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Multipurpose Wheel Hoe for Cost and Work Efficient Farming

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Abstract: ***It is said that Farmers are the backbone of the country, But nowadays they are leaving or either selling their farms and moving towards different profession for their living. And, by this our country is affected in all aspects. Due to lack of financial support, taxes on goods in market and low market value of the grown crops. Because of these reasons farming has becamed one of the expensive occupation or profession. So, we have decided as being an engineer and the citizen of this country we should contribute our knowledge and skills towards country and the people living in this country. By making our KISAN strong to face any situations.***

We have created an 'ALL PURPOSE FARMING MACHINE' which can do almost everything in the field which creates farming cost and work efficient named as 'MULTIPURPOSE WHEEL HOE'.

Our main motive is to:

1) ***To make agriculture easy and affordable.***
2) ***To support agriculture and the farmers willing to do farming.***
3) ***To bring back the farmers who left their profession as a farmer.***
4) ***To gather new generation towards farming for country's growth.***

I. INTRODUCTION

Development and Fabrication of "Wheel Hoe" is aimed to produce the multifunction tools according to the agriculture field conditions. Wheel Hoe has three implements which is used to trim weeds (WEEDER), to cultivate a soil (CULTIVATOR), to make the drainage (FURROWER) on the dried soils. But, we have enhanced traditional wheel hoe by developing two more attachments which is to plain soil (PLAINER) and to separate grains from waste material (HARVESTER) and we have named it as "Multipurpose Wheel Hoe".

Today's world requires speed in each and every field. Hence rapidness and quick working is most important. Now a day for achieving rapidness, various machines and the equipment are being manufactured. In such a modern era of liberalization, small scale industries are contributing in a big way to the growth of our country. New machines and techniques are being developed continuously to manufacture various products at cheaper rates and high quality. Taking into account the above contribution we have tried to manufacture a machine which can reduce human workload and can do various agricultural activities. The organic food system or often mentioned the organic agriculture is one of the activities Indian Government Program to decrease usage of chemical fertilizers and pesticides which is causing reduced soil fertility and an environmental damage. An organic agriculture is defined as the holistic and integrated system of agricultural productions, through optimizing the health and productivity of agro economy so, it will be producing the good quality of food. There are principles of organic agriculture that is the fertility and soil biological activity must be maintained, the soil must behave right humus and loose, trimming weed is using mechanical or semi- mechanical way of farming. Indian farmers problems are lack of agricultural mechanization to support the productivity of agricultural product. The Indian farmers are still using the traditional tools in their agricultural activities. Therefore, the outcome is less than the efforts they are putting in their fields.

II. LITERATURE SURVEY

A. Development and Evaluation of Wheeled Long-Handle Weeder

Silas O. Nkakini a,Ψ, and Abu Husseni b Department of Agricultural and Environmental Engineering, Faculty of Engineering, Rivers State University of Science and Technology, Nigeria (E-mail: nkakini@yahoo.com, E-mail: abusky4u@yahoo.com) Ψ - Corresponding Author. A push-type operated wheel weeder with an adjustable long handle, was designed, constructed and tested. The hoe performance from the tests on a field of Okra plant having an inter-row spacing of 800mm, showed that it could weed satisfactorily, and eliminate the drudgeries associated with the use of the short handle hoe such as backache, pains at the spine and lower waist region.

Field capacity and efficiency of 0.050ha/hr and 87.5% were obtained respectively. Furthermore, the average weeding index and performance index obtained were 86.5% and 1108.48, respectively. At a speed of 0.04m/s, a high efficiency of 91.7% at 0.4m depth of cut was obtained. The developed wheeled long- handle weeder was found efficient.

B. An Ergonomic Study on Evaluation of Single wheel hoe in Reducing Drudgery

SHILPI VERMA, SHOBHANA GUPTAAND C.P. PACHAURI

Women constitute a major task force in agricultural operations in India. Therefore, it becomes necessary to study the ergonomics of women operators involved in weeding and to suggest modifications for further reduction of human drudgery. Heart rate is one of the accurate means to evaluate the functional demands of work on the worker. Hence, the study was done to know the performance of improved weeder that is single wheel hoe in reducing drudgery among women engaged in weeding activity. The results showed that the total cardiac cost of work was 285.0 beats, the physiological cost of work was 6.33 beats/min, the average working heart rate during weeding was 112.5 beats/min and the average energy expenditure was 9.16 KJ/min during the weeding activity performed by improved tool , the single wheel hoe. Weeding activity was performed for maximum number of days in a year from morning till evening in squatting position majority of women perceived it as moderately heavy activity.

