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A

Minor Research Project Report

On,

"APPLICATION OF COMPUTER IN STUDY OF FRESHWATER MOLLUSC BIODIVERSITY THROUGH IMAGE PROCESSING."

Submitted

To,

University Grants Commission

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1. Project Title

"APPLICATION OF COMPUTER IN STUDY OF FRESHWATER MOLLUSC BIODIVERSITY THROUGH IMAGE PROCESSING."

2. Introduction

Rapid population growth, increasing living standards, increased human activities, industrialization and deforestations have leads to global warming. Due to this imbalance of biological diversity is increased and also some species are in danger. So there is need to protect biological diversity and these species. Due to poor knowledge of humans from this region about biological diversity and these species, it is difficult to protect the species. Outcome of this project will give some guidelines to the common people, students, and researchers about biological diversity and detailed information about molluscs species. So that it will be helpful to protect biological diversity.

The earth is home to a rich and diverse kind of living organisms. Biodiversity or biological diversity generally refers to the variability among living organisms from all sources this includes diversity within species, between species and of ecosystems. Thus, biodiversity is the totality of genetic, species, ecosystem and habitat diversity in a region that has evolved through millions of years of evolutionary history. Hence, the recognition and characterization of biodiversity depends critically on taxonomy, genetics and ecology. Taxonomy provides the reference system and depicts the pattern or tree of diversity for all organisms. Ecology provides knowledge of the varied ecological systems in which taxonomic and genetic diversity is located, and of which it provides the functional components.

In the recent past the importance and awareness on biodiversity studies are increasing enormously day by day. This has been the backbone of human food, livelihood and sustenance. The biodiversity refers to the variety and variability among living organism and the ecological complexes in which they live. There is an urgent need of conservations of ecological biodiversity since it is important for environment, scientific, economic and medicinal point of view.

They form an important link between the food chain which communicates the energy through phytoplankton, zooplankton to the fishes, amphibian and other higher groups. Majority of shell fishes belongs to phylum mollusc. It is also reported that molluscs are next to the insect and contributes 2nd largest invertebrate group on the earth.

Molluscs are important since they have morphological diversity, possesses well calcified skeleton and having excellent fossil record. The body contains elongated structure and has bilateral symmetry. The calcium carbonate for the manufacturing of the shell secreted by the mantle. They utilize either aragonite or calcite or mixture of both. The phylum mollusca is one of the largest groups of living animals. They include seemingly infinite verity of forms in their evolution. This phylum comprises animals like gastropods and lamellibranch which are of high quality of edibility and of commercial importance. The freshwater molluscan fauna represented primarily by Unionacaeae, Corbiculaceae and Dressinaceae families (Voke, 1980). *Lamellidens corrianus* is one of the commonest bivalves species in India which has similar anatomy as Anodonta and Unio. They are widely distributed from freshwater tanks, pools, rivers and are occasionally eaten by poor peoples. They are generally used as mango peeler in kitchens and also used as a handle of knife, preparation of buttons etc. The shells of these Molluscan species are converted to lime mainly in paper, carbides, and cement and fertilizers industries. Freshwater molluscs are filter feeder exposed to the drastic variation in surrounding aquatic media immediately alter the physiology, biochemical, histology of reproductive organs, central ganglia and histo-chemistry (Rao, 1980).

Biodiversity is one of the important lives supporting system on the earth. Mollusca found in various habitat and are divided into fresh water & marine & terrestrial forms. The freshwater Mollusca play a significant role in aquatic ecosystem.The phylum Mollusca have large group of animals having varied size, shape, habits& occupy different environment (Subba Rao1993). The

freshwater molluscs have a shell, in which the soft parts are enclosed. Most species can be conveniently identified by their shell characters. However, in some groups the conchological characters have to be supplemented by their anatomical characters are used for study of molluscan taxonomy.

The taxonomic survey of Indian freshwater mollusca has been done by Zoological Survey Of India (SubbaRao 1989) Indian gastropod studied by many workers Annadale (1919), Prasad(1925),Hora(1925&1926), Kulkarni(1971), Tonapi(1971). Satyamurthi (1952), studied the diversity of molluscs from the Gulf of Mannarand recorded 450 species of gastropod and 156 species of bivalves. The present study was carried out to study the diversity of the molluscs from the drought region Sangola of Solapur district. Sangola taluka come under semiarid region of Maharashtra. In the region there is scarcity of water since several years. The rainfall is scanty hence the region considered as drought prone. The main objective of present study was to document the molluscan diversity of the freshwater from drought prone region. The identification, taxonomic account and distribution of molluscs found in freshwater reservoirs willserveto keepcomplete record for further study.

Molluscs can be considered as good biological indicator. Certain species like *Thiara* and *Melanoides* survive in strictly polluted environment, another species *Lymnaea* can also thrive their live in polluted environment (Bly and Dongelem, 1996). Boycott (1935) while studying the habitat of land molluscs in Britan stated that, the presence of surviving pollution of molluscs indicate the land in not acidic. Hora and Rao (1927) while studying hibernation and aestivation in gastropod molluscs mentioned few rare or threatened non-marine molluscs for entire India. Mahyastha*et al*., (2002) studied the land snails of western ghat. Labotparaense(2005)studied various specimens from palnorbidaelymnedae and physidae of Argentina. Patil and Talmale (2005) have reported and published checklist of land snail and freshwater molluscs from Maharashtra. Annandel and Prasad (1990) have reported some freshwater molluscs from Bombay Presidency. The mollucsan are reported and published as early as by Lanford (1863), he has described the *Cremnochussyhadus and*

Lythotisreticola from western ghat. Patil (2003) studied the existence of freshwater bivalve molluscs from Pusad region of Yavatmal district, (Mharashtra.) SuryRao *et al*., (2000) studied the molluscan diversity from Ujain wet land region. Kamble and Kamble (2004) have reported the biodiversity of aquatic animal including some mollucs from Ruti reservoir near Asthi, district Beed (Maharashtra) and identified two orders and three genera of molluscs. JaykumarThampy and Sarvanan (2009) Reported new species of Thiara from small east flowing stream called Karuppanadhi in south Tamilnadu.

