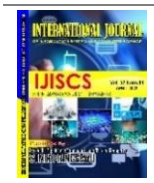

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RAD MODEL TO DESIGN AND CONSTRUCT FISH FEEDING EQUIPMENT IN NEGERI SAKTI PESAWARAN AUTOMATICALLY AND EFFICIENTLY

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Abstract
This research paper explores the design and construction of an automated fish feeder in the village of Negeri Sakti Pesawaran, aimed at enhancing efficiency in fish feeding, reducing errors, and boosting productivity and sustainability in fish farming. The study adopts the Rapid Application Development (RAD) method for its quick and iterative development approach. The methodology involves identifying needs, forming a development team, project planning, prototyping, system construction, and functionality testing. The implementation of the automated feeder has shown positive impacts on fish farming in Pesawaran. Challenges encountered during development have provided opportunities for learning and improvement. The success of this project serves as a foundation for the advancement of similar technologies in the aquaculture sector.

1.0 INTRODUCTION

Introduces the rapid population growth and increased demand for food, particularly protein sources like aquaculture. It discusses the importance of efficient fish farming management, the role of feeding in aquaculture, and the integration of technologies like AI, IoT, and blockchain. The paper focuses on designing and building an automated fish feeding tool to enhance efficiency and sustainability in fish farming. Human population growth is currently very rapid so that the increasing demand for food sources has encouraged increased attention to the aquaculture sector as a solution to meet animal protein needs [1]. Aquaculture has several terms, such as aquaculture, aquaculture, fish cultivation, and aquaculture. Fisheries cultivation is the activity of producing aquatic (water) biota (organisms) to gain profit [2]. In local terms, the aquaculture system is known as karamba[3].

Aquaculture, including fish farming, has become an increasingly important sector in supporting the fulfillment of global food needs. In this context, efficient and sustainable management of fish farming activities becomes crucial. One of the main aspects in fish farming is feeding as a central role in fish growth and health. Established aquaculture requires effective fish farm management to balance high yields with low farm effluent, as well as taking into account changes in available water sources [4].

In the present scenario, Artificial intelligence, IoT and Blockchain technologies are widely explored to improves livestock sustainability and for analysis of their chewing habits, eating patterns, their movement patterns i.e., standing, moving, drinking and feeding habits, indicate

the amount of stress the animal is going through which in turn helps in predicting the vulnerability to disease, weight gain, and production of the livestock[5]. These systems are limited by a lack of sensors that monitor the following process variables: temperature, dissolved oxygen, pH, turbidity, total ammonia nitrogen (TAN), tank water levels, and feeding [6].

Pesawaran Regency, which is known for its natural resource potential, has experienced significant development in the local economy in the aquaculture sector. However, fish farmers are often faced with challenges in providing optimal feed. The manual feeding process is not only time consuming, but also prone to errors in dosage and frequency, which can have a negative impact on fish growth and production efficiency. Effective feeding increases the growth rate of cultivated species and reduces food waste and water pollution [7].

In overcoming this problem, this research aims to design and build an automation tool for feeding fish in fish farming groups (Pokdakan) in Pesawaran Regency. This tool is expected to increase the efficiency of feed management, reduce the risk of feeding errors, and in turn, increase the productivity and sustainability of fish farming in the area [8]. In the initial stage, analysis of the needs of fish farmers, environmental characteristics and types of fish cultivated will be the focus. Furthermore, automation tools will be designed taking into account aspects of ergonomics, reliability and ease of use. Implementation of the tool prototype will involve field trials to ensure optimal performance and positive response from fish farmers [9].

With the development of this feeding automation tool, it is hoped that it can make a positive contribution to increasing the productivity of fish farming in Pesawaran Regency, as well as becoming a reference for other regions that have similar needs in managing fish feed efficiently. This research can also be a basis for the development of similar technology on a wider scale, supporting the sustainable growth of the aquaculture sector at national and international levels.

2.0 THEORETICAL

The theoretical framework related to the object of research in this study focuses on the Rapid Application Development (RAD) method, which emphasizes quick development, responsiveness to user needs, and iterative improvements. The RAD method aligns with the project's goal of enhancing efficiency and sustainability in fish farming through the development of an automated fish feeder. Additionally, the study utilizes theories and models related to technology development, user feedback incorporation, and continuous learning to guide the design and construction of the automated feeder [1].

