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Analysis of Old Trends in Indian Wine-Making and Need of Expert System in Wine-Making

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Abstract: ***Agriculture provides a living for the vast majority of Indians, either directly or indirectly. Some have an immediate connection to farming, while others are involved in the commercialization of agricultural products. The poor rate of agricultural productivity in India can be attributed to a number of factors, including a lack of socioeconomic growth, illiteracy, ineffective funding for farm output, and a lack of facilities for the sales and marketing of agricultural goods. There has not yet been widespread adoption of contemporary agricultural technology and modern farm equipment in the agricultural sector. In India, several different varieties of fruit are grown for the purpose of being sold commercially. The grape is a fruit that is essential to the production of many types of wine. There is evidence that winemaking dates back thousands of years. The production of wine is a completely natural process that requires almost no human involvement. The process of manufacturing wine consists of five primary components or steps: harvesting, crushing and pressing the grapes, fermentation, clarifying, maturing and bottling the finished product. The production of wines of high quality utilizing the ingredients listed above has given rise to a number of distinct trends in winemaking. The purpose of this essay is to investigate many antiquated practices that were a part of the winemaking process in India and how they influenced wine production. This study provides a comprehensive analysis of both established practices and emerging tendencies in the winemaking business.***
Keywords: Import, Export, Fermentation, Grapes Cultivation, Wine Consumption Trend

I. INTRODUCTION

The production of wine is one of the activities that has been practiced for thousands and thousands of years. In India, it has been around for a very long time prior to the time of Portuguese and British colonization of the subcontinent, when it was fostered and entrenched. Following the country's declaration of independence, the Indian government made it clear that the complete prohibition of alcohol was one of its goals. Because of this, the authorities in certain states pushed vineyards to switch their production to table grapes and raisins instead of wine. A renaissance of the Indian wine business occurred in the 1980s and 1990s as a result of worldwide influences and a growth in the demand for beverages among individuals in the middle class. This coincided with India's rise to prominence on the international stage.

The climate in India is perfect for growing grapes, and the states of Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu contain the majority of the country's grape-growing land. The remainder of the grapes are used for the production of wine, but they are also used to make a variety of other goods, such as grape juices, syrup, jam, jelly, vinegar, and dry fruits, among other things. As a result, the opportunities in this area are substantial, and if given the appropriate assistance and direction, this sector has the potential to be of significant assistance in terms of both employment and earnings. In more recent times, the notion that drinking wine has positive effects on one's health has gained widespread acceptance and even more attention in the realm of study. Every single year, people all over the world drink more than 6.2 billion liters of pure alcoholic beverages. There has been a significant amount of research conducted on wine, namely red wine. There is mounting evidence that drinking alcohol in moderation helps people live longer, lowers their risk of developing some malignancies, and makes their hearts healthier. In the manufacture of wine, the following practices were common in days gone by.

II. HOMEMADE WINE PRODUCTION IN OLD DAYS

Before industrialization, the wine is made in home and it can be consumed for different purposes like ceremonies, religious purpose or just for enjoy. Wine making in home is satisfying and enjoyable hobby. Homemade wine making is easy and simple process. If followed by simple instructions, it is no more complicated. It is good preservation method and requires extra concentration on preparation steps and some adjustments with ingredients like sugar contents, acid levels etc.

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In homemade wine making, buying the small quantities of high-quality fruit is major task. The normal winemaking can be divided into four basis phases.