This is the Computer Era and these machines are beginning to affect out lives in many ways with the promise of new and improved ways of thinking, living and working. A computer can be defined as an electronic data processing device, capable of accepting data, applying a prescribed set of instructions to the data, and displaying in some manner or form. It is a binding fact that these 'magical' machines are very productive, efficient and make our personal and professional lives more rewarding and that can do just about anything imaginable, moreover they really do extremely well in most of the areas such as Businesses, Education, Energy, Law Enforcement, Transportation, Bank, Agriculture, Government, Home Security, Health and Medicine, Manufacturing Industries, Scientific Research, Communication Industries, Real Time systems etc.

Some of its important features are Speed up record keeping (Data Storage), Predictions in some areas, Accuracy, Quality Control, Global Communication, Air traffic control, weather forecast, Expert system, Real time systems, Embedded Systems, the production process faster and cheaper, high speed etc. With the advent of more versatile and powerful computers, biological science, biodiversity and biomedical applications of computers have proliferated so rapidly that it would be virtually impossible to compile a comprehensive review of all developments in this field. Microprocessors are being widely employed in biological laboratories both for automatic data acquisition/processing and modeling. One of such particular area involves

digital image processing and is already established for routine clinical examinations.

Computers are used in many ways for teaching biological sciences. They may be used to present biological information and concepts, to simulate complex situations, develop generic skills, to graph and manipulate data, and to assess students. Use of New Technologies in teaching gives many advantages such as less money, reduce teaching time, generate interest of the student etc. As concerns about global warming, scientists are turning to sophisticated computational models to better understand human activities on biodiversity. So it is necessary to provide knowledge about biological taxonomy to the researchers, students and naturalist. Hence at international level subject is gaining lots of scope and importance. So the subject was designed and implemented to collate existing information, bring it out to the public and try to conserve the diverse biological wealth in every way possible.

The protection of biological diversity requires the development and implementation of national strategies and action. In turn, development of these strategies and action plans require the development of improved mechanisms for information collection and management, since without adequate information; it is difficult to develop effective strategies and action plans.

Checklist will also helpful to the naturalist, biologist, researchers and student to identify the species, for further research. It will create database of freshwater molluscs from draught prone area in Maharashtra. It would surely add to the conservation endeavor to ensure the sustainability of nature's wealth for future.

Present study is carried out to study biodiversity of freshwater molluscs through image processing for taxonomic study and to develop checklist. This study will help to identify and recognize particular species of molluscs from drought prone region of Maharashtra.

Review of literature:-

Annadurai(2006)studied diversity of gastropod of Gulf of Mannar : Tamilnadu noticed 150 species of gastropod with single subclass,three order:28 families,44 genus.Satymurthi(1952&1956) studied the molluscan diversity from the Gulf of Mannar. Subba Rao& Dey (1989)&Garg et.al(2009)studied a correlation between the molluscans diversity with physiochemical parameters with effect of water from Ramsagar reservoir. Kulkarni reported (1973)an account of land freshwater mollusca in Marathwada region. Amit Prabhakar & Roy (2009)studied the taxonomic diversity of shell. Several genera gastropod &bivalves are found in freshwater pond &reservoir (Parikh&Mankoli;2009) . The freshwater mollusca includes univalve&(snails)bivalves (Calm&Mussels)Taxonomically they belongs to class gastropod &pelecypoda.Annadale(1919)Tonapi(1971)Magare (2007,2012)diversity of freshwater mollusca of Satpuda mountain of Gujarat is carried out by Magare &Valvi (2013).several genera of gastropod & bivalve are found in the freshwater ponds& reservoir of Rajkot city the semi-arid zone of Raut &Ghose (1984)described various terrestrial mollusca of Nepal.Cooke et.al (1980)studied on Grina lake.

Image processing

Very little information is available on studies of biodiversity study through image processing in India as this is new and advanced techniques of identification of wild life includes plant and animals. Few Jaime et al., 2012 studied, Image Processing for Spider Classification through spider web images by using controlled and uncontrolled environments. (2013), studies Automatic Identification of Algal Community from Microscopic Images.Shalika andSeneviratne(2016) studied animal classification system based on image processing & support vector machinecompared performance of individual

descriptors, recognition of positive & negative image separately reported unsuccessful outpu and accuracy was only 80 percent.

Due to the advances in the technology and easy availability of high configured hardware and software, image classification is improved significantly in this digital era. Real-world images contain different types of features such as objects, colors, scenes, etc. Based on such a feature human may identify image but this identification may not be correct due to human perception and also it some factors may be effects such as emotions and motivations.

To identify images correctly; it is necessary to use some automated tools. The performance of such automated tools is high as compare to the human identification system. Image classification is one of the popular trends for the identification/classification of the images. Image classification is the process in computer vision that can identify/ classify images based on their features. [1]

Present study focuses to identify shell types. The shell is slightly elongated having many transverse ridges, the bodywhorl is small and oval, the whorl of spire is convex.

Due to the high configuration and inexpensive image capturing devices, now images having large and having complex structures. To do operations with such high regulation and complex images, traditional techniques require lots of time as well as lots of computer resources. To tackle this problem present study uses a Deep learning technique.

