iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** IX **Month of publication:** September 2019

DOI: http://doi.org/10.22214/ijraset.2019.9124

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue IX, Sep 2019- Available at www.ijraset.com

Recommended Actions for Natural Upheaval using Rule-Based Engine

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Abstract: In this paper, we have proposed a rule-based approach for generating relief action recommendations for an post-earthquake disaster to provide them humanitarian assistance.it is intended to assist local administration to provide quick and efficient relief asset to affected area people which reduces the loss of lives by the more reliable way. It comprises of three-layer-structure. First an input and data pre-processing layer, a single level computation layer and a resource dissemination layer. The second layer relies on a disaster ontology that depicts the knowledge base of the system. The rule-based reasoning approach consists of knowledge-based and rule base, written in Jena rules to apply inference logic for the recommended actions to be taken.
Keywords: Rule-based reasoning, knowledge-base, Recommended actions, Ontology, Jena rules.

I. INTRODUCTION

Over the years on earth natural disaster is a big challenge for the human to devastating its impact and destruction. As obvious natural disaster situation causes greater damage to lives, property, and nature which take a long time to rebuilt and accelerate human being and put back to their track. As concerned many researchers and institutes try to figure out how to curtail the destructive impact of natural disasters efficiently and effectively. In decade's natural disaster swallow many lives and cost million-dollars the property. The possible prevention is, of course, the best way to tackle these loses by an expert direction, and perhaps, this doesn't specify the quote "Precaution is better than cure". We need a powerful respond plan to tackle collide of the natural disaster. It is our primary concerned to keep low the statistics of human live losses and minimizing the infrastructure damage. One promising aspect of research for these factors is to build a more efficient and reliable recommendation system based on rule-based reasoning it allows much faster and often reliable actions of humanitarian assistance and also makes complex computational reasoning. Rule-Based reasoning widely used in medical applications, such as diagnosis analysis, stock market predictions and recommendation systems of an individual tech firm. The performance of these systems greatly boosts the resources management. We have developed such a system which comprises of more algorithms, structure, etc. which evolving fast-paced as well. The unforgettable part of these improving technologies is the semantic technology which is an extension of the current World Wide Web. Semantic web technology enriches the efficiency of reasoning in the expert system. The ability to structure knowledge in ontologies, in a hierarchical way and make it interpretable for the computer to perform logic reasoning on the data gives them the power to infer new knowledge that can be added to the knowledge base with semantic rules. It can give recommendation based on these rules.

Our proposed system uses this technology. The rule-based reasoning is a major part of it. Recommendation system builds with ontology with rule-based reasoning of Jena rules to infer recommended actions for a post-earthquake disaster. In this paper, we have introduced a rule-based reasoning recommendation system for a post-earthquake disaster. In the future, we develop a hybrid recommendation system based on a hybrid of two approaches one of them we have already discussed and another will be a machine learning approach.

II. RELATED WORK

Over the past few years, the recommendation system had a history of utilizing its power in many fields of computing and reasoning. In the medical field, diagnosis resource management, stock market prediction where recommendation system plays a key role. In all this areas recommendation system have had tremendous performance and proved that we can develop such a system by increasing computing power to sift through data and inference logic to get an optimal solution near the boundaries of exact recommended actions. Also, it is concluded by further ongoing research that we can make out a way to reduce time consumption required to make the right actions at the right time.

