Enhancing Efficiency in Livestock Management Through Digital Transformation

i-Pro, Farmers Support, and Restar collaboratively utilize advanced AI algorithms, computer vision, and Intel® technology to deliver MOOVIE, an automated solution that optimizes livestock management and simplifies operational complexity across Japan's cattle farms.

The cattle farming industry in Japan is facing unprecedented challenges that affect the productivity and economic viability of cattle farms. Recent data from the Ministry of Agriculture, Forestry and Fisheries (MAFF) indicates a 5% decline[1] in Japanese cattle farms, despite a 3% increase[1] in the total beef cattle herd size. This drop is driven by high operational costs and low market prices, forcing many smaller farms with less than 200 heads[1] of cattle to exit the industry. Furthermore, the recent conception rate for beef cattle in Japan is approximately 50%[2], showing a decreasing trend nationwide in recent years. This figure represents missed conception opportunities due to delayed or inaccurate estrus detection. This combination of challenges increases the burden on cattle farmers and makes managing cattle herds increasingly difficult.

However, the challenges aren't limited to herd sizes and cattle numbers alone.

According to the Ministry of Agriculture, Forests, and Fisheries (MAFF), as of 2024 Japan's agricultural workforce numbers 1.1 million, a 30% decrease from 10 years ago[1]. It is further estimated that the figure will plummet to 300,000 over the next 20 years. In addition, the median age of workers is nearly 70[1], indicating a marked aging of the workforce. The result is an industry grappling with heightened workloads and manpower shortages leading to operational inefficiencies. These inefficiencies stem from long working hours due to labor shortages, the remote, often mountainous location of farms, and traditional methods of calving and estrus detection which rely on 'rule of thumb' methods that require constant manual monitoring.

In response to these challenges, i-PRO, Farmers Support, and Restar collaborated on an AI-enabled, contactless livestock monitoring solution that harnesses Intel's powerful platforms for real-time detection of calving and estrus behavior in cattle. This solution helps farmers overcome operational challenges and ensures timely interventions, leading to improved animal welfare and enhanced farm productivity.

Innovation Driven by Collaboration

i-PRO's advanced camera and edge storage technology serve as the cornerstone of the solution, which is augmented by the innovative AI algorithms for detecting calving and estrus behavior developed by Farmers Support. Restar's expertise in systems integration ensures that the solution's components interface seamlessly. Intel was sought out for its robust hardware and AI-optimized computing platforms that could drive the solution's overall performance and efficiency. In a nutshell, this partnership brought together the strengths of each of its collaborators to create a comprehensive, innovative solution for modern cattle and livestock management.
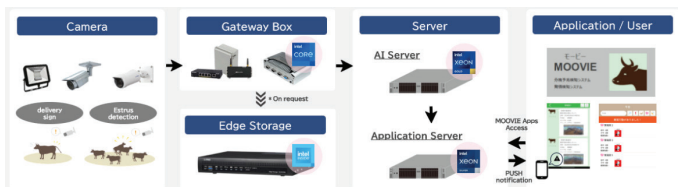

Figure 1: An overview of the MOOVIE contactless monitoring solution.

The MOOVIE Solution

By integrating i-PRO's advanced edge AI cameras and edge storage solutions with sophisticated AI and IoT technologies, MOOVIE offers a groundbreaking solution for the 24/7 monitoring of cattle. This system detects calving and estrus behavior in real time, automating livestock monitoring processes and significantly reducing the labor intensity of cattle farming operations.

Unlike conventional technologies that require sensors to be attached to animals or a CCTV feed monitored by farm workers, MOOVIE's AI-based image analysis is completely contactless, providing a unique advantage in cattle husbandry. The non-contact nature of the solution reduces labor hours spent on manual inspection of cattle for estrus and calving, both of which are time-sensitive factors that ultimately determine the profitability and success of cattle farming operations.

