Brilliance
Research of Artificial Intelligence

E-ISSN : 2807-9035
Volume 4, Number 1, May 2024
https://doi.org/10.47709/brilliance.v4i1.3736

Monitoring Cattle Farms Using Cloud Computing-Based Internet Of Things (IOT) Tools Using Artificial Intelligence Methods

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open access

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Article History:
Submitted: 27-03-2024
Accepted: 30-03-2024
Published: 22-04-2024

Keywords:
Cattle Farming, Artificial Intelligence Systems, Internet Of Things, Cloud Computing

ABSTRACT

Cows are animals valuable commodity and it one of the economic supports for people in animal husbandry and agriculture, cows it selves able to used for meat, there are currently many cattle farms in Indonesia and spread across several regions, the cattle breeding or livestock proses Currently including in two types, farming in cages and farming outside cages, the cows themselves can easily be infected by diseases which spread quickly to other cows, large numbers of cows diasble to monitor because of the limited equipment and number of farmers, the number of cages is flat being far from settlement areas will make the selection process difficult and disable simultaneously. To handle this problem, it can be deal with using sensor devices that are configured with IoT devices. These devices easily monitored health and room temperature which can be used for 24 hours, the results of the data from the temperature sensor are displayed information that represent like dashboard and displays the cow's temperature data in graphical view. The system sets a temperature range of 38.6 - 38.9. If above this temperature the cow is in distemper condition and needs to be quarantined and won't spread to another cow. This system provide information and make it easier for farmers to supervise their livestock.

INTRODUCTION

Cattle farming is currently supporting economy especially in agricultural countries like Indonesia, and currently there are several cattle in Indonesia that are being bred, namely dairy cattle and beef cattle, the dung from the cows themselves can be used for fertilizer and biogas, cattle farming now verywell organized, starting from maintenance and designing the layout of the cage and disposal of cow dung, this is intended to ensure that the cows are protected from disease and doesn't cause pollution around the livestock area. Apart from the place which must be in accordance with the standard requirements for the cage, another thing which is no less important is the process of caring for and feeding the cows so that the cows are in a healthy and fit condition, healthy cows will produce high quality milk and meat, breeders who have A large number of cows requires extra energy to check their health and be checked regularly and every day. This is possible if the cages are close together and the number of cows isn't very large, but it will be a big problem if there are large numbers of cows and the cages are separated. Some researcher using additional monitoring tools with the help of cameras installed in each cage, this system unoptimal because cattle diseases generally doesn't immediately show symptoms and unvisible so they need 24 hour supervision and it is impossible for farmers themselves to do this with a limited number of personnel.

The research will focus on the process of monitoring cows using IoT sensors. The sensor will function to record and record body temperature in cows, this is the easy part because several diseases enable to seen by a high increase in body temperature, temperature data from the sensor it will easily displayed able in graphic form and the farmer himself can see the health condition of the cow 24 hours a day, the sensor system is presented in the form of an information system whose data can be stored and can be analyzed so that the cow's body temperature increases indicating the presence of a disease or virus attack and can Immediately separate from other cows to prevent infection.

Based on the 2017 Livestock and Animal Health Statistics by the Ministry of Agriculture, the population of beef cattle spread across all provinces of Indonesia reached 16,599,247 head in 2017. However, several problems are still encountered in the management of cattle farms, including the management of cattle ranch development which tends to be natural. without new breakthroughs and a weak level of data validity and trustworthiness. Limited access to information technology is also a problem in Indonesia so that farmers' knowledge of cattle rearing technology is still relatively lacking (Babatunde O. Alao, Andrew B. Falowo , Amanda Chulayo, Voster Muchenje , 2017)

