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Flood Control Measures: A Case Study on Krishna River Bank (Mouje-Digraj Area,Sangli) using Q-GIS Software

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Abstract: ***The Krishna river bank Bank (Mouje Digraj) is prone to frequent and severe flooding, posing significant risks to the communi es and ecosystems along its course. Q-GIS enables the integra on of spa al data to analyse and model the river Bank (Mouje Digraj)'s topography, land use pa erns, and hydrological characteris cs. The research focuses on developing a comprehensive flood control strategy, incorpora ng Q-GIS- based tools for real- me monitoring, early warning systems, and decision support. Implementa on of structural measures such as reservoir management and embankments, coupled with non-structural measures like land-use planning and community awareness, are examined for their efficacy in mi ga ng flood impacts. The study aims to provide valuable insights for policymakers and stakeholders involved in disaster management, offering a sustainable approach to enhance the resilience of the Krishna river bank Bank (Mouje Digraj) against floods. Krishna river bank is one of the largest River Banks in India, covering an area of around 258,948 sq. km. It is a major source of irriga on, hydropower, and drinking water for the states of Maharashtra, Karnataka, and Andhra Pradesh. However, the Bank is also highly prone to floods, which cause extensive damage to life and property. The causes of floods in the Krishna river bank, Mouje Digraj can be a ributed to both natural and human factors. Heavy rainfall during the monsoon season is the most common cause of floods in the region. To mi gate the impact of floods in the Krishna river bank, several flood control measures have been implemented. These measures can be classified into structural and non-structural measures.***

Keywords: Krishna river bank Bank (Mouje Digraj), Flood Control, Quantum Geographic Information System (Q-GIS), Hydrological Modelling, Reservoir Management, Early Warning Systems, Structural Measures.

I. INTRODUCTION

The Krishna river bank is one of the major River s in India and flows through the states of Maharashtra, Karnataka, Telangana, and Andhra Pradesh before emptying into the Bay of Bengal. The River Bank is home to millions of people who depend on it for their livelihoods, and it is also a vital source of water for agriculture, industries, and hydropower generation. However, the Krishna river bank is prone to floods, especially during the monsoon season, which can cause extensive damage to property and infrastructure, displacement of people, and loss of lives. The floods in 2005 and 2009 in the Krishna Bank were particularly devastating, causing severe damage to crops and infrastructure, and resulting in the loss of hundreds of lives.

This study is of great importance, because flooding damages properties and endangers humans and all other living things' lives. This study is justified because floods are among the most frequent natural disasters that cause greater economic losses and difficulties to human activities. About 90% of the damages caused by natural disasters (excluding droughts) are caused by floods and associated water flows. The floods are responsible for the death of almost twice the amount of people as tornadoes and hurricanes put together. The water-related disasters account for 90% of all disasters in numbers of people affected. Social and economic costs of floods have risen in recent decades and the trend is to continue to rise if an action is not taken. By 2017, natural disasters related to water caused worldwide losses of US$ 306 billion. Between 1980 and 2016, 90% of natural disasters were climate-related. In 2016, 31% of global losses were due to storms, 32% attributed to flooding and 10% to extreme temperatures. In addition, this study is justified as there is the prospect that climate change may contribute to increase flooding resulting from rising sea levels and heavy rains in certain regions of the planet.

II. LITERATURE REVIEW

Several research papers were reviewed to study how the Q-GIS can be used for its applications. Reviewing papers helped in determining and limitation and the scope of the study.

In literature study, the research forecasted on the "Sustainable Development in Krishna River by Flood Control and Water Transfer through Micro Irrigation methods". A Framework for Flood Risk Analysis and Benefit Assessment of Flood Control Measures in Krishna river bank

III. METHODOLOGY

Mouje Digraj village is located in Miraj tehsil of Sangli district in Maharashtra, India. It is situated 20km away from sub district headquarter Miraj (tehsildar office) and 8km away from district HQ Sangli. As per m2009 stats, Mouje Digraj is the gram panchayat of Mouje Digraj village.

Flood is natural phenomenon which occurs due to prolonged high intensity of rain. This situation becomes hazardous when it causes colossal lost to human lives and property. Flood are usual phenomenon in north and eastern India, but the years 2005 and 2006 in July and August, the flood situation has been experienced in upper Krushna basin. About 3.5% of total geographical area of world affected by floods with its 16.5% of total population. The flood of rivers are responses of both natural and artificial factors. The causes of floods of alluvial rivers are highly complex and their relative importance changes from place to place

The methodology mainly relies on analysis of the satellite images and field visit. It involved several steps such as,

1) Study area selection using previous years flood data.
2) Field data collection by visiting actual site.
3) Process the field data for flood water diversion.
4) Calculations for flood water diversion.
5) Plotted route for flood diversion using Q-GIS software.
6) Final result.

