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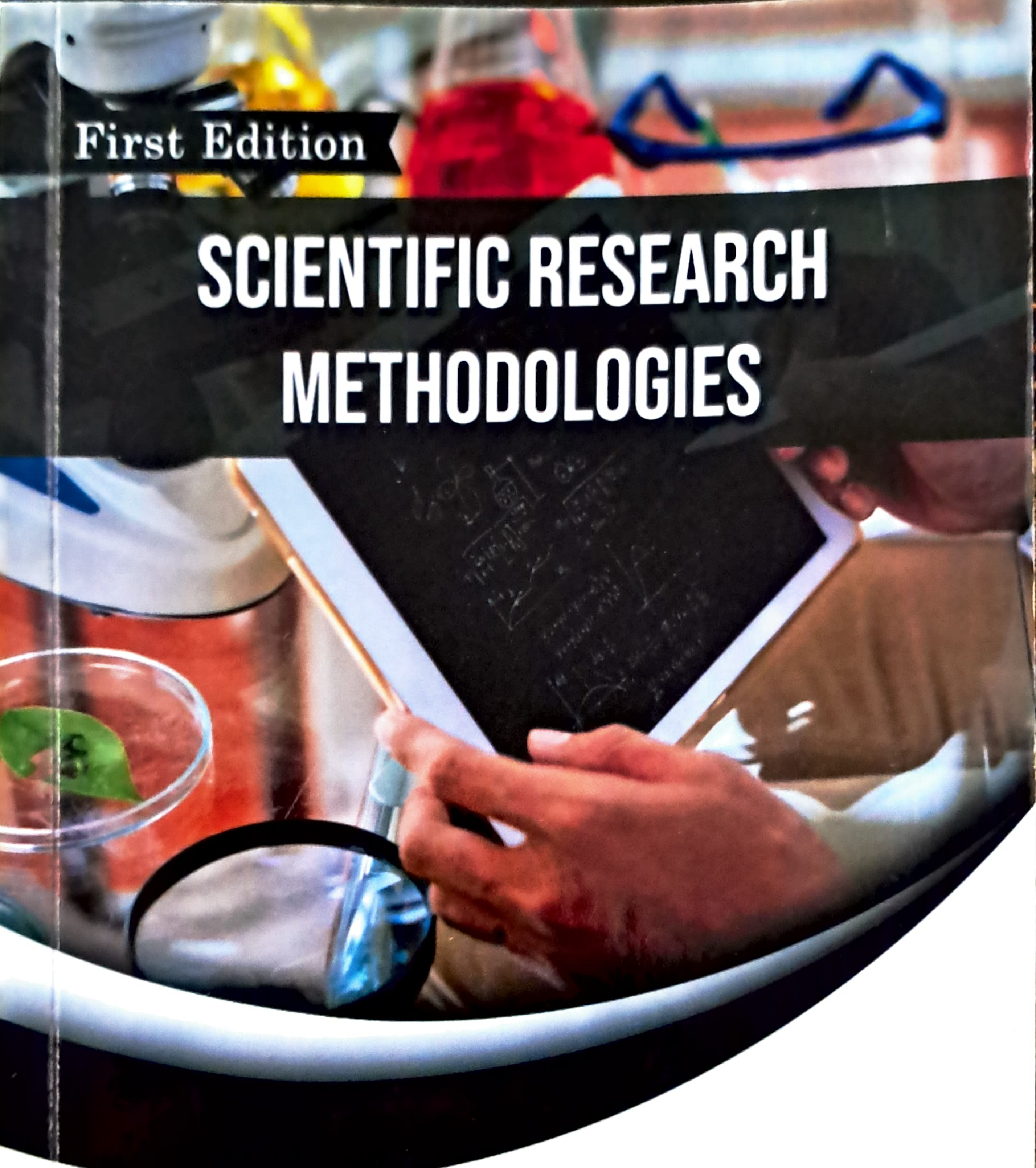
SCIENTIFIC RESEARCH METHODOLOGIES



Dr. Shivpal Singh
Prof. Punita S. Tiwari
Dr. Naveen Kumar Singh Chauhan
Prof. Bhavna Verma

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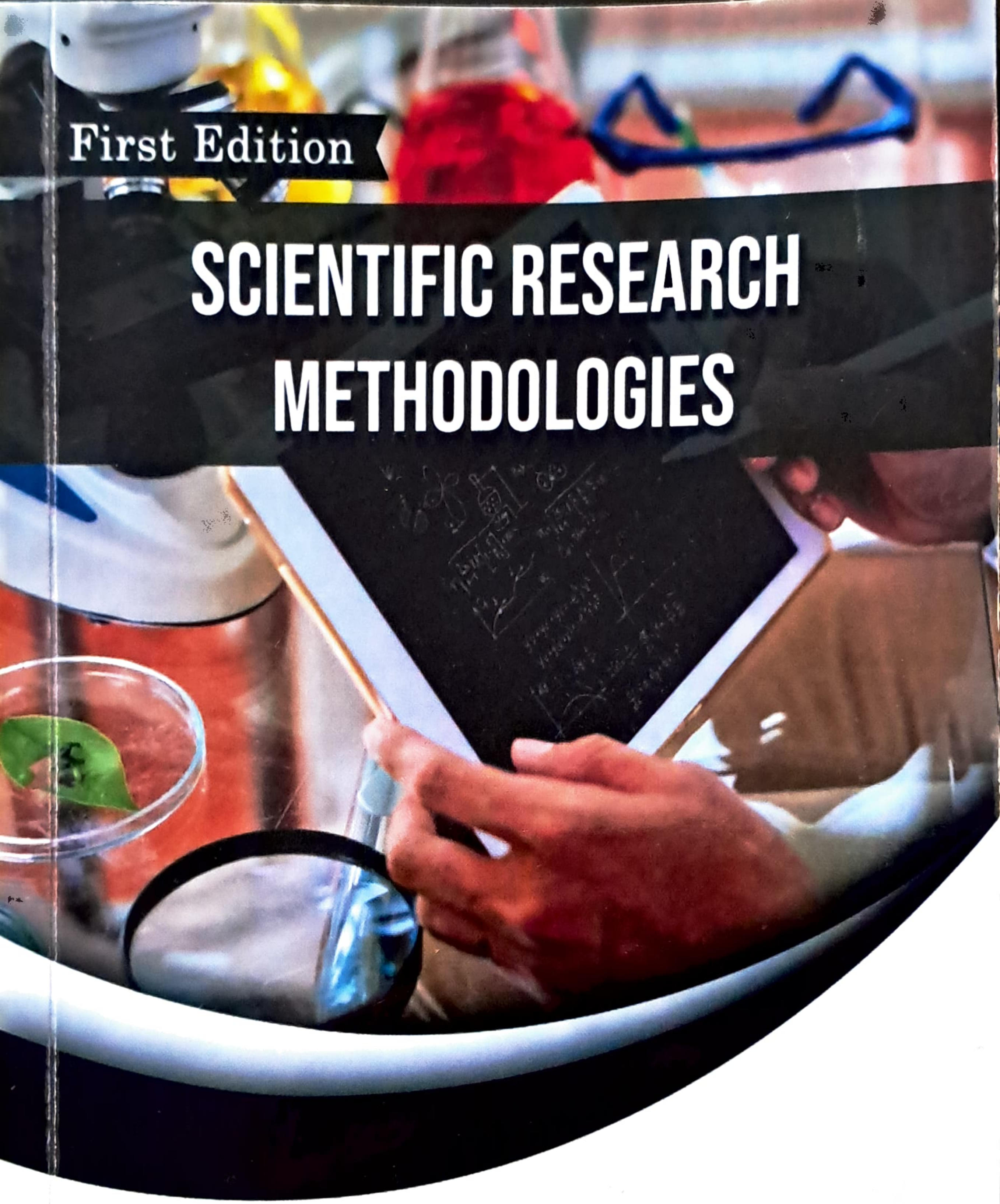

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FIRST EDITION

INTRODUCTION TO BOTANY- TAXONOMY OF ANGIOSPERMS

Dr. Girish C. Kamble
Dr. Rajeshwari Garg
Prof. Punita S. Tiwari
Dr. Ashwini B. Phokmare

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Pocket Handbook

Ethnobotany: Floristics, Alladoh Campus

Arts, Science, and commerce college chikhaldara

Dr. Sarang Dhote

Dr. Rajesh S. Jaipurkar

Dr. Ujwala Kokate

Pocket Handbook

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Editor's Name – Dr. Sarang S. Dhote

Author's Name- Dr. Rajesh S. Jaipurkar & Dr Ujwala R Kokate

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Preface

We are creating this compact guidebook with the aim of raising awareness among young students and nature enthusiasts about the diverse plants found at the Arts, Science & Commerce College in Chikhaldara.

Within this publication, photographs of different trees are equipped with the ability to communicate with students or readers. By scanning the corresponding QR codes using the Talking Tree app or any other scanning tool, individuals can engage in an interactive experience and gain additional information about the plants. It is significant for university students and Ayurveda.

Dr. Sarang Dhote

Dr. Rajesh S. Jaipurkar

Dr. Ujwala Kokate

1. Chlorophytum comosum

Spider Plant

2. Mangifera indica

Amba / mango

3. Acrocarpus fraxinifolius

Haligae

4. Putranjiva roxbughii

Putranjiva

5. Buchanania lanzan

Charoli

6. Mallotus philipense

Kumkum

7. Coffea arabica

Coffee

8. Mimusops elengi

Bakul

9. Grevillea robusta

Silver oak

10. Murraya koenigii

Meetha Neem

11. Cymbopogon martinee

Tikhadi

12. Lagerstomia parvifloa

Jarul

13. Terminalia bellirica

Behada

14. Eugenia jambolana

Jambhul / jamun

15. Psidium gajva

Peru

16. Cassia fistula

Amaltash

17. Phoenix dactylifera

Shindi

18. Emblica officinalis

Awala

19. Adhatoda vasica

Awala

20. Acacia auriculiformis

Ear leaf acacia

21. Hibiscus rosa sinen sis

Jaswand

22. Vitiveria zizanioides

Khus

23. Atrocarpus heterophyllus

Jack fruit / phanas

24. Cinnamomum tamala

Tejpan

25. Syzigium arimaticum

Lavang

26. Curcuma pseudomantana

Ranhald

27. Curcuma amada

Ambehalad

28. Bryophyllum pinnata

Panphuti

29. Kalanchoe pinnata

Panphuti

30. Urgenia indica

Pan kanda

31. Ammomum cardamomum

Ran vilayachi

32. Costus speciosus

Ranadrak

33. Ocimum tenuiflorum

Krishna tulas

34. Andrographis paniculata

Kalmegh / bhuineem

35. Alstonia scholaris

Saptparni

36. Gardenia gummifera

Dikamali

37. Asparagus racemosus

Shatavari

38. Piper longum

Long piper

39. Pinus roxburghii

Pine tree

40. Zamia integrifolia

Zamia

41. Argyreia nervosa

Samudrashosh

42. Cyperus rotundus

Nagarmotha

43. Bryophyllum cerratum

Panphuti

44. Euphorbia pulcherima

Panchatta

45. Coleus ambionicus

Ran oaa

46. Ruta graveolens

Sitap

47. Iphigenia stalluta

Ran Lasun

48. Tectaria macrodonta

Bachnag

49. Pumbago zeylanica

Chitrak

50. Ficus bengalensis

Wad

51. Ficus religiosa

Pipal

52. Callistemon lanceolatus

Bottle brush

53. Alpinia galangal

Kulingan

54. Ficus racemosa

Umbar

55. Morus alba

Saitus

56. Rawalphia serpentina

Sarpgandha

57. Ziziphus zijuba

Bor

58. Poinsettia rejia

Gulmohor

59. Acacia auriculiformis

Australian babhul

61. Pongamia pinnata

Kadubadam

62. Cupressus ornamental

Saru

63. Alove vera

Korphad

64. Gliricidia maculata

Gliricidia

65. Dendrocalamus strictus

Bamboo

66. Aurucaria bigonii

Khrismas tree

67. Ravenella madagascarensis

Ravenella

69. Pterocarpus santalinus

Raktchandan

70. Bahunia racemose

Aapta

71. Bahunia purpurea

Kanchan

72. Butea frondosa

Palas

74. Eucalyptus globosa

Nilgiri

75. Peltophorum pterocarpum

Sonmohor

77. Cymbopogon citratus

Gawati chah

79. Carissa carandas

Karwand

90. Mimosa pudica

Lajalu

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AN ADVANCE TOOL FOR QUALITATIVE ANALYSIS OF HEAVY METAL IN THIN LAYER CHROMATOGRAPHY

Sarang S. Dhote

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ABSTRACT

TLC is the most convenient analytical procedure for the study of the separation of multi-component systems. Here we introduce a simple and quick analytical software that is SS-831(Super-Saragraphy 831) which is useful for qualitative analysis of toxic metal ions from various samples. This software was copyrighted in the year 2018 in India. By using this software research scholars were getting results by simply uploading an image of a developed chromatographic plate in SS-831. The generated report gives information regarding the name of the metal and their R_f values.

Keywords- TLC, SS-831, Heavy Metal, Software, Image, Analytical.

1. INTRODUCTION

Low-cost Thin layer chromatography is found to be a superior analytical method for both qualitative and quantitative analysis. Many chromatographic experiments are carried out at the undergraduate level for the study of separation of components from multi-components systems. Various fundamentals of TLC such as R_f, H- bonding and polarity well explained for the students by the series of simple laboratory experiments [1], separation of pigments form ink [2], from beverages [3], separation of caffeine from beverages [4] and recent reversed-phase TLC was also explained in [5]. Various developments were carried out in TLC in terms of quantitative analysis, like rTLC [6] and qTLC [7].

The main limitation of this TLC is the maximum time required for the analysis and as soon as the number of the sample increases the requirement of time for analysis also increases. Hence rapid qualitative analytical tool is required for the development of TLC in the modern era. Here we present a simple and user-friendly software that makes students qualitatively analyze the components they are studying. This program is developed to work with images of developed chromatograms obtained by simple equipment like a mobile phone. In this article, we carried out a separation of heavy metal ions using silica gel-g adsorbent. While the tool's capabilities are illustrated in this separation analysis, the analytical approach is general and can be extended to a wide variety of other TLC experiments.

2. EXPERIMENTAL PROCEDURE

2.1. Materials:

Ethanol, Acetic acid (99.8%), various salts of some toxic metals were obtained from Loba Chemicals and Silica Gel-G was obtained from Merck India.

2.2. Test Solution:

TLC was performed using a standard aqueous solution (1%) of the chloride, nitrate or sulfate salts of the metal ions.

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2.3. Detection :

Fe^{3+}, Cu^{2+},U^{6+}, V^{5+}, Zr^{4+},and Th^{4+} were detected using 1% aqueous potassium ferrocyanide; Zn^{2+}, Cd^{2+}, Hg^{2+}, Bi^{3+}, Sb^{3+}, Pb^{2+}, Ag^{+}, Mo^{6+}, As^{3+}, and W^{6+} using 0.5% dithizone in carbon tetrachloride; and Ni^{2+}, and Co^{2+} using a 1% solution of alcoholic dimethylglyoxime.

2.4. Stationary Phase: Silica Gel-G in 1:1 (wt/wt) ratio.

2.5. Mobile phase: 1Vol% Acetic acid in Ethanol.

2.6. Thin-layer chromatography:

Silica Gel –G *plates* were prepared by mixing a mixture of Cellulose and aminoplast polymer with demineralized water in 1:2 ratios by weight with constant stirring to obtain a homogeneous slurry. It was then immediately applied to the glass plates by the dipping method. The plates were allowed to dry overnight at room temperature and were used the next day for TLC.

Test solutions were spotted onto thin- layer plates with the help of a micropipette positioned about 1.0 cm above the lower edge of the TLC plates. The spots were air-dried and the plates were then developed with the given mobile phase using the one-dimensional ascending technique in glass jars. The development distance was fixed at 10 cm in all cases. Following the development, the plates were again air-dried and the spots of the cations were visualized as coloring spots using the appropriate spraying reagent. R_F values were then calculated.

Separation- For the separation, the metal ions to be separated were mixed in equal amounts. A test solution of the resultant mixture was spotted onto the activated TLC plate and was then air-dried. The plates were developed to a distance of 10 cm. The spots were detected and the separated metal cations were identified by their R_F values. Figure 1 indicates the correct schematic protocol.

2.7. Qualitative Image Analysis :

Qualitative image analysis of chromatographic plates may be carried out by using the following procedures. After the completion of the elution of the solvent and drying of chromatographic plates, photographs of these plates were taken with the help of a mobile phone camera. For that, all chromatographic plates were placed in a black box (without UV Light) and through the eyepiece, the image was captured.

Figure 1 – a) Development of the TLC plates in the chromatographic chamber with a mobile phase system. b) Imaging through the eyepiece of a black box, c) direct imaging of the chromatographic plates.

The image was uploaded in SS-831 software. After that image was cropped by clicking the crop button of SS-831. And finally, we get resulted in an image with the name of metal ions and their R_f Value respectively. The working of SS-831 can be found in Figure 2.

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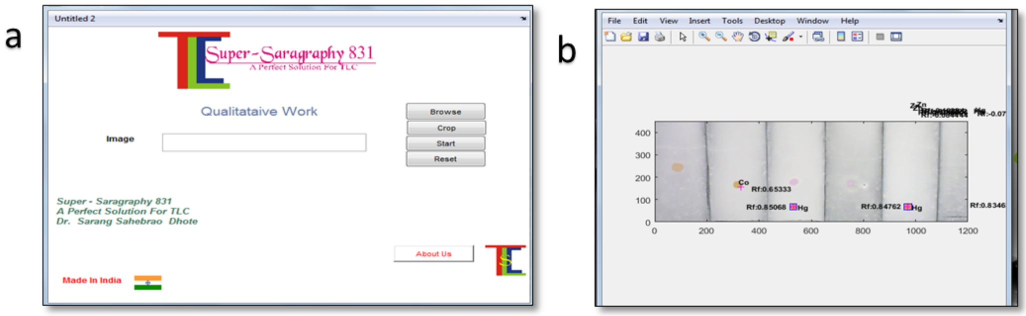

Figure 2 – a) Basic GUI of Super-Saragraphy-831. b) Resulted in a chromatographic plate with the name of metal ions and their R_f values.