3.0 METHODOLOGY

According to Whitten & Bentley (2007:98) Rapid Application Development (RAD) is a system development strategy that emphasizes speed in development through user involvement in rapid, iterative and incremental development of a series of prototypes of a system that can develop into a system. specific ending or version.[10] The RAD methodology applied in the research, including preparation, planning, design, construction, testing, implementation, evaluation, refinement, deployment, and maintenance phases. Like on figure below:

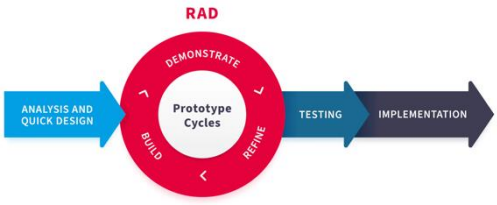


Figure 1. The Phases of RAD

The basic idea of Rapid Application Development (RAD) is as follows [11]:

1. To more effectively engage users in analyzing, designing and building activities.
2. To organize system development so that it is more focused, and involves more system owners, users, analysts, designers and builders.
3. To accelerate system requirements analysis and design activities through an iterative development approach.

4. To reduce the time needed for users to see the working process of the system being developed.
5. The following is the cycle process of Rapid Application Development (RAD).

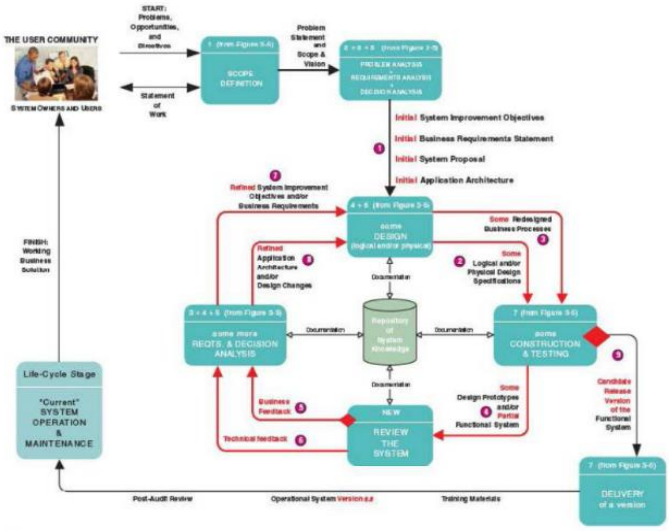


Figure 1. Rapid Application Development (RAD)
(Sumber : Whitten & Bentley, 2007, p99)

Whitten & Bentley explain the description of the rapid application development (RAD) process above as follows[10]:

1. To reduce the time required for system and application development, the problem analysis, system requirements analysis, and decision analysis stages need to be accelerated and consolidated. The use of RAD which uses an iterative approach in the initial analysis process can be completed within a few weeks. Evaluating the automated feeder further with key users and collecting additional feedback for necessary improvements
2. The physical and logical design processes are usually shortened and significantly accelerated. In each iteration cycle only a few design specifications are considered. When several system models can be taken, they can be selected and emphasized for the continuation of rapid development. Assumes errors can be discovered and resolved in the next iterative process.
3. It is rare but there is a possibility that business processes need to be redesigned to reflect application involvement in the system.
4. In each iteration cycle, several prototype designs and several functions of the system parts are built and tested. Later, the completed application will be the result of the final iteration process.
5. After each prototype and functional system is developed and tested, users are given the opportunity to try using it. User expectations for the prototype will become new system requirements and provide responses to the business process description.
6. After each prototype and functional system is developed and tested, system analysts and designers will review it to get technical feedback and development direction for the next process.
7. Based on the responses that have been obtained, the system analysts will identify the objectives or direction of justification for the system to be implemented or system requirements.

Based on the responses received, designers will identify the purpose or direction of design changes and justify the application architecture. Later the system will be assessed as ready to be implemented [12].

Advantages and Disadvantages of RAD

According to Whitten & Bentley (2007:100) Rapid application development (RAD) provides several advantages in its use in building website prototypes but also has disadvantages that

can cause losses. The following is a further explanation regarding the advantages and disadvantages of rapid application development in its use.