One of the main problems in animal husbandry is the inability to detect disease early. When a cattle disease gets worse, the disease can easily spread to other animals, causing capital losses. Livestock infrastructure in various seasons and environmental conditions plays an important role in the health of cattle. Sustainable cattle production is production that unprofitable but can also reduce environmental impacts and improve the health and welfare of cattle. Therefore, a long-term solution is needed in the form of an integrated system that regulates the interrelated biological and physical

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processes of cattle production. Currently, integration of the required information and coordination of actions is done manually by the farmer. However, even in advanced agricultural countries and the European continent, the number of livestock breeders has limited managerial capabilities and the profit margins from livestock are very small (Elsa Lamy, Sofia van Harten, Elvira Sales-Baptista, Maria Manuela Mendes Guerra, André Martinho de Almeida, 2012)

LITERATURE REVIEW

Livestock, farm animals are deliberately kept as a source of food, a source of industrial raw materials, or as helpers for human work. Livestock raising businesses are referred to as animal husbandry (or fisheries, for certain groups of animals) and are part of general agricultural activities. Farm animal keeping practices very greatly in different places in the world, and also between types of animals. Livestock animals are generally kept in cages and fed or given access to food (grazing). Some doesn't cage their animals or let the animals choose when to enter the cage (free roam). Livestock monitored in various ways such as using tags (painted on the animal's skin or hanging from the ear) or by modern methods such as using RFID implanted under the skin (Alexander Kappes, Takesure Tozooneyi , Golam Shakil, Ashley F. Railey, K. Marie McIntyre, Dianne E. Mayberry ,Jonathan Rushton , Dustin L. Pendell and Thomas L. Marsh , 2023).

Cows are one of the livestock whose meat and milk are used as human food. By-products such as skin, innards, horns and dung are also used for various human needs. In a number of places, cows are also used to transportation, cultivate land (plows), and other industrial tools (such as sugar cane crushers). Because of these many uses, cows have been a part of various human cultures for a long time. Humans raise cows to harvest their products and use their energy. Based on the benefits taken, domesticated cattle can be classified into beef cattle, dairy cattle and working cattle. Usually, certain breeds of cattle tend to be used for certain things, for example Limousin cattle are beef cattle while Holstein cattle are dairy cattle. Apart from meat and milk, the economically valuable parts of the cow's body are the skin, horns and feces (Ngetich W, 2019).

Cattle farming able to extensively (outside) or intensively (in a pen). On extensive farms, cows are allowed to roam the grazing land; whereas in intensive farming, cows are kept in pens and all their needs are provided by humans. Intensive farming carried out for industrial needs is called factory farming. Extensive and intensive rearing systems can be combined, for example on family farms where the cows are sometimes left to feed themselves and sometimes given prepared feed this mixed system is called semi-intensive farming (Gesa Busch, Elisa Bayer, Achim Spiller, Sarah Ku¨ hl, 2022).

Health is one of the determining factors for the success of livestock cultivation. Therefore, efforts to maintain livestock health is need serious attention so that livestock remain in a healthy condition so that they can live normally and produce optimally according to their genetic abilities. In order for livestock to remain in good health, efforts can be made through disease prevention programs, and if it is discovered that livestock are sick, it is necessary to immediately handle and treat them using the correct procedures, so that the livestock can recover quickly and if the disease is classified as an infectious disease, so that the disease doesn't spread to other livestock (I Gusti Ayu Putu Mahendri, Ratna Ayu Saptati, 2023).

Livestock are said to be sick if their body organs or the function of the body organs are abnormal and can't function as they should. These abnormalities can be identified through direct examination with the senses or using assistive devices. Pain is a physiological change in an individual which is the result of the cause of the disease (causal) (Cassius E. O. Coombs, Brendan E. Allman, Edward J. Morton, Marina Gimeno, Garth Tarr, LucianoA.González, 2022).