III. COMPONENTS

A. Main Frame

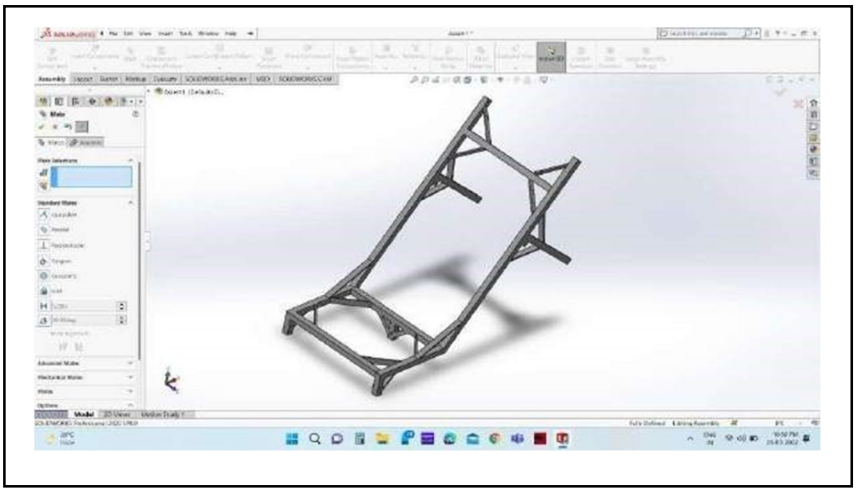


Figure 1. Main Frame

The main frame is the most important part of the project as it holds all the attachments and all the work is totally dependent on it.

B. Handle and Stand

Figure 2. Handle

Figure 3. Stand

1) Main Frame with Handle (for Cultivator, Weeder, Furrower and Plainer attachment). Main frame consists of handle which is removable, the main job of the handle is to steer the project and to do push and pull operation efficiently.
2) Main Frame with Stand (for Harvester attachment). The handle itself is the stand of the project. It's main job is to keep project stable while using Harvester attachment and to make project stand while not in use.

C. Attachment Holders

Figure 4. For Cultivator, Weeder, Furrower and Plainer

Figure 5. For Harvester

1) For Cultivator, Weeder, Furrower and Plainer attachment. It's job is to hold the following attachments mentioned above.
2) For Harvester attachment. It's job is to hold Harvester attachment, which is use to spin the Harvester.

D. Attachments

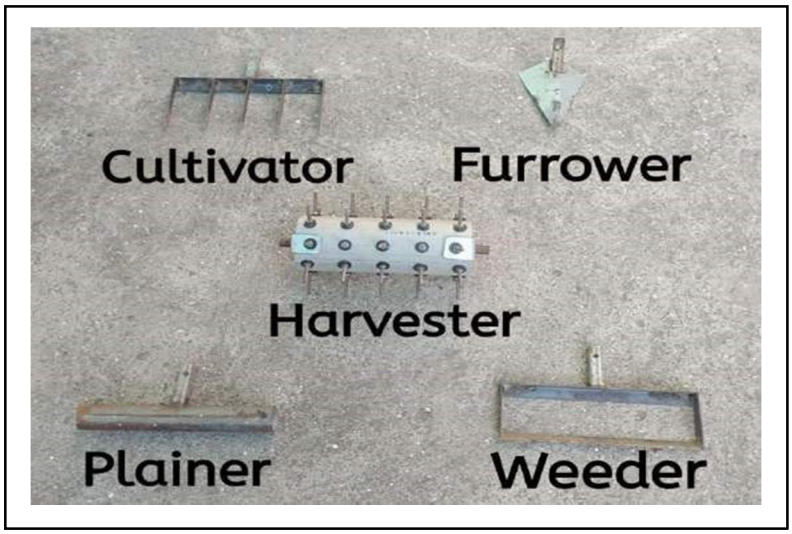


Figure 6. Attachments

Attachments are designed specially as per the job's desired requirement.

