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A robotics based surveillance system for livestock wellbeing and early disease detection in poultry farms

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Abstract
The robotics-based surveillance system for livestock wellbeing and early disease detection in poultry farms presents a cutting-edge solution to monitor and enhance the health and productivity of poultry livestock. By integrating Arduino technology and innovative sensor systems, this system offers real-time monitoring of key parameters such as temperature and humidity, enabling early detection of potential health issues. Through the use of advanced software specifications and sketch writing techniques, the system provides farmers with valuable insights to optimize farm management practices and ensure the welfare of their poultry. This paper delves into the software specifications, tools, and functionalities of the system, highlighting its potential to revolutionize poultry farming practices.
Materials and Methods: The materials used in this system include Gas sensor, MQ7 Sensor, DHT11 Sensor, Raspberry pi Pico W microcontroller, Buzzer, OLED and Robotic motor. The methods involve the integration of these components to create a comprehensive robotic based surveillance network within the poultry farm environment.

Keywords: Robotics-based surveillance system, livestock wellbeing, early disease detection, poultry farms, arduino technology, sensor systems, farm management, poultry health, software specification

Introduction
The global population's steady rise has underscored the critical role of poultry products in meeting the nutritional needs of humanity. Poultry farming plays a vital role in providing essential protein sources to communities worldwide, emphasizing the significance of efficient and sustainable animal agriculture practices. However, the poultry industry faces challenges such as disease outbreaks and the need for constant monitoring to ensure livestock wellbeing and optimal production outcomes.

To address these challenges, researchers and industry experts have turned to robotics-based surveillance systems for livestock monitoring and early disease detection in poultry farms. By integrating advanced technologies such as computer vision and artificial intelligence, these systems offer a promising solution to enhance the efficiency, accuracy, and overall health management of poultry populations. This document delves into the development and implementation of a cutting-edge robotics-based surveillance system designed to monitor livestock wellbeing and detect early signs of diseases in poultry farms. Through the utilization of innovative tools and techniques, this system aims to revolutionize poultry farming practices, improve animal welfare, and mitigate economic losses associated with disease outbreaks.

By leveraging the power of automation and data- driven insights, poultry farmers can proactively identify and address potential health issues, thereby ensuring the continued production of high-quality poultry products while reducing the reliance on manual labour-intensive monitoring methods. This transformative approach not only enhances the overall sustainability of poultry farming operations but also contributes to the global efforts to meet the growing demand for nutritious and safe poultry products.

Through a comprehensive exploration of the robotics- based surveillance system for livestock wellbeing and early disease detection in poultry farms, this document sheds light on the potential of technology to revolutionize the poultry industry and pave the way for a more efficient, resilient, and sustainable agricultural future.

Proposed system

An alternate strategy for disease control through vaccination is the one that is suggested. The Raspberry Pi was modified to better meet the requirements of the article in order to be used for the proof of concept in this work. Sensors measuring temperature, humidity, ammonia, and carbon dioxide were able to provide data to the system. The environmental factors that are being felt allow for the monitoring of the chicken's well-being.

