RFID Monitoring System and Management on Deer Husbandry

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Abstract. This research presents an RFID Monitoring System and Management on Deer Husbandry. The design of an RFID system monitoring on a deer farm that used the RFID Mifare tag at its 13.56 frequencies and database system is presented. The deer in a farm in Malaysia are hardly monitored with technological assistant such as the tagging system is not well supported. Thus, deer husbandry farm is hard to monitor especially on the management of deer biodata where a fast retrieved for a specific deer need to be located and inspected. Today, deer farmers faced a slow process and lack of Quality of Services. This research presents a designed system that the RFID able to scan the deer and data is captured in a short amount of time to a database. Every deer is designed with its monitoring ID based on group by ages, weight, breed, and its descendant. The design of deer farm management and monitoring system is developed based on hardware, software, and data analysis on deer on a farm that is presented on the web and mobile application. The result presents a success designed for prototype system on mobile application and data from the RFID tag deer is presented in gender, species, and year of birth. Analysis has been done based on a deer farm in Kulim Kedah and graphical outputs are presented. A total of 54 deers are successfully captured, monitored, and manage where Blynk and FavorIOT platform is designed. This research is significant to deer husbandry farmer in Malaysia where deer just become a new market in Malaysia.

1. Introduction

Many RFID Technology on a deer farm that was designed to use the RFID and online database system but sometimes faces scalable and reliable issues [1]. Data transmission by using RFID tag and reader is important today in the deer husbandry area. The deer in a farm nowadays mostly are without a tag and it creates a problem when the owner of the farm wanted to search for a specific deer for them to inspect. The current system which they have right now is difficult to manage to make a systematic system for the deer farm management. The management is having difficulties in identifying the deer because some of the deer are quite similar and they have a hard time identifying which deer they want unless there is more experienced personnel with them. This system is to help the management to make their farm management more systematic and to give them the correct type of deer in front of them when they check it without guessing [2]. This RFID method is almost similar to the development of the cattle breeding traceability system in China [3]. In which it helps incomplete documentation and tracking for the animal industry. This
method has been applied in many industries areas such as healthcare [4] and agriculture [5] that caters industry 4.0 revolutions.

The system developed at deer farm management is based on hardware, software, and data analysis on a deer on a farm. RFID is used to locate the deer and to specify what type of deer is it when they scan the deer. RFID plays an important role in the husbandry business. It promotes the improvement of the organization in terms of deer or animal management. The husbandry has a large number of deer to take care of. The husbandry not only offers to sell the deer randomly but with a type of breed of what the customers want. The RFID enables the collection of the deer data individually, which makes the task easier for the management. The accuracy of the deer breed and specific characteristic is crucial in the animal management or business for them to deliver better services towards the customer. The current method or system that they use right now is inefficient which that they use a "search, find and identity" method. This method is hard to do because if there is a new worker in a deer farm, they have a hard time to identify the type of deer that the management wants, and that results in a time management inefficiency. This is the problem that is crucial, but hard to maintain due to human error or lack of experience. One of the problems identified from this research where existing development is still using the traditional approach of deer husbandry system is non-supported with the technological system, such as the deer guessing approach and manual file log. Other than that, is the traditional method of recognizing and keeping the data of the deer is still by the manual process where the process of keeping a record of the deer location is unmanageable. Finally, is the method of monitoring ID of deer is still using the manual process where technological identification is not been implemented based on gender, weight, and ages, on mobile applications and web pages. Three objectives have been derived for this research which is to analyze the existing system supported for deer husbandry based on deer biodata, then is to design a database system and management using RFID technology to monitor the deer data for its biodata and its gender. Finally, it is to design the monitoring ID of deer in the farm based on ages, weight, species, year of birth, and presents on mobile applications and web pages with a data analytics platform.

The significance of this research is to study the RFID on deer husbandry is for us to understand the importance of this radio frequency identification method to make a life of a farmer easier in terms of management. The radio frequency identification is an improvement from the traditional way to detect the type of deer right in front of us. There will be no more guessing or delay to identify what type of deer, breed, name, and age of deer that is in front of us that we want to identify. Other than that, this study is to benefit us to have a more manageable database for the deer to let it be from the personal computer through the website or the smartphone through mobile apps. The data contained in the Radio Frequency Identification (RFID), is crucial for the management especially in the husbandry or any other industries that need to keep track of the movement of their assets from any location.