3. RESULTS AND DISCUSSIONS

Successfully used the proposed method to distinguish heavy metals from different samples such as river water, spiked water, and industrial waste. Results have been compared to the traditional, classical system. Table No. 1 displays comparable R_f Metal ion values,

Table 1: Comparative study of Rf values of metal

Metal	Old Classical Method (R_f Value)	Super-Saragraphy-831 (R_f Value)
Lab Sample		
Co^{2+}	0.65	0.65333
Ni^{2+}	0.51	0.50213
Cu^{2+}	0.19	0.19452
Fe^{3+}	0.34	0.34450
Hg^{2+}	0.86	0.85068
Cd^{2+}	0.72	0.71845
Zn^{2+}	0.32	0.31458
River Sample		
Co^{2+}	0.62	0.63147
Ni^{2+}	0.55	0.54781
Cu^{2+}	0.19	0.20134
Fe^{3+}	0.36	0.36147
Hg^{2+}	0.89	0.88478
Cd^{2+}	0.75	0.73581
Zn^{2+}	0.33	0.33001
Spiked Sample		
Co^{2+}	0.59	0.60147
Ni^{2+}	0.53	0.52147
Cu^{2+}	0.20	0.18954
Fe^{3+}	0.34	0.32147
Hg^{2+}	0.87	0.86458
Cd^{2+}	0.76	0.75423
Zn^{2+}	0.32	0.34711
Industrial Sample		
Co^{2+}	0.61	0.61258
Ni^{2+}	0.54	0.54712
Cu^{2+}	0.21	0.20146
Fe^{3+}	0.32	0.31456

Hg^{2+}	0.87	0.86314
Cd^{2+}	0.74	0.73214
Zn^{2+}	0.33	0.34781

4. CONCLUSIONS

SS-831software is found to be good for the students who are working on qualitative analysis of various components using TLC. Within 6 seconds we get the analyzed report after uploading the chromatographic image to soaftware this advantage can be useful in case of bulk samples. Currently, this software can identify toxic metals but due to its advantages, it opens possibilities for further utilization in the separation of enzymes, drugs, etc.

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Conflicts of interest

1. There are no conflicts to declare

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CURRENT ADVANCES IN MULTIDISCIPLINARY RESEARCH (VOL-2)

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QUATERNARY SEDIMENTSAND CLAY MINERALSSTUDY OF MANJRA RIVER NEAR PATODA, BEED DISTRICT

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ABSTRACT

The present work is intended to study the field and laboratory investigation of Quaternary sediments of Manjra River near Patoda, Beed district. For this extensive field work has been carried out in and around Patoda, Beed District. An attempt has been made to study the geographical, structural and lithological features of the sediments. The studies have found that the Deccan trap of Upper Cretaceous to Lower Eocene is found at the base of soil and Quaternary sediments. Samples have been collected from the field work for the laboratory investigations while carrying out the field work. The laboratory investigation includes the study of sieve analysis, pH and Granulometric studies. The studies manifest that the flow regime is turbulent and it is mixture of varying size of sediments based on the nature of sediments. Beside turbulent flow regime at some places, the flow is suddenly changed to stagnant, represented by the fine sediments. The overall investigations manifests that sediments of the study area are river transported.

***Keywords:** Patoda, Lithology, Upper Cretaceous, Sieve analysis, Turbulent.*

Introduction:

The present dissertation has been intended to study the field and laboratory investigation of Quaternary sediments of Manjra River. The various studies on geographical, lithological and structural mapping of a limited area and Quaternary sediments have been carried out from the upper and lower Godavari sediments by handful of workers. This prompted the author to take up the similar studies in Manjara River. Hence, the area near Patoda was selected for the present studies.The field observations were made and samples from various sections were collected.Sediment supplies from continental sources to adjoining river are gently influenced by climatic and tectonic variables at various spatio – temporal scales (Milliman and Meade, 1983; Vaithyanathan, et. al. 2002; Wasson, 2003, Chakrapani, 2005). Relating the sediments characterizes to their provenance/ source is, therefore, essential to understand the mechanism of transport and sediment flux. Mineral magnetism method is used for such studies to characterize the sediment source, sediment dispersal and sediment mixing patterns amongst variety of depositional environments.The following pages incorporate the work carried out for the various parameters of sediments to understand their source and depositional regime. First the geological field work subsequent laboratory work is explained respectively.

Study Area:

Present study area is located near Patoda in Beed and Ahmednagar districts of Maharashtra. The area fall on theSurvey of India Toposheet No. 47 N (Beed) and 56 B (Osmanabad). This can be reached by National High No. 561 by Road. The field locations can be reached by motorable road in all seasons. The river flows from west to east and the villages are on the either sides of the Manjra River. The samples were collected from Patoda (18° 48' 167" N) (25° 29' 343" E). The Manjra river is a tributary of the River Godavari. It passes through the states of Maharashtra, Karnataka and Telangana. It originates in the Balaghat range of hills near Pathardi in Ahmednagar District at an altitude of 823 meters (2,700 ft) and empties into the Godavari River. It has a total catchment area of 30,844 square kilometers (3,084,400 ha).

Literature Review:

Initially, all the available information about the area was collected. The published and unpublished geological literatures, on the main as well as surrounding area were consulted.

Clay mineral analysis :

Table 7: Clay mineral analysis with the help of color and bottom residue.

Conclusion:

From the above data it is observed that all the beds formed in the river are of river sediments it is clear from the Moiola, Weiser and Friedman graph. In the studied samples percentage of Illite mineral is more, except L3 / 1 / a, is having Montmorollinite. Sediments are very poorly sorted and they shows high percentage of strongly fine skewed type of sediments, it means generally sediments are extremely leptokurtic. The sediments also can be said that they were less transported.

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This has enabled to get acquainted with the regional geological setting. The Mineral magnetic Characterization of the Godavari River and Western Bay of Bengal Sediments was carried out by Kulkarni et al. (2015). The similar work and the sedimentological work specially on Quaternary sediments has not been carried out on Manjara River. However, work on various geological – particularly sedimentological aspects was critically carried out by Rao(1982), Sonam and Kale(1993), and Deshpande (1998 and references therein).

Geology:

The Deccan basalt geology has been explained by several geoscientists for various parts of Maharashtra (Table. 1). The surrounding parts of the Manjra River are covered with black cotton soil, at places it is with grey and brownish coloured. The Deccan basaltic flows are spread over the longer distances on either side of the river. The Quaternary soil is mainly exposed in river flood plain and along the river in the river bed. In general The Deccan basalt of Upper Cretaceous – Lower Eocene is overlain by recent alluvium.

Sub group	Formation	Member / flow
WAI	Desur	
	Panhala	
	Mahabaleshwar	
	Ambenali	
	Pladpur	
LONAVALA	Bushe	
	Khandala	
	Bhimashankar	Monkey hill GPB Giravalli GPB
	Thakurvada	Thakurvadi chemical type Water type member Thakurvadi chemical type High TiO_2 Thakurvadi basalt Thakurvadi chemical basalt Jammu patti member
KALSUBAI	Neral	Tunel type basalt Neral chemical type Termbre basalt Neral chemical type Ambivili picrite basalt
	Igatpuri	Kashele GPB Nilamati
	Jawhar	Thalghat GPB Juni Jawhar Val river Golbhan phyric Devbandh Khardi phyric

Table 1. Stratigraphy of Deccan Basalt – AfterBeane et al. 1986,Bodas et al.1988, Cox and Hawkesworth,1985,Subbarao and Hooper, 1988 and Khadri et al. 1988.

Methodology:

The collected samples were brought to laboratory for analysis of various parameters viz. sieving, pH, clay mineral analysis, cumulative curves, textural parameters. For understanding the depositional environment of sediments, the source rocks of the sediments, to know fossils content if any. From the river, various beds sections were taken, and care was also taken to avoid contamination of samples from different beds or levels. The collected samples were properly packed and brought to the laboratory then these were subjected to various analyses in the laboratory. The collected samples were brought to the laboratory for analysis of various parameters viz. sieving, pH, clay mineral analysis, cumulative curves, textural parameters. For understanding the depositional environment of sediments, the source rocks of the sediments, to know fossils content if any.

Table 4. a

L3 / 1 / b

Sieve Scale	Frequency %	Cumulative %	Φ Scale
7	32.62	32.62	-2
16	43.03	75.65	-1
30	19.23	94.88	1
60	-	-	2
120	0.17	95.05	3
240	0.51	95.56	4
Pan	4.44	100	5

Table 4. b

L3 / 1 / c

Sieve Scale	Frequency %	Cumulative %	Φ Scale
7	50.78	50.78	-2
16	26.07	77.21	-1
30	12.07	89.23	1
60	-	-	2
120	0.41	89.69	3
240	0.53	90.22	4
Pan	9.78	100	5

Table 4. c

Granulometric table:

Sample No.	Mz φ	Type of sand	σi φ	Vc	Ski	Vc	Kg	Vc
L3/1/a	4.36	Gravel	0.99	V. moderately sorted	0.52	Strongly F. skewed	5.9	Extremely leptokurtic
L3/1/b	2.5	Gravel	0.80	Moderately sorted	0.64	Strongly F. skewed	3.6	Extremely leptokurtic
L3/1/c	5.7	Gravel	1.22	Poorly sorted	3.04	Strongly F. skewed	5.9	Extremely leptokurtic

Table 5: Granulometric reading and analysis.

pH :

L3 / 1 / a	8.21
L3 / 1 / b	7.84
L3 / 1 / c	8.4

Sample	Clay suspension Methylene blue	Clay suspension + Methylene blue + KCL	Nature of the residueof the bottom of the test tube	Clay mineral present
L3 / 1 / a	Violet	Violet	Jelly like	Montmorollinite
L3 / 1 / b	Blue	Blue	Dense and Compact	Illite
L3 / 1 / c	Blue	Blue	Dense and Compact	Illite

Table 6. pH scale of different section.

Clay mineral present	Clay suspension Methylene blue	Clay suspension + Methylene blue + KCl	Nature of the residue At the bottom of test tube
Kaolinite	Violet	Violet	Dense & compact
Illite	Violet – blue, Blue- sky blue	Blue, Blue Skyblue	Dense & compact
Montmorollinite	Violet	Blue, skyblue, Green	Jelly- like
Bedeilite	Green	Green	Jelly- like

Table 2: Coloration and identification chat.

Result And Discussion:

Location: 1 (Patoda):

Lat. – Long. : 18⁰48'167" N, 25⁰29'343" E

These location is little hilly. In the middle of the river bolders and pebbles are found. There are 3 main sections found. In S1 section influx sudden flow of water may occur and matrix of various size grains settle there. In the second spell i.e. S2 graded pattern are seen it indicate that the flow was continuous and current is fluctuated multidirectional channel or flow. In the S3 clay is seen that means it may be clam water deposition. The sequence can be seen alternate in the given figure below. It may pass from alternate climate so the sequence is seen alternate,as shown in fig.1.It can be seen that alternate clay, matrix and graded sections are formed.

Sieving Data:

Table 3: Sieve analysis according to different matrix of sieve.

Sieve scale	7	16	30	60	120	240	270	total
L3/1/a	11.141	11.149	22.073	-	1.197	4.336	267.846	317.742
L3/1/b	122.422	161.515	72.179	-	0.623	1.923	16.660	375.322
L3/1/c	196.397	102.224	46.685	-	1.599	2.043	37.809	386.757

Clay mineral analysis :

Table 7: Clay mineral analysis with the help of color and bottom residue.

Conclusion:

From the above data it is observed that all the beds formed in the river are of river sediments it is clear from the Moiola, Weiser and Friedman graph. In the studied samples percentage of Illite mineral is more, except L3 / 1 / a, is having Montmorollinite. Sediments are very poorly sorted and they shows high percentage of strongly fine skewed type of sediments, it means generally sediments are extremely leptokurtic. The sediments also can be said that they were less transported.

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Revealing and Classification of Deepfakes Video's Images using a Customize Convolution Neural Network Model

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Abstract

Deepfake has been exploited in recent years despite its widespread usage in a variety of areas to create dangerous material such as fake movies, rumors, and false news by changing or substituting the face information of the sources and so poses enormous security concerns to society. Research on active detection & prevention technologies is critical as deepfake continues to evolve. Deepfake has been a blessing, but we've taken advantage of it by utilizing it to swap faces. Deepfake is a new subdomain of Artificial Intelligence (AI) technology in which one person's face is layered over another person's face, which is becoming more and more popular on social networking sites. Deepfake pictures and videos can now be created much more quickly and cheaply due to ML (Machine Learning), which is a primary component of deepfakes. Despite negative connotations attached to the term "deepfakes," technology is increasingly being used in commercial & individual contexts. New technical advancements have made it more difficult to distinguish between deepfakes and images that have been digitally manipulated. The rise of deepfake technologies has sparked a growing sense of unease. The primary goal of this project is to properly distinguish deepfake pictures from real images using deep learning techniques.

In this study, we implemented a customized CNN algorithm to identify deepfake pictures from a video dataset and conducted a comparative analysis with two other methods to determine which way was superior. The Kaggle dataset was used to train & test our model. Convolutional neural networks (CNNs) have been used in this research to distinguish authentic & deepfake images by training three distinct CNN models. A customized CNN model, which includes several additional layers such as a dense layer, MaxPooling, as well as a dropout layer, has also been developed and implemented. This method follows the frames extraction, face feature extraction, data preprocessing, and classification phases in determining whether Real or Fake images in the video reflect the objectives. Accuracy, loss, and the area under the receiver operating characteristic (ROC) curve were used to characterize the data. Customized CNN outperformed all other models, achieving 91.4% accuracy, a reduced loss value of 0.342, as well as an AUC of 0.92. Besides, we obtained 85.2% testing accuracy from the CNN and 95.5% testing accuracy from the MLP-CNN model.

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Keywords: Deepfake detection; Deep learning; Customize CNN; Deepfake Detection Challenge Dataset; Classification

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CamScanner

roduction

Many deepfake videos have been [1] shared on social media as a result of the ease with which new chnologies may be accessed. An example of a "deepfake" is a picture or video in which that person's likeness is ubstituted by that of another person. Deepfake is becoming one of the most severe concerns facing modern society. Many pornographic videos have included celebrities' faces being swiped over their photos using Deepfake. As well as spreading misinformation for politicians, deepfake was also utilized in this role[2][3][4]. In 2018, a fake video for Barack Obama was made to include comments he had never said. With Joe Biden's tongue out, deepfakes have been employed already in the US 2020 presidential election. Deepfakes may have a negative influence on our society and propagate misinformation, particularly on social media, as a consequence of these detrimental applications of the technology [5]. The term [6]"deepfake" is a fusion of terms "deep learning" and "fake." It is mostly the result of neural networks in machine learning and relates specifically to the forgeries of images, videos, and audio created by GANs (Generative Adversarial Networks) [7]. Deepfakes have the potential to accelerate the growth of the entertainment, cultural exchange, as well as education industries, therefore enhancing not only the teaching level in the area of education but also the whole quality of life. However, deepfake is frequently used to create fake news and fabricate electronic evidence, misinforming the public and disrupting societal order. This technique has developed into the most sophisticated method of network attack. Deepfake [8]is capable of creating bogus images/videos that are difficult to discern with human eyes, resulting in social chaos [9]. For a long time, academics and the film industry have been fascinated by the idea of synthesizing pictures or videos. The majority of early false pictures and videos were created using graphical algorithms, as opposed to other approaches. And it was not until later that a technology called Deepfake was made available to the general public that it became widely recognized. A few clicks are all it takes to create a video recording of someone doing or saying something they did not want to use Deepfake, which is heavily reliant on DNN (Deep Neural Networks). Deepfake videos [10] have had a considerably greater effect than anybody could have predicted, and this might influence how people evaluate the veracity of media reports in the future. The idea that "seeing is believing" has been disproven. While the technology is harmless when used for recreational reasons, some individuals may utilize it for political or other nefarious goals, which might have major repercussions[9].

In response to this scenario, researchers have begun to investigate several approaches for distinguishing deepfake videos from real ones. In most cases, machine learning is used in conjunction with other detection approaches. It is fairly uncommon for researchers to use NN [11] of various designs to look for differences among fake and real videos, but in other cases, they have turned to handcrafted features that may be used to uncover semantic differences like the pattern of eye blinking [12] or head postures or face warping traces or particular habits of facial expression and movement while speaking[13]. To the best of our knowledge, maximum approaches either rely only on features of individual frames, neglect temporal data, or are too reliant on training datasets, preventing them from being generalized. Most of the time, study on deepfake video forensics is still in its start [9].

In several domains, with computer vision, Natural Language Processing (NLP) [14], & machine vision [15], deep learning (DL) [16] has shown to be a powerful and valuable approach. Deepfakes employs DL technology to create fake photos and videos of people that are impossible to tell apart from the genuine thing when seen by a human eye. Recently, several research has been undertaken to better understand how deepfakes function, as well as numerous new algorithms using deep learning, have been developed to identify these fakes. Computer vision, big data analytics, and human-level control are all examples of complicated issues for which DL has been effectively used. As a result, DL technologies have also been used to construct software that might pose a danger to the security of the United States and its people's privacy. Deepfake is a recent example of a DL-powered application.

1.1. Motivation

For the most part, the Deepfake toolkit works by modifying the face's most important traits while leaving the rest of the face unchanged. With a few changes, the video's character has changed. As a result of this, the video's message may be entirely different. Such alterations are carried out frame-by-frame, which is seen to be the most

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STUDY OF CLASSIFICATION PROBLEM USING RANDOM FOREST

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Abstract: Classification is a popular task in the field of Machine Learning (ML) and Artificial Intelligence (AI), and it happens when outputs are categorical variables. There are a wide variety of models that attempts to draw some conclusions from observed values, so classification algorithms predict categorical class labels and uses it in classifying new data. Popular classification models including logistic regression, decision tree, random forest, Support Vector Machine (SVM), multilayer perceptron, naive bayes, neural networks have proven to be efficient and accurate applied on many industrial and scientific problems. Particularly, application of ML to astronomy has shown to be very useful for classification, clustering and data cleaning. It is because after learning computers, these tasks can be done automatically by them in a more precise and more rapid way than human operators. In view of this, in this paper, we will review some of these popular classification algorithms, and then we apply some of them to the observational data of non variable and the RR Lyrae variable stars that come from the SDSS survey. For the sake of comparison, we calculate the accuracy and F1-score of the applied models.

Keywords: Machine learning, Classification, Sloan Digital Sky Survey, Non variable stars, RR Lyrae variables.

Introduction:

Classification is a type of supervised learning problem in machine learning, where the goal is to predict the class or category of an input based on a set of features or attributes. In a classification problem, the input data is a set of features and the output is a label that belongs to one of the predefined classes.

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn. One of the most popular branches of ML is Supervised Learning (Jain, 1999). It is a machine learning approach defined by its use of labeled datasets to train algorithms to classify data and predict outcomes. The labeled dataset, which is called training set, has output labeled corresponding to input data. The machine is supposed to understand what to search for, in the unseen data and provide some predictions based on what it has already learned from the labeled data. There are two main areas where supervised machine learning comes in handy, classification problems and regression problems. Classification refers to taking an input value and mapping it to a discrete value. In classification problems, our output typically consists of classes or categories, but regression is related to continuous data and in that the predicted output values are real numbers[1].

There are two main types of classification problems: binary classification and multiclass classification. In binary classification, the output is one of two possible labels, such as true or false, yes or no, or spam or not spam. In multiclass classification, the output can be one of three or more possible labels, such as different types of flowers, animals, or products.

Some common algorithms used for classification include logistic regression, decision trees, random forests, support vector machines, and neural networks. The performance of a classification model is typically measured using metrics such as accuracy, precision, recall, and F1 score. The choice of algorithm and performance metrics depends on the specific problem and the characteristics of the dataset. There are several different methods for classification, each with its own strengths and weaknesses[2].

Popular Classification Algorithms:

Here are some of the most common methods:

Logistic Regression: Logistic regression is a simple and widely used classification algorithm that uses a logistic function to model the probability of the input belonging to a particular class. It works well for linearly separable data and can handle binary as well as multi-class classification problems.