1) *Phase 1:* Finding the high-quality fruit and grapes are harvested in an optimum condition.
2) *Phase 2:* Fermentation of grapes into wine. Winemaker manage the fermentation by controlling the different fermentation parameters like temperature, skin contact tie. pressing technique etc.
3) *Phase 3:* New wine is clarified by fining, rackling and filtration. also new wine is stabilized by removing excessive protein and potassium hydrogen tartrate (potassium bi tartrate). These materials must be removed to prevent them from precipitating out of the wine later.
4) *Phase 4:* Aging of wine is done. High quality wines are age in bulk and then for an additional time in the bottle. Winemakers play important role throughout the lengthy bulk aging process. Wines are continuously smelled, tasted and measured in every few weeks for any needed adjustments. Except for the first phase, the other three winemaking phases overlap each other. Homemade winemaker can reduce their cost of winemaking using different ways like purchasing grapes in ton quantity, use minimum number of equipment. Basic crush equipment consists of a crusher and a press. The key pieces of cellar equipment are wine storage containers, pumps, and filters, bottling equipment and test equipment. At many home wineries, a concrete driveway serves as the “crush area,” and the garage is the “cellar.” However, daytime temperatures in typical garages are often excessive for wine storage. Many home winemakers use new 32-gallon plastic trash cans for open red fermenters and surplus stainless-steel beer kegs for wine storage containers. New oak barrels can impart desirable vanillin flavor characteristics to red wines. On the other hand, barrels are difficult to handle in a small winery, and some leakage is always encountered. New oak barrels are expensive, and the oak flavor disappears after the barrels have been used for a few years. Oak chips can be used to impart desirable oak flavors in wine, and chips are inexpensive and easy to use

A. Grapes Processing For Homemade Wine

In homemade wine making, problems can occur if grapes are picked late in the afternoon on a hot day. Fermentation temperatures can become excessive easily when warm grapes are fermented. But the high-temperature fermentation is not suitable for wine quality. Home winemakers make the warm grapes cool before crushing or they avoid crushing hot grapes. To avoid the cost of large equipment, different hand crushing techniques can be developed like crush by foot, hand crush, and hand crank crusher. Mostly home winemakers used a hand crack crusher.

These machines are easy to operate and satisfactory for handling small quantities. A crusher/stemmer crushes the berries and removes the stems in one easy operation, some advanced home winemakers use motor-driven crushers/stemmers to process the grapes. home winemakers use a vertical basket press of some kind, and some of these presses are designed to produce high pressures. High press pressures dry the pomace quickly, but high pressures can also produce astringent and bitter wines. Very high press pressures are not desirable, and compound, ratchet-type presses must be used with care. For must adjustment home winemakers generally use potassium metabisulfite (sulfite) crystals to produce sulfur dioxide gas. Generally, 25 to 50 milligrams of SO2 per liter of juice are added before starting fermentation. The sulfite powder is dissolved in a small amount of water, and the solution is added as the grapes are being crushed.

Home makers are typically advised to add sugar to immature fruit. It will increase the content of alcohol in wine, increase the flavor or improve the weak varietal chrematistics but not reducing acidity. Here, adding sugar to the juice until the hydrometer reads 20 Brix or so might result in better quality wine. Immediately after pressing, the juice is cooled about 50 degrees so it will not start to ferment. The cold juice is allowed to settle overnight in a closed container. the yeast used for fermentation contributes little to the flavors of aged wine, home winemakers use Prise de Mousse or Pasteur Champagne for all their fermentations. Wine yeast can be purchased in both liquid and dry forms.

However, dry yeast is easier for home winemakers to store and use. Fermentation progress should be monitored by measuring the Brix each day with a hydrometer and by smelling and tasting the juice. Home winemakers remove hydrogen sulfide from wine when fermentation is complete by adding about 50 milligrams per liter of sulfur dioxide. Moderate quantities of sulfur dioxide may not control bacteria in high pH juices effectively.

During the primary fermentation, develop the large populations of Lactobacillus bacteria and produce excessive amounts of acidic acid and which can kill wine yeast. Beside these different microbial transformations occur in red wine. The malolactic fermentation mainly reduces wine quality and improves the long-term stability of red wine. ML fermentation produces the butter-like quality prevalent in heavier style Chardonnay wines, and it adds pleasing complexity to red wines.

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Several Fining materials are used to remove the unwanted material like unwanted color, haze, bitterness, excessive astringency, off-flavors, unpleasant odors, etc. from the wine.

Many different materials like Albumin (Egg white) , Bentonite , Carbon (Charcoal) , Casein, Isinglass, Kieselsol , Sparkolloid etc. are used to fine wine, and each material has different properties.

