2024 4th International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) | 979-8-3503-6016-5/24/$31.00 ©2024 IEEE | DOI: 10.1109/ICACITE60783.2024.10617410

The Different Way of Utilizing the Intellectual of Artificial Intelligence in the Animal Farming Field Progress of AI

Deepak Kumar,
Chitkara Centre for Research and Development, Chitkara University, Himachal Pradesh,174103, India.
deepak.pec94@gmail.com

Laith H. Alzubaidi,
The Islamic university, Najaf, Iraq.
laith.h.alzubaidi@iunajaf.edu.iq

Awadhesh Chandramauli,
Department of Civil Engineering, Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, India. awadheshcm@gmail.com

Raheem Unissa,
Assistant Professor, Department of CSE, CMR Technical Campus, Hyderabad, Telangana, India,
raheemunnisa.hb@gmail.com

Saloni Bansal,
Department of Computer Engineering and Applications, GLA University, Mathura.
saloni.bansal@gla.ac.in

K.Krishna Kumar
Department Of Conputer Science and Engineering Saveetha School of Engineering , Saveetha Institute of Medical and Technical Science - SIMATS Saveetha University , Chennai , India
krishnakumarkathiresan.sse@saveetha.com

Abstract: The goal of this project is to create a prototype smart farm using Internet of Things (IoT) technology. Developing an Internet of Things feeding control system and designing and implementing environmental monitoring and control systems for farm housing are the primary objectives. The development method uses open-source hardware and software and is conducted in pig farms in the Thai region of Nakhon Si Thammarat.An ESP8266 Wi-Fi microcontroller is crucial to the system design, allowing several sensors to be connected to the server and actuators to be controlled. The MQTT protocol is used to transmit data over a secure wireless local network. The data flow is designed using Node-RED, and storage is handled using a NoSQL database such as InFluxDB. The feeding control system achieved a 100% compliance rate by following instructions continuously. End customers can utilise a web application on their PCs or cellphones to obtain real-time data and operate the system. Furthermore, the collected data is processed and analysed as big data, which facilitates the analysis of climate change trends in the vicinity of the study site and forecasting. The overall performance rating of the system received great marks from users, averaging 4.40 out of 5 with a 0.46 standard deviation. As a result, the created IoT system functions as a prototype that may be further enhanced for use in bigger farms or other agricultural environments.

Index Terms- AI, MQTT protocol, Node-RED, NoSQL database, and smart pig farming

I. INTRODUCTION

The increasing prevalence of Internet of Things (IoT) technology is transforming people's lives by automating a variety of functions, from administration and maintenance to inspection and control. Many common objects can now wirelessly communicate with ease thanks to the widespread use of cutting-edge technology such as cloud computing, embedded computers, sensors, actuators, and the launch of increasingly compact, reasonably priced wireless devices. These wireless devices can be passive, small, and low-powered.[1]

The creation of sophisticated automation nodes—which may operate as Internet of Things gateways—is required by these cutting-edge sensors and actuators.

Message Queue Telemetry Transport (MQTT) uses Transmission Control Protocol/Internet Protocol (TCP/IP) as its operating protocol. protocol guarantees structured, lossless connections. The most widely used Time-Series Database (TSDB) on the market right now is InfluxDB. Node-RED is a programming tool that may be used to link physical devices, increasing the capability and adaptability of Internet of Things systems.[2]

Thorough investigation of IoT systems' potential for agricultural modernization has been spurred by their integration with big data analytics, cloud computing, and other technologies. Pig diseases are often caused by bright sunshine and heavy rains, which is a big concern for farmers in Muang district, Nakhon Si Thammarat province. Farmers, who are primarily concerned with generating additional revenue, find it difficult to follow feeding rules because of time restrictions.[3]

According to a poll, farmers are interested in adopting technology on their properties, especially in the areas where they house animals. Controlling humidity and temperature in pig farms has become important as pig growth can only occur in an ideal environment. Inadequate maintenance of the right circumstances might lead to slower development, longer raising times, and greater related expenses. The research's conclusions have the potential to improve agricultural methods and can be used to upcoming commercial farming projects.