Specific clinical symptoms are clinical symptoms that arise as a reaction to abnormalities in an animal's organ system. Each abnormality in the body's organ system will show distinctive (different) symptoms. In other words, if an abnormality occurs in one organ, it will show different symptoms from abnormalities that occur in other organs, for example: If an abnormality occurs in the digestive organ system, it will show symptoms that are different from the symptoms that arise due to abnormalities to occur in the respiratory organ system, circulatory organs, reproductive organs and others. By observing the special symptoms that arise, further examination can be more directed (I. Dittrich, M. Gertz, J. Krieter, 2019).

IoT has been in development for decades, although the concept was less popular until 1999. The first Internet device, for example, was a Coke machine at Carnegie Melon University in the early 1980s. Programmers can connect to the machine via the Internet, check the machine's status and determine whether or not there is a cold drink waiting for them, without having to go to the machine. This can happen because there is other hardware installed in the machine (MuhammadOsamaAkbar, Muhammad Saad Shahbazkhan, MuhammadJamshaidAli , Azfar Hussain, Ghazia Qaiser, Maruf Pasha, 2020).

The hardware contains a programmable microcontroller, sensors, actuators, and an internet connection. This device will collect data from sensor readings. Data received by the hardware will be sent via the internet to the cloud. This data can then be processed to be displayed in the application his allows users to access data anywhere and anytime (Nilo M. Arago, Chris, Alvarez, Angelita G. Mabale, Charl G. Legista, Nicole E. Repiso, Timothy M. Amado, Romeo

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Jr. L. Jorda, August C. Thio-ac, Lean Karlo S. Tolentino, Jessica S. Velasco, 2022).

The definition of cloud computing (cloud computing) is a combination of the use of computer technology (computing) in a network with internet-based development (cloud) which has the function of running programs or applications via computers that are connected at the same time, but not all of them are connected via the internet uses cloud computing. This Cloud system-based computer technology is a technology that makes the internet a central server for managing data and user applications. This technology allows users to run programs without installation and allows users to access their personal data via a computer with internet access (Benneth Chukwuemeka Uzoma, Isokpehi Bonaventure Okhuoya , 2022).

METHOD

This cow health monitoring system consists of two main components, namely hardware and software, each of which has its own subsections. The hardware uses an ESP32 microcontroller which already has a WiFi feature to send temperature data. Temperature data is obtained from a temperature sensor using the DS18B20 sensor. The software requires a cloud server to accommodate the data which is then displayed via a web application that can be accessed via a computer or mobile phone.

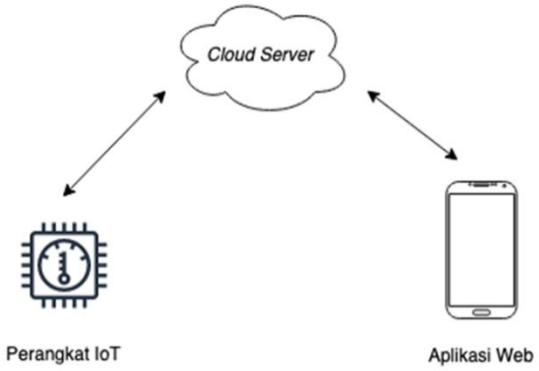

Figure 1. Cloud Computing based IoT network

In the picture above is an illustration of the configuration of the IoT device used to capture data and sensors installed on cows in the livestock area. These sensors will later be connected to a cloud computing device, the device contains a recap of temperature sensor data which displays the condition of the feed and the health of the cow. Other ways of detecting IoT devices on cow health are as follows:

