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Control and Monitoring System for Livestock Feeding Time via Smartphone

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Abstract: The livestock farming sector usually require a lot of manpower and may face problems such as adhering the designated feeding schedule. Therefore, this paper intends to aid in this sector by bringing the smart feeder system. The main objective of this paper is to control and monitor livestock feeding time using application via smartphones. This is to ensure that the livestock are fed according to the right schedule. This paper also highlighted the advantage of the smart feeder system where it can be used to save up money and energy that can be obtained by having less labor workers. This is because of the hopper storage that can accommodate the food up to three days. The importance of this system is its ability to automate the feeding system for the livestock. The smart feed system designed is different from the existing livestock feeding machines that are available anywhere in the market due to the implementation of Internet of Things (IoT) in the system. The usage of IoT allows farmers to set the feeding schedule automatically by using an application via smartphone. Besides, users will also be informed on the weight of food in the storage and food container through the application. This will allow the users to monitor the food storage and only come to refill it when it is empty. Farmers can also observe whether the livestock have eaten or not by getting updated on the level of food of the food storage using an ultrasonic sensor.

Keywords: Smart feeder system, livestock farming, Internet of Things

1. Introduction

In 1940, Sir Albert Howard wrote a book about the importance of livestock in agricultural systems called An Agricultural Testament. He expressed about one of the foundational principles of organic and regenerative agriculture where he stated that most farmers were not looking to maximize yield or profit, but were looking to optimize the functioning of the farming ecosystem itself [1]. Nowadays, food and agriculture sector are growing rapidly, including the livestock farming sector which is one of the contributors to the country's income. Livestock have high demand in Malaysia as they can be sold to customers in large quantities, especially to customers who want to make any events such as baby shower, feasts and many more. However, some of the livestock farmers are forced to close their farm due to the workers shortage. Prices of vegetables and poultry are expected to keep increasing due to manpower shortage at the

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farms. The freeze on foreign labor is badly affecting the local agriculture industry here with livestock farmers claiming that the industry will be crippled within a year if nothing is done [2].

According to the Federation of Livestock Farmers' Associations Malaysia president Datuk Jeffrey Ng, consumers would have to pay more for imported meat because local farms would be forced to close down due to the lack of workers [3]. He pointed out that the industry was facing a shortage of at least 8,000 workers. In Johor Bharu, the state's Small and Medium Poultry Farmers Association president Lim Ka Cheng said farmers and businesses had voiced out their concerns over the shortage of foreign workers [3]. This idea has come up as some problem occurs faced by the farmers which are they must always monitor the situation at the livestock areas. At the same time, livestock farming sector usually required a huge manpower to handle all the livestock that farmers had and nowadays it is hard to hire workers and the money to pay worker's salaries can be reduced if the farmers use the system or robot that can automatically feed their livestock. Next, some farmers do not feed their livestock on time or do not follow the right feeding schedule. This is because the farmers cannot monitor directly their livestock for 24 hours. They also have any other deals outside the farm.

In this era, the Industry 4.0 is the new approach to combining traditional manufacturing processes and technology such as the Internet of Things (IoT) to improve automation, communication and use of real-time data [4]. Internet of things is also known as a system that is interrelating to mechanical, digital machines and computing devices that are equipped with unique identifiers and the ability to transfer data without the need of human interaction over network [5]. In other words, the IoT refers to the billions of physical devices around the world that are now connected to the internet, collecting and sharing data [4]. IoT is not only used in agriculture sector, it is also used in mobility, hospitality, waste product and many more sectors. This is different than during the first industrial revolution which focused only on the use of steam-powered machinery, the second industrial revolution which focused on electrics and the third industrial revolution that leaned on the usage of information technology (IT) [4]. Smart feeder system is an IoT-based automatic feeding system which can be used in livestock farming. Unlike the normal livestock feeding machines that are already available in the market, this Smart Feeder System is unique due to the implementation of the use of Internet of Things (IoT) to facilitate the work of farmer. By using this system, farmers can set the feeding schedule automatically by using application via smartphone.

The main objective of this project is to control and monitor livestock feeding time using application via smartphones. The farmers can feed their livestock automatically by using smartphones only. This is to ensure that the livestock are fed according to the right feeding schedule. Next, this project can save energy and money to hire more workers. This is because the hopper storage can accommodate the food up to three days. Therefore, farmers do not need to give food on their own to their livestock every day. For the limitation, this project only focuses on livestock such as cows, horses and goats but not including poultry. This is because the way to feed poultry and cows is different. The importance of this project is to automate the feeding of the livestock. This project supports the livestock feeding to cope up with their needs in terms of automating the feeding of the livestock.