Table 1. Advantages and Disadvantages of Rapid Application Development (RAD) (Source: Whitten & Bentley, 2007, p100)

Profit	Loss
● Very useful for projects where the system requirements to be developed are not completely precise or uncertain. ● Encourage enthusiastic end-users to participate in the project. ● The project has high visibility and support due to user involvement. ● Software-based solutions are faster than business model-based solutions. ● Errors and omissions can be identified more quickly in this prototype than in the model system. ● Testing is a necessity for a product which is the basis of the prototype approach. ● An iterative approach is more natural because change is an expected factor in the development process	● Several issues say that RAD requires more energy, support, and more ● development that causes an increase ● necessary costs. ● RAD can solve the wrong problem if the problem is ignored and shortened. ● RAD-based prototypes can allow for less enthusiasm from analysts than others. ● Sometimes stakeholders see prototypes as a waste of energy and time. ● Emphasizing the speed of project completion can have a negative impact on product quality.

According to other experts, the RAD stage consists of planning, analysis, design, implementation, testing and maintenance. The RAD method is easier to implement because development focuses on each development requirement at one time and requires less time [11]. According to R. Astuti, S. Sfenrianto et al. explained that RAD was created by James Martin which was designed to provide faster development and quality results [13].

The RAD (Rapid Application Development) research method is a software development approach that emphasizes fast and iterative development. In the context of designing an automated tool for feeding Pokdakan Pesawaran fish, the following is the RAD research method used [14]:

Step 1: Preparation

Identify Needs:

Identifying the main requirements for the automated fish feeder through needs analysis and interviews with stakeholders.

- Needs analysis to determine the main requirements for fish feeding automation tools.
- Interview related parties, including fish farmers in Pokdakan Pesawaran, to understand their needs and expectations for this automation tool.

Step 2: Planning

Forming a development team with experts in technology, hardware design, software design, and fisheries.

Team Formation:

- Form a development team consisting of technology experts, hardware designers, software designers, and fisheries experts.
- Define the roles and responsibilities of each team member.

Preparation of Project Plan:

- Determine a development schedule that includes iterative stages.
- Identify potential risks and plan mitigation strategies.

Step 3: Design

Creating a project plan with iterative development stages and risk mitigation strategies.

Initial Prototype Design:

- Create a simple prototype of the automation tool to get initial feedback from users.
- Focus on user interface and basic functionality.

Prototype Iteration:
Designing an initial prototype to gather early user feedback.
- Perform multiple iterations on prototypes based on user feedback.
- Adjust the design based on needs that emerge during development.

Step 4: Construction
Constructing the system by implementing the agreed-upon hardware and software designs .
System Development:
- Implement hardware and software according to agreed designs.
- Perform repeated testing throughout the construction process.

Step 5: Test
Testing the functionality of the automated feeder to ensure effective fish feeding .
Functionality Test:
- Carry out functional tests to ensure that the automation tool can provide fish food effectively.
- Identify and fix bugs or deficiencies found during testing.

Step 6: Implementation
Implementing the automated feeder in a trial environment at Pokdakan Pesawaran and observing its performance and user feedback.
Initial Implementation:
- Deploy automation tools in a test environment in Pokdakan Pesawaran.
- Observe and record automation tool performance and user feedback.

Step 7: Evaluate
User Evaluation:
- Carry out further evaluation by involving key users.
- Gather further feedback to make necessary changes.

Step 8: Refinement
Optimization and Improvements:
- Make changes or improvements based on user feedback and evaluation results.
- Iterate on certain steps if necessary.

Step 9: Deployment
Full Implementation:
- Thoroughly implement automation tools in Pokdakan Pesawaran after ensuring good operational skills and user acceptance.

User Training:
- Provide training to fish farmers to ensure they can use automation tools effectively.

Step 10: Maintenance
Maintenance and Support:
- Establish a regular maintenance and technical support plan for users.
- Set up a system for reporting problems and handling repairs.

The Rapid Application Development (RAD) method offers several advantages for software development in the context of the automated fish feeder project. These include rapid development and responsiveness to changing needs, facilitating quick iteration and user feedback incorporation, ensuring practical needs are met, and supporting continuous learning and improvement.

However, there are also disadvantages to using the RAD method. These may include potential negative impacts on product quality due to the emphasis on project speed, as well as challenges in maintaining consistency and integrating prototypes. Despite these challenges, the iterative development approach of RAD provides opportunities for continuous learning and improvement, aligning with the project's philosophy of iterative development.

