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A SURVEY OF UNDERWATER FISH IMAGING TECHNIQUE

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Abstract

Underwater ecology to visualize is the important aspect of image processing in which different anatomical structure are of underwater images. Sometimes it becomes very difficult or impossible to detect or visualize fishes from underwater images/video by using simple imaging. The numbers of virtually all fish square measure declining and lots of square measure already vulnerable. To assist these species to survive, their environs ought to be strictly protected. This may be achieved by strictly observation them. Throughout this course, many parameters, constraints concerning the species and its environments square measure centered. Now, advances in detector technology facilitate the observation of species and their environs with less expenditure. Indeed, the increasing sophistication of underwater wireless sensors offers possibilities that change new challenges in an exceedingly heap of areas, like police work one. The approach has been tested on under-water images representing a variety of challenging situations typical of the underwater environment, such as background interference and poor contrast boundaries. The results obtained demonstrate that the approach is capable of overcoming these limitations and capturing the fish outline at sub-pixel accuracy.

Keywords— Fish Detection, Fish Classification, Video Object Detection, Underwater Object Detection, Tracking.

I. INTRODUCTION

The field of detection within the marine setting may be a hot topic since a few years, because of the properties of below water and also the limitation of human access during this setting. Oceans cowl most of the surface of the planet. It cowl just about one third of the surface of the earth. Historically, fish stocks within the oceans square measure ascertained by sampling with nets from analysis vessels. This needs tons of piece of work and vessel time, since all fish square measure separated by species and counted manually [1]. Fish detection plays a vital role in understanding of underwater ecology and fish behavior in addition on keep a log of species that is wide applied to fish police investigation in fisheries. In fisheries, individuals explore for fish from underwater videos and pictures to observe the expansion and quantities of fish. However the employment of artificial looking out of fish from videos and pictures is large. The detection of moving objects in an exceedingly scene may be a well-researched however looking on the concrete analysis still typically a difficult pc vision task [2]. Replacement human manually with pc mechanically is a vital half to chop the employment and lift potency. Recently, Scientists must apprehend the behavior of fish populations in underwater. Underwater video observation systems are of interest from several marine biologists in recent years for marine video police investigation. The benefits of video observation system over the manned videography or net-casting ways square measure that it doesn't influence fish behavior and provide an outsized and elaborated field of read through video knowledge. we are able to use this knowledge in marine closed-circuit television as an example to classify and estimate fish species or to research fish behavior. It's tough to human to manually analyze the huge amount of video knowledge. It's a time intense and error prone method. That's why AN automatic fish identification system that uses videos makes it easier to estimate fish amount and its existence. Fish Species classification is of nice utility to marine biologists for the understanding of underwater ecology and fish behavior in addition on keep a log of species that assists in fisheries management.

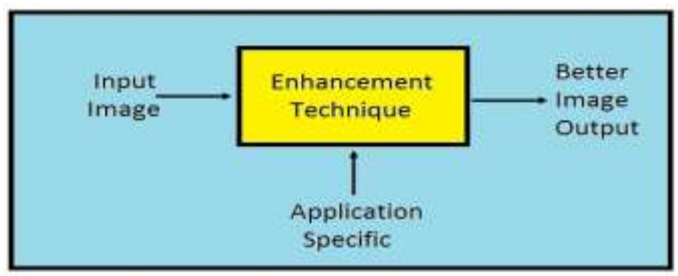

Fig 1: Basic block diagram of image enhancement

As mentioned earlier, underwater acoustic wireless sensing element networks is employed in a range of various applications, because it is finished by frequencies air networks. The subsequent square measure a number of the main areas:

• Environmental observation. Pollution is today one in every of the main issues, oil spills from ships or broken tubes will create tons of hurt to the marine biological activity, the business and tourer places. Observation ecosystems will facilitate understanding and predicting the human and climate or weather result in underwater setting.

• Underwater Navigation. The sensing element accustomed create routing, characteristic hazards on the seafloor, rocks or shoals in shallow water,

• Motor-assisted Navigation. Sensors is placed to spot hazards on the ocean floor, find dangerous rocks or shoals in shallow waters, mooring positions and drawing the measurement profile of the realm.

• Underwater Discovery. Underwater wireless sensing element networks is accustomed notice oilfields or reservoirs, find routes for putting connections for worldwide submarine cables. conjointly they may search for shipwrecks or anthropology or lost sink cities.

• Hindrance of natural disaster. By mensuration the unstable activity from completely different remote location the sensors might tune in to the coast places by detection moving ridge or submarine earthquakes alarms.

