The Implementation of IoT (Internet of Things) for Controlling Cow Health

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Abstract .Livestock health management is a major factor in the sustainability of cattle farms. However, health care for livestock by veterinarian costs lots of time and money. The purpose of this study was to develop an android IoT device for cow physiological health management through detection of cow temperature, heart rate and breathing rhythm. This device is built based on a microcontroller. By using the concept of IoT to send data, then the information generated on the device will be displayed directly to the android application. Three adult cows were measured using android IoT device compared to conventional measurement methods as controls. This procedure was carried out for morning (06:30-09:30 am), afternoon (11:00-01:00 pm) and evening (04:30-05:30 pm). Independent sample t-test was used to determine whether there were significant differences between Android IoT device and conventional measurement method. The results show that there is no significant difference between the two methods for temperature ($t(58) = -0.191$, $p = 0.849$) and heart rate ($t(58) = -0.459$, $p = 0.648$). Utilization of device makes it easy for cattle farmers to monitor cow health regularly at economical prices and provide remote information. Furthermore, this device needs to be tested on types of ruminants such as goats, sheep and buffaloes.

1. Introduction

Cattle farm in Indonesia is one of renewable natural resources developed for improving the dynamics of adequate economic growth productivity. The cultivation of cattle farm has largely developed in all over regions of Indonesia and it will keep developing because it has some superiorities such as reproduction efficiency, tested data of environmental adaptation, easy to be nurtured for various needs and has an excellent quality of meat and milk.

One of the ways to maintain animals' health is through checking livestock body and physiological condition. Physiological condition used to know the indication of healthy livestocks are body temperature, heartbeat frequency, and respiratory rhythm. This becomes the reference for veterinarian or livestock health staff if abnormality occurs among three of them.

A lot of research about physiological health of cow using microcontroller had been done, however still not interactive with the cattle farmer because it was still website based [[1][2][3].

Based on that problem, cattle farmers need high cost for maintaining livestock health. Therefore, ISEP-I is needed as the tool for conducting control and check on livestock health efficiently.

2. Methodology

2.1. System Analysis

Health problem on cows can possibly occur such as because of not knowing how to check cows' health condition. The success of livestock business is extremely determined by the livestock health. The selling price of healthy cows is certainly more expensive than unhealthy cows.

If seen from the method of checking cows' physiological health done at animal husbandry in Indonesia, still using traditional method, then by designing this system at the tool of temperature check and heartbeat by using temperature sensor and voice sensor will ease the farmers in conducting check on cows' physiological health without doing manual check and can monitor cows' health control and also the cows' health history periodically.

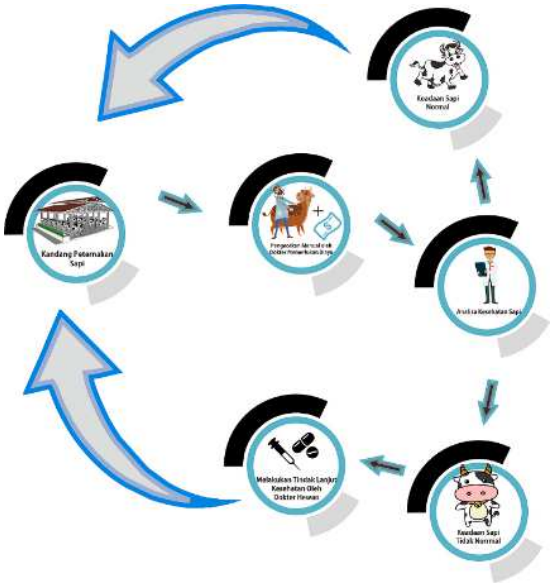

Figure 1. The General Procedure of Cows' Physiological Health Check

2.2. System Design

The system made is in the form of tool and application. The tool is strung of some electronics modules NodeMCU, temperature sensor, voice sensor, battery or power bank, and other electronics components. In the application would be made in the form of data information display sent by the tool. The sotfware used for making the system was arduino IDE using C language, and the wed design PHP based for handling server, CSS, HTML, and bootstrap for interface display from the website to be responsive. Then the information is displayed into android application.[4][5][6][7] [8][9][10]