A deep learning technique is useful to do operations on complex and high dimensional data. So deep learning is useful for the classification of images or speech recognition possible or other highly complex problems. [2]

In the paper,the author uses Convolutional Neural Networks (CNNs) which is one type of deep learning feed-forward network. They use a breast cancer dataset for image classification. The dataset is publicly available on the

internet. The author shows that CNN performance is better than other methods. They also use a combination of different CNN to gain more accuracy. [3]

The author uses convolutional neural networks (CNNs), one of the deep learning types for single-label image classification. They use recurrent neural networks (RNNs) with CNNs and given name as CNN-RNN framework. The result of CNN-RNN framework shows greater performance on image classification.[4]

In the paper,the author deals withthe problem of a large number of training samples. They use active learning framework which is capable to build a classifier model on less training sample. This was achieved by using deep learning techniques and cost-effective sample selection technique. This framework is known as" Cost-Effective Active Learning" (CEAL). The performance of this framework is considered high on face recognitionon CACD database. [5]

In the paper,the author deals with a problem of human inspection of the product. If inspection will be done based on digital image processing then the result will be good. The paper uses a wood board image database for classification purposes. They use CNN with text-based feature extraction technique and different data mining algorithms such as tree base, rule-based, etc. paper shows that deep learning technique is works fast and accurate for the complex dataset. [6]

In the paper,the author uses CNN for identifying plant disease using leaf image classification. They use 13 different types of plant disease leaf images as well as healthy leaf images. The model developed by the author can classify and identify leaf images that have diseases.The result of this experiment shows about 91% accuracy.The author suggests that in the future need to enrich diseases leaf images database and using different technique improving the accuracy of the model. [7]

In the paper,the author proposed an effective and efficient feature extraction technique based on the pyramid pooling concept for face recognition. This new technique is good than the current face recognition

technique. This technique doesn't involvethe learning phase but it extracts strong features from the image. The result was significantly improved on the standard face recognition dataset FERET and LFW. [8]

Objectives

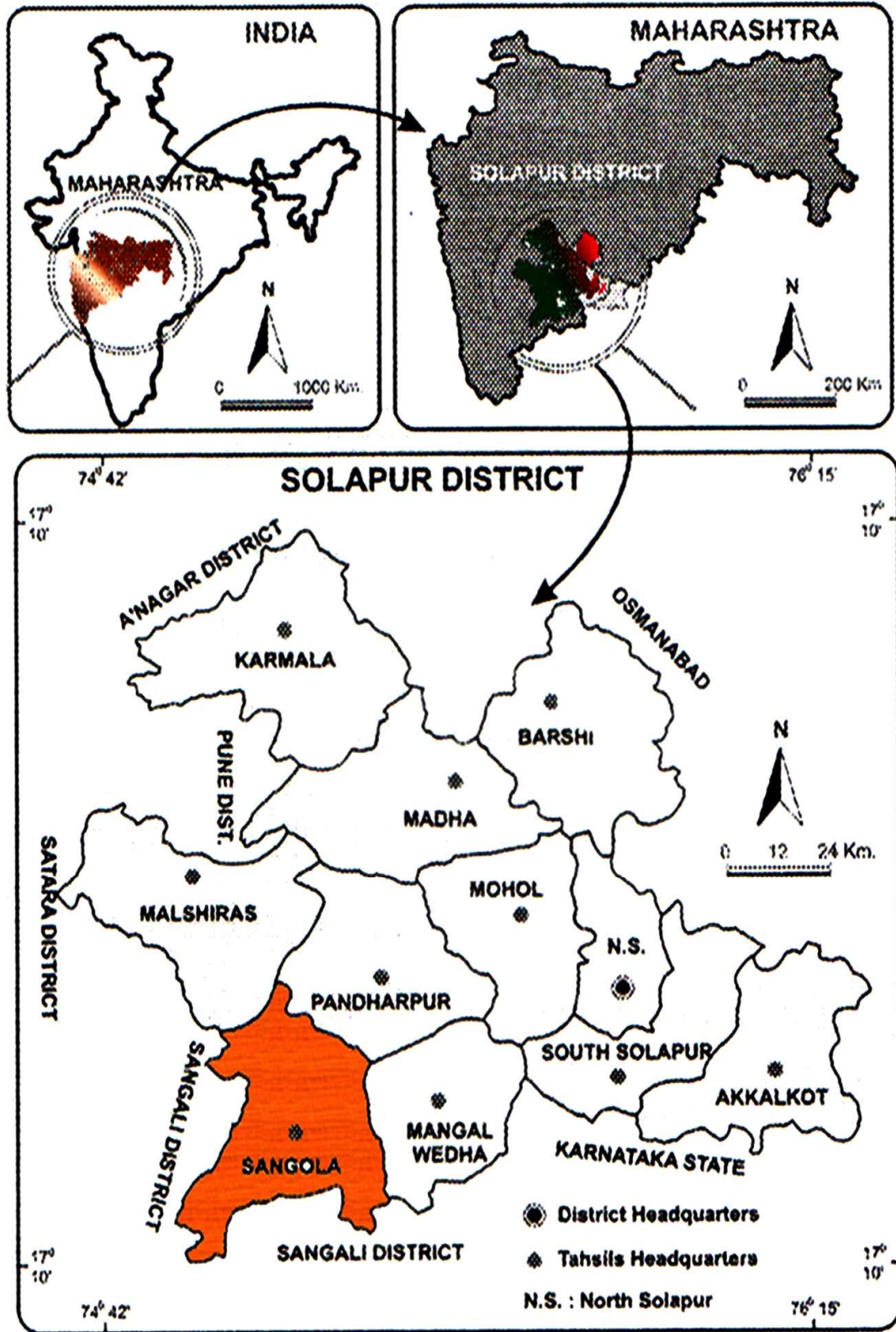1. To collect freshwater molluscs from drought prone area, Sangola of Maharashtra.

2. To study biodiversity and taxonomic study of freshwatermolluscs. from drought prone area, Sangola of Maharashtra.

3. To use image processing tool to collected data.

4. To use database management tool to store collected data in standardized form.

5. To develop checklist of molluscan diversity from collected data.

Material and Methods

a. Collection of dry shells

The freshwater molluscs have a shell, in which the soft parts are enclosed. Most species can be conveniently identified by their shell characters. However, in some groups the conchological characters have to be supplemented by their anatomical characters are used for study of molluscan taxonomy. For studying the biodiversity, the freshwater molluscs were collected from identified locations from Sangola; district Solapur, Soon after collection, the shells were cleaned to remove algal biomasses and brought to the laboratory and preserved in polythine container used for identification of various species with the field guide was used (Madhyastha, 1998, Rao). For further and final confirmation the sample were identified at Zoological Survey of India, Pune.

