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REVIEW: SMART AQUACULTURE FARM MANAGEMENT USING ARTIFICIAL INTELLIGENCE

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ABSTRACT

This article discusses clever fish constructions. The purpose of this essay is to demonstrate how complicated technology and temporal technology can be useful in this context, namely the usage of general intelligence (AI) in fish farming. AI mimics some of the talents of the human mind through artificial neural networks (ANN) to conduct positive responsibilities in modern aquaculture, assessing the notion of smart fishing, AI and fishing activities, size or biomass estimation, and water quality. prediction, clever analysis. The fish freshness quality assessment system employs artificial neural networks, remote monitoring, and a variety of sensors, among other programs. Fuel sensors are frequently used in environmental monitoring of vehicle business outputs, disaster avoidance, and other polluting sectors. Today's world has a fantastic There is a desire for tiny, adaptable, and cheaply priced gasoline video display systems. Provide the statistics to the fish farming supervisor via any remote platform, including the internet or a mobile device. However, due to the high quality robustness of the Arduino platform and the use of different extendable modules, the current machine can be accelerated by using a variety of modems.

KEYWORDS: *ANN- Monitoring Fish Stock – Sensors-AI- Biomass Estimation*

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INTRODUCTION

In 2016, the global fish catch reached a new record of 171 million tons. Of these products, 88% are consumed directly by humans and are crucial to achieving the FAO's goal of a world free of hunger and poverty. nutrition. However, as the world's population expands, so does the need for global fisheries (2). Smart fish farming is a brand-new health business that strives to maximize the use of ecological assets and promote long-term improvements in aquaculture by extensively integrating the Internet of Things (IoT), big data, cloud computing, synthetic intelligence, and other contemporary trends. Data technology. In addition, real-time data gathering, quantitative decision-making, intelligent management, one-time investment, and bespoke service were realized, resulting in a comprehensive version face. Overall innovation in fish. (3). The fishy smell will gradually grow after harvest, but it will never be overpowering or unpleasant. A strong ammonia stench can be caused by protein breakdown and frequently indicates old product, prolonged freezing in the garage, or possibly something that has been mismanaged in the garage(4). In some species, the enzyme trimethylamine TMAO causes protein modification and increased moisture loss upon freezing. The final product has a dry texture and an ammonia odor (5). Bacterial putrefaction, enzymatic degradation, and lipid oxidation are common causes of fish spoilage after death. Bacteria found on the surface, in the gills, and in the intestines of uncooked fish are the primary cause of seafood deterioration. After harvest, microbes infiltrate the flesh via the gills, skin, stomach mucosa, and blood vessels (6). Enzymes, such as TMAO, found in some species enable meat to melt more slowly, providing more food for bacteria and hastening deterioration. Oxygen in the air damages the oil, producing a rancid, disagreeable odor and flavor. Statistics and data are critical components of smart fish farming practices. The synthesis and superior analysis of all or some of the statistical data will allow judgments to be made only on scientific grounds. However, the vast volume of data linked with smart fish farming presents numerous issues. difficult conditions, including many chemicals, codecs, and sophisticated statistics. Many acquisitions include data about equipment, fish, the environment, and husbandry methods and people. Many codecs include text, **Images** and **sounds(7).**Statistical complexity arises from unique species, practices, and stages of cultivation. Handling the aforementioned huge, nonlinear, and massive statistics is a daunting challenge. These solutions have proven to be extremely beneficial in a variety of disciplines, including agriculture, plant-based language processing, medicine (nine), meteorology (8), bioinformatics and protection monitoring .DL falls under the realm of systems mastery, but it improves statistical processing by mechanically extracting complex and non-linear special characteristics over several layer sequences rather than requiring feature representation (9). The optimum function is constructed manually for the type of data selected, primarily based on the technology field. DL delivers modern analytics equipment to identify, measure, and analyze vast amounts of data into big statistics to enable common fish farming intelligence (10). Over the last decade, we have seen a remarkable increase in the use of electricity via computers in practically every aspect of industrial procedures. Machines are frequently used to automate processes and eliminate human contact steps in order to lessen the chance of errors (11). The concept of an automated fish farming machine developed from the difficulties encountered by this technological method**.** One issue is that manually inspecting and measuring every parameter and component of the fish pond takes a long time (12) . Another issue is that they cannot be placed in isolated regions where they can only be seen once a day, which is common nowadays, especially in very remote areas with no internet connection. This article introduces a smart IoT equipment that automates monitoring and security of fish ponds in faraway regions, with the goal of bringing it home. machine by the use of optimal remote monitoring employing Wi-Fi chat technologies such as cell phone, LoRaWAN, WiFi, or satellite TV for PC chat. This smart machine tries to minimize.