Design and Implementation

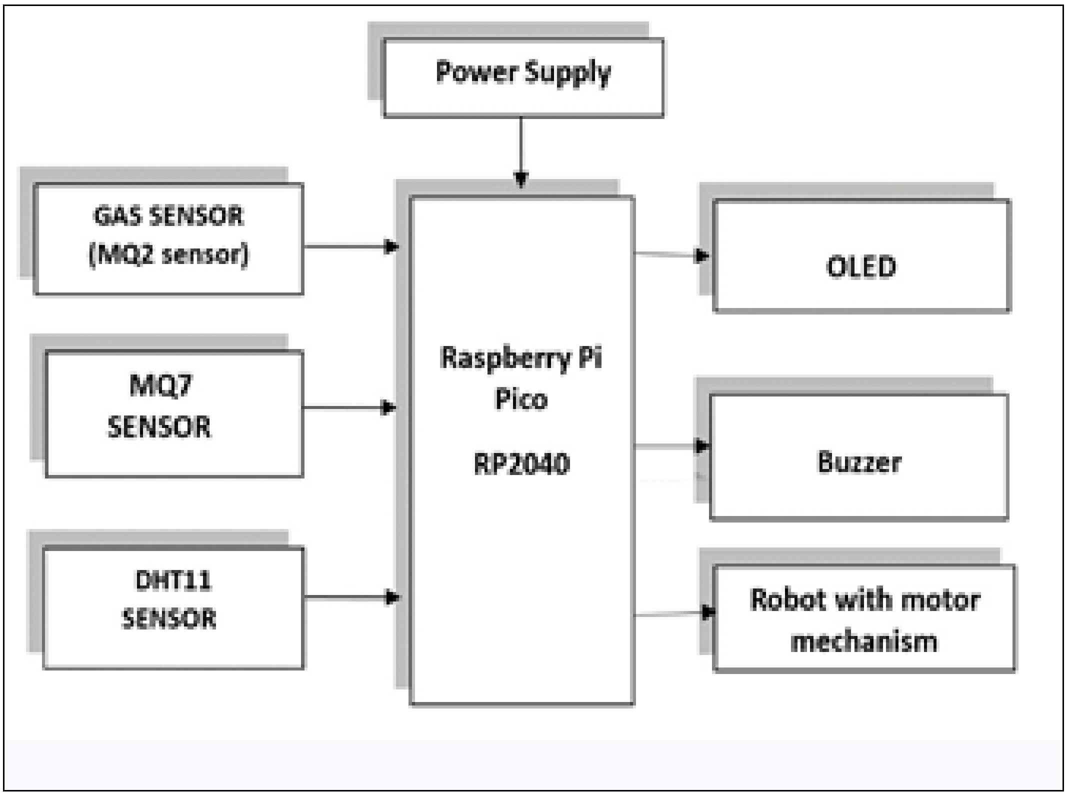

Fig 1: Block Diagram

The design and implementation of a robotics-based surveillance system for livestock wellbeing and early disease detection in poultry farms involve a comprehensive approach that integrates cutting-edge technologies and innovative methodologies. In this Paper Hardware Components such as Raspberry pi Pico W microcontroller, Gas Sensor, MQ7 Sensor, DHT11 Sensor, OLED, Buzzer, Robot with Motor Mechanism, Power supply. 'C' language is used for programming in this paper. Raspberry Pi Pico W is micro controller, to which all other peripherals are linked. We have used Dual-core ARM Cortex M0+ processor, with flexible clock running up to 133 MHz. It has 264kB of SRAM, and 2MB of onboard Flash memory, with a Built-in Wi-Fi. This System has 3 sensors, the Gas Sensor is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals, it is used to detect ammonia gas which is released with the odour smell. MQ7 Gas sensor is another one of Metal Oxide Semiconductor (MOS) type Gas Sensor of MQ Gas Sensors family involving MQ 2, MQ 4, MQ 3, MQ 8, MQ 135, etc. MQ7 sensor is most sensitive to CO gas, it may also respond to other gases present in the environment, including ammonia.

Fig 2: Gas sensor

Fig 3: Raspberry pi Pico Controller

Fig 4: MQ7 sensor

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

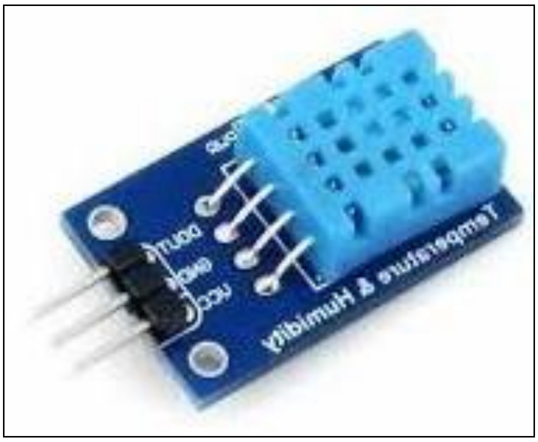

Fig 5: DHT11 sensor

Organic Light-Emitting Diode (OLED) is a form of LED with an emissive electroluminescent layer composed of organic chemicals. The layer is composed of polymers that emit red, green, or blue light when a voltage is applied. SSD1306 is the model's name of OLED used in this system. Pixel size is given by 128x64.Height of OLED is 0.96 inches and 3.3-5 volts of power supply is given to the OLED.