LOCATION MAP

INDIA

MAHARASHTRA

MAHARASHTRA

SOLAPUR DISTRICT

N

0   1000 Km.

N

0   200 Km.

SOLAPUR DISTRICT

74° 42'   76° 15'

17°   17°
10'   10'

A'NAGAR DISTRICT

OSMANABAD

KARMALA

PUNE DIST.

BARSHI

N

SATARA DISTRICT

MADHA

0   12   24 Km.

MOHOL

MALSHIRAS

N.S.

PANDHARPUR

SANGALI DISTRICT

SOUTH SOLAPUR

AKKALKOT

MANGAL
WEDHA

KARNATAKA STATE

SANGOLA

District Headquarters

Tahsils Headquarters

SANGALI DISTRICT

N.S. : North Solapur

17°   17°
10'   10'

74° 42'   76° 15'

15

a. Site selection for collection of molluscan shells from drought prone region of Sangola.
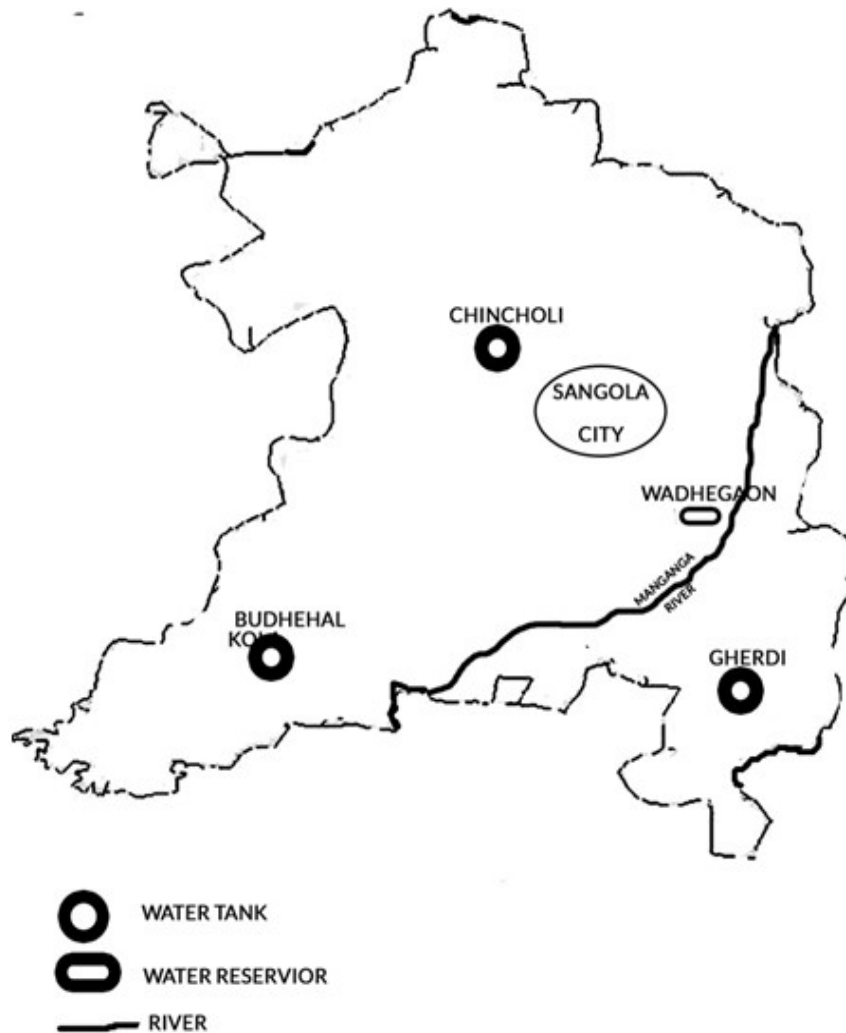
Shells of molluscs were collected from different water bodies such as ponds, reservoirs and tanks from above identified locations.

1. **Chincholi tank.**
2. **Wadhegaon Bandhara**
3. **Gheradi tank**
4. **Budhehal**
5.

b. Experimental Study: Image processing

All experiments are carried out with Intel Core i5, 2.5 GHz processer with 8 GB RAM and Windows 10 operating system. For the implementation of the present study, we use python.

For image classification using python, we use deep learning techniques.

A. Python: -

Python is a general-purpose, dynamic, high level and interpreted programming language. It supports Object Oriented programming, structured/modular programming, and interactive approach to develop applications. It is a simple but powerful and versatile scripting language and easy to learn the language. The Python IDLE (Integrated DeveLopment Environment) executes instructions a line at a time. It is freeware.[9]

Due to the simple syntax and dynamic typing (it carries out type-checking at runtime) of its interpreted nature, Python is an ideal language for scripting and rapid application development (RAD). Python supports multiple programming patterns, including object-oriented, imperative and functional or procedural programming styles.

B. Deep Learning:-

Deep learning is part of the machine learning technique which is specifically useful for pattern identification on high complex data such as image data or speech data.Deep learning uses artificial neural networks (ANN) technique. ANN is a computational model that is based on the human nervous system.In the human brain, each neuron takes input from its previous neurons, performs some processes and passes to the next neurons. [10]

 ANN is a connected graph having three types of layers. At the start, it hasan input layer, at last, it has an output layer and in between the input and output layer; there are 0 or more hidden layers. Hidden layers are based on the features in the data. In the Deep Learning network having more than 3 hidden layers.