Environmental pressures on fish populations in fish ponds (13). This is a topic of energy study, and researchers have created similar structures to automate environmental monitoring around fish farms. The authors developed an automated IoT system for automated fish farming that exhibited water temperature, pH, and level via a remote Wi-Fi connection. This will present issues for structures placed far from places where cells or network connectivity must be established. To address this issue, the authors of (14) devised a sort of GSM notification that involved sending SMS messages to end users.

One of this proposed machine's shortcomings is the approach. The concept of an automated fish farming machine arose as a result of challenges with this technological method. One issue is that manually checking and measuring each fish pond parameter and component takes a long time. Another issue is that they cannot be placed in isolated regions where they can only be seen once a day (15), This is commonly the case nowadays, particularly in distant locations with no internet access. This course aims to build a smart IoT machine that will automate the monitoring and security of fish ponds in remote regions, with the goal of bringing it home. machine by the use of optimal remote monitoring employing Wi-Fi chat technologies such as cell phone, LoRaWAN, WiFi, or satellite TV for PC chat. This smart equipment intends to alleviate the environmental load on fish populations in fish ponds (16). This is a topic of energy study, and researchers have constructed similar systems that seek to automate environmental monitoring around fish farms.

The authors developed an automated IoT system for automated fish farming that exhibited water temperature, pH, and level via a remote Wi-Fi connection. This will present issues for structures placed far from places where cells or network connectivity must be established. To address this issue, the authors of (17) devised a sort of GSM notification that involved sending SMS messages to end users. One of the limits of this proposed machine is its ability to achieve intelligent statistical evaluation and processing, intelligent optimization, and decision management capabilities in fish farming using IT and diverse technologies. This page offers a full description of DL and its smart fish. Farming programs (18) . To begin, many of the aquaculture-related tourist programs covered focus on current developments in linked disciplines, with technical material offered briefly.

WHY AI IN CURRENT AQUACULTURE?