1. IoT devices are used to optimize the sensor's ability to send data which is connected to an internal network in the form of WIFI and Wireless, because on farms there are still limited internet connections or you can use other components, for example using the Lorawan network.
2. Data sent to the cloud. In the second stage, the data that has been collected by the IoT system is sent to the cloud or data center. The data will be stored and processed using a number of technologies such as artificial intelligence (AI) and data analysis to produce useful information. This AI system will produce a graph of temperature and humidity as well as the existing feeding system for cattle, so that farm owners can predict and provide feed according to the portion of livestock and separate the animal if it is sick.
3. Information is sent to the device or user. The third stage of IoT is that after the data is processed, the resulting information is sent again to the IoT system and the end user. This information can be in the form of actions taken by the system, commands to control IoT devices or notifications to users. From the information display, to make it easier to read, it will be displayed in graph form. The indicators on this graph can determine temperature data in real time, every hour, every day, month and even year.
4. The IoT device is managed and configured by the user or farmer and this system is created in the form of a website and mobile application. The final stage is that the user can control the IoT device with a tablet, smartphone or computer application. This application sends commands to the Cloud and then the commands are forwarded to the IoT device to execute the data from the sensor which is transmitted with a delay every second.

RESULT

In this section, the researcher will explain the results of the research obtained. Researchers can also use images, tables, and curves to explain the results of the study. These results should present the raw data or the results after applying the techniques outlined in the methods section. The results are simply results; they do not conclude.

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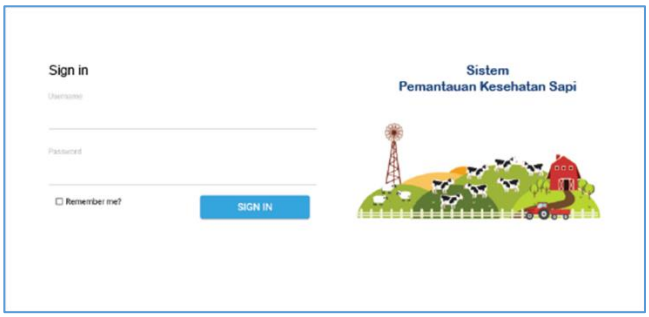

Figure 2. login page on the application

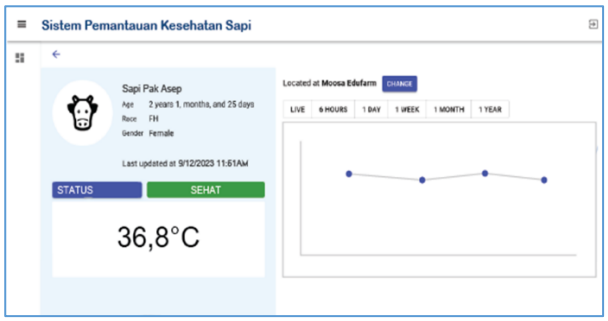

Figure 3. results of cow monitoring

After the IoT device is turned on, the temperature sensor reading data will appear on the web application displayed in graphical form. If the temperature value is in the range 38.6 - 38.9 then the cow's status will be "HEALTHY" and if it is outside the range the cow's status will be "UNHEALTHY".

