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Bangus (Chanos Chanos) Fry Counter

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Abstract: ***Agriculture has a key role in the Philippines economy, particularly the fisheries industry, which contributes 15% of the country's overall income. The sector offers significant employment and income for various parts of population, contributes to export earnings, and meets a large portion of the population's nutritional protein requirements. In terms of employment, the fisheries sector employs over one million people, or about 5% of the nation. The general objective of the study is to develop a portable bangus fry counter for the University of Antique – Hamtic Campus, Hamtic, Antique, and an affordable fry counter for the local fish fry vendor, fish pond owner and others that can benefit in this thesis. The researchers used the Arduino for the operating system and the light censor for the input and the LCD for the output. For the data gathering, the researchers used the ISO 25010 characteristic, the weighted mean formula to solve the mean and the Likert scale. The prototype showed excellent performance in terms of counting the bangus fry quantities. Based on the results of the evaluation, the participants strongly agreed with the functionality, reliability, portability, maintainability, security, compatibility, performance efficiency and usability of the device.***

Keywords: Fry Counter, Bangus, Chanos Chanos,

I. INTRODUCTION

Aquaculture is a major source of income and food, particularly in developing countries, Milkfish, tilapia, shrimp, seaweed, oyster, mussel and carp are common, aquaculture species [1]. Because of their excellent nutritional content, aquatic products are becoming increasingly popular. Many recent breakthroughs in aquaculture technology have resulted in major improvements in aquaculture operations, leading to creation of new techniques, especially in intensive aquaculture and aquaculture systems in natural waters. Lack of technology, on the other hand, will have an impact on the future expansion of the Philippine aquaculture in various areas. The stocking of fry is the first step in fish farming as part of aquaculture. In aquaculture, counting milkfish fry is a regular difficulty [2]. The majority of farmers count their fish using manual method, which is time consuming and prone to errors. Aquarists who use a milkfish fry counting system, on the other hand, may count their fish with significantly better accuracy and speed.

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Milkfish fry counting systems are sophisticated computerized system that leverage developments in sensors technology to automatically detect and count the fry without the use of human hands. Object counting in aquaculture is an important task, and has been widely applied in fish population estimation, estimation of lobster abundance and scallop stocks, and so forth. However, underwater object counting is challenging for biologists and marine scientists because of the diversity of backgrounds of the lake or ocean, the uncertainty of the object motion, and the occlusion between objects [3].
At present, there are three ways to count a fish in the aquaculture industry. The first is an auditory method using an acoustic camera. In this method, the image resolution deteriorates, and thus it is not appropriate for the task of counting many individual fish in aquaculture farming. The second, is checking for the electric potential alteration by placing an electrode under water, called a fish counter. It has been used to estimate the regression rate of Atlantic salmon (Salmo salar) in Western countries. It is said that in Japan, some researchers have also tried to verify this method. For implementing this technique, it is necessary to position the sensor in a specific fishway to detect the fish. This makes it difficult to count the number of individuals in general farm cages. The third is video analysis. There are also some techniques that use image processing to extract the foreground, and then applying a machine learning algorithm like a neural network to identify each individual fish [4].
With the overview and popularization of the concept of marine ranching, the offshore aquaculture industry has developed rapidly in recent years. The precise counting of the fish stocks provides the basis for the effective management of scientific feeding, sale, transportation, and breeding density control. The traditional counting method uses containers like net bag to sample, which brings lots of disadvantages like low efficiency, limited artificial experience and so on [5].
Fish counting is an open problem in a real environment and it is a priority necessity in aquaculture farming, where the fish count must be performed quickly and reliably for marine species in the process of growth and in some stages of production. On the one hand, knowing the amount of species under cultivation helps to provide the optimum conditions during the cultivation environment, thus guaranteeing the health and growth of the species and the proper inventory of the developed production at the established ranges [6]. Also, the calculation of catfish seeds is done conventionally, by sorting the size of seed catfish using a tub hollow then manually calculate the number of seeds [7].
It is in this notion, that the researchers were much eager to conduct such and to test the feasibility and efficiency of the fry counter.

II. RESEARCH OBJECTIVES:

General Objective:

The general objective of the study was to develop a portable bangus fry counter for the University of Antique – Hamtic Campus, Hamtic, Antique.

Specific Objectives:

Specifically, this study sought to:

1. implement a low-cost and portable bangus fry counting machine that can precisely and automatically count large number of bangus fry;
2. develop a bangus fry counter system using the Arduino microcontroller as the operating platform, and
3. test the quality of the developed system characteristics using ISO 25010 standards.