• Underwater Autonomous Vehicles (UAVs). Distributed sensing element in movement will facilitate observation space for police investigation, recognition and intrusion detection.

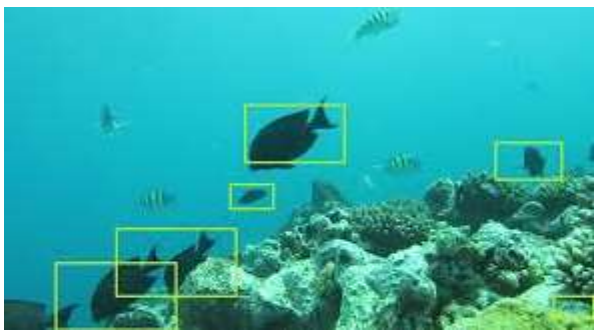

Figure 2: Fish detection.

II. Related Work

This paper [3] Illumination changes, non-stationary backgrounds and similar looking background pixels and foreground pixels form a complex background and pose a great challenge to the process of detection of moving objects from the video sequence and produce erroneous results. This algorithm will prove useful in various applications like video surveillance, traffic monitoring and controlling systems, human interaction systems and automation of industrial methods. The first step in such applications is differentiating the foreground object i.e. the region or object of interest from background objects that is the complementary set of pixels. Background subtraction is one of the simplest and most widely used methods for detection of moving object from a video sequence. Any background subtraction algorithm demands a stable background for efficient performance which makes the use of existing approaches very difficult in complicated real time applications. FCDH based background subtraction mechanism is proposed in this paper which uses a patch level approach instead of pixel level [16]. The color difference histogram (CDH) is computed in a locally existing small neighborhood which deals with the problem occurring due to dynamic backgrounds (e.g. running water, waving trees). The growing importance is a result of its application in fields like human tracking and activity recognition systems, video surveillance, traffic monitoring and controlling systems etc. The detected object can be further tracked using a simple frame difference method giving more information about the detected object. Detection of objects in motion from any video stream does not require any prior stored database but only multiple consecutive frames. In this paper, algorithm will work robustly in complex environments such as non-stationary backgrounds, varying illumination, frames with camouflage etc. Background modeling is done and foreground is detected using similarity matching. The video streams are analyzed for extracting useful information and that information is further used in other high end applications. Using this approach the focus is laid on the color difference and not on the color magnitude. Then, fuzzy c-means clustering (FCM) is employed to obtain fuzzy color difference histogram. In this paper an approach based on color features is proposed. The object is further tracked using frame differencing. This can be used in any high end applications leading to complete automation of systems. This helps to overcome the impact generated due to change in illumination (sudden or gradual). FCDH shows promising results by bringing down the number of false errors. This has become a dynamic area of research in the field of computer vision.

This paper [4] used system can detect and track fishes with 48.94 percent accuracy in videos, and it can identify fishes in high resolution still image with 91.7 percent accuracy where as in the low quality video fishes are detected with 40.1 percent accuracy Our main learning from this experiment would be, the challenges that we face while modeling a visual computing based machine learning system. In this research they can detect/track fish in low quality underwater video with 48.94 percent accuracy, and Average accuracy of fish species identification of the proposed system in low quality under water video is 40.1 percent. Detection is performed using GMM based background subtraction method, classification is performed using Pyramid Histogram Of visual Words (PHOW) features with SVM classifier and finally identified fishes are tracked using "Kalman Filter". Inherently and image based system will have the advantage of on-board processing of various image stabilization techniques that are available in still cameras. Specially, the differences that we observe in the performance of image based system and video based system. Above everything illumination variation in underwater video is one of the most challenging issue while detecting and/or tracking fishes in video. However, it showed an excellent recognition accuracy of 91.7 percent in good quality still images. To extract features to express fish images we used Pyramid Histogram Of visual Words (PHOW) [27] features. In order to capture spatial layout, Lazebnik [28] proposed pyramid histogram of visual words. First task in the monitoring process is to detect underwater moving objects as fishes. We have used state of the art, mostly illuminant invariant feature extraction techniques Pyramid Histogram Of visual Words (PHOW). Third task is to track the detected fish to avoid multiple counting and record their activities. Moreover, there is the issue of motion blurriness in video to still image conversion. Second Task is to identify the species of the detected fish. In this paper we propose an automatic marine life monitoring system. This experiment is performed using data-set from the CLEF 2015. Thus usually videos are of low resolution then still images. However, they have their limitations.