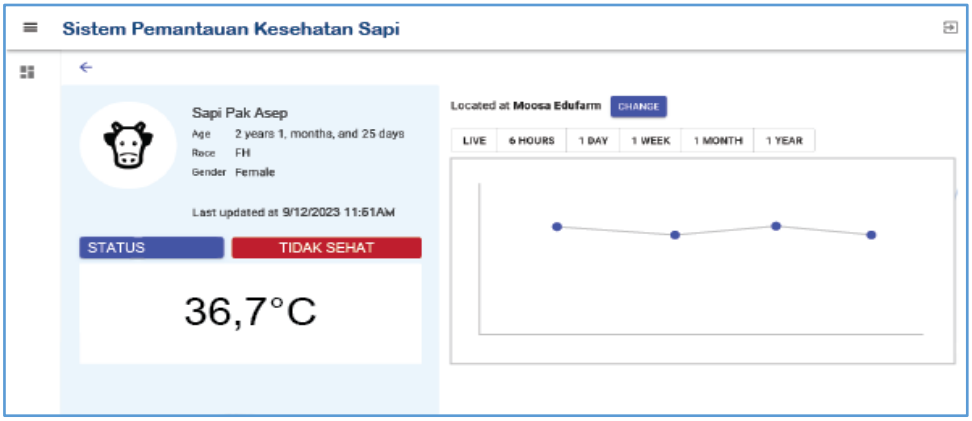

Figure 4. system monitoring results

In Figure 4 above are the results of the monitoring system which shows the health condition of the cows, this data can include data on the type of cow as well as the monitoring date when the sensor reading data can be updated, the menu is also equipped with a "live" feature which means the monitoring process can be done directly in real time, "6 Hours" is a menu that indicates a monitoring system every six hours, "1 Day" is a monitoring system that is carried out within one day, "1 week" this monitoring system is weekly and the last one is "1 month" and "1 year "This system records and views the health results of cows for one week and one year and usually the monitoring data is presented in graphical form.

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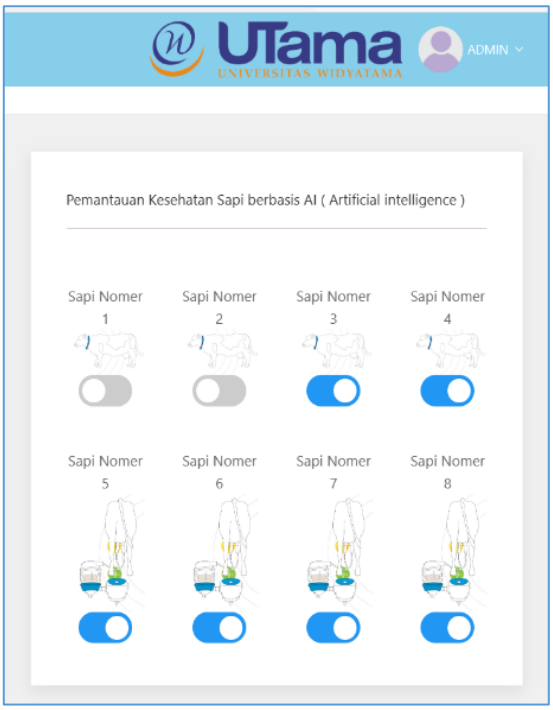

Figure 5. cow monitoring

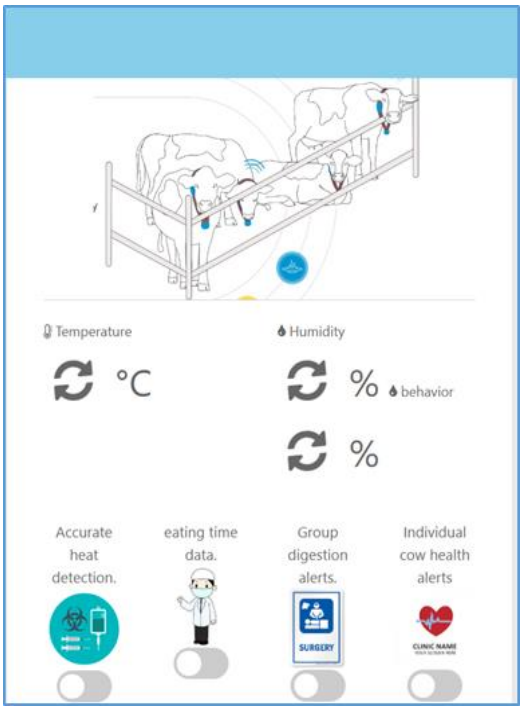

Figure 6. temperature measurement results

In Figure 5 is a system for monitoring cows one by one, this selection system functions to see the number of health in mixed pens, with this additional feature farmers can easily choose which cows will see their health and farmers can monitor and see which cows are healthy. will be checked first and what number the cow is. Meanwhile in Figure 6 is a menu that displays measurements of room temperature in Celsius and Fahrenheit units, while "humadity" functions to measure the humidity temperature of the cage. In Figure 6 there is also an additional menu, namely in the "Accurate Detection" feature mode, this menu functions to determine the room temperature in accordance with the barn temperature, "eating and time data" in this menu functions to see the amount and characteristics of the cow feed given, so that The amount of feed can be adjusted and not too much or too little, then in the "Group digestion alert" feature, a feature is provided if a cow is sick in the digestive area by looking at the body temperature condition of the cow so that sick cows can be separated and the last feature is "Individual Cow Health" in the admin or breeder feature can see the health condition evenly and this data shows the condition of the room temperature.