III. METHODOLOGY

A. Research Design

The researchers applied the developmental research methodologies to achieve the study's goal. This is a fact-finding procedure that comprises a thorough and accurate review of data and findings. The research was broken down into multiple iterative phases: analysis, design, development, implementation, and assessment. The results of a descriptive survey were used as a foundation for impact that might help solve practical problems.

B. Participants of the Study

The research was conducted at the University of Antique – Hamtic Campus, Guintas, Hamtic, Antique. In order to test the device's accuracy rate and efficiency, the researchers distributed to randomly selected 35 participants composed of BS Computer Science and BS Agriculture faculty and staff, students, and fishermen from Guintas, Hamtic, Antique.

C. Data Gathering Instruments and Techniques

The ISO 25010 evaluation questionnaires were used as the primary tool to collect data. The questionnaire consists of a sequence of questions based on the ISO 25010 characteristics.

D. Preparation of Instruments

The data collection was the most important aspect of this investigation. In order to develop the study's concept and data, the researchers prepared structured questions based on the characteristics of ISO 25010 on the instruments.

a. Validation of Instruments

The ISO standard questionnaire was used in the study.

b. Data Gathering Procedure

During the data collection, the researchers individually gave the questionnaire to the participants. First, the researchers distributed the questionnaire to the 35 randomly elected participants. Next, the questionnaires were gathered successfully. Finally, the researchers started to interpret the results out of the collected questionnaires.

c. Statistical Tools

Weighted mean-formula

The weighted mean for each item was calculated by multiplying the scale value of responses and dividing them by the total number of responses to get the weighted mean for each item. The central tendency is measured by the mean. It indicates where the majority of the responses to a question cluster.

Where:

$$x = \frac{\Sigma fx}{n}$$

X = Weighted Mean

F = Frequency

X = Scores

n = Total number of participants

Σ = Summation symbol

d. Likert Scale

The researchers used the Likert's Scale method to evaluate the weighted Mean (WM) using the following interval meanings. For the suggested Bangus Fry Counter, this 5-point scale was utilized to calculate the rank or adjectival description of the weighted mean of the responses. For each rating, the fields represent the rating, range, and adjectival description. These ratings are:

Table 1. Likert Scale with Range

Interpretation	Value	Range
Poor	1	1.00 - 1.79
Fair	2	1.80 - 2.59
Good	3	2.60 – 3.39
Very Good	4	3.40 – 4.19
Excellent	5	4.20 – 5.00

Table 1 shows the Likert Scale of the weighted mean. The weighted is categorized in five weighted points. The range for the 5-piont scale is shown in the table.

E. Ranking

This was used to get the rank average for each answer's choice and determine whichever is the highest and lowest rank based on the results.

a. Context Diagram

The Diagram that was used is shown below.

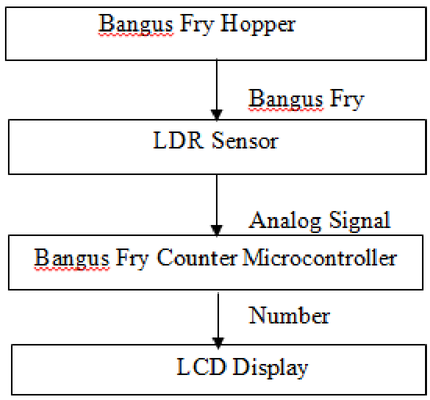

Figure 1. Context Diagram of Bangus Fry Counter

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F. Data Flow Diagram

The graphical representation of the flow of the data that was used.