C. **Image Classification:-**

The present study uses a Deep Learning technique for image classifications. The main aim of the classification technique is to predict the class label.A dataset which is used for classification purpose is divided into two parts-1. Training Data and 2. Testing Data. Training data has a class label whereas testing data has no class labels. Class labels in training datasets are assigned by some expert persons so classification technique is known as a supervised learning technique.

The classification technique works in two phases. In the first phase, it will train the model and in the second phase, the model will apply on unseen data to predict the unknown class label. [11].

In the image classification technique, the model will be generating from training data. In the model generation, we first teach the computer system how to identify objects based on unique features available in those images.

The present study uses image classification techniques for the identification of images.

D. **Dataset: -**

The present dataset contains a total 150Shell images in which 117 areterebia type and 38 are parrysia type images. All these shell samples were collected from Droght prone region Sangola.These images are divided into training and testing using 70% and 30%. The following table shows training and testing image quantities.

ShellType	Training	Testing	Total
terebia	80	37	117
parrysia	29	9	38

Table1:-Number of training and testing images

All these images are preprocessed. In this step, each image was converted into an equal dimension. Each image has 1800x1200 dimensions.

a. Data processing

The data is collected from the drought prone area Sangola of Solapur district (Maharashtra). It is in the form of text and images. This data is then cleaned and arranged in standard form. using data base technique such as normalization. Database is created in the form of table by using appropriate database tool through computer. By using collected data checklist is developed.

Results

The shell in gastropoda is a single, usually dextrally coiled spiral valve. The shell usually encloses the visceral mass and the foot when the animal is retracted into the shell. It has a large body whorl and a spire, including more than two whorls, terminating in an apex. The body whorl opens at the mouth or aperture, which is closed by a horny or calcareous operculum in prosobranchs . When a shell is held in hand with the apex pointing away and the aperture facing the observer the rim on the right side of the aperture is the outer lip and the left one is the inner lip or columella. The shell of freshwater gastropods offers a great number of characters useful in taxonomy. The general shape, the presence or absence of operculum, the number, nature of coiling and shape of whorls, sculpture, the nature of umbilicus and columella, and the shape of the aperture in a shell are very important to a taxonomist. In the present study, 17 species of molluscs including gastropods and bivalves were identified. Which listed below.

1. Indoplanorbis exustus,

2. Segmentina calatha,

3. Lymnaea luteola,

4. Thiara granifera,

5. Tuberculata lineate,

6. Bellamya dissimilis,

7. Bellamyabengalensis

8. Bellamyaebornea,

9. Zootecus chion,

10. Parreysia favidens,

11. Shurtleffiana khadakvaslaensis,

12. Spherium indicum,

13. Lammelidens marginalis, ,

14. Lammelidens corrianus ,

15. Corbicula   Peninsularis,

16. Corbicula peninsularis,

17. Striatella fluminea

Systematic position and taxonomic study

1.   Bellamya (Viviparous) bengalensis f. typical (Lamarck).

Phylum   -   Mollusca

    Class   -   Gastropoda

       Order   -   Mesogastropoda

         Family   -   Viviparidae

Taxonomic description:

Shell is smooth, thin and banded with two dark rusty brown or dark green banded in 4th whorl and 6-7 band in whorl. The whorl was convex and five in numbers. The operculum is elongated towards the body whorl.

2.   Bellamyadissimillis (Muller)

Phylum   -   Mollusca

    Class   -   Gastropoda

       Order   -   Mesogastropoda

         Family   -   Viviparidae

Taxonomic description:

Shell is smooth, thick and banded cream colored   brown. The shell is ovate in shape. The operculum elongated and the whorl was convex.

3.   Bellamya eburnean (Annandale)

Phylum   -   Mollusca

    Class   -   Gastropoda

      Order   -   Mesogastropoda

        Family   -   Viviparidae

Taxonomic description:

The shell was conical and truncated toward the apex. The whorls were convex and are about 4-5 in number. The operculum is elongated towered the body whorl.

4.   Melenodiestuberculatus (Muller).

Phylum   -   Mollusca

    Class   -   Gastropoda

      Order   -   Basommatophora

        Family   -   Melonidiae

Taxonomic description:

The shell is slightly elongated having many transverse ridges, the body whorl is small and oval, the whorl of spire is convex and 8 to9 in number and spire is strongly depressed.

5.   Terebia lineate (Gray)

Phylum   -   Mollusca

Class   -   Gastropoda

Order   -   Mesogastropoda

Family   -   Thiaridae

Taxonomic description

The shell sculpture with fine spiral, vertical ribs are present in the 2nd whorl, shell marked with rust colored spots. These snails are operculate and shell is elongated.

6.   Zootecuschion (Pfeiffer)

Phylum   -   Mollusca

Class   -   Gastropoda

Order   -   Stylommatophora

Family   -   Subulinidae

Taxonomic description:

The body whorl is slightly elongated smooth. The body whorls of spire are 4 in numbers from which 1st 3 are slightly convex and last whorl was rounded and blunt.

7.   Lymanea (pseudosuccinea) acuminate (Lamark).

Phylum   -   Mollusca

Class   -   Gastropoda

Order   -   Basommatophora

Family   -   Lymnaeidae

Taxonomic description:

It is lighter umber in color, the whorls of spire are four in number, the body whorl was convex and five in numbers. The operculum is elongated towards the body whorl.

8.   Lymnaealuteola (Lamark).

Phylum   -   Mollusca

Class   -   Gastropoda

Order   -   Basommatophora

Family   -   Lymnaeidae

Taxonomic description:

The body whorl is large oval and slightly elongated. The body whorls of spire are 4 in numbers which are slightly convex and pointed.

9.   Indoplanorbisexustus (Deshayes).

Phylum   -   Mollusca

Class   -   Gastropoda

Order   -   Stylommatophora

Family   -   Planorbidae

Taxonomic description:

It has brown, stout and spirally coiled shell. The shell is sinsistral and discoidal having depressed spire, whorl of spire is 3 in numbers with transverse striations.