Therefore, the winemaker must carefully select each material carefully to produce the desired results. clarity and stability are extremely important to both homemade wines. All wines can be clarified, stabilized and prepared for bottling using standard winemaking practices. These procedures include cooling the wine to cold temperatures, fining the wine with suitable materials and using appropriate filtration methods. home winemakers always prefer to produce brilliantly clear wine, but such clarity is seldom essential unless the home winemaker actively participates in homemade wine competitions. Home winemakers often use cartridge type filters, and these filters can produce excellent wine clarity. Last step is bottling of wine in which Some home winemakers turn up the hot water heater a few hours before starting to bottle wine.

Making wine in home is a labor-intensive process and it requires manpower. After some time of period wine being used as a medicine somewhere and wines are gaining a lot of attention. Ethanol ingredient which is formed in alcoholic fermentation of juice is useful for human body.

As per Researchers research moderate ethanol consumption from any type of beverage advances lipoprotein metabolism and lowers cardiovascular mortality risk by preventing clotting as it helps in thinning of blood thus prevents strokes. From last 20 years Indian wine industry has been progressively growing.

Wine becoming a part of urban Indian lifestyle. Rising incomes of Indian population, changing demography and exposure to new culture is adding to the higher consumption. In old days home wine makers don't have proper crush area, storage area and these storage areas are not maintained with proper temperature. Sometime most of the wine making procedure are satisfactory for small quantity of wine but for large quantity wine winemakers face lots of problem. In Wineries where large amount of making wine is possible and resolves home winemakers' problems. Now a days modern technology has result in refinement to process such as better-quality control, greater consistency and greater accuracy.

III. CHALLENGES FACED BY WINE INDUSTRY IN OLD DAYS

A. Grapes Cultivation

In India, one of the most profitable farming is grape cultivation. grape is cultivated under the variability of soil and climate conditions such as sub-tropical, hot tropical and mild tropical. There are some problems faced during cultivation of grape as follows:

1) *Change in Climate:* The ripeness of barriers is earlier due to hot climate due to this pre harvesting should be studied rather than ideal harvesting time. A hot climate affects the quality of the wine. Changes in climate increase pathogens on plants which increases disease harshness. Also, unseasonal rain is the reason for economic loss.
2) *Consumer Preference:* For a better quality of wine grape quality, grape should be in proper limit range of pH, Brix range (sugar), acidity level. Consumers always prefer to check all the values. In the market consumers mostly prefer chemical-free "Organic Grapes".
3) *Labor Shortages:* Expert manpower is required to manage the vineyard very well. Unavailability of capable and enough labor at important stages of the crop cultivation was a major issue in good grape production. Delay in harvesting time affects crop and quality and leads to lower returns from grape production.
4) *High Investment Cost:* The formation of vineyard cost is higher than any other agricultural crop. For a better quality of the crop, it requires higher input cost like maintaining vineyard (soil irrigation, weeding process, fertilizers, pesticides, etc.). Indian vineyards are not fully equipped with machinery so lots of manpower's requires but it leads to lots of time and labor costs.

B. The Area Under The Production Of Grapes

As per FAO (Food and Agriculture organization) data 2010 agency, major grapes producing countries are China, Italy, USA, Spain. As compared to European countries Asian countries have lower surface areas because of traditions, culture, advanced technology marketing. India is in the 18th position in the world for grape production. In India, maximum grapes production takes place in Maharashtra state also from Karnataka, Tamil Nadu, Andhra Pradesh, Panjab, Haryana. [1]. Fig. 1 Shows Top 10 countries in grapes production in world. Fig. 2 shows the area, production and productivity of grapes in India from 2001-2011.

Table1 shows the production of grapes of India's top 4 states from 2002 to the 2011 year in which Maharashtra state has a larger production of grapes as compare to other states. From 2009 to 2011 production of grapes is decreased.

TABLE I
Indian grapes production table of the top 4 states (Source: Database of National Horticulture Board, Ministry of Agriculture, Govt. of India.)

