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Design and Development of Wheelchair Cum Stretcher Mechanism

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Abstract: ***At present in world, the number of handicapped individuals is increasing each year. Their mobility has become a serious problem and it poses a great challenge before the engineering and scientific community. It demands conceptualizing and developing effective solutions in the form of mobility aids. Various mobility aids play a crucial role to empower their disabilities and bringing them back to normalcy. These tools help them in transportation and also act as a viable substitute for physical walking in indoor and outdoor environments. Out of all the equipment, the most common are stretcher and wheelchair. Wheelchair finds its usage in hospitals, railway stations, airports, shopping malls, and even in household activities. Primarily it is used in hospitals along with stretchers. Owing to its large-scale application in commercial and domestic purposes, it needs a modification in terms of flexibility and interconversion ability so that the problems which are arising in individual devices can be eliminated and particularly it will be more beneficial in medical industries. This paper presents an idea about developing such a mechanism so that we can integrate the advantages of both wheelchair and stretcher. It should be ergonomically designed and all the safety standards should be met. This paper also reviews the various areas of development made in the past about mobility aids for the comfort of both patients and hospital staff.***

Keywords: Mobility aids, Stretcher, Wheelchair, viable, ergonomically.

I. INTRODUCTION

A. Wheel Chair

It is a device having a chair with large wheels that a person who cannot walk can move through this due to his/her illness, injury or disability. It comes in different forms that allowing manual propulsion by the seated user turning the wheel of chair by hand i.e., manually or electric propulsion by motor. So, therefore this device is useful for the people who have facing problems in sitting and walking can make use of this device i.e., wheelchair. The wheelchair is consists of several parts which are described below: - Head Rest: It is used for posture and head alignment. It also adds comfort to patients. Hand Grip: It is used to push a wheelchair for attendant propelled wheelchair. Armrest: It can be fixed, detachable, or swing away. The detachable or swing away types allow greater ease in sliding board or sideways transfer. Backrest: It facilitates good posture and a removable backrest facilitates Back transfer. High backrest prevents the patient to hook his elbow and low backrest allows patients to lean over it. Seat: Seat is made up of fabric, resin, or solid materials. Caster: It is defined as two front wheel of the wheelchair which can turn in every directions and it also stabilize the wheelchair. Hand rim: It is defined as the part of wheel of a wheelchair where the user comes into direct contact with to move the chair. Calf pads: It is defined as the part of wheelchair which is attached to leg rest to keep the foot from striking with the front wheel. Footplates: It is defined as the part of wheelchair which is fixed and used to keep the foot while moving the wheelchair. The figure 1. Shows the different parts of wheelchair.



Figure 1. Different parts of Wheelchair

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A wheelchair is classified as follows:

Manual Wheelchair: It is defined as the wheelchair which can be move manually by the user by turning the rear wheel of chair by hand and also by grabbing the handle of the wheelchair by the other person who can push the chair to move the user who is seated in the wheelchair. The figure 2 shows the manual wheelchair.



Figure 2: Manual Wheelchair

Powered Wheelchair: It is defined as the wheelchair which can be move electrically propelled by a battery or motor operated. By the powered wheelchair the user can control the chair by sitting on it and can move forward or backward by the controls which are fitted in the wheelchair. The figure 3 shows the powered wheelchair.



Figure 3: Powered Wheelchair

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Paediatric Wheelchair: It is defined as the wheelchair which is specially developed for the benefit of children. This section consists of different kinds of chairs that can be operated manually and electrically. Some functional paediatric wheelchairs are planned and developed to accommodate exact mobility disorders to help children have independence with assistive technology. The figure 4 shows the Paediatric Wheelchair.