In the medical field expert recommendation system for diagnosis resource management provides ability to the administration to reason over a domain with the combination of rule-based reasoning and knowledge base [3]. After analysing we have found new possibilities to have come up with the best results in the area of recommendation system. A knowledge base of patient reports has developed for analysis and some inference rule applied to it. A new case with new data is feed into the system and after observing every aspect of data and report the optimal solution is concluded, however, the new case has arrived after gone through it, again and again this case stored in the knowledge base with vast possibilities of improved and substantial data. [5]. in stock market prediction application of semantic web is a crucial part of it. Decision-makers need to predict stock market information from raw data and convert it into valuable asset for the users. Semantic technologies are using over the years more and more to support the recommendation system. Semantic web's comprehensive information was in the survey [1]. A field that comprises a large number of emergency actions as it often requires recommendation under huge bother in a limited time. In today's world there do exist various approaches and proposals from different angles. Even there are approaches where recommendation response is gathered by USGS (United States geological survey) where management of resources is the primary concern. These kinds of approaches lead us to the management of resources with dynamic time allocation of resources in case of any emergency. In 2009, a resource management system came into the picture for handling emergencies, it generates recommendation actions for many people by analysing actions to various users, and in fact, we are also allowed to communicate with peoples who were unable to reach usual communication ways. Ontology has played a giant role to retrieve and make relation amongst entities for communicating and providing access for various users [6]. Many efforts have been applied to develop an ontology-based training system for an earthquake like SERVO Grid project which was based on a case-based reasoning system for working on earthquake disaster.

Some of the decision-based system comprises of two different approaches to gain the result of recommended actions in the meanwhile first it relies on case-based-reasoning which provides the recommended actions based on pre-historic earthquake response data by matching the similarity of its features from the current earthquake input features. Stored old earthquake response data have compared and based on similarity measure it retrieves the response data of most identical case [2]. This leads admin to calculate and predicts the optimal solution for the ongoing earthquake situation with a more reliable way.

Amongst many countries, India is lagging to develop efficient earthquake recommendation system for its sake of humanity. Since the increasing frequency of earthquakes is becoming a big problem for India. It is realized that current working precautions and technologies are not capable to handle earthquake disaster in an improvised way. However, there is a necessity of developing a rule-based engine for recommendation system for the earthquake with the combination of knowledge base and rules-based reasoning. That helps to minimizing the impact of the earthquake and its cause of casualties.

III.PROPOSED SYSTEM

We have purposed a system with the objective to increase performance of recommended responses in a constant timeframe and accurately. To make efficient and reliable actions we have applied inference logic to fulfil the requirements of earthquake disaster affected people. This proposed system is mainly focused on the rule-based approach where we have developed a prototype to show its impact and performance on earthquake past historic cases. So our main objective is to provide assistance the administrative at another level of intelligence and accuracy with the management of available resources. Our system provides recommended actions for humanitarian assistance with the statics of expert. Additionally, we have also created some rules to dictate expert-level resource estimation which is required at the site of the disaster. This entire approach insures that the system has the ability to provide optimal results for various knowledge level and dissimilar phases.

In our grown system consist of three-level architecture. The first layer is the user interface level and data input layer, which proceed the input data feature f1…f5 (country, state, city, magnitude, date) which were taken from the local admin at the time of earthquake occurred. The second layer then processes the data from the first layer and applies expert generated rules that are the most important part of the system. The first layer of input data of earthquake from the past has taken and feed into our system as this data become input for second layer.

We have developed our system for three countries India, Nepal, Japan whereas our main focus is on India this countries mostly faces crisis of earthquake disaster. In India we have included all states and major cities where earthquake most likely hits. For example in India state Jammu & Kashmir, city Kashmir, state Gujarat city bhuj, Vadodara, godhra, etc. we take input as magnitude which is the most important feature of our system. The Rscale ranges from 1 to 10. Also date is feed into system which is crucial part of system because time to time infrastructure and population increasing with the rate of water flow. For this rules have been defined in system by the direction of expert like time capsule. All this input data sent to the inference engine where logical rules have applied. In case whose magnitude, location and date has estimated according to the inference engine. After that finest solution of resource management displays on terminal.

We have shown illustration of Kashmir case in fig.1.