The attachments are as follows,

1) *Cultivator:* It is used to loose the soil for making field ready to get seeds sow in the soil.
2) *Plainer:* It is used to plain the soil.
3) *Weeder:* It is used to remove weeds from the field.
4) *Furrower:* It is used to make sections on the land or to make small gaps for planting.
5) *Harvester:* It is used to harvest crops by separating unwanted straws and waste materials.

E. Wheels

Figure 7. Wheels

The job of the wheels are to move the body of the project from one place to the another with ease. It plays the main role in reducing efforts required during various operations done on the field.

F. Assembly

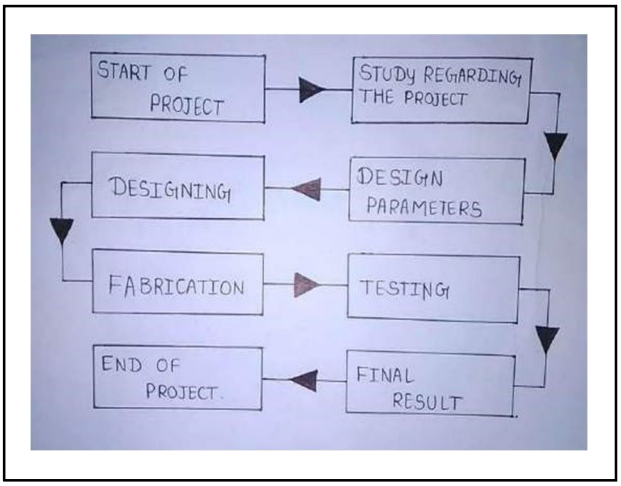
Figure 8. For Cultivator, Weeder, Plainer and Furrower.

Figure 9. For Harvester.

IV. METHODOLOGY

A. Working Methodology

1) Start of Project
2) Study regarding the project (Multipurpose Wheel Hoe)
3) Design parameters
4) Designing
5) Fabrication
6) Testing
7) Final results
8) End of Project



a) Design of the Equipment: The first stage of our project is to make proper plan and preparing the design of the equipment as per approximate suitable dimensions.

b) Fabrication of the Working Model: Once Designing is over we are planning to fabricate the working model using suitable materials.

c) Testing of the Model: Once the fabrication is over testing the equipment in the agricultural field by using different material.

d) Result and Conclusion: Once testing is over compare the results with manual wheel hoe and this is helps to give conclusion of our project work.

V. DATA AND ANALYSIS

A. Time v/s Working Methods Graph.

The tests were done on (2m × 2m) ground for (Cultivator, Furrower, Weeder and Plainer) and for Harvester (10kg) of crops were tested.