Sr. No.	State	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
1	Maharashtra	1163.10	1233.90	1275.03	1284.23	1290	1415.00	440.00
2	Karnataka	170.90	167.40	193.24	216.63	209	268.96	317.60
3	Tamil Nadu	59.90	69.70	84.80	91.61	83.5	91.1	44.10
4	Andhra Pradesh	35.00	37.80	56.41	51.77	52.4	62.24	29.80
	Total	1428.9	1508.8	1609.48	1644.24	1635	1837.21	831.50

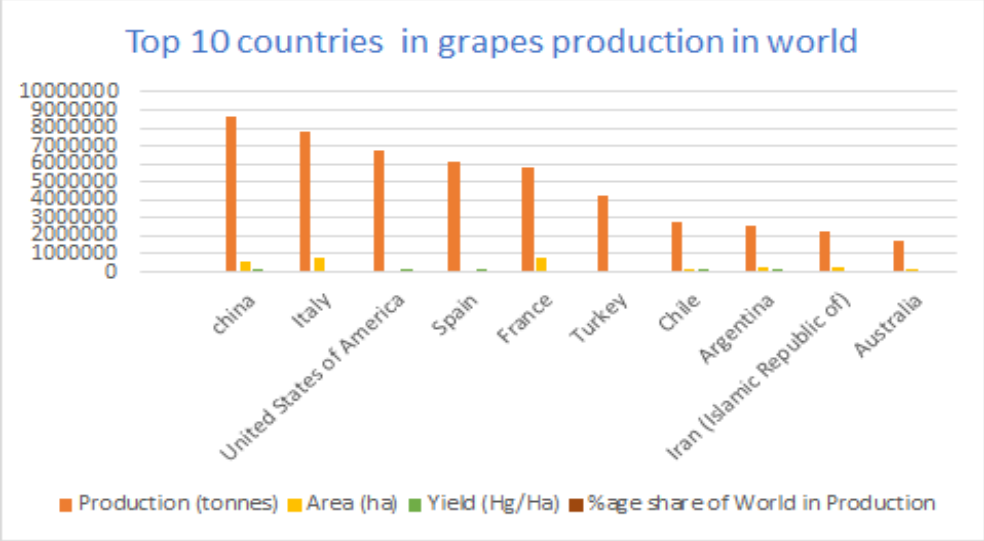

Fig. 1 (Source: Database of National Horticulture Board, Ministry of Agriculture, Govt. of India.)

Fig. 2 (Source: Database of National Horticulture Board, Ministry of Agriculture, Govt. of India.)

C. Wine Industry Status

In all over the world Indian country is known for their tradition and values due to this culture taking wine is considered a bad habit. In the old day's wine ban in India and price also high, the manufacture and consumption of wine in India were insignificant as compared to other countries. In earlier days wine has been sold through thousands of small wine shops.

Getting a retail license can be difficult and expensive, which limits the opportunity to open new stores thereby restricting growth in retail sales. The wineries were set up in India in 2001 -2010 with government support. In the 2000s, India has been promoted as an important developing market for wine. Maharashtra and Karnataka state has an ideal climate for grapes cultivation and high quality of grapes. The State Government has specifically provided in 'Maharashtra's Industrial Policy', 2001 that Wine Parks will be set up in Sangli and Nashik districts to encourage the Wine Industry in the state. [3] This policy provides successful wine production 712 kiloliters in 2002 to over 20 million liters in 2008-09. In 2008 the 'Karnataka Wine Policy' reduced the cost of, obtaining a winery license to expressively expand the market. [2] European countries still lead in the global wine industry with 75% of the world's production and consumption in Europe. One -half of the world's supply of wine is provided by France, Italy, Spain. [7]

