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Musculoskeletal Disorder and Ergonomics Evaluation of Cleaners

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Abstract: ***Cleaning work plays an important role in ordinary work and the public sphere as it improves the employee's / community's sense of health and well-being. The key to cleaning is to remove unwanted marks, dust from the useful area. An unclean environment can lead to physical and respiratory infections. The purpose of the cleaning can be described as a contribution to the maintenance of clean public spaces. Many cleaners are socially poor, have little education, and have little social support. The main aim of this paper is to find musculoskeletal disorder, injury, or pain among cleaners by using a computer-aided ergonomic assessment technique. Various musculoskeletal disorders in cleaning occupation are tendonitis, carpal tunnel syndrome, thoracic outlet syndrome, tingling in the finger, etc. Above mention, disorders occur due to repetitive movement of the body part, and awkward posture while performing cleaning activities.***
Keywords: work-related musculoskeletal disorder, cleaning, awkward posture, repetitive movement

I. INTRODUCTION

Cleaning work plays an important role in ordinary work and the public sphere as it improves the employee's / community's sense of health and well-being. Clean workplaces also promote productivity and product quality. Dirty areas can lead to accidents, and without cleaning there is a high risk of exposure to irritating substances that can lead to problems such as allergies and respiratory infections. The purpose of cleaning can be defined as contributing to the maintenance of sanitation and community facilities. Cleaning includes such things as dusting, scrubbing, sweeping, sweeping, scrubbing, and cleaning. Cleaning work can also include additional tasks such as handling garbage, lifting / moving furniture/equipment (Johansson et al., 1989). The main purpose of cleaning is to remove dust, marks, and unwanted items from useful areas. Cleaning work should be done without exposing cleaners to the possibility of injury or physical hazard (Sperling et al. 1993). While the corresponding rates for domestic workers in India are hard to come by, with the official and informal ratio of the exact number of domestic workers in India, the NSSO data is often more accurate (Battenvi et al, 1998). ILO (International Labor Organization) reports on domestic workers are very interesting legally protected internationally, official figures put the number employed in India as 4.75 million, (3 million of them women) but this is considered a serious understatement and the actual number is over a million workers 20 to 80. However, numbers alone do not explain the importance of their work or the difficulties they face. Many of these workers do not earn even a basic salary, they work long hours, and often do not get one day's rest.

A. Injuries and Physical Risk in Cleaning

Cleaning jobs can be physically demanding and should be done without putting workers at risk of accidental injury or work-related illness. Numerous studies have shown, however, that cleaners are at risk of developing musculoskeletal disorders (MSDs) of the back, neck, shoulders, elbows, hands, and lower limbs as a result of their work. MSDs are disorders of the body's structures such as muscles, joints, muscles, tendons, nerves, bones, and the local circulatory system, which are largely caused by work and the effects of the immediate environment in which the work is performed. Low back pain is a major work-related problem in almost every body-care activity. It can be described as chronic or severe pain in the lumbar or buttock area (sometimes called lumbago), or in the region of the upper leg (sometimes called sciatica). Low back pain can result from muscle or ligamentous pressure, degeneration of the joints or discs of the spine, or pressure on the nerve roots within the spine. Muscle stress is perhaps the most common cause of back pain. Lifting and carrying heavy loads is a major cause, but pushing and pulling or the need to adjust to a flexible or twisted posture is also dangerous. Other parts of the body and organs can be affected. Neck and upper limb disorders are caused by deformities of body structures such as tendon, nerve, muscle, joint, bursa, or local circulatory system, which are mainly due to the function of the work and the environmental effects when the work is done. They include many types of inflammation as well degenerative conditions such as shoulder injuries caused by prolonged working with hands overhead height or injury to the wrist caused by repeated work. Symptoms include pain and/or decreased ability to function normally. This can affect any region of the neck, shoulders, upper arms, elbows, arms, wrists, and hands. Some cleansing activities require prolonged standing, which can cause varicose veins in the legs.