Figure 10. Field Work

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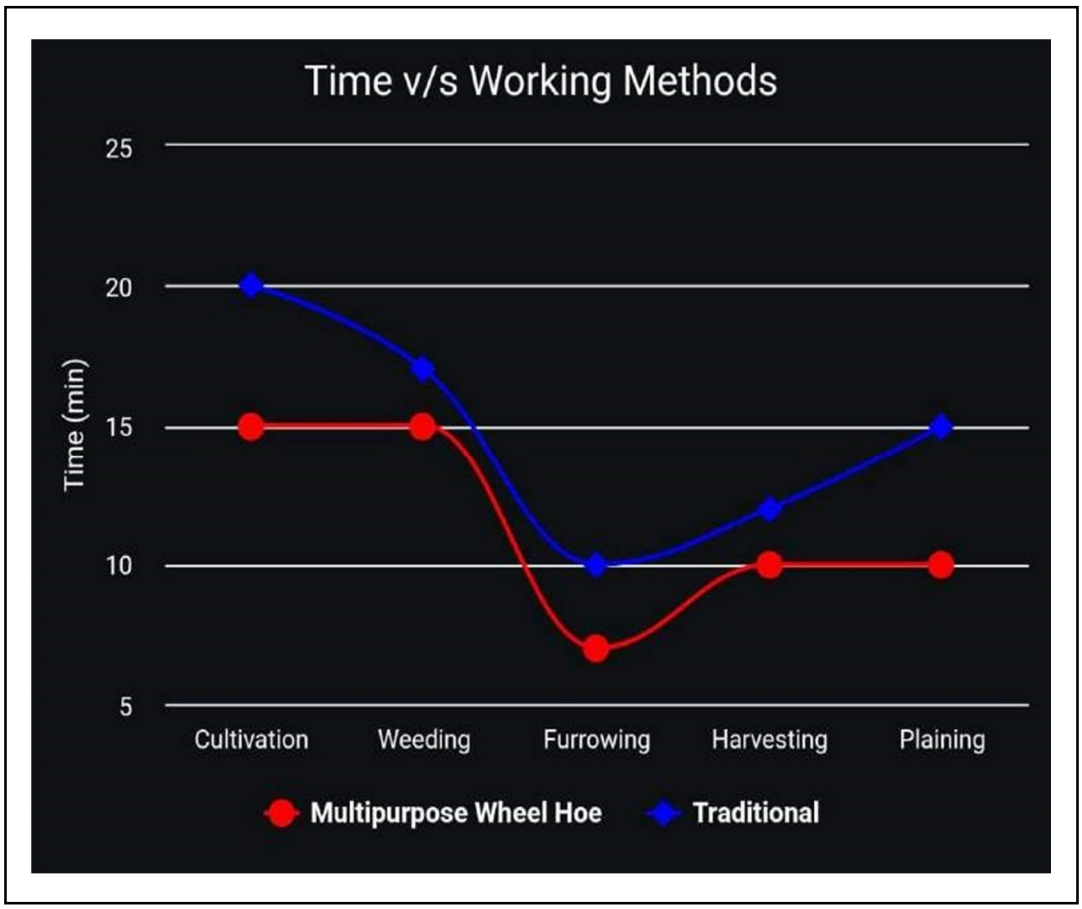
Table 1. Time and Working Methods.

Sr No.	Methods	Cultivation	Weeding	Furrowing	Harvesting	Plaining
1.	Traditional	20 min	17 min	10 min	12 min	15 min
2.	Multipurpose Wheel Hoe	15 min	15 min	7 min	10 min	10 min

Note: Time is taken in minutes.



Graph 1. Time v/s Working Methods Graph

The above given graph shows us the time comparison between traditional methods and the Multipurpose Wheel Hoe.
Conclusion: Multipurpose Wheel Hoe is more time efficient than traditional methods.

B. Ergonomical and field performance evaluation of the Multipurpose Wheel Hoe.

Five male subjects of age group (25 to 35) were selected for ergonomical investigation from the agricultural labour community; medical fitness test was carried out prior to the experiment and details are furnished in Table.2 The maximum aerobic capacity of the selected subjects was varied from 1.40 to1.84 l/min (lpm).

The varied individual differences in maximum aerobic capacity (VO_2max) was observed due to the differences in the ability to supply oxygen to the muscles and also due to genetic factors (Bridger 1995), whereas, Noakes (1988) suggested that failure of muscle power might be the reason for variation of the VO_2 max among the subjects.

Table 2. Details of the subjects participated in the study.

Sr No.	Subject	Age (years)	Average of Maximum HR, (bpm) For all 5 working procedures.	Average of Maximum aerobic capacity VO_2 max (lpm)	Height (mm)	Weight (kg)
1.	S1	34	186	1.61	165	63
2.	S2	30	190	1.74	163	74
3.	S3	36	184	1.55	173	68
4.	S4	36	184	1.41	168	67
5.	S5	27	193	1.84	156	56
6.	Mean	32.6	187.4	1.63	165.4	65.6
7.	SD	3.97	3.97	0.17	6.95	6.65

Here, (bpm = beats per minute; lpm = litres per minute)

C. Assessment of Physiological Cost of Work

The energy expenditure (KJ/min) was estimated using the following formula proposed by Varghese et al. (1994) for Indian housewives.

Energy expenditure = 0.159 x HR (bpm) – 8.72

Following formulae were used for calculation of physiological cost of work (PCW) and total cardiac cost of work (TCCW).

Cardiac cost of work = Average heart rate (AHR) x Duration of activity

where,

AHR = Average working heart rate – Average resting heart rate

CCR = (Average recovery HR - Average resting HR) x duration TCCW = Cardiac cost of work (CCW)

Cardiac cost of rest, (CCR is taken 0).

