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Fish Disease Detection to Sustain Hatchery and Pond Production System

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Abstract

Diagnosis of fish disease in aquaculture is a necessary process and needs an exceptionally high level of competency to sustain hatchery and pond production systems. Developing an system to overcome the challenges faced by fish farmers in stopping the spreading the disease that leads to economic loss, is a crucial task. A crucial initial phase in preventing the spread of disease is early identification of diseases in fish. The fish disease usually propagates quickly through the water, affecting large numbers of fish and causing financial loss to the farmers. Since tilapia aquaculture is one of the methods for producing food that is expanding the quickest and has the highest export value, we'd like to know more about the fish disease that affects this sector. The research uses the pathogen-infected fish. System is developed by working perfect image processing and machine learning techniques together. The proposed work has two phase. Image pre-processing has been used in the first phase to, respectively, reduce distortion and magnify the image. In the second section, the system extracts the relevant information and uses machine learning approaches for recognising the diseases. A trained machine learning model has been deployed to the first fraction's processed images. Then, using the chosen fish image dataset to study the fish disease, the research integrates an extensive experiment combining different methods.

Keywords: Fish Disease, CNN, VGG16, Aquaculture, Diagnosis.

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1. Introduction

The nation's food production is heavily impacted by fisheries and aquaculture, preserving the dietary integrity of the food supply, boosting agricultural exports, and employing nearly fourteen million people in various occupations. In India, there are 1.907 million reservoirs, Aquatic ponds and tanks encompassing 2.36 million hectares, 0.798 million ha of floodplain lakes, 195 210 km of rivers and canals, and other resources that could be used for aquaculture. Ponds and tanks are the main sources of freshwater aquaculture, but only around 40% of the attainable region is now exploited for this purpose. The biggest hazard to aquaculture is disease. Due to disease issues, a loss of between 10% and 15% of production costs may be experienced. To stop the disease from spreading, it is important to maintain ponds and hatcheries. Fish mortality is frequently observed as a result of inadequate management of ponds and hatcheries. Infection and mortality are strongly influenced by the pond environment, notably the water quality in ponds and hatcheries. The diagnosis of fish disease is a challenging process that requires much knowledge. Any effort to create a system for diagnosing fish diseases and overcoming obstacles has so far been without particularly notable success. To stop the spread of disease, it is important to identify sick fish as soon as possible. In aquaculture ponds, parasitic, fungal, and bacterial diseases are the main health issues.

2. Background

Fish farminghas become a major part in contributing to the Indian economy. The Fish breed Tilapia is widely used today in the fish farming due to its high exporting value and rich vitamin content. The Fish tilapia is mostly cultivated in ponds residing in acres of land. In Kerala, most of the Tilapia farming is done in extensive as well as intensive ponds.

Figure 1. Baby Tilapia

There are numerous bacterial and viral infections that affect the fishes . Tilapia lake virus is one of the most common viral diseases affecting tilapia fish. It is brought on by a pathogen that is extremely infectious and is bad for tilapia farming. As this microorganism has caused high fish mortality rates and significant negative economic effects on the aquaculture of tilapia, this virus, which was discovered in 2014, has drawn enormous attention from the aquaculture business worldwide. Aeromonas, streptococcosis, and columnaris infections are the resultant bacterial infections.

Figure 2. Kerala Natural Fish Ponds

Figure 3. Intensive Ponds

3. Related Works

Method [1] Image Processing Methods for Fish Disease Identification. The system acknowledges and differentiates regarding the fungal pathogen Aphanomyces invadans and the ailment known as EUS (Epizootic Ulcerative Syndrome). Real photos from the EUS - diagnosed fish database have been used in experiments conducted in the MATLAB environment. The paper finalises that the suggested integrating gave better accuracy after making utilisation of the machine method of learning. PCA helped in increasing the accuracy. In Approach [2] .utilising machine learning to identify and break down fish conditions. Fish illnesses are identified and diagnosed using probabilistic neural networks (PNN) in order to help aquaculture business owners. The article concludes that, after using the machine learning technique, the advocated combination delivered greater accuracy. PNN helped in increasing the accuracy. Another Approach [3] Fish Disease Detection Using Image Based Machine Learning Technique in Aquaculture. Involved features extracted to classify the diseases with the help of the Support Vector Machine (SVM) algorithm of machine learning with a kernel function. Approach [4] Automatic Recognition of Fish Diseases in Fish Farms. This approach is proposed to automatically recognize and identify three different types of fish diseases. The objective is to proactively detect and manage fish infectious diseases in fish farms. The computer known as the Raspberry Pi package is being used, and sensors, a camera, plus a desktop or laptop computer are fastened to it. Approach [5] AI Techniques for Detecting Abnormal Behaviours in Underwater Fish presents an approach for detecting fish anomalous activity underwater that combines fish tracking, deep learning object detection, directed cycle graph, and DTW (dynamic time warping). Approach [6].Creation and Use of Distant Fish Disease Skilled Video Monitoring Technology. Employing internet technology for communication, a live and remote fish illness video evaluation expert system may convey the morphological details, fish disease traits, and aquaculture ambient conditions to the suitable, distant digital experts. Approach [7] , a sophisticated fish illness monitoring mechanism Bayesian decision-making is used to make the diagnosis, and the users subsequently receive the analysis's results and precautionary measures through SMS. Approach[8] A simulation of infectious disease dynamics in an aquaculture facility using an agent-based model showed a simulation of the transmission of an a contagious condition in an infrastructure for fisheries using an agent-based model. The model enables us to investigate how sensitive the infectious disease is to variables like fish density, infectious radius, shedding rate, etc.