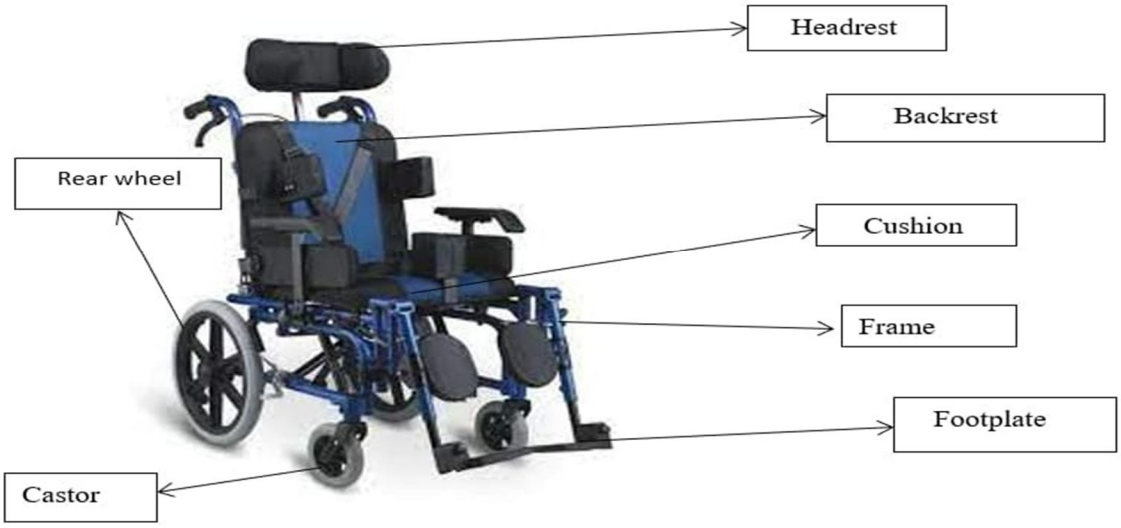


Figure 4: Paediatric Wheelchair

Positioning Wheelchair: It is defined as the wheelchair which offers the patient the capability to move in different areas on their wheelchair. These are operated electrically for mobility's as well as positioning. The figure 5 shows the positioning wheelchair.



Figure 5: Positioning Wheelchair

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B. Stret Cher

It is defined as a moving bed which is attached with wheels to transfer the patients who can't walk or stand with the help of others assistance. In case of accidents or emergencies and the people who are in critical stages can be transferred by the stretcher for one place to another place. It is simply designed with the metal bed supported by a metal frame with swivel caster wheels and at the top of metal bed where the patient is laying to transport to hospitals. Stretchers have been used since ancient times on battlefields and in emergencies to transfer the patients. Stretchers are classified as follows:

Portable stretcher: It is defined as the stretcher which is lighter than a simple wheel stretcher and it makes easier to moving a patient downstairs or out of tight spaces. The figure 6 shows the portable stretcher.

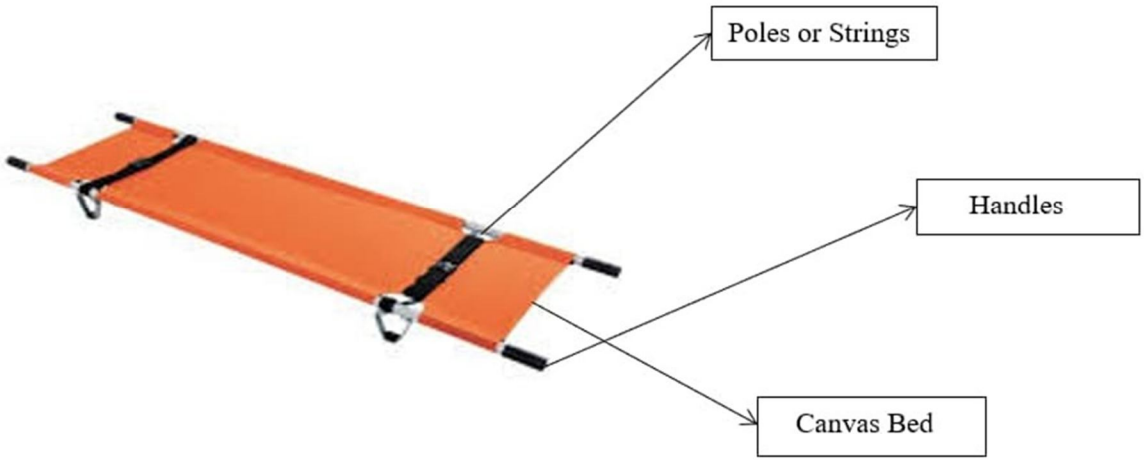


Figure 6: Portable stretcher

Basket stretcher: This type of stretcher used for cliff rescue operations to move the patients to hospitals easily. It is also known as stroke basket. The figure 7 shows the basket stretcher.