Various studies on cleaning method describe that most higher risk factor is associated with lower back and lower limb(Buchholz et al,1996). There are lots of hard-working body postures during mopping, wiping, surface cleaning, polishing, etc. The cleaners faced so many problems/pain during all these activities like lower back pain, neck pain, upper limb and lower limb disorder more. While cleaning they have to do one step in a quite repetitive manner, which leads to wrist joint pain. (Burdorf et al,1991).

Lower back pain is defined as the accurate pain which occurs in a lumbar area called lumbago, and an upper area called Sciatica(Corletta et al, 1999). Neck and upper limb are defined as the disorder or pain in muscles, joints, or in the localized shoulder area. These above-mentioned injuries and pain occurred due to awkward postures, repetitive movement or insufficient rest period, and also working in unorganized space(Hagberg et al,1995).

Cleaners adopt different awkward postures while performing their jobs. Sometimes some postures are very harmful, even they continuously do their work for a long time. Various work postures which are performed by workers are physiological demanding and time-consuming. Although the women cleaner performing the job in forwarding bending and squatting postures, these postures can cause serious physical risk and injuries.

II. METHOD

For better support of the literature review and mentioned objective, a pilot study on simulation task of cleaning work was done on Technomatix Process Human Simulate software.

A. Subject

15 cleaning workers of age between 28 to 45 participated in the preliminary survey, their posture and movement were recorded by videos and pictures. These workers were divided into various subgroups according to their gender and age.

B. Data Collection

A Nordic questionnaire (Annexure-II) was used for collecting the data from the worker about pain, discomfort, and any injury during their work. From that data, various problems faced by cleaners during cleaning activities were observed.

C. Method Used

In this study, the awkward working posture of cleaners and their movement were observed and analyzed by using Ovako Working Posture Analysis (OWAS) Ergonomic Assessment Technique.

The computer-aided Ergonomics tool “Technomatix Process Human Simulate” version 16 has been used to analyze low back pressure and abnormal posture. At Technomatix, the visible representation of the human body can be created by feeding anthropometric data, such as weight and height.

