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Automated Duck Egg Classifier with Web-Based Monitoring System

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Authors' contributions

This work was carried out in collaboration among all authors. Authors JLO and NEA designed and implement the study, wrote the protocol and wrote the first draft of the manuscript. Author NPS performed the statistical analysis, edited the study, managed the literature searchers and enriched the results and discussion. All authors read and approved the final manuscript.

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ABSTRACT

The main objectives of the research were to develop a module that classify fertilized/unfertilized duck eggs according to its classification using Light Dependent Resistor during candling process of the duck eggs, a project that segregate the duck eggs to its designated classification area using servo motor, to develop a webpage that displays the number of classified duck eggs in a tabular and graphical presentation using Windows Form and to capture the level of effectiveness of the Automated Duck Egg Classifier with Web-Based Monitoring System in terms of functionality, reliability, usability, efficiency, maintainability and portability. Recipient-beneficiary of the project is the balut producer's industry. The method that was used by the project-developers was waterfall approach as a process model for the system. The project-developers used Visual Studio 2012 as front-end and Text File as back end of the system. Asp.Net will be used for designing the user's interface. Using these applications, the project team created a Web-Based Application that displays

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the number of classified duck eggs which could be presented in a tabular and graphed. Therefore, the study intended to help the balut producer's industry. Project developers developed an Automated Duck Egg Classifier with Web-Based Monitoring System that able to solve the aforesaid problems of the producers. The common problem encountered by the said industry is the manual process in classifying duck eggs. After the project was tested, the developers concluded that the project finally resolved the traditional problems of classifying duck eggs as the balut expert stated.

Keywords: Egg classifier; sensor; monitoring; software development.

1. INTRODUCTION

The Philippine duck industry is dominated by balut production and the continuing survival industry's future growth depend on its ability to compete which, in turn, depends on the efficiency of the production and marketing systems relative its competitors. In the egg industry, some technologies are being used in classifying eggs [1].

Some balut industry in the Philippines use the traditional way of classifying fertilized duck eggs. The egg was tested using the traditional gadget where the incandescent light bulb was put inside the box with a hole inside where the egg should be placed to be able to see inside of the egg if there is an embryo (balut) or not (penoy). Implementing a new technology in this manual process give the balut industry a big help.

In this study, the proponents are motivated to create a project classifying the duck eggs after it is incubated for how many days to help the balut industries. This project also includes counting the numbers of classified eggs to lessen the time and effort of the employees that can be seen in the monitoring system of the project.

The project entitled "Automated Duck Egg Classifier with Web-Based Monitoring System" was developed to automate the classification of duck egg after incubation. In addition, the project was developed to answer the following problems; how to develop a module that classifies fertile and not fertile duck eggs, how to develop a project that segregates duck eggs to its designated classification area and how to develop a webpage that displays the number of classified eggs in a tabular and graphical representation.

1.1 Objectives of the Study

1. Developed a module that classifies fertilized/unfertilized duck eggs according to its classification.
2. Developed a project that segregates the eggs to its designated classification area.
3. Developed a webpage that displays the number of classified duck eggs in a tabular and graphical representation.
4. To evaluate the level of the effectiveness of Automated Duck Egg Classsifier with Web-Based Monitoring System in terms of;

   4.1. Functionality
   4.2. Reliability
   4.3. Usability
   4.4. Efficiency
   4.5. Maintainability
   4.6. Portability

1.2 Significance of the Study

Automated Duck Egg Classifier with Web-Based Monitoring System is very useful and helpful in a balut business because it lessens the time and effort on classifying the fertilized and unfertilized duck eggs. This project also counts the number of eggs that are already classified and the data was saved to the database. In addition, the project developed an information system through the development of a web-based system for inventory purposes.

Implementing a technology in this type of business is very helpful and beneficial to the owner who wants to make their work done in an easiest and hassle-free procedure.

1.3 Scope and Its Limitations

The scope of this project focused in designing and developing the prototype of the Automated Duck Egg Classifier with Web-Based Monitoring System. It only focused in displaying the tabular and graphical representation of the number of classified duck eggs via Windows form application monitoring system, classifying the duck eggs using Light Dependent Resistor during candling process and segregating the eggs using the servo motor. The project was limited only to classify two types of duck eggs classification, namely: penoy(no embryo developed inside of

the egg) and balut(embryo was developed inside of the egg).

