IOT Based Smart Sheep Farm Monitoring System Using RFID Technology

Mrs.K.Priyadevi,[1] [2]Ms.A.Dharani, [3]Ms.S.Suntharambal, [4]Ms.S.Suvedha, [5]Ms.S.Vaitheki
[1]*Assistant Professor, Department of ECE, Mahendra College of Engineering, Salem*
[2,3,4,5] *UG Students, Department of ECE, Mahendra College of Engineering, Salem*

Abstract: The smart sheep farm monitoring system provides a pioneering approach to sheep farming, integrating advanced technologies to optimize operations and ensure livestock welfare. The Enhanced Smart Sheep Farm Monitoring System incorporates IoT, RFID, and advanced sensor technologies for precise individual sheep identification, weight monitoring, and environmental oversight. Additionally, a Python-based species recognition program enhances security by detecting and notifying farmers of unauthorized presence on the farm premises. Real-world examples and data-driven insights demonstrate how this comprehensive solution streamlines farm management, prioritizes animal welfare, and enhances efficiency and sustainability in sheep farming practices. The project research explores the potential of smart farming to revolutionize traditional agricultural practices, offering practical solutions for modern farming challenges.

INTRODUCTION

Smart sheep farming, an innovative approach to traditional livestock management, is poised to revolutionize the industry by harnessing the power of advanced technologies. Historically, sheep farming has relied heavily on manual labor and the expertise of farmers to monitor and manage flocks effectively. However, the emergence of IoT (Internet of Things) and RFID (Radio Frequency Identification) technologies presents a paradigm shift, offering unprecedented opportunities to streamline operations, enhance productivity, and prioritize animal welfare.

Our project aims to develop an Enhanced Smart Sheep Farm Monitoring System, a comprehensive solution that integrates various cutting-edge technologies to optimize farm management practices and improve the overall well-being of the livestock. At the core of this system are RFID tags, individually attached to each sheep for precise identification. These tags allow for seamless tracking of each animal, enabling farmers to monitor their movements, behavior, and health status in real time. Additionally, load cells are employed to accurately measure the weight of each sheep, providing valuable insights into their growth and nutritional needs.

Environmental monitoring is another crucial aspect of smart sheep farming, and our system incorporates temperature sensors to track ambient conditions within the farm environment. By continuously monitoring temperature levels, farmers can ensure that the sheep are kept in optimal conditions, mitigating the risk of heat stress or exposure to extreme weather events. This proactive approach to environmental management is essential for safeguarding the health and well-being of the flock.

The heart of the Enhanced Smart Sheep Farm Monitoring System lies in its data processing capabilities, facilitated by an Arduino Uno microcontroller. This powerful device collects and analyzes data from RFID tags, load cells, and temperature sensors, providing farmers with actionable insights and real-time updates on the status of their flock. The information processed by the microcontroller is displayed on an LCD screen, allowing for easy visualization and interpretation by farm personnel.

In addition to on-site monitoring, our system is integrated with an IoT application that offers remote access to farm data and analytics. This user-friendly app provides farmers with detailed information about each sheep, including their identification, weight, and environmental temperature. Moreover, the IoT app is programmed to send alerts to farmers' mobile devices in case of any anomalies or emergencies, such as sudden changes in temperature or irregular behavior patterns among the flock. This proactive notification system enables farmers to respond swiftly to potential threats and take appropriate action to ensure the health and safety of their livestock.

Water and food management are critical components of effective sheep farming, and our system addresses these

needs through innovative technologies. A level sensor is installed in the water tank to monitor water levels continuously. When the water level falls below a predetermined threshold, the system automatically activates a water pump to replenish the tank, ensuring a constant and reliable water supply for the flock. Similarly, feeding technology operates on a timed basis, with the system automatically refilling the feeding tank at regular intervals to provide the sheep with a consistent source of nutrition.