4. Data Collection

The dataset was collected by taking the pictures of the fish tilapia both healthy and unhealthy from the fish farms. The various unhealthy images were collected.4 types of diseased fish images was collected from various sources. The disease include streptococcus, tilapia lake virus, columnaris and Aeromonas. The image augmentation such as geometrical transformation was done in order to increase the dataset and to improve the accuracy.

5. Proposed Work

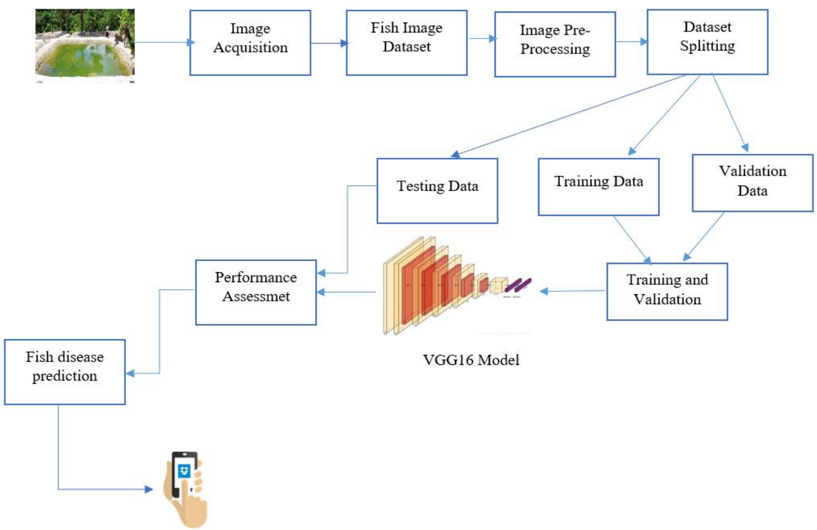


Figure 4. System Architecture

5.1 User Management Module

The user module enables the fish farmers to register to the application with their user id and password. After the completion of the registration process the farmers can login with their valid credentials in order to access the application. The images of the fishes has to be uploaded in order to determine whether the fish is healthy or not. The users can get the health status and the type of disease along with the necessary precautions through this module.

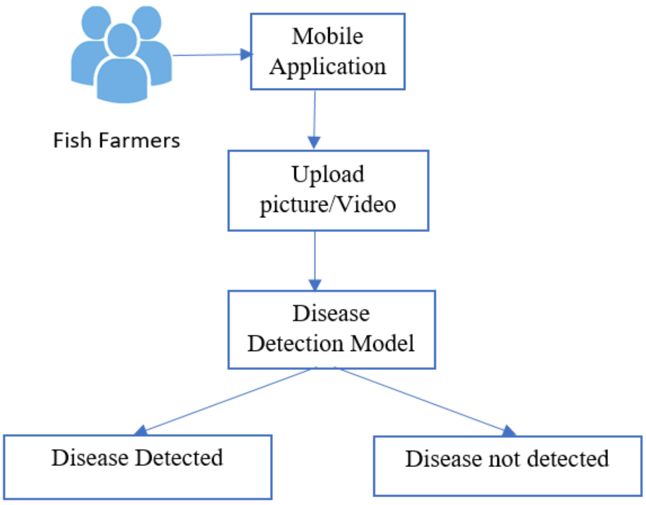


Figure 5. User Management Module

5.2 Admin Management Module

The admin can login with their valid credentials to access the application. The Admin can view the details of the registered users and can manage the users. The images uploaded by the users can be managed by the admin.

