Asia-Pacific Research Digest
Volume 01, Number 01, 2025 pp. 10-22
P-ISSN: XXXX-XXXX E-ISSN: XXXX-XXXX
Open Access:

Automated Salted Egg Production An Arduino-Based System for Optimized Salting and Temperature Control

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ARTICLE INFO

Article history:
Received: August 8, 2025
Revised: August 8, 2025
Accepted : August 8, 2025
Available online

Kata Kunci:

Keywords:
Arduino, Salted Egg, Fermentation

ABSTRACT

One of the most popular and traditional preserved egg products in oriental countries is the salted egg (Gao et.al, 2013). This product is traditionally made by brining the whole eggs in saturated saline or by coating the eggs with soil paste mixed with salt (Su, et.al, 2021). The process of producing salted egg takes a very long time, according to Wang et.al (2013), it usually takes twenty (during dry season) to forty (during wet season) days to make salted egg. According to Ginanjar, 2021, duck egg is better compared to hen eggs in the production of salted eggs based on their characteristics. There are two methods in producing salted egg; coating and immersing which affects the characteristic of salted egg white and yolk after cooking. Desirable cooked salted egg having the red yolk with hardness and high oil exudation could be obtained when salting was carried out for 3 and 4 week for immersing and coating method, respectively (Thammarat, 2011).

1. INTRODUCTION

Salted duck eggs is also known as 'itlog na maalat' in the Philippines is one among of the features on every Filipino dining table especially during breakfast. The salted egg can be eaten with mixed in salad style with diced tomatoes and onions, it can also be eaten alone or with steamed rice (pinoybisnes.com, 2022). A study of Ganesan et.al. , 2014 compared the nutritional value of fresh and salted duck egg shows that the fresh duck egg contains a range of 9.30-11.80% of protein, 11.40-13.52% of fat, 1.50-1.74% of sugar and 1.10-1.17% of ash whereas the salted duck egg contains 14% of protein, 16.6% of fat, 4.1% of carbohydrate and 7.5% of ash. Proteins, lipids, and ash contents are found to be greatly enhanced during the pickling and salting process of salted duck eggs.

In 2018, SAAD (Special Area for Agricultural Development) Program implemented the Mallard Duck Production and Swine Production Projects. Forty–one individual farmers from Brgy. Cagbonga, Borongan City were validated and selected as project recipients. Twenty–one farmers became recipients of the Swine Production Project, while the remaining twenty received a package of the Mallard Duck Production Project. The beneficiaries formed a registered association with the Department of labor and Employment as Cagbonga Backyard Swine and Duck Breeders Association (CBSDBA) on February 2019 (DA, 2022). According to Ms. Marlyn D. Gordora, Area Coordinator II, PPMSO–Eastern Samar, the organization will soon be engaging in value-adding schemes such as sales of meat products, to benefit both the members and community by involving them in project implementation.

This study focused on developing an Arduino microcontroller based salted egg production device that can be used by the CBSDBA members in expanding the schemes offered by the organization. The researchers used different Arduino microcontroller modules such as PTC heater Plate, Stepper Motor, Real Time Clock (RTC) and Thermocouple Sensor to control the salinity of the water during salting process of duck eggs. The advantages of this controller include simple and

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convenient development environment, open source code of the program and Arduino-based device projects that can work independently or interact with computer software (Ivanchenko, 2018). A questionnaire adopted from IBM Computer System Usability for Quality Metrics Evaluation was used in evaluating the developed device.

Objectives:

1. Design and develop an Arduino microcontroller-based device that can be used in producing salted egg.
2. Control and monitor the temperature of the device during salting procedure.
3. Conduct an evaluation of the developed device using the System Usability Scale.

2. METHOD

3.

A. Salted Egg Production Device

A schematic diagram of the device is shown in Fig 1. It depicts how the sensors, and other modules are attached in the microcontroller. Each module is assigned to Analog and Digital pins or the Arduino microcontroller to perform different tasks. As shown in Fig 2, Fig 3, Fig 4 and Fig 5, the researchers also developed an initial design before developing the actual device.

