ICITSI 2020

by Adrizal Adrizal

Submission date: 19-Apr-2022 10:10PM (UTC+0800)
Submission ID: 1814510389
File name: 2020-ICITSI_Dodon-_Design_of_Cow_Cattle_Weighing.pdf (502.78K)
Word count: 4182
Character count: 20223

2020 International Conference on Information Technology Systems and Innovation (ICITSI)
Bandung - Padang, October 19 - 23, 2020
ISBN: 978-1-7281-8196-7

Design of Cow Cattle Weighing System Technology and Automatic Giving Feed

Dodon Yendri
Computer Engineering Department
Faculty of Information Technology
UNAND,
Padang, Indonesia
dodon@fti.unand.ac.id

Adrizal
Animals Department
Faculty of Animals Husbandry
UNAND
Padang, Indonesia
adrizal_am@yahoo.com

Derisma
Computer Engineering Department
Faculty of Information Technology
UNAND
Padang, Indonesia
derisma@fti.unand.ac.id

Hafni Afif
Computer Engineering Department
Faculty of Information Technology,
UNAND,
Padang, Indonesia
hafni11afif@gmail.com

***Abstract*— Many cow breeders have difficulty weighing the cattle. This is due to the cow's body that is quite large and heavy and the lack of weights in conventional farms or livestock markets. This research aims to help farmers to do cattle weighing and automatically feeding based on morning, day and night meal schedules. The technology is design using a keypad as an input device, a load cell sensor for heavy weighing, the HX711 module as an ADC, the RTC DS3231 for scheduling time readings, the servo motor to rotate and push the weighed feed, the Arduino as a control center and a LCD as an information viewer tool. The results showed that the system could work properly. All components used can function as expected. Load cells can carry out heavy weighing of cows with a success rate of 91.90%. The RTC DS3231 can read the time to schedule distribution of feed according to the desired time, and Servo Motor can distribute feed on the cow feeding schedule with a success rate of 93.62%.**

Keywords—loadcell, HX711 module, keypad, RTC DS3231

I. INTRODUCTION

All farmers want to know the weight of their cattle at all times because the weight of cows is an important factor to get a big profit[1][13]. There are five important reasons why you must weight your livestock regularly[2][12], namely (1) Identifies optimal breeding time, (2) Helps in determining feed quantity, (3) Easy monitoring of animals' health, (4) Helps in picking the weaning time, and (5) Evaluates breeding performance. With these benefits, it can be a reference for farmers in raising their cattle.

The weighing of cows should be carried out periodically and carefully[3] to prevent excessive injury and stress on cows that can lead to heavyweight decline when weighing and thereafter. The behavior of cattle when weighing takes place causes a bigger difference in weight[4]. Cow weighing that is done periodically will provide important information about the development of cow weight and the amount of feed to be given. The tools used in weighing should also be considered. Cow weigh tools is different from the tool used to weigh dead objects so that static scales cannot be used.

In this information and communication technology era, there are many advanced types of equipment connected which can be processed using a computer. In developed countries and modern livestock weighing cattle done in modern[5]. This means that weighing using digital [6] or dynamic scales that read through the sensor. One of the sensors that used is the load cell sensor[7][10].

In the dynamic scales known as Live Weighing or Animal Weighing[8] means the scale has the function to hold or lock the weight of the cattle weighed so that the weight value will not change even when the cattle move. By locking the weight of cattle in certain numbers will obtain more accurate scales results. During this time the problem is in addition to the performance to longer (because it has to wait for position of livestock almost silent), also caused the debate between the weighing officer to customers who buy cows, because the heavy recording is always changing because of cattle that do not want to dwell.

By knowing the weight of the cow[15] accurately will make it easier for farmers to know how much feed needs to give. Generally, the feeding time is three times a day[9][14] that is at 08.00, at 12.00, and 17.00. To overcome the problem, the author has built a technology design aimed to do heavy weighing of cattle cow using a sensor load cell capacity of 500 kg and automatic feeding of cows whose needs arranged using a servo motor and the meal schedule adjusted to the feeding time using the RTC sensor namely morning, afternoon and afternoon[11].