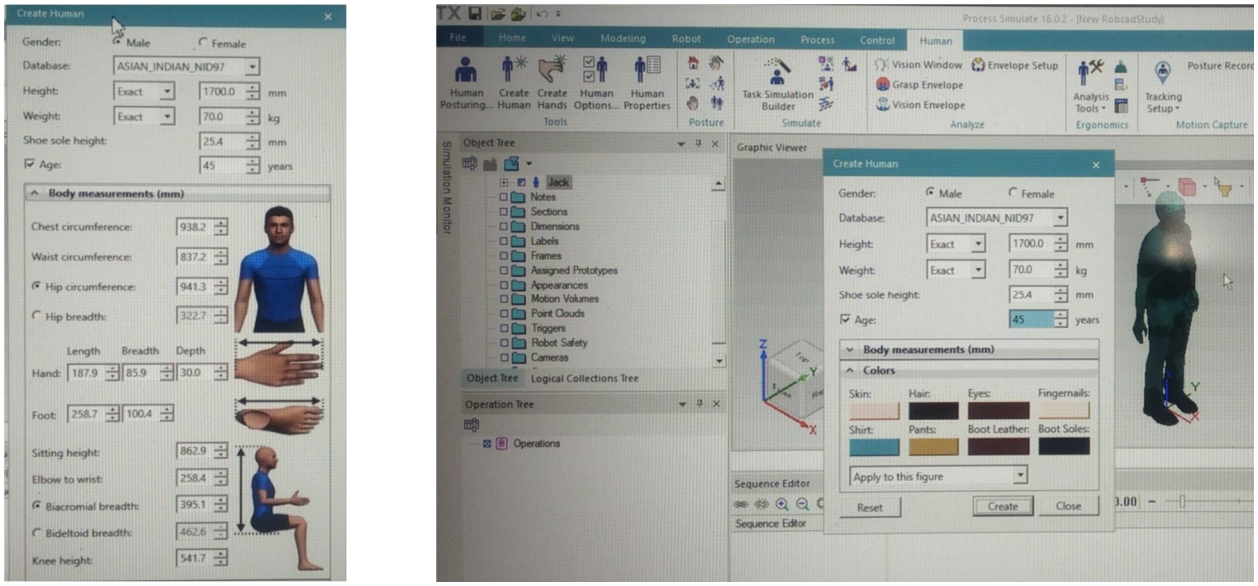

Figure 3: Virtual jack creation with ASIAN_INDIAN Anthropometric data

The low back compression analysis tool is part of the Technomatix software analysis tool kit. It helps to calculate the spinal force acting on a virtual human's lower back under posture and loading conditions. In a study, Technomatix process simulation software was used for assessing the performance of the jack (simulated cleaner). Figure 4 showed the postures of cleaners and their posture loading condition during cleaning which are used for OWAS analysis. Figure 5 showed the lower back analysis using the above posture loading condition and simulation task.