Field data:

An extensive field visit for the collection of topographic points and ground validation was done during May 2023. Required data and information have been collected from various sources. The vast statistical data and concerned information have been collected through personal visit to Mouje Digraj, Sangli.

The secondary data have been taken from socio-economic reviews and districts statistical abstract of Mouje Digraj, Sangli. Various articles published on flood situation in daily newspaper, journals, magazines and reference were also reffered.

To find out causes of floods in Mouje Digraj, the relative information regarding the rainfall, area under irrigation, bridges on Krishna and other river, statistical information about flood affected area and population were collected through primary and secondary sources of data.

CAUSES OF FLOOD SITUATION

Underground water level: After severe drought in 1972 Krishna Basin has brought vast area under irrigation. Before 1972 age-old Krishna Canal was only available source for irrigation to the left side of Krishna River. It starts from Karad to Tasgaon in Sangli district. The Canal was drawn from Khodsi weir and constructed during the British regime. After 1972 Maharashtra government has introduced several major lift irrigation schemes in Satara, Sangli and Kolhapur districts. Similarly thousands of co-operative lift irrigation societies have also made available irrigation facilities at every village on both the sides of these rivers. These lift irrigation schemes have provided water to the area some 10 to 50 km away from the concerned river. At present more than 70% agricultural area on both sides of the river is permanently irrigated, and sugarcane is the major perennial crop taken in the area to which water is supplied year-round. Due to continuous water supply the underground water table in Krishna valley has increased considerably, which is at ground level during the rainy season and about one-two meter during dry season.

Cropping pattern: Due to vast expansion of canal and lift irrigation schemes in Krishna and its tributaries, about 70 % sown area is under irrigation. The region has number of co-operative sugar mills in the radius of 5-10 km from each other. Therefore, most of the irrigated area is under sugarcane. The crop requires year-round water supply. Sugarcane is planted in two different seasons. "Adsali" during July-August, and "Suru" October-November months. During the rainy season, Adsali crop is about two to three meters high, which resists flow of flood water and makes the flood situation more serious and worse. During the floods, due to increased water table, water is not absorbed and percolated in the soil, but the volume of run off is increased which creates severe flood.

River bridges: Bridges on river provide transportation facility and link both sides of the rivers. There are about 22 bridges on Krishna and its tributaries within Maharashtra state. The height of these bridge is usually low, below the height of both sides of the river. During floods most of these bridges are drowned. Due to this situation the flood level beyond the bridge is increased with the breadth of the bridge. While considering the total number of bridges and the flood of water they impeded, it has been observed that they increased the level of flood by some meters more than the actual flood level of 2005 and 2006.

Almatti dam: Though, it is not officially established, the severe flood condition in Sangli district and near Shirol tehsils of Kolhapur district is due to Almatti dam, constructed on the Krishna river in Bijapur district in Karnataka State. It is about 260 km from Sangli town. The height of Almatti dam is about 519 metres from sea level and almost the same height is also recorded at Shirol tehsil and Sangli (527 m). It reveals that all the discharge and run-off from Krishna basin is collected in Almatti dam. Therefore, the completed plain area of Sangli, Shirol to Almatti has drowned under floods.