Duck (Anas Platyrhynchos) egg was used for egg classification. This prototype duck egg classifier is limited only for small scale which serves only as a model for implementation. The study was conducted at SPAMAST Matti, Digos City, Davao del Sur.

2. REVIEW OF RELATED LITERATURE

This chapter focuses on different variables related to the study and provides sufficient knowledge and application for designing and in constructing a file management system. These serve as guidelines in the theoretical and actual conceptualization of the study.

2.1 Chicken Eggs Measuring and Classifying Machine

According to Buencamino et al. [2], the classifying of chicken eggs is often manually done by the workers in the poultry farm and mostly done by hand and takes time until the eggs are ready to be delivered to the market place. Small-time entrepreneur cannot hire more workers for their farm to make the production faster. Chicken eggs are graded by size or weight for sales and large commonly used for recipes.

2.2 Vision-Based Egg Grade Classifier

In the study of Zalhan et al. 2017, digital image processing techniques (DIP) have been widely used in various types of application recently and being used in many types of application area such as intelligent system, robotics, etc. This paper proposes the implementation of digital image processing techniques to classify three different categories of commercial eggs and the study of different types and real size measurement of commercial eggs using Coordinate Measure Machine (CMM) and camera, classification algorithm and the development of vision-based egg classification system.

2.3 Improving the Performance of a Vision-Based Computerized Egg Grader

According to the paper of Pabico et al. [3], candling is the manual method of egg grading common in the Balut (duck egg embryo) making industry in the Philippines. Labor intensive and susceptible to some mechanical intrusion as human contact with the eggs is unavoidable. To improve efficiency, minimize errors and capture the human's expertise, they developed a computer-based vision system using an artificial neural network (ANN) as a grader.

2.4 Egg's Grade Classification and Dirt Inspection Using Image Processing Techniques

According to Ibrahim et al. [4], due to the high demand of eggs by the consumers, the egg production industry has become one of among large industries in many countries. Egg grading is one of the important processes that need to be done to control the quality of eggs produced. The candling method technique is actually a manual handling method where a human worker or labor is needed during the classification of eggs. In this paper, image processing techniques have been applied to determine the grade and size of eggs, and also used to inspect dirt on eggshell.

2.5 Web-Based Construction Project Performance Information System

According to Cheung et al. [5], the development of a Web-based Construction Project Performance Monitoring System (PPIS) aims to assist project managers in exercising construction project control and measure its performance for the inclusion of PPIS such as People, Cost, Time and etc. The monitoring process is automated through the use of World Wide Web and database technology.

2.6 Web-Based Information System

In the paper of Chandrinos et al. [6], the widespread use of the Web for information management, has revealed the weak points of HTML as a general-purpose scripting language for information retrieval and query result presentation over the HTTP protocol and the digital libraries should offer the end-user enhanced functionality compared to the physical library. The main problems of standard HTML for Web-Based Information System are intended to present based on the experienced during the project design.

2.7 Microcontroller-Based Egg Candling System

According to S. Saidu, et al., candling refers to the process of transilluminating an egg with light to determine the presence or absence of a viable embryo is a useful tool for quality assurance and determination of poor hatches and parameters are being measured during the incubation process. The embryonic circulation and the change in blood flow photo electrically through embryonic heartbeat were being detected.

2.8 Grading and Quality Inspection of Defected Eggs Using Machine Vision

In the paper of Dehrouyeh et al. [7], algorithms based on image processing for detecting internal blood spots and eggshell dirt by processing acquired images from eggs under different illuminations. In order to carry out image processing and extract useful features of captured images of eggs by machine vision, the author developed an algorithm in HSI color space. Eggshell dirt was detected using connected areas detection technique.

2.9 Machine Vision System for Detecting Fertile Eggs in the Incubation Industry

According to Hashemzadeh et al. [8], Candling process is labor consuming, and is not very efficient in checking thousands of eggs per day, therefore, the development of an accurate, rapid and cheap machine vision system for detecting the infertile eggs inappropriate time would be advantageous to the incubation industry. Candling machines are used in this process where eggs are exposed to a sharp dim of light.

2.10 Automated Chicken Egg Classifier with Web Based Monitoring System and GSM Notification

According to Adlawan et al. [9], automating the process of egg classification gradually reduced the number of cracked or contaminated eggs as it decreased human contact. Additionally, a web-based monitoring information system efficiently produces inventory reports signifying the number of eggs classifieds for a certain weight class and a GSM notification system helped owners monitor remotely.