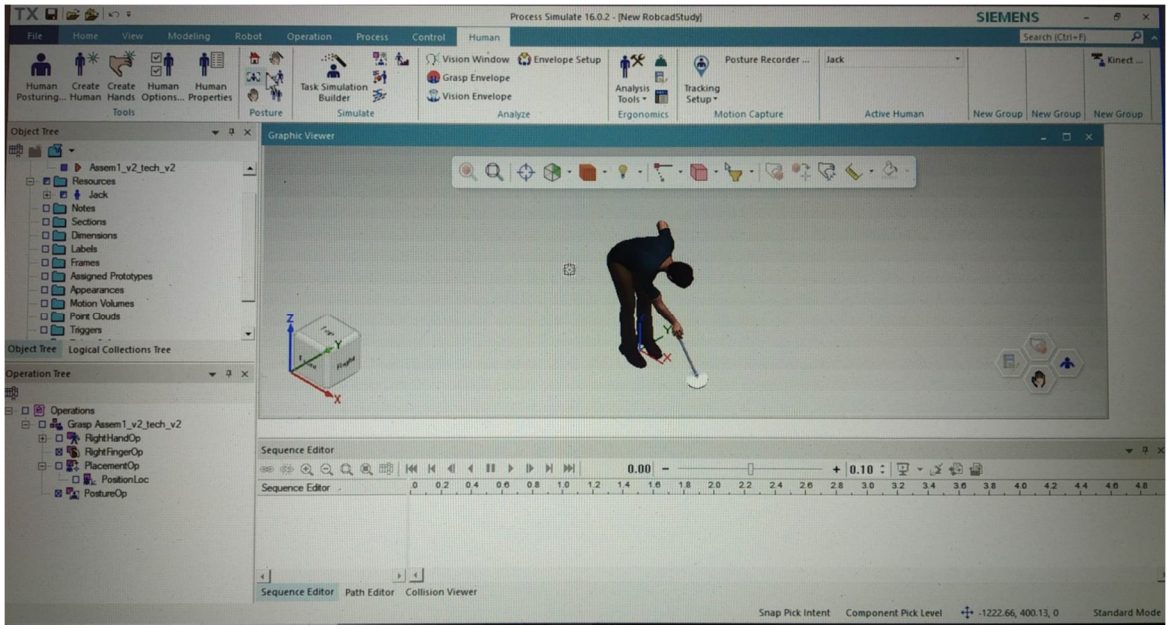

Figure 4: Posture Loading condition

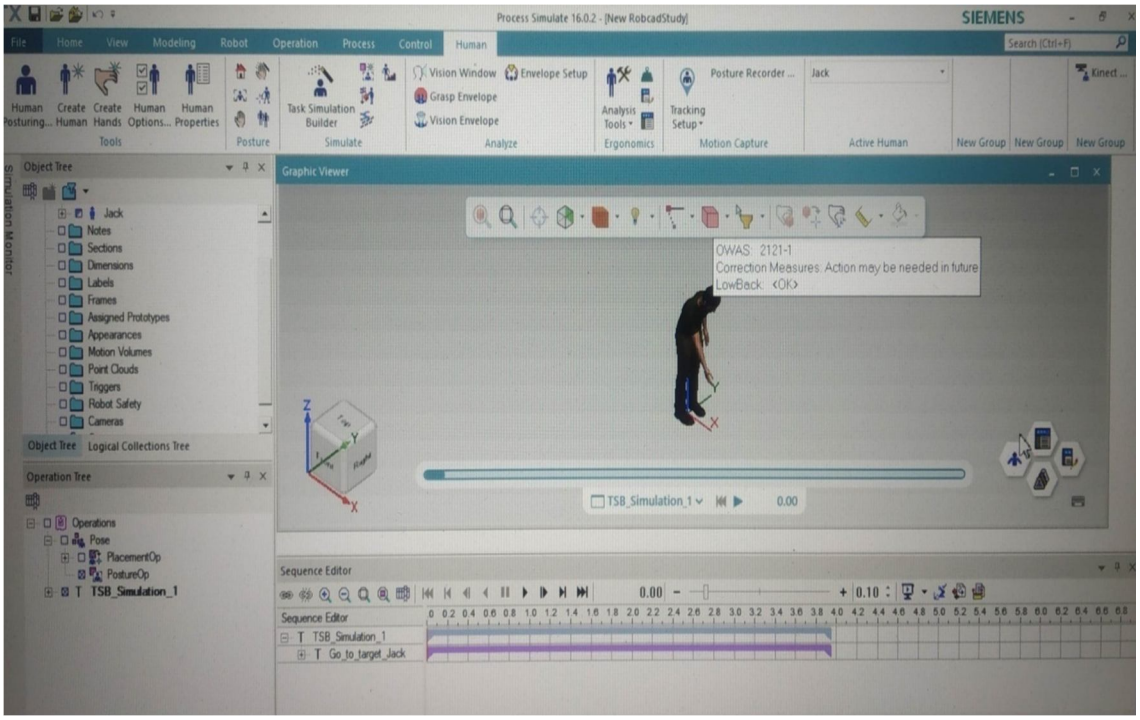

Figure 5: Lower back analysis (Lumbago) of virtual human

Several manual tasks involve significant body movement was found to be very helpful to evaluate specific exertion within a cleaning task and performing a biomechanical analysis. Such analysis is normally evaluated by combining the postural information (body angles) which are obtained from stopped videos, images, or still photos of a cleaner.

III. RESULT

Ovako working posture analysis (OWAS) was analyzed on this task simulation and was found to be a correction action level of 2(Action may be needed in near future). OWAS posture analysis report showed that higher left hip flexion and left ankle extension are the main reason for pain and injury, although wrist flex was of higher degree angle as shown in tables 1 and 2 during mopping the surface.