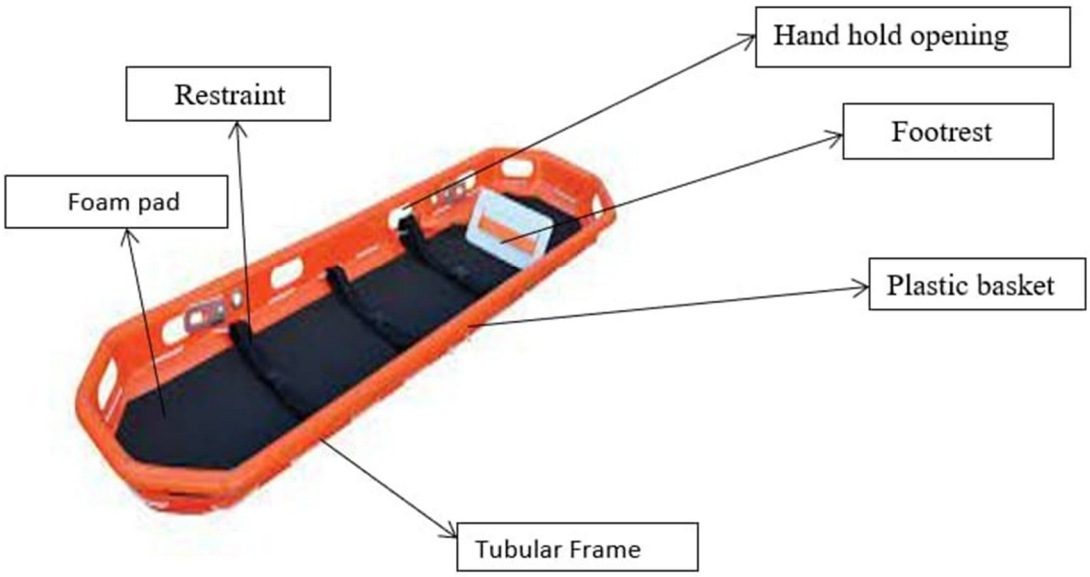


Figure 7: Basket Stretcher

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Scoop stretcher: It is defined as the stretcher which splits vertically into two pieces which can be used to scoop the patient up and helps in transferring to hospitals. The figure 8 shows the basket stretcher.

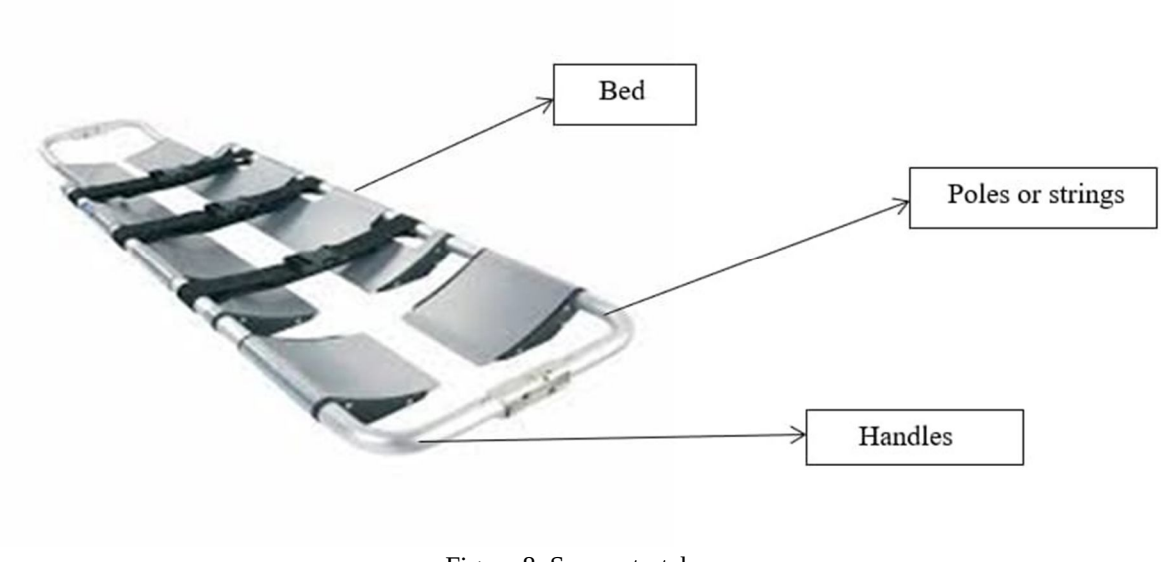


Figure 8: Scoop stretcher

Stair chair stretcher: This type of stretcher helps the rescuers to move the seated patients down stairways and through compact places where the normal stretcher not fit to lift the patients. The figure 4 shows the stair chair stretcher. The figure 9 shows the basket stretcher.