2. Literature Review

2.1. RFID Tag in Deer Husbandry

RFID used on the animals is in a small size [6]. In addition to that, the RFID type used is the UHF RFID tag. UHF is the ultra-high frequency, it is being used to operate the RFID between the tag to the RFID reader. One thing about the UHF RFID tag, it is not commonly used in the animal husbandry industry, not as the LF or low-frequency tag. The ultra-high frequency tag can be efficiently used, which can impact the management towards a positive outcome. The placement of the RFID reader is important compared to the importance of RFID tag size itself [7]. An RFID tag is placed at each department and stage such as the farmer, vaccination process, veterinarian meetings, server at the official update, to the farm, and repeats all over again. The placement of the RFID reader or writer is crucial for the animals' update, especially for the animal husbandry management. The RFID reader or writer is crucial to keep track of the animal's record
each time for any process they went through. That is the reason why the RFID reader or writer is being placed on each department for the animals update whether manually or automatically by the management. The implementation of RFID is important for information management [8]. They focused on several government departments and breeders, sellers, feeders, animal clinics, animal protection associations, which form a complex network that can be partitioned into thousands of pet-centric networks. The information that is contained inside the RFID tag is crucial for the animal department to keep. One of the reasons why they make RFID tag information crucial is because, when the animal is lost or transferred, the founder of the one who manages the lost animal, can obtain the animal information and return the animal safely. Additional to that, the main focus of this RFID implementation is to have common information for all departments that manage the animal. For example, the breeders, sellers, feeders, and animal clinics all have common data and updated data every time the data is updated online. The RFID tag will only be scanned for data input and updates. Animal live tracking is very important especially for the Zoo [9]. The live tracking consists of records of their races, health, and live location. The live location, instead of by using RFID, it is more focused on GPS implementation on the animal. In addition to that, for the health monitor, it uses the sensor nodes, for example, to take the live temperature of the animal. The RFID tag is more to information keeping for the animal, and less functioning towards the live location because it is being done by the GPS itself.

UHF-RFID technology is the only alternative for the designed approach to retrieve animal data while the animal truck moving through the animal checkpoint [10]. The technology that is being implemented right now is an LF-RFID system that only enables a one by one check for the animal at a certain range. The animal that is being checked by the RFID device will pass to one checkpoint to retrieve their data. The data that is being retrieved is to be kept and send to any agencies that need the animal data. Which in their case, the animals are being transferred by a truck from one place to another, to perform the animal count and animal data retrieving, RFID is needed. By that, all of the animals will go out from the truck to walk pass by a checkpoint one by one to have their data checked and sent to the E-government website. This is the case where they use the LF-RFID device method. As for the other case, the desired condition is to use the UHF-RFID device method, as the animal truck that brings some animal will only pass through one checkpoint to be checked, and all of the animal data inside the truck will be taken directly. This method does time-saving and more efficient for animal transportation and information management. The RFID tag can be implemented on an animal at husbandry for a medical purpose [11]. The RFID tag will not be a common tag, but it came along with a set of sensor nodes. Those sensor nodes are composed of MCU & RFIC, antenna matching circuit, antenna, battery, and sensors depending on applications. From the first till the last prototype that they have made consists of 4 sensor nodes. The last prototype compiles all of the sensors into one small device which will be implemented into an animal. That sensor is a temperature sensor, accelerometer, ADC to measure the voltage of the power unit, and digital interface to other sensors. All of those sensors are in a small size that is being compacted into a small capsule, and then that capsule will be implemented into an animal such as a white-mouse and a cow. The RFID tag will save all of the results that had been taken from all of the sensors, and the saved result will be sent to the RFID reader to be read. The RFID tag which had been implemented into the animal is a passive RFID tag, which can save energy and increase the lifespan of the RFID tag to continue its activity. RFID plays an important role in a population of animals that are being carried by trucks [12]. The traditional method is based on papers, inspection, manual sign-in, and checkpoint to go through. The traditional method may cause a human error, such as bad handwriting, lost count, misinformation. In addition to that, the delay of the papers and information to transfer to another department for a report may be one of the problems, for example, the checkpoint status checks transfer data to the transport ministry registration. This lead to the RFID implementation to the animal poultry truck. Poultry by means is domesticated birds kept by humans. Birds transfer data are very crucial because birds or chicken can bring or spread a disease from one country to
another. That's why RFID implementation is applied to this case. The RFID is being implemented to the truck, that carries all of the bird's data, and they only have to go through one checkpoint to have their RFID tag being scanned and they are well to go through the border without any delay. Adding to that, the animal data will be transferred immediately online and all departments that need the animal movement data are well received without any delay. By means, for such cases that a bird may bring harm or disease, the data that had been transferred online, will notify any department on which truck that brings the animal should be stopped.