2.
3.

Fig 6: OLED

A buzzer or beeper is a signal device, usually electronic, typically used in automobiles, house hold appliances such as a microwave oven, or game shows. Robot motors convert electrical energy into mechanical motion, allowing the robot to move from one place to another.

These primary components are connected to the following pins on the Micro controller:
Gas (MQ2) Sensor: The sensor is connected to the microcontroller's 26th general purpose input output pin.

1. **MQ7 Sensor:** The sensor is connected to the microcontroller's 27th general purpose input output pin.
2. **DHT11 Sensor:** The sensor is connected to the microcontroller's 27th general purpose input output pin.
3. **OLED:** The SDA and SCL pins of the OLED are connected to the microcontroller's GPIO 6 and GPIO 7 pins.
4. **Buzzer:** The buzzer is connected to the microcontroller's 16th general purpose input output pin.
5. **Robot motor:** The motors m1, m2, m3& m4 pins are connected to microcontroller's 21, 20, 18 &19 GPIO pins.

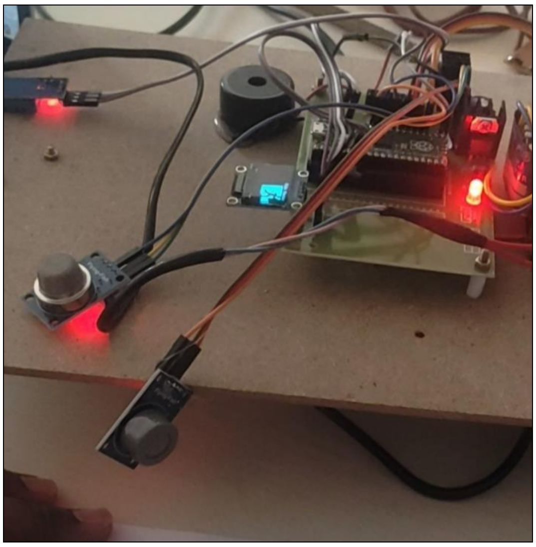

Fig 7: Hardware Setup

Result and Discussion

The implementation of a robotics-based surveillance system for livestock wellbeing and early disease detection in poultry farms has yielded promising results, showcasing the potential of advanced technologies to revolutionize poultry farming practices. The system's performance and outcomes can be discussed in the following key areas:

Livestock Wellbeing Monitoring

- The integrated sensor network successfully monitored environmental variables such as temperature, humidity, and gas levels, providing real-time insights into the poultry farm conditions.
- Automated data collection and analysis enabled continuous monitoring of livestock wellbeing, allowing farmers to proactively address any issues that could impact animal health and productivity.

Early Disease Detection

- The image processing algorithms and machine learning models accurately identified signs of distress, illness, and abnormal behaviour among the poultry population.

By leveraging computer vision techniques, the system demonstrated the capability to detect early symptoms of common poultry diseases like coccidiosis, enabling timely intervention and disease management.

Robotic System Performance

The integration of robotics platforms facilitated autonomous navigation and data collection within the farm environment, enhancing operational efficiency and reducing manual labour requirements.
The robotics system effectively interacted with sensors, cameras, and the central processing unit, demonstrating seamless coordination and data exchange for comprehensive surveillance tasks.

Accuracy and Reliability
- Testing and validation procedures confirmed the system's accuracy, reliability, and scalability in detecting early signs of diseases and monitoring livestock wellbeing.
- The machine learning models, particularly the CNN architecture, exhibited high accuracy rates (up to 91%) in classifying healthy and unhealthy birds, showcasing the system's effectiveness in disease detection.