II. LITERATURE REVIEW

The use of accelerometers in behavioural research has transformed the field of pig welfare studies by providing nuanced insights into animal behavior. These tools provide thorough insights on animal wellbeing by capturing minute movements and behaviours.[3] Accelerometers are essential instruments in these kinds of investigations because of their capacity to track daily patterns and activity levels, even in the intricate setting of raising pigs. Accelerometers have a clear promise to help understand pig behaviour, but research on livestock uses them is still in its infancy. It is essential to interpret accelerometer data in light of the animal's

surroundings, physiological state, and general health in order to fully realise the promise of this technology.

Fig. 1. Pig Farming [5]

Using the Zephyr BioHarness to simultaneously collect accelerometer, heart rate, and respiration rate data is an innovative method of collecting animal physiological data. [4-9] This method enhances animal welfare by monitoring multiple variables with a single device, reducing stress on the animals. Furthermore, the automatic, real-time data collection minimizes animal handling, streamlining the process.[10] Accurately categorising pig behaviour with accelerometer sensors is still difficult, though. Precise data collection is contingent upon several factors, including but not limited to sensor location, durability, battery life, and minimising disturbance to the pigs' routine behaviours. [11]

Our study is centred on using sensor data to investigate pigs' overall welfare, with a focus on stress levels and gait quality. By analysing this data, we want to find complex patterns pertaining to heart rate, breathing rate, and activity. This will allow us to see abnormalities that may indicate lameness and separate out behavioural patterns that occur during different activities like feeding, isolating, or pairing. [12]

III. Proposed Framework

In this study, IoT technology was employed to aid small pig farms, with a focus on Small and Micro Community Enterprise (SMCE) farms. The farmer's routine tasks included cleaning enclosures, ensuring adequate food, and managing feeding using a motorized feed hopper. Monitoring pigs' daily food intake and providing cooling on hot days to prevent heat stress were additional responsibilities, along with providing warmth on chilly or wet days.[13]

Fig. 2. Proposed system

An IoT system was developed using open-source hardware and software to monitor temperature, humidity, feed level, and feeding management. Implementation testing, software design, and hardware design comprised the development process. The system's overall design, depicted in a block diagram, employed a NoSQL database for large-scale applications on a local server. IoT node data in JSON format was kept in InfluxDB., offering rapid read/write speeds and high scalability. Node-RED, a browser-based programming tool, facilitated easy wiring of flows using various nodes.[14]

Hardware components included ESP8266/WEMOS D1 Mini, DHT11 sensor module for temperature and humidity detection, HC-SR04 Ultrasonic Module for distance detection, and a relay module for system component control. The system architecture involved two IoT nodes, each managing specific tasks related to temperature regulation, feeding control, and feed level monitoring.Evaluation of the IoT system's efficiency involved statistical assessments by specialists, farmers, and interested parties, indicating a very high degree of satisfaction with the system's performance. The average evaluation score of 4.50, with a standard deviation of 0.47, underscored the system's effectiveness and stability.[15-16]

IV. Result And Discussion

The results are in line with the goals of the research, which were to create IoT-based feeding control systems and environment monitoring and control systems. For monitoring and control, a Node-RED server that is deployed locally is used. The ESP8266 gathers sensor data, which is then sent via HTTP, GET, REQUEST, and MQTT protocols to the Node-RED server. This makes it possible to keep an eye on the feed level, temperature, humidity, and relay module control throughout feeding operations. Clients connect to devices using the MQTT protocol, which serves as a middleman. A client then subscribes to the pertinent topic and records the measurements that are received in a NoSQL database. Using an online application, users or farmers may control feeding and view real-time sensor data by using the On and Off buttons. The data kept in the database is amenable to additional processing and analysis. The pigs' health was not negatively impacted by the ambient factors, such as humidity and temperature, which persisted throughout the study. In order to anticipate or research climate change in the study region, environmental data must be continuously collected.[17] This allows for processing and analysis in the future. The result is shown in figure 3 and 4 as mean and standard deviation.