From the report, owas posture code appear as

2	1	7	1	1

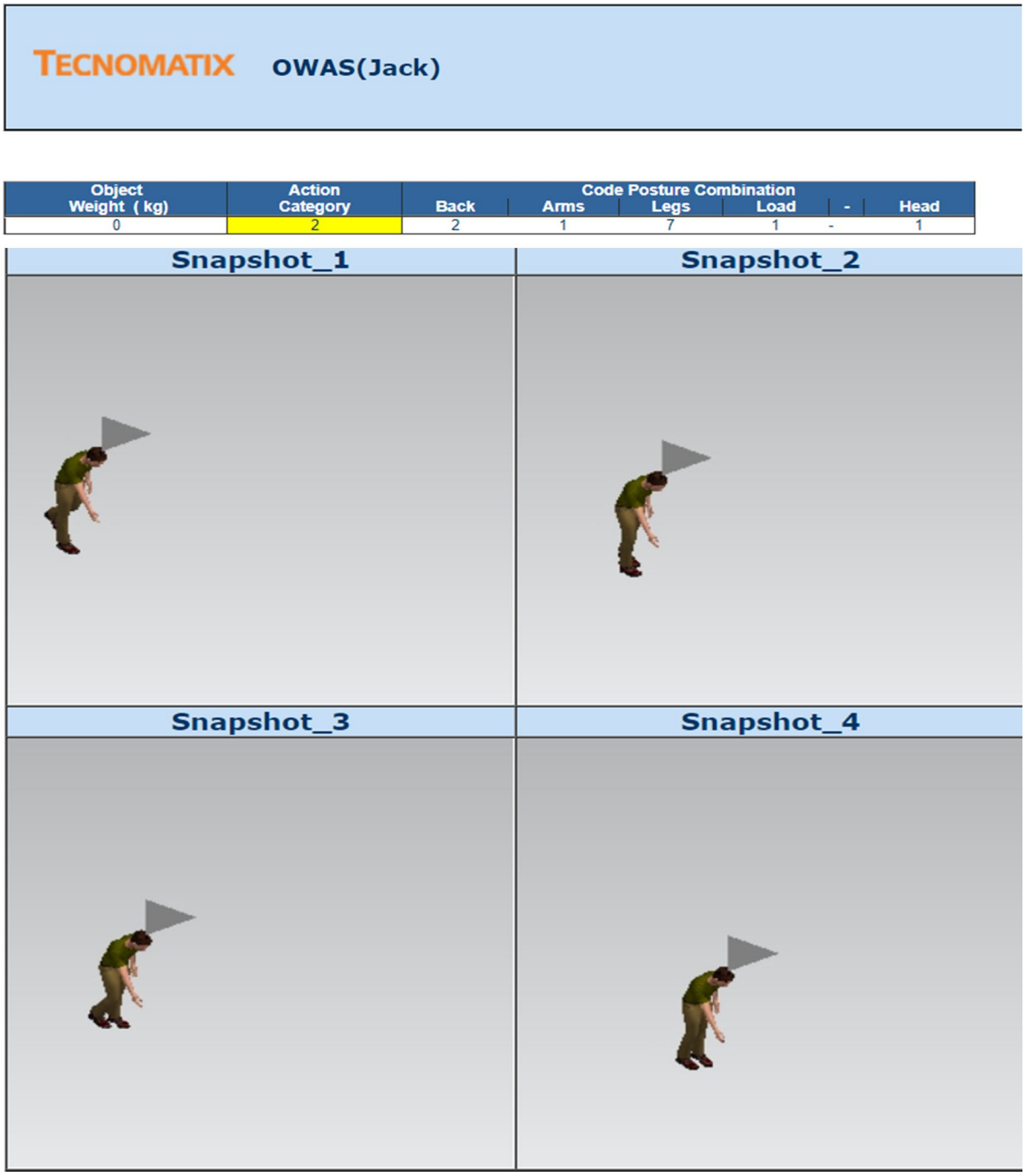

Figure 6: OWAS category and posture code of the simulation while mopping the surface.

Table 1. Wrist, shoulder, and trunk capability chart during simulation

Capability Summary Chart											
		Left					Right				
		Moment (Nm)	Muscle Effect	Mean (Nm)	SD (Nm)	Cap (%)	Moment (Nm)	Muscle Effect	Mean (Nm)	SD (Nm)	Cap (%)
Wrist	Flex/Ext	1.2	EXTEN	67.5	19.7	100	0	--	0	0	100
	Rad/Ulnar dev	0	--	0	0	100	0	--	0	0	100
	Sup/Pro	0	--	0	0	100	0	--	0	0	100
Elbow		-67	--	296	94	100	-1.4	FLEXN	60.3	14.8	100
Shoulder	Abduc/Adduc	-3.8	ABDUCT	80.1	19.7	100	-4.7	ABDUCT	86.4	21.3	100
	Rotation Bk/Fd	1.2	BACKWARD	69.5	20.3	100	0	--	0	0	100
	Humeral Rot	0	--	0	0	100	0	--	0	0	100
Trunk	Flex/Ext	-55.1	EXTEN	291.6	91.9	99.5					
	Lateral Bending	0	--	0	0	100					
	Rotation	0	--	0	0	100					
Hip		-30.1	EXTEN	198.4	79.6	98.3	-29.8	EXTEN	198.4	79.6	98.3
Knee		-24.6	FLEXN	140.8	41.5	99.7	-24.1	FLEXN	140.8	41.5	99.8
Ankle		-40.3	EXTEN	149.2	49.3	98.6	-39.9	EXTEN	149.2	49.3	98.7