10.   Lamellidens corrianus (Lea).

Phylum   -   Mollusca

Class   -   Bivalve

    Order   -   Eulamellibranchiata

    Family   -   Unionidae

Taxonomic description:

Shell is strongly equilateral, transverse, large and thinner. The two pseudo cardinals present on left and right valve, bears two parallel lamellar pseudo cardinals, left valve is with single thin lamella-like cardinal teeth an the right valve is with two elongated straight lateral teeth . umbos are slightly elevated and bear coarse ridges.

11.   Lamellidens marginalis (Lamark).

Phylum   -   Mollusca

    Class   -   Bivalve

    Order   -   Eulamellibranchiata

    Family   -   Unionidae

Taxonomic description:

Shell is transversely oblong, ovate or oval. The umbos are swollen, knoblike placed much near the anterior end of each shell valve and bears coarse ridges.

12. Parreysiafavidens (Benson).

Phylum   -   Mollusca

    Class   -   Bivalve

    Order   -   Eulamellibranchiata

    Family   -   Amblamidae

Taxonomic description:

Shell is rounded, elliptical to oval, broad in proportion, thick, short in contrast to lamellidens. Cardinal teeth are found to be narrowed. The umbos are elevated with strong ridges.

Diversity of Freshwater molluscs from drought region Sangola Region

Kingdom: Animalia
Phylum: Mollusca
Class: Gastropoda

Bellamya bengalensis   **Bellamya desssimilis**   **Bellamya eburnea**

Indoplanorbis exustus   Lymnaea lutiola   Lymnaea scuminata   Zooticus chion

Melnoides tuberculatis   **Terebia liniata**

Diversity of Freshwater molluscs from drought region Sangola Region

Kingdom: Animalia
Phylum: Mollusca
Subphylum: Conchifera
Class: Bivalvia

Lamellidens corrianus

Lamellidens marginalis

Parreysia favidense

Table No. 1. Check list of Molluscs:

Sr. No.	Class	Order	Family	Genus	Species
1	Gastropoda	Basomamatophora	Planorbidae	Indoplanorbis	exustus
				Segmentina	calatha
			Lymnaeidae	Lymnaea	luteola
		Mesogastropoda	Thiaridae	Thiara	granifera
					tuberculata
					lineate
			viviparadae	Bellamya	dissimilis
					bengalensis
					ebornea
		Stylommatophora	Subulinidae	Zootecus	Chion
2	Bivalvia	Unionoida	Unionidae	Parreysia	favidens
					Shurtleffiana
					khadakvaslaensis
				Spherium	indicum
				Lammelidens	marginalis
					corrianus
		Veneroida	Corbiculidae	Corbicula	Peninsularis
					striatella
			Cyrenidae		fluminea

Identification of molluscs through image processing using image classification technique.

The images used for classification purpose are stored in folder on drive. These images are separated into two groups named as train and test. The location of image is shown in following figure.

```
Volume in drive F has no label.
Volume Serial Number is F01E-1D45

Directory of F:\kambale sir\Research Paper

10/24/2019  05:45 PM    <DIR>          .
10/24/2019  05:45 PM    <DIR>          ..
07/22/2019  11:20 PM             20,644 image classification.ipynb
10/24/2019  05:42 PM    <DIR>          terebia
10/24/2019  05:45 PM    <DIR>          Test
10/24/2019  05:43 PM    <DIR>          Train
               1 File(s)         20,644 bytes
               5 Dir(s)  10,560,761,856 bytes free
```

For image classification purpose Deep learning technique is used. The Deep Learning algorithm is implemented using python language. For implementation purpose Anaconda Jupyter Notebook tool is used. To implementation purpose different packages are needed to load. Following figure shows different packages/libraries which are used in this algorithm.

```python
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras import backend as K
```

In this program accusation was calculated using training and testing data, in this experiment total 117 image of sample 1 is used in which 80 images are used for training purpose and 37 images are used for testing purpose. All the images used to train algorithm are stored into train folder whereas images used for testing purpose are stored in test folder. This part is shown In following figure

```
img_width, img_height = 224, 224

train_data_dir = 'train'
validation_data_dir = 'test'
```

In the image classification technique, the model will be generating from training data. In the model generation, system first learn how to identify objects based on unique features available in those images. Then this model is applied to testing image for checking accuracy purpose.

To get more accurate result; present study used 10 rounds for validation and accuracy checking. Following figure shows accuracy obtained by each round.

```
Found 109 images belonging to 2 classes.
Found 46 images belonging to 2 classes.
Epoch 1/10
25/25 [==============================] - 55s 2s/step - loss: 0.7295 - acc: 0.8221 - val_loss: 0.1012 - val_acc: 0.9783
Epoch 2/10
25/25 [==============================] - 42s 2s/step - loss: 0.0870 - acc: 0.9625 - val_loss: 0.4104 - val_acc: 0.7174
Epoch 3/10
25/25 [==============================] - 42s 2s/step - loss: 0.0393 - acc: 0.9850 - val_loss: 0.0800 - val_acc: 0.9783
Epoch 4/10
25/25 [==============================] - 42s 2s/step - loss: 0.0435 - acc: 0.9858 - val_loss: 0.0687 - val_acc: 0.9783
Epoch 5/10
25/25 [==============================] - 42s 2s/step - loss: 0.0137 - acc: 1.0000 - val_loss: 0.0505 - val_acc: 0.9783
Epoch 6/10
25/25 [==============================] - 42s 2s/step - loss: 0.0120 - acc: 0.9944 - val_loss: 0.1190 - val_acc: 0.9565
Epoch 7/10
25/25 [==============================] - 42s 2s/step - loss: 0.0023 - acc: 1.0000 - val_loss: 0.0264 - val_acc: 0.9783
Epoch 8/10
25/25 [==============================] - 42s 2s/step - loss: 0.0962 - acc: 0.9900 - val_loss: 0.0198 - val_acc: 0.9783
Epoch 9/10
25/25 [==============================] - 42s 2s/step - loss: 0.0062 - acc: 0.9975 - val_loss: 0.1273 - val_acc: 0.9565
Epoch 10/10
25/25 [==============================] - 42s 2s/step - loss: 1.7168e-04 - acc: 1.0000 - val_loss: 0.2191 - val_acc: 0.9565
```

The analysis of above figures clearly indicated that, average accuracy of training and testing data From the above figure, we observe that the overall(average) accuracy of training data and testing data is 0.974 and 0.946 respectively. That is , near about 98% of images are correctly classified in training data whereas 95% of images are classified in testing data.

