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Improving Application Of Ergonomics In Engineering Machine Design Using ANN Based System

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Abstract: The integration of ergonomics into engineering machine design is essential for enhancing user comfort, reducing workplace injuries, and improving operational efficiency. Traditional ergonomic assessments often rely on manual evaluations and predefined models, which may not fully capture the complexity of human-machine interactions. This study explores the application of Artificial Neural Networks (ANN) to optimize ergonomic design in engineering machines. ANN-based systems leverage intelligent learning algorithms to analyze human factors, predict ergonomic risks, and recommend design improvements. By incorporating real-time data processing and adaptive learning, ANN enhances decision-making in ergonomic assessments, leading to safer and more efficient machine designs. The research examines key ergonomic parameters, including posture analysis, force exertion, and user adaptability, utilizing ANN to refine design configurations. The proposed approach aims to bridge the gap between conventional ergonomic methods and intelligent automation, ultimately contributing to a more effective and user-centered engineering design process. This study highlights the potential of ANN-based systems in revolutionizing machine ergonomics, fostering enhanced productivity, and promoting workplace safety. The conventional Resistance to Change that cause poor application of ergonomics in engineering machine design was 15%. Meanwhile, when an ANN based system was imbibed into the system, it reduced it to13.4%. Finally, the percentage improvement in application of ergonomics in engineering machine design when an ANN based system was applied was 1.6%.

Keywords: Improving, application, ergonomics, engineering, machine, design, ann, based, system

1.0 INTRODUCTION

The application of ergonomics in engineering machine design plays a critical role in enhancing productivity, safety, and operational efficiency. Ergonomics, which focuses on optimizing human-machine interactions, ensures that machines are designed to reduce physical strain, improve user comfort, and minimize the risk of work-related injuries (Bridger, 2018). Despite advancements in engineering design, many machines still fail to adequately consider ergonomic principles, leading to inefficiencies and increased occupational hazards (Salvendy, 2012). With the rise of Artificial Neural Networks (ANN), intelligent systems have shown significant promise in optimizing ergonomic design. ANN-based systems can analyze vast datasets, predict user interactions, and recommend design modifications that improve usability and efficiency (Haykin, 2009). By integrating ANN into machine design, engineers can develop systems that dynamically adapt to user needs, leading to improved safety standards and reduced workplace fatigue (Rahimi et al., 2020). This study explores the potential of ANN-based systems in enhancing the application of ergonomics in engineering machine design. By leveraging AI-driven optimization techniques, this approach seeks to bridge the gap between traditional ergonomic assessments and intelligent predictive modeling, ultimately improving machine efficiency, safety, and user comfort.

2.0 METHODOLOGY

To characterize and establish the causes of poor application of ergonomics in engineering machine design

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Table1 characterized and established causes of poor application of ergonomics in engineering machine design

S/N	Cause of Poor Ergonomic Application	Percentage (%)	Description
1	**Lack of Awareness and Training**	25%	Many engineers and designers have limited knowledge of ergonomic principles, leading to poor implementation.
2	**Cost Constraints**	20%	The incorporation of ergonomic features increases design and manufacturing costs, leading to reluctance in adoption.
3	**Resistance to Change**	15%	Traditional machine design approaches often neglect ergonomics, and industries may resist adopting new methods.
4	**Limited Research and Development**	12%	Insufficient investment in ergonomic research results in outdated design methodologies.
5	**Focus on Functionality Over User Comfort**	10%	Engineers often prioritize machine performance and efficiency over user well-being.
6	**Lack of Standardization and Regulations**	8%	Weak enforcement of ergonomic standards leads to inconsistent application across industries.
7	**Technological Limitations**	5%	Some industries lack access to advanced tools and AI-driven systems like ANN for ergonomic optimization.
8	**Time Constraints in Design and Production**	5%	Fast production cycles reduce the time available for detailed ergonomic assessments.

This table summarizes the key factors contributing to the poor application of ergonomics in engineering machine design, highlighting the need for awareness, investment, and technology integration to improve ergonomic efficiency.