Decision Trees: Decision trees are another popular classification method that uses a tree-like model to make predictions based on the input features. The tree is constructed by recursively splitting the data based on the feature that provides the most information gain. Decision trees can handle both categorical and continuous features and can handle binary and multi-class classification problems.

Naive Bayes: Naive Bayes is a probabilistic classification method based on Bayes' theorem. It assumes that the input features are conditionally independent given the class and uses this assumption to calculate the probability of the input belonging to a particular class. Naive Bayes works well for high-dimensional data and can handle both binary and multi-class classification problems.

k-NearestNeighbors (k-NN): k-NN is a non-parametric classification method that works by finding the k nearest neighbors of a given input in the training data and using their class labels to predict the class of the input. The value of k is a hyperparameter that can be tuned to optimize the model's performance. k-NN works well for small datasets and can handle both binary and multi-class classification problems.

Support Vector Machines (SVMs): SVMs are a powerful classification method that works by finding the hyperplane that best separates the data into different classes. The hyperplane is chosen to maximize the margin between the classes, which helps to improve the model's generalization performance. SVMs can handle both linearly separable and non-linearly separable data and can handle both binary and multi-class classification problems.

Random Forest: Random Forest is an ensemble learning method that combines multiple decision trees to improve the accuracy and generalization performance of the model. The algorithm works by constructing a set of decision trees on randomly sampled subsets of the data and features and then combining their predictions through voting. Random Forest can handle both binary and multi-class classification problems and is robust to noisy and irrelevant features.

Gradient Boosting: Gradient Boosting is another ensemble learning method that works by iteratively adding weak learners to the model and fitting them to the residuals of the previous learners. The algorithm uses gradient descent to minimize the loss function and can handle both binary and multi-class classification problems. Gradient Boosting is highly effective and can achieve state-of-the-art performance on many classification tasks.

These are some of the most commonly used classification methods. Choosing the right method for a given problem depends on various factors such as the nature of the data, the number of features, the number of classes, and the desired level of accuracy and interpretability [3].

Literature Review:

"Random Forests for Stellar Classification" by F. Bailer-Jones et al. (2008), in this paper, the authors present a method for classifying stellar spectra using random forest. The method is applied to a dataset of over 18,000 stars with spectra obtained from the Sloan Digital Sky Survey (SDSS). The authors show that random forest outperforms other classification methods such as support vector machines and neural networks. The results demonstrate the potential of random forest for the classification of data. "Automatic classification of galaxies in the SDSS using decision trees and random forests" by O. I. Wong et al. (2008)In this paper, the authors use decision trees and random forest for the automatic classification of galaxies in the SDSS. The authors extract various features from the images, such as shape parameters and color indices, and use them as input to the

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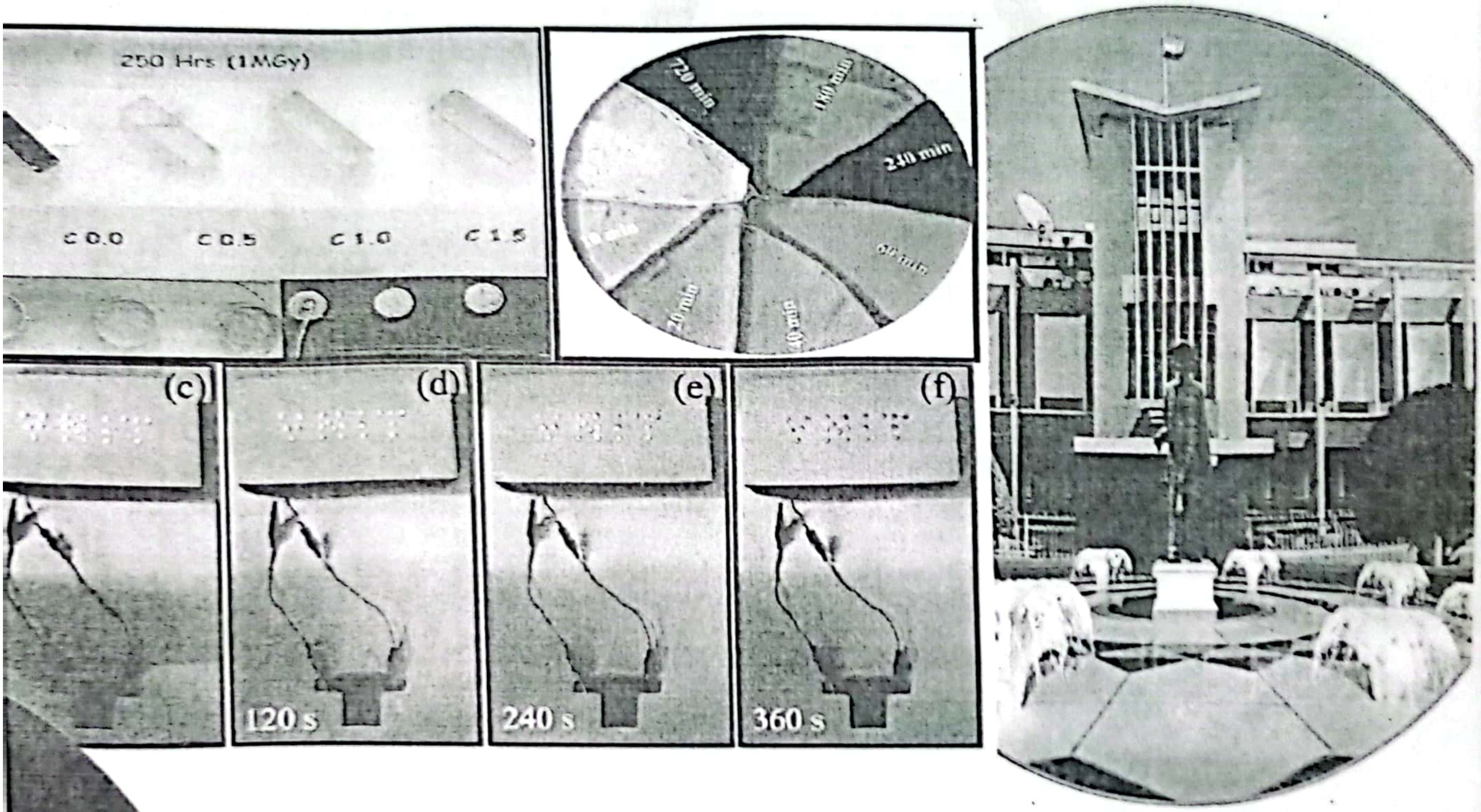

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Photoluminescence of Eu3+ Doped Strontium-Calcium Penta boroaluminate ($Sr_xCa_{(6-x)}B_5AlO_{15}$) Phosphors

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Abstract:

Strontium calcium penta boroaluminate phosphors were prepared via solid state synthesis. The all reagent was unit together to obtain a homogeneous mixture. After for 30 minutes, the precursor mixture was transferred to furnace pre-heated to anneal 500^{0}C for 2 hrs. Then prepared phosphors were again re-annealed at 800^{0}C for 4hrs. Remove the sample from the furnace after slow cooling having white crystalline floppy powder of Eu^{3+} Doped Strontium Calcium Penta Boroaluminate Phosphors.

All PL-Spectrum for various concentrations of Strontium-Calcium Penta Boroaluminate phosphor assigned due to the $5D_0 \rightarrow 7F_1$ and $5D_0 \rightarrow 7F_2$ transition of Eu^{3+} in red – orange region. The second one, is due to force electric dipole transition, first one occurs due to magnetic dipole transition.

In the near future as lighting sources, demand for new material with low energy consumption and Hg free lamps as lighting will increasing. The mercury free fluorescent lamp required excitation wavelength other than 254nm. The excitation of Eu^{3+} doped Strontium-Calcium Penta Boroaluminate phosphor is observed at 395nm. The PL emission peak at 596nm and 610nm in the red orange region of the visible spectrum after excitation of 392nm lights. PL emission of 596-610nm is due to the transition of Eu^{3+} located at 395nm. The excitation peak 395nm is near UV excitation and other than that of the conventional mercury excited lamp (254nm). Eu doped Strontium-Calcium Penta Boroaluminate phosphor may be useful for solid state lighting and lamp industry.

Keywords: Photoluminescence, long lasting, phosphorescence, boroaluminate

References:

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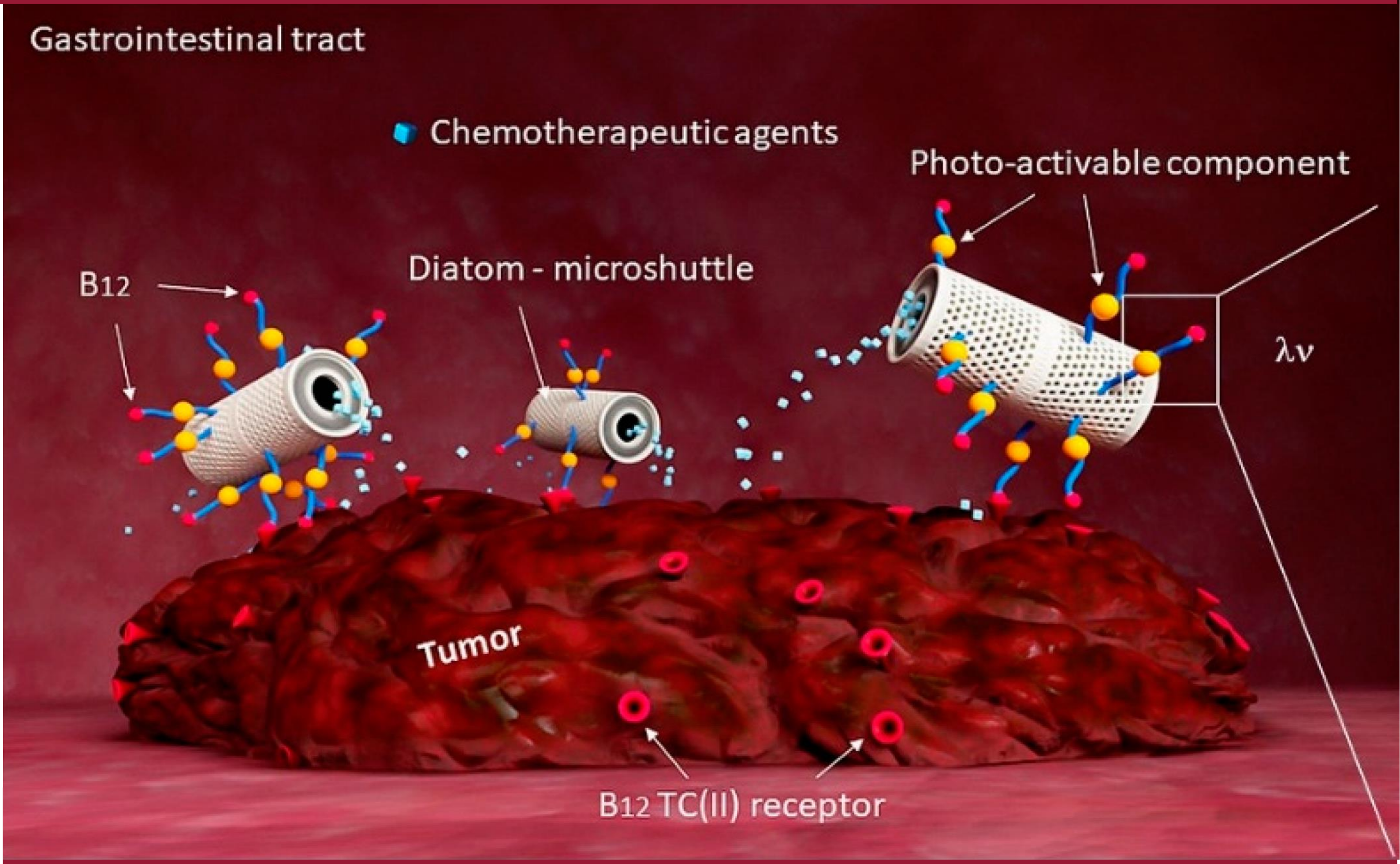

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EXPLORE THE WORLD OF DRUGS AND ITS DELIVERY SYSTEM

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QUATERNARY SEDIMENTSAND CLAY MINERALSSTUDY OF MANJRA RIVER NEAR PATODA, BEED DISTRICT

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ABSTRACT

The present work is intended to study the field and laboratory investigation of Quaternary sediments of Manjra River near Patoda, Beed district. For this extensive field work has been carried out in and around Patoda, Beed District. An attempt has been made to study the geographical, structural and lithological features of the sediments. The studies have found that the Deccan trap of Upper Cretaceous to Lower Eocene is found at the base of soil and Quaternary sediments. Samples have been collected from the field work for the laboratory investigations while carrying out the field work. The laboratory investigation includes the study of sieve analysis, pH and Granulometric studies. The studies manifest that the flow regime is turbulent and it is mixture of varying size of sediments based on the nature of sediments. Beside turbulent flow regime at some places, the flow is suddenly changed to stagnant, represented by the fine sediments. The overall investigations manifests that sediments of the study area are river transported.

***Keywords:** Patoda, Lithology, Upper Cretaceous, Sieve analysis, Turbulent.*

Introduction:

The present dissertation has been intended to study the field and laboratory investigation of Quaternary sediments of Manjra River. The various studies on geographical, lithological and structural mapping of a limited area and Quaternary sediments have been carried out from the upper and lower Godavari sediments by handful of workers. This prompted the author to take up the similar studies in Manjara River. Hence, the area near Patoda was selected for the present studies.The field observations were made and samples from various sections were collected.Sediment supplies from continental sources to adjoining river are gently influenced by climatic and tectonic variables at various spatio – temporal scales (Milliman and Meade, 1983; Vaithyanathan, et. al. 2002; Wasson, 2003, Chakrapani, 2005). Relating the sediments characterizes to their provenance/ source is, therefore, essential to understand the mechanism of transport and sediment flux. Mineral magnetism method is used for such studies to characterize the sediment source, sediment dispersal and sediment mixing patterns amongst variety of depositional environments.The following pages incorporate the work carried out for the various parameters of sediments to understand their source and depositional regime. First the geological field work subsequent laboratory work is explained respectively.

Study Area:

Present study area is located near Patoda in Beed and Ahmednagar districts of Maharashtra. The area fall on theSurvey of India Toposheet No. 47 N (Beed) and 56 B (Osmanabad). This can be reached by National High No. 561 by Road. The field locations can be reached by motorable road in all seasons. The river flows from west to east and the villages are on the either sides of the Manjra River. The samples were collected from Patoda (18º 48' 167" N) (25º 29' 343" E). The Manjra river is a tributary of the River Godavari. It passes through the states of Maharashtra, Karnataka and Telangana. It originates in the Balaghat range of hills near Pathardi in Ahmednagar District at an altitude of 823 meters (2,700 ft) and empties into the Godavari River. It has a total catchment area of 30,844 square kilometers (3,084,400 ha).

Literature Review:

Initially, all the available information about the area was collected. The published and unpublished geological literatures, on the main as well as surrounding area were consulted.

This has enabled to get acquainted with the regional geological setting. The Mineral magnetic Characterization of the Godavari River and Western Bay of Bengal Sediments was carried out by Kulkarni et al. (2015). The similar work and the sedimentological work specially on Quaternary sediments has not been carried out on Manjara River. However, work on various geological – particularly sedimentological aspects was critically carried out by Rao(1982), Sonam and Kale(1993), and Deshpande (1998 and references therein).

Geology:

The Deccan basalt geology has been explained by several geoscientists for various parts of Maharashtra (Table. 1). The surrounding parts of the Manjra River are covered with black cotton soil, at places it is with grey and brownish coloured. The Deccan basaltic flows are spread over the longer distances on either side of the river. The Quaternary soil is mainly exposed in river flood plain and along the river in the river bed. In general The Deccan basalt of Upper Cretaceous – Lower Eocene is overlain by recent alluvium.

Sub group	Formation	Member / flow
WAI	Desur	
	Panhala	
	Mahabaleshwar	
	Ambenali	
	Pladpur	
LONAVALA	Bushe	
	Khandala	
	Bhimashankar	Monkey hill GPB Giravalli GPB
	Thakurvada	Thakurvadi chemical type Water type member Thakurvadi chemical type High TiO_2Thakurvadi basalt Thakurvadi chemical basalt Jammu patti member
KALSUBAI	Neral	Tunel type basalt Neral chemical type Termbre basalt Neral chemical type Ambivili pierite basalt
	Igatpuri	Kashele GPB Nilamati
	Jawhar	Thalghat GPB Juni Jawhar Val river Golbhan phyric Devbandh Khardi phyric

Table 1. Stratigraphy of Deccan Basalt – AfterBeane et al. 1986,Bodas et al.1988, Cox and Hawkesworth,1985,Subbarao and Hooper, 1988 and Khadri et al. 1988.

Methodology:

The collected samples were brought to laboratory for analysis of various parameters viz. sieving, pH, clay mineral analysis, cumulative curves, textural parameters. For understanding the depositional environment of sediments, the source rocks of the sediments, to know fossils content if any. From the river, various beds sections were taken, and care was also taken to avoid contamination of samples from different beds or levels. The collected samples were properly packed and brought to the laboratory then these were subjected to various analyses in the laboratory. The collected samples were brought to the laboratory for analysis of various parameters viz. sieving, pH, clay mineral analysis, cumulative curves, textural parameters. For understanding the depositional environment of sediments, the source rocks of the sediments, to know fossils content if any.

Clay mineral present	Clay suspension Methylene blue	Clay suspension + Methylene blue + KCl	Nature of the residue At the bottom of test tube
Kaolinite	Violet	Violet	Dense & compact
Illite	Violet – blue, Blue- sky blue	Blue, Blue Skyblue	Dense & compact
Montmorollinite	Violet	Blue, skyblue, Green	Jelly- like
Bedeilite	Green	Green	Jelly- like

Table 2: Coloration and identification chat.

Result And Discussion:

Location: 1 (Patoda):

Lat. – Long. : $18^0$48'167" N, $25^0$29'343" E
These location is little hilly. In the middle of the river bolders and pebbles are found. There are 3 main sections found. In S1 section influx sudden flow of water may occur and matrix of various size grains settle there. In the second spell i.e. S2 graded pattern are seen it indicate that the flow was continuous and current is fluctuated multidirectional channel or flow. In the S3 clay is seen that means it may be clam water deposition. The sequence can be seen alternate in the given figure below. It may pass from alternate climate so the sequence is seen alternate,as shown in fig.1.It can be seen that alternate clay, matrix and graded sections are formed.

Sieving Data:

Table 3: Sieve analysis according to different matrix of sieve.