Therefore, PCW = TCCW / Total Time Of Work.

Calculations,

Table 3. For Traditional Methods.

Sr No.	Methods	Energy Expenditure (EE)	Total Cardiac Cost of Work (TCCW)	Physiological Cost of Work (PCW)
1.	Cultivation	21.0766	3748	187.4
2.	Weeding	21.0766	3185.5	187.4
3.	Furrowing	21.0766	1874	187.4
4.	Harvesting	21.0766	2248.8	187.4
5.	Plaining	21.0766	2811	187.4

Table 4. For Multipurpose Wheel Hoe.

Sr No.	Methods	Energy Expenditure (EE)	Total Cardiac Cost of Work (TCCW)	Physiological Cost of Work (PCW)
1.	Cultivation	21.0766	2811	187.4
2.	Weeding	21.0766	2811	187.4
3.	Furrowing	21.0766	1311.8	187.4
4.	Harvesting	21.0766	1874	187.4
5.	Plaining	21.0766	1874	187.4

Conclusion: Total Cardiac Cost of Work:
(Traditional Farming Methods > Multipurpose Wheel Hoe).
Hence, Less efforts and same outcome with Multipurpose wheel Hoe.

D. Health issues due to Traditional Methods on Human Body.

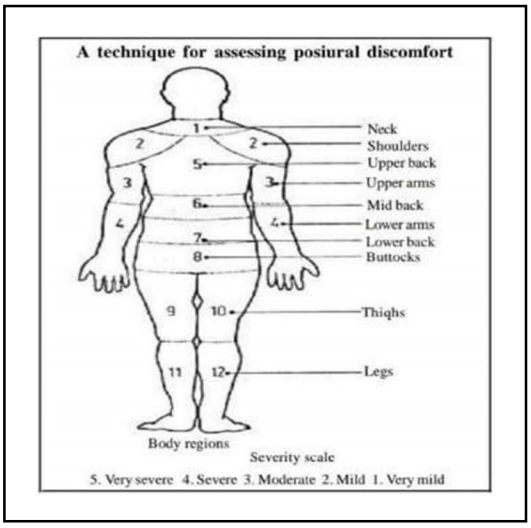


Figure 11. Technique for Assessing Posiural Discomfort

After Using “Multipurpose Wheel Hoe”.

Table 5. Responses on Musculo-skeletal problems and perceived exertion experienced by respondents

Sr No.	Methods Used	Musculo-skeletal problems	Rating of perceived Exertion(RPE)
1.	Traditional	Severe pain in shoulders, upper and lower back and upper arms	Very heavy
2.	Multipurpose Wheel Hoe	Moderate to light pain in shoulders, hands and arms	Moderately heavy