II. METHODOLOGY

The design of cow weighing and feed distribution technology is automatically carried out by experimental research methods. Experimental research implemented in stages as seen in Fig.1.

978-1-7281-8196-7/20/$31.00 ©2020 IEEE

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

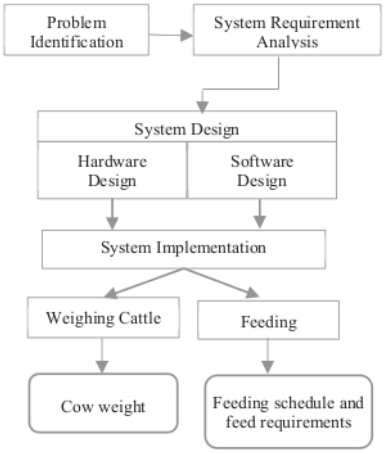

Fig.1. Methodology

Based on Fig.1., it can be explained that the research starts with identifying the problems of weighing and feeding cows in the field. From the existing problems, then analyze the problems and system requirements. The results of the analysis are then followed by a system design consisting of hardware design and software design for weighing cattle and feed needs and setting feeding schedules.

A. Hardware Design

The hardware design of the cow weighing system and automatic feeding can see in Fig.2. below.

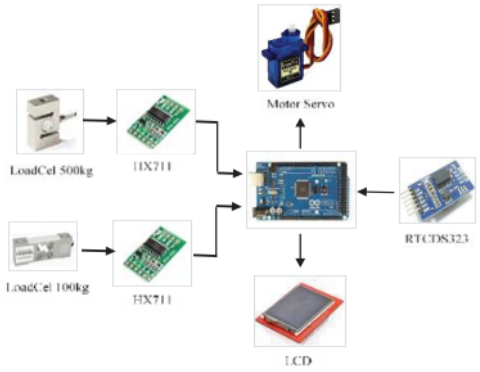

Fig.2. Hardware Design

Fig. 2 above can explained that the sensor load cell is the main component in the weighing system. The load cell sensors use pressure principles utilizing a strain gauge that will turn a mechanical shift into a change in resistance. The pressure from the weighed weight would result in resistance of the wire foil (thin-sized tin or silver) changing to the length. Changes in the resulting prisoners will be comparable to strain changes. This change is then measured by the Wheatstone bridge, and the output voltage will be the load reference that the load cell receives. The next received voltage data will be converted through the HX711 module to generate digital data. The value of the obtained sensor will be processed by the microcontroller to get the cow's weight data which is then displayed on the LCD. RTC DS3231 was used as a time reader to distribute feed based on the meal schedule of cows.

Based on Fig.2, further implemented with the design of the tool as shown in the following Fig.3.

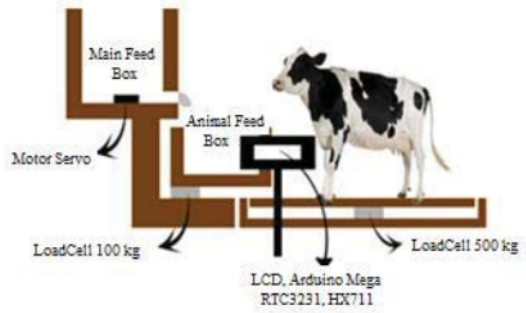

Fig. 3. Tools Design

The 500 kg S-shaped load cell sensor mounted right in the center of the bottom wooden cow foothold. Wooden footers made like a scale. While the load cell 100 kg mounted on the edges of the livestock feed box. This done to load cell 100 kg in the form of the rod can stabilize the weight value of the feed that is in the animal feed box. Servo motors mounted on the central part of the main feed box to distribute cow feed to the livestock feed box. While the LCD, Arduino Mega, module RTC DS3231, and module HX711 installed on a separate panel.