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Fig. 1 First layer of input of recommendation system

Then at the second layer rules have comes into the picture and inference engine starts working by taking first layer data. The inference engine at second layer tracks the recommendations for system admin by applying certain Jena rule to establish relationship amongst current situation of earthquake to the rule-based result at this point the combined result evaluated with the help of protégé tool [4] which retrieves the appropriate humanitarian assistance and relief equipment statics data as a response to the current earthquake. The relevant data and information has processed to find the resources for the current case. At the final level by the outcome of second layer generated recommended actions serve to administration and manpower with the better direction of procedures of earthquake disaster prerequisites which helps to minimize the causalities and provide them relief equipment in meantime. The final outcome has shown in fig 2.

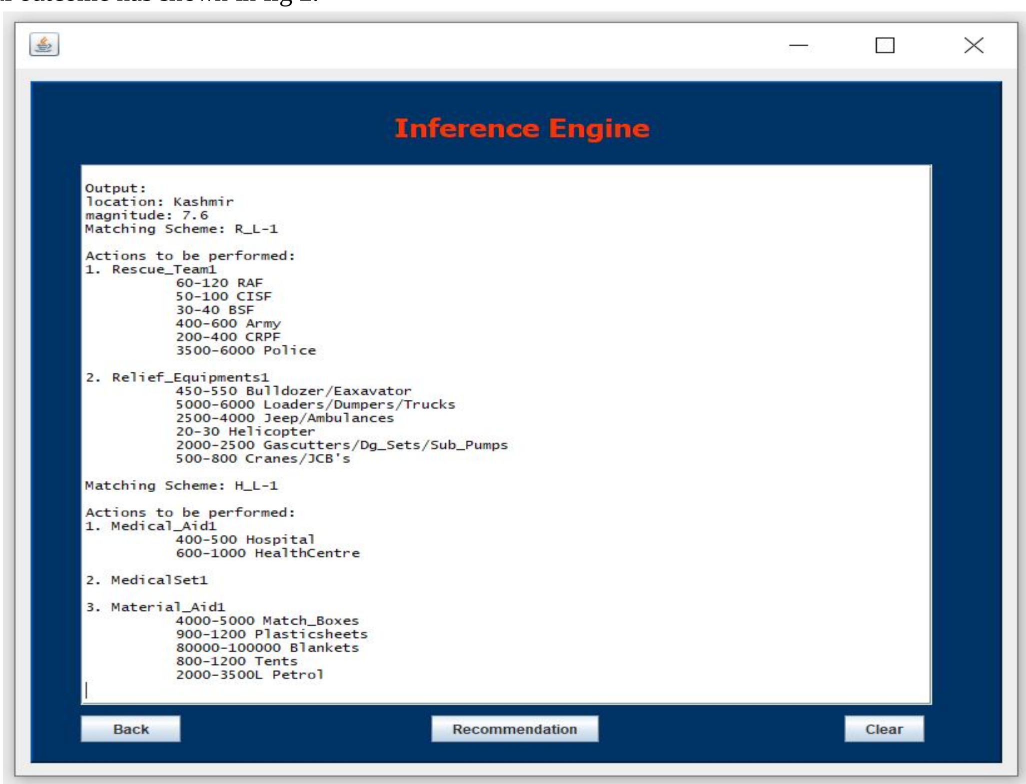

Fig. 2 Resources estimation for local admin

This resource plays an important role in the process of estimating appropriate actions at the disaster site in a sufficient time frame. At this point our objective of saving innocent lives and providing them our hand by realizing them that in their hard time we are with them has accomplished.