The Enhanced Smart Sheep Farm Monitoring System represents a significant advancement in agricultural technology, offering farmers a comprehensive solution for managing their flocks more efficiently and effectively. By leveraging IoT, RFID, and advanced monitoring technologies, our system enables farmers to optimize farm operations, enhance productivity, and ensure the welfare of their livestock. With its integrated approach to data collection, analysis, and decision-making, the system empowers farmers to make informed choices that drive sustainable and profitable sheep farming practices.

LITERATURE REVIEW

Jianming Xu; Weichun Liu; Yang Qin; Guangrong Xu [2022], said that due to the uneven distribution and large scale change of sheep in the pasture, it is not conducive to the counting and statistics of sheep in animal husbandry. The traditional target counting algorithm has low counting accuracy in the field of animal husbandry, and there are fewer sheep data sets for research. To solve these problems, the data set of sheep density estimation was established, and a method of grassland sheep number estimation based on multi-scale residual visual information fusion Network (MRVIFNet) was proposed. This method extracts multi-scale features of sheep targets by using multiple parallel hole convolutions with different hole rates, and designs a depth neural network that is more suitable for live counting of sheep, so as to reduce the grid effect caused by hole convolution and better adapt to multi-scale changes of sheep. In the sheep density data set, the method obtained the lowest mean absolute error (MAE) and root mean square error (RMSE). In addition, a convolutional neural network model based on view branch sharing is also studied. Compared with the five popular methods, this method can achieve better performance. It is applied to solve the problem of pedestrian scale change and chaotic distribution in complex scenes; The performance of this method is better than that of comparison method, and the application results in actual scenarios verify the effectiveness of this method.

Emanuel Pereira; Ícaro Araújo; Luís Felipe Vieira Silva; Mateus Batista [2023], said that the application of animal tracking holds significant importance across diverse economic domains, encompassing sectors including livestock husbandry, agricultural practices, and the conservation of wildlife populations. It aims to track and understand animal behavior, movement patterns, and health status. The predominant use of RFID technology is observed within the domains of logistics, localization, and the tracking of goods. Notably, the application of this technology in the field of animal tracking has experienced a significant surge in popularity in recent years. This paper conducts a systematic literature review focused on understanding how RFID technology is being applied in the field of animal tracking. We have conducted a state-of-the-art research regarding animal tracking solutions in the scientific literature and patents. We have analyzed these solutions targeting which animals are being tracked, which problems are addressed, operating frequency, and whether other technologies are combined with RFID for animal tracking purposes. Among the categories of problems addressed, livestock management emerged as the main area, followed by animal tracking and traceability. Mammals, especially cattle, are the most common type of animal monitored. Considering RFID technology, passive UHF tags appeared more often. Moreover, many works also employed cameras and GPS together with RFID. Finally, this work can significantly contribute to this field by systematically presenting a state-of-the-art application of RFID for animal tracking.

Sai Ma; Qinping Yao; Takashi Masuda; Shogo Higaki; Koji Yoshioka; Shozo Arai [2021], Concluded that annually, numerous cattle die of various diseases, necessitating the need for effective cattle health management. To ensure cattle disease detection at an early stage and identify the health status of cattle, we collected the environment temperature, humidity, illuminance, and infrared images of cattle in an actual-life environment as input parameters to develop an artificial intelligence characterization module for measuring deep body temperature in a contactless manner. By analyzing the correlation of estimating deep body temperature at the horn, eyeball, and nose of cattle, the most effective way of estimating this temperature was

found to be at the horn. The estimation accuracy was particularly high in the sitting state. Moreover, we proposed a noncontact measurement system that can approximately measure the moving distance of cattle and depict the cattle movement trajectory. The usability and reliability of the proposed systems were verified via an experiment using special feed. We used moving distance data as an additional input for the body temperature estimation system and found that rumen temperature can be accurately estimated. The body temperature estimated using the proposed system can be used to realize long-term remote monitoring of cattle health and early and timely abnormality detection.