Adding up to the research, RFID is important when it comes to animal monitoring. The RFID that is being made by Volk, have a concept of biotelemetry. It goes more towards modern veterinary medicine. The monitoring data that they want to obtain are dynamic bio-potential (ECG), pressure, temperature, oxygen saturation, and activity. The power-on concept and wired sensor are attached to an animal are the problem for monitoring the animal. By that, the RFID tag with the concept of biotelemetry is a step towards change for the veterinary department to monitor the animal via wirelessly[13]. All of the data that had been obtained will be stored to the online server for any other department that needs the animal data, will have its data immediately. Recently animal and human interactions are crucial in husbandry sectors. The impact between a human and an animal is increasing, and a solution towards animal integration is needed. Therefore, they come up with a solution of RFID-MMS which is RFID based mobile monitoring system. The RFID tag system that is being attached to the animal, mainly pets, has specific information that can be kept inside of it, such as information retrieving, location tracking, behavior analyzing over a wireless network, and medical records. By such means as the location tracking, the RFID reader that is designated for the tag, the RFID reader must be implemented all around the city, so that any animal that passes through the RFID reader with its RFID tag will have its tag scanned and all of its location information is being transferred online and the owner of the animal will be notified about the animal live location through windows operating system online[14]. The use of RFID to monitor animal movement for scientific research purposes is a solution for accuracy and time management. The use of RFID should be implanted inside the animal if it has the needs of body movement and body-related data. The RFID that they use can measure ECG, arterial blood pressure, and body temperature. That is why the need for the RFID tag along with sensors are needed to be implanted inside of the animal is crucial for the animal body data. The RFID that is being made is only to make a behavior tagging and locating where the animal is inside the cage[15].

2.2. Radio-Frequency Identification Device

RFID is an identification device that uses electromagnetic fields to automatically identify and track tags attached to objects. The RFID comes with two devices which are the tags and the reader or writer. Tags have two types, which are active tags and passive tags. The use of RFID is widely used for single device movement monitoring, or group monitoring [16]. It is widely used in an industry, to detect shipments item movement. There are two classes of RFID tags, which are active and passive. The active tags need a power source to power the tag, either by battery or power infrastructure. The cost and life span of the active RFID tag is an expensive and shorter life span due to the implementation of batteries. The passive tags, however, works without the batteries. It only powers up because of the RFID reader. The tag reader is responsible for powering and communicating with the tag. The tag antenna captures the energy and transfers the tag's ID. The focus of this research is to study the collection of data from an RFID tag to the reader/writer, and on how to specify the data to a tag from the writer. The RFID tag is to be implemented to a deer at husbandry, to enable them to have their data inside a tag. RFID systems are using galvanic contacts which using instead of magnetic or electromagnetic fields [17].

2.3. Components of RFID

The RFID consists of 3 main components, they are the RFID tag, reader, antenna, and backend database [18]. The scanning antenna sends out the radio-frequency signals in a short amount of time. By
that, RF radiation occurs. The RF radiation does two things, which are to act as a means of communication with the transponder tag and to provide energy to communicate for a passive RFID tag. The RFID tags do not contain batteries which makes it cheap and can sustain long-term usage. The RFID tag information can be read by using a mobile application or through a website by opening a personal computer. The RFID reader uses its antenna to read the RFID tag, and the read data is to be sent to the host PC. Data analytics on the database on mostly viewed by smartphones and websites which support the Internet of Things (IoT) technologies platform for sensors to data visualizations [4, 19].