This paper [5] is a theoretical model of real fish occlusion tracking, imaginary fish occlusion tracking, and real and imaginary fish concurrent occlusion tracing based on the following methods: the plan mirror imaging principle, and basic techniques of image processing such as target segmentation. The results show the effectiveness of the proposed 3D fish target occlusion tracking Model. This paper derives systematically a mathematical model of real fish occlusion tracking, imaginary fish occlusion tracking, real and imaginary fish concurrent occlusion tracking, according to each type of occlusion situation. This is achieved by using the single-camera tracking method of fish groups, and analyzing the occlusion condition of fish, fulfilling the work beforehand for fish target behavior analysis, and we verify the correctness of the theory by our experiment. This method has a higher precision compared with previous methods as in [25] [26]. Using this model, we aim to achieve 3D fish tracking without occlusion, fulfilling the requirements beforehand for fish target behavior analysis. To achieve multi-target tracking, this paper proposes an occlusion based method of fish tracking based on water quality testing platform. Multi-objective shining positioning and tracking technology is essential to behavior analysis in fish tracking.

This paper [6] demonstrates that the approach is capable of overcoming these difficulties and capturing the fish outline to sub-pixel accuracy. In this paper, an automated approach for the detection of fish from underwater images has been proposed, developed and tested. The results show that level sets can be used to delineate fish outlines from underwater images if the shape information of the fish species is incorporated into the level- sets energy functional. Furthermore, it was found that an energy function that is independent of image gradients and includes the shape model is able to overcome various kinds of disturbances and the problems related to low-quality images recorded in the underwater environment, such as poor contrast and uneven illumination. The shape information of fish is incorporated into the level-sets formulation through the PCA method to overcome such limitations as poor contrast boundaries, background clutter and occlusions caused by neighboring fish. The Haar classifier is used for precise localization of the fish head and snout in the image, which is vital information for close-proximity initialization of the shape model. The techniques developed here have clear potential to be extended to wild habitats provided that the deformation of the fish body and movement information derived from image sequences is taken into account. The approach has been tested on underwater images representing a variety of challenging situations typical of the underwater environment, such as background interference and poor contrast boundaries. To provide a close initialization for the shape model, the pose of fish in the image is determined using the Haar classifier. In this paper an automated approach for fish detection, using a shape-based level-sets framework, is presented. The developed approach has been applied to 35 samples of varying quality and levels of occlusion, and includes a quantitative evaluation of the results using three buffer-width values. Knowledge of the shape of fish is modeled by principal component analysis (PCA). Underwater stereo-video systems are widely used for the measurement of fish. 9, causing the fish detection approach to break down. In wild habitats, fish can move in any direction with large deformations occurring in the body. It comprises a region-based level-set method that enables the delineation of the fish outline. The current approach is developed to detect SBT in a farming aquaculture environment. However, the effectiveness of stereo-video measurement has been limited because most operational systems still rely on a human operator.

This paper [7] uses multithreading fuzzy c-mean (MFCmean) method which is able to track more than one fish with high detection rate as compared to existing approaches and give the result that the proposed method can able to track and detect underwater fishes with high detection rate. This paper proposed a multi-threading fuzzy c-mean (MFC mean) approach to detect multi-moving fishes in a noisy and dense condition. The Matlab results show the detection rate of 98.35% with multithreading which is higher than generalized multithreading parallel approach. In this approach, we combine the multi-threaded parallel (MTP) approach and kernel based approach for optical flow. Previously many algorithms are used but they are suffered in complex textures and low detection rate. The drawback of this method [30] is to work quickly for small displacement. Fuzzy c-mean algorithm [32] for intensity difference is chosen to solve the problem of inaccurate estimation of motion boundaries [31].It is able to track the objects even if their motion is erratic and fast. A fuzzy c-mean concept provided as a supporting factor. That can be analyzed in noisy environment. Recently, Scientists needs to know the behavior of fish populations in underwater.

This paper [8] main object detection is an important process in image processing; it aims to detect instances of semantic objects of a certain class in digital images and videos. In this paper researcher present a method for preprocessing and fish localization in underwater images. Object detection has applications in many areas of computer vision such as underwater fish detection. These images are split into regions utilizing the mean shift algorithm. We are based on a Poisson–Gauss theory, because it can accurately describe the noise present in a large variety of imaging systems. For each region, statistical estimation is done independently in order to combine regions into objects. In the preprocessing step we denoise and restore the raw images. The proposed approach outperforms state of the art methods. The method is tested under different underwater conditions.