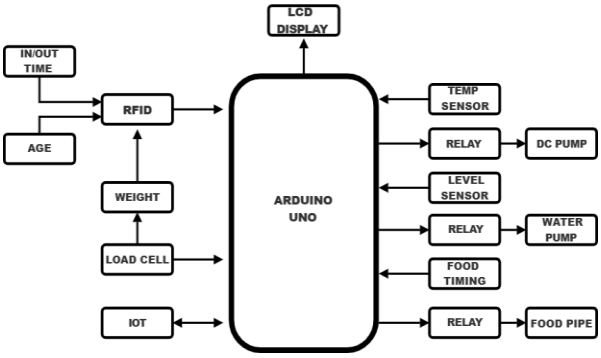
Mario E. Palendeng; Tharcilla I.R.C. Alvarenga; Stephanie Fowler [2020], Determining the age of the cattle is important in the cattle industry especially for trading purposes. Dentition and ossification scores are currently used to estimate the age of cattle. Both these methods have limitations which can create significant differences in carcass value. In this study, a fibre-optic probe-based spatially resolved diffuse reflectance spectroscopy system was used to investigate the possibility of using visible-near-infrared spectra for predicting the chronological age of beef cattle. This investigation was carried out on hide samples taken from 80 cattle with accurate date of birth and of the same breed. Spectra of hide samples taken from the neck area were used to build partial least squares models to estimate the age of the cattle. Various empirical pre-processing methods and wavelength selection using genetic algorithm (GA) were used to investigate whether these approaches could enhance model performance. Model performance was evaluated using the repeated learning-testing (RLT) method. A model with the lowest average root mean square error of prediction (ARMSEP) of 2.0 years was obtained when reflected intensity spectra collected from a source-detector distance of 1.0 mm was used after pre-processing with automatic Whittaker filter and applying wavelength selection using GA indicating the feasibility of this method for estimating the age of cattle. Two approaches for utilising measurements from all the source-detector distances collected by the spatially resolved measurement system were also considered. Both these approaches, co-adding and data fusion through augmentation, led to poorer model performance compared to using measurements from only one source-to-detector distance.

Xingyu Chen; Xiaodong Ye; Miao Li; Zhixian Song; Hualong Li; Xuanjiang Yang [2023], Chinais a big country in animal husbandry, and sheep breeding is an important part of animal husbandry. With the scale and modernization of the sheep farm, good management of the sheep shed is an essential factor to ensure the health of the sheep, including counting the sheep number in real time. This paper proposes an object detection method based on fusion allocation strategy and multi-objective loss function for sheep number counting. The fusion allocation strategy selects the pre-selection box based on the cross-grid strategy, and then calculates the minimum allocation loss function to distinguish the positive and negative samples, and the multi-objective loss function changes the confidence loss to VarifocalLoss, which strengthens the detection performance of the model for multi-objective situation. The experimental training was carried out on a single 1080Ti GPU, and the comparative analysis was based on the attention depthwise YOLO detection model. The result shows that the mAP value of the model reached 87.81%, which is superior to the previous model, and proves the feasibility of the model in actual application scenario.

METHODOLOGY

The working methodology of the Enhanced Smart Sheep Farm Monitoring System encompasses a series of steps aimed at integrating advanced technologies to optimize farm operations and enhance the welfare of the livestock. The initial phase involves setting up and installing the necessary components of the system across the farm premises. RFID readers are strategically positioned to cover the entire farm area, ensuring comprehensive detection and tracking of tagged sheep. Additionally, temperature sensors are strategically placed to monitor environmental conditions effectively, while the water and feeding tanks are equipped with appropriate sensors and actuators.

Once the infrastructure is in place, each sheep in the flock is tagged with an RFID tag for individual identification. These tags are securely attached to the ear or collar of each sheep, ensuring reliable detection and tracking as they move throughout the farm. Concurrently, load cells are calibrated to accurately measure the weight of each sheep. This calibration process involves applying known weights to the load cells and adjusting the calibration parameters to ensure accurate weight measurements.



