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Development an Automatic Fish Drying Machine Using MEDP

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Abstract: Drying is one method of preserved using simple techniques, such as sun-drying. However, weather conditions are usually unpredictable, and this drying process will be hindered when the rainy season comes. As a result, dried fish will take longer to dry and will be produced with less efficiency. The development of complex machinery has made the drying process less challenging. Therefore, the aim of this study is to develop an automatic fish drying machine to assist in the solution of the dried fish problem. The Model Engineering Development Product (MEDP) utilized in the study contains five phases: identification of the problem, making possible solutions, prototype development design, modelling the best solution, refinement, and retesting the model. The sensor alerts the Arduino microcontroller when raindrops are found. The Arduino commands the motor to move the roof to keep dry fish from becoming wet. Overall, it was found that the automatic fish drying machine worked well and achieved the study's objective. However, the product needs to be improved to allow the fish to continue drying during rain.

Keywords: Drying fish, Engineering Design Process Model, Product Development

1. Introduction

Fish drying is one of the oldest methods of preserving fish, which has been used for centuries. The purpose of drying fish is to reduce the moisture content of the fish so that it can last longer without spoiling. In drying fish, sunlight and dry air are essential in aiding the drying process. In addition, the cleanliness of the drying area needs to be maintained to prevent contamination from animals or insects that can damage the quality of the fish. Strict supervision and protection from theft are also important to ensure the safety of dried fish.

The main issues in fish drying in Malaysia are the lack of suitable infrastructure and technology for fish drying and the influence of climate change that can affect the success of fish drying. In addition,

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the lack of access to good markets and marketing is also an issue that affects the sustainability of the fish drying industry in Malaysia (Azmi & Idris, (2016); Abdullah, Easa, & Jinap (2012)).

In addition, the issue of climate change can affect the success of drying fish in many ways. First, changes in temperature and humidity levels can affect the drying process, as excessive heat and humidity can cause damage or the growth of harmful bacteria in the fish (Rajeev, Mustafa & Raghavan (2014); Halim, Bakar & Baharuddin (2019). Additionally, changes in weather patterns such as erratic rain or strong winds can disrupt the drying process and cause damage to the fish. Furthermore, sea level rise and ocean acidification can also affect fish populations, affecting the availability and quality of fish for drying. These factors highlight the need for adaptation strategies and investment in more resilient and sustainable fish drying practices.

1.1 The purpose of drying dried fish

Drying is the broad term for the process of removing water by evaporation. Fish have a water content of 70–80% (Maktoof, 2020; Annathai, 2014). When fish is dried, germs and other microbes that could ruin the fish are prevented from growing. By reducing the moisture level as well, the environment is made unfavorable for the growth of these organisms, extending the fish's shelf life (Alahmad K, 2021).

Essential elements including proteins, omega-3 fatty acids, and vitamins are maintained in the fish during the drying process. Fish is typically preserved via drying, which has the added benefit of better nutritional values, as opposed to other procedures that could result in nutrient loss (Fitri, 2022). As a result, dried fish is an excellent source of nutrients, especially in areas where fresh fish may not always be available.

Drying fish is a practical method of preservation that has several benefits. The method gives flexibility in culinary applications, increases the shelf life of fish, maintains its nutritional content, makes storage and transit easier. By understanding the purpose and benefits of drying fish, communities can harness this traditional preservation technique to ensure food security, reduce waste, and make the most of available fish resources.

1.2 Traditional technique dried fish

The traditional method of preserving the oldest fish is to let the wind and sun dry them. The use of traditional methods is much cheaper and more effective in countries with hot climates. Usually, the drying work is done by fishermen and their families. The use of traditional methods in drying dried fish is still used by dried fish entrepreneurs, but there are also entrepreneurs who are choosing to use the latest technology so that they can commercialize dried fish products quickly and more widely. Study by Santoso et al, (2020) The simplest drying method is laying the fish, whole or split, directly on the ground or on a mat laid on the ground in the sun for one to three days. Fish dried in this manner are likely to be partially rancid, contaminated with fly larvae, and sand or dust infested. Small fish species that can be dried in a matter of hours, like anchovies, are most suited for this method.