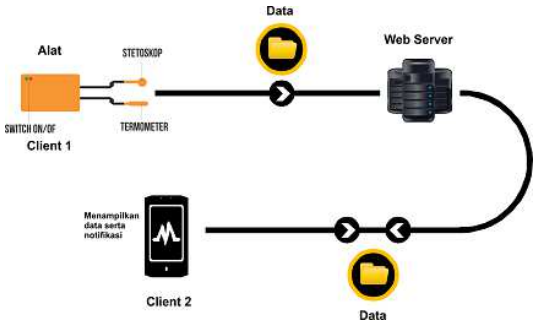

Figure 2. The System Design

Figure 2 shows that the system has two sides; client and server. Client as the user that uses the tool and application. The tool will give cows' health information such as temperature, voice, and number of heartbeats obtained from the combination of some sensors then sent to web server through connection, then the user can see the results of information in android application.

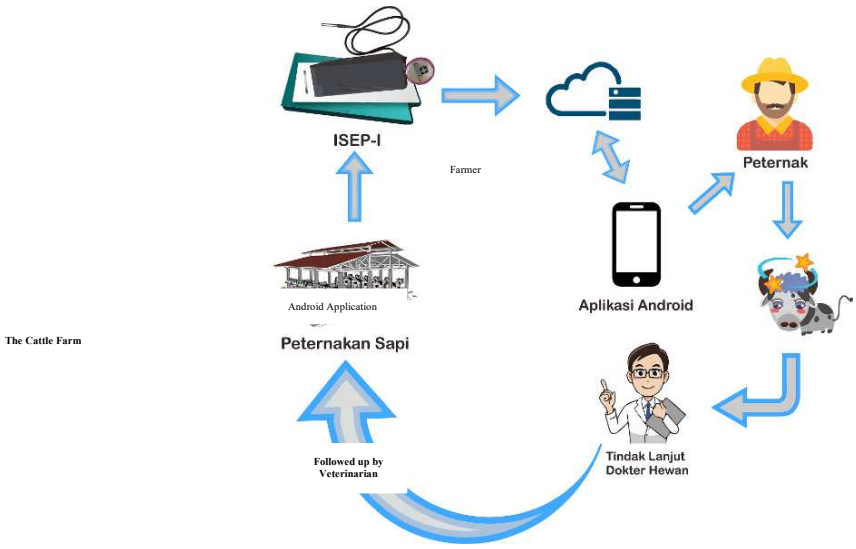

Figure 3. The Cycle of Health Check Using ISEP-I

Figure 3 is the cycle of checking cows' physiological health using ISEP-I. In the usage of this ISEP-I, first turn it on through switch on/off button, then turn on the hotspot from the smartphone with determined username and password. Data will be sent to the server when the tool is connected to the hotspot and also has internet connection. Data sent by the tool can be seen in android application also needs internet connection.

2.3. Test and Data Analysis

ISEP-I sends data in the form of temperature and hearth rhythm every 0,02 second to the server, data for the hearth rhythm will becalculated to be heartbeat per minute (bpm). These data then accepted by the server to be processed and saved by the server. After data are processed by the server, then they are forwarded to the client in the form of android application to monitor the process and result of check. The system workflow can be seen in Figure 4.