2.11 Automatic Classification of Fertilized Duck Eggs via Image Processing with Short Message Notification

In the paper of Bernardo et al. [10], the mechanism that reduced the time consumed on classifying duck eggs better compared to the traditional system. The project was using an image processing algorithm in classifying eggs. When all of the eggs were classified, the data could be send to the poultry owner or operator through SMS by pressing a button that would signal the GSM module linked at the Arduino Mega that stored the data.

3. METHODOLOGY

3.1 Technical Background

The proposed project use both Hardware and Software for developing a project. In the hardware area component, the proponents used: Desktop Computer, Arduino Uno, Light Dependent Resistor (LDR), Light Bulb, Synchronous Motor and Servo Motor. The use of Arduino Uno, LDR, Light Bulb, Synchronous Motor and Servo Motor are for the prototype to classify the duck eggs. The desktop computer is used to monitor and records the classified duck eggs that have been classified through the prototype. For the software, the proponent uses the following: For the front end, the proponent uses the Visual Studio and the back end of the project the proponent used My SQL where the data can be saved or stored in the database and the operating system is Windows 7 and Arduino Software. Adobe Photoshop CS6 also was used for editing and designing of the project, for editing of our documentation is Microsoft Office Word 2007.

3.2 Locale

The capstone project “Automated Duck Egg Classifier with Web-Based Monitoring System” will be conducted in the SPAMAST School.

3.3 Details of the Software Used

The software and hardware that was used for the development of the project runs to any several versions of Windows 7, 8 and 10 operating system.

1. *Arduino Software* – this is where all the sensors that were used for the project are being coded.
2. *Microsoft Visual Studio 2012* – this is where the monitoring system of the project are being coded using the C# programming language.
3. *MySQL Administrator* – serve as the database of the project where all the data are being stored.
4. *Adobe Photoshop* – use for designing the system.
5. *Arduino Uno* – serves as the microcontroller of the project.
6. *Light Dependent Resistor (LDR)* – a sensor used to read the light resistance produces by the egg during the candling process.
7. *Light Bulb* – used for the candling process of the duck eggs.
8. *Synchronous Motor* – used for the conveyor to transport the duck eggs.
9. *Servo Motor* – used for segregating the classified duck eggs after classifying it.

3.4 Operational Framework

The user can classify the duck eggs automatically using the prototype. After the classification, the data that was gathered from the prototype during the classification process was saved to the database of the monitoring system and it can be displayed in a tabular and graphical representation managed by the user/admin.