Environmental monitoring forms a crucial aspect of the system's functionality. Temperature sensors installed throughout the farm continuously monitor ambient temperature levels, transmitting data to the central processing unit, an Arduino Uno microcontroller. This microcontroller serves as the brain of the system, collecting data from the RFID readers, load cells, and temperature sensors, and processing this information in real-time.

The processed data is then displayed on an LCD screen installed in a central location on the farm, providing farmers with real-time insights into the behavior, health, and environmental conditions of the flock. This real-time monitoring enables farmers to make informed decisions about farm management practices, such as adjusting feeding schedules or providing shelter during adverse weather conditions.

In addition to on-site monitoring, the Smart Sheep Farm Monitoring System is integrated with an IoT application that offers remote access to farm data and analytics. Farmers can access detailed information about each sheep, including their identification, weight, and environmental temperature, from any location using a mobile device or computer. Furthermore, the IoT application sends alerts to farmers' devices in case of any anomalies or emergencies, ensuring timely intervention and proactive management of the flock.

Water and food management are critical components of effective sheep farming, and the system addresses these needs through innovative technologies. A level sensor installed in the water tank continuously monitors water levels, automatically activating a water pump to replenish the tank when levels fall below a predetermined threshold. Similarly, feeding technology operates on a timed basis, automatically refilling the feeding tank at regular intervals to ensure a consistent source of nutrition for the flock.

Continuous monitoring and maintenance practices are integral to the system's operation, with regular inspections and calibration checks conducted to verify the accuracy of sensor readings and the functionality of all system components. Any issues or malfunctions are promptly addressed to minimize downtime and ensure uninterrupted monitoring and management of the flock. In summary, the Enhanced Smart Sheep Farm Monitoring System offers a comprehensive solution for optimizing farm operations, enhancing productivity, and ensuring the welfare of the livestock through the integration of advanced technologies and meticulous monitoring practices.

RESULT AND DISCUSSION

The implementation of the Enhanced Smart Sheep Farm Monitoring System yields a multitude of tangible benefits across various aspects of farm management. Firstly, the system significantly enhances farm efficiency and productivity by providing real-time data on individual sheep identification, weight, and environmental conditions, enabling informed decision-making and resource allocation. This leads to optimized feeding schedules, shelter arrangements, and health interventions, ultimately increasing overall farm productivity. Moreover, the system contributes to improved animal welfare by ensuring optimal environmental conditions and a constant, reliable water supply through its integration with advanced monitoring and water management technologies. Additionally, the system's proactive risk management capabilities, facilitated by real-time alerts and monitoring, enable farmers to swiftly respond to potential threats and emergencies, minimizing the impact on farm operations and livestock well-being. Furthermore, the implementation of the Smart Sheep Farm Monitoring System promotes sustainability and environmental stewardship by optimizing resource utilization, reducing waste, and fostering data-driven decision-making practices that minimize the farm's ecological footprint. In summary, the adoption of this innovative monitoring system not only enhances farm efficiency, productivity, and animal welfare but also promotes sustainable agricultural practices, ensuring the long-term viability and success of sheep farming operations.

CONCLUSION

The implementation of the Enhanced Smart Sheep Farm Monitoring System represents a significant advancement

in sheep farming practices, offering a comprehensive solution for optimizing farm management, enhancing productivity, and ensuring the welfare of livestock. By leveraging advanced technologies such as IoT, RFID, and automated monitoring systems, farmers gain access to real-time data and insights that empower informed decision-making and proactive management strategies. The system's ability to monitor individual sheep identification, weight, environmental conditions, and resource levels enables farmers to optimize feeding schedules, manage health risks, and respond swiftly to emergencies, ultimately increasing farm efficiency and productivity. Moreover, the integration of water and food management technologies promotes sustainable resource utilization while prioritizing animal welfare. Overall, the Enhanced Smart Sheep Farm Monitoring System not only improves farm operations but also embodies a commitment to sustainability, environmental stewardship, and the well-being of both livestock and farmers alike, ensuring a prosperous and sustainable future for sheep farming.