This paper [9] contrast to the state-of-the-art methods, which operate on single input images, our method makes, use of explicit image set matching which renders it robust computationally. The classification of fish species gives an accuracy of 91.66% which is very high compared with the other current methods used for this application. Generally, the classification of underwater images is challenging due to difficulties in camera calibrations, which lead to distortion, background noise, occlusion, and image quality to name a few [17]. Fish Species classification is of great utility to marine biologists for the understanding of underwater ecology and fish behavior as well as to keep a log of endangered species, which assists in fisheries management. The method couldn't achieve 100% accuracy as some images couldn't be classified accurately due to the effect of background noise. In comparison with the previous classification methods, this method results in considerable discrimination accuracy improvements. Traditional methods being either tedious or too computationally intensive lead to the requirement of an automated method of analysis and counting.

This paper [10] use of protocol by analyzing changes in the subcellular distribution of RNAs and proteins in cells exposed to a variety of stress conditions. Here we provide a detailed protocol to perform multicolor RNAFISH in combination with IF to simultaneously detect the subcellular localization of RNAs and proteins in cultured cells under diverse conditions of cellular stress. Here, we provide a user-friendly step-by-step protocol to perform multicolor RNA-FISH in combination with IF to simultaneously detect the subcellular localization of distinct RNAs and proteins in cultured cells. We describe conditions and reagents used in our laboratory to image abundant cellular RNAs, such as 18S and 28S ribosomal RNAs, as well as polyadenylated mRNAs, and monitor their characteristic localization using fluorescently labeled, linear LNA/DNA oligonucleotide probes. We further show that the presented RNA-FISH conditions are also compatible with in vivo labeled GFP-fusion proteins, allowing endogenous fluorescent tagging and imaging of proteins of interest. The RNA-FISH to detect the localization of poly(A)-mRNAs and 28S rRNAs. Subsequently we performed IF using primary antibodies for CELF1 and DDX6, a helicase known to specifically localize to PBs [29]. Fluorescence in situ hybridization (FISH) and Immune fluorescence (IF) are sensitive techniques used for detecting nucleic acids and proteins in cultured cells. The protocol is compatible with subsequent IF application, allowing for the detection of proteins of interest within the same experiment. In conclusion, our method is a simple, robust, and flexible tool to study the co localization of RNAs and proteins. It is suitable for studying the impact of cellular stress on RNA expression, transport, and mRNA translation. However, these techniques are rarely applied together, and standard protocols are not readily compatible for sequential application on the same specimen.

This paper [11] use sensible video set from underwater moving cameras show the reliable performance of the projected methodology with abundant less machine value examination with progressive techniques. during this paper, a unique object following technique for moving cameras supported DMKs is projected for the difficult state of affairs of following a faculty of live fish from associate underwater camera with ego-motion. The rotation-invariant uniform type of local binary patterns (LBP) histogram proposed in [18]. This results show the projected methodology outperforms each the normal kernel primarily based following approaches and up to date following-by-detection strategies for tracking one or multiple live fish in difficult underwater videos, associated so provides an efficient answer to video-based fisheries surveys conducted with dynamic cameras. integration the DPM wide used for object detection to the MS optimization algorithmic program, the projected methodology with success combines the benefits from each techniques: the DPM introduces gradient options and half deformation prices to facilitate multiple-kernel following, whereas the MS algorithmic program significantly reduces the computations needed by typical tracking-by-detection paradigms.

This paper [12] shows that the planned approach is powerful and extremely correct for the employment of fish recognition and identification of real-world underwater empirical video knowledge. A fish recognition and identification methodology of most chance of partial ranking (SRC-MP), supported a distributed representation-based classification, was developed and enforced on a fish class info. A most chance, partial ranking methodology, supported distributed representation-based classification (SRC-MP), is planned for real-world fish recognition and identification. The planned fish recognition and identification methodology were evaluated by comparison with current standard strategies and tried to perform higher within the given real-world dataset. e plan to implement compressive sensing method, to improve the performance of fish detection: for example, by using a real time compressive tracking algorithm (Zhang et al., 2012). The fish pictures on the fish class info were collected from a real-world tera-scale underwater video dataset, employing a multiple bounding–surrounding boxes approach.

This paper [13] shows that the planned approach outperforms typical ways. During this work, we've got planned a brand new methodology for underwater image pre-processing. The Gaussian mixture is among the most popular models applied in statistics [19], [20]. We tend to strengthen the strategy by applying an applied mathematics method supported the calculation of the log-likelihood quantitative relation and their use as a check for sleuthing object or non-object in underwater pictures. The obtained results show that the planned methodology outperforms typical pre-processing ways.