Sieve scale	7	16	30	60	120	240	270	total
L3 / 1 / a	11.141	11.149	22.073	-	1.197	4.336	267.846	317.742
L3 / 1 / b	122.422	161.515	72.179	-	0.623	1.923	16.660	375.322
L3 / 1 / c	196.397	102.224	46.685	-	1.599	2.043	37.809	386.757

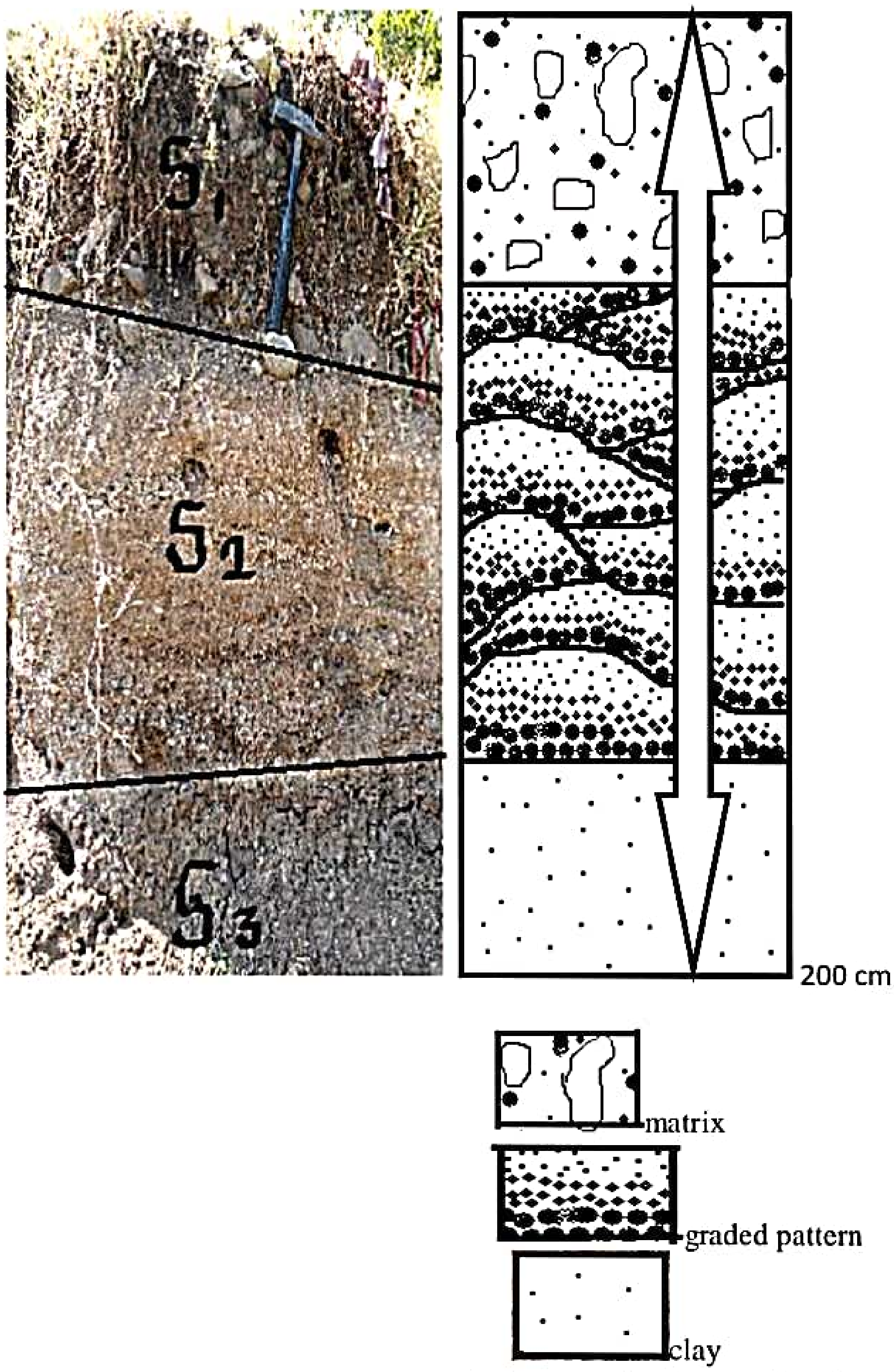

Fig. 1, vertical section of Location I

L3 / 1 / a

Sieve Scale	Frequency %	Cumulative %	Φ Scale
7	3.51	3.51	-2
16	3.51	7.02	-1
30	6.95	13.97	1
60	-	-	2
120	0.38	14.35	3
240	1.36	15.71	4
Pan	84.30	100	5

Table 4. a

L3 / 1 / b

Sieve Scale	Frequency %	Cumulative %	Φ Scale
7	32.62	32.62	-2
16	43.03	75.65	-1
30	19.23	94.88	1
60	-	-	2
120	0.17	95.05	3
240	0.51	95.56	4
Pan	4.44	100	5

Table 4. b

L3 / 1 / c

Sieve Scale	Frequency %	Cumulative %	Φ Scale
7	50.78	50.78	-2
16	26.07	77.21	-1
30	12.07	89.23	1
60	-	-	2
120	0.41	89.69	3
240	0.53	90.22	4
Pan	9.78	100	5

Table 4. c

Granulometric table:

Sample No.	Mz φ	Type of sand	σi φ	Vc	Ski	Vc	Kg	Vc
L3/1/a	4.36	Gravel	0.99	V. moderately sorted	0.52	Strongly F. skewed	5.9	Extremely leptokurtic
L3/1/b	2.5	Gravel	0.80	Moderately sorted	0.64	Strongly F. skewed	3.6	Extremely leptokurtic
L3/1/c	5.7	Gravel	1.22	Poorly sorted	3.04	Strongly F. skewed	5.9	Extremely leptokurtic

Table 5: Granulometric reading and analysis.

pH :

L3 / 1 / a	8.21
L3 / 1 / b	7.84
L3 / 1 / c	8.4

Sample	Clay suspension Methylene blue	Clay suspension + Methylene blue + KCL	Nature of the residueof the bottom of the test tube	Clay mineral present
L3 / 1 / a	Violet	Violet	Jelly like	Montmorollinite
L3 / 1 / b	Blue	Blue	Dense and Compact	Illite
L3 / 1 / c	Blue	Blue	Dense and Compact	Illite

Table 6. pH scale of different section.

Clay mineral analysis :

Table 7: Clay mineral analysis with the help of color and bottom residue.

Conclusion:

From the above data it is observed that all the beds formed in the river are of river sediments it is clear from the Moiola, Weiser and Friedman graph. In the studied samples percentage of Illite mineral is more, except L3 / 1 / a, is having Montmorollinite. Sediments are very poorly sorted and they shows high percentage of strongly fine skewed type of sediments, it means generally sediments are extremely leptokurtic. The sediments also can be said that they were less transported.

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10

Strategies of nanotechnology as a defense system in plants

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Chapter outline

10.1 Introduction

Agriculture has been the backbone of a country's economy, GDP (gross domestic product), and employment. There should be concerted efforts to modernize agriculture. Improving

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rural infrastructure is also considered essential. Under "globalization," farmers have been exposed to new challenges from the green revolution to the gene revolution and now in the era of nanorevolution (Fig. 10–1). Farming varies from subsistence to commercial type, from traditional farming such as plantation farming, organic farming, gene-modified farming, and the next hypha is nanofarming. Nanotechnology is a promising field that has a lot of scope in the fields of medicine, pharmaceuticals, and agriculture. It improves the agricultural sciences, especially the defense mechanism in plants. The nano-based diagnostic kits enhance the speed and power of detection (Prasanna, 2007; Singh et al., 2015).

Defense means resistance against any "damaging act" or response of the plant system. Plant protects them at pregermination and germination stages of pathogen's entry with structural defense (preexisting structures). Biochemical defense is activated when the plant fails to shield by the structural defense (Freeman & Beattie, 2008). The potential benefits of nanotechnological strategies for various diseases and defense management to improve crop productivity were studied by many researchers (Kah & Hofmann, 2014; Mishra & Singh, 2016; Parisi et al., 2015; Prasad et al., 2012). Nanoparticles (NPs) have numerous possible applications in the area of biosensors such as precision farming and helps in determining rapid and real-time crop efficiency. It also provided information about the availability of natural resources such as plant fractions, soil, and water in agroecosystems. The application of nanomaterials (NMs),

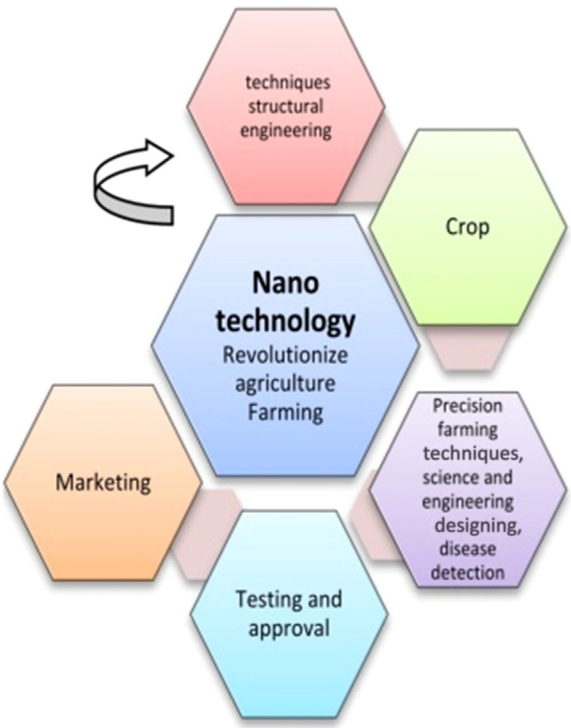


FIGURE 10–1 Nanotechnology in agriculture.

nanominerals, nanozeolties, and nanosensors used for detecting the contaminants of microbes, bacteria, viruses, pathogens, and pollutants by locating and signaling pathways used to improve the nutrient quality of the soil (Barik et al., 2008; Bhattacharyya et al., 2016; Gupta et al., 2018; Ismail et al., 2017; Joyner & Kumar, 2015; Oliveira et al., 2015; Prasad et al., 2014, 2017a, 2017b; Prasad, Gupta, Kumar, Wang et al., 2017; Wilson et al., 2008). For the sustainable farming and protection of the environment, the encapsulation plays a vital role by reducing drifting and leaching. The bionanohybrid is a versatile tool and diverse raw materials with improved structural and functional properties that constitute an assembly of molecular and inorganic substrates through interactions on the nanometric scale. Biominerals are produced by organisms called biomineralization. It controls the nucleation and the growth of inorganic materials. The biosilicification gives amorphous hydrated SiO_2 (biosilica) that is developed in sponges and many higher plants (Ruiz-Hitzky et al., 2007). The harmful substances act as a vehicle for carrying the functional ingredients at the desired site of action. This nanostructure applied to plants increased the yield, durability and provided protection against pests. Metal-based NMs were also widely used to increase the efficacy of pesticides with minor doses (Abd-Elsalam, 2013). The NPs pose antioxidant properties, and functionalised a delivery system as they interact with the free radicals that are responsible for converting them to harmless products (Sandhir et al., 2015). The environmental pollutants caused toxicity that increases the formation of reactive oxygen spores and influences the antioxidant defense systems (Eftekhari et al., 2018). For the reduction of reactive oxygen spores (ROS), we need a green synthesis of metallic NPs and plants with high antioxidant and reducing capacities. Natural antioxidants were used commercially as additives or nutritional supplements such as rosemary, sage, and zataria (Schuler, 1990). In the present scenario of pandemic, the high costs of vegetables, fruits, and other essential crops need to be revolutionized by the strategies of nanotechnology. The smart use of smart materials, that is, nanoscience and nanotechnology are more focused on research.

10.2 Nanotechnology in plant defense mechanism

10.2.1 Nanobiosensors

Nanobiosensors (NBSs) are analytical devices having at least one dimension no greater than 100 nm. This powerful device can be applied along with the entire food chain and in the process of manufacturing of food engineering, packaging, equipment, food quality, safety, freshness, authenticity, and traceability (Fraceto et al., 2016; Perez-de-Luque & Rubiales, 2009; Torney et al., 2007). These devices combine biological element recognition with chemical or physical principles (Khiari, 2017). It has been shown that since the last decade, the bionanosensors have been used in the field of agroecosystem very effectively (Liu, 2003). On the plant leaves, in the suspension spray treatment a large number of these devices could be positioned (Joyner & Kumar, 2015). The plant chlorophyll absorbs red light as an energy source. The healthy plants during photosynthesis absorb more red light and reflect a larger amount of near-infrared light than those that are unhealthy. NBSs consist of three components—(1) bio-sensitive probe, (2) transducer, and (3) data-recording unit (Espinosa et al., 2015; Habibi & Vignon, 2008). In plants, adenine–dinucleotide, flavins, chlorophyll, and lipids (Zeiri, 2007) and targeted two molecules, a *Bacillus anthracis* biomarker and glucose in a serum–protein mixture, were attributed (Yonzon et al., 2004). In this chapter a detailed study on the NBSs that are developed to defense mechanism by detecting the contaminants, crop production, metabolism, and environment is discussed. In plants the localized surface plasmon resonance, surface-enhanced Raman scattering (SERS), fluorescence resonance energy transfer (FRET), electrochemical, carbon-based, optical nanosensors are elaborated. SERSs—surface-enhanced Raman scattering nanosensors—are molecule-based nanosensors.

10.2.1.1 FRET-based nanosensors

These sensors are either genetically encoded or added to externally synthesized NPs. In plants, FRET-based saccharide glucose and sucrose sensors are used to monitor sugar levels in the cytosol of both roots and leaves, tissues with moderate square pulses *Agrobacterium* sugar-binding protein (Deuschle et al., 2006; Lager et al., 2006). Nanogold in the epidermal membranes of onion (*Allium cepa* L.), free gold NPs showed a detection limit for sucrose, and they are of various sizes and diameters (Bagal-Kestwal et al., 2016). Besides, FRET is used in genetic engineering NPs, and in plants, it is difficult to gene silencing. The variety of NPs has been used in genetic engineering and detection of biomolecules, metal ions and organic compounds, mesoporous and polymers (Maxwell et al., 2002; Huang & Murray, 2002). The disadvantages of using FRET-based nanosensors are the overlap in the emission of wavelengths with chlorophyll autofluorescence and cell walls (Chaudhuri et al., 2008).

10.2.1.2 Electrochemical nanosensors

The nanoelectrochemical systems have dynamic potential by detecting DNA, biological molecules as specific enzymes, analysis of soil, crop production, quality of food, pH, and concentration of toxic heavy metal ions in the soil plant, potatoes, and vegetables, fertilizer management, liquid fertilization strategies, and nutrient demand of the plant in greenhouse industry systems. The chemiresistive sensors are another advanced type of electrochemical detection platform that was discussed in the nanosensor technology applied to living plant systems (Kwak et al., 2017). Both sensors and biosensors degrade the excess potentials of marginal analytically essential electrochemical reactions (Merkoci de-Luque et al., 2012). The NMs-based biosensors were synthesized without fabrication process (Sagadevan & Periasamy, 2014) and were based on photoactive and metallic NPs, that is, electrolysis. The use of electrochemical biomolecule sensor has its advantages in various fields such as food quality, clinical analysis, pathogens, microorganisms and can receive very low detection mechanism (Hernandez-Santos & Gonzalez-Garcia, 2002). The magnetic NPs, nanowires, carbon, and biological NMs improve multidetection capability and sensitivity. Various metallic NPs can be used to increase an electronic signal such as Au, Ag, and Cu (Sagadevan & Periasamy, 2014). The universal fluorescence quenchers to develop a specific DNA and modified DNA is used to develop a microcantilever-based DNA biosensor and the detection of DNA through an ion channel switch biosensor (Maxwell et al., 2002; Su et al., 2003; Wright & Harding, 2000).

10.2.1.3 Carbon-based nanosensors

Carbon NMs (CNMs) are a class of engineered NMs (ENMs) and are classified mostly to their geometrical structure. It includes graphene, carbon atoms, graphene oxides, and single- or multiwalled carbon nanotubes (SWCNTs or MWCNTs) that are horn-shaped, spherical or ellipsoidal (fullerenes), carbon nanodots, and nanofibers (Jampílek & Kralova, 2020). The research is focused on both the positive and adverse effects of CNMs. Its application has been increased due to its exceptional, optical, chemical, mechanical, and thermal properties (Bennett et al., 2013) and delivery in nucleic acid, water treatment, and suppression of plant diseases caused by pathogens. These overall studies show that these carbon-based NMs are of low-cost solution for crop promotion and protection (Shojaei et al., 2019). The entry of CNTs through root hairs and translocate into aerial parts of the plants via xylem vessels affects plant growth and seed quality. Thus, the entry of CNTs into plants is inversely proportional to their size (Acharya & Chhipa, 2020). The ability of MWCNTs to penetrate the seed coats of corn, barley, and soybean shows the positive effect of MWCNT on the germination and growth of seedlings (30 nm) as well as leaf segments at 50 mg mL^{-1} (Hao et al., 2018; Lahiani et al., 2013; Mondal et al., 2011). In SWCNTs, MWCNTs nanocomposites were found to be a promising biomaterial in the field of agriculture and biotechnology (Patel et al., 2020). CNTs penetrate tomato seeds (10–40 mg mL^{-1}) and their toxic bioavailability in plants to penetrate the cell wall and membrane of intact plant cells shows the positive and negative aspects of CNMs (Khodakovskaya et al., 2009; Liu et al., 2017; Nair et al., 2012; Shojaei et al., 2019). In the field of nanoagronomy the carbon-based model is determined, which assists the plant nutrition, contaminants, improves surface modification, and develops sensor accuracy for efficient plant growth (Ashfaq et al., 2017) due to its accurate detection systems of heavy metal ions, gas molecules, food additives, toxic as well as antibiotics.

10.2.2 Nanoencapsulation

The nanoencapsulation involves entrapping one matrix over the other or active core material (inert) with few nm to mm diameter. The ingredient, which is used to encapsulated core material, is called coating material (carrier material). This miniature is used for techniques such as nanocomposite, nanoemulsification, and nanostructuration (Gibbs et al., 1999; Jyothi et al., 2010; Zuidam & Shimoni, 2010; Bayraktar et al., 2017). Inert or entrapped material is mostly liquid, but in few, it may be solid or a gas. The classification of the different structural arrangements of core-shell materials is in nanoencapsulated composites (Timilsena et al., 2020). In agriculture particularly, nanoencapsulation in defense mechanism is used through which the release of chemicals like insecticides is controlled; plants need to protect the crop from various technological modifications (Scrinis & Lyons, 2007). The outcomes of nanoencapsulation are interrelated; the major goals can be the increase of controlled release properties of the pesticide, solubility of active ingredients, protection against premature degradation, and the increase of the stability of pesticides (Nuruzzaman et al., 2016). Presently, nanoencapsulation received great attention in the field of agriculture that is not yet a widespread and implemented technique but is mostly used in food, cosmetic, and pharmaceutical industries (Suganya & Anuradha, 2017). Sustainable crop production in the field of nanotechnology has many challenges. The intensive usage of pesticides causes ecotoxicity in the environment and reduction of production cost. In nanoencapsulation the particle size gives a larger surface area and improves properties, coating composition such as melting point, water-solubility, flexibility, friable, and other properties and layers of coating with more tiny or fewer thick layers. In hydrophobic pesticides, it is used as a versatile tool for enhancing dispersion in media and permitting a controlled release of the active compounds (Guan et al., 2008). Currently, it is a reliable technology for the identification of insects' pests. Formulations of nanodiameter pesticides require other chemicals for the delivery of DNA into plant tissues (Torney et al., 2007). This method revolutionizes the process of plant defense, and it is the time to release nitrogen loss, eutrophication, improve soil, and solve problems associated with drifting and leaching (Guan et al., 2008). In the Maize crop the use of PCL nanocapsules having atrazine could not lead to persistent side effects and safe tool against weed control (Oliveira et al., 2015). The nanoencapsulated pyridalyl suspension shows more efficient result than technical and commercial materials against tomatoes, fruits, and shoot borer of *Helicoverpa armigera*, and the insecticide loaded to the environment may be reduced by using nanoformulations. Many industry-based formulations contain NPs ranging 100−250 nm. The water- and oil-based NPs are in the range of 200−400 nm. The diameter easily dissolved within the media such as water gels, creams, and liquids. Some microencapsulated products containing the active compound lambda-cyhalothrin breaks open in contact with leaves. These data are focused on modern strategies used for the defense and potential of nanoencapsulation in sustainable agriculture management (Saini et al., 2014).

