

Automatic Fish Cutting and Cleaning Machine using Digital Image Processing



M. Bhuvaneshwari, R. Emmanuel Gospel Raj, T. Vignesh

Abstract: *There are many varieties of fishes available in the market and the consumers are increasing day by day. This paper is mainly concentrated on automatic cleaning and cutting of fish. There is huge demand for fish cutting and cleaning machine in the market for easy use. Time and labor can be effectively managed if this type of machine is implemented in the fish market. This paper introduces the concept of Digital image processing technology to identify the various types of fishes and their sizes. Special convey rollers mechanism need to be designed and developed for handling different types of fishes. Technology will ensuring hygiene, quality and waste disposal. The following are the objectives of this paper design and implement Automatic Fish Cutting and Cleaning Machine. The shape, size of fish is analyzed using Digital Image Processing techniques. This will improve the living standard of rural women who sells different variety of fishes in the market, which empowers women in the society.*

Index Terms: *Fish cutting and cleaning, digital image processing, conveyers.*

I. INTRODUCTION

The object of this paper is to introduce a automatic cleaning and cutting machine to facilitate women who are living in rural area near the seashore or river. Women living in these areas usually are involved in the medium scale business of selling fish in the market or at the roadside area to meet the basic needs of their family. Fish, being a unpreserved food commodity, it required proper preservation and handling to have an extended desirable quality and nutritional values for human being to consume. The main concern for processing of fish is to prevent fish from rotting. Several factors are accountable for deterioration such as effectiveness of cleaning, time, and labor. While male, who are strong physically strong can do the cleaning and cutting process quickly and effectively, women, who are weak, cannot do it with ease. It is therefore proposed to design and fabricate a new machine for fast, easy and effective cleaning and cutting

of fishes. This machine would increase productivity with time efficiency and reduce rough handling of fishes and would in turn prevent contamination. Image processing technique is used for effectively handling all types and sizes of fishes. Processing equipment would comprise of parts like conveyors which is used to carry fish from one block to other, filleting machines depend on the fish type, fish waste washing tanks, trimming tables, slicers, brining tanks, gutting machines including vacuum systems, etc. Hygienic design of equipment is especially important for the fish industry because wet and humid environment of processing is encourages bacterial spread and growth. A compact automatic Fish cleaning and cutting system needs to handle removal of scales or skin and fillets along with cutting or slicing of fish. The machine needs to cut bones of all types of fishes by considering several factors through digital image processing algorithms. Applications of image processing technologies play a significant role in major areas in research, including process optimization, automated sorting and grading and automated processing. All these tasks need to be completed with less time and labor. Aquatic products consuming are popular among consumers, their quality is used for manually sorting, grading, species classification and freshness assessment. To reside in the competitive global market, it is essential to take the benefits of technology to increase productivity and profitability. There are few cutting machines available in the market without cleaning machine. The cleaning machines available are used to clean the fillet from the fish. There is scale removing machines which would not perform fillet removal task. There is no automatic fish cutting machine along with cleaning feature in a single machine. If this is implemented Productivity would be increased labor cost and time could be saved. It will reduce rough handling of fishes that would in turn prevent contamination. Image processing technique is used for effectively handling of all types and sizes of fishes. It can be used anywhere in the country. Waste disposal would also be effective, which promotes the Clean India motion.

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II. FISH CONSUMPTION IN INDIA

Fishing is a major industry in the coastal states. It employs over 14 million people approximately as per a survey during 2017-18. In India approximately 8,129 km is sea coast in this around 3,827 fishing villages are available. Approximately 1,914 traditional fish landing centers are there.



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It has fresh water source for about 195,210 km (121,300mi) as rivers, dams, lake and canals. There was 2.9 million hectares of minor and major lake. Around 2.4million hectares are sand pond lakes, and about 0.8million hectares of flood plain wetland and sand water bodies. The Marian resources offer a sustainable fishing potential of over 4million metric tons fish every year. In addition, India's water and natural resources offer a tenfold growth in farm fishing harvest. This level is close to 3.9million metric tons of fish. Despite the increasing rate in total fish production of India, a fish farmer's avail an average production 2 tons per person annually in India compared to other countries like Norway yield 172 tones, china 72 tons etc. Higher production, knowledge in sustainable fishing, continuous growth in fish production shows tremendous increase in fish exports and the living standards of Indian fishermen is improved. Presently, cleaning machines and Cutting machines are separately available in the market. The available machines can cut and clean only few types of fishes. The proposed system will help to process the fish by cutting and cleaning in the single machine. It would be helpful for the society by benefitting rural women who sell fish. Productivity would increase with requirement of less labor power. The machine would also be portable and compact. This machine would be a time effective solution for fish cutting and cleaning process. It is a unique idea that hasn't been developed. The technology would be developed based on user-friendly design features and therefore, it could be easily to use by a nonprofessional. No patented technology is available for cleaning and cutting of fishes involving identification of fishes using image processing technique. Designing a single machine that performs fish cleaning and cutting is limited to fish size and shapes. The available technologies include separate machines for either cutting or cleaning and not both. Therefore, the proposed paper would be a first of its kind in the area of fish industry.