CONCLUSION: Traditional method was leading to posiural discomfort and drudgery

VI. SOLIDWORKS MODEL

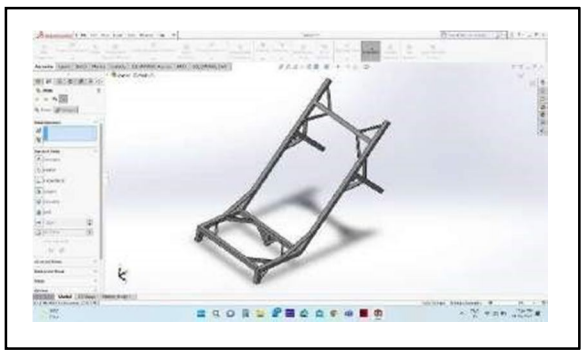


Figure 12. Main Frame

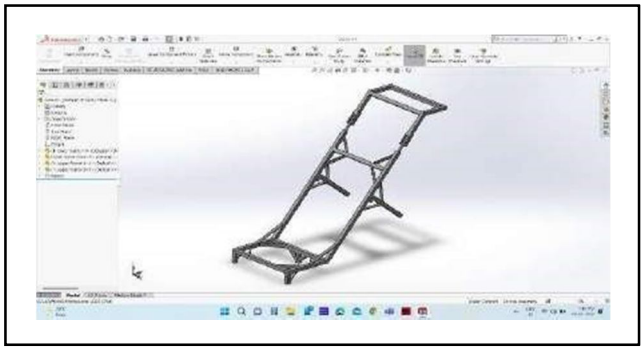


Figure 13. Assembly for Cultivator, Weeder, Furrower and Plainer

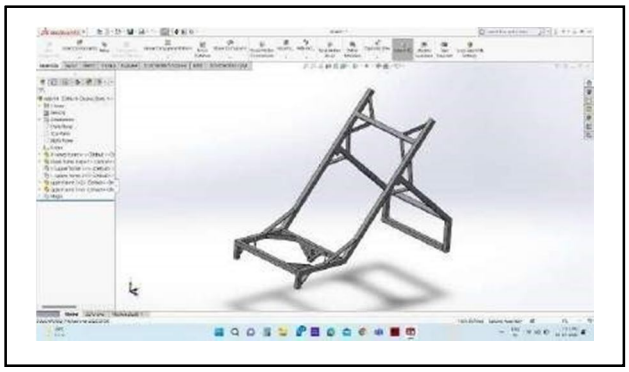


Figure 14. Assembly for Harvester

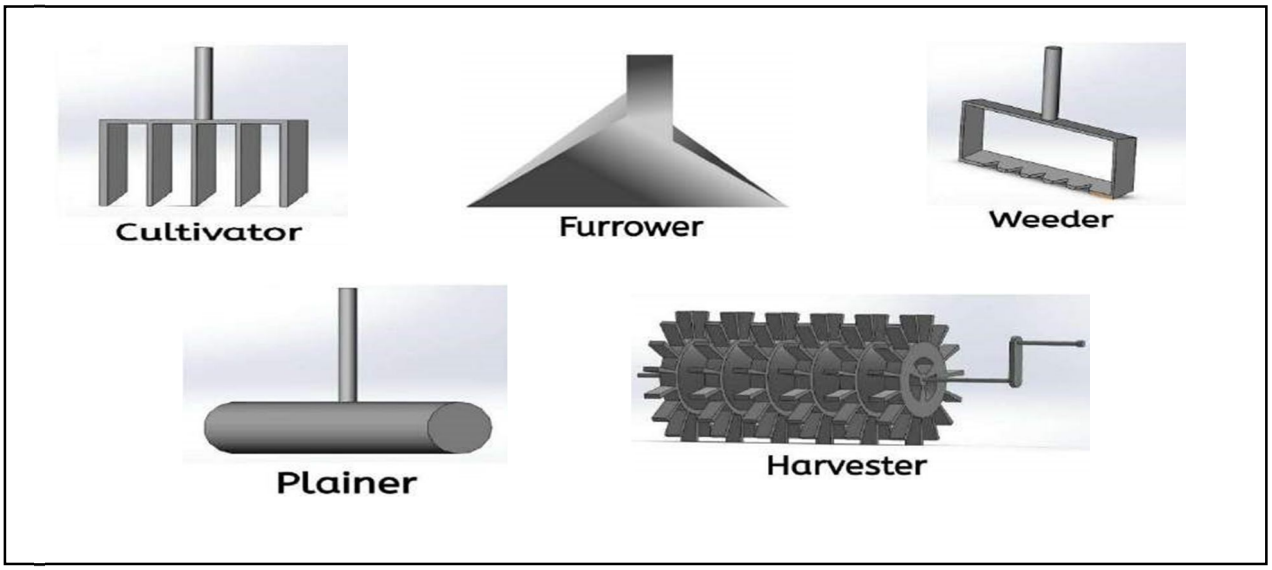


Figure 15. Attachments

VII. CONCLUSION

Multipurpose Wheel Hoe was found useful in terms of saving time, human effort, increasing work capacity and productivity. It was found to be compatible, easy to handle and applicable in field situation as well as most efficient in vegetable fields. It was observed that use of Multipurpose Wheel Hoe improved posture and efficiency of worker. The body discomfort reduced with use of Multipurpose Wheel Hoe because it employed standing posture eliminating muscular fatigue and excessive loading of inter-vertebral discs of backbone. This proved that Multipurpose Wheel Hoe is ergonomically sound, women friendly, drudgery reducing and improves efficiency of farmers.