2. Materials and methods

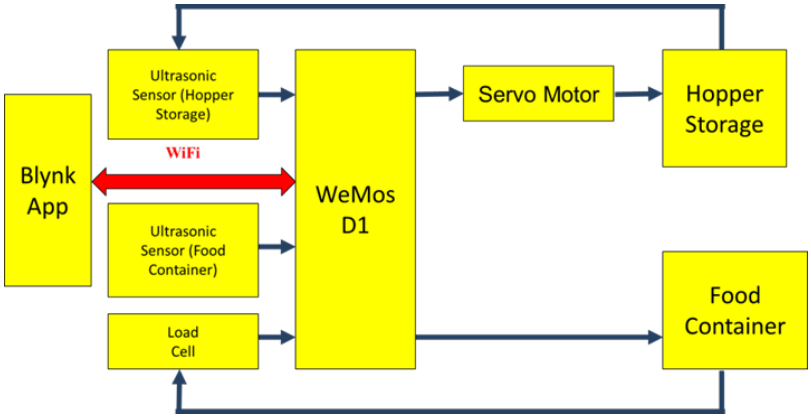

Fig. 1 - Block diagram

Fig. 1 shows the block diagram of the connection between hardware and software system for this project. It consists of two parts which are the hardware part such as ultrasonic sensor, load cell and Arduino WeMos D1R2 and software part such as Blynk app. First, we install Blynk application from the Apps store in the phone. Then, we can code the Arduino WeMos by using Arduino IDE software [6]. From this software, we can connect directly to the Blynk [7]. By using Blynk, this system can monitor and control the hardware used. In this project, users will be able to control the time to feed their livestock (cows) and monitor the level of food in the hopper storage, the amount of food in the container and the presence of livestock (cows) near the food container by using smartphone application.

Operation of the system:

1. Set time using the smartphone application.
2. When the time is reached, the actuator of the hopper storage will open to drop the food on the food container of the livestock.
3. User can also manually control the actuator using the app.
4. The ultrasonic sensor in the hopper storage will sense the level of food and send a notification through the app to user so that user can monitor the level of food present.
5. The ultrasonic sensor at the food container is used to sense the presence of livestock while the load cell will sense the weight of food left in the container so as to help user to monitor whether the livestock have eaten.

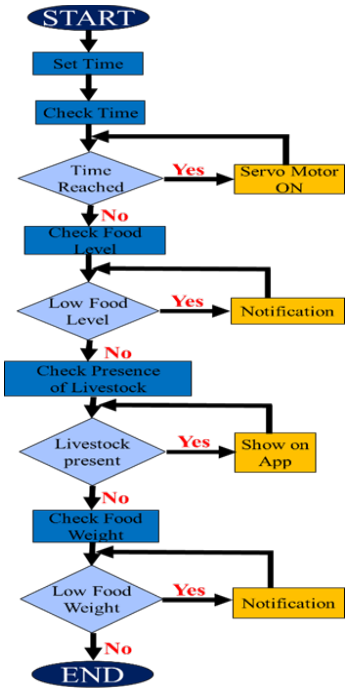

Fig. 2 - Flowchart of the smart feeder system

The operation system can be seen in the flowchart as in Fig. 2. Arduino WeMos is same like Arduino Uno but with the added advantage of built-in WiFi [8]. So it means the board looks and works like the Uno except this system required good line coverage to get the high speed internet. Blynk app connects with the Arduino WeMos with the help of internet connection. Next, the wires from the Arduino connected to the circuit and to the sensors.

Fig. 3 shows the schematic diagram of the smart feeder system. The schematic diagram is plotted using the Fritzing tool. There are two ultrasonic sensors, load cell with HX711 amplifier module and servo motor connecting to the WeMos D1R2 model.

