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Vegetation Cover Analysis Based on NDVI in Moushuni Island, Sundarban, India

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Abstract: Moushuni island is one of the island of Indian Sundarban, but changes of vegetation cover is occurred due to natural and anthropogenic activity.
The aim of this paper is to emphasis the changes of vegetation cover between 2000 and 2020 of Moushuni island. Vegetation indices like Normalised Difference Vegetation Index (NDVI) is used to identify the changes of vegetation cover from 2000 to 2020. Based on NDVI value, the study area is classified into four classes -Dense vegetation, Sparse Vegetation(vegetated), No vegetation and Water.
Result shows an overall increase of dense vegetation cover (8.1%) in the island. The percent of vegetated area coverage is decreased during the study period. The major cause of decrease vegetation may be attributed to increase of rural settlement and salinisation.
Keywords: Moushuni, NDVI, Dense vegetation, Vegetated, Salinisation.

I. INTRODUCTION

Sundarban is one of the fragile ecosystem of the world with diverse ecosystem. It is the home of floral and faunal bio-diversity with significant ecological value. Moushuni island also enriched with floral and faunal bio-diversity. But it is also susceptible to climatic and anthropogenic interference.
Remote sensing is an appropriate tool to monitor the change detection of mangrove ecosystem. This study only focus on vegetation cover change of Moushuni island by NDVI (Normalised Difference Vegetation Index) from 2000 to 2020. Landsat 5 TM and Landsat 7 ETM+ has been used for NDVI calculation and spectral reflectance curve is presented for better understanding the health of vegetation.
NDVI is applied to quantify the vegetation density of the island. Landsat 5 TM and Landsat 7 ETM+ data of NIR and Red band is used to monitor vegetation cover change in large scale. Corelation coefficient and regression analysis has been used for radiometric normalization.(Islam, M.T. 2014).
The aim of this study is to highlight the change detection of vegetation cover between 2000 to 2020 of Moushuni island using remote sensing data and spectral indices. .

II. STUDY AREA

Moushuni island is a part of Sundarban delta of West Bengal. The island is extended between 21º36′23″N to 21º43′13″N latitudes and 88º11′00″E to 88º13′39″E longitudes. Moushuni island is bordered by Muriganga river in west and north western side, pitt's creek in the east and Bay of Bengal in south.
The geographical area of this island is 27.1 sq km.(Census 2011). This island is located in Namkhana block of Kakdwip subdivision of South 24 Parganas district of West Bengal. It is a deltaic island consisting of 4 revenue villages(mouzas)-Moushuni, Bagdanga, Kusumtala and Baliara.
The mouzas are under Moushuni Gram Panchayet and Frazer gaunge police station. Physiographically, the island is comprises with mud flats, salt marshes, sandy beaches and dunes formed by fluvio-marine geomorphic process. The entire island is crisscrossed by numerous tidal creeks.
The soil of Moushuni island is comprises mainly saline alluvial soil consisting of clay, silt, fine sand, and coarse sand particles. The weather of this island is almost moist with 80% humidity, the annual average temperature ranges from 34º C to 20ºC and rainfall is extremely high. The population mainly depends on agricultural activity.