D. Import Export of Wine

Import of wine Totally banned until 2001 except for imports of wine by hotels and special licensing. France, Italy, and Australia are the largest exporters of wine to India. Due to a high federal tariff, wine imports grew gradually from $1.5 million in 2003 to $16.4 million in 2008. The export of wine dropped from 4.3 million liters in 2007 to 2.2 million liters in 2009 [5]. After awareness of red wine benefits some consumers are prior to wine rather than other higher alcohol content. wine consumption is considered a sign of status for some. Consumption of red wine 45 percent, white wine at 40 percent, sparkling 10-15 percent and rose wine 1-5 percent. The market for domestic and imported wines is controlled by excise taxes, licensing processes, complex distribution procedures, poor handling and storage options, competition from whiskey and limited advertising options. [6]

As shown in table 3 import of wine from different countries progressively increases but on the 2009 year total import quantity was decreased again in raised. France, Australia, Italy are major distributors in India.

As shown in table 4 in 2007 a large amount of wine exported to different countries and in 2009 export quantity was dropped. In France, Italy Chile countries wine was exported quantity is more.

TABLE III
Domestic Availability of Wine (1,000 liters)
*Import and export data are through June 2010 Trade data are official Indian Statistics

	2003	2004	2005	2006	2007	2008	2009	2010
Production	3600	4725	5850	8550	11250	11700	12600	13500
Imports	446	874	1421	1836	3067	3307	1795	1013
Annual Supply	4046	5599	7271	10386	14317	15007	14395	NA
Less:								
Exports	423	280	483	752	1048	1636	2078	411
Equals:								
Domestic Availability	3623	5319	6788	9634	13269	13371	12317	NA
Availability (1000 cases)	403	591	754	1070	1474	1486	1369	

TABLE IIIII
Indian Imports from Major Suppliers (1,000 liters)

Sr. No.	State	2006	2007	2008	2009	2010	2011
1	France	785	971	1023	566	612	1318
2	Australia	288	821	568	226	362	422
3	Italy	228	283	305	245	361	399

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4	Singapore	6	26	65	130	186	322
5	United Kingdom	109	141	130	97	149	254
6	United States	100	102	129	125	103	245
7	United Arab Emirates	23	20	22	38	24	237
8	Germany	61	36	42	16	54	198
9	South Africa	27	344	605	48	78	147
10	Chile	42	95	97	97	147	14
11	Spain	20	36	88	45	48	69
12	New-Zealand	7	39	36	44	37	53
13	Argentina	44	47	28	25	17	18
14	others	95	106	168	92	372	611
	Total	1836	3067	3307	1795	2551	4439

E. Wine Consumption in India

The main problems in the development of the wine market are the price of wine which is comparatively very high than other alcoholic beverages and India people are price sensitive they don't prefer consuming wine. Wine is one of the highest-taxed products in India as it is considered a luxury, not a necessity. The use of wine is discouraged by the Indian Constitution. In India, the tourist's wine consumption level is considerably higher than the country's wine consumption. The Indian wine industry has been steadily growing over the last ten years. Wine is slowly becoming a part of the urban lifestyle of India. Wine consumption is mostly seen in metro cities such as Delhi (23%), Mumbai (39%), Bangalore (9%) and Goa (9%). India ranks 77th in terms of world wine consumption. Following factors have contributed to India's low wine consumption:

1) *Storage And Transport Problem:* Followed with government rule distribution system wine transported from wine production area to distinct market wines 'shelf life reduces' due to this consumer does not always get the wine in the best condition.
2) *Lack Of Promotional Activities:* In India television promotion for alcoholic beverages is prohibited in public. Many companies participate in substitute advertising by which companies an advertisement that only mentions the name of the company.
3) *Lack Of Wine Tourism:* In India Lack of wine tourism due to low awareness about wine tourism to local producers to earn some revenue. It allows the tourist to know the basics of winemaking and to market wine products directly to tourists at a resalable rate.