MOOVIE also enhances animal welfare by eliminating the need for invasive sensor attachments that need to be surgically attached. This approach ensures that the cattle are monitored continuously without regular physical intervention which could lead to stress. Long-term chronic stress in cattle manifests as lowered immunity which in turn leads to diseases and lowers the productivity and profitability of cattle farms[3].
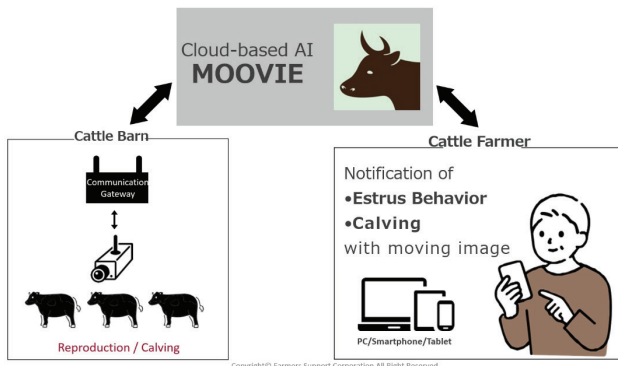

Figure 2: MOOVIE in action.

At the core of the MOOVIE system are i-PRO's edge AI cameras, engineered for durability in harsh environments such as rain, dust, and corrosive gasses. These cameras are IP67 certified, ensuring they are both dust-tight and water-resistant, making them ideal for the challenging operating conditions often found in livestock farming. These cameras capture high-quality images, even in low light or backlit conditions, ensuring accurate detection of key behavioral indicators such as mounting, tail raising, and the appearance of the amnion. The cameras also process RAW data before compression, increasing the precision of AI detection and reducing the communication load—critical in settings where numerous cameras are deployed.
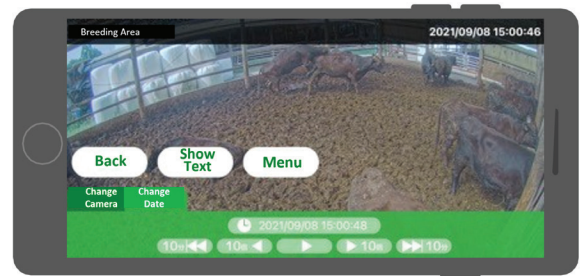

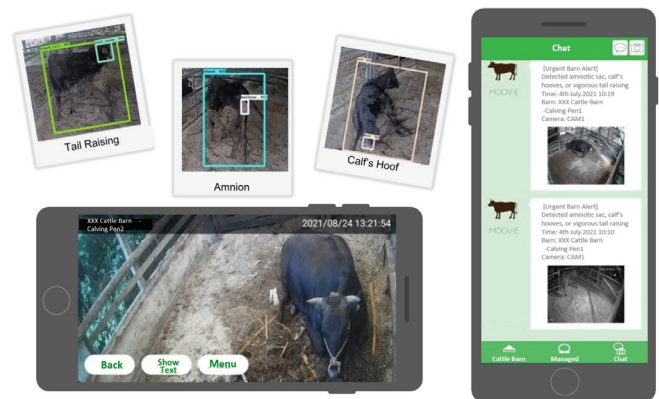Figure 3A: Screen grabs from the MOOVIE app depicting the detection of estrus behavior.

Figure 3B: Screen grabs from the MOOVIE app depicting the detection of calving behavior.

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The images captured by the cameras are stored on i-PRO's scalable and secure edge storage devices before being transferred to AI servers for further inference and analysis. Upon detecting signs of calving or estrus, the system immediately notifies farmers via devices such as laptops, smartphones, or tablets, enabling timely and informed interventions to ensure the welfare of their cattle.

The table below provides an overview of the MOOVIE solution, highlighting its key components and the technologies that drive this innovative platform.

The Solution At A Glance

i-PRO Edge AI Cameras
Continuously monitor cattle behavior to detect calving and estrus signs.