Before knowledge management **systems** and collaborative workspaces existed, **users** needed access to centrally managed and controlled databases. The advent of new technologies and the sharing of technology is entirely dependent on the productivity of a few people in a large group, which by comparison has become an incremental approach. The AI architecture can be built such that stakeholders can meaningfully contribute to the development of new technologies based on their stories, which can then be combined with the technologies developed by trials. Various medical testing, and the entire process becomes faster and simpler than before. This eliminates the necessity for a centrally managed database. The AI framework can adjust based on data gathered through tests. conducted using new techniques in transition scenarios. b) The knowledge base allows people in the research institute or company to create, collaborate, extend and access new knowledge, more often as participants, generating unexpected feedback or even create and modify new knowledge, if necessary. c) The knowledge base provides complete context for a know-how topic by structuring “what, why, who, where, during, how” queries. d) Ideally There is a demand for small, versatile, and low-cost gasoline video display systems. Provide statistics to the fish farming supervisor via any remote platform, such as the internet or a mobile device. However, because of the Arduino platform's great quality and robustness, as well as the usage of several expandable modules, the current machine can be accelerated utilizing a number of modems. at the safest level or now more. If the values are out of range, the widget displays corrective responses and also triggers action through a fully AI-based engine that reads actual corrective responses. For example, a software prototype enhanced the number of water parameters needed for Asian seabass in our hatcheries: salinity (10-30 ppt), dissolved oxygen (4-9 ppm), pH (7.5-8.5) and temperature (26-32°C). The so-called four-parameter encoding machine shop mind can check whether the obtained values lie inside or outside the manifold. The software can be combined with alarms to notify all hatchery workers if values are out of range. In addition, nuanced coding can also be decided for each parameter and the critical above or below breed values to let the hatchery staff know the exact nature of the problems related to the best water parameters. Definition and framework of a smart fish farm. The authors accept the fact that smart fish farming is an automated production method in any weather, with a complete system and in any space, that is, in cases where employees are no longer involved in fish farming, a completely new method will be implemented. The data era IoT, big data, general intelligence Artificial intelligence (AI), 5G, cloud computing, and robots are all used in large-scale fish farm or robotic management. Favors fishing institutions, equipment, and apparatus that promote optimal production and aquaculture control. Finally, smart fish farms use the virtual and intelligent era to address difficulties such as aquaculture labor scarcity, water pollution, high risk, and low efficiency. Smart fish farming is the commercial transformation of fishing production methods and the creation of future fisheries. Smart fish farms are grouped into four varieties based on their unique traditional setting: pond-shaped smart fish farms, entirely land-based smart fish farms, smart cage-shaped fish farms, and smart fish farms. Smart marine camp. The pondstyle smart fish farm captures the best water data utilizing real-time sensors and aerial drone patrols to enable fish water activities. Biological fish demonstrate the increasing popularity and manner of feeding fish. Fertilization and chemical spraying on unmanned boats improve water quality control. The bait is transported using unmanned vehicles. DO should be handled with smart aerators. Smart bait dispenser allows for exact and automatic feeding. Smart harvesting employs a computerized trawl system and fish feeders. Only When all of the structures operate together, a smart pond-shaped fish farm may be guaranteed to run well. A smart fish farm that primarily operates on land and specializes in automated recirculating aquaculture. This integrated fish farm includes microfilters, organic filters, smart feeders, aquaculture tail water filtration and utilization equipment, as well as the most modern version and technology of Smart Equipment for creating a three-dimensional aquaculture model of the fish's motions. Based on a thorough investigation of the connection between the fundamental needs of aquaculture biology and the RAS machine operating parameters, medical decision making at optimal stocking densities, water habitats Controlling green aquaculture for below-recycled ground fish requires adequate methodologies. The aquaculture method is carried out specifically through the collection of production statistics and the integration of an extensive statistical evaluation era. By incorporating cutting-edge production and breeding technologies, the fish farm ushers in a new era of precision breeding methods ideal for circular aquaculture, as well as the complete process of fish mating, egg incubation, fry rearing, individual raising, sales, and packaging. Smart cage-style fish farms use sensors to capture the most accurate data from sea and ocean water, as well as strong sonar and systems that can conceive and forecast fish motions and feeding. Feeder barges can offer bait based on water conditions, fish biomass, and eating habits. The underwater Internet is cleaned automatically by an Internet washing robot. Computerized fish Fishing is detected using automatic fish pumps and lifts. Emergency water management is best accomplished through gentle replenishment and an emergency oxygen concentrator. Fish farms are divided into floating type and stranded type. It will shape a three-dimensional aquaculture regime suitable for the water layer where unique aquaculture devices live. Lure, energy, and other crafting materials can be transported from the warehouse on land to spawning area by drone aircraft.Modern ocean data, cyclones, and numerous other marine environment data connected to fishing can be remotely detected using artificial aperture radar's early detecting era thanks to the interaction between microwaves and the microscopic form of the seabed. Drones can be used to drop bait into the air, or unmanned boats can be used to seal off the water's bottom so that farm animals can feed themselves. Deliveries of lychees to fields at sea are typically made using unmanned boats using a land-sea transfer methodology. The four different types of smart fish farms all have water and feed management systems, as well as equipment for monitoring the environment above and below water. Precision fishing infrastructure is also included in these systems.

ANALYSIS OF SMART FISHERY CONCEPT

AI and Monitoring Fish Stock

We qualify them as AI and smart fishing if they directly contribute to fishing/fishing activities, resulting in 22 articles. The fisheries articles mentioned below are written by those who have direct experience with the impact of AI on fish populations. AI has discovered advantages in counting fish species. Separating, identifying, and classifying fish components in marine environments allows researchers to get information about fish abundance. Many papers focus on class automation. Artificial intelligence is utilized to automate the fish classification procedure.