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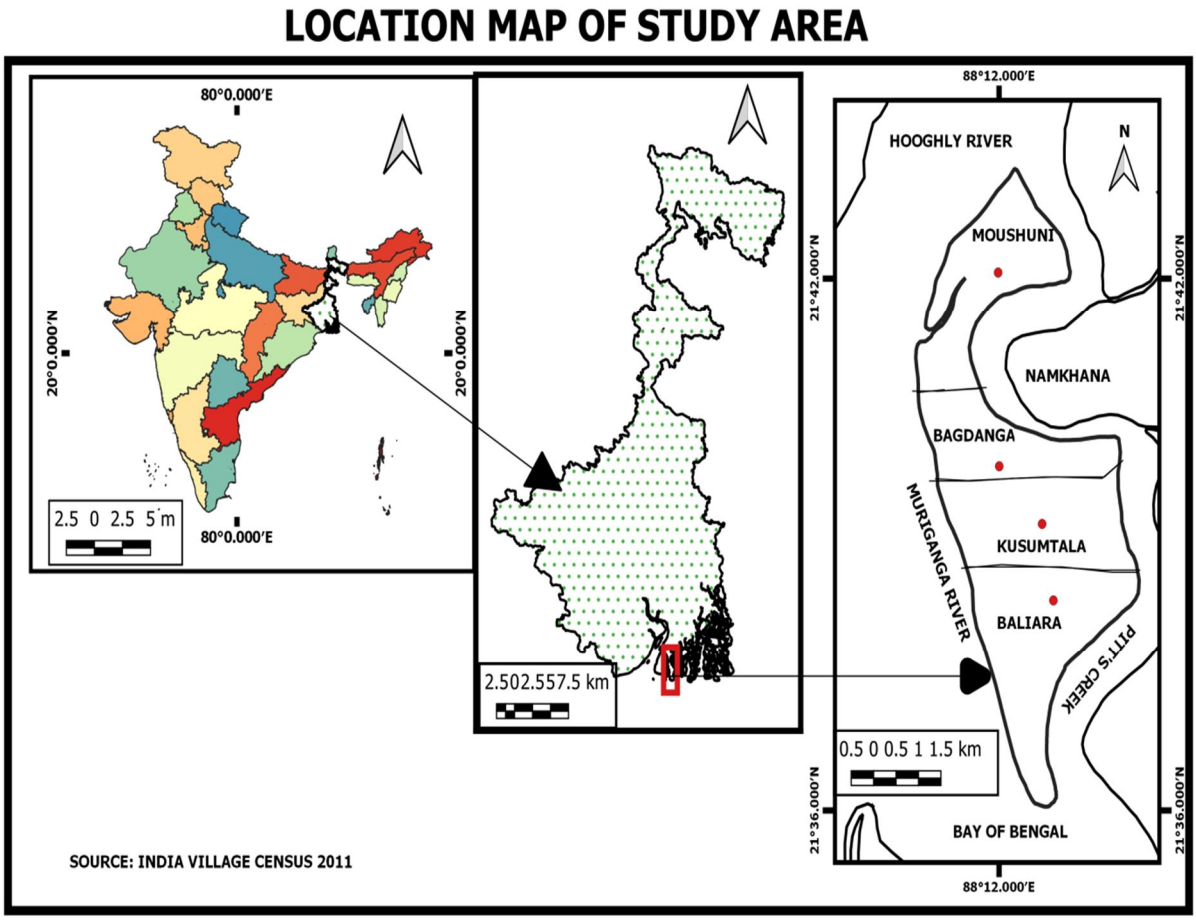

Fig:1 Location Map of the study area

III. MATERIALS AND METHODS

For studying the change of forest cover in Moushuni island Landsat 5 TM satellite data of 26/01/2000 and Landsat 7 ETM+ of 10/02/2020 of winter season were downloaded from USGS Earth Explorer(https://earthexplorer.usgs.gov/). The formula of NDVI (Normalised Difference Vegetation Index) (NIR - RED) / (NIR + RED) is also applicable for both Landsat 4-5 TM and Landsat 7ETM+ satellite data. The NDVI technique is used to monitor whether the area is vegetated or not. It's value ranges from +1 to -1 where +1 represents highly vegetated area 0<&<+1 represents "Vegetated (V)"area, 0 represents "No-vegetated (NV)" area, and -1<= &<0 represents "Water (W)" area**.** Based on NDVI value, the study area is classified into four categories as Highly vegetated, Sparse Vegetation, No vegetation and Water.The overall work is performed by QGIS 3.12 software. MS Excel has been used for graphical representation of forest cover change.

Satellite/Sensor	Path/Row & Date of Aquisition	Number of Spectral Bands	Sun Azimuth	Sun Elevation
Landsat 5 TM	138/45 26/01/2000	7	138.86167918	38.00693825
Landsat 7ETM+	138/45 10/02/2020	9	135.77582872	41.74531001

TM- Thematic Mapper ETM+ - Enhanced Thematic Mapper Plus

Table 1: Satellite data used in the present study

IV. RESULTS AND DISCUSSION

For this study all satellite data are georeferenced to UTM projection with WGS 84 Datum at north 45 zone.