TABLE IV
Exports to India from Major Suppliers (1,000 liters)

Sr. No	State	2006	2007	2008	2009	2010	2011
1	France	881	1125	906	879	587	640
2	Italy	255	336	277	191	348	391
3	Chile	104	176	180	143	187	242
4	Singapore	37	26	75	160	215	221
5	United States	135	250	207	135	246	207
6	Spain	62	105	109	95	137	156
7	South Africa	48	516	0	54	152	124
8	United Kingdom	52	45	70	37	44	56
9	Argentina	90	55	41	40	39	50
10	New-Zealand	9	25	20	24	36	48
11	Germany	98	118	77	38	78	44
12	Portugal	62	69	60	28	40	40
13	Others	96	5	20	21	14	18
	Total	2559	4186	3096	2295	2844	2848

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IV. WINE INDUSTRY CHALLENGES

The wine industry faces a major problem with farm size and high cost of farmland to cultivate grape in a large area for large quantity production of grapes. New vineyard requires high investment for grapes cultivation, for constant and successful grapes cultivation technical information also needed. India farmer is not too much aware of technical resources and information. The wine industry has a high range of packaging costs like glass bottles, labels, foils, etc.

1) *Distribution Policies:* Wine importers also experience the problem of obtaining licensing clearances for distribution and sales of wine. Each state having its own licensing procedure.
2) *State, Excise, Sales Taxes, and Other Fees:* State governments apply a range of state taxes such as licensing fees, excise tariffs and vend fees on imported wine marketed from other states. Although excused from central import duties, hotels and restaurants must pay the state excise taxes and other fees and taxes. Excise taxes and fees are different from state to state.
3) *Marketing Regulations:* In India, every state has its own excise policy on the marketing of wine that includes warehousing, distribution, retailing, and labeling and disclosure requirements. [5]
4) *Transport Permit:* The state excise department issues the transport permit after receiving the payment of the state Excise duty, vend fee, and other taxes. Upon presentation of the transport permit, the bonded. The warehouse will release the specified quantity of wine to the retailer/hotel and the licensed distributors will transfer the product to the retailer/hotel after paying the sales (value-added) tax. [5*]*
5) *Awareness:* India is not a wine-drinking country and most people have no sign about what quality wine is good for health. It is been recommended to the wine companies in India to start a joint effort to make the consumer aware of quality wines and how wines are supposed to be consumed. [4]

V. NEED FOR INCLUSION OF EXPERT SYSTEM IN WINE-MAKING

Expert system is being increasingly used in the wine-making industry to improve various aspects of the process. Some applications of expert systems in wine-making include:

1) *Grape Harvesting Optimization:* Expert systems algorithms can be used to predict the optimal time for harvesting grapes based on factors such as weather conditions and vineyard characteristics.
2) *Quality Control:* Expert systems can be used to analyze the chemical composition of wine and predict its quality, helping winemakers to optimize their production processes.
3) *Wine blending:* Expert systems algorithms can be used to predict the ideal blend of different wine varietals to produce a specific flavor profile.
4) *Marketing And Sales:* Machine learning can be used to analyze consumer preferences and buying habits, which can help winemakers to make informed decisions about their marketing and sales strategies.

Overall, expert systems has the potential to greatly enhance the efficiency and effectiveness of wine-making, helping winemakers to produce high-quality wines that are well-received by consumers.

VI. IMAPCT OF INCLUSION OF EXPERT SYSTEM IN WINE-MAKING

Expert systems can be applied in the analysis of old trends in Indian wine-making by:

1) Collecting and processing historical data on wine production, sales, and consumer preferences in India.
2) Training expert systems algorithms on the data to identify patterns and trends in the wine industry.
3) Using these algorithms to predict future trends and analyze how the industry has evolved over time.
4) Evaluating factors that have influenced the growth and decline of different types of wine in India, such as cultural preferences, government regulations, and economic conditions.

By using expert systems, it becomes possible to uncover insights and make informed predictions about the future of the Indian wine industry, helping winemakers and distributors make strategic decisions

VII. CONCLUSIONS

The consumption of wine is not encouraged in traditional Indian society, and there is also a lack of information regarding the significance of drinking wine. The process of making wine at home is extremely labor-intensive. Additionally, some winemaking processes fail owing to improper temperature, crushing procedures, fining methods, and bottling styles.