The RAD method allows for rapid development and responsiveness to changing needs, making it suitable for projects with dynamic environments such as the design of fish feeding automation equipment in Pokdakan Pesawaran.

4.0 RESULANTS

The application of this feeding automation tool is applied to the fish cultivation group (Pokdakan) located in Negeri Sakti Village, Gedong Tataan District, Pesawaran Regency, Lampung Province, Indonesia. This research was conducted over 4 months, namely December 2023–March 2024. The implementation of this Fish Feeding Automation Tool went through several stages:

Step 1: Preparation

Identify Needs:

A needs analysis was carried out to determine the main requirements for a fish feeding automation tool. The need for pokdakan is the need for a tool to provide feed automatically and on a schedule [15]. Interview related parties, including fish farmers in Pokdakan Pesawaran, to understand their needs and expectations for this automation tool. The results of the interview were that this tool could reduce the intensity of the farmer's role in providing feed twice every morning and evening every day.

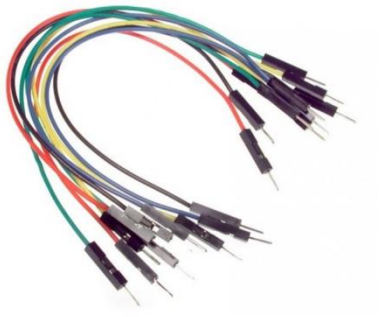
The tools needed in designing this automation tool include:

Nodemcu ESP8266 Lua Wifi V3 4mb 32mbits Ch340 With Base Plat

40 Pcs Jumper Cable Kabel 20cm Female To Female Dupont

40 Pcs Jumper Cable Kabel 20cm Male To Male Dupont

40 Pcs Jumper Cable Kabel 20cm Male To Female Dupont



Bread Board Breadboard Mini 8.5x5.5 Cm Holes High Quality Arduino

Adabtor 12 V 10 Ampere

Towerpro Motor Servo Mh996r Metal Gear Upgrade

Dc Jack Power Adabtor

Spots / Body Cables / Automotive Car Motorcycle Cables

Step 2: Planning

Team Formation:

Form a development team consisting of technology experts, hardware designers, software designers and fisheries experts along with a development schedule that includes iterative stages which can be seen in the following table:

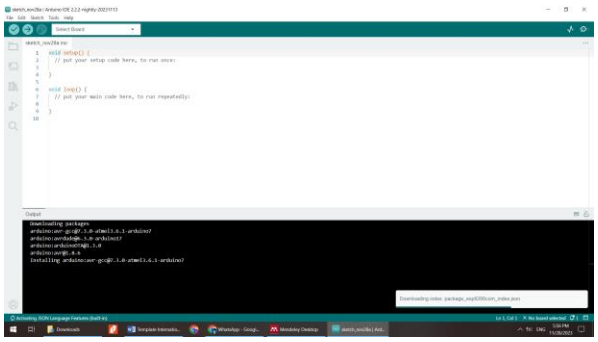
Table 2.

No.	Project Preparation Stages	Estimated Time (Week)	Responsibility
1	Preparation and Needs Analysis	2	Development Team
2	Team Formation and Project Plan	1	Project Manager
3	Initial Prototype Design	3	Software Designer
4	Prototype Iteration	2	Development Team
5	System Implementation	4	Hardware Expert
6	Functionality Test	3	Testing Team
7	Initial Implementation and Observations	2	Development Team
8	User Evaluation	2	Evaluation Team
9	Optimization and Enhancement	3	Development Team
10	Full Implementation and Training	2	Implementation Team
11	Maintenance and Support	On Going	Maintenance Team

Step 3: Design

Initial Prototype Design:

A simple prototype of an automation tool to get initial feedback from users. This tool is designed without a user interface and basic functionality. Repeated iterations on the prototype using Arduino IDE software series 2.2.2.



Step 4: Construction
System Development:
Implement hardware and software according to agreed designs. Repeated testing during the construction process is carried out with discussions and practice directly in front of the pokdakan.