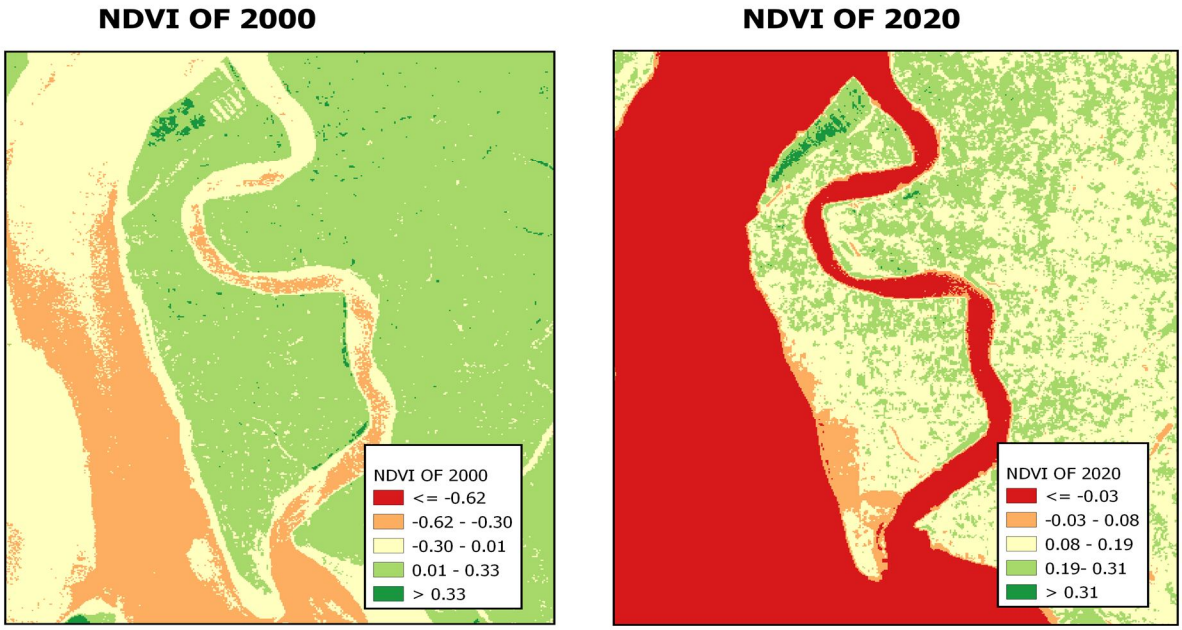

Fig 2: NDVI of Moushuni island in 2000 and 2020

In 2000 dense vegetation is seen in western part of the island and very low amount of dense vegetation is seen in eastern part of the island. And maximum part of the island is vegetated where the value is between 0.01-0.33. The causes of increase of vegetation cover in 2000 than 2020 is slower rate of settlement growth and salinity .In 2020 the scenario is different from 2000 as no vegetation is observed in south-west of the island. The NDVI value is ranges between -0.03 to 0.08. Apart from some area of western part other part of the island is covered by scattered vegetation, distributed in the entire study period.