A. Case Study:

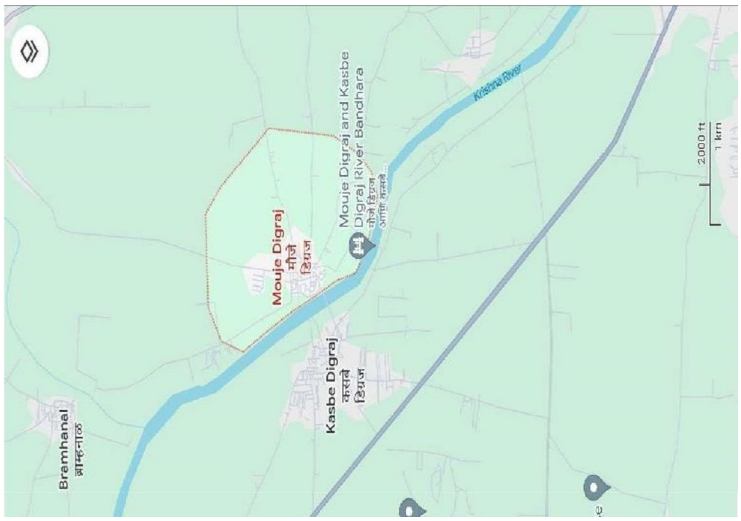


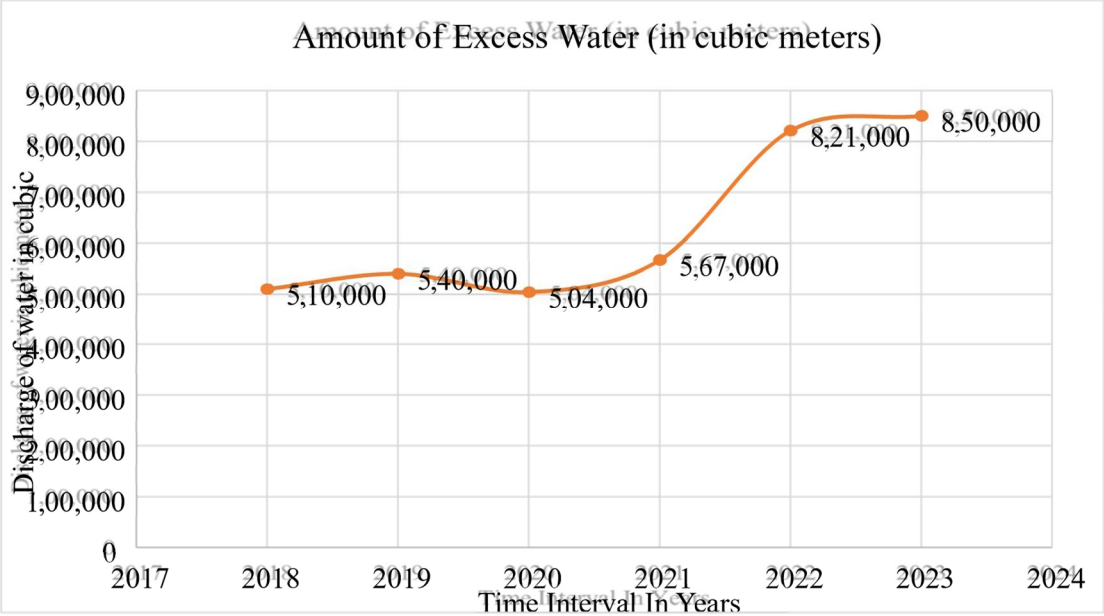
Fig.1 Study Area Map (Mouje Digraj)

Fig.2 Study Area Survey Images (Mouje Digraj,Sangli District)

B. Amount of Excess Water Gathered During Flood:

Table No.1 Amount of excess Water Gathered During Flood

Year	Amount of Excess Water (in cubic meters)
2018	510,000
2019	540,000
2020	504,000
2021	567,000
2022	821,000
2023	850,000



C. Flood Plain Level

Table No.2 Flood Plain Level

Year	Flood Plain Level (meter)
2018	7.2
2019	7.9
2020	6.3
2021	7.8
2022	8.1
2023	9.1