10.2.3 Metal-based nanoparticles

The metal-based NPs (MBNPs) will also cause toxicity to terrestrial plants but very less information is there on its defense mechanisms (Monica & Cremonini, 2009; Zhu et al., 2012). Several studies have reported that nanoformulations are often used for improving the yield and quality of several crops by reducing the number of chemicals released in the environment; the nanotechnologies potential is often used as an integrated pest management issue as price-effective and eco-friendly methodologies. MBNPs are engineered for the types of various metals such as Au, Ag, Pt, Ni, and Zn (Dolez, 2015). It has distinct physical and chemical properties besides different biological actions (Elena & Katarina, 2013). Like gold, it is also small in size with larger spacing between atomic coordinators and acts as a catalyst (Saleh, 2020). Metal NPs (MNPs) are a crucial part of nanotechnology and nowadays research is focused on their sizes and shapes to manipulate their distinctive mechanical optoelectronic, magnetic, and catalytic properties (Burda et al., 2005; Govender et al., 2010; Haverkamp & Marshall, 2009). A physicochemical property of MNP determines their interactions with living organisms (Elena & Katarina, 2013). It has been shown that their exaggerated toxicity with decrease particle size (Tripathi et al., 2017) and the double-edged sword properties give positive benefits and negative effects on health on exposure. The MBNPs possess some more toxicity such as silver, gold, and copper with their smaller size of NPs (Schrand et al., 2010). NMs are used in plant defense mechanisms and their management of various farming practices. In recent years, nanotechnology has opened the way for new approaches for numerous agricultural problems ranging from plant protection and detection of diseases, management, and control of plant infective agents, pesticides, or fungicides. It increases bioavailability through active ingredients and decreases the impacts on nontargeted organisms (Freeman & Beattie, 2008). For the production of pesticides or fungicides, mostly silica, titanium, and copper-based NPs are used (Kah et al., 2014; Lopez-Moreno et al., 2010).

The nanofertlizers enhance crop yield and proper plant development by serving the required absorption of the micro- and macronutrients. Controlled release, raising the selectivity and stability of the pesticide that permits the more time period of the active chemical compound and reducing expenses of pesticides, nanofertilizers, nanoherbicides, and soil absorption (Abigail & Chidambaram, 2017; Paramo et al., 2020; Pascoli et al., 2018). These MBNPs not solely enhance the growth of the plant but additionally protect against environmental stresses like drought, salinity, waterlogging, and temperature changes. Nanostructure fertilizers such as Cu, Zn, Mn, Fe, and Mo will promote plant growth and agronomic yield with a little amount leading to vital economic and environmental advantages (Liu & Lal, 2015). NPs are free from their matrix and enter the sewage system (Durenkamp et al., 2016). It is more effective in plant protection as it plays a vital role in plant physiology, morphological, and genotoxic changes (Nair, 2016). NP applications were different for various soil types. MBNPs will enter the agricultural system through direct and indirect pathways. The application of nanoformulated agricultural chemicals together with nanofertilizers and nanopesticides has increased (Monreal et al., 2016). The MBNPs sink with organic and inorganic contaminants in soil and water that will ultimately reach the ecosystem (Bundschuh et al., 2018). The excess application of NPs clearly indicates their negative, adverse impact on ecosystems. Studies explore the toxicity of NPs in relation to water and biota (Living organism). Current risk assessments are related to their use, distribution in the environment (Rajput et al., 2019). The field studies are used to give better knowledge about the effect of MBNPs in agricultural systems (Tripathi et al., 2017). MBNPs are toxic to flora and fauna as they are used to inhibit its further growth (Navarro et al., 2008; Siddiqi & Husen, 2017). Table 10−1 shows the accumulation of bionanoparticles in plant roots and their translocation to the different parts of plants. The increase in shoot length as well as a reduction in root length and their proliferation were reported by Lin and Xing (2007).

MBNPs are toxic to flora and fauna as they are used to inhibit their further growth (Navarro et al., 2008; Siddiqi & Husen, 2016). The severe problem being faced now is the generation of phytotoxicity of NPs that cause produce of reactive oxygen species (ROS), increase of oxidative stress, lipid peroxidation, protein, DNA harms in plants, and weakening of pathogen management throughout the plant life (Prasad, 2017; Arruda et al., 2015; Singh, Tripathi, et al., 2017; Singh, Vishvakarma, et al., 2017). Nanotechnology is an emerging technology in agriculture, and it provides efficient and sustainable food production by improving

Table 10–1 Positive and negative impacts of interaction of metal-based nanoparticles (NPs) with different crops.

Sr. no	Metal-based NPs	Plant	Effect	References
1	Ag	Lettuce	No adverse effects of phytotoxicity	Larue et al. (2014)
		Carrot	The germination and growth of seed is reduced. Chlorophyll content and oxidative stress is increased	Zhu et al. (2012)
		Chrysanthemum, *Gerbera*, and *Cape primrose*	Inhibits rhizogenesis	Tymoszuk and Miler (2019)
		Mung bean and sorghum	Soil toxicity increases and affects seedling growth	Lee et al. (2012)
		Onion	Improves onion seed germination	Acharya et al. (2019)
2	Au	Maize	Boosted germination of seeds. Nontoxic and biocompatible	Mahakham et al. (2016)
		Chrysanthemum, *Gerbera*, and *Cape primrose*	Au increases root regeneration in gerbera, primerose propagation, inhibits formation of adventitious shoots in *chrysanthemum*	Tymoszuk and Miler (2019)
		Onion	Increases germination, plant height, leaf length, and diameter without toxicity symptoms	Acharya et al. (2019)
3	Fe, Cu, Ni	*Triticum vulgare*	FeNPs—stimulated growth, Ni, and Cu. NPs cause toxic effects on growth as metal content elevated, and caused at very low concentration in root growth	Korotkova et al. (2017)

rapid diagnosis and detection of various diseases and pest incidence in the plant using nano-formulations, enhancing the flexibility of plant to regulate diseases and environment-safe application of chemicals, and increasing the effectiveness of pesticides with minor doses through nano-based materials.

10.2.4 Nanohybrid

The nanohybrid is a nanosized particle with organic and inorganic elements connected through noncovalent bonds at the nanometer scale. Nanohybrid materials play an essential role in the innovation of advanced materials (Liu et al., 2017; Sanad & Rashad, 2017). This advanced material provides a chance to form a colossal variety having well-controlled structures with multiple functions (Chougle et al., 2020). TiO_2 nanocomposites may supportively function as a sort of promising wound dressing to planting extract with polyvinyl alcohol and obtain fungal inhibition zones between 11.2 and 15.9 nm and could also be a useful medicinal drug and antifungal properties. The inhibition zone diameter for every material was obtained from 8.5 to 16.4 nm. Borohydride surface—modified AgNPs/Mg-A1-LDH nanohybrid was prepared by an in situ synthesis method by which Mg-A1-LDHs were synthesized in the presence of borohydride surface–modified AgNPs (Mehrabani et al., 2018; Taufiqa et al., 2020 The ready conductor NPs/Mg-A1-LDH nanohybrid may be appropriate to use in future antimicrobial applications (Mdusanka et al., 2014). The bionanocomposites square measure materials contain constituents of the biological origin with a minimum dimension within 1–100 nm. Its development represents ecological differences because the properties of the perishable polymers make it environment-friendly and renewable (Ruiz-Hitzky et al., 2007). This bionanocomposite square measure will not prepare biomaterials such as scaffolds and implants, drug systems, diagnostic, medical devices that lead to a mix of polysaccharides such as starch with a solid square measure called inexperienced nanocomposites or bioplastics (Pandey et al., 2005). Due to increasing populations, the excessive use of agrochemicals such as fertilizers, pesticides leads to an increase in the level of contaminants (level) in soil and water. The soil correction methodology such as phytoremediation, thermal treatment, and electrokinetic degradation improves the victimization of NPs. The nanoclays, nanozeolites, and nanominerals square measure could not improve nutrient quality and contaminants from soil (Pulimi & Subramanian, 2016). Hydroxyapatite carbamide nanohybrids slow-release fertilizers showed the positive power in potency by plants throughout unfavorable conditions (Raguraj et al., 2020). The application of nanohybrid slowly unleashes care of yield to the soil. A gas fertilizer into plants and fewer coating of sulfur or polymers have been applied to urea to slow its release to the soil (Kottegoda et al., 2017). According to Xiong et al. (2013), a biocompatible and noncytotoxic coating made up of charged polydiallyldimethylammonium chloride (PDADMAC) and polyvinyl resin salt were designed on living eubacterium during a layer-by-layer fashion. PDADMAC was catalyzed and then induced for half-an-hour interval in place of BGA-biosilification as shown in Fig. 10–2.

The advantages of the liquid transport mechanism are solution containing the metal ions and organic linkers from vascular tissues of the plant through the cohesive and adhesive forces (Guo et al., 2020). The plant macronutrient studies explored that their potential is used as an agent or a carrier of gas (N) or an element (P) fertilizer. The major benefit of victimization of nHA with relevancy showed wide intrinsic biocompatibility and biodegradability (Gomez-Morales et al., 2013;

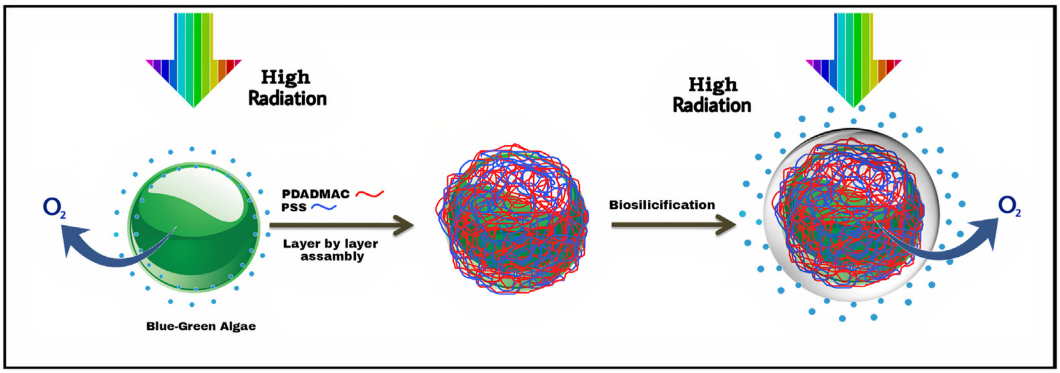


FIGURE 10–2 Effect of PDADMAC and PSS on oxygen-producing capacity of blue-green algae. *PDADMAC*, Polydiallyldimethylammonium chloride; *PSS*, polyvinyl resin salt.

Sprio et al., 2017; Tampieri et al., 2016). The high concentrations of nontoxic effects on *Solanum lycopersicon* CMC-nHA is used as a P provider and carrier of molecules (Marchiol et al., 2019). The composite membrane ZnO/GO-PVDF, AG/GO-PVDF, and GO-PVDF showed the wonderful antimicrobial ability of a metal−zinc conductor within nanohybrids. The nanohybrid was found to be electrically awake to the incident ultraviolet light compared to ZnONPs alone. This methodology will result in the fabrication of a sensitive double-jointed lightweight detector (Rattan et al., 2020). The major characteristics were exhibited as porosity, pore size, surface charge, morphology, and algal organic matter (AOM) filtration (Chong et al., 2017). This current nanoagriculture model showed a progressive enlargement of land input of energy, fertilizers, pesticides, and water (Pisante et al., 2012).

10.2.5 Nanoantioxidant mechanism

Antioxidants once act with free radicals, terminate the adverse chain reactions, and convert them into harmless products. Thus, antioxidants cut back the aerobic stress and play a serious role in the treatment of ROS-induced diseases (Khalil et al., 2020). Nanoinhibitors embrace inorganic NPs possessing internal antioxidant properties and NPs equipped with inhibitors protein to operate as an inhibitor delivery system (Sandhir et al., 2015). Biosynthetic secondary compounds (alkaloids, terpenoids, polyphenols, and phenolic resin) show potential inhibitor activity that cuts back and stabilizes the aluminous ions (Kumar et al., 2020). Natural antioxidants such as rosemary, sage, and zataria are used commercially as inhibitor additives or nutritionary supplements (Schuler, 1990). According to the studies of Goodarzi et al. (2014), the plants with the highest antioxidant capacities can also be able to show higher reducing capacity, which were found in some sp. of *Zataria multiflora* and *Rosmarinus* sp. Fridovich (1989) stated that superoxide dismutase (SOD) is the metalloenzyme that plays a crucial role within the inhibitor defense system against aerobic stress by catalyzing extremely poisonous reactive oxygen species to less poisonous H_2O_2 and O_2. ROS causes harm to metabolic enzymes lipids, proteins, DNA, and carbohydrates and leads to several abnormalities in the metabolic pathway. To unravel this drawback, antioxidant molecules have gained vital attention to attack and degrade these harmful free radicals and ROS (Kumar et al., 2020). Ma et al. (2010) investigated that when rice was exposed to CeO_2NPs, its SOD activity was elevated. According to Faisal et al. (2013), tomatoes showed a much-elevated level of SOD when are exposed to NiONPs. The antioxidants defense system was interrupted because of the decline of SOD activity. Some of the other synthesis techniques utilize distinct capping compounds, as well as LCSN (lignin-capped silver NPs) inserted on the polymer that was 10−15 nm in size, spherical, and crystalline (Marulasiddeshwara et al., 2017). Sriranjani et al. (2016) reported that *Sida cordifolia* leaf decoction elicited the synthesis of AgNPs in daylight. A mixture of nano-TiO_2 and SiO_2 was incorporated into soy inflicting a rise in nitrate enzyme activity. This process accelerates germination and growth by increasing the uptake of water and food by the plants (Lu et al., 2002). The AgNPs antimicrobial activity was conjointly investigated, and the results were recorded as minimum inhibition concentration. Silver NPs showed a powerful antibacterial and antifungal drug, effective against Gram-positive bacterial strains such as

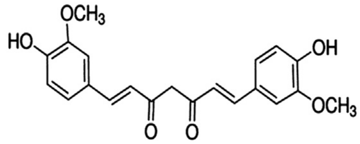
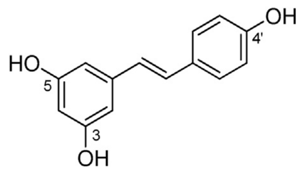
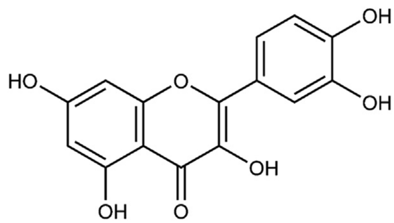
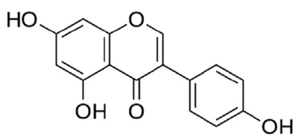
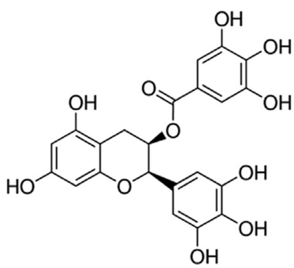
Staphylococcus aureus, *Enterococcus hirae*, *Bacillus cereus*, and Gram-negative *Escherichia coli*, *Pseudomonas aeruginosa*, *Legionella pneumophila*, and the fungus *Candida albicans*, respectively (Aygun et al., 2020; Liu et al., 2003). NPs derived from macrofungi, together with varied mushroom species, such as *Agaricus bisporus*, *Lentinus* sp., and *Ganoderma* sp. are accepted to possess the high organic process, immunostimulatory, antimicrobial inhibitor, and anticancerous properties. *Pleurotus*-derived MNPs are familiar to inhibit the expansion of various foodborne infective bacterium and fungi. The potential antimicrobial activity against foodborne microorganisms is beneficial for the food business to use such MNPs to scale back the contamination of foodstuffs and preservation (Bhardwaj et al., 2020; Mohanta et al., 2018). Crypto- and phanerogams are the producers of numerous secondary metabolites and phenolic resin compounds with extraordinary inhibitor properties. These compounds may well be employed in integration with biogenic-derived NPs for higher inhibitor potential. Plants derived from nanoantioxidants are widely used for their effective functions in the diagnosis of several cases such as nano-curcumin and nano-genistein that are used for their antioxidant properties along with antiinflammatory actions (Table 10–2). They are also useful in treating aging-associated pathological conditions and effective in the management of oxidative stress. Nano-resveratrol and nano-epigallocatechin-3-gallate are potential ROS scavengers along with antitumor and antiinflammatory properties. In plants, nano-epigallocatechin-3-gallate inhibits cellular oxidation and prevents free radical damage to cells. On the other hand, nano-quercetin is used in the treatment of diabetes and it is a component of antihypercholesterolemia drugs.

10.3 Nanotoxicity and nanobusiness

10.3.1 Nanotoxicity—monitored toxicity and potential health risks of nanomaterials

NPs have a unique potential that may cause toxicity. In the current scenario the phytotoxicity of NPs profile in the field of agriculture is in the initial stage. Its adverse effect is not well understood, and the exact impact of NPs on plants depends on their size, concentration, and properties. Nanotechnology could find applications, development of analytical devices dedicated to biosecurity, and safety aspects along with its supply in the food chain (Valdes et al., 2009). The data showed that a specific type of NPs could cause toxicity if it is exposed to direct wastes containing NPs that are further used in agricultural ecosystems. The NMs in the field of agricultural practices are to improve conventional sustainability. The dose ratio of NPs to relatively biological toxicity should be monitored. The awareness levels of nanotoxicity associated with plant defense systems, soil health risks, and various environmental pollutions were identified and adapted. Eric Drexler talked about the specific risks associated with self-replicating nanomachines known as gray goo. Gray goo is a potential threat to the speculative vision of molecular nanotechnology (Singh & Shipra, 2016). Nanotoxicity is the study of the potential health risks of NMs. However, all NPs are not toxic. The modified study on engineered NPs (ENPs) and ENM shows that they are capable of penetrating into leaves and transport DNA and chemicals into plant cells (Galbraith, 2007; Torney et al., 2007). The

Table 10–2 Nanoantioxidants: source and structure.