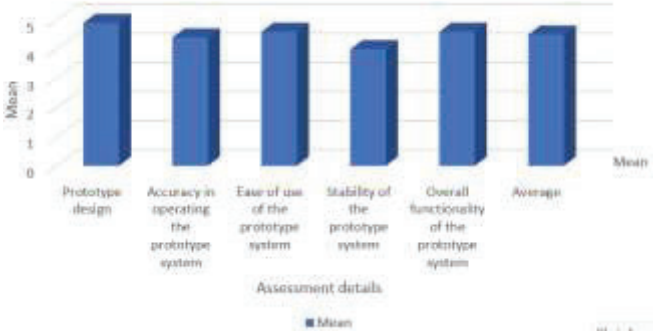

Fig. 3. Mean Values in context of parameters included in the proposed system

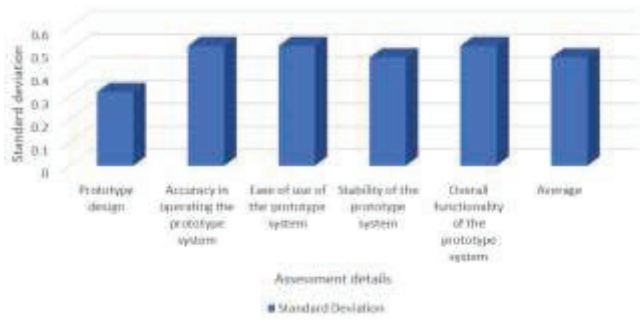

Fig. 4. Standard deviation distribution

V. Conclusion And Future Work

This project aims to develop and implement an environmental monitoring and control system for a pig farm using Internet of Things technology. Socket programming is used to obtain real-time data, which is then saved in InfluxDB using Node-RED. This allows for remote Grafana analysis and monitoring. Over the course of the study, 28°C was the average temperature recorded, with a range of 24.43°C to 34.34°C.. The average humidity was 92%. As a result, since the temperature stayed within the designated range, no temperature control was required. 100% of the time, the feeding control system performed as instructed. The customers gave the overall system performance evaluation a very good grade, 4.40 on average out of 5 with a standard deviation of 0.46. Farmers may manage their farms more effectively and with less effort by using IoT technology to monitor the health and growth rates of their livestock. Therefore, as a prototype, the proposed IoT system has potential and may be scaled up for use in bigger farms or other agricultural contexts.

References

[1] T. S. Zhao et al., "Eco-Friendly, Low-temperature Solution-processed InO/ A1oThin-film Transistor with Li - incorporation," 2019 Joint International EUROSOI Workshop and International Conference on Ultimate Integration on Silicon (EUROSOI-ULIS), Grenoble, France, 2019, pp. 1-4, doi: 10.1109/EUROSOI-ULIS45800.2019.9041879.

[2] H. Yang, K. Wanaskar, H. Shrivastava, S. Mansahia, S. Richhariya and M. Eirinaki, "Prompt Recommendations for AI Art," 2023 IEEE Sixth International Conference on Artificial Intelligence and Knowledge Engineering (AIKE), Laguna Hills, CA, USA, 2023, pp. 62-65, doi: 10.1109/AIKE59827.2023.00017.

[3] T. S. Zhao et al., "Eco-Friendly, Low-temperature Solution-processed InO/ A1oThin-film Transistor with Li - incorporation," 2019 Joint International EUROSOI Workshop and International Conference on Ultimate Integration on Silicon (EUROSOI-ULIS), Grenoble, France, 2019, pp. 1-4, doi: 10.1109/EUROSOI-ULIS45800.2019.9041879.

[4] Y. Zhang, F. Hu, Y. Han, W. Meng, Z. Guo and C. Li, "AI-Based Energy-Saving for Fog Computing-Empowered Data Centers," 2023 International Conference on Mobile Internet, Cloud Computing and Information Security (MICCIS), Nanjing, China, 2023, pp. 16-21, doi: 10.1109/MICCIS58901.2023.00009.

[5] K. Wakunuma, G. Ogoh, D. O. Eke and S. Akintoye, "Responsible AI, SDGs, and AI Governance in Africa," 2022 IST-Africa Conference (IST-Africa), Ireland, 2022, pp. 1-13, doi: 10.23919/IST-Africa56635.2022.9845598.