Software design is used to read data from the sensor reading results, then the processing of the microcontroller will be able to provide output according to the condition. Software design is done with programming on the Arduino IDE. Software architecture is a pipeline of programs that will run on the Arduino Mega microcontroller. The system began to weigh cows at the time the weigh function activated and the system will schedule meals three times a day in the morning (at 08.00), noontime (13.00), and afternoon time (17.00). The scheduling flowchart of cattle feeding three times a day is as shown in Fig. 4. below.

B. Software Design

Software design is used to read data from the sensor reading results, then the processing of the microcontroller will be able to provide output according to the condition. Software design is done with programming on the Arduino IDE. Software architecture is a pipeline of programs that will run on the Arduino Mega microcontroller. The system began to weigh cows at the time the weigh function activated and the system will schedule meals three times a day in the morning (at 08.00), noontime (13.00), and afternoon time (17.00). The scheduling flowchart of cattle feeding three times a day is as shown in Fig.4. below.

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

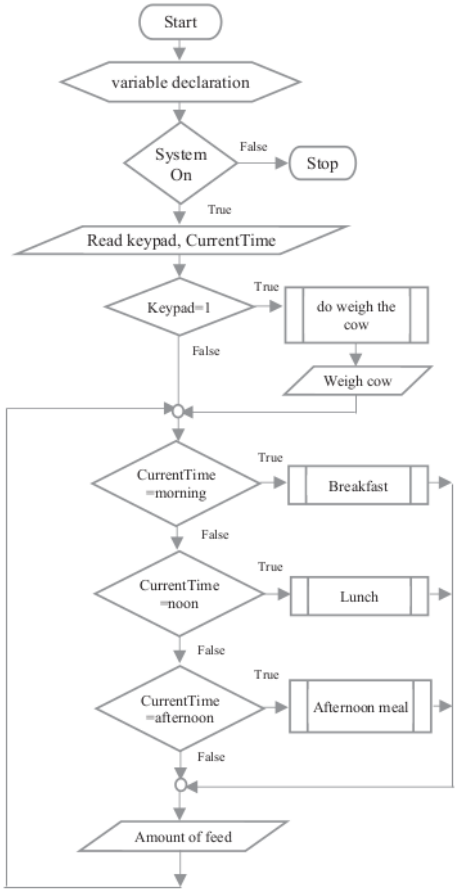

Fig.4. Weighing and feeding flowchart

Fig. 4. explains how the program flows as a whole, where the process starts from the keypad readings and the current time. If the keypad variable is weighing = 1, then the system will do a weight-loss function call. If the current time is the same as the morning time, then the system will call the function of breakfast. If the current time is the same as the daytime, then the system will call the lunch function. If the current time is the same as the afternoon time, then the system will call the afternoon function. If the current time does not correspond to the condition, then the system will only display the required information on the LCD screen of the Touch Screen. Fig. 5 is a flowchart of functions used by the system for weight-weighing.

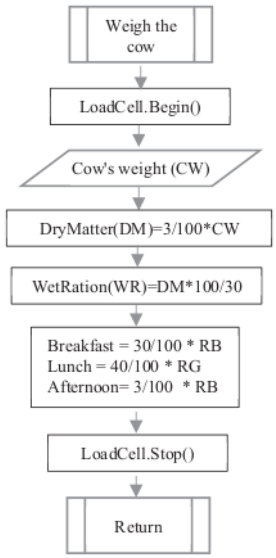

Fig. 5. Weight Loss Function Flowchart

First, the system will enter the weight weighing function when the keypad variable is worth 1. Weight loss function reads cow weight from the sensor load cell 500 kg. With the weight of cattle, the system will do an estimate of the feed needs of cattle using the formula DM, WR. By knowing DM and WR, the system will then calculate feed needs for the morning, noon, and afternoon.

After hardware and software design performed, the next step is system testing. The goal is to know whether the built system delivers the results according to expectations. During testing conducted observations and analyses of the process occurred.

III. RESULTS AND DISCUSSION

Cattle weighing system and feeding are automatically implemented in two main parts, namely hardware implementation and software implementation.

A. Hardware Implementation

The implementation of the hardware consists of three components, namely the cow weighing section, the feeding section of the cattle feed, and the panel/control section as follows.