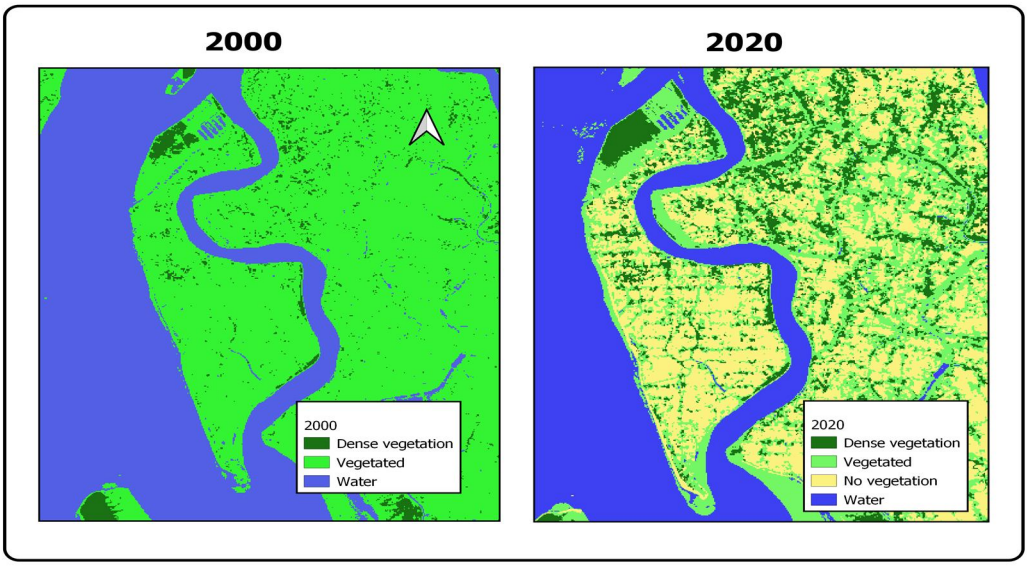

Fig 3: Spatial distribution of vegetation

According to NDVI it is seen that percentage of dense vegetation is increased from 12.34% to 20.44% in 2000 to 2020 respectively. The main cause of increase of dense vegetation in the north western part of the island is conservation of mangroves and regeneration of vegetation by Government at Kakramari char, Namkhana Forest Range. The percentage of vegetated area is decreased from 2000 (29.06%) to 2020 (13.64%) in the entire area .

2000	NDVI value	PERCENTAGE	2020	NDVI value	PERCENTAGE
Highly vegetated	>0.33	12.34	Highly vegetated	>0.31	20.44
Vegetated (Sparse vegetation)	0.01-0.33	29.06	Vegetated(Sparse vegetation)	0.19-0.31	13.64
No vegetation	-0.30-0.01	00	No vegetation	0.08- 0.19	8.72
Water	-0.30 - <= -0.62	58.58	Water	0.08 -<= -0.03	57.18

Table 2: Percentage of vegetation in 2000 & 2020

The reason of decrease of vegetation in 2020 is increase of rural settlement, salinization. The percentage of No vegetation in 2020 is 8.72%. But in the year of 2000 maximum area of the island was vegetated. The percentage of water in 2000 is 58.58% and the percentage of water in 2020 is 57.18%.The dominant species of mangrove vegetation of Moushuni island are Hental (*Phoenix Paludosa*), Goran (*Ceriops decandra*), Gewa (*Excoecaria agallocha)*, Golpata (*Nypa fruticans)* are True mangroves and Bani (*Millettia pinnata*) is Semi-mangrove . There also seen sparse woody vegetation like mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), banyan (*Ficus benghalensis*), and bamboo (*Bambusoideae sp*.).The percentage of sparse vegetation is high in 2000 than 2020. Except this woody trees different types vegetables is seen as orchards like bitter guard (Momordica charantia) , pumpkin (Cucurbita) , pointed guard (Trichosanthes dioica) , chilli (Capsicum frutescens). Rural people of this island cultivate dudheswar, pankaj rice seeds.