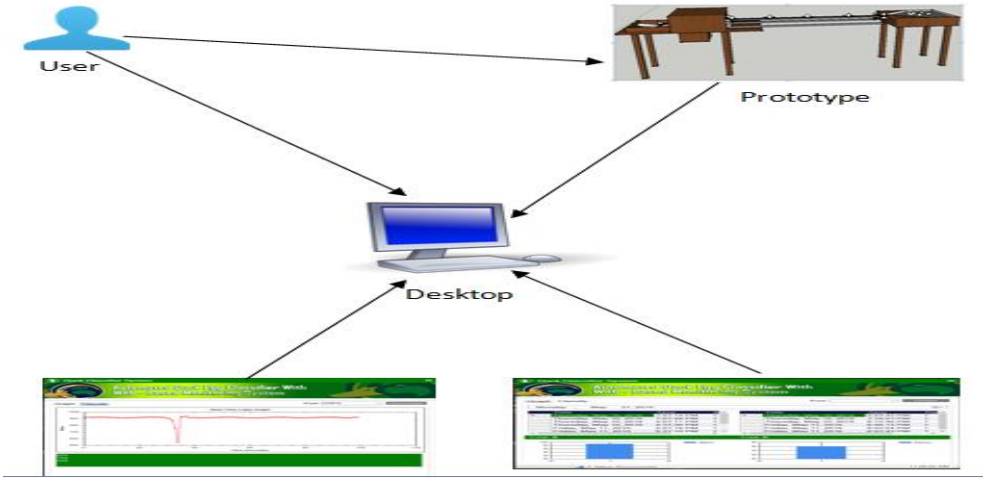


Fig. 1. Operational framework

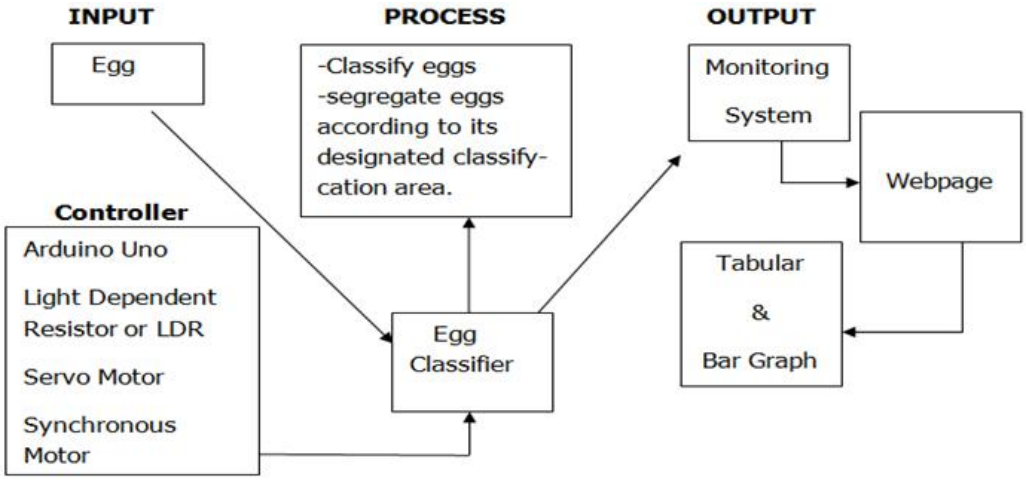


Fig. 2. Process of the project

3.5 Theoretical Framework

In classifying the fertilized duck egg in this proposed project, the incandescent light bulb will be placed inside the hole of the design classifier for the candling process where the egg stops. With this, the Light Dependent Resistor will measure the brightness of the egg through the reflection of the light of the bulb. The result data from the duck egg classifier that stored in the Arduino will be saved to the database of the monitoring system. After that, the webpage will display the graphical information about the classification of duck eggs.

4. RESULTS AND DISCUSSION

The result and discussion of the methods of the project entitled Automated Duck (AnasPlatyrhynchos) Egg Classifier with Web Based Monitoring System were based on the objectives. The project was made in order to give the balut producers and an efficient way of classifying duck eggs. Objectives were answered and defined specifically [11].

The overall mean derived from the questionnaires that were given to the respondents were also presented as evidence to the output of the project. During the testing, there were twenty (25) respondents: Twenty-three (23) students, and two (2) balut expert. The said objectives of the study are being answered by the following explanations:

4.1 Development of Module in Classifying Duck Eggs

Light Dependent Resistor (LDR) is what we used for sensing the light resistance produce of the duck eggs during candling process in order for us to classify whether it is a balut(fertilized) or penoy(unfertilized). If the light resistance is less than 399, the egg is considered as balut and greater than 400, the egg is penoy.

4.2 Development of the Project that Segregates the Eggs to Its Designated Classification Area

Servo Motor was used for segregating the duck eggs. This motor was connected to the LDR, whatever the LDR sense during candling process of the duck eggs, the servo motor rotates, 270degrees if the classified egg is penoy and 120degrees rotation if it is balut.

4.2.1 Development of the monitoring system (Tabular)

The monitoring system was in a Windows Form. It has a back-end of TextFile and a front-end of Visual Studio 2012. Whenever the user/admin wanted to see the data stored, the user/admin of the system just have to click the classified tab and it showed the date, time and the garbage level when the data being gathered and within that tab, there is a calendar at the top of it where the user/admin can select the date of the classification and the data are being shown.