1) Cow Feeding Section

The cow weighing section was constructed from a box made of wooden panels with two layers measuring 130 cm x 90 cm x 50 cm. At the center of the box bottom (base section) implanted a load cell 500 kg as a weight balance device and the upper part in each corner mounted spring so the reading

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

from the load cell sensor is more stable if given a load. Figure 6 shows the implementation of weighing parts.

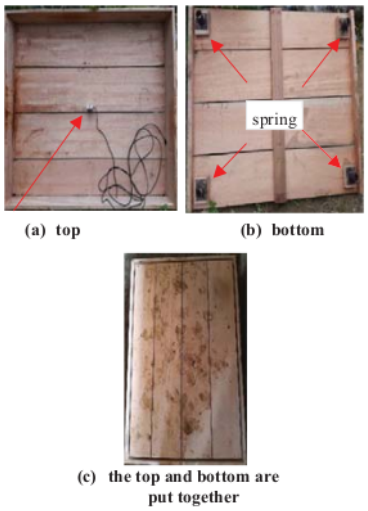

Fig. 6. Cow Weighing Section Box

This part has to weigh the weight of cattle used as a parameter calculation of the number of feed cows in one day.

2) Cow Feeding Section

Cattle feed need calculating based on the result of the weight measurement of cattle after weighing. To measure the weight of the feed in the Feed box used one 100 kg load cell sensor that mounted on the edges of a box measuring 60 cm x 40 cm x 40 cm which is called the cow feed box. Load cell sensors read the weight of cow feed distributed by the main feed box. The main feed box is a box that filled by farmers manually every morning. This box is made with a size of 60 cm x 40 cm x 60 cm. The main feed box works are by rotating the servo motor equipped with a wooden piece to push the feed, so the feed out at a position that melted and the feed falls and enters the feed box. The cow feeding section can see in Fig.7 main feed box and Fig.8 cow feed box.

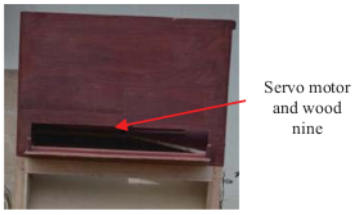

Fig. 7. Main Feed Box

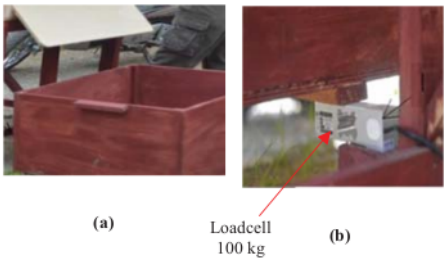

Fig. 8. (a) Feed box is seen from the side (b) Feed box is seen from behind.

3) Panel Section

This section of the panel serves as a configuration of the components used in the system. The panel consists of two parts, the bottom, and the top. The bottom to configure the components put in a box and consist of the Arduino module as a system controller, the HX711 module for the amplifier value of the Load cell, RTC DS3231 as the time reader, LCD as the result viewer. The bottom panel section is shown in Fig.9 below.

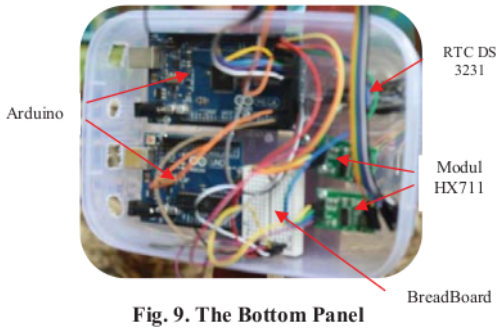

Fig. 9. The Bottom Panel

This part of the panel is the center of the system. The readout value of the load cell 500 kg and load cell 100 kg was delivered to the HX711 module. Because the output value of the load cell is small and cannot be processed by the Arduino directly, then the HX711 module will amplify the output value of the 500 kg load cell so that the Arduino can process its value. When the time read by the RTC DS 3231 according to the timing of the meal, the Arduino will instruct the servo motor on the feeding section of the cattle spinning so that the feed distribution process executed and when the weight of feed is enough need then the servo motor turned off so the feed distribution process stops. The LCD at the top will display the display of the system. The button used when weighing cows.