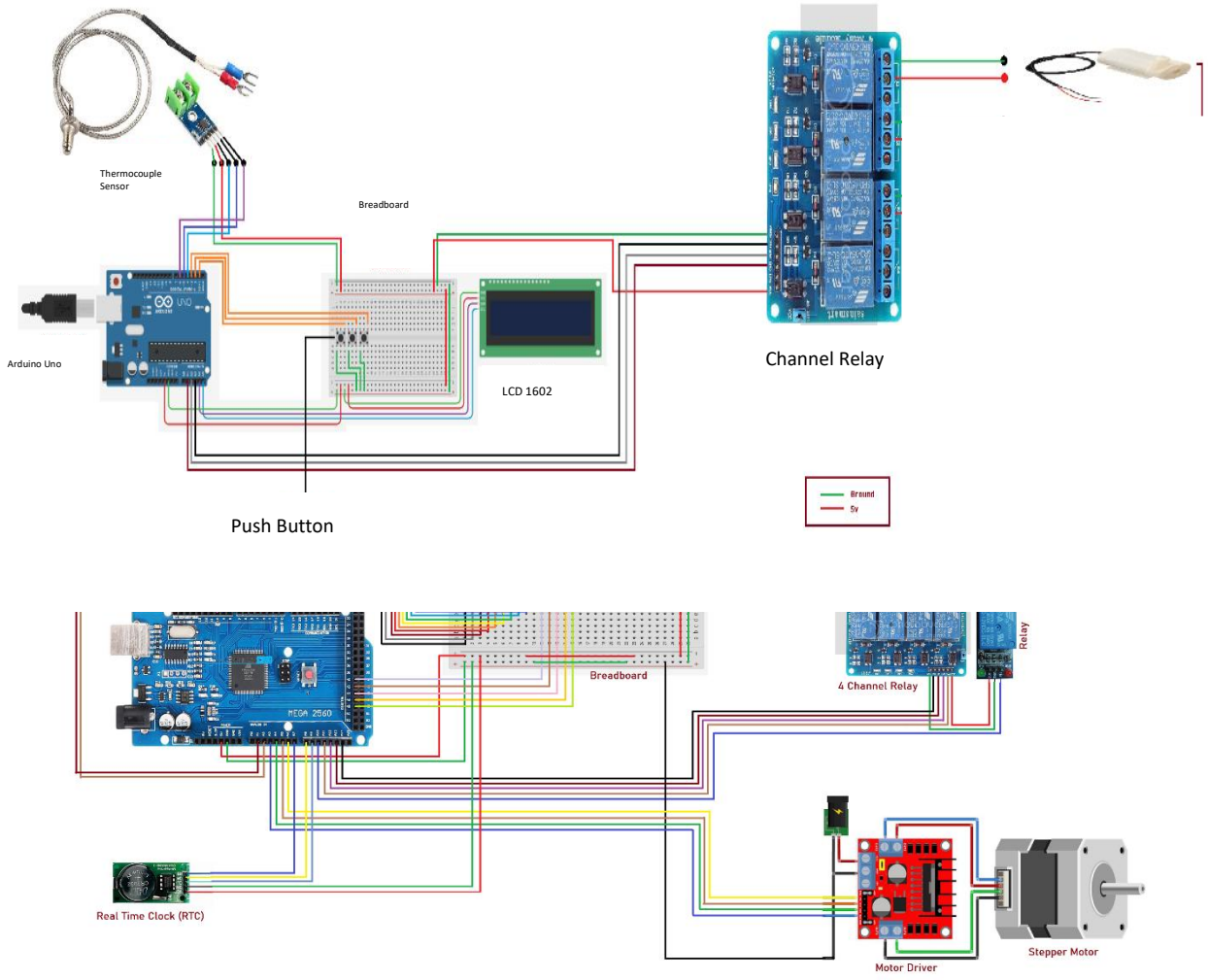
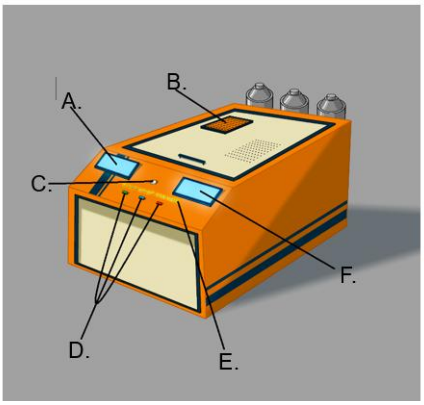


Fig 1. Schematic Diagram

- **Breadboard.** It helps on connections of the pins and circuits in to the device
- Arduino Uno. This reads the code inputs of all components used in the device.

- **12V charger.** Primary power source of the device which power up the 12V fan and stepper motor, and Arduino.
- **220V plug.** Primary source of our PTC heater plate element to boiled a water.
- **2x 16X2 LCD.** Monitor the measured temperature while fermenting the salted egg and display the current date and time.
- **15X LED.** Indicating the Number of days in fermentation the egg.
- **PTC heater Plate.** A heater with a positive temperature coefficient (PTC), often known as a self-regulating heater, has a resistance that rises dramatically with temperature.
- **Stepper Motor.** To lift the screen when the fermenting process is done
- **Real Time Clock (RTC)**. It is an electronic component that measures date and time.
- **8 Channel Relay.** It helps to control the PTC Heater element and water pump.
- **5V Water Pump.** Suction method which drain the water through its inlet and released it through the outlet.
- **Thermocouple Sensor**. A sensor to measure the temperature while fermenting the salted egg
- **12V Fan**. It helps to control the temperature inside the device.