REFERENCE

[1] Tuwanut, P.; Kraijak, S. A survey on IoT architectures, protocols, applications, security, privacy, real-worldimplementation and future trends. In Proceedings of the 11th International Conference on WirelessCommunications, Networking and Mobile Computing, Shanghai, China, 21–23 September 2015.

[2] Ray, P.P. A survey on Internet of Things architectures. J. King Saud Univ. Comput. Inf. Sci.2018,30, 291–319.[CrossRef]

[3] Kidd, P.T. The role of the Internet of Things in enabling sustainable agriculture in Europe. Int. J. RF Technol.2012,3, 67–83.

[4] Kwong, K.H.; Wu, T.T.; Goh, H.G.; Sasloglou, K.; Stephen, B.; Glover, I.; Shen, C.; Du, W.; Michie, C.;Andonovic, I. Implementation of herd management systems with Wireless Sensor Networks. IET Wirel.Sens. Syst. 2011,1, 55–65. [CrossRef]

[5] Llaria, A.; Terrasson, G.; Arregui, H.; Hacala, A. Geolocation and monitoring platform for extensive farmingin mountain pastures. In Proceedings of the 2015 IEEE International Conference on Industrial Technology,Seville, Spain, 17–19 March 2015.

[6] Rajandekar, A.; Sikdar, B. A survey of MAC layer issues and protocols for Machine-to-Machinec ommunications. IEEE Internet Things J. 2015,2, 175–186. [CrossRef]

[7] Al-Fuqaha, A.; Guizani, M.; Mohammadi, M.; Aledhari, M.; Ayyash, M. Internet of things: A surveyon enabling technologies, protocols, and applications. IEEE Commun. Surv. Tutor.2015,17, 2347–2376.[CrossRef]

[8] Sethi, P.; Sarangi, S.R. Internet of Things: Architectures, Protocols, and Applications. J. Electr. Comput. Eng.2017,2017, 9324035. [CrossRef]

[9] Naik, N. Choice of effective messaging protocols for IoT systems: MQTT, CoAP, AMQP and HTTP.In Proceedings of the 2017 IEEE International Systems Engineering Symposium, Vienna, Austria,11–13 October 2017.

[10] IEEE Standard for Low-Rate Wireless Networks. IEEE Std 802.15.4-2015 (Revision of IEEE Std 802.15.4-2011); IEEE: Piscataway, NJ, USA, 2016; pp. 1–709.

[11] Kushalnagar, N.; Montenegro, G.; Schumacher, C. IPv6 over Low-Power Wireless Personal Area Networks(6LoWPANs): Overview, Assumptions, Problem Statement, and Goals; IETF RFC 4919. 2007. Available online: https://tools.ietf.org/html/rfc4919 (accessed on 31 January 2019).

[12] Mr.D.Balaji, Smart trash can using internet of things, International Journal Of Advanced Research Methodology In Engineering & Technology, Vol.01, issue 3, 2017

[12] Shelby, Z.; Hartke, K.; Bormann, C. The Constrained Application Protocol (CoAP)—IETF RFC 7252. 2014.Available online: https://tools.ietf.org/ html/rfc7252 (accessed on 31 January 2019).

[13] Ritchie, M.; Chase, J.; Atwell, M.; Sadjadi, S.; Schloming, R.; Hat, R.; Conway, A.; Shaw, S.; Godfrey, R.;Sustrik, M.; et al. AMQP Advanced Message Queuing Protocol Protocol Specification License. Availableonline:https://www.rabbitmq.com/resources/specs/amqp0-9-1.pdf (accessed on 26 January 2018).