IV. RULE-BASED APPROACH

The motive of the recommendation system is to create more replicate of knowledge, meanwhile brushing the skills of human expertise in an individual area, and then to utilize this outcome to resolve most likely obstructions without the intervention of any human expert. Our research depicted that in the context of expert system there are numbers of rule and inference engines and after gone through it, with the great possibilities emerged us for a deeper analysis and the end of our research, we have found Jess Rule Engine, the Jena Rule Engine, the BaseVisor Rule Engine or a reasoned like pellet in combination with SWRL rules and on the road of efficiency, performance and compatibility we have used a rule engine because it fulfils our requirements from top to bottom also we need a rule engine where the antecedents meets the infer recommended actions which are well explained in consequence. The antecedents should be either identified by facts of our KB (Knowledgebase) or have to be matched from the input data [8]. This type of variety of reasoning is known as forwarding reasoning and Jess works on backward reasoning while Jena Rules and Pellet forward is forward reasoning with all mentioned rule and inference engine. Most of the rules engine depends on rete-algorithm and the pellet reasoned carried out by tableaux method. The rete-algorithm developed for a rule inference and therefore that is why it acquired top position in table’s method. Additionally, the outcome of the SWRL rules used with the pellet reasoned and toughened confidently with the statements which depicted that this is extended to the ontology and follow to the knowledge base perhaps this could be not possible practically as the outcomes could have had to have vanished after usage of the system. So they will remain unaffected for future usages of the system but Jess Rule engine does not support OWL in our ontology. If we want to use the Jess Rule engine first we have to convert ontology into jess format which is unpractical for our ontology because our ontology needs continuously update and contradict to it, our ontology has to be updated again and again. Other engines support OWL but Jena rule does not support OWL2 fully. The partial constructs are not good for our system. Jena rules of Jena framework is a subset of it and that is why it is highly recommended and of course excellent for java. This is as same as we follow the developed and updated with the Jena Rule engine which seems to be more satisfying to the system as a whole. Also, it is compatible with our system as a Java Application using the Jena Framework. So we agreed to use the Jena rule engine for the rule-based inference.

The motive behind using Jena rule in our system is that it has its rule language and has a precise syntax and common conventions for antecedents and consequence. These shows as a list of elements which can be a triple pattern, a rule itself if elements in the antecedents are identified the element, in consequence, get asserted to a deductions model where they read out easily. Variables in an element use symbol of a question mark and namespace within the semantic web applications.

(1) [SampleRule: (?element ex:hasProp ex:SampleProperty),
(?element ex:hasName “Sample”)
-> (?element ex:hasProp ex:SecondProperty)]

In the above rule, we named it as "SampleRule" with two triple patterns. The first one verifies existential of an individual with a property "SampleProperty" in the domain. If it exists then it is assigned to the variable "?element". Both the "hasProperty" and the "SampleProperty" are part of the example namespace “ex:”. The second element of the body checks if this individual that has been assigned to the variable “?element” also has a name “Sample”. If both those triple patterns are matched the head. In this case, the individual gets the property “SampleProperty”

There is a high possibility that rules might be more complex it can be a hurdle to encode expert knowledge efficiently. From this rules we infer the rules and the stored estimated data has relationship amongst entities in ontology which later used to depict the resources as shown in fig 3 [6].