Impact and Future Directions
- The successful implementation of the robotics-based surveillance system signifies a significant advancement in poultry farming technology, offering a holistic approach to livestock management and disease control.
- Future research directions may include expanding the system's capabilities to cover a broader range of poultry diseases, enhancing automation features, and integrating additional sensors for comprehensive monitoring.

As a result, the threshold value of Gas sensor is 540 ppm, when it exceeds the buzzer gives a sound and OLED displays "MQ2 is Leaked". The Threshold value of. The Threshold value of MQ7 Sensor is 350ppm, when it exceeds the buzzer gives a sound and OLED displays "MQ7 is Leaked". In DHT11 Sensor, the threshold value of temperature is 45 degrees when it exceeds the buzzer gives a sound and OLED displays "Temperature is Abnormal!!!", the threshold value of humidity is 80%RH when it exceeds the buzzer gives a sound and OLED displays "Humidity is Abnormal!!!". By using this robot we can perform early disease detection and take preventive measures to save the chickens in poultry farms.

Fig 8: OLED displaying "Temperature and Humidity in the air"

Conclusion
In conclusion, the results of the robotics-based surveillance system for livestock wellbeing and early disease detection in poultry farms demonstrate its potential to enhance animal welfare, improve production outcomes, and contribute to the sustainability of poultry farming practices. By leveraging the power of technology and automation, this system represents a transformative solution for addressing key challenges in the poultry industry and ensuring the continued supply of safe and nutritious poultry products to meet global demands.

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References
1. Athiraja A, Vijayakumar P. Banana disease diagnosis using computer vision and machine learning methods. Journal of Ambient Intelligence and Humanized Computing. 2021;12(6):6537-6556. DOI: https://doi.org/10.1007/s12652-020-02273-8.
2. Aydin A, Cangar O, ErenOzcan S, Bahr C, Berckmans D. Application of a fully automatic analysis tool to assess the activity of broiler chickens with different gait scores. Computers and Electronics in Agriculture. 2010;73(2):194-199. DOI: 10.1016/j.compag.2010.05.004.
3. Ayim-Akonor M, Krumkamp R, May J, Mertens E. Understanding attitude, practices and knowledge of zoonotic infectious disease risks among poultry farmers in Ghana. Veterinary Medicine and Science. 2020;6(3):631-638. DOI: https://doi.org/10.1002/vms3.257.
4. Bi M, Zhang T, Zhuang X, Jiao PR. Recognition method of sick yellow feather chicken based on head features. Transactions of the Chinese Society for Agricultural Machinery. 2018;49(1):51-57. DOI:https://doi.org/10.6041/j.issn.1000-1298.2018.01.006.
5. Caldas JV, Hilton K, Boonsinchai N, England JA, Mauromoustakos A, Coon CN. Dynamics of nutrient utilization, heat production, and body composition in broiler breeder hens during egg production. Poultry Science. 2018;97(8):2845-2853. https://doi.org/10.3382/ps/pey133.
6. Chmiel M, Słowiński M, Dasiewicz K. Application of computer vision systems for estimation of fat content in poultry meat. Food Control. 2011;22(8):1424-1427. DOI: 10.1016/j.foodcont.2011.03.002.
7. Fang C, Huang J, Cuan K, Zhuang X, Zhang T. Comparative study on poultry target tracking algorithms based on a deep regression network. Biosystems Engineering. 2020;190:176-183. DOI: 10.1016/j.biosystemseng.2019.12.002.
8. Ferentinos KP. Deep learning models for plant disease detection and diagnosis. Computers and Electronics in Agriculture. 2018;145:311-318. DOI: https://doi.org/10.1016/j.compag.2018.01.009.
9. Guanjun B, Mimi J, Yi X, Shibo C, Qinghua Y. Cracked egg recognition based on machine vision. Computers and Electronics in Agriculture. 2019;158(March):159-166. https://doi.org/10.1016/j.compag.2019.01.005.
10. Huang J, Wafng W, Zhang T. Method for detecting avian influenza disease of chickens based on sound analysis. Biosystems Engineering. 2019;180:16-24. DOI: https://doi.org/10.1016/j.biosystemseng.2019.01.015.