

# Power Devices and IoT for Intelligent System Design

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# **Power Devices and IoT for Intelligent System Design**

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# Development of Efficient Algorithm for Detection and Tracking of Infected Chicken at an Early Stage of Bird Flu with a Suitable Surveillance System Using RFID Technology

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## Abstract

The poultry industry is an important part of our society, and one of the primary threats to this farm is the avian influenza (AI), simply known as bird flu. This disease, being highly contagious, has the potential to cause a huge financial loss and loss in terms of business property. The outbreaks cause millions of animals to be dead, and thus maintenance of animal welfare is a priority. Some of the features of AI-infected birds are reduced egg production, nasal ejection, lack of coordination, and ruffled feathers along with many others. Among the various symptoms of diseased birds, this work utilizes symptoms like loss of appetite causing a decrease in weight and weakness causing a lethargic behavior of chicken to detect the infected birds. The innovations in technology have now made it possible to use the stated symptoms as factors or parameters for a system which continuously monitors the changes in the activities of the chickens in real time and identifies whether they are infected by AI virus. The RFID (radio frequency identification), being a wireless/noncontact technology, has its own advantages in this scenario. Thus, to get rid of such AI issue, this work aims to find a cost-effective and manpower-efficient surveillance system based on real-time implementation of RFID. The RFID technology enables the identification of unique objects like different products and also

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- and the problem with connection and separation. *SICE Annual Conference*, pp. 1991–1994, 2011.
17. Tragas, P. and Manolakos, E.S., Traceability from “farm to fork” using RFID technology. *17th IEEE International Conference on Electronics, Circuits and Systems*, pp. 958–961, 2010.
  18. Minbo, L. and Chen C., R.F.I.D., Complex Event Processing Mechanism for Logistics Tracking and Tracing. *International Forum on Computer Science-Technology and Applications*, pp. 44–48, 2009.
  19. Keertana, P., Vanathi, B., Shanmugam, K., A Survey on Various Animal Health Monitoring and Tracking Techniques. *Int. Res. J. Eng. Tech.*, 4, 2, pp. 533–536, 2017.
  20. Liu, G., Mao, L., Chen, L., Xie, S., Locatable-Body Temperature Monitoring Based on Semi-Active UHF RFID Tags. *Sensors*, 14, pp. 5952–5966, 2014.
  21. Li, L., Xing, Y., Wen, P., Yu, Y., Li, C., Huang, R., Measurement and Prediction of Rectal Temperature of Chicken Based on Genetic Programming. *Instrum. Meas. Métrologie*, 18, 3, pp. 317–322, 2019.
  22. Ross, R., Anderson, B., Bienvenu, B., Scicluna, E.L., Robert, K.A., WildTrack: An IoT System for Tracking Passive-RFID Microchipped Wildlife for Ecology Research. *Automation*, 3, 3, pp. 426–438, 2022.

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