5.3 Fish Disease Detection Module

This module plays the major role in the detection of the fish disease. It consists of the sub modules such as Image pre-processing, color space conversion, feature extraction and image classification. The Image pre-processing is done by gathering the images of the dataset, renaming the pictures according to their classes, merging them into a folder, resizing the images and converting all images into the same file format. The image extraction and classification is done by VGG16 CNN model. VGG16 is a deep convolutional neural network involve 16 layers that have been combined multiple times 3*3 convolutional layers and 2*2 pooling layers repeatedly, and VGG16 has an incredible quality the potential of extraction to generate beneficial outcomes in image characterization of the system to detect the disease of infected fishes.

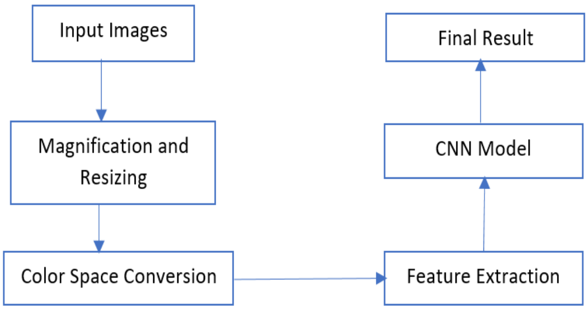


Figure 6. Disease Detection Module

5.3.1. Level-1 Data Preprocessing

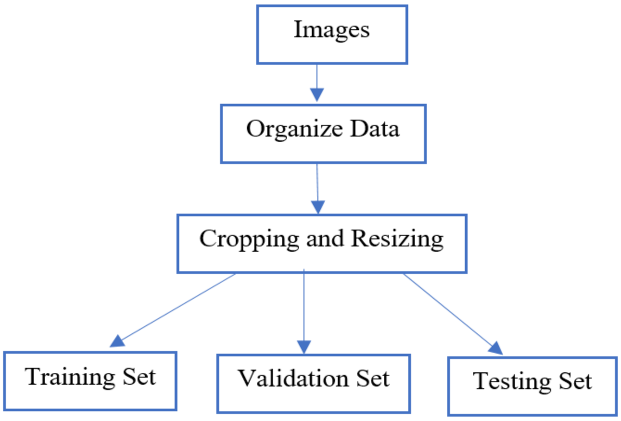


Figure 7. Data Pre-processing

5.3.2. Level-2 Colour Space Conversion

The translation of a colour's representation from one basis to another is known as colour space conversion. Chromaticity coordinates of the supplementary its primary colours for red, green, and blue define an RGB colour space. White point chromaticity, a common type of illuminant. The tone response curve (TRC), commonly referred to as the transfer function or gamma, transfers chromaticity to tristimulus values.

5.3.3. Level-3 Feature Extraction and Classification

Feature extraction seeks to reduce the number of features in an analysis through the extraction of additional attributes from current ones. The retrieved feature signals used by the neural network for classification are applied to the input image.

6. Experimental Results

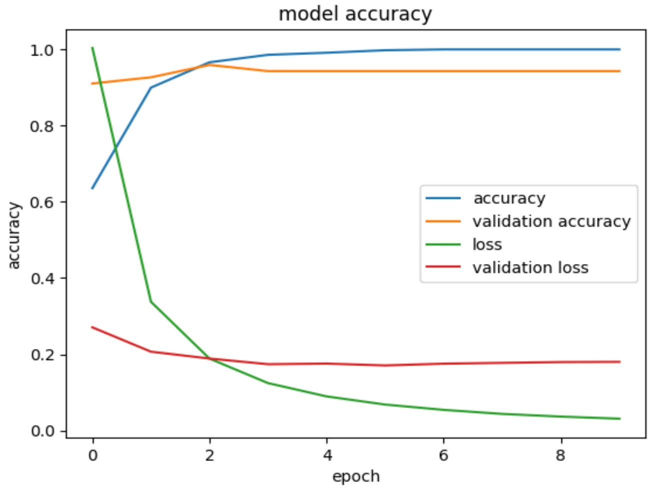
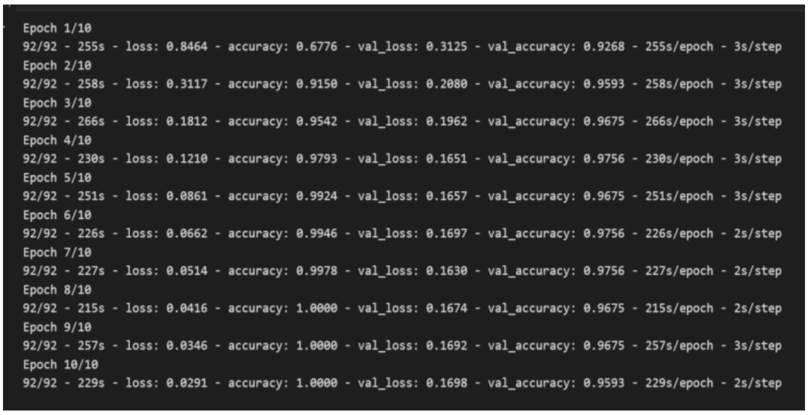