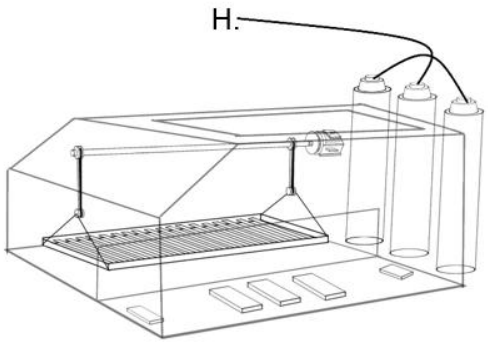
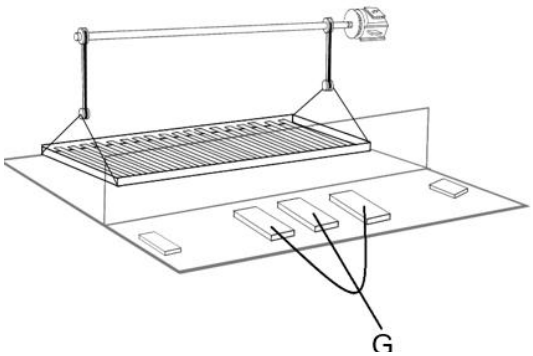


Fig 4



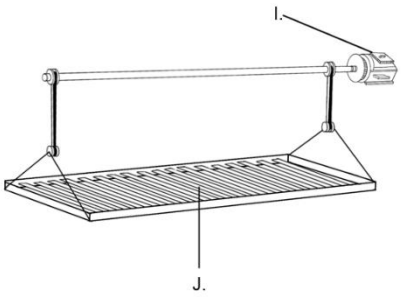


Fig 5

Legend:

A. LCD 1 – Displaying the temperature in fermenting the salted egg.

B. Fan – Controlling the heat temperature inside the box.
C. Start Button – To start the all components of the device.
D. Flavoring Buttons – To choose what flavor you desire in fermenting in salted egg.
E. 15x LED – Represent the number of days in fermenting of salted egg.
F. LCD 2 – Displaying the current date and time.
G. 5x Heater – To boiled and cook the salted egg.
H. Tank – The storage of fermenting solution of salted egg.
I. Stepper motor – To lift the screen if the fermenting is done.
J. Screen – To hold the egg for soaking.

Evaluators

The respondents of the study will consist of **twenty (20) personnel** from the **Cagbonga Backyard Swine and Duck Breeders Association (CBSDBA).** These evaluators will assess the **usability, functionality, and effectiveness** of the developed **Arduino microcontroller-based salted egg production device.**

Evaluation

The developed hardware will be evaluated using the **System Usability Scale (SUS)**, a standardized tool for measuring **system usability and user experience.** The SUS questionnaire consists of **ten items** rated on a **5-point Likert scale**, which helps determine the system's **ease of use, efficiency, and overall satisfaction.**

Research Instruments

The system was evaluated using the System Usability Scale. The SUS is described as "a straightforward, ten-question scale that provides an overall perspective on subjective usability assessments". Each question offers five response options, ranging from "strongly agree" to "strongly disagree." The SUS generates scores between 1 and 100, with 68 being regarded as the average score. These scores can be influenced by the complexity of both the system and the tasks users must complete before answering the SUS (Hinchliffe et.al, 2020).

Scoring

The System Usability Scale is a Likert scale consisting of 10 questions that device users will respond to. Research Respondents rate each statement on a scale of 1 to 5, where 5 indicates strong agreement with the statement and 1 signifies strong disagreement. Table 1 shows the scoring method for the System Usability Scale (SUS), which uses a Likert scale with 10 questions. Respondents rate each question on a scale from 1 to 5, reflecting their level of agreement with the statement. A score of 5 indicates "Strongly Agree," while a score of 1 indicates "Strongly Disagree." The table provided clarifies the qualitative descriptions corresponding to each score, ranging from strong agreement (5) to strong disagreement (1). This method is designed to quantify users' subjective assessments of a system's usability, providing a consistent way to measure user satisfaction of the website.

Table 1 METHOD OF SCORING

Rating Scale	**Qualitative Description**
5	Strongly Agree
4	Agree
3	Slightly Agree

2	Slightly Disagree
1	Strongly Disagree

Computation

Step 1: Convert the scale into numbers for each of the 10 questions:

Strongly Disagree: 1 point

Disagree: 2 points

Neutral: 3 points

Agree: 4 points

Strongly Agree: 5 points

Step 2: Calculate:

- X = Sum of the points for all odd-numbered questions − 5
- Y = 25 − Sum of the points for all even-numbered questions
- SUS Score = (X + Y) x 2.5

Interpretation

SUS score will be able to tell the website's usability performance in the aspects of effectiveness, efficiency, and overall ease of use. Although each response yields a score on a scale of 0–100. The interpretation is shown in Table 2.

Table 2 Survey Result Interpretation

SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68 – 80.3	B	Good
68	C	Okay
51 – 68	D	Poor
< 51	F	Awful

Retrieved from (https://uiuxtrend.com/measuring-system-usability-scale-sus/)

B. RESULT AND DISCUSSION

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Discussion

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C. CONCLUSION

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D. ACKNOWLEDGE

An acknowledgement of no more than 100 words should be included. Authors should declare the source of funding, if there is any. Conflict of interest must be stated, including assignment of copyright, and compliance to ethical standards).

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