Step 5: Test
Functionality Test:
Carry out functional tests to ensure that the automation tool can provide fish food effectively. Identify and fix bugs or deficiencies found during testing.
Step 6: Implementation
Initial Implementation:
Implementation of automation tools in a test environment in Pokdakan Pesawaran.
Observation and Records of automation tool performance as well as user feedback.
Step 7: Evaluate
User Evaluation:
Further evaluation by involving key users.
Further feedback to make necessary changes.
Step 8: Refinement
Optimizations and Improvements:
Changes or improvements based on user feedback and evaluation results.
Iterate on certain steps as necessary.
Step 9: Deployment
Full Implementation:
Thoroughly implement automation tools in Pokdakan Negeri Sakti Pesawaran after ensuring good operational skills and user acceptance.
User Training:
Conduct training for fish farms to ensure they can use automation tools effectively.
Step 10: Maintenance
Maintenance and Support:
Establish a regular maintenance and technical support plan for users.
Set up a system for reporting problems and handling repairs

Design of an automation tool for feeding Pokdakan Pesawaran fish using the RAD method:

1. Results of Automation Tool Development
   The application of the Rapid Application Development (RAD) method in developing automation tools for feeding pokdakan fish in Pesawaran has resulted in significant progress. The iterative, prototype-focused development process allows the team to quickly respond to changing user needs[16].
2. Initial Prototype and Testing
   In the initial phase of development, a prototype automation tool was successfully built utilizing the RAD approach. This prototype was then tested intensively involving fish farmers in Pesawaran. Feedback obtained from users plays a key role in defining clearer requirements and identifying necessary improvements[17].
3. Flexibility and Adaptability

The RAD approach provides great flexibility in accommodating changing requirements that may arise during development. The ability to quickly respond to user feedback allows customization of the design and function of automation tools, ensuring that the resulting solutions meet the expectations and practical needs of fish farmers[18].

4. Performance of Automation Tools
   At the implementation stage, the automation tool demonstrated satisfactory performance during field trials. The accuracy of feed dosage and ease of use of the interface earned praise from users. A development phase involving rapid iteration allows the team to effectively address technical issues that may arise during testing[19].
5. Economic Impact and Sustainability
   The implementation of automation tools has had a positive impact on the economic aspects of fish farming in Pesawaran. Although initial investment is required, long-term cost savings related to feed efficiency, time, and increased production can strengthen the sustainability of fish farming at the local level[20].
6. Challenges and Learning
   The development process using the RAD method is not without challenges, including the need to maintain consistency and prototype integration. However, these challenges provide opportunities for continuous learning and improvement, supporting the iterative development philosophy underlying RAD[21].
7. Implications for Other Technology Development
   The successful development of this automation tool provides the basis for the development of similar technology in the context of fish farming in other areas. A RAD approach that is responsive to user needs can become a model for developing other technologies in the aquaculture sector.

The Rapid Application Development (RAD) method contributes to the efficiency and sustainability of fish farming in Negeri Sakti Pesawaran by allowing for quick development and responsiveness to changing needs, facilitating rapid iteration and user feedback incorporation, ensuring that the automation tool meets practical needs and expectations. This approach also enables the development of a maintenance plan, technical support for users, and a problem reporting system, supporting continuous learning and improvement.

5.0 CONCLUSION

Indonesian fish farmers often rely on manual feeding, which can be time-consuming, lead to over or underfeeding, and ultimately affect fish growth and production efficiency. The advantages and disadvantages of the automated fish feeding system, emphasizing its positive impact on fish farming productivity and sustainability in Pesawaran. It also suggests implications for similar technology development in other regions. The research proposes designing and building an automated fish feeder to address these challenges. The feeder is expected to Improve feeding efficiency and reduce reliance on manual labor. Optimize feeding practices by delivering the right amount of feed at the right time. Potentially contribute to increased fish productivity and better sustainability in aquaculture. The researchers plan to analyze the needs of fish farmers and the specific environment to design the feeder. It will consider factors like ergonomics, reliability, and ease of use for farmers. The project will involve building a prototype and field testing it to ensure optimal performance and positive feedback from fish farmers. The RAD approach allows for quick and iterative development, focusing on identifying needs, forming a development team, planning, designing prototypes, constructing the system, and testing functionality. The automated fish feeder aims to enhance efficiency, reduce errors, and ultimately improve productivity and sustainability in fish farming, with positive impacts observed in Pesawaran's aquaculture sector.

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