Image classification experiment is carried out using deep learning and python. For this purposejupyter notebook is used [12]. This experiment uses keras

library. For image classification purposes 10 epocs are set. The experiment result for each epoch is shown in the following table.

Table 2:-Accuracy and losses of training and testing data

| Epoch	Acc	Val_acc	loss	Val_loss
1	0.822	0.978	0.730	0.101
2	0.963	0.717	0.087	0.410
3	0.985	0.978	0.039	0.080
4	0.986	0.978	0.044	0.069
5	1.000	0.978	0.014	0.051
6	0.994	0.957	0.012	0.119
7	1.000	0.978	0.002	0.026
8	0.990	0.978	0.093	0.020
9	0.998	0.957	0.006	0.127
10	1.000	0.957	0.000	0.219
Mean	0.974	0.946	0.103	0.122

The above table shows two accuracy measure i.e. acc and val_acc. The acc is accuracy measures based on the batch of training data whereas Val_acc is an accuracy measure based on testing data. Similarly, the table shows two losses named loss and val_loss which are losses based on training and testing data respectively.

From the above table, we observe that the overall accuracy of training data and testing data is 0.974 and 0.946 respectively. From this, we say that near about 98% of images are correctly classified in training data whereas 95% of images are classified in testing data. Actually in some epoch i.e. in epoch 5,7,and 10, accuracy is 1. That means in this epoch accuracy is 100%.
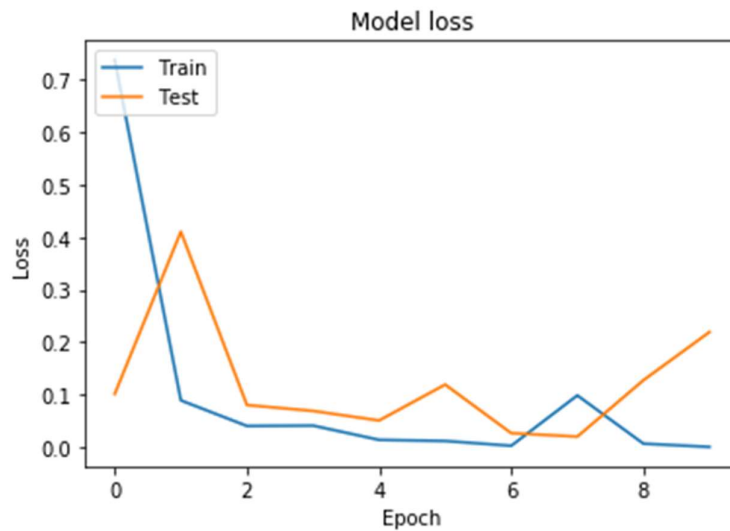
Similarly, the above table shows average losses of training and testing data are 0.103 and 0.122 respectively. Compare to another study these losses are very less.

The following figures show a of accuracy and losses.
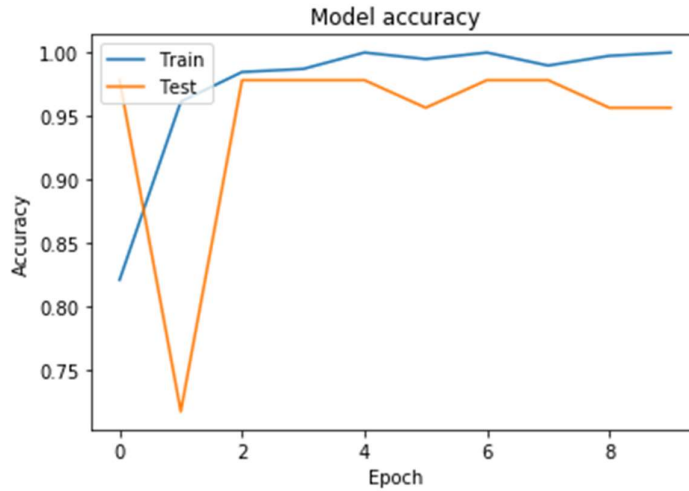
Fig 1:- Training and testing accuracy (i.e. Acc and Val_acc)

and

Fig 2:- Training and testing losses (i.e. loss and Val_loss)

Discussion

Molluscan are considered are the most diverse and dominant benthic fauna both from lentic and lotic region which are mainly represented by the two major classes namely Gastropods and Pelecypods. (Mackie, 1998).Patil and Talmale (2005) published the checklist of the land and fresh water molluscan of Maharashtra state reported, 142 species of molluscan of all forms belonging to 42 genera including 23 families. Amitkumar and Roy (2009) have observed 18 Gastropod species and 7 Pelecypod species from north Bihar region of India.

Patil (2003) studied the existence of freshwater bivalve molluscs from Pusad region of Yavatmal district, (Maharashtra.) Surya Rao*et al*., (2000) studied the molluscan diversity from Ujain wet land region. Kamble and Kamble (2004) have reported the biodiversity of aquatic animal including some molluscs from Ruti reservoir near Asthi, district Beed (Maharashtra) and identified two orders and three genera of molluscs. JaykumarThampy and Sarvanan (2009) Reported new species of *Thiara* from Karuppanadhi in south Tamilnadu. Kamble and Rao (2009) studied diversity of fresh freshwater molluscs from Chincholi tank near Sangola and reported, 13 species of molluscs.