Furthermore, the top panel consists of the LCD and Keypad components as shown in Fig. 10.

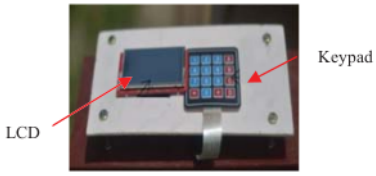

Fig. 10. The top part of panel

The keypad is used as input media to activate the system, whereas the LCD is used as weighing results viewer.

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

B. Software Implementation

The automatic cattle system was built based on the planted system platform (Arduino). Programming is done by using the Arduino IDE (Integrated Development Environment). There are two main functions of the software, (1) weighing cattle function by calculating feed, and (2) giving feed function according to a predetermined meal schedule.

Programming in this section started by *loadcell* stabilization on setup function and weight collection of the cow that read by *loadcell.* Weight value will be shown on the LCD. Fig.11 is the program code used to weighing weight.

```
LoadCell1.update();
Load1 = LoadCell1.getData();
if (millis() > t + 250)
{
tft.fillScreen(BLACK);
tft.setCursor(25,50);
tft.setTextSize(8);
tft.setTextColor(WHITE);
tft.print(Load1);
tft.println("KG");
t = millis();
```

Fig. 11. Coding for weighing weights

After gets the weight value, it is used as a formula for calculating feed in a day with this equation 1:

$$\text{TotalMeal} = 3\% \times \text{cow weight} \times 3 \quad (1)$$

The total food obtained then distributed for three meals, they are breakfast, lunch, and afternoon meal with this following formula:

$$\text{Breakfast} = 0.3 \times \text{Total Meal} \quad (2)$$
$$\text{Lunch} = 0.4 \times \text{Total Meal} \quad (3)$$
$$\text{Afternoon meal} = 0.3 \times \text{Total Meal} \quad (4)$$

To implements feed distribution three times a day, done with program code like Fig. 12 below:

```
CowWeight = Load1;
TotalMeal = CowWeight * 100 * 3;
BreakFast = TotalMeal * 3/10;
Lunch = TotalMeal * 4/10;
Afternoon – TotalMeal * 3/10;
```

Fig. 12. Coding for calculating feed

After calculating the weight of feed for each meal schedule, it is then displayed on the LCD.

Giving the feed according to meal schedule System reads current time used RTC DS 3231. When feeding time comes, the system will order motor servo to rotate so feeds will be distributed from the main feed box to the feed box according to its need. Figure 13 is a reading time program code used RTC DS 3231 which is taken from date and time system.

```
dt = clock.getDateTime();
```

Fig. 13. Reading time coding by RTC DS 3231

The feed distribution process is done when the current time is the same with a predetermined meal schedule. The system reads the weight of the feed based on the weight of the cow result, and the feed is distributed using a motor servo by turning the wooden slats so the grass will be pushed out and fall on the feed box. Each feed that falls is weighed using a 100Kg *loadcell.* If the distributed feed weight is sufficient for the feed needs at that time, the system will order the motor servo to stop and the feed distribution process is complete. The following is program code for distributing feed as shown in Fig. 14 below.

```
LoadCell2.update();
float Load2=LoadCell2.getData();
tft.fillScreen(BLACK);
tft.setCursor(25,50);
tft.setTextSize(3);
tft.setTextColor(WHITE);
tft.println("Feeding lunch");
tft.print("Feed Weight : ");
trf.print(Load2);
if (Load2 < Breakfast)
{
 // myservo.write(0);
 digitalWrite(pinMotor, HIGH);
}
else
{
  // myservo.write(0);
  digitalwrite(pinMotor, LOW);
  Load2 = 0;
  buff = 1;
}
```

Fig. 14. Coding giving the feed program

C. System testing and analysis

1) Cattle weighing testing

Weighing a cow is done by raising the cow on the scale. After the cow is on the scale, the cattleman presses the button to start weighing and watches the movement of numbers on the scale. After the numbers do not move anymore, the cattleman presses the finish button and the system will automatically record the weight of cow into the database. Fig. 15 shows a cow being weighed using a tool.