Figure 9: stair chair stretcher

II. LITERATURE REVIEW

A. WHEEL CHAIR

Around hundreds of years wheelchairs are there, but these were done only to support a handicapped individual to shift from one area to another area. As the community progressed and handicapped Individuals became more integrated and the role of the wheelchair began to change as well. Nowadays these are treated not only a means of transit but also a way to allow the patient to convey their individualism.

[1]Harry Jennings and Herbert Everest are two friends where, Herbert Everest is a disabled person and both where mechanical engineers and they invented their first wheelchair in 1933 which is made up of steel and it is light in weight and the chair can be collapsible. In a mining accident the back of Mr Everest was broke. They saw that the employment potentiality of their design is turn into early mass manufacturers of wheelchairs. Their "x-brace "design is still in simple in operation even if with modified materials and new advancements.

The first mechanized wheelchair was invented in the 1950s and a motor is used to power the wheelchair. In that same time where the wheelchair sports were first introduced. The first Paralympics games which was held in Tokyo, Japan in the year 1964. Now the modern day wheelchair is made up of light materials with microprocessor-controlled and many other arrangements were used. There is an innovation of wheelchairs are accessible present-day operate by requirements and inclinations of the user. In the forthcoming we expect an exceptional scope of wheelchairs that could suit the interest of the individual minds and deliver to the needful one.

B. Stret Cher

1) Meng-Hui Hsu, Hsueh-Yu Chen, Jen-Yu Liu, and Chien-Liang Chen (2009) in their paper "Dual-purpose wheelchair mechanism designs" stated that the wheelchair having double benefits i.e., sitting and reclining which is helpful to the patients. In addition the dual purpose wheelchair is designed as per the comfort of the patients. In the wheelchair where the rear wheels are movable and the whole mass centre of the wheelchair can move between the rear and front disk of the chair.

2) Sreerag C S, Gopinath C, Manas Ranjan Mishra (2011) in their paper "Design and development of conceptual wheelchair cum stretcher" has stated that mobility aids are useful for patients for transit and a substitution for walking mainly in surroundings. In their study they show that it is achievable to save maximum area i.e., 50% by the idea which has been developed. Therefore they conclude that the device which is developed is an efficient mobility aid in hospitals.

3) U. D. Gulhane, R. J. Dahake, O.M.Sharma (2005) In their paper titled "Wheel Chair cum Stretcher, an innovative product for small hospitals and patients", stated that the wheelchair which was being developed can easily be transformed into a stretcher and a operation table depending on the necessity in the hospital .They use the simple parallelogram mechanism for lifting and driven hydraulically. The hydraulic piston which is used in the wheelchair can operated both automatically and manually and the chair gets transformed into a stretcher while lifting. They also developed a five-legged support which maintains the stability required to the stretcher and the design which is being developed is more economical than automatic ones.

4) Hsin-yi Liu, Rory A. Cooper, Jonathan Pearlman, Rosemarie Cooper, Samuel Connor (2008) in their paper titled "Evaluation of titanium ultra-light manual wheelchairs using ANSI/RESNA standards" stated that the wheelchair which is being developed is having the important features i.e., light weight, Comfortable propulsion and support that helps to maintain the upper-limb integrity of hand operated wheelchair users and increases availability. The titanium wheelchair is developed in response to the above mentioned principles but none of the test results have been disclosed before this research. They consider that these wheelchairs would comply with the engineering standards i.e., ANSI so, they conduct an assessment with 12 ultra-light titanium wheelchair rigid frame on four prototype of same wheelchair frame using the above engineering standard testing method and they correlate the assessment results with the previously assessed result of ultra-light and lightweight aluminium wheelchairs.

5) Sandip S. Bag, Prem D. Lohe, Harshal K. Hajare, A. N. Madne and Ajinkya S. Hande (2007) in their paper titled "Design and Fabrication of Multiutility Wheelchair" stated that the advanced wheelchair cum stretcher which is being designed, fabricated, tested and developed in a low cost option as compared to the other wheelchairs present in the retail for lower extremity immobility inpatients and outpatients to recline down and rest at will. Hence the substantially challenged patients can shift and relax on the wheelchair by itself which was developed. Hence the cost of this wheelchair is very much less than the electrical operated wheelchair available in the market.

6) Kolgiri S. G., Bandgar Anil Bhagwan, Bhalerao Hrishikesh Rajendra, Bhosale Avinash Anil, and Doiphode Sunil Dinesh (2017) in their paper titled "Design and fabrication of Wheelchair convertible stretcher "stated that the concept which was used in design and manufacturing of wheelchair cum stretcher has many advantages.