2.4. RFID Tag

The work of the tag is only to respond to the RFID Reader signal. RFID Tag can only be read or write-once. The tag consists of 3 which are active tags, passive tags, and semi-passive tags. As for the active RFID tag, it can be read at a long distance. The only drawback of the tag is that it needs a battery to work, which results in the cost and size of the tag. As for the passive RFID tag, it does not contain any power to power up the tag, unless being supplied by the reader signal [20]. The lifespan of the passive RFID tag is very long, that it can take up to 20 years. While it is less expensive and small. The tag can only be read by the RFID reader in a short distance. The third type is the semi-passive RFID tag, which is a combination of both active and passive tags, which results in having both advantages of the tag. It can be read at a long distance while needing less power compared to active tags. In addition to that, the lifespan of the semi-passive tags is much longer than the active tag and resulting in high maintenance and cost too.

2.5. RFID Reader

The RFID reader is a device that is being used to read the information stored inside the RFID tag. Radio waves are being emitted within the range of the RFID tag to enable it to be read. The RFID reader can be implemented in many ways, such as Mobile RFID Reader, Vehicle Mounted RFID Reader, and Fixed RFID Reader. Such a reader has the same application, it is only that being applied in various situations and usage. The Fixed RFID Reader can be used efficiently at a factory or a mall, to detect any RFID tag that went through the Fixed RFID Reader pathway. As for being implied at an animal, the Mobile RFID Reader is best to be applied at that situation, because animals can move anywhere and, to read the animal data by using RFID attached at the animal collar can be easily done. One of the main components of the RFID reader is the antenna. The other name for the antenna is the reader. The antenna specifically is a middle-ware technology. This is due to the antenna only works when it is attached to the reader. The antenna transmits RF waves to the tags. The tag will be responded by the RF waves that had been transmitted by the antenna from the RFID reader [21]. The frequency used for identification, the antenna gain, the orientation, the transponder antenna, as well as the placement of the tag on the object to be identified will have an impact on the RFID system’s read range.

The backend database of the RFID reader contains networking such as an Ethernet connection that connects the RFID-read event to a central server. The central server is a database application to enable the functions of matching, tracking, and storage. In some cases, for block chain situation, alarm or alert function is added. The other main component of the RFID reader is the Arduino. Arduino is an open-source microcontroller that referring to the central processing unit (CPU). It consists of both a microcontroller and an integrated development environment that runs on a computer, used to write, and upload the computer code. Arduino is a small computer that can be programmed to process any input and output between the device and any external component connected [22]. This microcontroller is using C and C++ language for its programming. With the numerous amounts of input/output pin that the Arduino has, it can interface with more than one circuit. Other than that, to power up the Arduino, it has the USB to serial converter that enables the Arduino the host the PC and the serial communication on board by using the USB converter alone being connected to the PC, the Arduino can be powered up [23]. Arduino also can be powered up by an external power supply such as the battery or the AC to DC adapter. A website is
to display the analyzed for the deer as deer husbandry management system using HTML codes. The
database is a crucial part of this project in terms of management. The data of the deer is to be sorted and
its data will show up when the desired deer data is being chosen. Incomparable to the breeding
management information system, they highlight the data management network [24]. The research that had
been run, is to have a database and analysis system developed to support the specific domain of forest
canopy research. Besides, the research is to solve the problems of a database system, such as the absence
of data, absence of data search, poor data visuals, and lack of tools for data. The same goes for the deer
husbandry, where the data is being used to solve the problem of finding the deer data visually much easier
via database. An RFID tracking system is very important; one of the methods is the supply chain
management system. The RFID tag is always be monitored in anywhere the RFID tag goes to be scanned.
In addition to that, the radio frequency is used to transmit signals. Once they scanned the RFID tag, the
animal data will be seen on a monitor, by that, the animal had passed a checkpoint, to pinpoint where the
animal went through.