III. PERFORMANCE OF AVAILABLE TECHNOLOGY

This product is basically a glove to help grasping, scaling, cleaning, and cutting fish. The glove has provisions for securing, cleaning and cutting fish. It is just a hand held tool to assist manual processing of fish. It is therefore cost-effective solution, but not a time effective and labor effective solution for cleaning and cutting of fish [1]. This product is an automatic portioning machine. It automatically measures the size of object placed on its conveyor belt and cuts into equal sizes of fragments. It could be used for cutting fishes. However, it is not specifically developed for cutting fish and it doesn't have cleaning feature incorporated [2]. The above product offers cleaning of fishes using water cyclone. The product is a vessel with specially designed interior volume and a pipe provision to help creating a cyclonic path for water that helps cleaning of fish. The machine only washes fish and helps cooking it manually. It does not offer the possibility to cut fish. It is neither an automatic machine nor a time effective solution for fish cleaning and cutting [3].

IV. DEMAND OF TECHNOLOGY

Fish, being a fresh food commodity, it is essential to manage properly and protect it from rotten for our extended self-life, desirable quality and nutritional values. The important concern of fish processing is to prevent fish from decaying and to support full nutrition value to the consumers. Several factors are accountable for deterioration such as effectiveness of cleaning, time, and labor. Male who are strong physically can do the cleaning and cutting process quickly and effectively. Women, who are weak, cannot do it with ease.

As per the Central Marine Fisheries Research Institute (CMFRI) Census 2015, there are nearly 3,288 marine fishing villages and 1,511 oceanic fish landing hub in 9 sea states and 2 union territories are in India. The population of marine fisherman was about 4 million.. Calcutta is the second-largest producer of fish our country and tenth largest in the world, according to a fisheries science magazine. Despite standard catch, the income was low because middlemen tap off the profit of fisher man. They never paid the fishermen on time. The fisher families had to struggle for survival under economic pressure, lack of money or men's frustration caused by paucity. Women were the victims. Women in coastal villages have turned to selling fish and value-added fishery products after eliminating middlemen. Women came together to empower themselves as businesswomen, taking their families and community forward in the process. Selling fish at the local fish market is a pride in introducing themselves as business women instead of fisherwomen. They buy fish every morning from fishermen who fish in lake or sea, sell the fish with 10 -20 percent profit and earn a good income to their family. Women not only contribute to economic progress of their families, but also to the improvement of their social status by their earnings. These women rooted out their problems one after the other, and emerged as successful entrepreneurs. The target beneficiary is women who sell fishes near the seashore or market areas. This Paper provides very useful method for cleaning and cutting different kind of fishes. It's a boon to rural women who are involved in fish selling business. Customer also gets fish cleaned and cut through a hygienic and time effective process.

V. COST BENEFIT ANALYSIS

The expected price of the product would be around Rs. 10,000/- which is a bearable cost for families involved in fish business considering it as a long term investment. If the machine yields an additional profit of Rs. 2000/- per month, which can be easily made possible, break-even can be achieved in 5 months. Further to this period, the beneficiary would be able to make profit out of the machine as high as Rs. 25,000per month, or at least double the profit without the machine, whichever is higher. The following table shows the details that exhibit a huge scale of fish business in India:



Indian Fisheries	
Global position	3rd in Fisheries
Contribution of Fisheries to GDP	1.07 %
Annual Production per year	10.8 million tons
Approximate no of people employed in fishing business	14 million
Approximate no of women employed in fishing business	6.7 million

This clearly indicates a huge benefit especially for the people involved in fish business across India. No of Beneficiaries: As mentioned in the above table, the number of beneficiaries will be 6.7 to 14 million people.

VI. PROCESS FLOW AND TECHNOLOGY

The annual per capital consumption of fish in India is around 5-6 kg. The fish eating population is found to be 8-9 kilogram, which is a poor 50 per cent of the global rates. The Indian Council of Medical Research recommends 12 kg per annum. The census of India's Population during 2018 is the seventh-biggest country and the second-most swarmed country (with 1.2 billion people or more), It is encompassed by the three oceans namely Indian Ocean, Bay of Bengal and the Arabian Sea. Two third of Indian's population consume fish approximately. Fish has been an important source of protein and other nutrients for humans. Fish has many nutrition and meditational values .It is consumed by all people irrespective of their age. Buying fish in the market and cleaning it properly place a challenging job. Many people feel hesitated to go to a wet market. Women would be the major seller in the market. Being women, it is a tough task to handling fish processing need a support and takes time for proper cleaning and cutting. Rural women do the processing manually with knife which is not safe every time. It is necessary to implement a low cost, portable, easy handle fish cutting and cleaning machine in the market. It would improve the life style of the fishing marketing women and their family. There detailed method of designing a fish cleaning and cutting is given below.

A. Hydro cleaning

Hydro cleaning, high-pressure cleaning or water blasting, are terms which describe the use of water propelled at high speeds to clean surfaces and materials.

B. Waste Management

It is very essential to manage the Waste produced during fish processing. Waste material can be of any form like solid or liquid.