During the evaporation process, the substance may undergo other modifications. Musa (2018) claims that two processes heat transfer and gasification, as well as the mechanism by which water is removed from the substance during drying are among the events that take place. The transfer of water vapor in mass from a material's surface to the air is the second process, and it is known as mass transfer. Heat transfer takes place because the material's temperature is lower than the temperature of the air surrounding it (Musa, 2018).

1.3 Objective of study

Thus, there are 2 main objectives of the study which are:

1. Develop a product that can prevent dry fish from getting wet in the rain.

2. Testing the functionality of the sensor module, LED, buzzer, and Arduino Uno can function properly in the rain

2. Methodology

Model Engineering Development Process (MEDP) or Design Model Development Process is a framework used to develop and manage models in design projects. The purpose of the MEDP is to ensure that the developed model meets the needs and objectives of the project, and can be properly tested, validated, and verified. MEDP includes 5 phases: identification of the problem, making possible solutions, prototype development, modeling the best solution, refinement and retesting the model.

2.1 Phase 1: Identification of The Problem

The first phase is to identify problems related to drying fish through past research and observation of existing products in the market. The problem identified by dried fish operators is the unpredictable weather, which causes the drying time of dried fish to be longer. Existing products on the market are suitable for large-scale use and are also expensive. Therefore, researchers have planned to develop an automatic fish drying machine that can protect fish when it rains suddenly.

2.2 Phase 2: Making Possible Solutions

Figure 1 is an idea sketch for the development of automated fish products. In this design, the researcher has changed from moving the Tray. The researcher moves the roof to cover the dry fish to prevent it from being exposed to rain. If the roof is moving, then the dry fish will be in a static state.

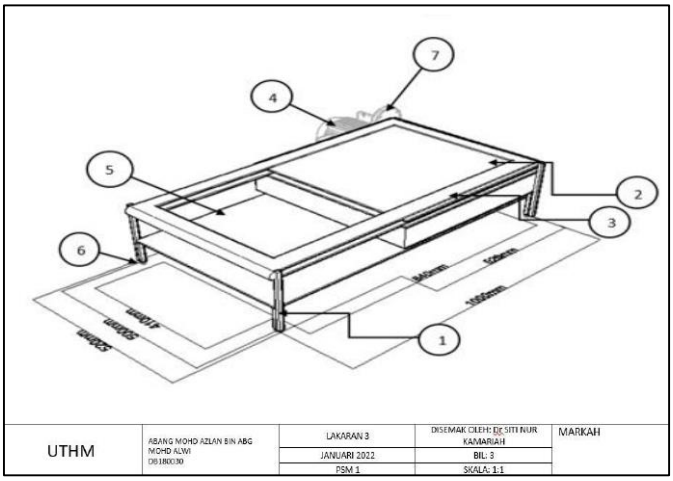

Figure 1: Product design sketch

Table 1 shows the list of components and materials needed to develop the product. B.O.M.

Table 1: Bill of Materials

Part List				
Item	Quantity	Material	Description	Size (cm)
1	5	Stainless steel	Square Tube	100 x 20 x 20
2	1	Perspek	Cover	60 x 0.5 x 60
3	1	Conveyor	Polythene	60 x 0.5 x 60
4	1	DC Motor	Electric Motor	-
5	1	Jaring	Polythene	60 x 0.5 x 60
6	6	Rolling Wheel	Higher Quality Plastic	-
7	2	Roller	Stainless Steel	-

2.3 Prototype Development

For the development of the dry fish drying rain sensor machine, angle bar is used as the frame of this product. The available wood will be made to make the place where the fish nets are placed where the fish drying will take place. The frame was chosen because it was light and suitable for moving tools

Figure 2: Final product

2.4 Phase 4: Test and Evaluate the Solution

To ensure that the model in the Model Engineering Development Process (EDP) works correctly and meets the needs and objectives of the project. To test and evaluate solutions in the Model Engineering Development Process (EDP), machine evaluation tests are performed to ensure that the product or solution produced meets the requirements and objectives set.

