional status. These traits are important indicators of dairy performance. Key measurements include body length, height at the withers, chest girth, frame size, body depth, and body weight. Together, they help assess the animal's physical development and functional capacity. Animals with greater body capacity usually consume more feed. This supports better metabolic efficiency and higher milk production. However, body capacity should always be evaluated along with overall structural balance. Traditionally, these measurements are recorded manually. Today, AI-enabled mobile applications can estimate them accurately from smartphone photographs. This approach reduces manual effort and provides rapid, objective, and consistent measurements.

3. Structural Soundness

Structural soundness is one of the most important characteristics of a high-performing dairy animal. It provides the physical foundation for health, productivity, reproduction, and longevity. A strong and well-balanced skeletal framework helps animals withstand the demands of repeated lactations. It also supports good mobility and overall functional performance. The General Appearance Score Card evaluates several important structural traits. These include the topline, loin strength, spine alignment, shoulder placement, rump angle, rump width, hip and pin bone structure, tail setting, and overall structural balance. Together, these traits reflect skeletal strength, body symmetry, and functional efficiency. Dairy animals with sound structural conformation usually move more efficiently. They often show better reproductive performance and greater resistance to musculoskeletal disorders. They also remain productive in the herd for a longer period. As a result, structural soundness is a key criterion for selecting genetically superior animals. It supports sustained milk production while maintaining good health and animal welfare throughout the productive life.

4. Feet and Legs: The Foundation of Longevity

Healthy feet and legs are the foundation of a productive and long-lasting dairy animal. They are essential for efficient movement, feed intake, reproductive performance, and animal welfare. Strong and well-structured limbs help animals perform efficiently throughout their productive lives. Dairy animals spend many hours walking to feed and water, standing during milking, and moving within housing systems. These daily activities place continuous stress on the feet and legs. Therefore, sound limb structure is essential for maintaining health and productivity. The General Appearance Score Card evaluates several important feet and leg

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traits. These include front-leg correctness, rear-leg alignment, hock set, pastern strength, hoof angle, hoof shape and uniformity, joint soundness, and locomotion score. Together, these traits reflect the animal's ability to bear weight, move comfortably, and withstand the physical demands of high milk production. Animals with sound feet and legs usually have better mobility and higher feed intake. They also show improved reproductive performance and remain productive for a longer period. In contrast, poor leg structure and hoof abnormalities often lead to lameness, pain, reduced feed intake, lower milk yield, impaired fertility, and premature culling. These problems result in significant economic losses. Early identification of structural defects is important for effective herd management. Systematic conformation scoring and AI-assisted gait analysis help detect problems at an early stage. This allows timely corrective management, better hoof care, and more informed breeding decisions. As a result, animal welfare improves, and productive herd life is extended.

5. Dairy Character

Dairy character is one of the most important indicators of milk-producing potential. It reflects the animal's ability to convert feed nutrients into milk rather than body fat. Animals with strong dairy character are usually more efficient milk producers. High-producing dairy animals have a distinctive body form. They appear angular, open, refined, and feminine rather than fleshy or heavily muscled. This body type is closely associated with efficient milk production. Typical dairy characteristics include a long and lean neck, well-sprung and open ribs, refined and clean bones, soft and elastic skin, and a deep wedge-shaped body. These features provide adequate body capacity for high feed intake and efficient metabolism. The proposed General Appearance Score Card evaluates several important dairy character traits. These include angularity, rib spring, neck refinement, skin texture, bone quality, body capacity, and overall body symmetry. Together, these traits provide valuable information about metabolic efficiency, feed utilization, and milk-producing ability. Animals with strong dairy character generally produce more milk. They also show better functional efficiency, improved reproductive performance, and a longer productive life. Therefore, dairy character is an essential component of dairy animal selection and precision breeding programs.

6. Health and Welfare Indicators

The physical appearance of a dairy animal provides valuable information about its health, nutritional status, and welfare. It is an important part of general appearance evaluation. External features often reveal health problems before clinical signs become visible. The proposed General Appearance Score Card evaluates several important health and welfare

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indicators. These include body condition score (BCS), coat quality, eye brightness, alertness, external parasite load, injuries, skin lesions, posture, and standing behavior. Together, these traits provide a comprehensive assessment of the animal's overall condition. Body condition score reflects the animal's energy reserves and nutritional status. A smooth, glossy coat and bright, alert eyes usually indicate good health and proper management. In contrast, external parasites, wounds, skin lesions, abnormal posture, or difficulty in standing may indicate disease, pain, or poor welfare. Regular monitoring of these indicators helps detect health problems at an early stage. It also supports the early identification of lameness, nutritional disorders, and management-related issues. Timely intervention improves animal health, reduces treatment costs, and enhances productivity. Artificial intelligence (AI) and computer vision have further improved health and welfare assessment. These technologies enable continuous and non-invasive monitoring of dairy animals. They support early disease detection, improve welfare evaluation, and provide reliable data for evidence-based management decisions in precision dairy farming.