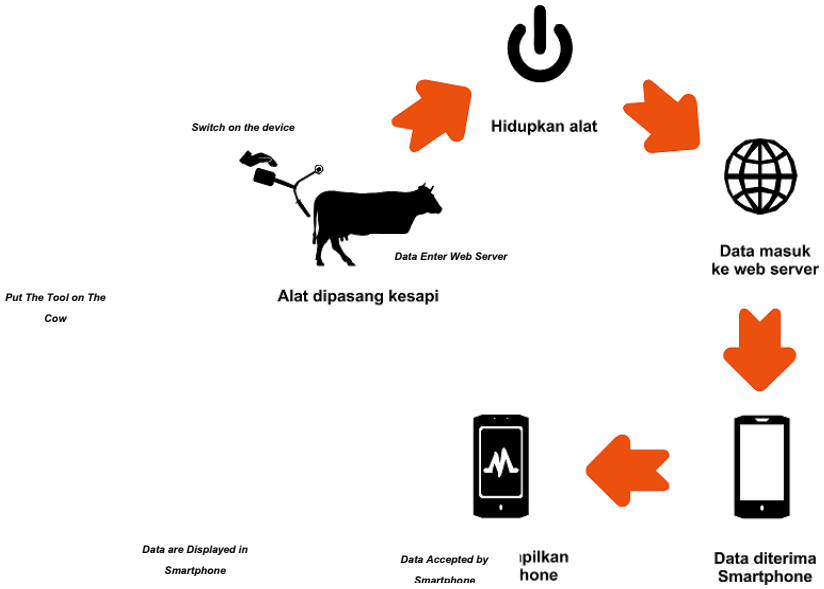

Figure 4. System Workflow

The test is done towards 5 adult cows with conventional measurement method. The measurement procedure is done three different time with morning measurement (06:30-09:30 am), afternoon (11:00-01:00 pm), and evening (04:30-05:30 pm). The test process is started with manual test in which for testing the temperature is done by using thermometer for the cow, then continued with testing using ISEP-I. After that, followed by the heartbeat test at the base of cow tail manually using stethoscope, continued with the examination using ISEP-I to compare the result obtained manually and using ISEP-I tool.

3. Results and Discussion

This part will show the test results of the system had been made. The test is conducted in two stages. First, the temperature sensor test with ESP8266 Wi-Fi module. Second, the heartbeat check test.