Sr. no.	Plant-derived nanoantioxidants	Source	Chemical formula
1	**Nano-curcumin** (polyphenol compound)	Turmeric plant (*Curcuma longa*)	1,6-Heptadiene-3,5-dione, 1,7-bis (4-hydroxy-3-methoxyphenyl) 
2	**Nano-resveratrol** (polyphenol compound)	Grapes (skin and seeds) *Vitis* sp.	3,5,4′-*Trans*-trihydroxystilbene 
3	**Nano-quercetin** (bioactive flavonoid)	Onions (*Allium cepa*), grapes (*Vitis* sp.), cherries (*Prunus avium*), broccoli (*Brassica oleracea* var. *italica*), and lemon, orange (*Citrus* sp.)	3,5,7,3′,4′-Pentahydroxyflavone 
4	**Nano-genistein** (phytoestrogenic isoflavone)	Soybeans (*Glycine max*)	4′,5,7-Trihydroxyisoflavone genisterin 
5	**Nano-epigallocatechin-3-gallate** (polyphenol)	Tea: green, white, oolong, and black teas (*Camellia sinensis*)	Epigallocatechin 3-gallate 

toxicity of containing metal and metal oxide NPs showed an impact on both microbes and plants. Particularly, nitrogen-fixing bacteria are mostly affected due to the elimination of CeO_2 from soybean crop, so antioxidant enzymes also increase and regulate the stress metabolism at a low level of silver NPs resulting in the reduction of the compounds. The exposure of gold NPs showed an inhibition of ROS (radical oxygen system) that suggests the free radical scavenging ability (Salama, 2012; Siddiqi & Husen, 2016).

10.3.2 Nanobusiness and its risky path

Nanotechnology is involved in, making raw materials, industrial production (Ratner & Ratner, 2005). For this business, a full setup of research lab, raw materials production, marketing and field application by farmers, and yield distribution in society must be implemented. On this basis the ENPs receive or import, on the plant, the composition, concentration, and size, physical and chemical properties that the ENPs receive on the plant. This effective, responsive, and flexible plan should be developed and managed properly (Ma et al., 2010; Aithal, 2016). In plants and the fertility of the soil the drug delivery mechanism is helpful (Prasad, Bhattacharyya, et al., 2017; Prasad, Gupta, Kumar, Kumar, et al., 2017; Prasad, Gupta, Kumar, Wang, et al.,). The nanotechnological inventions fail to capture the market because they are not cost-effective and require huge capital, regulatory issues, and low public acceptance. The inventions are only confined to the academic and patent sector (Parisi et al., 2015). A large amount of basic infrastructure, well-equipped laboratories, scientific packing, marketing, and distribution as well as large massive economy, corporations, and commercialization of nanoproducts at local and global levels are required. Knowledge of power bullet will be given to the farmers at ground level. Various policies, programs, and intellectual properties need to be implemented for the investors and developers. Nanobusiness is quite different than others in several ways. There are various social problems, such as clean drinking water, nutritious food, shelter, poverty, sustainable health, long life, security, education, and services such as storage of raw materials, food packaging, fuel, medicines, electric, electronic, automobiles sectors, and building space materials. The innovation-based nanobusiness, including production on a large scale, advertising, retailing, transportation distribution, communication, and technical services, should be required.

10.4 Conclusion

The nanotechnology-based delivery of NPs has given promising results for plant disease resistance and defense mechanism that build up plant growth and nutrition. This study suggested that the use of nanotechnology in the area of agriculture encourages the diffusion of precision agriculture by using nanosensors. The encapsulation showed a better drug delivery system and controlled release properties such as subcellular size and biocompatibility with plant tissues and cells. The functionalization of some components of nanohybrid could be suitable to be used as antimicrobial application due to its slow release of nitrogen fertilizers and also a good ecological alternative. It has shown that it significantly decreases the number and quantity of chemicals used while sustaining yield. A nanooxidant has unique physiochemical functions and potential to boost plant metabolism and defense with several pathological conditions like scavenging of reactive oxygen species.

Future line of work

More research must be done on the risks, health, toxicology, and environmental consequence of nanotechnology, particularly nanoencapsulation and nanohybrids in the agricultural sector. Plants have both positive and negative effects of MBNPs, but the mechanism of NPs phytotoxicity and translocation pathway within plants and the knowledge of its uptake capacity, limitations, and ecotoxicity of various NPs are still unknown. Increasing challenges to allure all stakeholders, as well as researchers, nongovernmental and buyer corporations to acquire support for this technology so that the detection, prevention, and defense technique are rapid, reliable, accurate, and cost-effective have to be properly met.

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Revealing and Classification of Deepfakes Video's Images using a Customize Convolution Neural Network Model

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Abstract

Deepfake has been exploited in recent years despite its widespread usage in a variety of areas to create dangerous material such as fake movies, rumors, and false news by changing or substituting the face information of the sources and so poses enormous security concerns to society. Research on active detection & prevention technologies is critical as deepfake continues to evolve. Deepfake has been a blessing, but we've taken advantage of it by utilizing it to swap faces. Deepfake is a new subdomain of Artificial Intelligence (AI) technology in which one person's face is layered over another person's face, which is becoming more and more popular on social networking sites. Deepfake pictures and videos can now be created much more quickly and cheaply due to ML (Machine Learning), which is a primary component of deepfakes. Despite negative connotations attached to the term "deepfakes," technology is increasingly being used in commercial & individual contexts. New technical advancements have made it more difficult to distinguish between deepfakes and images that have been digitally manipulated. The rise of deepfake technologies has sparked a growing sense of unease. The primary goal of this project is to properly distinguish deepfake pictures from real images using deep learning techniques.

In this study, we implemented a customized CNN algorithm to identify deepfake pictures from a video dataset and conducted a comparative analysis with two other methods to determine which way was superior. The Kaggle dataset was used to train & test our model. Convolutional neural networks (CNNs) have been used in this research to distinguish authentic & deepfake images by training three distinct CNN models. A customized CNN model, which includes several additional layers such as a dense layer, MaxPooling, as well as a dropout layer, has also been developed and implemented. This method follows the frames extraction, face feature extraction, data preprocessing, and classification phases in determining whether Real or Fake images in the video reflect the objectives. Accuracy, loss, and the area under the receiver operating characteristic (ROC) curve were used to characterize the data. Customized CNN outperformed all other models, achieving 91.4% accuracy, a reduced loss value of 0.342, as well as an AUC of 0.92. Besides, we obtained 85.2% testing accuracy from the CNN and 95.5% testing accuracy from the MLP-CNN model.

Keywords: Deepfake detection; Deep learning; Customize CNN; Deepfake Detection Challenge Dataset; Classification

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1. Introduction

Many deepfake videos have been [1] shared on social media as a result of the ease with which new technologies may be accessed. An example of a "deepfake" is a picture or video in which that person's likeness is substituted by that of another person. Deepfake is becoming one of the most severe concerns facing modern society. Many pornographic videos have included celebrities' faces being swiped over their photos using Deepfake. As well as spreading misinformation for politicians, deepfake was also utilized in this role[2][3][4]. In 2018, a fake video for Barack Obama was made to include comments he had never said. With Joe Biden's tongue out, deepfakes have been employed already in the US 2020 presidential election. Deepfakes may have a negative influence on our society and propagate misinformation, particularly on social media, as a consequence of these detrimental applications of the technology [5]. The term [6]"deepfake" is a fusion of terms "deep learning" and "fake." It is mostly the result of neural networks in machine learning and relates specifically to the forgeries of images, videos, and audio created by GANs (Generative Adversarial Networks) [7]. Deepfakes have the potential to accelerate the growth of the entertainment, cultural exchange, as well as education industries, therefore enhancing not only the teaching level in the area of education but also the whole quality of life. However, deepfake is frequently used to create fake news and fabricate electronic evidence, misinforming the public and disrupting societal order. This technique has developed into the most sophisticated method of network attack. Deepfake [8]is capable of creating bogus images/videos that are difficult to discern with human eyes, resulting in social chaos [9]. For a long time, academics and the film industry have been fascinated by the idea of synthesizing pictures or videos. The majority of early false pictures and videos were created using graphical algorithms, as opposed to other approaches. And it was not until later that a technology called Deepfake was made available to the general public that it became widely recognized. A few clicks are all it takes to create a video recording of someone doing or saying something they did not want to use Deepfake, which is heavily reliant on DNN (Deep Neural Networks). Deepfake videos [10] have had a considerably greater effect than anybody could have predicted, and this might influence how people evaluate the veracity of media reports in the future. The idea that "seeing is believing" has been disproven. While the technology is harmless when used for recreational reasons, some individuals may utilize it for political or other nefarious goals, which might have major repercussions[9].

In response to this scenario, researchers have begun to investigate several approaches for distinguishing deepfake videos from real ones. In most cases, machine learning is used in conjunction with other detection approaches. It is fairly uncommon for researchers to use NN [11] of various designs to look for differences among fake and real videos, but in other cases, they have turned to handcrafted features that may be used to uncover semantic differences like the pattern of eye blinking [12] or head postures or face warping traces or particular habits of facial expression and movement while speaking[13]. To the best of our knowledge, maximum approaches either rely only on features of individual frames, neglect temporal data, or are too reliant on training datasets, preventing them from being generalized. Most of the time, study on deepfake video forensics is still in its start [9].

In several domains, with computer vision, Natural Language Processing (NLP) [14], & machine vision [15], deep learning (DL) [16] has shown to be a powerful and valuable approach. Deepfakes employs DL technology to create fake photos and videos of people that are impossible to tell apart from the genuine thing when seen by a human eye. Recently, several research has been undertaken to better understand how deepfakes function, as well as numerous new algorithms using deep learning, have been developed to identify these fakes. Computer vision, big data analytics, and human-level control are all examples of complicated issues for which DL has been effectively used. As a result, DL technologies have also been used to construct software that might pose a danger to the security of the United States and its people's privacy. Deepfake is a recent example of a DL-powered application.

1.1. Motivation

For the most part, the Deepfake toolkit works by modifying the face's most important traits while leaving the rest of the face unchanged. With a few changes, the video's character has changed. As a result of this, the video's message may be entirely different. Such alterations are carried out frame-by-frame, which is seen to be the most significant limitation of Deepfake so far. A well-designed system can fine-tune each image to make it more realistic, but coordination of realism of huge series of pictures on which multiple temporal limits are imposed is very challenging.

We employ a CNN (Convolutional Neural Network) learning model in our approach. Using facial landmarks detection, structured data is retrieved from video frames and supplied as input to the model, as illustrated in Fig. 1. Automatic feature extraction is performed using video image frames fed directly into the CNN. To get the final result, the CNN output is coupled to a dense neural layer as well as an activation layer.

1.2. Contribution

The following is a list of the paper's key contributions:

1) To detect deepfake face images using CNN deep learning techniques.
2) Use of customized deep learning method to detect deepfake face image to get the best accuracy.
3) Detect all face features (eyes, lips, nose, etc.) using the Facial landmark predictor model.
4) Achieved the best accuracy as an important factor that kept in mind is the different facial expressions of faces.
5) To develop a universal frame model to detect deepfake faces with greater accuracy.
6) To perform comparative analysis with three methods.

The paper is organized as follows. Deepfake's development status and our contributions are briefly discussed in Section 1, and related efforts are discussed in Section 2. In Section 3, we describe the architecture, innovation, and benefits of our deepfake detection approach in great detail; in Section 4, we explain our experimental setup and provide our detection performance results; in Section 5, we summarize and introduce future work.

2. Related work

In this part, we are going to look at some of the research that has been done in the field of Deepfake detection & production. Deepfake films like these are becoming more popular on social media networks, prompting the international community to take the threat seriously and, as a result, encouraging academics throughout the globe to build sophisticated deepfake detection tools. It is possible to find a variety of ways in the recent literature.

Unsupervised contrastive learning is used to build a novel deepfake detection algorithm in this study [17]. We first make 2 different versions of an image and feed them into 2 separate networks, one of which is an encoder and the other is a projection head. Maximizing the projection head's outputs' degree of correspondence is how the unsupervised training is accomplished. To test the detection efficiency of our unsupervised technique, we train an efficient linear classification network using the unsupervised features. Unsupervised learning may achieve equivalent recognition efficiency to current advanced supervised algorithms in both inter & Intra database contexts, according to several experiments. In addition, they carry out ablation tests to test the efficacy of our approach.

In this article, [18] CNN facial recognition models, such as Alex Net & Shuffle Net, are applied to distinguish between authentic and fraudulent images of people. Fake/real face recognition collection from Yonsei University's Computational Intelligence Photography Lab is used to evaluate the performance & operation of all separate algorithms After normalizing the images, Error Level Analysis (ELA) is performed before the images are used in a variety of CNN models, which are all unique. Next, the K-NN (K-Nearest Neighbour) & SVM (Support Vector Machine) techniques are used to extract the detailed features from the CNN models An accuracy of 88.2% was found for Shuffle Net's KNN, compared to an accuracy of 86.8% for Alex Net's vector.

In this article [19], multilayer hybrid recurrent DL models for deepfake video detection are presented. Noise-based temporal face convolutional features & temporal learning of hybrid recurrent DL models are used to create the models proposed in this article. These models' performance against stacked recurrent DL models has been shown via experiments.

A deep ensemble learning method called DeepfakeStack has been proposed thru [20] to address the issues given by Deepfake multimedia. The proposed method generates a better composite classifier by combining several state-of-the-art classification models based on deep learning. With an accuracy of 99.65 percent and an AUROC score of 1.0, our tests reveal that DeepfakeStack beats the competition in identifying Deepfake. A Real-time Deepfake detector might be built using our technique.

This work [21] provides a method for exposing such fake videos, which makes usage of CNN architecture & Transfer Learning approach. Every video frame is fed into a CNN, which then utilizes the extracted feature information to train an effective binary classifier that can tell the difference between genuine and altered videos. A comprehensive collection of deepfake videos collected from a variety of datasets is used to test the method's accuracy. All of the models had good training accuracy, with each model achieving more than 98%. It was the inceptionV3-based model that had the best accuracy.

In this study [22], the proposed strategy is depending upon utilizing residual noise, which is the difference between the original picture as well as its denoised form. Research of residual noise has shown that it is efficient in deepfake detection due to the unique and discriminative properties that it has, which can be captured successfully by CNNs with TL (Transfer Learning). To test the effectiveness of our technique, we used low-resolution video clips from FaceForensics++ & high-resolution video clips from Kaggle DFDC (Deepfake Detection challenge). When compared to other competing methodologies, the acquired findings demonstrate a high degree of accuracy.

[16] examine deepfake detection algorithms Xception &MobileNet as 2 techniques for classification tasks to repeatedly identify deepfake videos in this research. Four fake video creation techniques & 2 advanced NNs were used to train, test, and compare a total of 8 deepfake video classification models, which were then associated & reviewed. Each model demonstrated adequate classification performance when applied to the corresponding dataset that was utilized in its development. This article makes use of four datasets created using four distinct deepfake technologies that were used in the development of FaceForensics++ to train and evaluate the algorithm. The accuracy of the findings is high across all datasets, with accuracy ranging between 91 and 98 percent depending upon deepfake technologies used. In addition, we built a voting process that can identify fake videos by aggregating results of all 4 approaches, rather than just one.

3. Research Methodology

3.1. Problem statement

Building systems that conduct facial identification poses several challenges for face detection, making it one of the most difficult tasks in image processing. Face detection is the first issue to be addressed. The following two causes are to blame for the difficulties in Face Detection[23]. face expressions and diverse facial traits are included. People communicate their feelings and intentions via their facial expressions, making them one of the most impactful and immediate temperaments. It is important to note that facial emotions, such as anger or enjoyment, may directly change the look of a person's face. Many individuals wear spectacles, while others have a beard or mustache, and yet others exhibit scars from an earlier life. These features are known as facial features. There has been a steady rise in the quality of deepfakes, which has increased the need for new detection approaches. To deepfake detection, deep classifiers & shallow classifiers are the two major classifier types. Fake images and videos may be distinguished from genuine ones using shallow classifiers because of the irregularity of their features. As an example, the reflections in the eyes may be lost, as well as other details. Similar discrepancies may exist in the teeth, which may be exploited in the same way.

To identify fake videos, this study presents a DL (Deep Learning) [20]strategy based on customized CNN (Convolutional Neural Networks) [24]. Fig. 1 depicts the proposed system's steps. Video is first given as an input, from which individual image frames may be retrieved. The location of the eyes, nose, and lips may be determined with the use of a facial landmarks detector. Eye blinks and other facial features may also be deduced from this information. Before feeding the model with this data, it is necessary to do some kind of preprocessing. However, pre-processing step transforms the pictures into their numerical form. In this first, it crops the face region of interest and resizes the input image frames into 224 x 224. Now ensures that all images are in the RGB channel. Training, validation, and testing sets have been separated after completing the preprocessing phase. Then, the customized CNN model conducts feature extraction and trains on features that are extracted. Classification stage can predict whether given video is deepfake or not using this customized deep learning technique based on CNN model.

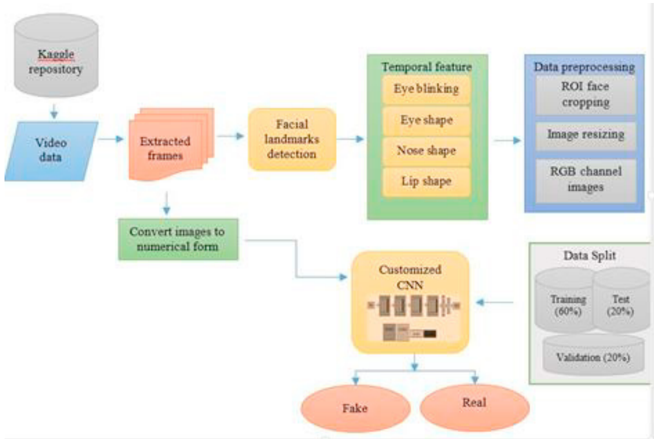


Fig 1. Block diagram of the proposed model

This section describes a proposed mechanism for categorizing video as REAL or FAKE by following a series of processes outlined in the previous section.

3.1.1. Frame Extraction & Facial Landmarks Detection

Image frames are created by slicing a video into individual images. There are a total of 3735 frames in this video. The face is identifiable in each image. The positions of 68 facial landmarks (x, y coordinates) are retrieved from the face area. The dlib library includes a facial landmark detector that has already been trained. To identify a face in a picture, the dlib library is used to first identify 68 facial landmarks. This landmark detector uses an ensemble of regression trees to predict the face's landmark placements based on pixel intensities in images.

3.1.2. Temporal Facial Feature Analysis

1) Eyeblink detection

As most novice deepfakes have either no blinking or quick unnatural blinking, deepfakes need a higher level of complexity to avoid compromising on eye blinking. The blinking pattern of the subject in the shot is picked up in this step. Eye coordinates (points 37–46 in list of retrieved facial landmarks) are derived from the face landmarks and provided as input to the blink detector. Detection of blinking is done by calculating the eye's aspect ratio (EAR). It is possible to depict each eye individually using six distinct landmark locations. The eye is signified by six (x, y) coordinates, beginning with the left corner (p1) & progressing clockwise from there by plotting points (p2, p3, p4, p5, p6). The EAR for a single eye is determined using the following equation:

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 + p_4\|} \quad (1)$$

where ||p2-p6|| means the distance between points p2 and p6.

When the eye is open, the value of EAR stays constant; however, when the eye is closed, the value of EAR drops to zero. The frequency of blinks is increased if the average of the EAR values of both eyes falls below a threshold

(EYE_AR_THRESH) in defined no. of consecutive frames (EYE_AR_CONSEC_FRAMES). We utilized parameters 0.3 & 3 for EYE_AR_THRESH and EYE_AR_CONSEC_FRAMES, respectively, in this study.