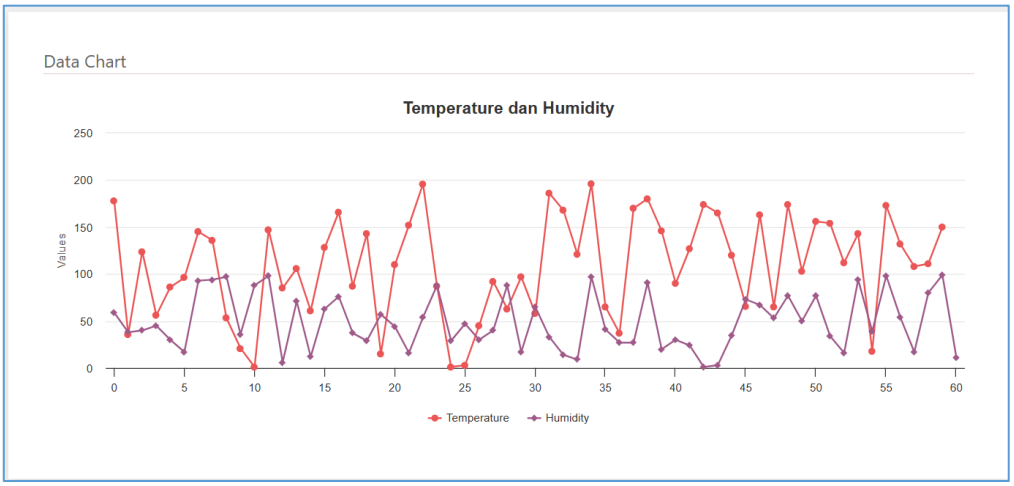

Figure 7. calculation of temperature and humidity graph

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Table 1. Results of Differences in Room Temperature Measurements

Temperature Sensor Reading (°C)	Thermometer Reading (°C)	Difference in numbers of data
36,7	38,6	1,9
37,0	38,9	1,9
37,0	38,9	1,9
36,8	38,8	2,0
37,3	38,8	1,9

Table 1 shows the results of measurements on the temperature sensor of the 5 cows tested with thermometer reading values as a comparison. From the reading results, a difference of up to ~2°C was found. This reading has a difference due to the temperature difference between the cow's hairy skin and the cow's actual body temperature which is detected through the cow's anus.

DISCUSSION

Comparison of readings was carried out on the temperature sensor used in the system with a manual measuring instrument that has been tested and used on cattle farms, namely the Digital Thermometer. The test method is by inserting a Digital Thermometer into the cow's anus to determine the cow's body temperature accurately. The data from the Digital Thermometer can be compared with the data read on the temperature sensor. The system is tested by looking at the data displayed in the web application according to real-time comparison data. The web application should also display cow health information based on sensor readings.

CONCLUSION

Based on testing of an Internet of Things (IoT) based cow health monitoring system that uses temperature parameters, the following conclusions can be drawn: An IoT based cow health monitoring system has been successfully developed. This system allows monitoring cow health more efficiently and effectively. There is a difference in temperature sensor values which reaches around 2°C. This difference is caused by variations in temperature between the cow's neck, the place where the sensor is installed, which is generally covered in hair, and the temperature on the surface of the cow's body. The application that is integrated with the system is capable of displaying sensor reading results in real-time. Apart from that, this application can also automatically determine and display the health status of cows based on the collected data.

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