- Solid wastes are the fish skin, fish bones, scales etc. The materials are not of same thickness and texture Solid. It required proper waste recycling. It can be recycled and treated in fishmeal plants or municipal waste.

- Liquid wastes in fish include blood water and brine waste etc. These are available in the drained storage tanks, and water discharges during the fish processing operation like washing and cleaning. This waste should be disposed properly without damage to the environment and the fish quality. The liquid waste disposal depends on the substance levels available as mixed waste content. The solid and organic matter, nitrogen, phosphorus, oil and grease content are some liquid waste content. The liquid treatment depends mainly on consideration factors such as acidity levels, temperature, odor and chemical oxygen demand. The level of waste management depends on volume of waste present, availability and nature of the pollutants it holds, the haste at which it is ejected during processing etc. Many countries are disposing liquid wastes directly through their municipal sewage process or directly into a waterway. This will badly affects the other municipal sewage and the waterways. This in turn will affect receiving water body it will degrade the organic and inorganic waste components. The management of liquid waste does not damage the aquatic ecosystem.

The following are the treatments levelsfor managing the waste. It can be primary and secondary treatment methods.

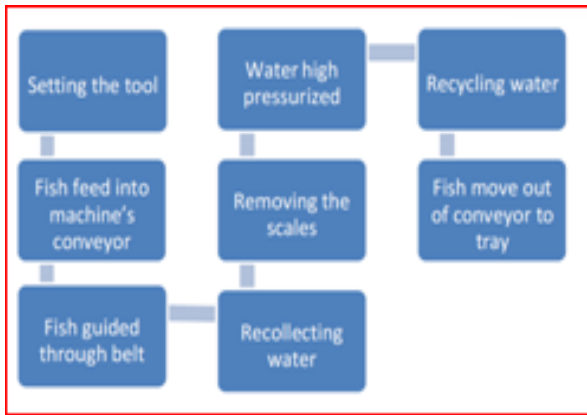
- Primary treatments are usually physical methods such as flotation, screening, and sedimentation for the purpose of oil removal, grease removal and other suspended solids removal process. The initial stage of treatment can be done in this level.

- Secondary treatments are done by biological and physicochemical way. In Biological treatment the use of microorganisms is introduce for the purpose of metabolize the organic polluting matter in the form of energy and biomass. These microorganisms will be aerobic or anaerobic bacteria. The generally used aerobic processes are activated sludge system, aerated lagoons, trickling filters or bacterial beds and the rotating biological contractors. In anaerobic processes, the microbes will digest the organic matter in tanks to produce gases like methane, CO₂ and biomass. Sometimes an Anaerobic digester are heated, with the part of the methane gas produced for the purpose of maintaining temperature of 30 to 35°C physicochemical treatments are also called as In the physicochemical treatments, also called coagulation-flocculation. In this process chemical substances are added to the effluent. This is done for the purpose of reducing the surface charges which are responsible for particle repulsions in a colloidal suspension, thus reducing the forces that keep its particles apart. These reduction in charge causes flocculation (agglomeration) and particles of larger sizes are settled and make clear effluent at the end .The sludge produced by primary and secondary treatments is further processed in digesting tanks through anaerobic processes or sprayed over land as a fertilizer for plant nourishment. After the treatment it should be note for the availability of pathogens which may available in latter case. So at most care must be exercise to make sure that the sludge is free of its pathogens.

C. Methodology



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Tools used are LabVIEW/ MATLAB software, Water Jet machine, Electronic Monitoring system (sensors, motor, pump, etc.) Components (Pump, nozzle and roller conveyor, etc.), Friction welding.

VII. RESULT AND CONCLUSION

A detailed study of Fish types was done and the data related to different types of fishes available in the market are analyzed and stored. Based on the information, simulations were carried out using Matlab / Lab VIEW. Using the software, testing and simulation were done according to the required information like Shape of cutting, method of scale removal, type of cleaning etc, and can be analyzed and verified using the simulation tools. When data acquisition (information about fish) is completed, then the details were analyzed for further processing. Design of suitable digital image recognition algorithm for identifying the shape, size and cleaning process of fish could be then made. It is necessary to design of automatic cutting equipment and cleaning equipment based on the simulation results. Cleaning of scales or removing the skin are not suitable for all the types of fish. It can however be done based on the data received. Pressure washer or power washer, Hydro cleaning, high-pressure cleaning, water blasting, etc., can be used for cleaning. First, it is proposed to introduce cleaning process then the cutting process. Cutting tools include different types of cutting tools available in the market for different applications. Cutting Process and cleaning process were selected. The final design procedure was the fabrication of system, which consist of Hardware units like cutting tools and cleaning tools with Electronic Monitoring units. Electronic monitoring units provide information related to fish for cleaning and cutting the tools attached will perform the given tasks. Cleaning and Cutting process were carried out. Any type of fish could be detected with the help of stored information. The product was verified and tested with the required fish types. The test and validation is done at the initial level once verified it could be validated in the market place and would be demonstrated to the people. This could improve the selling of fish in the market and in rural areas. Labor cost would be reduced. Rough handling of fish could be avoided. Even cutting and hygienic fish would be supplied to the customer.

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