7) And the motor-powered drive can shift the patient to the bed and back again to its real cast due to the 360 degrees movement of wheelchair seat. So the user can transfer from any side of the wheelchair. The head section, leg section and seat of the chair are stitched with cushions to ensure the comfort ride for the user. Therefore there study was to establish a concept of wheelchair that can be modifiable to a stretcher to save maximum area in the hospitals and prevents the pain of the patients by assuring that it doesn't get hurt to them.

8) Siddhartha M. Ahluwalia, Nivin Varghese T, Nayan S.Patil, Mayur R. Sarbhukan, Saheb Khan U.K. Pathan, Akshay S.Jaiswal, Iliyas Khan H.K. Pathan, Tosik Y. Khatik Student of B.E Mechanical at, Godavari Foundation's Godavari College Of Engineering ,Jalgaon, Maharashtra, India (2017) in their paper titled "Design and Fabrication of Sensors Assisted Solar Powered Wheelchair " stated that the Developing of a solar-powered wheelchair is useful for disabled people and this wheelchair is the combination of all wheelchair such as an automatic wheelchair, electric wheelchair, solar wheelchair, etc. and this is generally designed for the person who has difficulty in operating manual wheelchair due to arm, hand, shoulders disabilities. The important part is the sensors which sense obstacles either physically or in sound waves form such as sound, we have included an emergency buzzer alarm to call upon any help in an emergency.

9) Pothamsetty Kasi V Rao Assistant Professor, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India(2018) in their paper titled "Design of stair climbing wheelchair-using tri-wheel mechanism" stated that the wheelchair which was being developed by the help of tri-wheel mechanism. In the fabrication process of the wheelchair the quasi-planetary wheel frame is determined as a tri-wheel frame as it creates more frictional force and it provides an easy power transmission for climbing stairs.

10) Roshan D. Ugale, Sanket N. Virulkar, Prof. Atul T. Bathe in their paper "Design and Development of Human scale Wheelchair cum stretcher" stated that the design of wheelchair and stretcher showing sit tilting mechanism by means of linear actuator system which leads to optional source for physically challenged. Their aim is to provide a better solution for patient handling to those hospitals having limitations for use of fully automated bed or wheelchair cum stretcher.

11) Akshay Hirudkar, Chetan Bhusari, Akshay Khedkar, Akshay Parekar, Prof. S.P. Daf in their paper " Automatic Stretcher cum Wheelchair" stated that providing remote control for the ease of patients to move without being dependent on anyone or applying extra force for movement. Also it removes difficulties for shifting patients from stretcher to wheelchair.

12) S. Srinivas in their paper "Wheelchair cum Stretcher with Head Gesture Recognition System" stated that the wheelchair is fully capable of carrying the load up to 120Kg, and motion is provided in accordance with the head gesture given by the user who is using the wheelchair. The wheelchair can be improvised and developed in certain way to be used for people who are paralyzed whole body. Certain eyes gesture or brain signals reader can be imparted on the wheelchair system to make it better. For now, it works for all kinds of physically challenged people, and even for those patients whose whole body is paralyzed but still head movement is possible.

13) Manoj Kumar Ambalagi, Prasad Phadtare, Nikhil Athani in their paper "Design and Analysis of Automated Wheelchair cum Bed with Sanitizer Mechanism "stated that the CAD software was used to create and analyse the dual-purpose wheelchair .Based on the results of our survey, we believe that our wheelchair cum bed design is simple to use for elderly people as well as people with leg impairments and the motion of the wheelchair has also been automated. Finally, due to the on-going COVID-19 pandemic, we have installed an automatic sanitization function over the bed.

14) F. I. Ashiedu and M. O. Okwu in their paper "Ergonomic analysis of a developed wheelchair using creative algorithm " stated that the development of wheelchair was targeted to offer assistance to disabled and aged persons for easy routing about their various activities. The materials for the construction are local lightweight materials for the structural members of the supporting frame. The system is economical light efficient. The AHP model, an effective decision metrics technique for complex stochastic process was achieved by reducing complex decisions to a series of pair wise comparisons. The ergonomic rating of 62% showed that the developed wheelchair is quite comfortable for users. Thus, enabling them pursue their vocational and educational goals. In conclusion, creative algorithm like Fuzzy logic and ANFIS can be adopted in subsequent research.

15) Therefore the literature review specifies that the patient handling meth and equipment, where the wheelchair and stretcher currently can't prevent the physical handling of the patients from hospital bed to wheelchair/ stretcher.