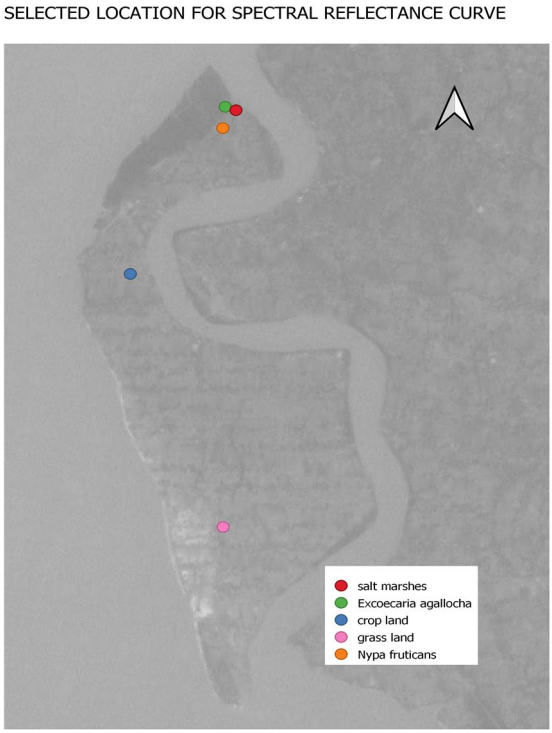

Fig 4: Selected location for spectral reflectance curve

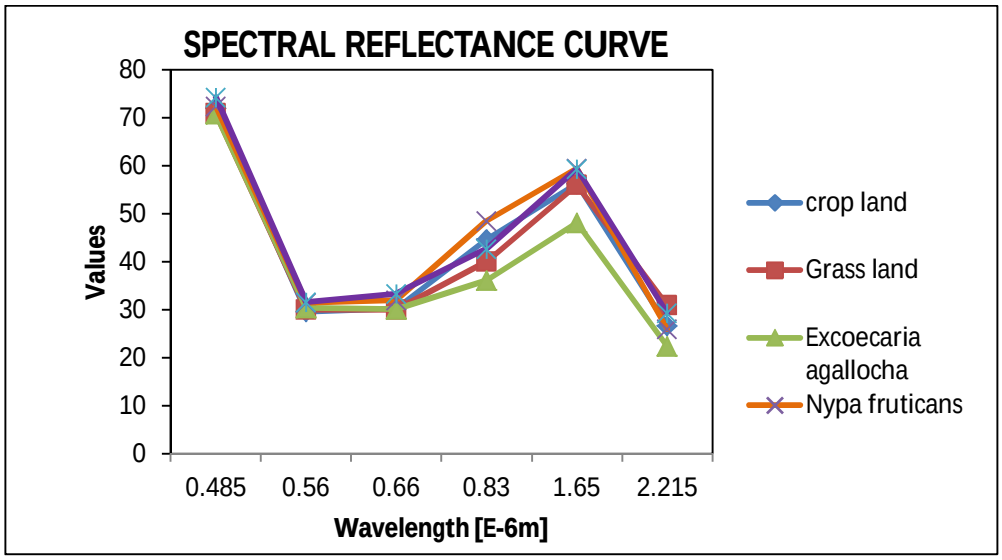

Fig 5: Graphical representation of spectral reflectance curve

Different location for Spectral reflectance curve has been selected for cropland (lat 21.699 long 88.197), Grass land (lat 21.711 long 88.207), Excoecaria agallocha (lat 21.712 long 88.207), Nypa fruticans (lat 21.708 long 88.206) and Salt marshes (lat 21.711 long 88.208).Spectral reflectance of vegetation depends on light absorption by leaf pigments in the visible region (400-700 nm).According to Spectral reflectance curve high reflectance is seen in Nypa fruticans(Golpata)and low reflectance is seen in Excoecaria agallocha (Gewa). Structural characteristics of leaves depend on transmission and reflection of energy which results high reflection value in Near Infrared Region. Nypa fruticans has a high reflectance value between 1.65 to 2.215[E-6m] because reflectance is higher than absorption due to sharp or needle structure of leaves. But the absorption is higher in Excoecaria agallocha (Gewa) because of flat surface of leaves. Saltmarshes, crop land and grass land also have high reflectance value than Excoecaria agallocha. The absorption of light in Band 2 (GREEN wavelength 0.56-0.66 [E-6m]) is higher in Excoecaria agallocha and less in salt marshes.

Orchards or Scattered Vegetation Mangrove Vegetation

V. CONCLUSION

From the study of NDVI values of Moushuni island it is evident that there is an over all decrease of vegetation due to anthropogenic activity, increase of settlement and salinisation. Only there is an increase of mangrove vegetation due to plantation and conservation of mangrove vegetation. The increase of dense vegetation cover is 8.1% and decrease of vegetated area is 15.42% from 2000 to 2020. The spectral reflectance in NIR (Near Infrared) region is high in Nypa fruticans than Excoecaria agallocha due to the structural differences of leaves. High reflectance in NIR region also depicts the healthy vegetation in the selected areas. This island also suffer from shifting of shore lines , Cyclone and other natural calamity. Increase of vegetation is one of the major resistance to natural calamity. So local people as well as Government should take necessary steps to increase the vegetation belt of the island.