[6] H. Benbrahim and A. Behloul, "Fine-tuned Xception for Image Classification on Tiny ImageNet," 2021 International Conference on Artificial Intelligence for Cyber Security Systems and Privacy (AI-CSP), El Oued, Algeria, 2021, pp. 1-4, doi: 10.1109/AI-CSP52968.2021.9671150.

[7] K. Chait, A. Laouid, L. Laouamer and M. Kara, "A Multi-Key Based Lightweight Additive Homomorphic Encryption Scheme," 2021 International Conference on Artificial Intelligence for Cyber Security Systems and Privacy (AI-CSP), El Oued, Algeria, 2021, pp. 1-6, doi: 10.1109/AI-CSP52968.2021.9671216.

[8] H. Garg and M. Dave, "Securing IoT Devices and SecurelyConnecting the Dots Using REST API and Middleware," 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad, India, 2019, pp. 1-6, doi: 10.1109/IoT-SIU.2019.8777334.

[9] C. Sharma and N. K. Gondhi, "Communication Protocol Stack for Constrained IoT Systems," 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), Bhimtal, India, 2018, pp. 1-6, doi: 10.1109/IoT-SIU.2018.8519904.

[10] Lavanya, S., Prasanth, A., Jayachitra, S., Shenbagarajan, A.

[11] Wan, X., Zhang, K., Ramkumar, S., Deny, J., Emayavaramban, G., Siva Ramkumar, M., Hussein, A.F.

[12] Selva, D., Nagaraj, B., Pelusi, D., Arunkumar, R., Nair, A.

[13] Baskar, S., Mohamed Shakeel, P., Kumar, R., Burhanuddin, M.A., Sampath, R.

[14] Velusamy, P., Rajendran, S., Mahendran, R.K., Naseer, S., Shafiq, M., Choi, J.-G.

[15] S. K. Vishwakarma, P. Upadhyaya, B. Kumari and A. K. Mishra, "Smart Energy Efficient Home Automation System Using IoT," 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad, India, 2019, pp. 1-4, doi: 10.1109/IoT-SIU.2019.8777607.

[16] J. Kumar and P. R. Ramesh, "Low Cost Energy Efficient Smart Security System with Information Stamping for IoT Networks," 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), Bhimtal, India, 2018, pp. 1-5, doi: 10.1109/IoT-SIU.2018.8519875.

[17] G. Shukla, K. Gowri and G. Sudhamsu, "Fostering Smart Agriculture: Using Vision-Based AI for Livestock Managing," 2023 International Conference on Advances in Computation, Communication and Information Technology (ICAICCIT), Faridabad, India, 2023, pp. 784-790, doi: 10.1109/ICAICCIT60255.2023.10465732.

[18] T. -Y. Chen, Y. -H. Lin, C. -S. Shieh, C. -C. Lo, S. -W. Guo and M. -F. Horng, "A RFID-based Diet Estimation of Grower Pigs," 2021 International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS), Hualien City, Taiwan, 2021, pp. 1-2, doi: 10.1109/ISPACS51563.2021.9651019.

[19] S. A. Shaik Mazhar and G. Suseendran, "Precision Pig Farming Image Analysis Using Random Forest and Boruta Predictive Big Data Analysis Using Neural Network and K- Nearest Neighbor," 2021 2nd International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2021, pp. 260-264, doi: 10.1109/ICIEM51511.2021.9445328.

[20] C. -T. Chu and Z. -X. Lin, "Deep Learning for Pig Size Detection in Smart Farm Imaging," 2023 18th International Microsystems, Packaging, Assembly and Circuits Technology Conference (IMPACT), Taipei, Taiwan, 2023, pp. 283-286, doi: 10.1109/IMPACT59481.2023.10348741.

[21] Solikin, I., & Darmawan, D. (2023). Impact of Artificial Intelligence in Improving the Effectiveness of Accounting Information Systems. Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 14(2), 82-93.

[22] Ahmad, Shakir Salman, and Mohammed I. Habelamateen. "Application of Artificial Intelligence and Machine Learning in Software Defined Networks." Journal of Smart Internet of Things (2023).