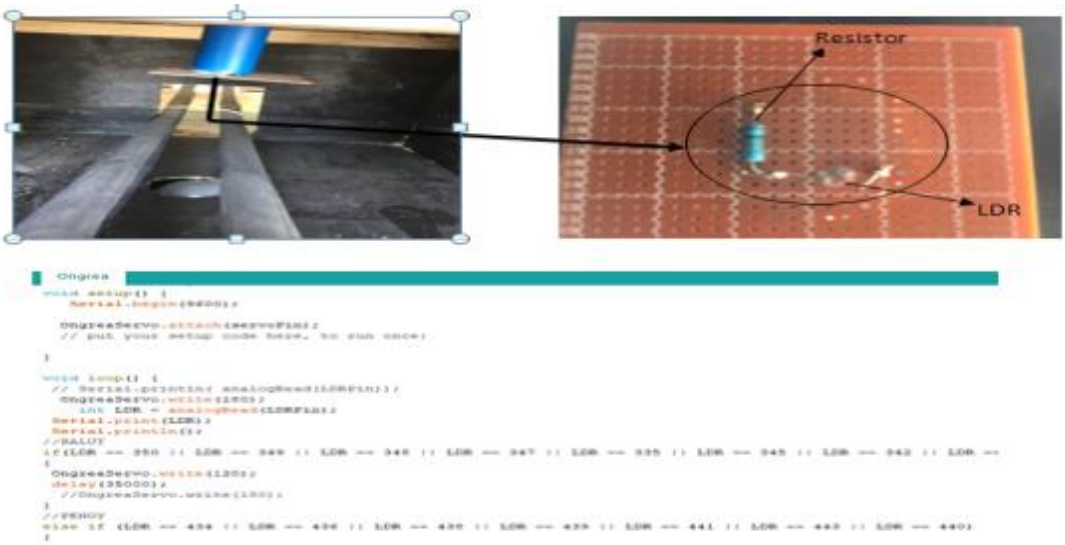
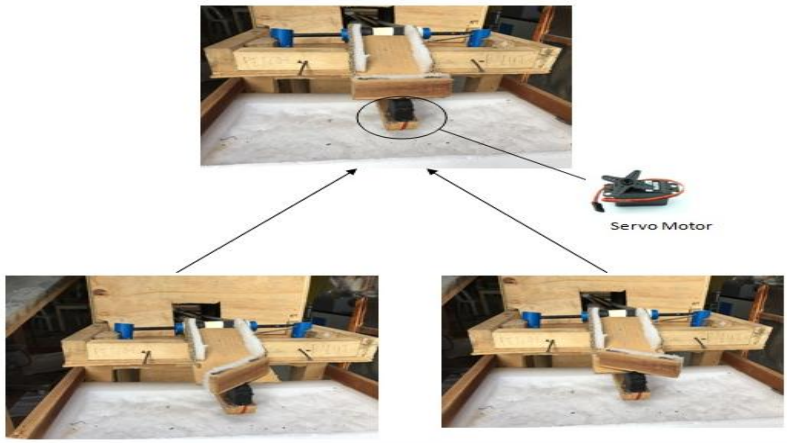


Fig. 3. Development on segregating duck eggs




```
void loop() {
 // Serial.println( analogRead(LDRPin));
  OngreaServo.write(180);
    int LDR = analogRead(LDRPin);
 Serial.print(LDR);
 Serial.println();
//BALUT
if(LDR == 350 || LDR == 349 || LDR == 348 || LDR == 347 || LDR == 335 || LDR == 345 || LDR == 342 || LDR == 341
{
 OngreaServo.write(120);
 delay(35000);
  //OngreaServo.write(180);
}
//PENOY
else if (LDR == 434 || LDR == 436 || LDR == 438 || LDR == 439 || LDR == 441 || LDR == 443 || LDR == 440)
{
 OngreaServo.write(240);
delay(35000);
 // OngreaServo.write(180);
  }
```

Fig. 4. Interfaces segregating duck eggs

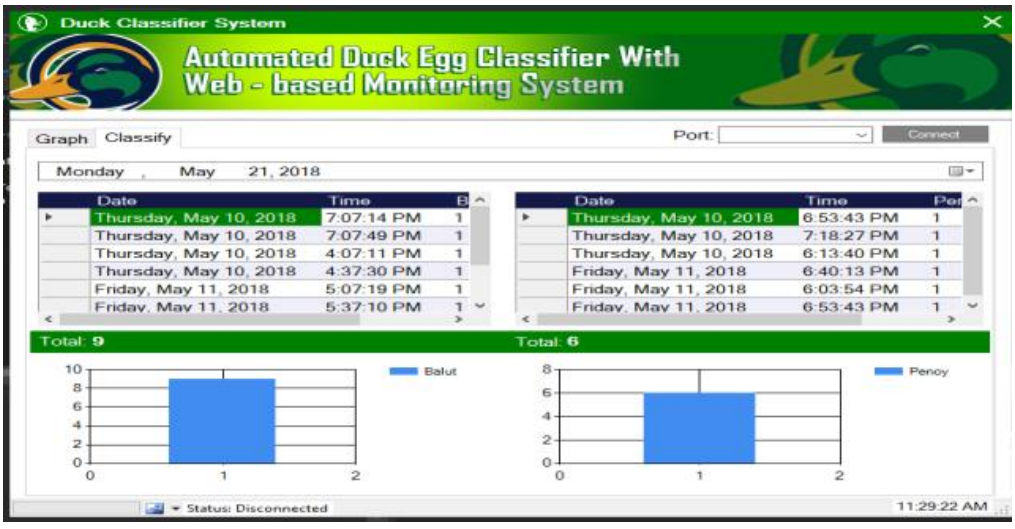


Fig. 5. Interfaces of the monitoring system (Tabular)

