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APPLICATION OF AUTOMATION IN FISH FARMING (*Feeder with microcontrollers)*

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Abstract: This prototype seeks to mitigate the variation in the control and frequency of manual feeding of fish raised in large tanks. The use of technologies that increase the quality of production in fish farming is a determining factor in the growth of Brazilian agriculture. The main problem in the feeding of juvenile fish is the periodicity of feeding and the control of the amount of feed. Through the experimental methodology, a system was produced with the application of microcontrollers that allow the homogeneous monitoring of the amount of feed disposed in the tank, as well as the variation of the feeding frequency. The automation of the prototype was developed from a mechanical structure and electronic constitution. The system created provided manipulation of the quantity and predefinition of tank supply schedules, through automatic mechanical actions, dispensing with the manual action of the worker and reaching the expected objectives.
Keywords: Automation, automated feeder, fish farming, microcontrollers.

INTRODUCTION

According to the Yearbook of the Associação Brasileira da Piscicultura, Brazil is the fourth largest producer of tilapia *(Oreochromis niloticus)* in the world, a species that represents 63.5% of the country's production. The growth of aquaculture brings with it the need to use technologies to improve the production process. The feeding management of this process is one of the main challenges in the production of fish in cages, since species such as tilapia, during the fry phase, need to be fed from eight to twenty times a day, in day and night periods, reaching a frequency of three to five times a day during the juvenile phase, thus, biomass and age are determining factors in the feeding management schedule (NUTRIÇÃO & SAÚDE ANIMAL, 2022).

The automation of the feeding process and the number of intervals in the daily manual feeding procedure is a difficulty found in places where activities are carried out with fish in tanks, as it depends on the experience of the responsible team and on a feeding management schedule. It appears that the feeders offered on the market have a high cost of acquisition, maintenance and insufficiency in serving large tanks.

Given the above, the need to use technologies that favor progress in the feeding process is an object of search for producers. The built prototype provides the supply of food in high demand and frequency, aiming to minimize these difficulties, through electronic controllers and constructive details made with low cost materials.

MATERIAL AND METHODS

Using the experimental methodology, the automatic feeder was built in order to induce a better feeding for the fish, considering the concept of sustainability and the economy of the equipment. The prototype was made using PVC (Polyvinyl chloride) and MDF (Medium Density Fiberboard) materials. The experiment was built and applied in the fish farming reservoir of Campus II of Centro Universitário Católica do Tocantins for the dimensioning of the storage capacity and power of the engine to be used in the prototype.

The equipment has constructive details dimensioned to act efficiently and with low noise frequencies. The mechanical structure of the feeder was built using a PVC pipe with a diameter of 75mm and a length of 200mm, a PVC tee with an inlet of 50mm and an outlet of 75mm in diameter, a conveyor screw made of MDF with a length of 404mm and a diameter of 72mm., an MDF box with a length of 250mm and a width of 150mm and a 20-liter gallon of water.

The prototype is structured as follows: To store the feed, a container with a capacity of 20 liters was used, to be coupled to the main tube, used as a feed dispenser, through the PVC tee. The tube serves as a channel to control feed output; whose movement is guaranteed by means of a revolving thread inside the PVC tube. The rotational screw, used to move the feed, was made in MDF in the three-dimensional format of a helix, whose rotation causes the horizontal displacement of the feed. The electronic control box was attached to the duct, before the entrance to the reservoir.

Image 1. Finished automatic feeder prototype.

The layout of the electronic part of the prototype consisted of an ARDUINO UNO® microcontroller board responsible for transmitting the commands to the other components. The composition of the electronic control box was made up of a relay module, an ultrasonic sensor, an L-1200 model motor with a power of 1200w and a voltage of 127V, an RTC module (Real Time Clock), an active buzzer, a 12V power supply and breadboard.

The electronic components were arranged as follows: The relay module was connected to port 8 and had the function of producing sudden changes; the ultrasonic sensor had its connections connected to port ~9 and ~10 with the function of detecting and measuring the distance of the feed inside the container triggering a shortage in the feed volume. The RTC module attached to ports 2, ~3 and 4 with the task of detecting alarms and thus executing actions at predetermined times, the active buzzer connected to GND and port ~11 designed to emit sound signals when receiving information, all the ports, respectively, located on the microcontroller board. The motor linked to the relay module only receives current when the circuit is activated.

The ARDUINO UNO® microcontroller was programmed using the C++ language to order the activation sequence of the devices that make up the electronic system. The equipment was designed to be activated every 1h30min, working for a period of 15 minutes, at the end of this period a new cycle begins. The frequency of action is subject to change according to the need to treat the fish species in the net-tanks. The board was programmed with data that refer to the amount and intervals of dispersion of the food, therefore, there is control of the circuit so that there are no harmful variations to the creation of the fish.