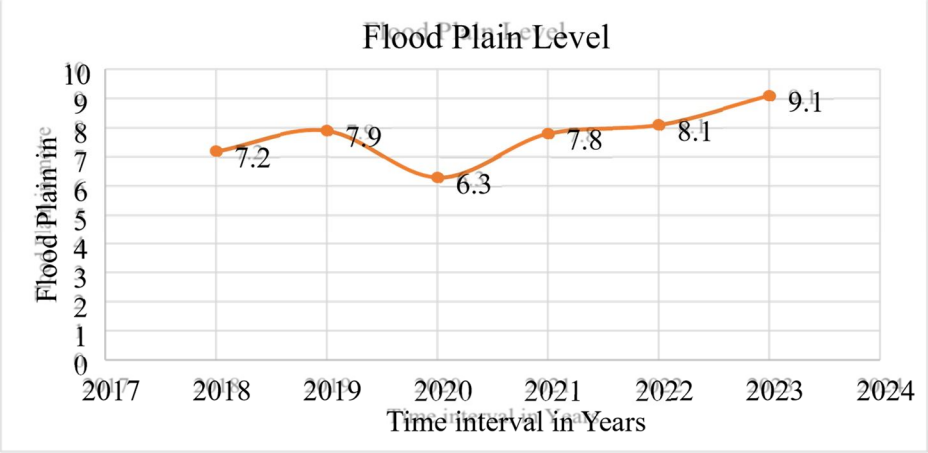


Fig. 3 Flood Plain Mapping

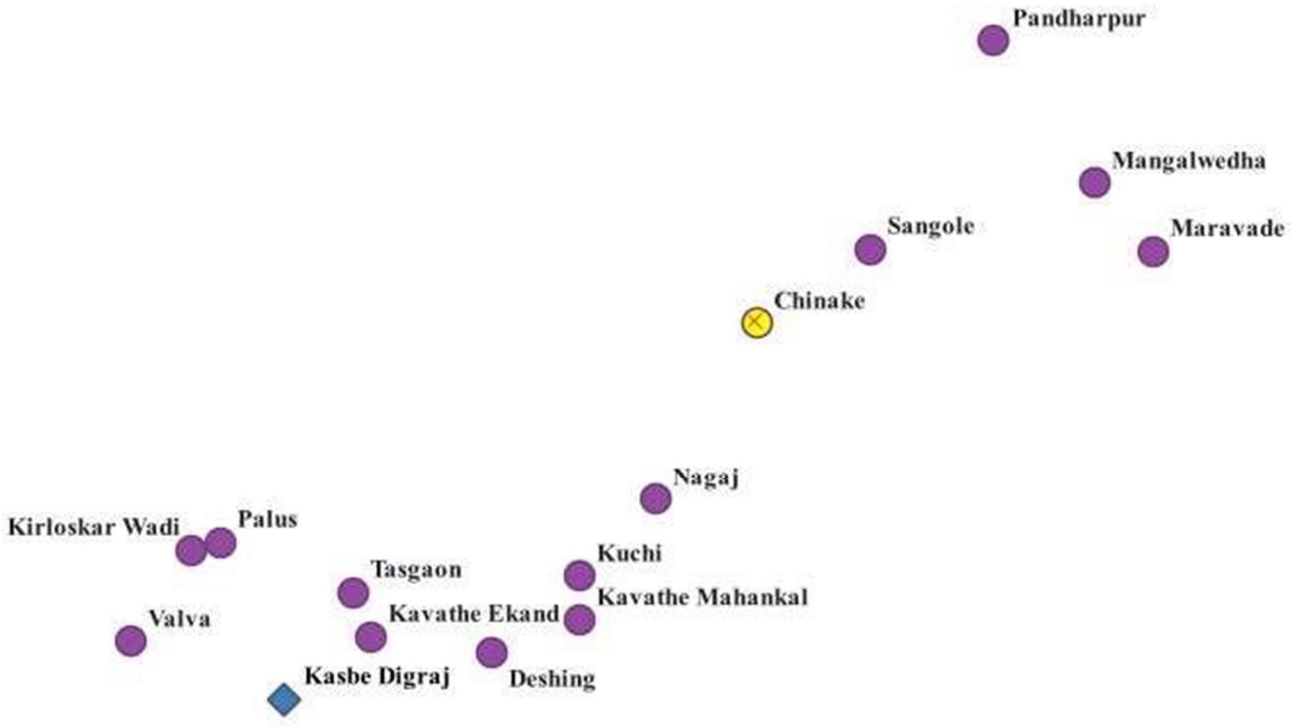
D. Utilizing Diversion Channels to Manage Excess Water Flow on the Krishna river bank at Mouje Digraj Bank

The Krishna river bank, one of the major rivers in India, poses a significant challenge in flood management due to its fluctuating water levels, particularly during monsoon seasons. Mouje Digraj Bank, situated along the banks of the Krishna river bank, faces the risk of flooding, especially when excess water gets blocked by the backwaters of the Almatti Dam. To mitigate this risk, implementing effective flood control measures becomes imperative. One such measure involves the construction of diversion channels to redirect excess water away from vulnerable areas, thereby minimizing the impact of flooding.

E. Source: Construction of Diversion Channels

Construction of diversion channels is a proactive approach to managing excess water flow on the Krishna river bank at Mouje Digraj Bank. These channels serve as alternate pathways for the river water, diverting it away from densely populated or economically significant areas. The implementation of diversion channels requires meticulous planning, engineering expertise, and significant investment.

However, the benefits in terms of flood prevention and mitigation outweigh the costs incurred.