4.2.2 Development of the monitoring system (Graphical)

The real-time monitoring system showed the graphical representation of classified duck eggs from its real-time data where the date, time and numeric light resistance of the eggs were shown. This helped the user/admin see the graphical representation of classifying the duck eggs.

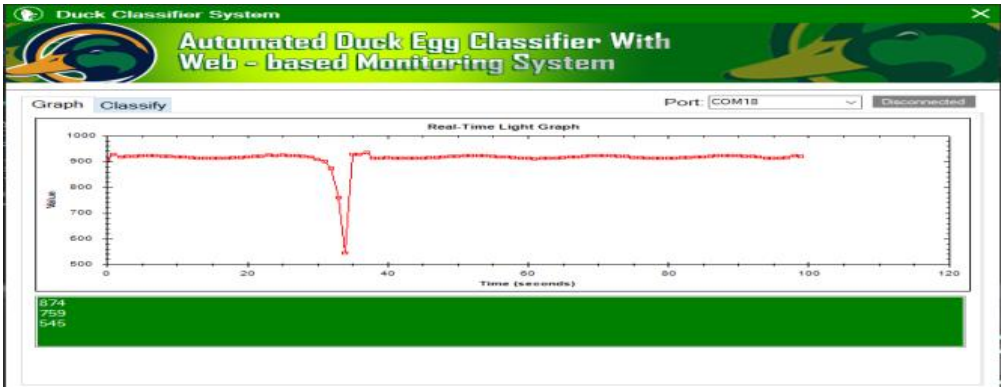


Fig. 6. Interfaces of monitoring system (Graphical)

4.3 Descriptive Ratings of Functionality, Reliability, Usability, Efficiency, Maintainability and Portability of Automated Duck Egg Classifier with Web-Based Monitoring System, April 2018

The descriptive evaluation of the developed system is illustrated in this part of the study which uses the evaluation tool used in the study of Sobejana in the testing the functionality, reliability, usability, efficiency, maintainability and portability of the system [11].

4.4 Functionality

It shows the evaluation of the functionality of project Automated Duck Egg Classifier with Web-Based Monitoring System. According to the results, the monitoring systems displays the number of classified eggs with a weighed mean of 4.5, the project automatically classifies the duck eggs through the use of sensor with a weighed mean of 4.6 and that the project automatically segregates the duck eggs according to its classification area with the use of servo motor with a weighted mean of 4.5. Overall, the rating of the functionality of the project has a consolidated mean of 4.5 which means “Excellent”.

4.5 Reliability

According to the results of the evaluation in regards with the reliability of the project, most errors have been corrected overtime with a weighed mean of 4.4, The project is capable of maintaining its performance despite the presence of errors when used with a weighed mean of 4.2 and that the project resumes working after failure with a weighed mean of 4.2. Overall, the rating of the reliability of the project has a consolidated mean of 4.2 which means “Very Good”.

4.6 Usability

It shows the evaluation of the usability of the project. According to the results, the information generated by the project is easy to understand with a weighed mean of 4.2 and that the project straightforwardly performs tasks with a weighted mean of 4.3 again. Overall, the rating of the usability of the project has a consolidated mean of 4.2 which means “Very Good”.

4.7 Efficiency

It shows the evaluation of the efficiency of the project. According to the results, the project responds immediately when used with a weighed mean of 4.2 and that the project maximizes the utilization of available resources such as people, data and materials with a weighed mean of 4.3. Overall, the rating of the efficiency of the project has a consolidated mean of 4.2 which means “Very Good”.

4.8 Maintainability

It shows the evaluation of the maintainability of the project. According to the result, the project is easily tested with a weighed and a consolidated mean of 4.3 which means “Very Good”.