RESULTS AND DISCUSSION

To demonstrate the functioning of the automated feeder, the system was submitted to tests in order to demonstrate its efficiency, taking care to reach the expected objectives with the project. the feeder was built with the purpose of solving the difficulty of feeding fish raised in net-tanks, ensuring the frequency and adequate flow of feeding. The reservoir was filled with approximately 15 liters of feed, in order not to approach its maximum capacity of 20 liters; this way, the variation in the distance between the feed level and the tank lid is the determining factor for activating the buzzer in case of

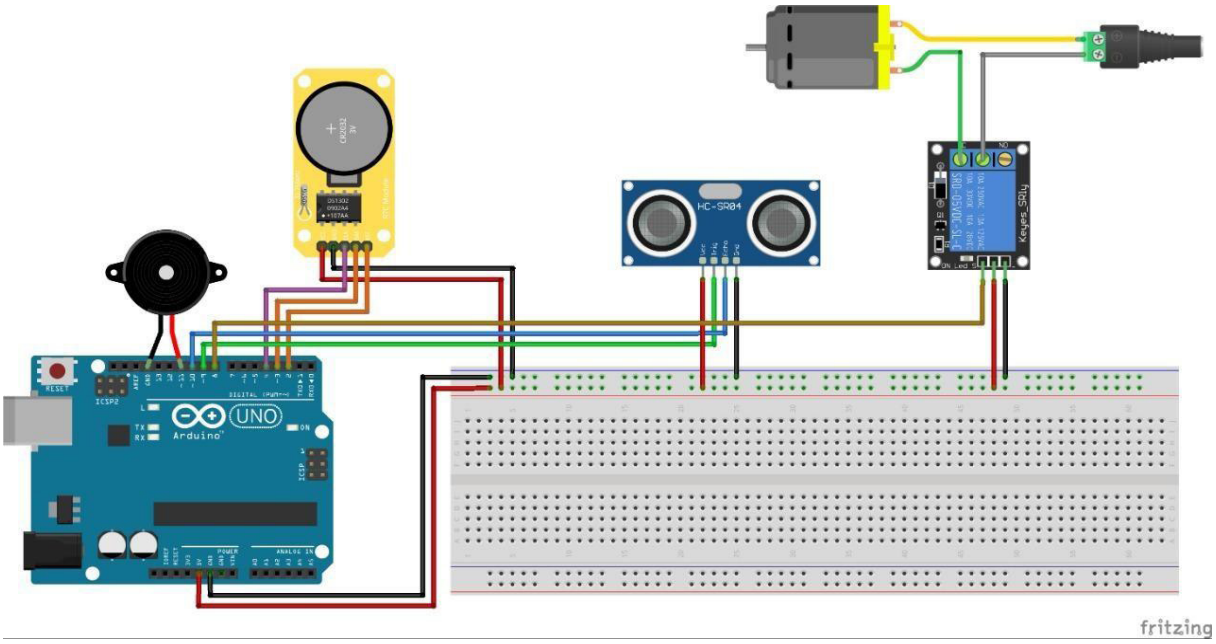


Figure 1. Control box electrical circuit.

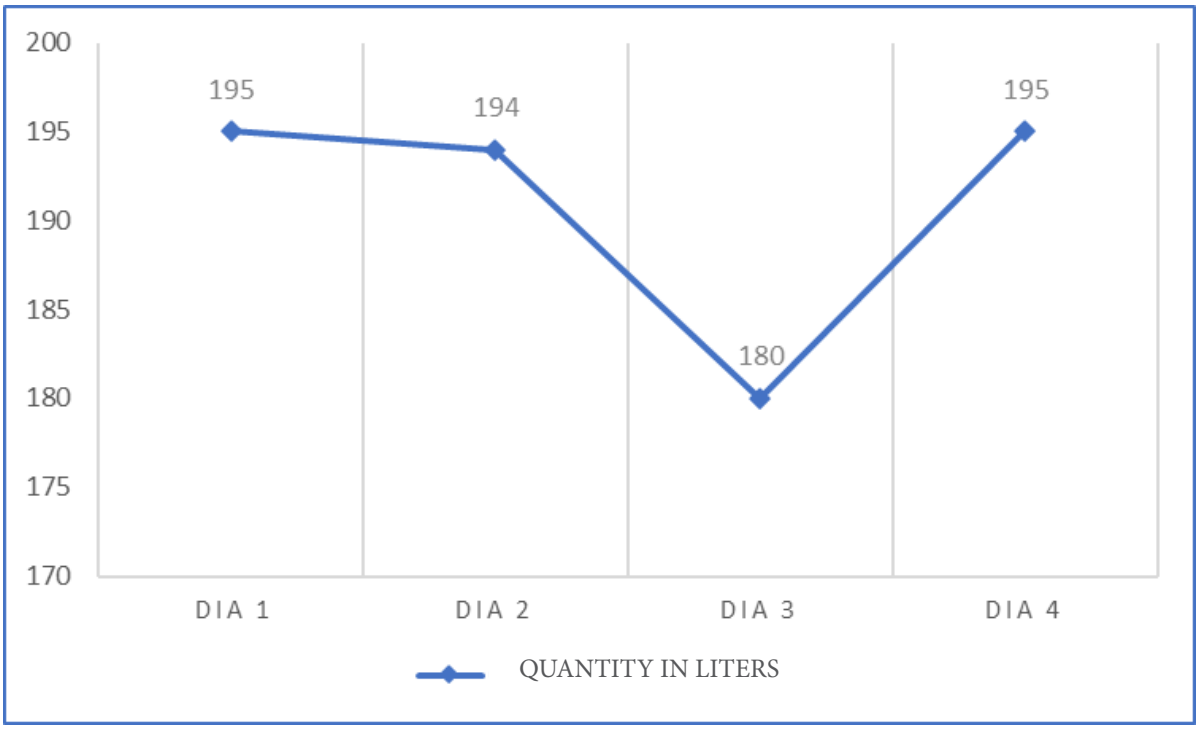
insufficient feed quantity when the flow was below 30% of the tank capacity, the buzzer notifies the replenishment.