AI-Enabled Image Processing
Filters and prioritizes data for efficient real-time analysis.

Real-Time Analysis & Inference
Detects calving or estrus signs and triggers notifications.

i-PRO Edge Storage
Stores recent video footage for quick access and redundancy.

MOOVIE App
Provides a mobile platform for farmers to receive notifications and monitor cattle remotely 24x7 .

Enhancing the MOOVIE Solution with Intel's Powerful Platforms

The MOOVIE solution leverages Intel's powerful platforms to deliver high-performance AI capabilities essential for modern livestock management. The solution is powered by the Intel® Core™ and Intel® Xeon® processors, ensuring efficient data processing and real-time analysis. These processors enable the MOOVIE system to manage the complex tasks of image analysis and AI-driven decision-making, providing farmers with timely and accurate insights.

Intel® Xeon® Processors and Intel® Data Center GPUs: Maximizing MOOVIE's AI Performance

4th Gen Intel® Xeon® Gold processors and Intel® Data Center GPU Flex Series 170 form the backbone of the MOOVIE AI server, enabling it to handle the high-volume data streams generated by the solution's AI-enabled cameras. In addition, 3rd Gen Intel® Xeon® Scalable processors provide a balanced architecture with built-in acceleration and advanced security capabilities for the MOOVIE solution's application server, enabling consistent performance for data-centric workloads.

Together, these processors and GPUs efficiently manage demanding AI workloads, ensuring that the MOOVIE system can quickly and accurately detect signs of calving or estrus in cattle and promptly send out data and alerts to farmers.

By utilizing Intel's powerful processing capabilities, MOOVIE offers a robust, cost-optimized, and scalable solution that meets the needs of farms of all sizes.

Intel® Core™ Processors: Enhancing the Efficiency and Scalability of the Solution

Deployed in the Gateway AI Box that serves as an intermediary between the edge AI camera and the MOOVIE AI servers, 13th and 14th Gen Intel® Core™ processors play a crucial role in the initial image processing phase. The Gateway AI Box analyzes the feed from the edge AI camera to efficiently detect the number on a cow's ear tag or detect behaviors such as estrus and calving. These processors provide reliable local storage management and edge processing capabilities, supporting the overall architecture's scalability and enabling the solution to function effectively in remote or resource-constrained environments on farms.

Delivering High-Impact Benefits with MOOVIE

The MOOVIE solution offers a range of powerful benefits designed to revolutionize livestock management by enhancing efficiency, reducing labor burdens, and improving animal welfare.

AI-Driven Manpower Optimization

MOOVIE's AI-enabled cameras replace the need for human eyes, while advanced AI algorithms stand in for human experience and expertise. This setup provides continuous, real-time monitoring of cattle behavior, allowing farmers to detect signs of calving and estrus with high accuracy vs. traditional rule-of-thumb methods that need constant human intervention and greater manpower. The system's 24-hour monitoring significantly reduces the burden of manually monitoring cattle, optimizing cattle farming operations amidst ongoing labor shortages.

Improvement in Conception Rates and Reduced Birthing Complications

MOOVIE's AI-driven estrus detection functionality provides detailed insights into the onset and end times of estrus by precisely identifying mounting behavior. This accuracy helps farmers target the optimal conception window (6-12 hours after estrus ends), leading to higher conception rates. Further down the cattle breeding process, MOOVIE provides high-precision AI detection of calving behavior such as the presence of amnion, tail raising, and the appearance of the calf's hoof, with an accuracy rate of 90-95%[4].

The solution then notifies farmers up to an hour before birth[4], enabling prompt action and reducing the risk of stillbirths and dystocia which account for up to 2.46%[5] and 8.55%[5] of calf mortality respectively, and lead to a proportional loss in profitability.

Calving	Notification	Undetected	Detection Rate	False Notification	Rate of False
43	41	2	95%	5	11%

90-95% accuracy in notification	Average of 56 minutes earlier (*20 - 90 min.)