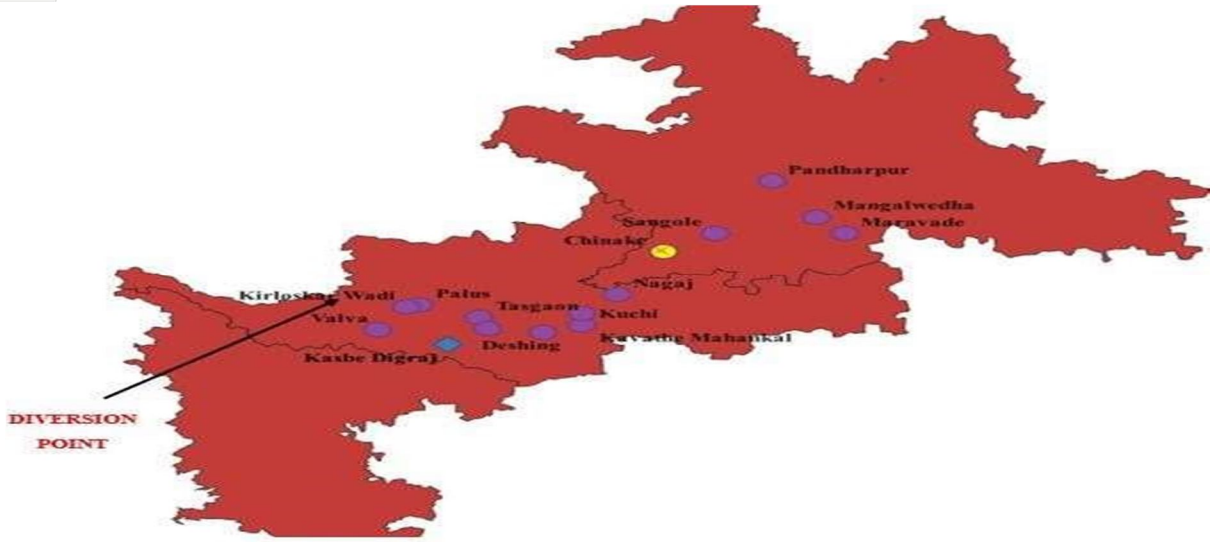


Fig.5 Water diversion Area (Walwa to Pandharpur)

F. Calculation:

Average Gradient between Walwa and Pandharpur:- 0.79 ≈ 1.00 Average flood water discharge:- 6,20,000 cubic meter.

Let us take discharge of flood water = 45,142 m^3/day

 86,400 ÷ 45,142

= 0.52 ≈ 1 m/sec

But assume 0.5 as velocity of river water

= 1,92,000 m…….(dist. between Walwa and Pandharpur)

= 1,92,000 ÷ 0.5

= 3,84,000 sec

Now, to calculate days required to reach

= 3,84,000 ÷ 86,400 …….... (86,400 seconds in 24 hours)

= 4.44 ≈ 5 days

 Water from Walwa, after diversion will take about 5 days to reach Pandharpur.

IV. RESULTS

Krishna River water diverted

Flood control measures on the Krishna River bank in the Mouje Digraj area of Sangli are crucial for safeguarding the region from the devastating impacts of flooding. One of the key strategies in flood control is the diversion of water to prevent overflow and inundation in vulnerable areas. This process involves redirecting excess water to alternative channels or storage areas, effectively managing the water flow and mitigating potential flood risks.

In the context of Mouje Digraj, the use of Q-GIS software can play a pivotal role in identifying suitable locations for water diversion. Q-GIS (Quantum Geographic Information System) is a powerful tool for spatial analysis, allowing for the visualization and interpretation of geospatial data. In the case of flood control, Q-GIS can aid in mapping out the topography, hydrology, and land use patterns in the area, helping planners make informed decisions about where water diversion is most effective.

1) Enhanced Resilience: The presence of diversion channels enhances the resilience of communities against natural disasters, enabling them to withstand extreme weather events with minimal disruption.
2) Economic Sustainability: Investing in flood control measures such as diversion channels yields longterm economic benefits by preventing costly damages associated with flooding, including property loss, infrastructure damage, and crop destruction.

V. CONCLUSION

From the above project study carried out the following conclusion

1) Diversion from Walwa towards Pandharpur will reduce the excess water at Mouje Digrai.

2) This strategic plan will reduce water stress at Pandharpur.
3) Agricultural sector at Pandharpur would get a significant boost.
4) This strategic plan of disersion, would sould decrease the financial -and physical damage caused at Mouje Digraj.
5) It will reduce the.cost of relocation of people and livestock due floods at Mouje Digraj.