III. CONCLUSION

The paper was purposed for making a review on design and fabrication of multiutility wheelchair that can prevail over the conventional wheelchair.

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By assuming different research processes which helped us to recognize the different points of the matter, priority of security along with hygiene, and understanding of materials and manufacturing process involved in the development of whole product. Therefore this project mainly focuses on cost-effectiveness and easy acceptance. The design of a wheelchair cum stretcher allows the easier transferring and handling of patients in hospitals without causing any damage to patient's bodies externally and internally. The mechanisms which are used in the design and fabrication of wheelchair are simple and can be easily controlled.

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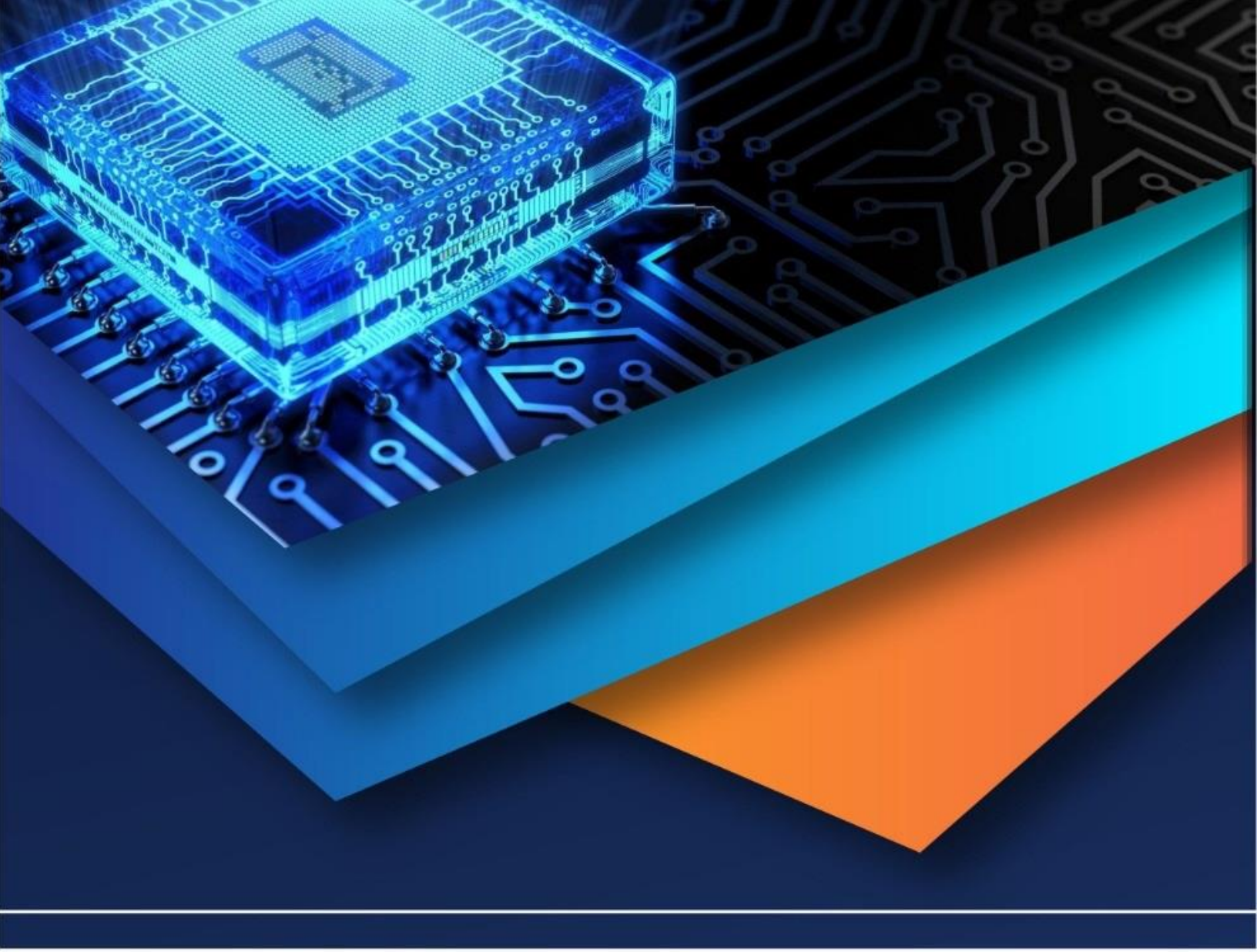
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