The facial landmarks detector is used to extract face features including eye, nose, & lip coordinates. To capture the vast range of eye forms produced by the face-swapping approach prevalent in most deepfake videos, features from the eyes were extracted. A person's eye shape in a real video is quite stable, according to our research. Regardless of how the video was modified to make it seem false, this was never the case. Additionally, the majority of facial abnormalities, including facial warping, occur around the mouth area. Because of deepfake manipulation, there are different lip forms. This is why we want to use the variations in the face characteristics' shapes crosswise frames to train our classifier.

The eye shape detector uses eye coordinates (points 37–46) derived from facial landmarks as input. Using an eye form detector, the eye shape detector calculates Euclidean distance (d1) among endpoints of the left eye & Euclidean distance (d2) among endpoints of the right eye, respectively. The Lip shape detector uses lip coordinates (points 49–68) retrieved from face landmarks. Using d1 among inner lip coordinates, the length of inner lips (d3) is calculated. Similar to this, the length of outer lips (d4) may be determined by computing Euclidean distance among outer lip coordinates. When the Nose Shape detector receives facial landmark data (points 28–36), it uses that information to determine the nose's shape. The Euclidean distance (d5) among a base of the nose's two edges is used to calculate the nose's base width. A similar calculation is made using Euclidean distance (d6) to determine the nose's highest point. Consequently, the widths of the eyes (d1, d2), the inner & outer lip coordinates (d3, d4), and the top & base width of the nose (d3, d4) were retrieved as form features (d5, d6).

3.1.3. Data Pre-processing

Before analysis, we must increase the image's quality so that we can do so more effectively. Preprocessing allows us to remove unwanted artefacts and improve some aspects that are critical to the application we're working on. Depending on the application, some of these aspects may be different. We need to establish a baseline size for all pictures that are fed into our AI algorithms since the size of certain images captured by a camera and put into our AI algorithms might change.

1) Crop the face region of interest (ROI)

Using computer vision, Face Crop can automatically identify faces in photos. A rectangle crop is then applied, focusing on either all of the faces of the largest face. Select a DNN (Deep Neural Network) for better accuracy and to set the degree of confidence in face identification before implementing the algorithm. At 300x300 pixel scales, faces can be recognized by DNNs even when the picture has been scaled up or down. By "cropping" a picture, we mean choosing and removing the area of interest (also known as the ROI) from the image. A face-detection application, for example, may need cropping the face out of a picture. When we crop a picture, we are attempting to eliminate the areas of the image that are outside of our interest range. Selecting a Region of Interest, or ROI is a frequent term for this step. NumPy array slicing may be used to crop a picture after it has been captured.

2) Image resize

Resizing is the process of increasing or decreasing the size of a picture without removing any content. In essence, resizing a picture means making it larger or smaller. Because in certain cases, size does play a role. As a result, resizing is most effective when used to reduce the photo's size to meet a certain dimension or reduce the file size. In this case, we have resized the photos to 224 × 224 pixels in resolution.

3.1.4. Data split: Training, Validation, and Testing

Training, validation, & testing subsets are included in this dataset. 60 percent of the data was utilized for training, 20 percent for validation, and 20 percent for testing in every database. This is the equivalent of 2399, 750, and 600 photos in the dataset. In each subset, the percentage of an actual and fraudulent video was the same. To identify the optimum CNN architecture, the validation phase was employed in this process. To train the model, the validation set was utilized to choose the best-performing architecture, & training &test sets were combined to assess the model once it had been trained.

3.1.5. Customized Convolutional Neural Network (CNN)

To identify patterns in pictures, a convolutional neural network(also known as a ConvNet or CNN) [25] is a DNN[26] that is frequently utilized. In the first stage, the video's visual frames are retrieved and converted to numerical data (NumPy arrays). Additionally, each picture is resized to fit within the dimensions of 220px by 3px for easier processing & consistency. The CNN is supplied this information about the visual frames. As an input parameter, 32, 64, & 128 increasingly bigger filters are used so that the network may learn more distinct features. It is made up of 40 epochs of layers such as Conv2D → ReLU → BatchNormalization → MaxPooling2D, as well as a densely connected layer, and it is trained using a customized CNN. Afterward, we apply a thick layer on top of the previous one, along with the requisite Batch Normalization & Dropout layers. The overall model summary for the proposed Customized CNN is given in table 1. In this model, we have used a total of 20 layers to make the CNN as customized CNN that included four convolution layers (conv2d), six batch normalization layers, three max-pooling layers, four drop-out layers, one flatten layer, and two dense layers.

Table 1. Summary of the proposed Customized CNN.

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 224, 224, 32)	896
batch_normalization (BatchNormalization)	(None, 224, 224, 32)	128
max_pooling2d (MaxPooling2D)	(None, 74, 74, 32)	0
dropout (Dropout)	(None, 74, 74, 32)	0
conv2d_1 (Conv2D)	(None, 74, 74, 64)	18496
batch_normalization_1 (BatchNormalization)	(None, 74, 74, 64)	256
conv2d_2 (Conv2D)	(None, 74, 74, 64)	36928
batch_normalization_2 (BatchNormalization)	(None, 74, 74, 64)	256
max_pooling2d_1 (MaxPooling 2D)	(None, 37, 37, 64)	0
dropout_1 (Dropout)	(None, 37, 37, 64)	0
conv2d_3 (Conv2D)	(None, 37, 37, 128)	73856
batch_normalization_3 (Batc hNormalization)	(None, 37, 37, 128)	512
conv2d_4 (Conv2D)	(None, 37, 37, 128)	147584
batch_normalization_4 (BatchNormalization)	(None, 37, 37, 128)	512
max_pooling2d_2 (MaxPooling 2D)	(None, 18, 18, 128)	0
dropout_2 (Dropout)	(None, 18, 18, 128)	0
flatten (Flatten)	(None, 41472)	0
dense (Dense)	(None, 1024)	42468352
batch_normalization_5 (BatchNormalization)	(None, 1024)	4096

dropout_3 (Dropout)	(None, 1024)	0
dense_1 (Dense)	(None, 2)	2050

===

Total params: 42,753,922
Trainable params: 42,751,042
Non-trainable params: 2,880

An explanation of CNNs is provided in this section. We use a filter to examine the impact of surrounding pixels. We yield a filter of a size set via user (a rule of thumb is 3x3 or 5x5) and slide it over the image from the top left to the bottom right, which is precisely what you would expect. A convolutional filter is used to determine a value for every pixel in the picture. A feature map is created for each filter once it has passed over the picture. An activation function is used to determine if a certain feature is extant at a specific position in the picture. Add additional filtering layers & construct more feature maps to create a deeper CNN that becomes abstract as we go deeper into the network. Even though pooling layers may theoretically do any sort of operation, only max-pooling is employed since we need to locate outliers – these are the points at which our network perceives the features.

Several filters are applied to the picture to extract various information using a convolutional layer. When it comes to CNN's, the ReLU (Rectified Non-Linear Unit) [27]is the most effective non-linearity since it combats sigmoidal gradients. ReLU is simpler to calculate & provides sparsity.

When building a CNN, there are three kinds of layers to consider: convolutional layer, pooling layer, & fully connected layers/dense layer, as well as an additional layer known as the dropout layer. There are a variety of factors that may be tweaked in each of these levels, and they each have a specific job to do with the supplied data.

1) Convolution Layers

These are the filtering layers in a deep CNN, where the original picture is filtered or additional feature maps are applied. This is where the vast majority of the network's user-defined parameters are located. No. of kernels & also size of kernels are the two most critical characteristics to consider while creating a model.

The 2D convolution layer is the most often used kind of convolution and is sometimes abbreviated as conv2D. In a conv2D layer, a filter or kernel performs elementwise multiplication on two-dimensional input data. As a consequence, all of the data will be condensed into a single display pixel. When the kernel slides over a site, it will do the identical action at each position, changing a 2D matrix of features into another 2D matrix of features.

2) Pooling layers

There are several different types of convolutional layers, however, pooling layers serve a particular function like max-pooling, which takes the largest value in the filter area, or average pooling, which takes the average value in the filter region. In most cases, they are utilized to minimize the network's dimensions.

3) Dropout layers

In most cases, dropout is applied to the fully connected layers solely since these layers have the most parameters and are thus more prone to excessively co-adapt, leading to overfitting. Convolutional layers (for example, Conv2D) & pooling layers may both be employed before or after dropout (for example, MaxPooling2D). A basic heuristic says that dropout should only be applied after the pooling layers, however, this isn't always true. It is possible to apply dropout to every feature map cell or element.

4) Fully connected layers/ Dense layers

Dense layers or FCLs are added before the classification output of CNN and also utilized to flatten findings before classification. It is comparable to an MLP's output layer.

3.1.6. Proposed Algorithm

Input: Deepfake video dataset
Output: Good classification results

Strategy:

Step 1. Input video dataset from Kaggle
Step 2. Frames extraction from videos
Step 3. Detection of the all-face features using Facial landmark predictor model
  a. Eyes blink detection
  b. Eyes shape detection
  c. Lips shape detection
  d. Nose shape detection
Step 4. Perform data preprocessing on frames
  a. Crop the face region of interest
  b. Image resize into 224 x 224
  c. Ensure all images in the RGB channel
Step 5. Data splitting into three parts
  a. Training set (60%)
  b. Validation set (20%)
  c. Testing test (20%)
Step 6. Hyper Parameters setting
Step 7. Apply Customized CNN model by adding some layer for training
  a. conv2d layer
  b. Batch normalization
  c. Max pooling layer
  d. Drop out layer
  e. Flatten
  f. Dense layer
Step 8. Perform testing on a test set
Step 9. Calculate performance metrics
Step 10. Classification results whether it is fake or real

4. Research Methodology

Python and also its libraries were used to conduct this research. The initial learning rate was set to 0.0001 as well as batch size was set to 32 for purpose of testing. This process was stopped after 40 epochs. To extract the frames from the videos, a 10-frame-per-10-second frame rate is used. CNN training convergence led to the selection of this maximum value. The accuracy, loss, & ROC AUC metrics are used in a quantitative examination of the performance of the designs in the study. The percentage of rectified pixels in each class is referred to as the accuracy.

4.1. Data description

From the dataset collected by the Deepfake Detection Challenge, we employ 242 videos, 199 of which are fictitious, while the remaining 53 are authentic. A single video lasts for ten seconds. To get a more even distribution of actual and fraudulent videos, we have included 66 videos from the YouTube dataset acquired from Dessa that contains real videos to achieve a more balanced distribution of real and fake videos. In all, 318 videos were utilized, 199 of which were fraudulent and 119 of which were authentic.

The material is made up of.mp4 files that have been compressed to a total of ~10GB each. In addition to a filename, label (REAL or FAKE), original and split columns, described below under Columns, the metadata.json accompanying each pair of.mp4 files include the following:

Columns

- filename - filename of the video
- label - whether a video is FAKE/REAL
- original - in case that train set video is FAKE, the original video is enumerated here
- split - It is always equal to "train".

Figure 2 shows collection of sample images of both type fake and real.

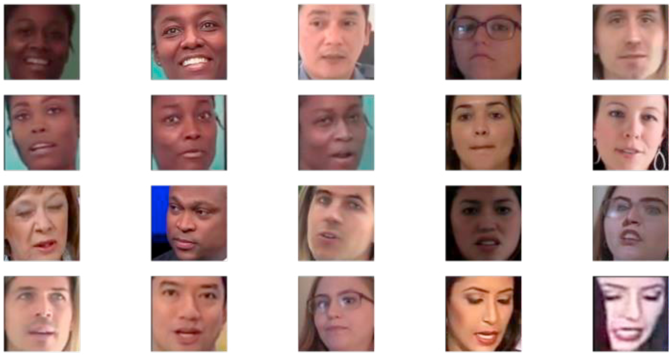


Fig. 2. Sample images

4.2. Data description

An important element of every project is testing our ML method. A metric such as accuracy_score may provide satisfactory results when testing this model, however other metrics like logarithmic_loss or any other of its kind may yield bad results. The majority of the time, classification accuracy is utilized to evaluate the efficiency of the proposed model; nevertheless, this is not adequate to evaluate the proposed model. Various forms of assessment metrics have been discussed in this section.

- Logarithmic Loss
- Classification Accuracy
- Area under Curve
- Confusion Matrix

4.2.1. Classification Accuracy

When we use the word "accuracy", we most often refer to classification accuracy. A good measure of accuracy is the ratio of accurate predictions to the total no. of input samples.

$$Accuracy = \frac{Number\ of\ correct\ predictions}{Total\ number\ of\ predictions\ made} \quad (2)$$

Only if there are equal numbers of examples from every class can it be used effectively.

Considering the following description: 98% of the samples in our training set to come from class A, while the remaining 2% come from class B. Our model can easily reach 98 percent training accuracy by correctly predicting every training sample in class A. " The test accuracy would be 60% on a set of samples with 60% from class A and only 40% from class B. However, classification accuracy offers us a false perception that we have attained great accuracy levels.

4.2.2. Binarycross entropy/Logarithmic Loss (LL)

A logarithmic loss, often known as a log loss, is used to penalize false classifications in data. The multi-class classification works well with it. Using LL[28], the classifier must assign probabilities to every class for all data. LL is computed as follows if there are N examples belonging to M classes:

$$Logarithmic\ Loss = \frac{-1}{N} \sum \sum Y_{ij} * \left(\log P_{ij}\right) \quad (3)$$

where,

p_ij, shows the probability of sample i belonging to class j
LL has no upper bound also it occurs on a range [0, ∞)
y_ij, shows whether sample i goes to class j or not.

Log Loss that is closer to 0 suggests better accuracy, whereas LL that is farther away from 0 specifies less accuracy. As a general rule, minimizing LL results in better classification.

4.2.3. Confusion Matrix

This is, as its name implies, generates a matrix as output that summarizes the overall performance of the model.

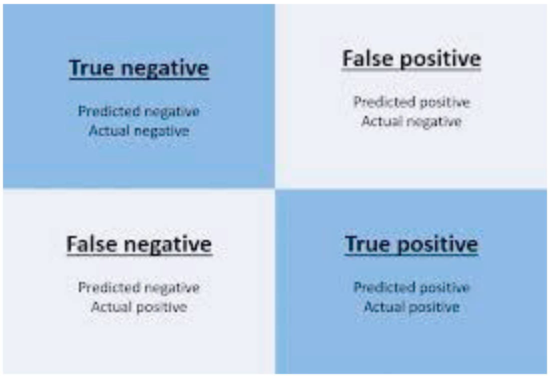


Fig. 3. Confusion Matrix

There are four significant terms:

- **True Positives:** TP
- **True Negatives:** TN
- **False Positives:** FP
- **False Negatives:** FN

Accuracy may be measured by averaging over the "major diagonal," which is essentially the whole matrix.

$$Accuracy = \frac{True\ Positive + True\ Negative}{Total\ Sample} \quad (4)$$

The Confusion Matrix serves as the foundation for all other measurements.

4.2.4. Area Under Curve

An assessment statistic called AUC (Area Under the Curve) is extensively utilized. Classification problems are solved with it. This means that a classifier's AUC is equal to how likely it is to rank a randomly picked positive sample more than an equally randomly generated negative sample in terms of AUC. Before determining AUC, we need to grasp a couple of fundamental terms:

True Positive Rate (Sensitivity): TPR (TP/FN+TP) is calculated as TP/(FN+TP). The TPR is a percentage of all positive data points that are taken into account when determining whether or not a sample is positive.

$$True\ Positive\ Rate = \frac{True\ Positive}{False\ Negative + True\ Positive} \quad (5)$$

True Negative Rate (Specificity): TNR is calculated as follows: TN / (FP+TN). In other words, the FPR is a percentage of negative data values that are accurately classified as negative data points.

$$True\ Negative\ Role = \frac{True\ Negative}{True\ Negative + False\ Negative} \quad (6)$$

False Positive Rate (FPR): FPR is calculated as follows: *FP / (FP+TN)*. In the context of all negative data points, FPR is a percentage of negative data points that are wrongly labelled positive.

$$False\ Positive\ Rate = \frac{False\ Positive}{True\ Negative + False\ Positive} \quad (7)$$

4.3. Result Evaluation & Analysis

This research has been able to tell if a video is a deepfake or not. A voice or a face swap may be used in a deepfake (or both). In training data, it is indicated by the label "FAKE" or "REAL" in the label column. Here, we have projected the probability of the video being fraudulent.

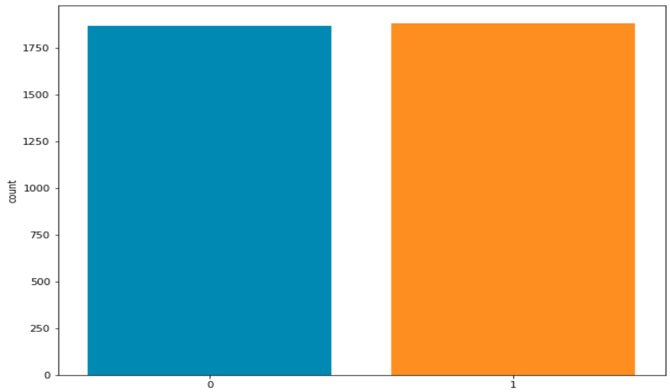


Fig. 4 shows a dataset distribution graph for the deep fake video dataset

Fig. 4 shows a dataset distribution graph for the deep fake video dataset. Here, the x-axis shows video class & the y-axis shows total counts. In this plot, the video class is categorized as 0 and 1, where 0 for Real and 1 for Fake. From this graph found that there is the almost same number of counts for both classes.

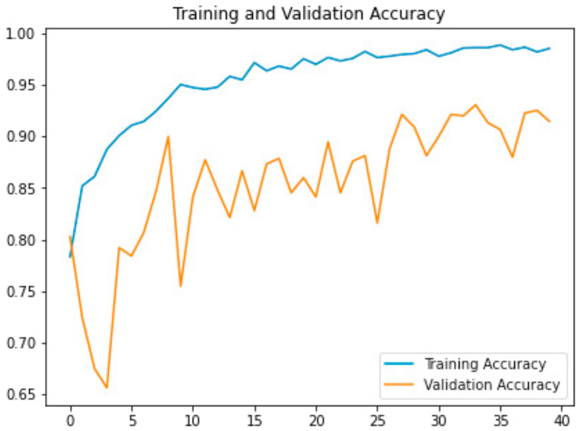


Fig. 5. Model accuracy graph

Fig. 5 depicts the proposed Customized CNN model's model accuracy with blue and orange lines denoting training and validation accuracy, respectively. There are epochs on the x-axis & percent accuracy on the y-axis. This plot found that training accuracy is very high with an increased number of epochs while validation accuracy is minimized in comparison to training accuracy however it has also achieved a great accuracy level and there are many variations during the testing.