To design a conventional SIMULINK model for application of ergonomics in engineering machine design

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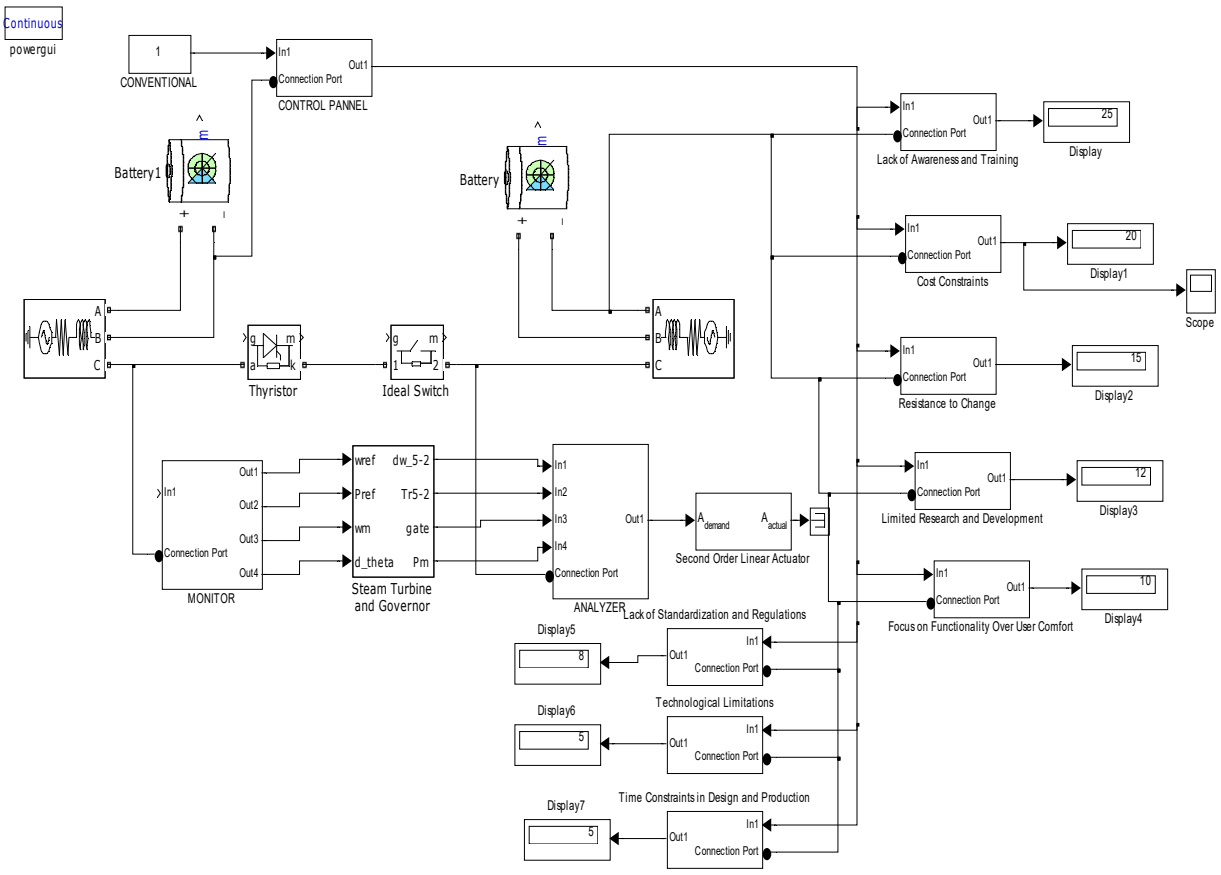

Fig 1 designed conventional SIMULINK model for application of ergonomics in engineering machine design
The results obtained were as shown in figures 6 and 7

To train ANN in the causes of poor application of ergonomics in engineering machine design for its effective application of ergonomics in engineering machine design