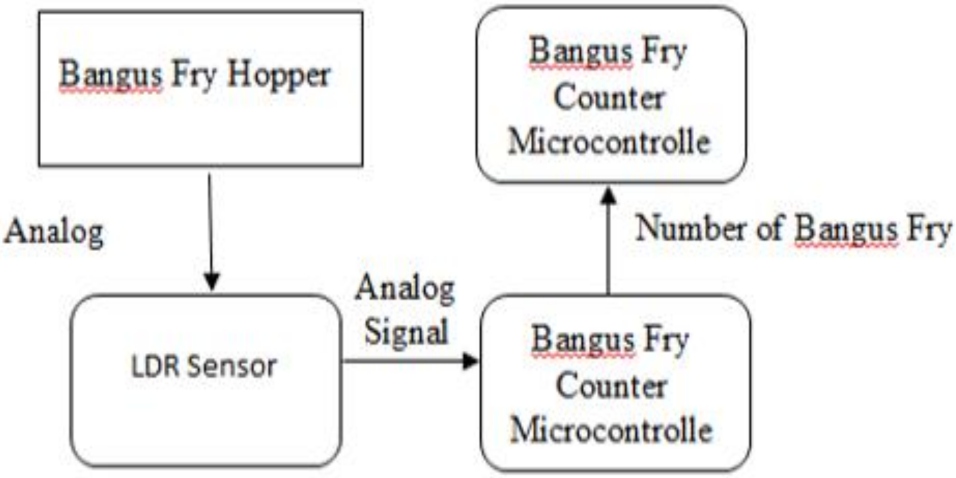

Figure 2. Data Flow Diagram of Bangus Fry Counter

G. Use case Diagram

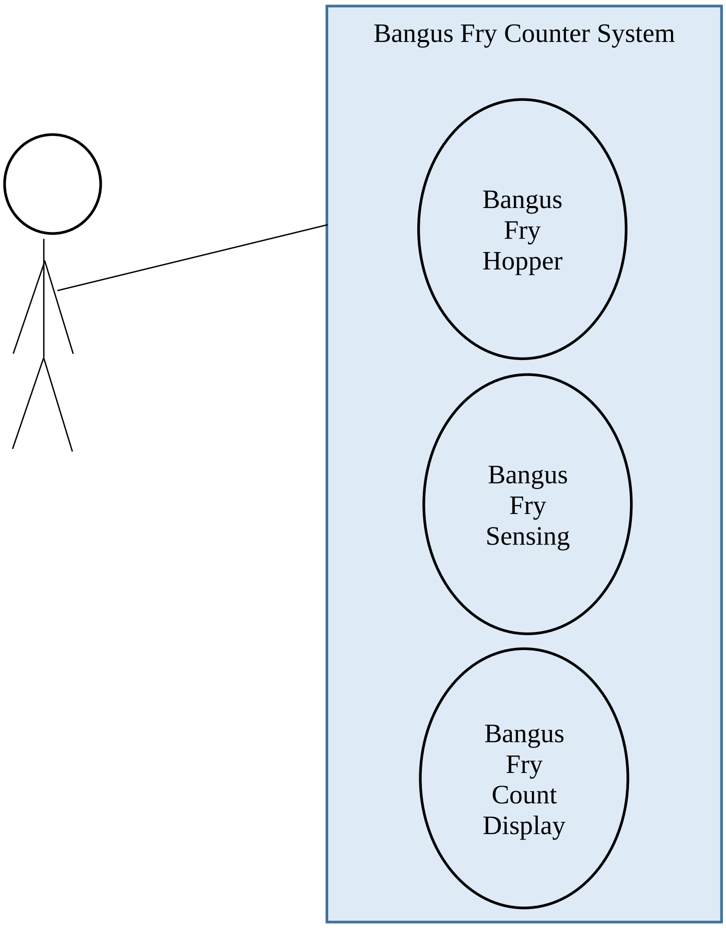

Figure 3. Use Case Diagram of the Fry Counter

The figure below shows the process of Rapid Application Development; (1) Requirements Planning, (2) User Design, (3) Construction, and (4) Cutover

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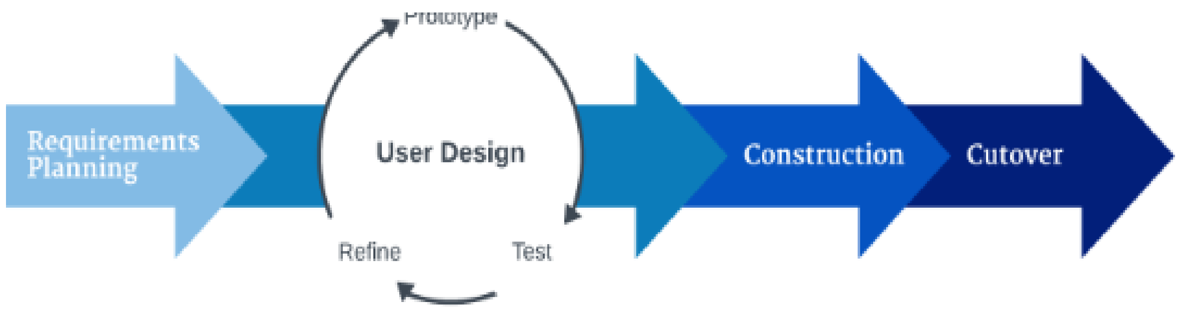

https://kissflow.com/application-development/rad/features-of-rapid-application-development-software/

Figure 4. RAD (Rapid Application Development) Model

Rapid Application Development 9RAD) is a team-based technique for accelerating the development of information systems and producing a working system. Like Joint Application Development (JAD), RAD takes a collective approach but takes it a step further. While JAD's final outcome is a requirement model. RAD's final product is a new information system. RAD is a full approach with four phases that correspond to the Systems Development Life Cycle (SDLC) phases. Companies utilize RAD to minimize development costs and time while increasing the likelihood of success.