7. Behavior and Temperament

Behavioral traits influence both productivity and ease of management. Parameters such as temperament, walking pattern, posture analysis, locomotion score, and standing behavior provide valuable information regarding stress, musculoskeletal health, and overall welfare. Computer vision systems can automatically analyze these behavioral characteristics through continuous video monitoring without disturbing the animals.

Artificial Intelligence is Transforming Dairy Animal Evaluation

Artificial intelligence (AI) is revolutionizing dairy animal evaluation by assessing general appearance more objectively, accurately, and efficiently than ever before. Traditionally, the evaluation of dairy animals depended largely on the expertise and experience of judges, making the process time-consuming and prone to subjective variation. Today, advances in computer vision, machine learning, and smartphone technology enable farmers and livestock professionals to capture images or short videos of animals using a mobile phone. AI algorithms automatically detect important anatomical landmarks such as the head, withers, shoulders, hips, hook and pin bones, tail head, legs, hooves, and other key body regions to generate precise morphometric measurements. Based on these digital images, the system can simultaneously evaluate body dimensions, body condition score, locomotion, posture, breed characteristics, structural soundness, body proportionality, image quality, and overall general appearance. In addition, AI-assisted systems can identify structural defects,

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monitor gait and mobility, estimate body weight, and assess animal welfare with minimal human intervention. This digital approach significantly reduces observer bias and human error while improving the speed, repeatability, consistency, and objectivity of animal evaluation. As a result, AI-powered phenotyping is emerging as a powerful tool for precision dairy farming, supporting better breeding decisions, genetic improvement, health monitoring, and sustainable dairy production.

Digital Image Quality: The Foundation of Accurate AI-Based Dairy Animal Evaluation

The accuracy and reliability of artificial intelligence (AI)-based dairy animal evaluation depend largely on the quality of the images used for analysis. Even the most advanced computer vision algorithms cannot produce precise measurements if the captured images are blurred, poorly illuminated, partially obstructed, or misaligned. To ensure accurate and consistent phenotypic assessment, the proposed General Appearance Score Card incorporates several image quality and validation parameters. These include evaluation of image clarity, proper lighting, complete body visibility, correct animal positioning, and the accurate detection of anatomical landmarks such as the head, withers, shoulders, hook and pin bones, tail head, legs, and hooves. The system also assesses morphometric accuracy by comparing AI-derived body measurements with standardized manual measurements and evaluates body proportionality to ensure conformity with breed standards. By incorporating these quality-control measures, the digital phenotyping system minimizes measurement errors, improves the reliability and repeatability of AI-generated results, and ensures that automated evaluations are scientifically robust and comparable with expert assessments. High-quality image acquisition therefore forms the foundation of reliable AI-assisted conformation assessment, precision breeding and data-driven decision-making in modern dairy farming.

Towards Precision Dairy Breeding

AI-enabled digital phenotyping is transforming precision dairy breeding. It integrates seamlessly with advanced genomic technologies. This combination provides a powerful platform for accurate animal selection. Unlike conventional methods, digital phenotyping generates objective and standardized data. It captures information on body conformation, structural soundness, dairy character, locomotion, and general appearance. These data are collected rapidly and consistently. The phenotypic data can be combined with milk production, reproductive performance, pedigree records, genomic single nucleotide polymorphism (SNP) profiles, health records, and other performance traits. This integrated

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approach provides a comprehensive assessment of an animal's genetic potential and functional efficiency. The combined data improve the accuracy of genetic evaluation. They help identify superior breeding animals more efficiently. They also enhance genomic prediction and accelerate genetic gain. Digital phenotyping also supports the conservation and genetic improvement of indigenous cattle and buffalo breeds. It enables objective breed characterization and helps identify elite germplasm for future breeding programs. The integration of artificial intelligence (AI), computer vision, digital phenotyping, and genomic information shifts dairy animal selection from subjective visual judgment to evidence-based decision-making. This approach promotes sustainable genetic improvement, higher productivity, improved animal welfare, and a more resilient dairy industry.