2.5 Phase 5: Deliver the Solution and Redesign

The Solution Delivering and Redesign phase is an important process in the Engineering Development Process (EDP) Model to prepare a new product or solution that has been validated and has good quality. The evaluation of three experts in the mechanical field was chosen to confirm the design, development, and functionality of the product. The results of suggestions and views given are taken for the improvement of the tool in the future.

3. Results and Discussion

In this section, there is feedback given by three experts while evaluating the entire prototype that has been developed. This analysis is also known as the evaluation phase because experts will evaluate the effectiveness of the prototype that has been developed from the following aspects:

a) System

b) Product design

c) Functionality.

3.1 System

In part A of the questionnaire, it is related to the Automatic Rain Sensor Drying Machine (Dry Fish) system that has been developed. The results of the feedback are shown in Table 1.

Table 1: Expert Analysis (System)

N	Items	Yes	No
	Is the system developed		
1.	Suitable for use?	100%	
2.	Meet user needs?	100%	
3.	Stable when powered on?	100%	
4.	Easy to handle?	100%	

As a result of the analysis that has been done, experts in electrical systems agree that the system used is appropriate because it is able to meet the needs of users. In addition, experts also agree that the developed dry fish drying system is stable as well as easy to operate.

3.2 Product Design

Part B of the questionnaire is about the design of the Automatic Rain Sensor Drying Machine (Dry Fish) that was developed. The results of the feedback are shown in Table 2.

Table 2: Expert Analysis (Product Design)

N	Items	Yes	No
1.	Is the size of the product developed appropriate?	100%	
2.	Selection of the right material?		100%
3.	Is the construction of the Automatic Rain Sensor Drying Machine (Dry Fish) Strong?	100%	

The results of the data show that all the experts agree that the product design for the Automatic Rain Sensor Drying Machine (Dried Fish) has an appropriate product size and a solid construction with a percentage value of 100%. However, experts agree that the selection of materials is not chosen accurately with a percentage of 100%. According to experts, the selection of materials for product design is not suitable for a long period of time.

3.3 Functionality and Testing

Part C in the questionnaire is about the functionality of the prototype Automatic Rain Sensor Drying Machine (Dried Fish). In this section there are three questions that the experts want to study and test. The results of the feedback are shown in Table 3.

Table 3: Expert Analysis (Functionality)

Bil	Item	Ya	Tidak
1.	Automatic Rain Sensor Drying Machine Control (Dry Fish) can work well.	100%	
2.	Rain sensor Automatic Rain Sensor Drying Machine (Dry Fish) works well.	100%	
3.	Arduino operation of Automatic Rain Sensor Drying Machine (Dry Fish) works well.	100%	

The results of the data show that all the experts agree that the Automatic Rain Sensor Drying Machine product (Dry Fish) can work well with a percentage value of 100%. Experts suggest to get more even drying is to improve the internal design of the machine.

The modules involved in the drying of dried fish underwent functional tests. When the circuit linked to the rain sensor module is accurate or faulty, the operation of the rain sensor is shown in Figure 3. What should happen when the rain sensor contacts water is depicted in Figure 4. The buzzer and LED lights turn on when the rain sensor module detects water. The signal will then be delivered to the Arduino Uno before being sent to Relay 1. The motor will spin anticlockwise if Relay 1 is engaged. The top cover will be moved indirectly by the motor to cover the fish that has to be dried.