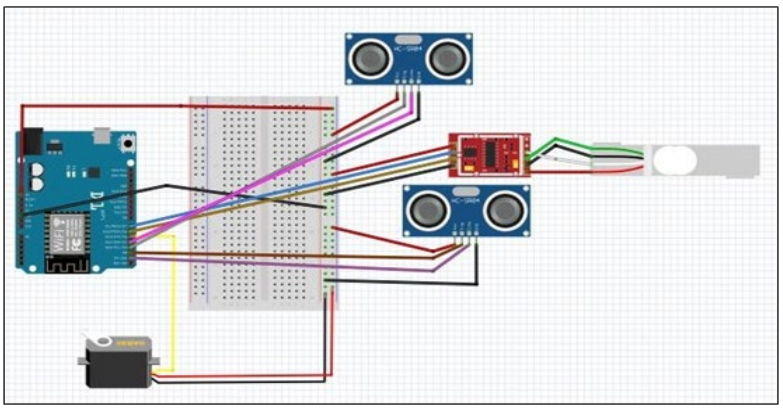

Fig. 3 - Schematic diagram

3. Results and Discussion

Fig. 4 shows the final result of this project. The design consists of hopper storage (for feeding system) and a container (for weighing system). The sensors used are two ultrasonic sensors and a load cell. A servo motor is used to open or close the actuator for the dropping of food. Fig. 5 shows the user interface of the feeding system and the weighing system that can be seen on the smartphone via the Blynk application. Fig. 6 and 7 shows the results obtained when each parameter or condition is occurred.