VI. ACKNOWLEDGEMENT

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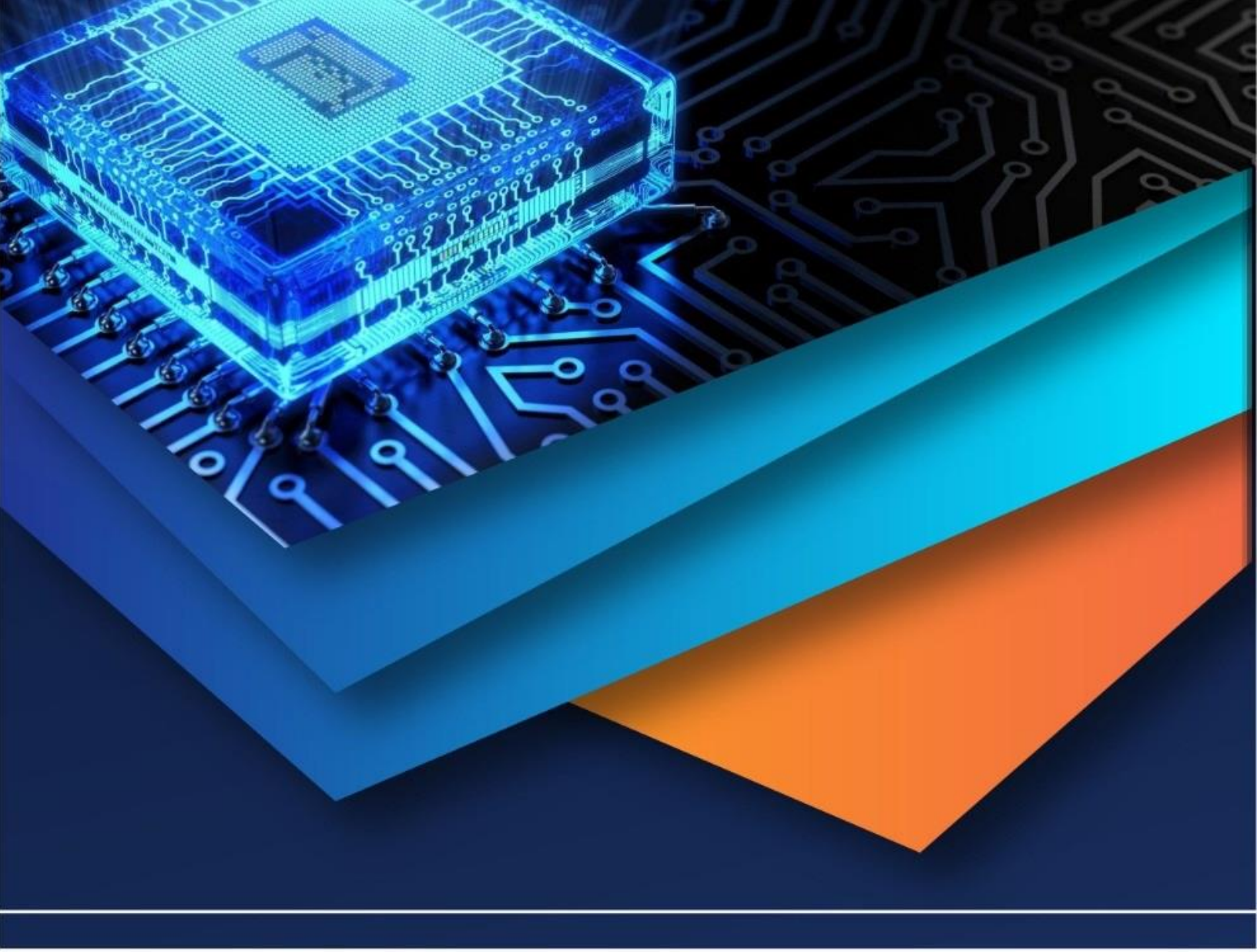

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