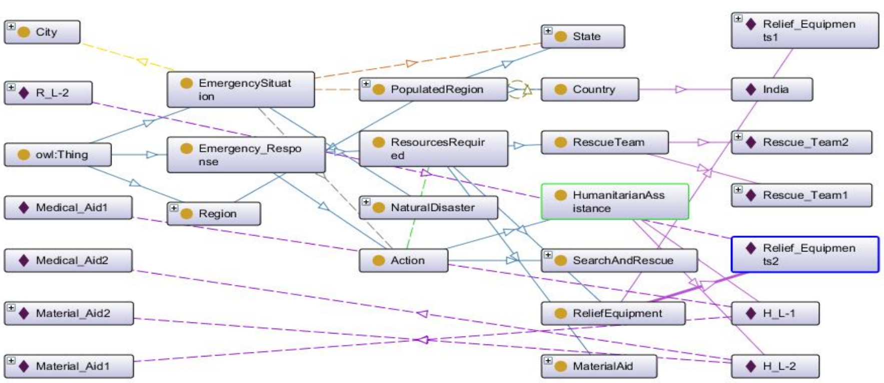

Fig. 3 Graph representation of the ontology entity relation model

V. CASE STUDY

To illustrate our developed prototype of a rule-based approach we have run a case of earthquake occurred in Kashmir in 2005. We have implemented our approach of the rule-based engine to estimate the recommended actions for Kashmir. Also, it is mentioned that we have just developed a prototype as a demonstration and well working of our approach. This case study illustrates that by using inference reasoning how we can assist admin to estimate the resources and activities that have to be taken at the time of earthquake occurred. The motive behind this implementation is to contribute to an improved post-earthquake response to the affected people. The Kashmir earthquakes centre of activity close to the city of Kashmir, in the state of Jammu & Kashmir of India. It hits on the 8th October 2005 and districts everything that came into his path including innocent lives, infrastructure all had collapsed. According to the source of Wikipedia, it is estimated that 86,000–87,351 were death and 69,000–75,266 were injured. The response of this disaster was unanalysed and had no statistics of data to deploy resources and relief aids to the locals. They were facing a different kind of challenges and obstacles which was still unsolvable for such casualties. What if local admin and authorities should have some estimated data of response to this tragedy maybe we could save more lives and stops death trolls. The most important action should be taken after an earthquake is a quick assessment of the situation to avail decision-makers to take decisions. Actions can range from the deployment of small to big assessment.

In the case of the Kashmir earthquake, our system generated recommended actions for humanitarian assistance in two categories, one Relief equipment and medical aid. First one comprises of Cranes/JCB's, Gascutters/Dig-Sets/Sub_pumps, helicopter, jeep/ambulances, loaders/dumpers/trucks, bulldozers and estimated data of rescue team. Another one consists material aid (petrol, tents, blankets, plastic sheets, matchboxes) and a medical set (healthcare, hospitals).

Our developed prototype of system has calculated and recommends following data 60-120 RAF, 50-100 CISF, 30-40 BSF, 400-600 army soldiers, 200-400 CRPF, and 3500-6000 police. Relief equipment 450-500 bulldozer, 5000-6000 loaders, 2500-4000 jeep, 20-30 helicopter, 2000-2500 gas cutter/DG_sets/Sub pumps, 500-800 cranes/JCB's. in medical aid includes 400-500 hospital, 600-1000 health centres, 4000-5000 matchboxes, 900-1200 plastic sheets, 8000-10000 blankets, 800-1200 tents, 2000-3500L petrol. As it is concluded that it is a prototype to demonstrate how the system will work using a rule-based approach so data is the approximation from previous cases and research.

Some more complex rules by expert knowledge are still required to reach the optimal solution. The objective of the system is to assist local admin to estimate the recommended action as the response of earthquake disaster.

All these different recommended actions provided to the local admin with an optimal solution that indicates this system has incredible future possibilities to be a part of earthquake disaster response with an appropriate and comprehensive manner. It is also highlighted that the system is just another tool for the emergency managers to depend on and not solely executing the emergency response. Especially since it requires a well build rule base and a thoroughly populated knowledge base. But if they are provided the system gives adequate recommendations for the Kashmir Earthquake, 2005 which shows that a recommendation system can be of use during the handling of earthquake responses.

VI. CONCLUSIONS

The proper resource management as a response to an earthquake requires a highly qualified expert to make sure certain efficiency. This way will take years to come up with an efficient solution perhaps technology is growing with tremendous rate, especially recommendations system.

Many of giant tech players spent their lot of time and money to enhance recommendation what is the need of user and trying to speed up with the process of increasing performance and efficiency of their system. An actual field study where the system gets tested under real conditions and in real-time remains to be carried out when the system is fully completed.

Also, there are many aspects in which the system can be refined and improved. Of course, it remains to be extended to deal with all kind of disasters. Also, the rule base and the database have to be fully populated to ensure the optimal performance of the system. In the future our next objective will be developing hybrid recommendation system which consists of rich set of database and machine learning so that our system will perform more efficiently and accurately.