Figure 4: Sample data of MOOVIE's proving test for calving detection at a cooperative cattle farm[4].

Cost-Effective Livestock Management

The MOOVIE solution leverages existing hardware infrastructure powered by Intel® processors, minimizing the need for additional specialized equipment. This approach reduces upfront costs and ongoing operational expenses, making advanced livestock management accessible to farms of all sizes, even those in remote, mountainous areas. By automating key processes, MOOVIE delivers cost savings and ensures that farmers can focus on other critical tasks, further enhancing the farm's overall efficiency. Since the solution stores the data at the edge there is no monthly cloud storage fee, which optimizes running costs even further.

Scalable and Flexible Solution

MOOVIE is designed to scale with the needs of the farm, whether small or large. The system's flexible architecture allows for easy expansion, accommodating additional cameras and processing power as needed. This scalability ensures that MOOVIE can grow alongside the farm, adapting to increased demands and providing continuous value as the operation expands.

Reliable and Efficient Operations

Powered by robust Intel® processors, the MOOVIE solution ensures reliable and efficient operations. The system's real-time processing capabilities allow farmers to receive accurate and timely information, enabling quick and informed decision-making. This reliability reduces downtime of the solution, improves productivity, and provides greater peace of mind for farmers. Additionally, AI notifications assist in improving the skills of personnel, particularly those new to cattle farming, by providing guidance and insights that enhance their understanding of husbandry management.

Improved Animal Welfare

Since the system is contactless, the need for surgically attached trackers is eliminated. Moreover, with the timely detection and automated notifications of estrus and calving behavior, the system ensures that human intervention is kept to a minimum. This greatly reduces the stress faced by cattle, and eliminates the risk of stress-induced disorders, contributing to the improvement of animal welfare, herd health, and profitability.

The Way Forward for the MOOVIE Solution

The success of the MOOVIE solution in Japan has demonstrated its significant impact on transforming livestock management by improving efficiency, reducing labor burdens, and enhancing animal welfare. Building on these positive outcomes, MOOVIE is now being evaluated for deployment in overseas markets, with the potential to become a global standard in smart livestock management.

As part of its future evolution, Intel® Distribution of OpenVINO™ Toolkit is being evaluated for deployment alongside the current AI-optimized hardware to further enhance the solution's AI inference capabilities. Using OpenVINO will also further enhance MOOVIE's ability to contribute to other applications in agriculture, food production, and sustainability efforts, helping farmers worldwide achieve similar benefits in productivity and environmental stewardship.

About Farmer's Support Corporation	About Intel
Farmer's Support Corporation is a startup that researches, develops, and provides systems utilizing ICT and artificial intelligence for primary industries such as livestock farming. As professionals in AI image analysis technology, Farmer's Support leverages expertise and know-how gained from accumulating on-site data and fine-tuning AI to suit specific environments. By understanding the challenges faced by farmers, Farmer's Support aims to provide a system that alleviates daily livestock management burdens and mental stress while also being economically beneficial. Learn more about Farmer's Support here: https://farmers-s.co.jp/	focuses on developing technologies that change the world, drive global progress, and enrich human lives. Driven by Moore's Law, Intel is dedicated to the continuous innovation of semiconductor design and manufacturing to provide customers with solutions to major challenges. By integrating intelligence with the cloud, network, edge, and various computing devices, Intel unlocks the potential of data and helps improve both business and society. Learn more about Intel® AI solutions here: https://www.intel.com/content/www/us/en/artificial-intelligence/overview.html

intel.

Source:

[1] Ministry of Agriculture, Forestry and Fisheries, Japan
[2] Livestock Improvement Association Japan Inc.
[3] Interactions between Temperament, Stress, and Immune Function in Cattle
[4] Farmers Support Corporation
[5] Risk Factors for Stillbirth and Dystocia in Japanese Black Cattle