Table 2. Wrist, shoulder, knee, ankle, and trunk joint chart during simulation

Joint Angle Summary (deg)				
Calculated Limb Angles			Calculated Trunk Angles	
	Left	Right		
Wrist Flex/Ext	121	97	Trunk Flexion	63
Wrist Rad/Ulnar	34	78	Trunk Lateral Bend	65
Forearm	98	65	Trunk Rotation	0
Elbow included	126	175		
Shoulder Vertical	15	62		
Shoulder Horizontal	-50	85		
Humeral Rotation	-39	-10		
Hip Included	146	146		
Knee Included	170	170		
Ankle Included	83	83		

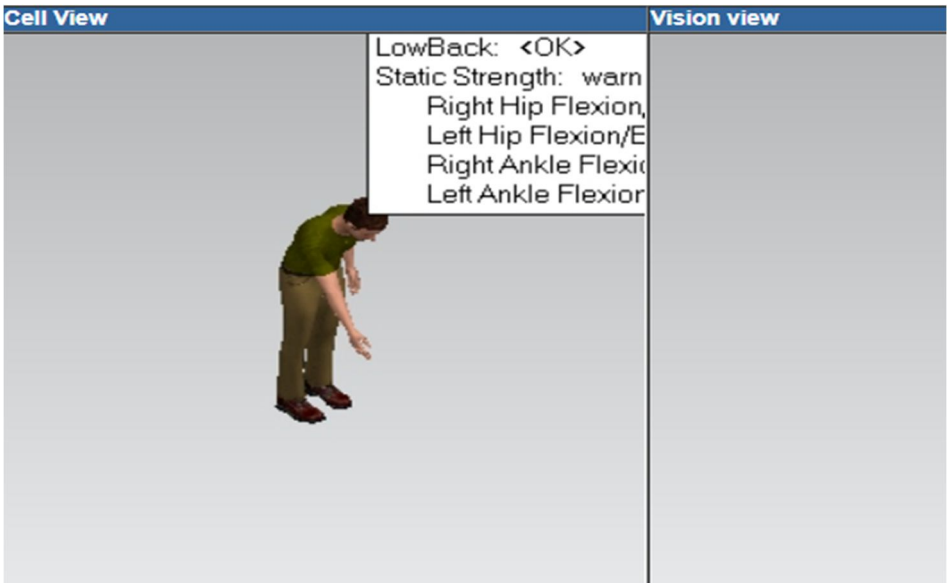

Figure 7: Right and left Hip Flexion

Figure 6 contains a picture of the study and analysis of human simulation, also shown the body postures code and action category for the simulation and Figure 7 conclude various factor which contributes to injury in cleaning occupation. After analyzing this cleaning method it was seen that the level of exertion is more during mopping the surface. The lesson for the problem is that consideration of more equipment will be more suitable for the cleaners and equipment should be trailed before purchase to make suitable for the work environment. While moping various problems are identified when cleaning under furniture, cleaner was squatting forward over 65^0 and also, the cleaner had to stretch to access some areas which adopt awkward shoulder posture.

IV. DISCUSSION

A few preliminary findings are as follows-

A. Suitable equipment will be provided to cleaners which will reduce pain and injuries problem. This must apply to the shorter stature cleaners.