Figure 1 shows the sample of RFID Mifare Tag and Figure 2 shows the RFID
location is based on
multiple RFID antenna is being placed surrounding the RFID tag. The actual location of the RFID tag is
being estimated by calculating which part of the RFID antenna is being triggered. Other than that, the
method that is used for tracking system is, by using the passive RFID reader. This method is more cost-
saving and efficient to be employed at the deer husbandry. The deer RFID tag will only be read and
updated for each time it passes by an RFID antenna at a point which passage for in and out of the deer
farm. The location is stated when the deer is inside the shelter or in the open field. As the deer husbandry
is only 2 acres, the deer data location is not as crucial as open wildlife centers which require the animal
movement and live location data. This system is implemented on a cattle farm, that the RFID tag location
is updated on a scan basis. The system will be updated by the scanning of the RFID tag at tag for medical
information update and daily information management. The data update is only on personal computer
data. This scanning method is, automated where the system automatically identifies the object, collects
data about the object, and then enters that data into a computer system without any human intervention
[25].

Previous research presented that five key areas are being focused on. The key areas are RFID Tag
type, RFID Reader type, data storage, method of tracking, and what is it used for. The RFID tag consists
of passive, active, and semi-passive. As for the RFID reader, there is a fixed position of the reader and a
non-fixed, such as portable RFID readers are currently being used. In addition to that, data storing have a
very important role for this project, it is because that it defines the scope of the project whether it is for
commercial use, lab use, or international affairs usage. The recent animal data need to be monitored and
updated by using a personal computer and an online database system.
3. Methodology

3.1. Flowchart

Figure 3 shows the process of the system flow chart describes how the RFID tag and RFID reader works with the integration of the personal computer. The RFID reader will first identify the RFID tag. Afterward, if the RFID tag is correct and registered in the reader database, the RFID reader will read the data from the RFID tag. Only then the RFID reader comes with an output of the RFID tag. Figure 4 shows the process of reading the RFID tag using an RFID reader. The RFID reader is activated to detect and read the RFID tag. The read RFID tag data will be sent to PC and the output or the data of the RFID tag will be shown, hence the RFID tag input data is sent to FavorIOT and Blynk to be saved online.

![Figure 3. System flowchart](image1)

![Figure 4. Software flowchart](image2)

3.2. System Architecture

Figure 5 shows the interaction of RFID between an animal to the database on a PC. The animal or to be precise the deer will always have the RFID tag with it along the way and the user who has the RFID reader will scan the deer RFID tag to identify the deer and keep its input data on the PC database. The PC database is online, and each input of the deer RFID tag will be sent and kept online, at FavorIOT and Blynk.
3.3. System Hardware

Figure 6 shows the connection of NodeMCU ESP8266MOD is connected to the RFID RC522 module. The NodeMCU is also connected to the personal computer. While running the program, Arduino IDE is being used and FavorIOT is being used to monitor the RFID tag data. Figure 7 shows the circuit diagram of the NodeMCU ESP8266MOD is connected to the RFID RC522 module. The NodeMCU is then connected to a personal computer.

3.4. The interface of FavorIOT and Blynk

Figure 8 shows the FavorIOT interface that reads the input of RFID tag from the NodeMCU and Figure 9 shows the interface of Blynk from a mobile app that reads the input of RFID tag from the NodeMCU. The total of all deer is 54; each deer has its special RFID tag to be scanned. Each deer database is kept online, and the sum of all deer count is being analyzed. The important data of the deer are its RFID number, birth date, age, weight, gender, and species.
4. Results and Discussions

4.1. Sample of Deer Data

Table 1 shows the deer data that is being extracted from FavorIoT and Blynk. The table consists of a sequence number, ID, birth date, age, weight, gender, and species of the deer. The highlighted data are to differentiate the gender type, species type, and age of the deer. These are a sample of 25 deer data from a total of 54 deer data.