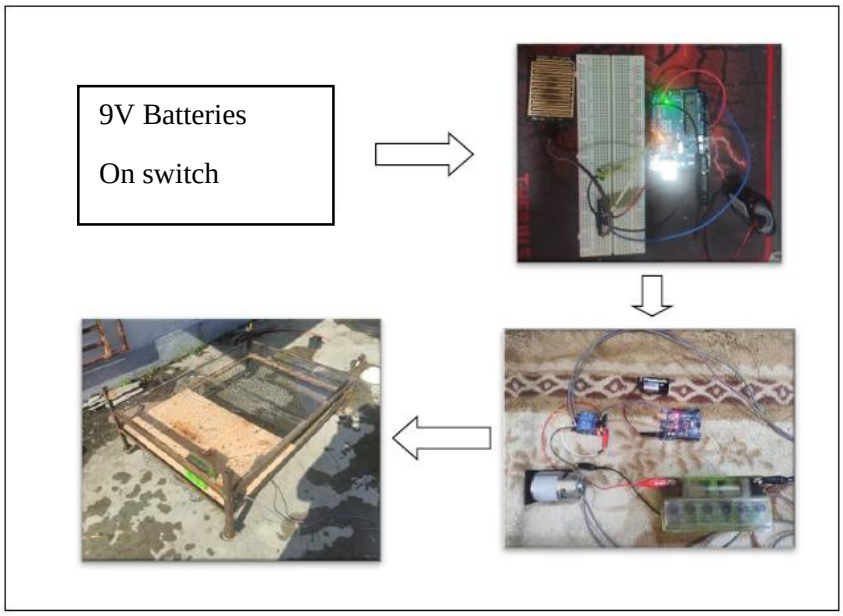

Figure 3: Operation of rain sensor

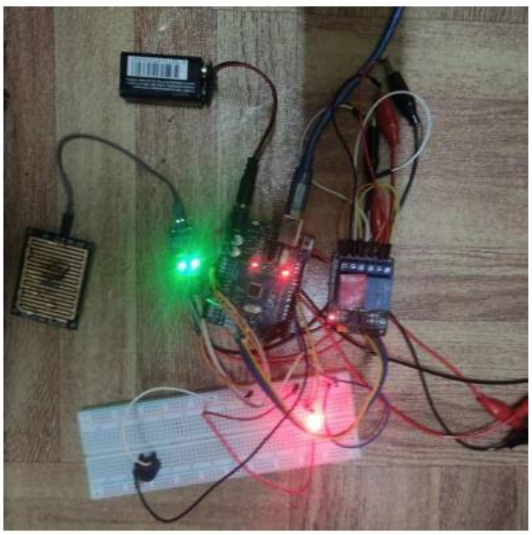

Figure 4: Rain sensor contact with water

Table 4: Testing for product functionality

Types	Testing									
	Day 1		Day 2		Day 3		Day 4		Day 5	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
LED	/		/		/		/		/	
Buzzer	/		/		/		/		/	
Arduino Relay 1	/		/		/		/		/	
Arduino Relay 2		/		/		/		/		/
Motor	/		/		/		/		/	

The sensor module, LED, buzzer, and Arduino Uno are tested for five days to make sure they can function properly. According to Table 4, the rain sensor module, LED, and buzzer can function properly because they show that when raindrops contact the sensor module, the LED illuminates, and the buzzer sounds.

To verify if relays 1 or 2 are rotating in the direction that the motor is moving to determine whether an Arduino Uno is functioning. According to Table 4, the motor rotated anticlockwise after five days of rain. This indicates that it is possible to indirectly assure that just Relay 1 operates without relying on Relay 2 for assistance. Overall, it demonstrates the ability of the sensor module, LED, buzzer, and Arduino Uno to function effectively, as well as the ability to protect the fish from the rain.