B. It is a must for a cleaner to know how to use the equipment correctly and day to day proper training should be given to cleaners.

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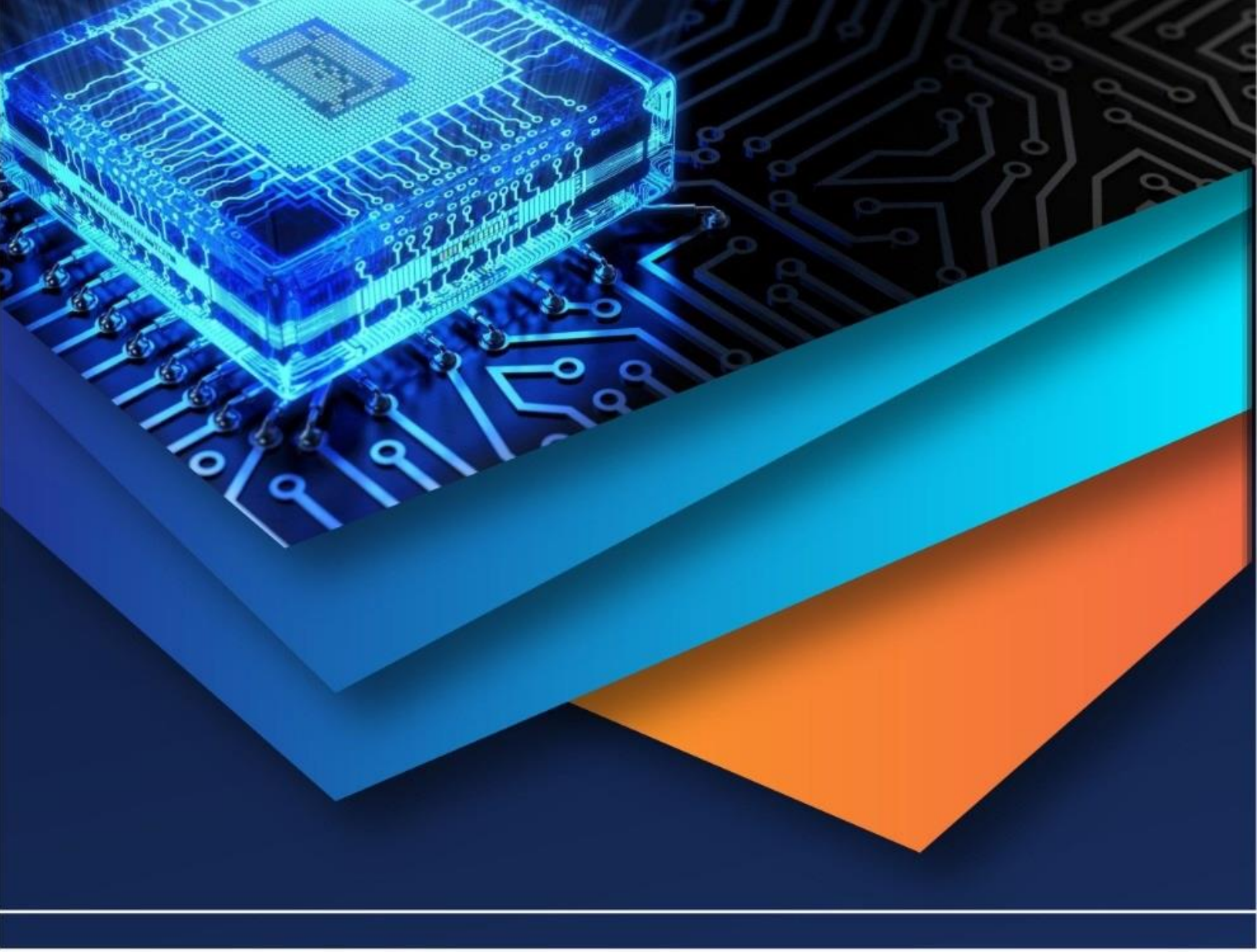

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