Some publications discuss fish detection architecture. To recognize and count fish items, such systems rely fully on deep network design, regardless of benthic history or light circumstances. Although there is some overlap between fish detection and identification, these automation concerns have a similar impact. Data on the species composition and abundance distribution of fish species are critical for monitoring the status and viability of fish populations. The vision of automation is smart fishing as a tool to assist in classification, Identifying, detecting, and estimating fish abundance. According to one of the publications reviewed, fish abundance is one of the most unsustainable causes for national and worldwide fishing practices. According to the publications reviewed, AI-based smart and sustainable fishing is not the most effective way to monitor fish stocks. Sustainable fishing is also related to environmental monitoring. The data show that contaminants pose a serious danger to fish populations. Furthermore, oil spills in seas and oceans, which are the principal source of pollution owing to artificial sporting activities and increased demand for oil and transportation capacity, endanger animals and aquatic flora. Song et al. also presented this information, noting that frequent oil spills cause widespread maritime pollution and pose significant risks to marine ecosystems, the environment, and fisheries. Furthermore, As global temperatures rise, there is an urgent need to research how future climate change may affect fisheries. The bulk of the research examined aimed to contextualize environmental monitoring automation by focusing on fisheries and aquaculture, primary production, and marine health. The Mediterranean Sea is one of the places focused on automating fish stock monitoring and experimenting with technological advancements. Primary production is increasingly seen as crucial to understanding Earth's largest biome. Additionally, some artificial neural networks (ANNs) can assess the impact of environmental variables on mud dispersal and compute the total volume of marine mud in the central Mediterranean Sea. Overall, the Mediterranean Sea is considered as the most effective LME for implementing AI into three environmental monitoring activities using a completely ecosystem-based approach, including fish/water, fisheries, number one production, and marine health. This will allow LMEs to recycle vitamins while maintaining expected production levels.

AI and Fishing Activity

The fishing sector has several AI applications, ranging from analyzing the economics of commercial fleets to digitally tracking traps and by catch, identifying and predicting fisheries, and simulating fishing vessel behavior. The most successful article analyzed discussed AI technology in the sport of fishing. It is difficult to understand why this type of effort was rejected. Bradley et al. stated that one of the most difficult conditions that can hinder you from adopting and integrating the most recent statistical technologies established by fisheries in all fishing sectors is

The fishermen's trust and support have been lost. For example, illegal fishing operations influence how fishermen perceive a reduction in the overall number of traps permitted each year as speculative and unneeded, resulting in dispute and mistrust between parties. Related to fishing. Fishermen's suspicion appears to be a barrier to incorporating AI technology into fishing structures that agree to record fishing activities in marine environments, allowing researchers to combine cumulative data from licensed fish traps. This setback is a positive step in the fight against illegal sport fishing. The two publications evaluated are about automating the monitoring of illicit fishing tactics. They are focusing their efforts on what could be dubbed the AI age of "returning the catch to current statistics and times," which includes tracking massive traps through illicit fishing tactics. They contend that deep-sea fishing vessels give data for monitoring seafood supplies at sea while also increasing illegal, unreported, and unregulated (IUU) fishing and trafficking. Contraband, marine transit, and illegal fishing activities. They stressed that one of the most important aspects of improved ecosystem monitoring and conservation is precisely tracking the spatial distribution of several human influences, including fishing. They point out that, while this is significant from a systems perspective, there are numerous explicit AI projects, such as monitoring marine fisheries and implementing spatial controls, including in marine areas (MPA), vast ecological and biological regions (ZIEB), and outside the closed fishing area.