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

Fig. 15. Cattle weighing by cattleman

Cow weighed using *the Loadcell* 500kg sensor. Weighing is done by comparing the results of the cow's weight with the scale on the livestock. The result can be shown in Fig.16 below.

(a) Measuring with scale (b) Measuring with the designed system

Fig. 16. Cow weighed testing (a) Measuring with existing scale, (b) Weighed testing with the designed system

Cow weighed testing is done to four cows with different sizes. From the testing of four cows, the results can be showed in table 1 below.

TABLE 1. Testing result *LoadCell* 500Kg sensor

No.	*Result of Measurement System designed (kg)*	*Measurement results with existing scales (kg)*	*difference*	*% Error*
1	210,0	217,5	7,5	3,44
2	190,0	223,0	33,0	14,79
3	121,0	128,0	7,0	5,46
4	273,0	299,0	26,0	8,69
Average Error				8,09

From the data of test results in Table 4.1, it can be seen that there are gaps in weight obtained by measuring the weight by a designed system with the results of measuring weight using existing scales. Based on the analysis, this occurs because the *load cell* used in the designed system is only one and standing position of the cow when weighed is not always at the center of the scale, so the weight of the cow is held back by a balancing spring at each corner of the scale. The average error of *the load cell* sensor test of the designed system compared to the existing weighing tool was obtained 8.095% or rounded to 8.10%. Thus it can be said that the cattle weighing designed system using a *loadcell* sensor has a success rate of 91.90%.

2) Feed Distribution Testing According to Meal Schedule

This test is carried out after the cow has been weighed. The result of cattle weight is used as the basis for calculating the distribution of feed which is set automatically according to the meals schedule, morning (08.00), afternoon (12.00), and evening (18.00) as shown in Fig. 17.

Fig. 17. Cow weighing's result and calculating feed in a day

When the meals schedule comes (08.00, 13.00, and 17.00), the system will be automatically distributed feed from the main feed box into the feed box as much as meals portion. Figure 18 is feed distribution from the main feed box to feed box for breakfast as much as 3.46 Kg.

(a) feed distribution for lunch by motor servo (b) result of reading distributed feed's weight

Fig. 18. The distribution process for breakfast

Testing the feed distribution by a weighing system from the weight 128 kg of the cow on breakfast schedule (3.45 kg), lunch (4.61 kg) and dinner (3.45 kg), the test was carried out for two days on 9 and 10 November 2019 with results such as shown in Table 4.4 below.

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

TABLE 2. Feed distribution on 9 and 10 November 2019 according to meals schedule

Day/ Date	Eating Schedule	System time	Feed removed from the main feed box (Kg)	Should (kg)	Difference (kg)	Error (%)
Sat, 9-11-2019	Breakfast (08.00)	08.00	3.41	3.45	0.04	1.16
	Lunch (12.00)	12.00	3,45	4.61	1.16	25.16
	Aftemoon (18.00)	18.00	3.20	3.45	0.25	7.24
Sun, 10-11-2019	Breakfast (08.00)	08.00	3.15	3.45	0.30	9.27
	Lunch (12.00)	12.00	4.0	4.61	0.61	13.23
	Aftemoon (18.00)	18.00	3.25	3.45	0.20	5.79
Everage Error						6.38

From Table 2 above, can be seen that the distribution of feed needs in two days for breakfast, lunch, and dinner schedules have an average error 6.38%. It can be said that the success rate of distributing feed according to the meal schedule of breakfast, lunch, and afternoon is 93.62%.

IV. CONCLUSION

Based on the implementation, automatic testing of weighing and feeding cattle, it can be concluded that the system built can run well. Where all the components used can function as desired. Where the 500 kg Load Cell sensor can weigh the cow's weight with a success rate of 91.90%. The servo motor can distribute the feed needs of the cows with a success rate of 93.62%, which is regulated by RTC3231 in scheduling cow feeding time, namely morning, afternoon and evening.