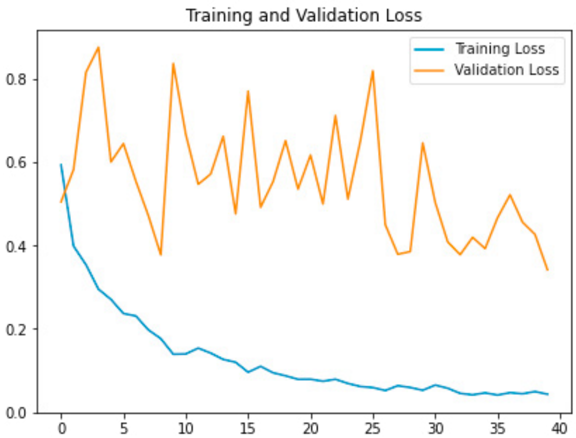
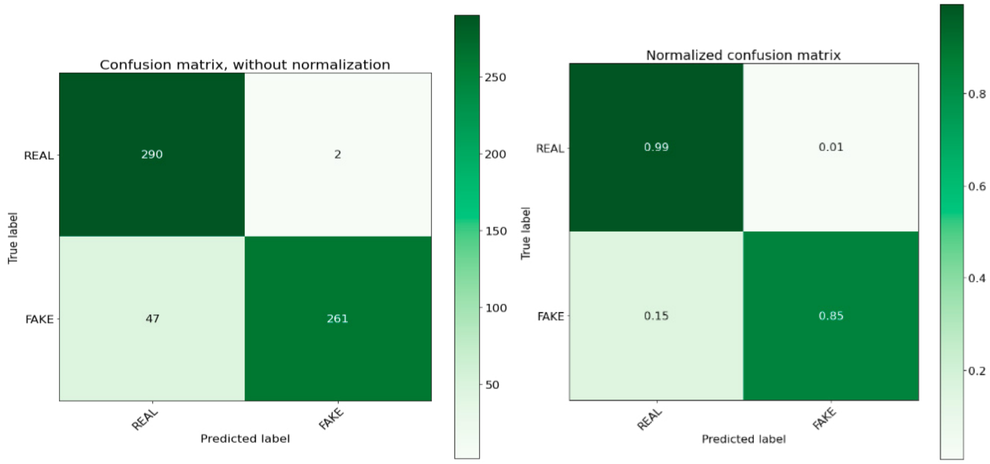


Fig. 6. Model loss graph

Fig. 6 depicts the proposed Customized CNN model's model loss graph, with orange & blue lines denoting training and validation losses, respectively. As a similar way of accuracy graph, if accuracy is high then obviously loss will be minimized. Thus the training loss is high in the training data but the validation loss is minimized with many variations during testing.



(a) (b)

Fig. 7. Confusion matrix for test data

Fig. 7 shows the confusion matrix for test data in which fig. 7 (a) plotted the confusion matrix without normalization whereas fig. 7 (b) plotted the normalized confusion matrix for calculating the video is fake or real. Let's suppose we have a binary classification problem. We have several examples that fall into 2 categories: Fake and Real. In addition, we have our particular classifier that predicts class for provided input example based on data. This is what we found after running our model through 600 tests.

The 4 important terms are represented as :

- **TP**: A total of 261 examples were identified in which we predicted Fake, as well as the actual output, was likewise Fake.
- **TN**: The instances when we predicted Real, as well as the actual output, was Real, that is, 290.
- **FP**: The instances when predicted Fake, as well as actual output, was Real, that is, 2.
- **FN**: The instances when we predicted Real, as well as actual output, was Fake, that is, 47.

Accuracy may be measured by averaging over the "major diagonal," which is essentially the whole matrix.

Accuracy = (TP+TN)/ total sample
= (261+290)/600
= 0.918

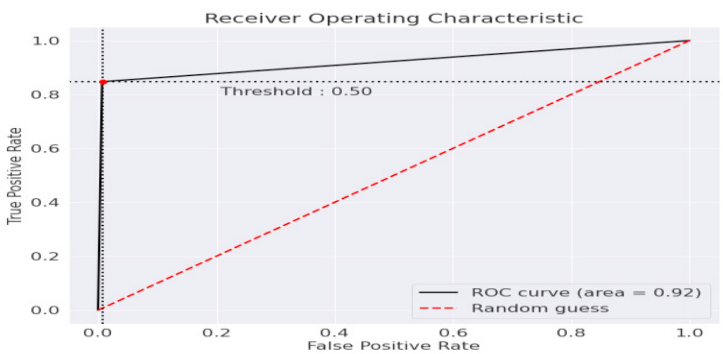


Fig. 8. ROC curve (customized CNN)

Figure 8 depicts the ROC curve. AUC) is derived from the ROC, and it is an essential measure. AUC is an appropriate statistic to utilize due to the imbalance of the dataset. There is a [0, 1] range of values for the FPR & TPR. The FPR and TPR are both calculated and a graph is created at numerous threshold values like (0.00, 0.02, 0.04,...., 1.00). AUC denotes the area under the curve of a plot of FPR versus TPR at various locations in the interval [0, 1]. Our model's performance improves as the value increases. This model's AUC score is 0.92, indicating that it has a 92% probability of successfully identifying a fake video.

Table 2. Performance results evaluation of the proposed customized CNN with two models

Model	**Training loss**	**Training Acc**	**Validation loss**	**Validation Acc**	**AUC score**
Base (MLP-CNN)	0.1948	0.9552	0.4383	0.8929	0.87
CNN	2.2433	0.8523	2.2810	0.8501	0.83
Proposed	0.1003	0.9721	0.3420	0.9147	0.92

Table 2 represents the accuracies of three models along with their AUC scores, in this proposed CNN model is compared with both existing methods.

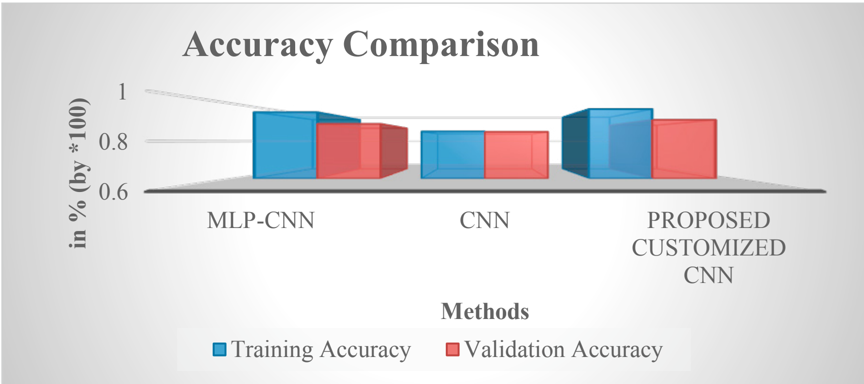


Fig. 9. Bar graph for accuracy comparison

Fig. 9 visualized the comparison bar graph for accuracy among three methods. This comparative graph shows that the training and validation accuracy of CNN only is approximately equal but it is very minimal to another method MLP-CNN which has achieved higher training accuracy but reduced validation accuracy (compared to training data). However, MLP-CNN achieved good classification results but proposed Customized CNN outperform for both training and validation data accuracy over these two methods.

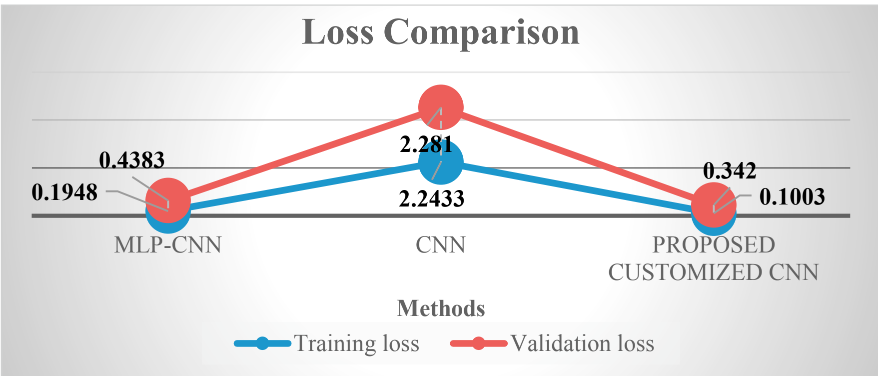


Fig. 10. Line graph for loss comparison

Fig. 10 visualizes the comparative line graph for displaying loss value (binary cross-entropy) differences among all three methods. This comparative visualization shows that training and validation loss of CNN only is 2.243 and 2.281, respectively but it is very high to another method MLP-CNN which has achieved training and validation loss 0.194 and 0.438, respectively, which is minimal (compared to CNN only method). However, MLP-CNN achieved decreased loss values but proposed Customized CNN outperform by achieving reduced loss value for both training and validation data, which are 0.1 and 0.342, respectively, over these two methods.

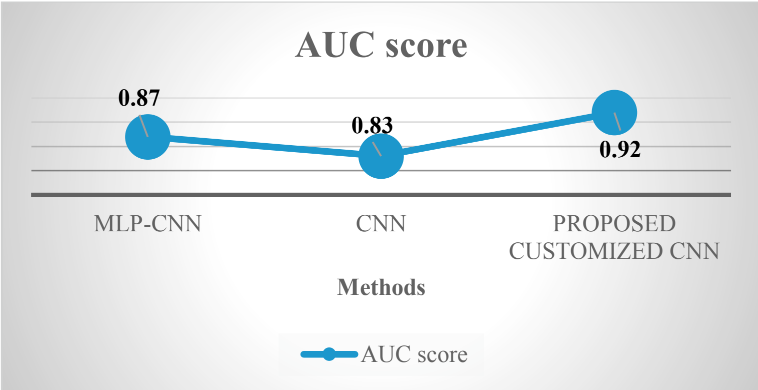


Fig. 11. Line graph for AUC score comparison

Fig. 11 visualized the comparison line graph for comparing the AUC score for all three methods. This comparative line graph shows that the AUC score for MLP-CNN is 0.87 but it is higher than another existing method CNN only that achieved AUC score is 0.83. As we can see that MLP-CNN achieved good AUC score value than CNN only results but it is also has minimized AUC score value than proposed Customized CNN that achieved a 0.92 AUC score value.

5. Conclusion and Future work

As part of this study, a unique approach has been developed to reveal AI-generated deepfake video together with powerful feature extraction & classification utilizing customized CNNs. The proposed method exhibits testing accuracy of 91.47%, loss of 0.342, and AUC score of 0.92 despite of training on a small subset of data. The comparative analysis found that the proposed customized CNN outperform two existing methods like CNN and MLP-CNN.

The future scope of this study might include identifying strategies to broaden the variety of people who can be reliably detected by the algorithm, like people of color, in order to guarantee justice and minimized prejudice in the system. More spatial & temporal face data should be included in a reasonable mix as well. In addition, it is required to evaluate better models using additional DL approaches on larger, more balanced datasets.

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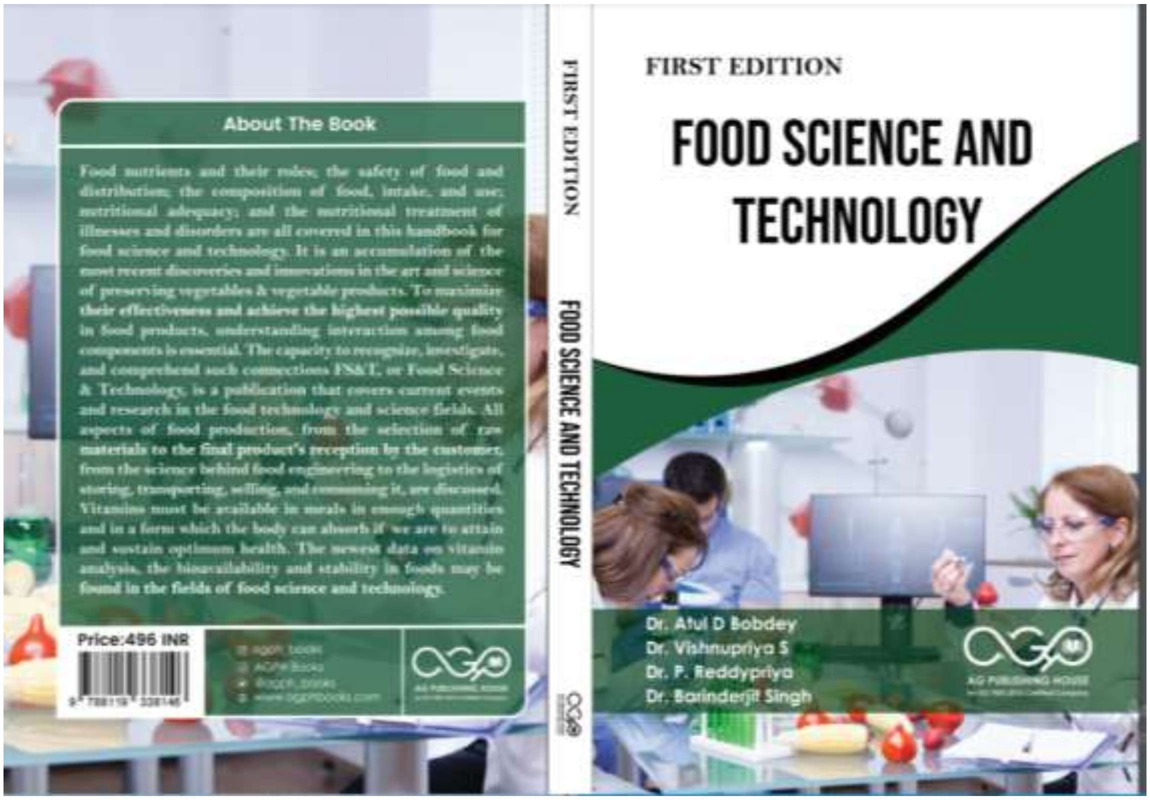

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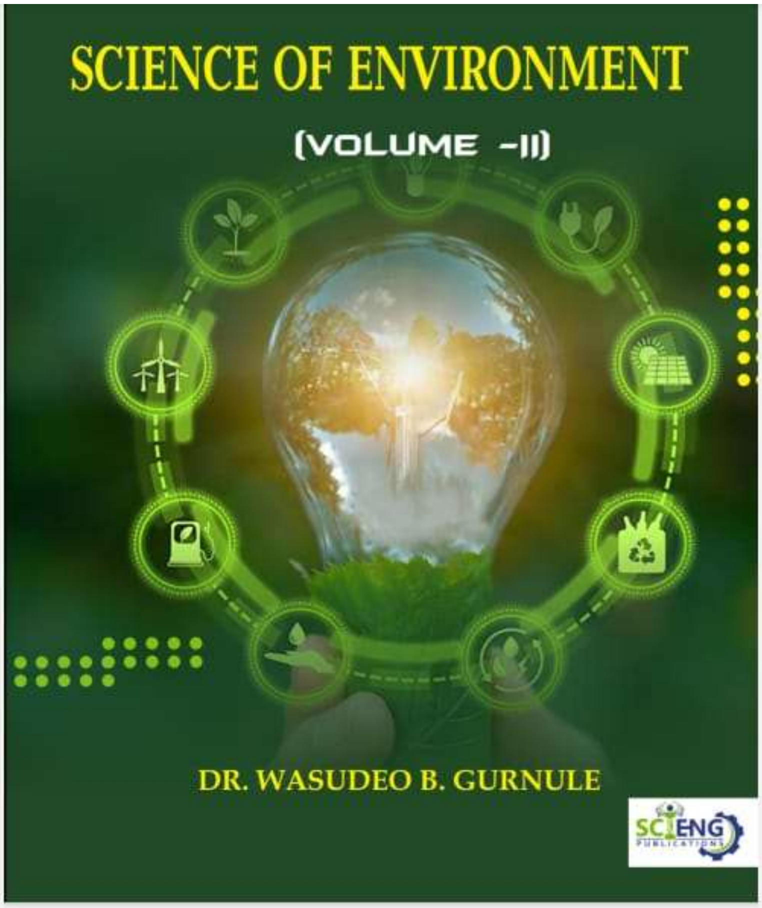

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Chapter 5

DRINKING WATER CONTAMINATION AND HEALTH IMPLICATIONS WITH RESPECT TO FLUORIDE AND PESTICIDES IN MAHARASHTRA STATE, INDIA

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ABSTRACT
Ground water is vital life support system. However there is growing concern on the deterioration of ground water quality due to industrialization and agricultural activities. Present paper reviews some locations in the state of Maharashtra where the fluoride in ground water exceeds maximum limit in drinking water i.e. 1.5 mg/lit recommended by WHO and pesticide residues in water bodies are above the permitted levels .In this regard, the development of green analytical chemistry in line with the concept of sustainable development that led to a whole range of novel, alternative extraction and residue analysis techniques has been discussed. This paper reviews the causes, remedial methods and human health effects of fluoride and pesticides in drinking water.

KEYWORDS: Drinking water, Fluoride, Pesticides, Maharashtra

INTRODUCTION
Ground water is an essential and vital component of our life support system, utilized for drinking, irrigation and industrial purposes. However there is growing concern on the deterioration of ground water quality due domestic sewage, industrial waste, excessive use of fertilizers & pesticides in agriculture and naturally occurring rocks, soil and climate.

The chemical parameters like Salinity, Hardness, Chlorides, Fluorides, Nitrates, Iron ,Arsenic and Pesticides determines the suitability of ground water for drinking purposes and their presence beyond the permissible limits make water unfit for drinking purpose. According to Chemicals of Health Significance as described by World Health Organization Guidelines (WHO) for Drinking water Quality in fourth edition (2011), the permissible limit of drinking water for fluoride (1.5 mg/litre), Chlorine (5 mg/litre), Arsenic (0.01 mg/litre) Nitrate (50 mg/litre) and for pesticides, DDT (1 μg/L), Aldrin and Dieldrin (0.03 μg/L), Chlorpyrifos(30 μg/l) and Lindane (2 μg/l).

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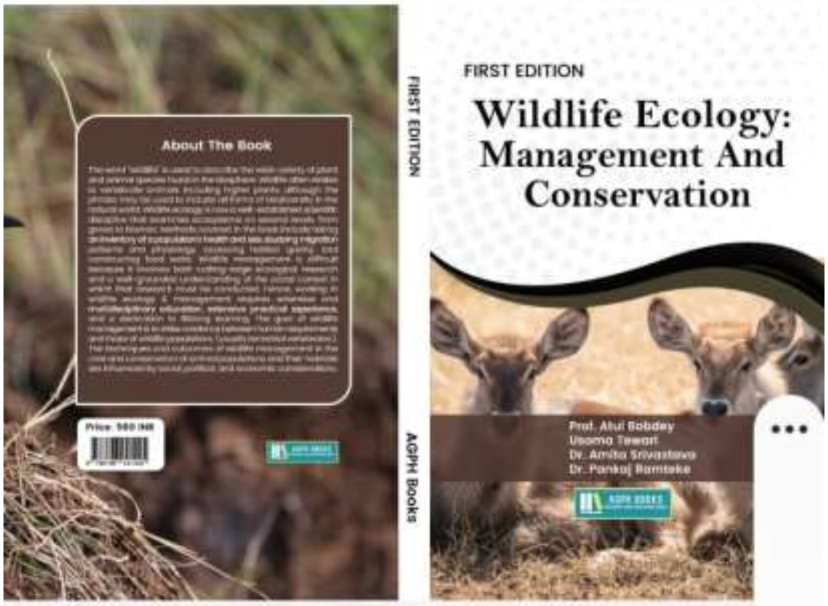

Wildlife Ecology

Management And Conservation

By

Prof. Atul Bobdey
Usama Tewari
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&
Dr. Pankaj Ramteke

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