| No. | ID   | BD   | A    | W   | SC  | GC  | G  | S  |
|-----|------|------|------|-----|-----|-----|----|----|
| 1   | 1001 | 2016 | 3.1  | 96  | 100 | 1000| M  | BT |
| 2   | 1002 | 2016 | 3.1  | 91  | 100 | 1000| M  | BT |
| 3   | 1003 | 2016 | 3.5  | 92  | 100 | 1000| M  | BT |
| 4   | 1004 | 2016 | 3.6  | 96  | 200 | 1000| M  | BA |
| 5   | 2001 | 2016 | 3.7  | 42  | 100 | 2000| F  | BT |
| 6   | 2002 | 2016 | 3.3  | 41  | 100 | 2000| F  | BT |
| 7   | 2003 | 2016 | 3.3  | 46  | 100 | 2000| F  | BT |
| 8   | 2004 | 2016 | 3.3  | 43  | 100 | 2000| F  | BT |
| 9   | 2005 | 2016 | 3.5  | 49  | 100 | 2000| F  | BT |
| 10  | 2006 | 2016 | 3.6  | 47  | 100 | 2000| F  | BT |
| 11  | 2007 | 2016 | 3.8  | 51  | 100 | 2000| F  | BT |
| 12  | 2008 | 2016 | 3.6  | 53  | 100 | 2000| F  | BT |
| 13  | 2009 | 2016 | 3.1  | 49  | 100 | 2000| F  | BT |
| 14  | 2010 | 2016 | 3.5  | 47  | 100 | 2000| F  | BT |
| 15  | 2011 | 2016 | 3.7  | 42  | 200 | 2000| F  | BA |
| 16  | 2012 | 2016 | 3.1  | 43  | 200 | 2000| F  | BA |
4.2. Analysis of Deer Biodata

The deer data is a key factor for a good and systematic deer husbandry management system. From the deer data, we can see the dominant gender, how many are 2 years and above. These data will make a good decision-making process for a company whether they should sell the deer or not. These data too can determine whether the company should add a male deer or a female deer to their husbandry to improve their deer breed process. Other than that, from the gathering of the deer data, we can observe the type of breed of deer that deer husbandry has. That is very crucial for a deer husbandry company because some customers desire a specific type of deer breed. Some examples are when there is a shortage of deer number in Baka Australia breed, the deer husbandry company will add more of that breed or hold the sale of that breed.

![Figure 10. Deer species code data](image-url)
Figure 11. Deer ID number and age data

Figure 12. Deer ID and birth date data

Figure 13. Deer gender data
Figure 14. Comparison of deer data on gender

M represents Male, while F represents Female. As for species, BA represents Baka Australia and BT represents Baka Timorensis.

Figure 15. Deer age range data

5. Conclusion and Recommendation

The use of RFID technology in animals such as deer do make data analysis much simpler. The implementation of the RFID tag and RFID reader makes the data of each deer easy to get or scanned. The FavorIOT and Blynk make the data gathering much easier as it can convert the data into Excel. As such the animal needs to be gathered or transferred, the latest animal count and data can be acquired. Any further steps to be taken, as such at the deer husbandry, the animal is well proceeded to be sold or not. The animal data is needed to make the headcount of the deer, such as, is it the correct breed of deer, is it the right age of deer, these deer data is very important to the deer husbandry owner to make the call to sell the deer or to monitor the deer. The result presents the deer data is well taken and the hardware running the RFID reader and RFID tag are running well as expected. The data obtained from FavorIOT and Blynk are obtained from each RFID tag without any data missing. The easy RFID tag reading from deer enables the
deer information to be correctly extracted without guessing what deer it is. Future recommendation for this research is where the RFID reader is to have a greater range of reading. The current project which uses MFRC522 RFID has a short-range to read but has a good data input ratio. By enabling this, the range of work and data input can be extended.