Figure 8. Accuracy Visualization

the research has used 918 samples for learning the architecture and 80 examples to evaluate it. Figure 9 displays an analysis of the experiment's training accuracy at an average rate of learning of 0.001. Fig. 8 demonstrates the graph as an overview.



```
Epoch 1/10
92/92 - 255s - loss: 0.8464 - accuracy: 0.6776 - val_loss: 0.3125 - val_accuracy: 0.9268 - 255s/epoch - 3s/step
Epoch 2/10
92/92 - 258s - loss: 0.3117 - accuracy: 0.9150 - val_loss: 0.2080 - val_accuracy: 0.9593 - 258s/epoch - 3s/step
Epoch 3/10
92/92 - 266s - loss: 0.1812 - accuracy: 0.9542 - val_loss: 0.1962 - val_accuracy: 0.9675 - 266s/epoch - 3s/step
Epoch 4/10
92/92 - 230s - loss: 0.1210 - accuracy: 0.9793 - val_loss: 0.1651 - val_accuracy: 0.9756 - 230s/epoch - 3s/step
Epoch 5/10
92/92 - 251s - loss: 0.0861 - accuracy: 0.9924 - val_loss: 0.1657 - val_accuracy: 0.9675 - 251s/epoch - 3s/step
Epoch 6/10
92/92 - 226s - loss: 0.0662 - accuracy: 0.9946 - val_loss: 0.1697 - val_accuracy: 0.9756 - 226s/epoch - 2s/step
Epoch 7/10
92/92 - 227s - loss: 0.0514 - accuracy: 0.9978 - val_loss: 0.1630 - val_accuracy: 0.9756 - 227s/epoch - 2s/step
Epoch 8/10
92/92 - 215s - loss: 0.0416 - accuracy: 1.0000 - val_loss: 0.1674 - val_accuracy: 0.9675 - 215s/epoch - 2s/step
Epoch 9/10
92/92 - 257s - loss: 0.0346 - accuracy: 1.0000 - val_loss: 0.1692 - val_accuracy: 0.9675 - 257s/epoch - 3s/step
Epoch 10/10
92/92 - 229s - loss: 0.0291 - accuracy: 1.0000 - val_loss: 0.1698 - val_accuracy: 0.9593 - 229s/epoch - 2s/step
```

Figure 9. Model Accuracy

The model was retrained for the increment of the accuracy. The accuracy was increased from 95.42 to 97.93 and 97.93 to 99.24 and so on after the retraining of the machine learning model.

7. Implementation

The Django framework for Python was employed to develop the system. Tensor flow, Keras, and OpenCV were some of the Python libraries utilised in the image processing. The machine learning platform called Tensor Flow is simple to master. Fully linked layers make up the CNN's top layer. These layers are produced in Keras using the dense category. The data is conserved in Django SQLite's built-in database.

Table 1. Similar System Comparison

SYSTEM	METHODS	ACCURACY
[3]	SVM	91.42%
[7]	BAYESIAN METHOD	85%
PROPOSED APPROACH	CNN	99.78%

8. Conclusions

This system will definitely help the farmers who deal with the fish cultivation in order to meet their daily needs. This system is expected to reduce the mortality of the fish breed Tilapia which are mostly cultivated in Kerala. The system automatically detects the diseased fish and notifies the farmer by providing the necessary steps to be taken in order to prevent the disease from spreading. By providing more dataset of the fish tilapia to the machine learning model the accuracy can be again improved. In future this model can be trained my using more species and can be used to detect the health status of more fish species.

9. Future Scope

The disease of different fish's species can be classified and predicted by increasing the dataset. Fish growth can be analysed in order to bring out good healthy fishes. The water quality suitable for the fishes can be tested and thus maintaining a healthy fish production system with zero loss to the fish farmers can be achieved.

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