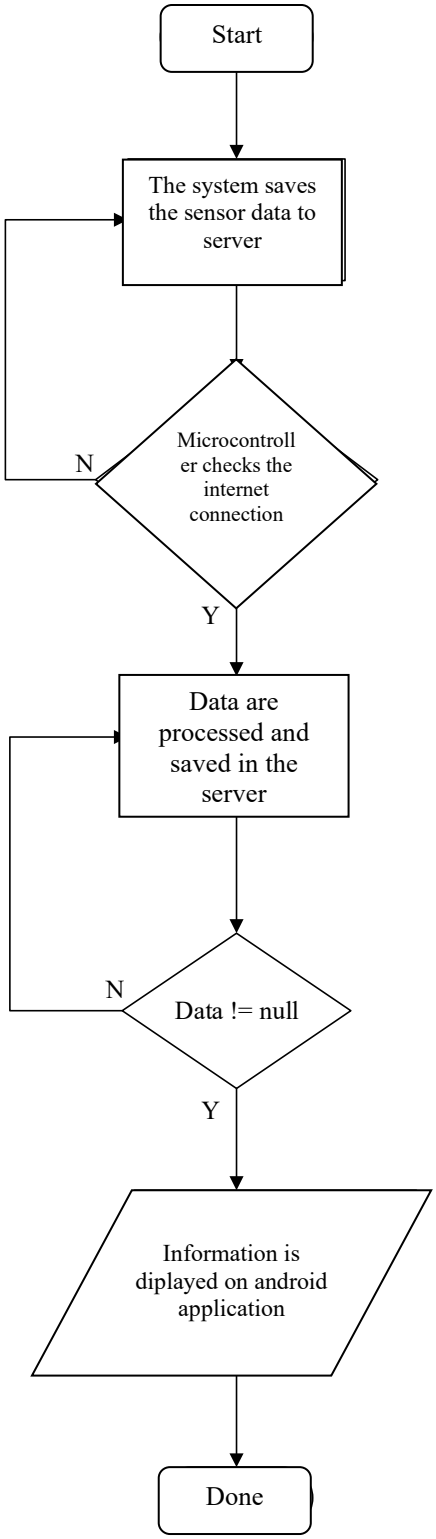

Figure 5. Flowchart of ISEP-I Tool

3.1. The Test of Temperature Sensor

This test is conducted to see if the temperature sensor can obtain the temperature data and save it in server database and then display it on android application for the farmer. Figure 6 shows the prototype of the tool being made, the temperature sensor is put into the cows' butt, the temperature value is displayed on the application, then compared to cows' thermometer tool. Look at figure 6. Cows' thermometer is the tool used to measure the cows' temperature. The way to test and measure the temperature is by putting the temperature sensor into the cows' butt. The test results can be seen in figure 7.

Figure 6. The test of temperature sensor on the cow

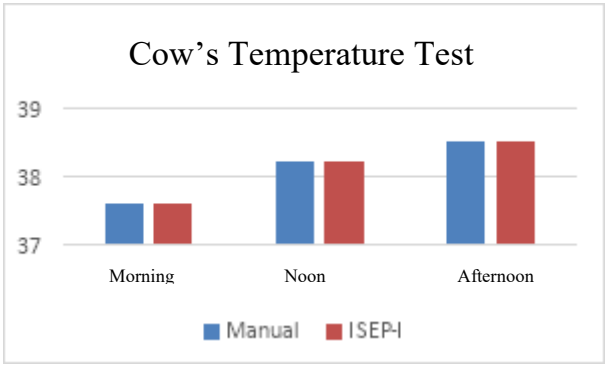

Figure 7. The Result of Morning Test and Measurement on The Temperature Sensor

Based on statistics test independent sample t-test, it obtains that there is no significant difference between manual check (38.06 +- 0.47) and ISEP-I (38.08 +_0.47) (t(58) = -0.191, p = 0.849). The temperature sensor can measure and detect the cows' temperature sent to database through internet connection and displayed on android application with average error 0.002%. The temperature sensor data after client connection process is done then given delay for 500 ms meant so that the sensor can read the data in realtime and then data reading will be started from the temperature sensor. Module ESP8266 works together to process the data after sensor data obtained then sent to database. For saving the temperature data of cows then the new table is made namely "temperature". In order the data can be accessed by the farmers, they must have the account to log into andriod, such as seen in Figure 8.

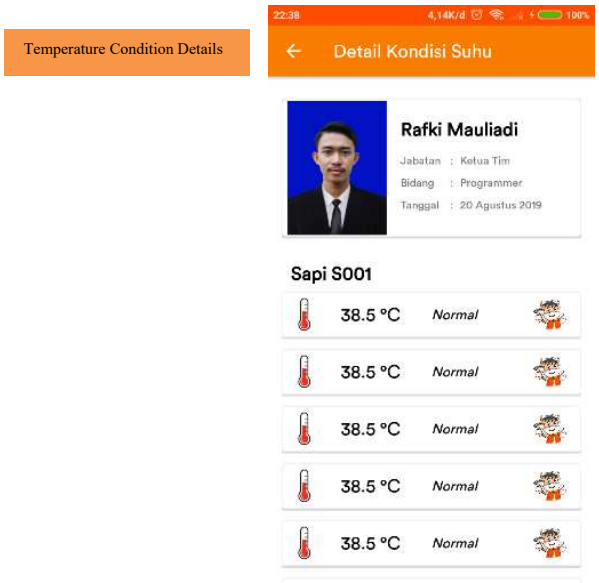

Figure 8. The Diplay of Realtime Temperature Check in Android Application

3.2. The sensor test of heartbeat

The test of heartbeat sensor is done just like temperature measurement, but the testing site is at the base of cows' tail. Figure 9 shows the prototype of the tool being made, heartbeat sensor is put at the base of cows' tail, the score of heartbeat is displayed on android application in the form of BPM then compared to the manual check using stethoscope. The way of testing and measuring the cows' heartbeat using stethoscope is by putting the stethoscope at the base of cows' tail. The test results can be seen in figure 10.