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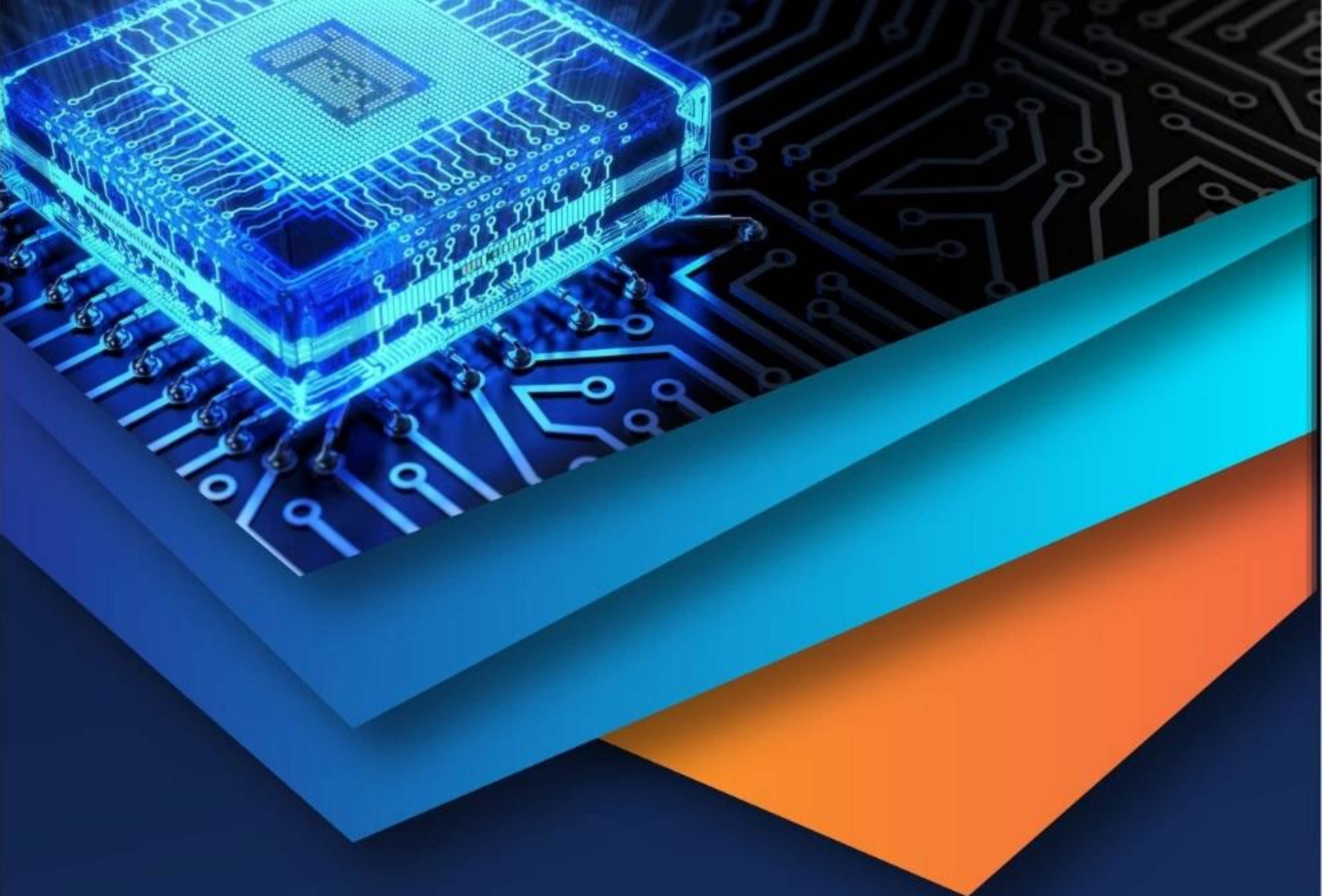

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