VIII. FUTURE SCOPE

A. Since, the machine is totally man-powered working efficiency is less. So, to increase it motor or engine is required for the enhancement.
B. Various mechanisms should be used to improve maneuverability.
C. More attachments should be designed to attach on this machine to benefit consumers.
D. Design of the product should be made more simple to reduce product cost, maintainance cost and durability.

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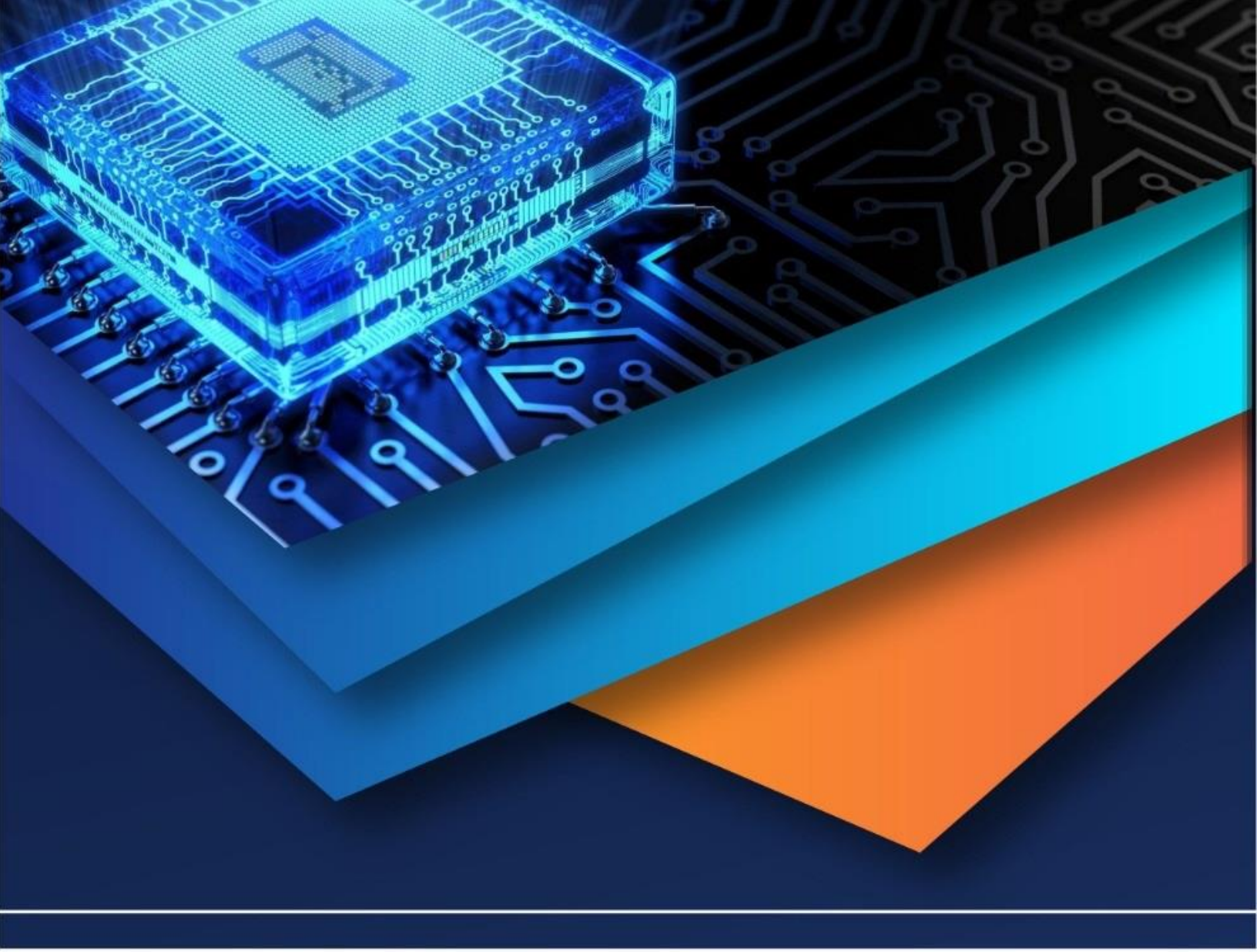

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