The Road Ahead

The future of dairy farming is being transformed by digital technologies. These innovations are making dairy animal evaluation more objective, efficient, and data-driven. Smartphones equipped with artificial intelligence (AI), computer vision, machine learning, and cloud-based analytics are expected to become essential tools for dairy herd management. They will enable rapid and automated assessment of body conformation, structural soundness, body condition, locomotion, health status, and breed characteristics with minimal human intervention. Digital phenotyping will play a key role in precision dairy farming. It will generate standardized and high-throughput phenotypic data. These data can be integrated with genomic, production, and reproductive records to improve breeding decisions. As imaging technologies become more affordable and AI algorithms become more accurate, digital evaluation will become widely accessible. Farmers, veterinarians, breeders, and dairy organizations will be able to evaluate animals more quickly, consistently, and scientifically. The integration of digital phenotyping with genomic prediction, precision nutrition, reproductive management, and real-time health monitoring will further improve breeding accuracy, productivity, and animal welfare. It will also support the conservation and genetic improvement of indigenous dairy breeds. The future of dairy animal evaluation lies in intelligent and evidence-based decision-making. This transition from conventional visual appraisal to AI-assisted digital phenotyping will support a more productive, sustainable, and technology-driven dairy industry.

Conclusion

The General Appearance Score Card represents a major advancement in dairy animal evaluation. It combines traditional livestock judging with modern digital technologies. The

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score card includes 60 scientifically validated traits. It provides a comprehensive assessment of body conformation, dairy character, structural soundness, health, behavior, welfare, and breed conformity. When integrated with artificial intelligence (AI), computer vision, and genomic information, the system becomes a powerful tool for dairy animal evaluation. It improves selection accuracy and supports precision breeding. It also enhances animal welfare and accelerates genetic improvement. The shift from subjective visual assessment to AI-assisted digital phenotyping marks a new era in precision dairy farming. It enables objective, standardized, and data-driven evaluation. This approach supports the development of a more productive, sustainable, and technology-driven dairy industry.

References

Ajayi, P., Baumung, R., Boettcher, P., Leroy, G., & Vaccari, G. (2026, February). Preparation of the Third Report on the State of the World's Animal Genetic Resources for Food and Agriculture. In World Congress on Genetics Applied to Livestock Production Digital Archive (Vol. 2026, No. 1). Iowa State University Digital Press.

Berry, D. P., et al. (2019). Genetics of body conformation traits in dairy cattle. Journal of Dairy Science, 102, 10252–10267.

Bewley, J. M. (2021). Precision dairy farming technologies. Veterinary Clinics of North America: Food Animal Practice, 37, 455–469.

De Haas, Y., et al. (2020). Novel phenotypes for dairy cattle breeding. Journal of Dairy Science, 103, 11039–11052.

Guo, Y., et al. (2023). Artificial intelligence applications in precision dairy farming: A review. Animals, 13, 2571.

Halachmi, I., Guarino, M., et al. (2020). Precision livestock farming: Review of technologies for body condition assessment. Animal, 14, s287–s295.

https://doi.org/10.1016/j.sbsr.2020.100367

ICAR-NBAGR. (2023). Breed descriptors of indigenous cattle and buffaloes of India. ICAR-NBAGR, Karnal.

Li, G., Zhao, K., Liu, Z., et al. (2021). Deep learning-based computer vision technologies for livestock monitoring: A review. Computers and Electronics in Agriculture, 185, 106144.

Molins Colomer, M. (2026). Development and Evaluation of Computer Vision Solutions for Precision Livestock Systems.

Neethirajan, S. (2020). The role of sensors, big data, and machine learning in modern animal farming. Sensing and Bio-Sensing Research, 29, 100367.

Pryce, J. E., et al. (2021). Precision phenotyping for genetic improvement in dairy cattle. Animal Frontiers, 11, 34–42.

Salau, J., et al. (2020). Automated body condition scoring using deep learning in dairy cattle—Computers and Electronics in Agriculture, 173, 105386.

Schlageter-Tello, A., et al. (2020). Review of automated locomotion scoring systems in dairy cattle. Animals, 10, 1763.

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Published 10/07/2026

Tullo, E., Fontana, I., Diana, A., & Norton, T. (2019). Application note: Labeling, data processing, and machine learning techniques in precision livestock farming. Animal, 13(4), 881–891.https://doi.org/10.1017/S1751731118001774

Van Hertem, T., et al. (2018). Machine learning for automated lameness detection in dairy cows. Journal of Dairy Science, 101, 8824–8834.

Viazzi, S., et al. (2019). Image-based body measurements in dairy cattle using machine vision. Computers and Electronics in Agriculture, 156, 76–84.