Size or Biomass Estimation

Upon arrival at the fish farm, fish parameters such as number, quantity, length, and weight must be regularly checked. Bureaucratic concepts for "quantitative fish biomass estimation" of conservation strategies and medical catch management for sustainable fish production. However, it is impossible to determine fish biomass without human assistance since fish are extremely sensitive and move freely in conditions that need vision, lighting equipment, and the capacity to maintain equilibrium. There is no stopping the overall decline. In the context of intelligent fish farming, recent tourism projects that focus on aquaculture knowledge offer substantial opportunity for large-scale sampling. Deep learning, combined with machine creativity and foresight, can enhance estimations of fish morphological traits as period, width, weight, and area. The programs were described as semi-supervised or monitored by the majority of participants. For instance, the size of European cod, blue cod, and pollock (Pollachiusvirens) was determined using the Mask R-CNN structure. Another indirect method to measure a fish's length is to use the DL to locate the fish's head and tail first. version, then calculate the fish's period based on that**.** Although this method increases the workload, It is suitable for more complicated photographs. The structural qualities and computational capabilities of the DL model can be completely utilized to obtain superior performance when compared to other models. Furthermore, techniques based on global DL can delay the overlapping effects of fish during the period estimation procedure. Fish schools can also help improve smart constructions. DL has been useful in animal computing. Fish distribution maps can be created using DL to acquire computerized counts of high-density fish groups and general congestion characteristics; then, the distribution, density, and number of fish can be determined. These numbers can indirectly represent the fish's condition, including malnutrition, aberrant circumstances, and other states, therefore giving significant reference information for feeding or harvesting decisions plan. The age of the fishing school is another important aspect of the fisheries evaluation model. The latest method for evaluating the age features of fish populations is guided otolith age examination, which is a meticulous and well-proven procedure. By utilizing a pre-trained CNN to estimate fish from otolith images, the DL method can also reach the necessary prevalence rate. Much faster, but with accuracy comparable to that of human specialists. Two widely used methods for calculating fish biomass are optical imaging and sonar. A set of DL rules can be used to automatically examine the transition between the ultrasound and optical images, creating a "daylight" image that blends the CCTV and ultrasound images. A similar online evening. This method can be used to precisely count the quantity of fish in various programs.

Water Quality Prediction

It is vital if you want to anticipate changes in water best parameters to detect common events, avoid disease, and reduce the corresponding risks to fish. In real-world aquaculture, the aquatic environment is characterized by numerous characteristics that interact with one another, causing considerable challenge inside the forecasting methodology. Large datasets are known to cause a well-known loss of long-term modeling functionality and generalizability as well as the difficulty of traditional machine learning-based fully predictive models to mirror the crucial aspects of the datasets due to their lack of robustness. On the other hand, nonlinear approximation, self-mastery, and generalization are domains where DL offers exact skills. Deep learning-only prediction systems have gained popularity in recent years. But for short-term water best projections, most modern approaches have yielded the most accurate findings. Long-term projections have piqued the curiosity of students more and more in recent years. Finding the spatiotemporal correlations between the water's best features and external factors is essential for long-term prediction. Consequently, spatiotemporal kinds utilizing RNNs and LSTM networks are highly favored. For instance, an interest-based fully RNN model has a higher mastery potential than other techniques for both short- and long-term dissolved oxygen forecasts, and it can generate a clear and effective representation of time-area relationships. To increase the accuracy of these fashion predictions, they can be refined continuously during the forecast process. The prediction of dissolved oxygen and other ideal characteristics of water are directly related to time. DL models with attention-equipped LSTM, DBN, and others can mine time series data efficiently and generate high-quality output. Consequently, employing DL approaches helps prevent or lessen the adverse effects of uncertainty factors on forecast results.

An Intelligent System for Assessing Fish Freshness Quality Using Artificial Neural Networks

Fuel sensors are widely used in a number of applications, including environmental monitoring of vehicle enterprise outputs and disaster avoidance and other pollutant-related industries. In today's world, there is a great demand for small, flexible, and reasonably priced gasoline video display systems. For example, gasoline detection plays an important, if not vital, role in a variety of areas, ranging from food safety to environmental tracking; one of the most well-known examples is hearth alarms that are solely dependent on CO detection. Another potential application of such a sophisticated gasoline sensor equipment is environmental protection. The spread of gaseous emissions from a chemical reaction or combustion can be detected and tracked using a cell or desk-bound network of gasoline sensor structures.