This paper [14] based on imaging recorded exploitation associate degree underwater stereo–video system throughout transfers of SBT from tow cages to grow out cages, it's been incontestable that the semi-automatic rule produces fork length measurements with a mistake of but a hundred forty five of verity length and with a minimum of a six fold reduction in operator time compared to manual measurements. Exploitation imaging recorded throughout transfers of Southern Bluefin Tuna (SBT) from tow cages to grow out cages, we tend to demonstrate that the semi-automatic rule developed will get fork length measurements with a mistake of but a hundred forty five of verity length and with a minimum of a six fold reduction in operator time as compared to manual measurements. This is an area that needs to be prioritized for future research [21]. Future systems for underwater fish mensuration and biomass estimation can see advancement within the complete process pipeline, ranging from improved video cameras that are optimized for the task in terms of signal to noise magnitude relation and frame rate, additional correct detection algorithms to initialize the trailing templates, and trailing algorithms which will additional accurately predict the situation of the fish snout and tail supported swimming action.

This paper [15] have accuracy of the algorithmic program was evaluated by exploitation hand-labeled ground truth knowledge on 30000 frames happiness to 10 completely different videos, achieving a mean performance of regarding ninety four, calculable exploitation multiple ratios that offer indication on however smart may be a pursuit algorithmic program each globally (e.g. investigation objects in an exceedingly fixed vary of time) and regionally (e.g. in distinguish occlusions among objects).In this work we have a tendency to tackled the matter of fish pursuit, that shows many difficulties because of the at liberty surroundings, the uncontrolled scene conditions and also the nature of the targets to be half-track, i.e. fish, whose motion tends to be erratic, with explosive direction and speed variations, and whose look will endure fast changes. Further developments on this work will investigate the use and adaption of this algorithm in different contexts, e.g. pedestrian or vehicle tracking in urban environments [23].

TABLE I
REPRESENTS THE VARIOUS TECHNIQUES FOR FISH DETECTION ALONG WITH CONTRIBUTIONS OF EACH METHOD.

S.No.	Author	Technique Used	Objective
1	Prerna Dewan et al.	fuzzy c-means clustering (FCM)	To make the complement set of pixels tracked using frame differencing
2	Ekram Hossain et al.	Fish Activity Tracking And Species Identification	To detect/track fish in low quality underwater video with 48.94 percent accuracy, and Average accuracy of fish species.
3	Mao Jia-Fa et al.	3D fish target occlusion tracking Model	To derives a mathematical model of real fish occlusion tracking, imaginary.
4	Mehdi Ravanbakhsh et al.	Shape Matching	To detect the fish outline from under water image.
5	Sushil Kumar Mahapatra et al.	Multithreading Fuzzy C-Mean	To detect multi-moving fish in a noisy and denser conduction.
6	Mohcine Boudhane et al.	Mean Shift Algorithm	With the help to this method they combine the region into objects.
7	Snigdhaa Hasija et al.	Graph Embedding Discriminant Analysis	To renders state-of-the-art methods to robust computationally,
8	Cindy Meyer et al.	Fluorescence in situ hybridization (FISH) and Immune fluorescence (IF)	Is to simple robust and flexible the co localization of RNAs and protein.
9	Meng-Che Chuang	Histogram of oriented gradients (HOGs)	Use as a check for sleuthing object or non-object in underwater pictures.
10	Yi-Hao Hsiao	Sparse representation-based classification (SRC)	To obtain plan for real-world fish recognition and identification.
11	Mohcine Boudhane	Poisson-Gaussian mixture (PGM)	To estimate statistically the type of the region
12	Faisal Shafait	Exploitation imaging data	To approximate accurately predict the situation of the fish snout and tail supported swimming action.
13	Concetto Spampinato	Pursuit algorithmic	To obtain the nature of the targets to be half-track

III. CONCLUSION

This paper has conferred a review of the techniques used for the detection, identification, measure, chase and enumeration of fish in underwater stereo-video image sequences, together with thought of the ever-changing body form. And also paper presents a comprehensive review of state-of –the-art techniques for extracting region of interest from underwater images/videos. The review has known the common approaches and their shortcomings, resulting in AN analysis of the techniques presumably to be a general answer to the identification and measure task. Algorithm gives best results for various performance metrics. Finally, the paper has planned AN approach that's doubtless to supply the very best attainable success rate in automation of the method and can be the topic of future analysis and development.

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