IV. RESULTS AND DISCUSSION

The researchers used the Rapid Application Development (RAD) model for the development of a system that requires a highly interactive or complex user interface because of its complete methodology that relies on prototyping and user involvement in every phase, which help reduce the cost and development time while increasing the likelihood of success.

Table 2. Mean Distribution of functional suitability of the Bangus (Chanos Chanos) Fry Counter

Functional suitability	Mean	Std. Deviation	Range
Completeness	4.51	0.50	Excellent
Correctness	4.43	0.55	Excellent
Appropriateness	4.49	0.60	Excellent

Note: Mean is described as follows: 5.0-4.20 Excellent; 3.40-4.19 Very Good: 2.60-3.39 Good; 1.80.59 Fair; 1.00-1.79 Poor

Table 2 shows the mean distribution of functional suitability of the system based on the completeness, correctness and appropriateness. Based on the result, the participants of the study interpreted and described the functional suitability of the bangus (Chanos chanos) Fry Counter as "excellent" in terms of completeness, correctness with computed mean of 4.51 (SD=0.50), 4.43 (SD=0.5) and 4.9 (SD=0.60) respectively.

Table 3. Mean Distribution of Reliability of the Bangus (Chanos Chanos) Fry Counter

Reliability	Mean	Std. Deviation	Interpretation
Maturity	4.51	0.55	Excellent
Availability	4.49	0.60	Excellent
Fault Tolerance	4.46	0.60	Excellent
Recoverability	4.51	0.69	Excellent

Note: Mean is described as follows: 5.0-4.20 Excellent; 3.20-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Reflected in Table 3 is the mean distribution of reliability of the system based on maturity, availability, fault tolerance and recoverability. Based on the result, the participants of the study interpreted and described the Reliability of the Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of maturity, availability, fault and tolerance and recoverability with mean of 4.51 (SD=0.55), 4.49 (SD=0.60), 4.46 (SD=0.60) and 4.52 (SD=0.69).

Table 4. Mean Distribution of Portability of the Bangus (Chanos Chanos) Fry Counter

Portability	Mean	Std. Deviation	Description
Adaptability	4.46	0.69	Excellent
Durability	4.46	0.55	Excellent
Instability	4.49	0.60	Excellent
Replaceability	4.31	0.57	Excellent
Affordability	4.43	0.65	Excellent

Note: Mean is described as follows: 5.0-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Table 4 presents the mean distribution of portability of the system based on adaptability, durability, instability, replaceability and affordability. Based on the Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of adaptability, durability, instability, replaceability and affordability with mean of 4.46 (SD=0.69), 4.46 (SD=0.55), 4.49 (SD=0.60), 4.31 (SD=0.57) and 4.33 (SD=0.65) respectively.

Table 5. Mean Distribution of Usability of the Bangus (Chanos Chanos) Fry Counter

Usability	Mean	Std. Deviation	Description
Appropriateness Recognizability	4.6	0.55	Excellent
Learnability	4.43	0.55	Excellent
Operability	4.49	0.60	Excellent
User Error Protection	4.4	0.64	Excellent
User Interaction Aesthetics	4.6	0.55	Excellent
Accessibility	4.51	0.65	Excellent

Note: Mean is described as follows: 5.0-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

The data in Table 5 show the mean distribution of usability of the system based on appropriateness recognizability, learnability, operability, user error protection, user interaction aesthetics and accessibility.

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Based on the result the participants of the study interpreted and described the Usability of Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of appropriateness recognizability, learnability, operability, user error protection, user interaction aesthetics and accessibility with mean of 4.6 (SD=0.55), 4.490 (SD=0.60), 4.4 (SD=0.64), 4.6 (SD=0.55), 4.51 (SD=0.65) respectively.

Table 6. Mean Distribution of Performance Efficiency of the Bangus (Chanos Chanos) Fry Counter

Performance Efficiency	Mean	Std. Deviation	Description
Time Behavior	4.51	0.55	Excellent
Resource Utilization	4.51	0.55	Excellent
Capacity	4.43	0.65	Excellent

Note: Mean is described as follows: 5.00-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Table 6 shows the mean distribution of performance efficiency of the system based on time-behavior, resource utilization and capacity. Based on the result, the participants of the study interpreted and described the Performance Efficiency of the Bangus (Chanos Chanos) Fry counter as "excellent" in terms of time behavior, resource utilization and capacity with the mean of 4.51 (SD=0.55), 4.51 (SD=0.55), and (SD=0.65) respectively.