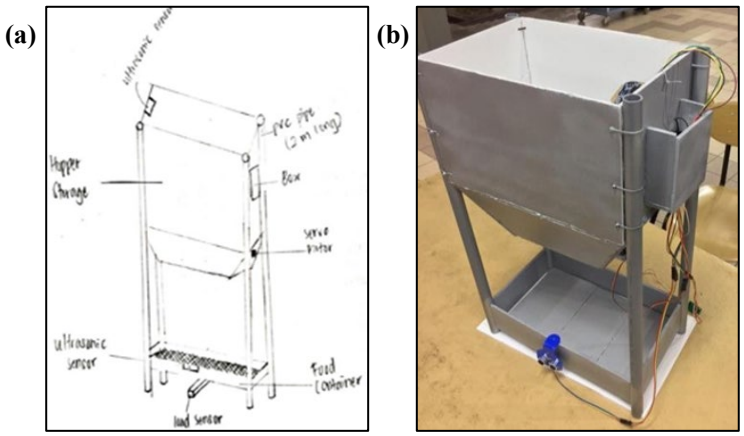

Fig. 4 - Prototype design (a) design sketched; (b) real design prototype

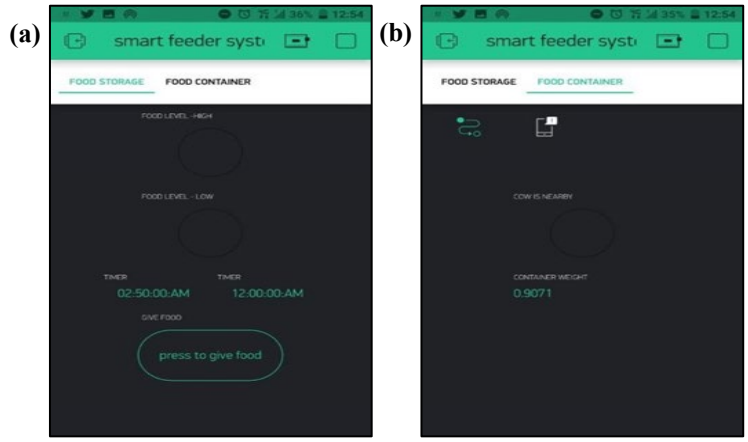

Fig. 5 - User interface (a) feeding system; (b) weighing system

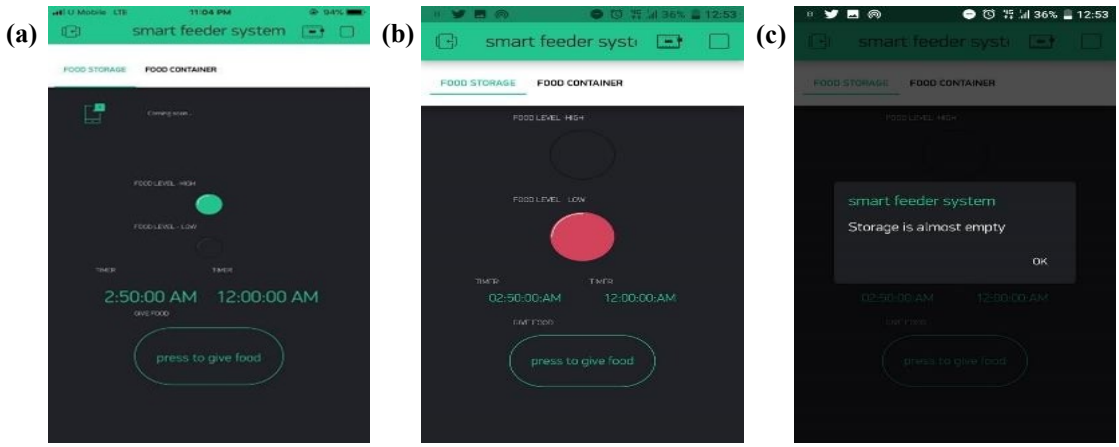

Fig. 6 - User interface (a) food level is high; (b) food level is low; (c) notification popped up

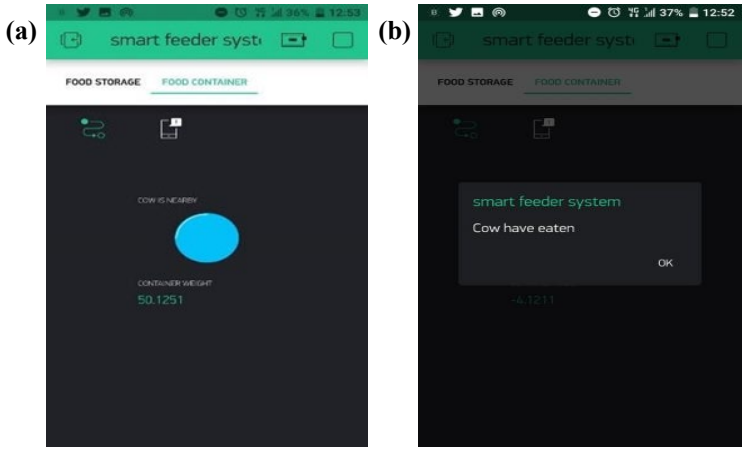

Fig. 7 - User interface (a) livestock is near the container; (b) notification popped up when food is less than 100 grams

The first step which is to enable users to input feeding time, there are two slots of time provided, which means users can set two time slot per day to feed the livestock automatically through app [11]. In the time slot, users can set the time by hour, minute, second and AM or PM for feeding the livestock. When the time is reached, the servo motor, that acts as the actuator will be turned on to drop the food into the container. In this project, the food used is the pet- use bedding. The bedding is used as "food" in this project because the size of the bedding is almost similar to the cow feed pallet, which is 2 cm and its price is not expensive and is within the budget given. The time for the actuator to open is set at 1 second and the degree of the actuator is 90º when it is open. The open time and degree of the actuator can be modified through Arduino coding. The ultrasonic sensor in the hopper storage can detect the level of food, whether it is high or low. The level of the food is considered high when it is in between 0 to 2 cm from the sensor whereas the level of the food is considered low when it is 8 cm away from the sensor. The parameter for high and low food level can be set through Arduino coding.

The ultrasonic sensor located at the food container is used to detect the present of the livestock whether they are coming for the food. Since the system is used in outdoor farming, it is important to know the presence of livestock for the food so as to avoid food wastage and loss of money. The load cell is connected to a HX711 module. HX711 module is used to get measurable data out from a load cell and strain gauge [9-10]. When the food is dropped onto the container, the load cell will start detecting and measuring the weight of the food in the container.

4. Conclusion

In a nutshell, this project was successfully carried out and completed with most of the results achieved as expected. Although there are some limitations, especially on the amount of food given, this project did achieve the main objective in which a smart and user friendly feeding system by using IoT is being developed to solve real life problems in the livestock farming sector such as lacking of workers, feeding not according to schedule as well as helping farmers to monitor the farming progress. This smart feeder system was built based on the use of IoT and emphasize its practicality and functionality. This smart feeder system enables users to set time so as to automatically feed the livestock and monitor the condition in the farm, such as the level of food in the hopper storage. Users only need to switch on the app in their smartphone and all the farming condition are on their fingertips. After doing all the testing and optimization, most of the tasks were performed well without major issues. In short, the overall progress is good and most of the difficulties and problems faced during the process were overcome and the smart key system is working as expected.

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