In present study 17 species belongs to class gastropoda and bivalviafrom four identified spots from drought prone region Sangola. In present study 10 species from class gastropoda belongs to 03 orders, 05 families and 06 genera were recorded.

 From class bivalvia, 09 species from 02 orders, 03 families and 05 genera were recorded. In present study, large number of species were recorded from class gastropoda includes 11 species. Order mesogastropoda consists of large number of species (07) followed by basommatophora (03).

In class bivalvia, large number of species were recorded form genus corbicula and parreysia consists of 03species each. 02 species were recorded

from genus lammelidens. From order stylommatophoraof class gastropoda only one species was zootecuschion was recordedIn the present investigation it is observed that the major and abundant representative from family Thiaridae of the individuals *Melanodiestuberculatus*which is followed by Viviparadae representative *Bellamyabengalensis*. Annadurai (2006) studied diversity of gastropod of gulf of Mannar, Tamilnadu noticed 150 species of gastropod with single subclass, three orders, 28 families, 44 genus. Satyamurthi (1952 and 1956) studied the molluscan diversity from the gulf of Mannar and reported 450 species of gastropod and 156 species of bivalve. Devraj (1998) while studying the conservation and sustainable management of living resources from gulf of Mannar reported 100 species of gastropod and 158 species of bivalve. In the present study also the gastropod species were predominantly found compare with bivalve.

Kulkarni*et al*; (2006) while studying the diversity of some mollusc of Haji Ali sea shore of Mumbai, observed 7 species of gastropod belongs to seven genera and two species of bivalve representing two genera's were reported. Subrayamanyan*et al*; (1952) studied the marine gastropod diversity from Bombay. Jaykumar and Sarvanabhan (2009) reported a new species of Thiara from western ghatstreamfromKarappanadhi a tributary of TampiraparanifromTamilnadu, they have reported new species of gastropod as *Thiaratuberculataaruna.*Lymnea (1980) reviewed the freshwater bivalve mollusc, remains recorded from archeological sites in the Colombia basin. AmitkumarPrabhakar Roy observed 20 species of gastropod and 10 species of polycypods from Cosi region of North Bhihar. They further noticed from gastropod the speices belong to genera Bellamya, Pila, Lymnaea and Planorbis were as from Pelecypoda species belonging to Lamellidens and Parreysia were most abundant. In present study specimens from genus planorbis were more abundant than other genera.

At present, all camera-based studies of wildlife use a manual approach where researchers examine each photograph to identify the species in the

frame. For studies collecting many tens or hundreds of thousands of photographs, this is a daunting task (Fegraus ,2011).

Shalika and Seneviratne(2016) studied animal classification system based on Image processing & support vector machine to study the animal behavior in wild life using face detection and tracking.Xiaoyuan et al., (2013) carriedout studies on automated identifications of trapped images of wild animals. They concluded that, object recognition practices from computer visualization science can be successfully used to identify and recognize wild mammals on orders of photographs taken by camera traps in nature, which are In the future work. They further advised that some biometric features that are important for species analysis will be included in the local features, such as color, spots, and size of the body. Since the original sequences captured with motion-sensitive camera traps have motion information, we will develop an automatic animal segmentation algorithm in the future. In present study, I strongly in agreement with them.

Bolger et al. (201) used coat patterns of animals for identification for subsequent photographic mark-recapture analysis. They used data in the form of images, which is a cost-effective, non-invasive way to study population. The method they used was the SIFT key points extraction and matching. Thus, they only focused on individual animal identification for these strongly marked texture species.present study is also cost effective and no-invasive way to study population of individual animals. I used molluscs for image processing which are large in number but comparatively few in generic basis. So it is one of the most useful system of identification of animals.

Xing et al., (2016)studied growth patterns of marine molluscs scallop shells found in Dalian Zhangzidao Fishery Group Co. Liaoning Province, China.

Currently, photographic mark–recapture (PMR) has gained popularity because of the advances in digital photography and image processing software. The abundance of species with variable natural marking patterns makes this an

attractive method for many researchers. PMR has been employed particularly in the studies of populations of marine mammals and mammalian terrestrial predators (Fearnbach, Durban, Parsons, &Claridge, 2012; Forcada& Aguilar, 2000; Karanth& Nichols, 1998; Langtimm et al., 2004). Some image analysis algorithms have been used to extract, store, and compare pattern information from digital images (Bolger, Morrison, Vance, Lee, &Farid, 2012).(Michio&Hiromichi, 2013). Using a combination of mark– recapture methods, the features of these rings in mollusk shells can be adapted and applied to studies on the population biology of the scallop (Allison & Brand, 1995; Berkman, 1990), which are used to determine the habitat value of the ecosystems for fishery restoration and for enhancement through stocking. Perhaps the most important tool of

This individual recognition method can be easily applied to species identification. Species identification is necessary because Yesso scallop, Weathervane scallop, and Zhikong scallop, as major economic aquaculture species, form mixed species in many areas around the China. Yesso scallop and Weathervane scallop, as cold-water species, prefer food-rich environment and have relatively poor ability to resist pollution (Shumway & Parsons, 2011).

Conclusion

In present study 17 species belonging to 10 genera, under 08 families were recorded. This information of freshwater Mollusca from drought prone region Sangola is pioneer work. There is quiet need for comprehensive study of fresh water Mollusca from drought prone region. Further, extensive surveys of this area will definitely make known the presence of voluminous species than what is known today.

Image classification is one of the important research problems in today's word. The present study uses image classification technique by the deep learning method. This technique is one of the important technique for image classification. In the field of biodiversity study. The classification accuracy of the present study is near about 98% for training data and 95% from testing data. So, we may say that this accuracy is acceptable.

Biodiversity study reflected the conservation aspect of the water body it is necessary to conduct further experimentations before coming to the final remarks and the aspect related to identification of animals biodiversity through image processing relations needs to be undertaken from different seasons in future.

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