In order to guarantee homogeneity in the dispenser output flow, the 1.5mm granulometry of the feed was deferred, in order to adapt to the rotational movement of the screw conveyor, preventing friction with the surface from interrupting the rotation frequency. When activating the system, the conveyor screw rotates clockwise, ensuring the transport of feed along the dispenser.

A sequence of tests was carried out that made it possible to verify the rate of variability that the equipment presents in relation to the feeding in the fish tanks. The analysis took place in the UniCatólica fish farming reservoir, in tanks with a capacity of 30m^3. The number of daily repetitions of the equipment was observed, measuring the amount of feed flow in liters ejected at each completed cycle. After examining the amount thrown using a container to collect the feed, it was placed on a scale to verify the results.

Tests to assess accuracy and efficiency were carried out after 4 days. Taking into account the number of cycles performed during the verification days, there was an average of 12.75 cycles performed per day. It was observed that at the end of each cycle 15 liters of feed were dumped, therefore, there was an average of 191 liters of feed used in the feeding period in the four-day period.

The dispersion of the feed in the tank showed a homogeneous character of distribution, with a varied range, thus enabling the feeding of fish around the entire perimeter of the tank, preventing fish from agglomerating in specific spaces of the reservoir during feeding management. The margin of variation in the distance in the dispersion of the feed was heterogeneous, with a maximum range of 22000 mm and a minimum of 200 mm, ensuring stability for all fish in the feeding process.



Graph 1. Feed flow in liters as a function of time.

CONCLUSION

It is concluded that after tests carried out in fish farming tanks, the automated feeder presented the expected results, such results were previously predicted theoretically. The built system allows the control of fish feeding management, making it possible for the technology operator to periodize the feeding, through the use of microcontrollers combined with a programmable microprocessor, thus serving a greater number of fish species and their particularities, which makes the process more efficient. The system ensured stability in feeding frequency and a lower rate of variation in feed distribution compared to traditional feeding methods.

It was possible to conclude with the introduction of the feeder that it is feasible to reduce human interference in the process, which allows the standardization and control of the feed flow and the frequency of feeding cycles, increasing the quality of the species in different stages of creation. The number of feeding cycles over the period of analysis proved to be effective in ensuring the expected nutrition of the fingerlings.

The results obtained allude to the effectiveness of the application of automation in fish farming for fish feeding, which brings a solution to the problem presented in the context of fish farming in large reservoirs. Once it proves to be effective, the feeder, when used, contributes to greater efficiency in fish management, thus improving the fish farming process.

REFERENCES

ANSCHAU, Sandra Paula et al. Protótipo de alimentador automático para a larvicultura da tilápia (Oreochromis niloticus). 2016.

JUNIOR, Carmelin; APARECIDO, Célio. Sistema automatizado de alimentação de juvenis de tilápia. 2014.

NETO, Bruna Ponciano. Como Criar Tilápia? Confira 6 Dicas Essenciais Sobre Como Funciona. NUTRIÇÃO & SAÚDE ANIMAL, 2022. Disponível em: < https://nutricaoesaudeanimal.com.br/como-criar-tilapia/>. Acesso em: 10 de novembro de 2021.

SOUZA, Marcos; FIGUEIREDO, Marcos. Automação para arraçoamento de peixes mantidos em laboratório. In: **Anais do XVIII Escola Regional de Computação Bahia, Alagoas e Sergipe**. SBC, 2018. p. 348-356.

SOARES, Filipe Avila. Desenvolvimento de um alimentador de peixes microcontrolado para sistemas de aquaponia. 2019.

SANTOS, Diego Fracasso Menezes dos et al. Desenvolvimento de um alimentador automático para evisceradora de pescado. 2018.

TETU, Patrick Nereu. Frequência de arraçoamento, com manejo automatizado da ração, para tilápias na fase juvenil de criação. 2016.

ASSOCIAÇÃO BRASILEIRA DA PISCICULTURA. Peixe BR, 2022. Disponível em: < https://www.peixebr.com.br/>. Acesso em: 12 de novembro de 2021.