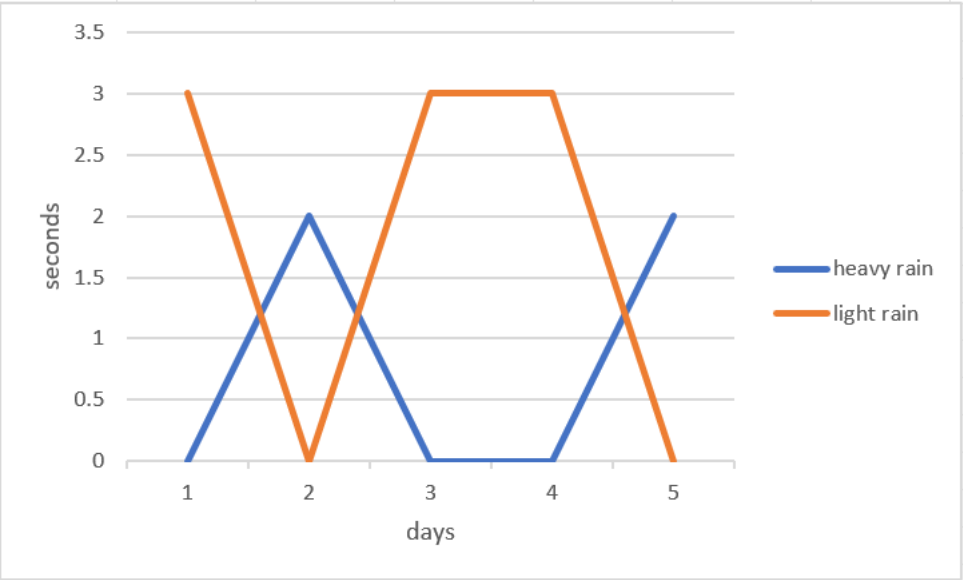

Figure 5: Time response rate against raindrops

Based on the data collected, it can be concluded that both light and heavy rain have an impact on how quickly the rain sensor moves the motor. Due to the huge raindrops, when it rains heavily, the rain sensor will be able to detect faster. The rain sensor will instantly transmit a signal to the Arduino Uno when its surface becomes heavily wet.

4. Conclusion

The EDP model is used to create a device that can shield dry fish from rain. Jalil (2001) points out that the proper approach to product development is to use systematic design techniques. Additionally, it is crucial to acquire information before beginning the process of developing a product design. According to Jalil (2001), to analyze the issue and gather data in the form of the product, you need to contrast the current product with the one you wish to build. It includes suggesting the shortcomings of the traditional drying techniques utilized by dried fish farmers. The outcomes of the concerns discovered will help in the creation of concepts for automatic dried fish drying systems that can address the issues faced by dried fish farmers.

The procedure of building an automatic fish dryer by making a few prototypes using Solid Work software and analyzing the final sketches to select an appropriate design. Additionally, the design must work with the circuit that will be developed for the system. The Arduino is the main component that will regulate and command the relays, motors, and rain sensors to function in accordance with the raindrops the sensor detects.

A few factors, including materials that can produce heat reflection in the machine, were taken into consideration when developing the design of the Automatic Rain Sensor Drying Machine for dried fish. The heat reflector in this product is crucial to ensuring that the machine's heat can be maintained even when it rains. Even if it rains, the drying process can proceed while the machine's temperature is consistent. Due to the product's small size and light weight, customers may carry the automatic dried fish drying machine with ease.

Functionality analysis is done via product testing and expert evaluation. Two experts in total contributed to the evaluation of this development. The sensor, LED, and Arduino modules are appropriate for usage and perform effectively, according to the input we obtained from two machine design experts.

The sensor module, LED, Buzzer, and Arduino can move the motor while it's raining, according to product testing. Five days were devoted to testing. On the first, third, and fourth days of the week, it rained lightly; on the second and fifth days, it rained heavily. The test's findings demonstrate that the sensor can function effectively in both light and heavy rain. In approximately three seconds, the sensor module activates the motor to close the fish. On the third day, it started to pour heavily, but the sensor quickly moved the motor to cover the fish in response.

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