4.9 Portability

Table 6 shows the evaluation of the portability of the project. According to the results, the project performs its functions even it is moved to another environment with a weighed mean of 4.3 and that

the project can easily be installed with a weighed mean of 4.3. Overall, the rating of the portability of the project has a consolidated mean of 4.3 which means "Very Good".

Table 1. Descriptive ratings of functionality of the automated duck egg classifier with web-based monitoring system, May 2018

Particulars	Mean	Description
Monitoring system displays the number of classified duck eggs.	4.5	Excellent
Automatically classifies the duck eggs through the use of sensor.	4.6	Excellent
Automatically segregates the duck eggs according to its classification area	4.5	Excellent
Consolidated mean	**4.5**	**Excellent**

Table 2. Descriptive ratings of the reliability of automated duck egg classifier with web-based monitoring system, May 2018

Particulars	Mean	Description
Most errors have been corrected overtime.	4.4	Very good
Capable of maintaining its performance despite the presence of errors when used.	4.2	Very good
The project resumes working after failures.	4.2	Very good
Consolidated mean	**4.2**	**Very good**

Table 3. Descriptive ratings of usability of automated duck egg classifier with web-based monitoring system, May 2018

Particulars	Mean	Description
Information generated is easy to understand.	4.2	Very good
Performs tasks in a straight-forward manner.	4.3	Very good
Consolidated mean	**4.2**	**Very good**

Table 4. Descriptive ratings of efficiency of automated duck egg classifier with web based monitoring system, May 2018

Particulars	Mean	Description
Project responds immediately when used.	4.2	Very good
Maximizes the utilization of available resources	4.3	Very good
Consolidated mean	**4.2**	**Very good**

Table 5. Descriptive ratings of maintainability of automated duck egg classifier with web based monitoring system, April 2018

Particulars	Mean	Description
Project is easily tested.	4.3	Very good
Consolidated mean	**4.3**	**Very good**

Table 6. Descriptive ratings of portability of automated duck egg classifier with web based monitoring system, April 2018

Particulars	Mean	Description
Performs its functions to another environment.	4.3	Very good
Project easily be installed.	4.3	Very good
Consolidated mean	**4.3**	**Very good**

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The project entitled Automated Duck Egg Classifier with Web Based Monitoring System was designed to help the balut producers industry. The capstone project met all the objectives of the study where it automatically classify the duck egg through the use of LDR sensor in which it detect and calculate the light resistance that the egg produces during candling process, segregate the duck eggs according to its classification area, and the monitoring system displayed the number of classified eggs.

The problems encountered by the users were determined to the frequency it occurs upon use. Most errors were due to slow speed of the synchronous motor use for the conveyor. On the other hand, evaluators had also given recommendations. These problems and recommendations recorded during the testing help the projects future development.

5.2 Conclusion

It was concluded that the designed project Automated Duck Egg Classifier with Web Based Monitoring System, succeeded during the testing. Most of the twenty-five (25) respondents agreed that the project met all the objectives stated.

The functionality, reliability, usability, efficiency, maintainability and portability of the project were evaluated. The functionality of the project had the consolidated mean of 4.5 which means “Excellent”. The reliability of the project had the consolidated mean of 4.2 which means “Very Good”. The usability of the project had the consolidated mean of 4.2 which means “Very Good”. The maintainability of the project had the consolidated mean of 4.3 which means “Very Good”. The efficiency of the system had the consolidated mean of 4.2 which means “Very Good”. The portability of the system had the consolidated mean of 4.3 which means “Very Good”. Therefore, the users declared the overall result based on the evaluation of the project that it was successfully passed with the project’s satisfactorily performance with a consolidated mean of 4.2 which means “Very Good”.

During the testing of the project, there were problems encountered such as that the egg must be automatically putted to the conveyor with egg holder for the transporting it to the box for classification instead it was putted manually and the speed of the motor that was used is not in a high speed rotation in running the conveyor.

5.3 Recommendation

The very positive response from the evaluators does not mean that system was flawless, but an improvement on future developments was not limited. The testing did not only improve the functionality, reliability, usability, portability, efficiency and maintainability of the system but also generate recommendations were as follows:

1. The egg must be put to the conveyor with egg holder automatically.
2. The motor that should be used for the conveyor should have a 10 watts or above so that it will rotate the conveyor in a high speed.
3. Improve the monitoring system of this project; it should be displayed in a webpage.
4. The creation of the prototype should also be improved. It must be nice if the prototype is design with the use of metal.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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