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References
1. Fahim A, Elbatt T, Mohamed A, Al-Ali A. Towards extended bit tracking for scalable and robust RFID tag identification systems. IEEE Access. 2018;6:27190-204.
2. Medeiros CR, Costa JR, Fernandes CA. RFID smart shelf with confined detection volume at UHF. IEEE Antennas and Wireless Propagation Letters. 2008;7:773-6.
3. Wang Z, Fu Z, Chen W, Hu J, editors. A RFID-based traceability system for cattle breeding in China. 2010 International Conference on Computer Application and System Modeling (ICCASM 2010); 2010: IEEE.
4. Kassim M, Ali NAN, Idris A, Shahbudin S, Rahman RA, editors. Dengue Attack Analysis System on Mobile Application. 2018 IEEE 8th International Conference on System Engineering and Technology (ICSET); 2018 15-16 Oct. 2018.
5. Shahbudin S, Zamri M, Kassim M, Abdullah SAC, Suliman SI, Ieee. Weed Classification using One Class Support Vector Machine2017. 7-10 p.
6. Li J, Huang Y, Wen G, Xu R, Ma L, editors. Compact UHF RFID Tag Antenna for Application of Domestic Animals Management. 2018 Cross Strait Quad-Regional Radio Science and Wireless Technology Conference (CSQRWC); 2018: IEEE.
7. Anu VM, Deepika M, Gladance LM, editors. Animal identification and data management using RFID technology. International Conference on Innovation Information in Computing Technologies; 2015: IEEE.
8. Liu Y, Shao P, editors. Applying RFID to the pet's information management to realize collaboration. 2010 7th International Conference on Service Systems and Service Management; 2010: IEEE.
9. Kim S-H, Kim D-H, Park H-D, editors. Animal situation tracking service using RFID, GPS, and sensors. 2010 Second International Conference on Computer and Network Technology; 2010: IEEE.
10. Ketprom U, Mitrpant C, Makhapun P, Makwimanloy S, Laokok S, editors. RFID for cattle traceability system at animal checkpoint. 2011 Annual SRII Global Conference; 2011: IEEE.
11. Lu J, Zhang L, Matsumoto S, Hiroshima H, Maeda R, Gotoh T, et al., editors. Development of wireless sensor nodes for animals husbandry and medical applications. 2017 IEEE SENSORS; 2017: IEEE.
12. Chansud W, Wisanmongkol J, Ketprom U, editors. RFID for poultry traceability system at animal checkpoint. 2008 5th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology; 2008: IEEE.
13. Volk T, Jansen D, editors. Implantable RFID sensor platform to monitor vital functions of small animals controlled by network based software. Smart SysTech 2012; European Conference on Smart Objects, Systems and Technologies; 2012: VDE.
14. Ting JS, Kwok S, Lee W, Tsang AH, Cheung BC, editors. A dynamic RFID-based mobile monitoring system in animal care management over a wireless network. 2007 International Conference on Wireless Communications, Networking and Mobile Computing; 2007: IEEE.
15. Volk T, Gorbey S, Bhattacharyya M, Gruenwald W, Lemmer B, Reindl LM, et al. RFID technology for continuous monitoring of physiological signals in small animals. IEEE Transactions on Biomedical Engineering. 2014;62(2):618-26.

16. Kassim M, Mazlan H, Zaini N, Salleh MK, editors. Web-based student attendance system using RFID technology. Proceedings - 2012 IEEE Control and System Graduate Research Colloquium, ICSGRC 2012; 2012.

17. Thomas SJ, editor. RFID for Everyone: Design of an Easily-Accessible, Experimental UHF RFID Platform. 2019 IEEE International Conference on RFID (RFID); 2019: IEEE.

18. Elbasani E, Siriporn P, Choi JS. A Survey on RFID in Industry 4.0. Internet of Things for Industry 40: Springer; 2020. p. 1-16.

19. Kassim M, Ismail M, Yahaya CCK. A Web Based Temperature Monitoring System. International journal of multidisciplinary sciences and engineering. 2011;2(1):1-9.

20. Bouet M, Dos Santos AL, editors. RFID tags: Positioning principles and localization techniques. 2008 1st IFIP Wireless Days; 2008: Ieee.

21. Bolic M, Simplot-Ryl D, Stojmenovic I. RFID systems: research trends and challenges: John Wiley & Sons; 2010.

22. Zain BAM, Anuar FF, Al-Shaibani N. Comparative Study on Flexible Link Aerator Using Arduino Programming and Dissolved Oxygen Meter. International Journal of Integrated Engineering. 2018;10(4).

23. Galadima AA, editor. Arduino as a learning tool. 2014 11th International Conference on Electronics, Computer and Computation (ICECCO); 2014: IEEE.

24. Yan B, Lee D, editors. Application of RFID in emu breeding management information system. 2009 ISECS International Colloquium on Computing, Communication, Control, and Management; 2009: IEEE.

25. Miaji Y, Mohamed MAA, bin Daud N, editors. Rfid based improving supply chain traceability. 2013 IEEE International Conference on RFID-Technologies and Applications (RFID-TA); 2013: IEEE.