Figure 9. The test of heartbeat sensor on a cow

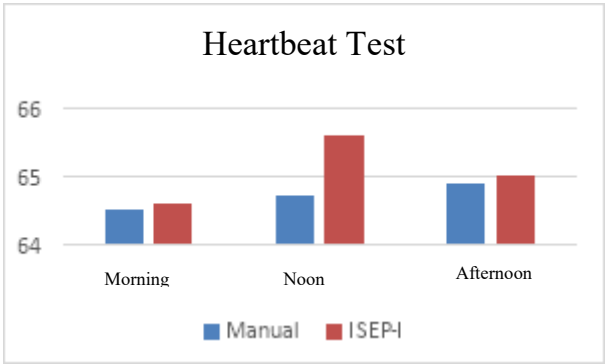

Figure 10. The Result of Morning Test and Measurement of Heartbeat Sensor

In statistics test independent sample t-test, obtained that there is no significant difference between manual check (64.70 +- 2.86) and ISEP-I (65.06 + 3.31) ($t(58) = -0.459$, $p = 0.648$). Heartbeat sensor can measure and detect cows' heartbeat which is sent to database through internet connection and displayed in android application with average error 0,05%. Data of heartbeat sensor after client connection process then given delay for 500 ms which is meant to let sensor read data in realtime and then data and the reading of heartbeat sensor data will be started. Module ESP8266 works simultaneously to process the data after data sensor obtained then the data are sent to database. To save the data of cows' heartbeat data then the new table is made namely

"heartbeat". In order the data can be accessed by the farmers, they need to have the account to log into android application as seen in figure 11.

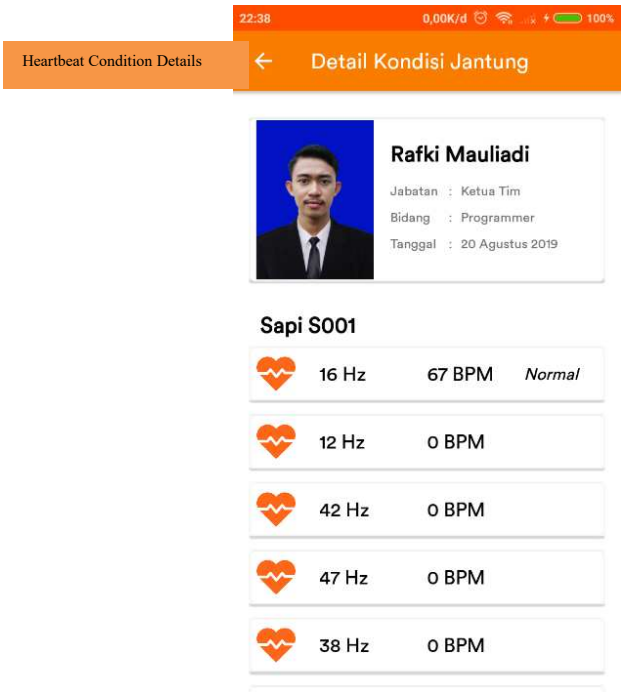

Figure 11. The display of realtime heartbeat check on android application

4. Conclusion

In this research, we propose IoT monitoring system of cows' temperature and heartbeat with the concept of Internet of Things (IoT) to save the data to database. There is efficiency in the check of cows' physiological health android technology based to ease and decrease the cost of livestock check. The farmers can see the information of temperature and heartbeat of cows directly in their android application. Beside that, there is also system of saving data to the server the results of each check. The future research will develop the system which be connected directly to android application without using internet connection.

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