Table 7. Mean Distribution of Security of the Bangus (Chanos Chanos) Fry Counter

Security	Mean	Std. Deviation	Description
Confidentially	4.54	0.55	Excellent
Integrity	4.49	0.65	Excellent
Non-repudiation	4.57	0.49	Excellent
Accountability	4.49	0.65	Excellent
Authenticity	4.49	0.55	Excellent

Note: Mean is described as follows: 5.00-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Table 7 shows the mean distribution of security of the system based on confidentially, integrity, non-repudiation, accountability and authenticity. Based on the result, the participants of the study interpreted and described the Security of the Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of confidentially, integrity, non-repudiation, accountability and authenticity with mean of 4.49 (SD=0.65), 4. 57 (SD=0.49), 4.49 (SD=0.65), and 4.49 (SD=0.55) respectively.

Table 8. Mean Distribution of Compatibility of the Bangus (Chanos Chanos) Fry Counter

Compatibility	Mean	Std. Deviation	Description
Co-existence	4.51	0.55	Excellent
Interoperability	4.37	0.64	Excellent

Note: Mean is described as follows: 5.00-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Table 8 shows the mean distribution of compatibility of the system based on co-existence and interoperability. Based on the result of the participants of the study interpreted and described the Compatibility of the Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of co-existence and interoperability with mean of 4. 51 (SD=0.55), and 4.37 (SD=0.64) respectively.

Table 9. Mean Distribution of Maintainability of the Bangus (Chanos Chanos) Fry Counter

Maintainability	Mean	Std. Deviation	Description
Modularity	4.63	0.48	Excellent
Reusability	4.43	0.69	Excellent
Analyzability	4.63	0.48	Excellent
Modifiability	4.49	0.70	Excellent
Testability	4.54	0.60	Excellent

Note: Mean is described as follows: 5.00-4.20 Excellent; 3.40-4.19 Very Good; 2.60-3.39 Good; 1.80-2.59 Fair; 1.00-1.79 Poor

Table 9 shows the mean distribution of maintainability of the system based on modularity, reusability, analyzability, modifiability and testability. Based on the result, the participants of the study interpreted and described the Maintainability of the Bangus (Chanos Chanos) Fry Counter as "excellent" in terms of modularity, reusability, analyzability, modifiability and testability with mean of 4.63 (SD=0.48), 4.43 (SD=0.69), 4.63 (SD=0.48), 4.49 (SD=0.70), and 4.54 (SD=0.60) respectively.

V. SUMMARY AND CONCLUSIONS

A. Summary

Developing a portable Bangus Fry Counter for the University of Antique-Hamtic Campus was the main objective of the study. The university and the students can benefit it by having an access to a low cost bangus fry counting device that can be utilized in laboratory activities. To achieve those objectives, the researchers had gathered relevant data through interviews with the personnel, faculty and students of the University of Antique-Hamtic Campus, as well as from new online articles and current devices that were related to the device. Survey forms were also distributed and collected from the participants after the initial development and final testing. The results were accumulated which were found on tables presented, and it was proven that the researchers' objectives were met.

VI. CONCLUSIONS

After the thorough analysis and evaluation of the gathered data from the participants through the initial testing and their evaluation, the researchers came up with the following conclusions: The prototype showed excellent performance in terms of counting fry quantities. Based on the evaluation results, the participants strongly agreed with the functionality, reliability, portability, maintainability, security, compatibility, performance efficiency, and usability of the device. It was also determined that bangus fry counter, which was designed with low-cost and easily accessible technology, can be manufactured and used to lower the margin of error in experiments that required large-scale human counts of bangus fry, thereby optimizing the process.

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Availability of Data and Material/ Data Access Statement	Not relevant.
Authors Contributions	All authors having equal contribution for this article.

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Mr. Glenn J. Frencillo, hails from Lanag, Hamtic, Antique. He finished his Bachelor of Science in Computer Science at the University of Antique, main Campus, Sibalom, Antique. Very much eager to widen his horizon in the field of computer education he enrolled his Master of Science in Computer Science (MSCS) at Iloilo School of Arts and Trade-University (ISAT U), Iloilo City. Presently, he is the MIS Coordinator of the University of Antique-Hamtic Campus, Guintas, Hamtic, Antique. Presently, he is connected with the College of Computer Studies of the University of Antique-Hamtic Campus, Guintas, Hamtic, Antique. glenn.frencillo@antiquespride.edu.ph