VI. FUTURE SCOPE

1) Benefit: How Pandharpur and neighbouring, towns will benefit from the diverted water.
2) Economic Development: How Industrial and agricultural sector will grow and increase production due diverted water.
3) Monitoring: How use of Q-GIS will help monitor the conditions of the diverted route and maintenance of hydraulic structure.
4) Benefit Cost ratio: Calculation of benefit cost ratio to mitigate the severity of water scarcity.

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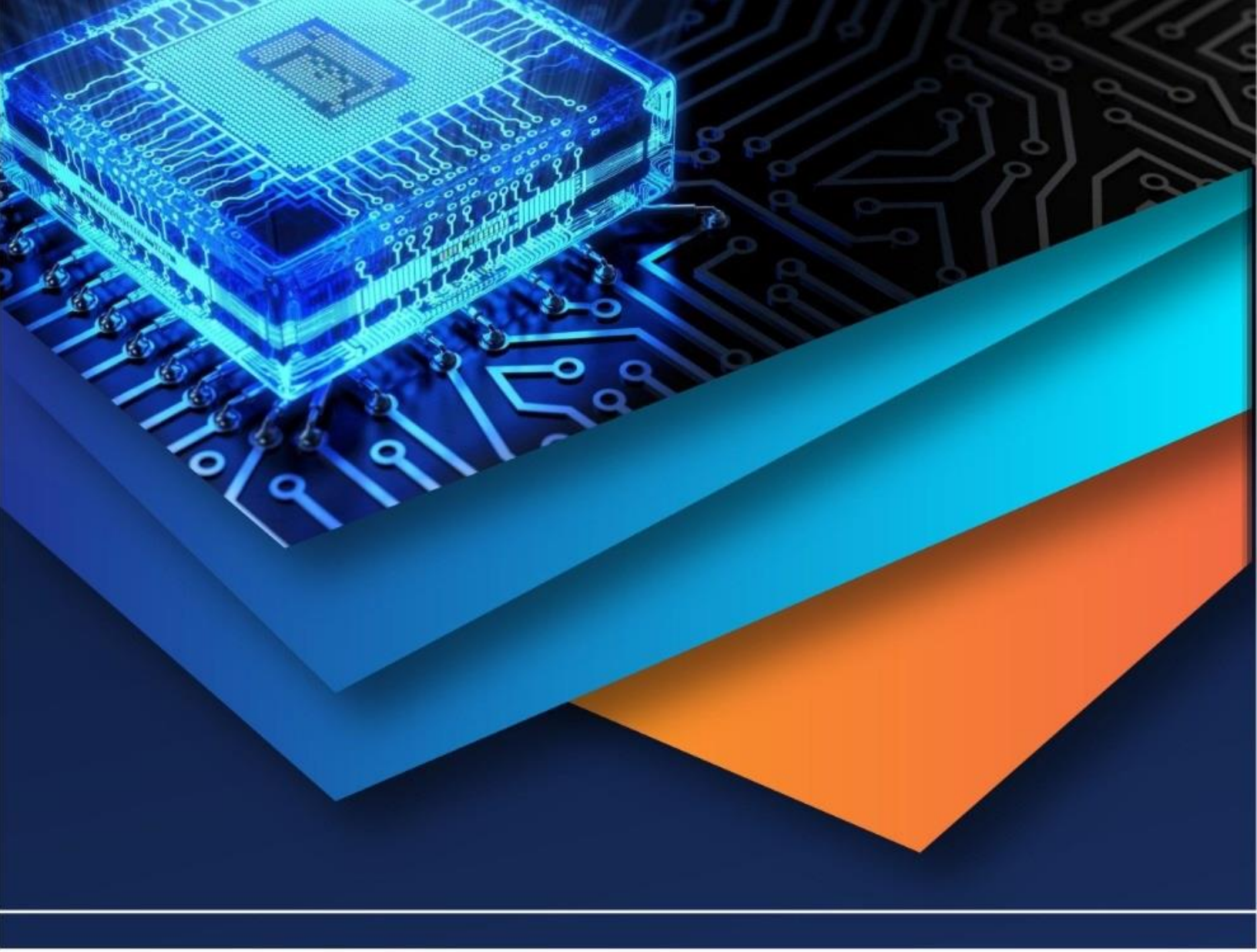

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