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The quantity of grapes and the amount of wine that is imported and exported around the world is expected to expand as a result of a new trend that sees sophisticated technologies being implemented in vineyards and the winemaking process.

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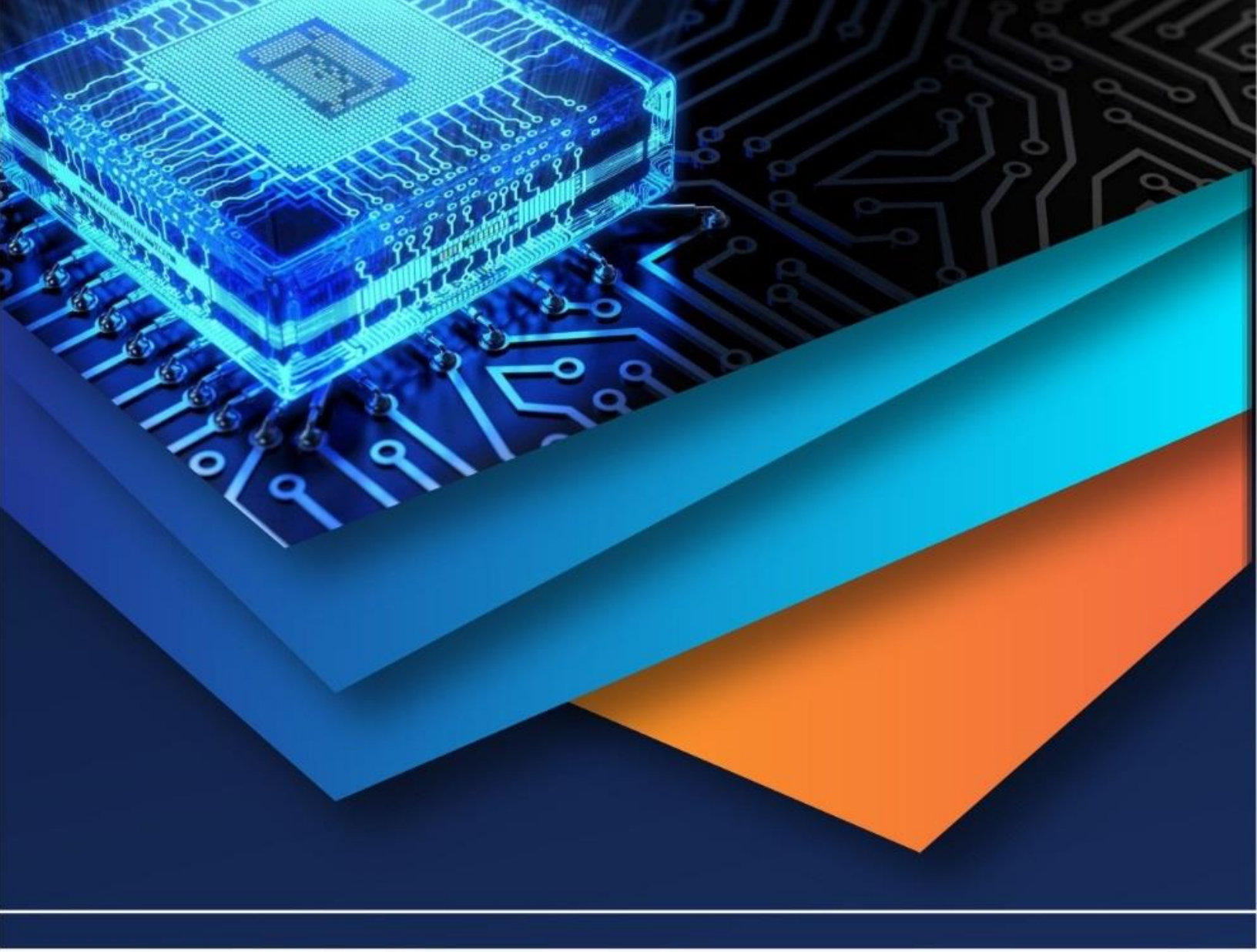

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