Remote Tracking and Different Sensors

Present-day IoT devices are unable to transmit data to the supervisor of fish farming using any remote platform, including the internet or a mobile platform. However, the current machine can be accelerated by using multiple types of modems because of the excellent quality, robustness of the Arduino platform and the usage of multiple expandable modules. We made the decision to utilize the Wivity module in our case, which enables computer chats via internet access via satellite TV, GSM, Wi-Fi, or LoRa WAN. This may be especially important in the case of fish farming ponds since the area around the pond may be quite far away and there may not always be a cell and thus no net communication. More significantly, the Wivity fish farming managers can connect several fish ponds in various locations, making it simple to select the modem that works best in that area without requiring you to modify the code. This device's electrical flexibility is another issue. The instrument also has a micro-USB connector for improved power delivery. The next element that makes connections faster and more dependable is the ability to switch between fixed and mobile antennas. The tool has an integrated SIM module and helps with Java execution on board as well. Relationally speaking, it features an integrated protocol stack that offers clear and opaque TCP/UDP buyers and servers in addition to DNS, SMPT, FTP, HTTP, and ping the buyer. The program's usage of TLS for all previous protocols, which enhances security for Internet of Things devices, is another noteworthy aspect. When an HTTP request is submitted to the Wivity modem over the USB or serial interface, an IoT device and this module often interact. Regardless of the used discussion community, this HTTP server, which is housed at the Wivity modem, transmits statistics to the backend cloud server. For all of this to function, We can give end users access to additional features by utilizing improvement kits such as SIGFOX. In addition to this deposit for remote tracking and management, a utility interface for an internet or cell utility, if you wish to suggest the renown of the pond, will provide the chance to set a few new values to the machine's parameters, such as new minimum and maximum temperatures, operating hours that are mild, etc., have to enable the end-user to have an even better experience. Sending SMS texts for the most important tasks could be one such choice. might put the fish habitat at jeopardy. The addition of new sensors to the machine with the aim of enhancing fish quality and productivity is another crucial element. In our quest to enhance the IoT device, sensors that detect pH or dissolved oxygen come first. The PH detector

Similar to the sensor that was provided, this one is crucial because it gauges the water's acidity. it has to remain between six and eight. A pH of less than 5 makes the water too acidic for the fish, which can lead to a number of illnesses include tissue coagulation necrosis, acid erosion of the gills and tissue, and finally death. Another essential element of fish farming ponds is aeration, or the measuring of dissolved oxygen. This measure indicates the amount of dissolved oxygen in the water. Temperature, stress, and salinity all contribute to its low state. It is employed in the chemical oxidation of minerals, fish respiration, and the aerobic degradation of natural materials. Fish population growth will be slowed or prevented by low dissolved oxygen levels. The fish will intentionally die if it is not patient enough. While there are other sensors available, DF Robot has already developed one specifically for the Arduino platform. Utilizing this sensor to connect to an air pump and mechanically modify the water's oxygen content is an additional concept. You can change the pump's current by increasing or decreasing it based on the amount of dissolved oxygen..

CONCLUSION

Synthetic impartial networks to a degree reflect the capabilities of the mind, consequently the water best control machine also can use the equal standards in figuring out the variety for the 4 Water parameters can be obtained through the entry layer using the YSI tool. The software program code captures the values via a hardware interface, and after the values have been collected, the hidden (or logical) layer performs the logical computations using various "if" "else" circumstances to test whether or not the numbers are in the most reliable variety or no longer. If the data are out of the range, then the utility gives corrective replies and at the same time activates an action using an AI primarily. Based solely on a tool that delivers actual remedial responses. They underline that accurate monitoring of the geographical distribution of multiple human impacts, including fishing, is a critical task in cutting-edge ecology and conservation management. They argue that, while crucial from a systematic standpoint, there are numerous visible AI projects, such as tracking marine fisheries and enforcing spatial control measures, such as marine protected areas (MPAs), Ecologically and biologically massive areas (EBSAs) are in addition to fisheries exclusion zones. Goal popularity can be evaluated from otolith images using a deep learning approach and a pretrained CNN. Precision is comparable to that of human specialists, and it is far faster. Optical imaging and sonar are routinely used to assess fish biomass. A DL set of rules can be used to automatically evaluate the conversion The link between sonar images and optical photographs allows for the creation of a "daytime" image from a sonar photograph and a comparable nighttime imaginative and prescient digital camera shot. This method can be used appropriately to count the number of fish, among other applications. Fuel sensors are frequently used in environmental monitoring of vehicle business outputs, disaster avoidance, and other polluting sectors. Today, there is a high demand for tiny, adaptable and affordably priced gasoline-powered television display devices. Provide the statistics to the fish farming supervisor via any remote platform, including the internet or a mobile device. However, due to the high quality robustness of the Arduino platform and the use of different extendable modules, the current machine can be accelerated by using a variety of modems.

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