REFERENCES

[1] Diina Ndakeva, The Importance of Body, Animal Health, Livestock, Weight In Livestock Animals, 2019.

[2] ScaleDepot.com, 5 Important Reasons Why You Must Weigh Your Livestock Regularly, https://scaledepot.com/blog-ntep-certified-commercial-scale-scale-depot-australia/5-important-reasons-why-you-must-weigh-your-livestock-regularly/

[3] Safe cattle handling, Good Practice Quidlines, Work Safe, New Zealand, 2014.

[3] J. Dairy, An automated walk-over weighing system as a tool for measuring liveweight change in lactating dairy cows, Sci. 96:4477–4486 http://dx.doi.org/10.3168/jds.2012-6522

[4] Akindele Ayoola E, Awodeyi Afolabi I, Matthews Victor O, Alashiri Olaitan A, Idowu Oriyomi K, Olaloye Folarin J. 2018. Development of an Electronic Weighing Indicator for Digital Measurement. University Ota Nigeria. Nigeria.

[5] Digi Star, Solutions Home, Livestock Weighing Systems, https://digi-star.com/solutions/1-3/Livestock_Weighing_Systems.

[6] Gabriele Mattachini, Johanna Pompe, Alberto Finzi, Emanuela Tullo, Elisabetta Riva and Giorgio Provolo. Effects of Feeding Frequency on the Lying Behavior of Dairy Cows in a Loose Housing with Automatic Feeding and Milking System. Universita degli Studi di Milano. Milan. Italy, 2019.

[7] Tossaphon Jaysrichai, Load Cells Application for Developing Weight-Bearing Detection via Wireless Connection, The Open Biomedical Engineering Journal, Volume 12, Publisher Id: TOBEJ-12-101 DOI: 10.2174/1874120701812010101, Page 101-107, 2019.

[8] M.A.Mahmud, P. Shaba and U.Y. Zubairu, Live Body Weight Estimation in Small Ruminants-A Review, Global Journal of Animal Scientific Research, 2 (2),102-108. 2014.

[9] Wyatt Bechtel, Feeding Calves 3X vs 2X per Day, Farm Journal, AG Web, 2014.

[10] *Load Cell* can do the cattle weighing with success rate 91.90%.

[11] Sadeque Reza Khan, Alvir Kabir, Dilshad Ara Hossain, Designing Smart Multipurpose Digital Clock using Real Time Clock (RTC) and PIC Microcontroller, International Journal of Computer Applications (0975 – 8887) Vol. 41. No.9, March 2012.

[12] R. A. Dickinson, J. M. Morton, D. S. Beggs, G. A. Anderson, M. F. Pyman, P. D. Mansell, An automated walk-over weighing system as a tool for measuring live weight change in lactating dairy cows, 2012.

[13] Stanly Fon Tebug, Ayao Missohou, Souahibou Sourokou Sabi, Jarmo Juga, Elizabeth Jane Poole, Miika Tapio & Karen Marshall, Using body measurements to estimate live weight of dairy cattle in low-input systems in Senegal, Journal of Applied Animal Research, ISSN: 0971-2119, 2018.

[14] K. A. Beauchemin, Invited review: Current perspectives on eating and rumination activity in dairy cows, 2018.

[15] Chuncheng Xu, Yimin Cai, Jianguo Zhang, Hiroki Matsuyama, Feeding value of total mixed ration silage with the spent mushroom substrate, Animal Science Journal 81(2):194-8, DOI: 10.1111/j.1740-0929.2009.00728.x

Authorized licensed use limited to: University of Gothenburg. Downloaded on December 19,2020 at 06:50:49 UTC from IEEE Xplore. Restrictions apply.

ICITSI 2020

ORIGINALITY REPORT

7%	4%	4%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

3%

★ Submitted to School of Business and Management ITB

Student Paper

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		