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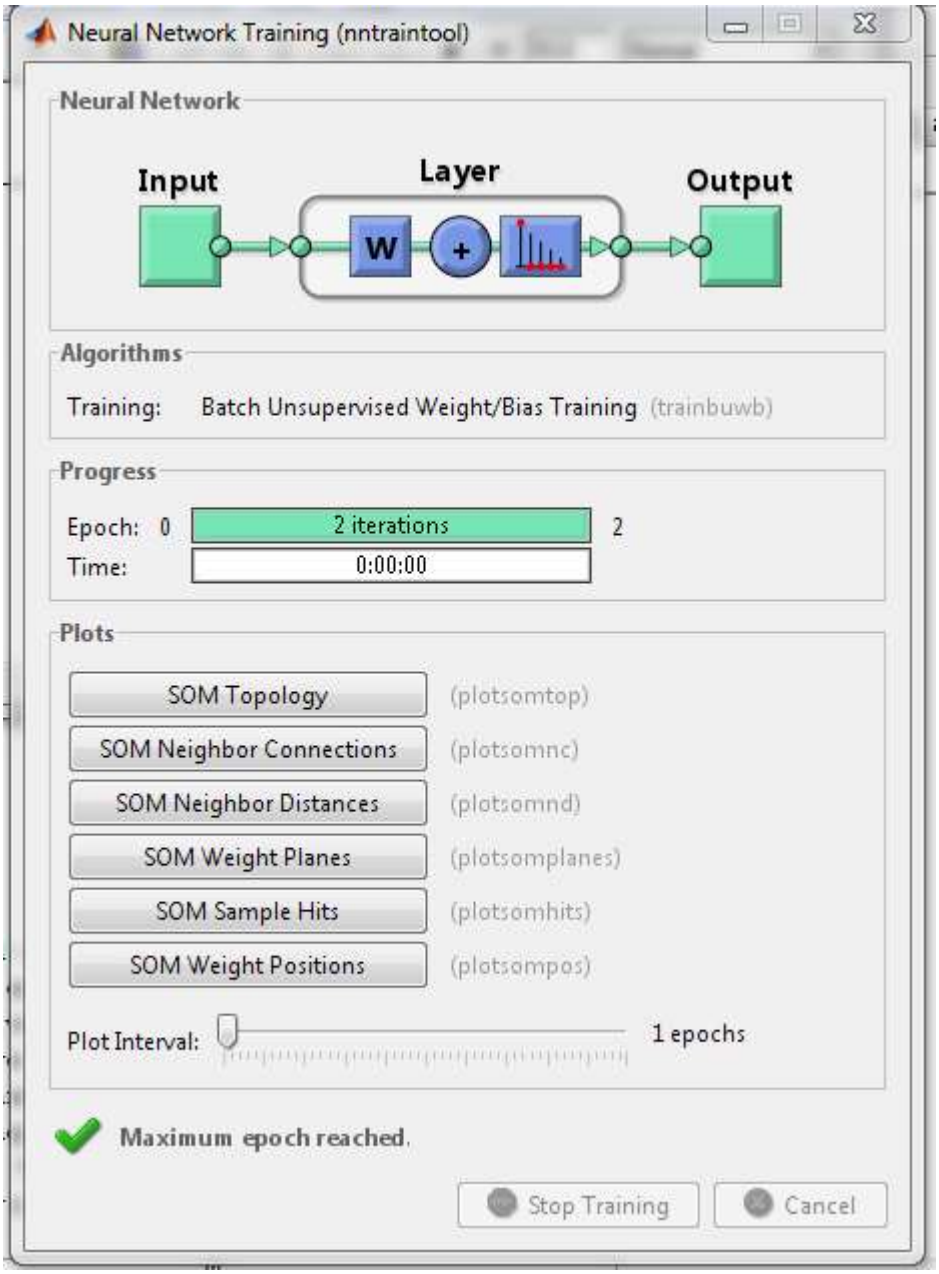

Fig 2 ANN training tool

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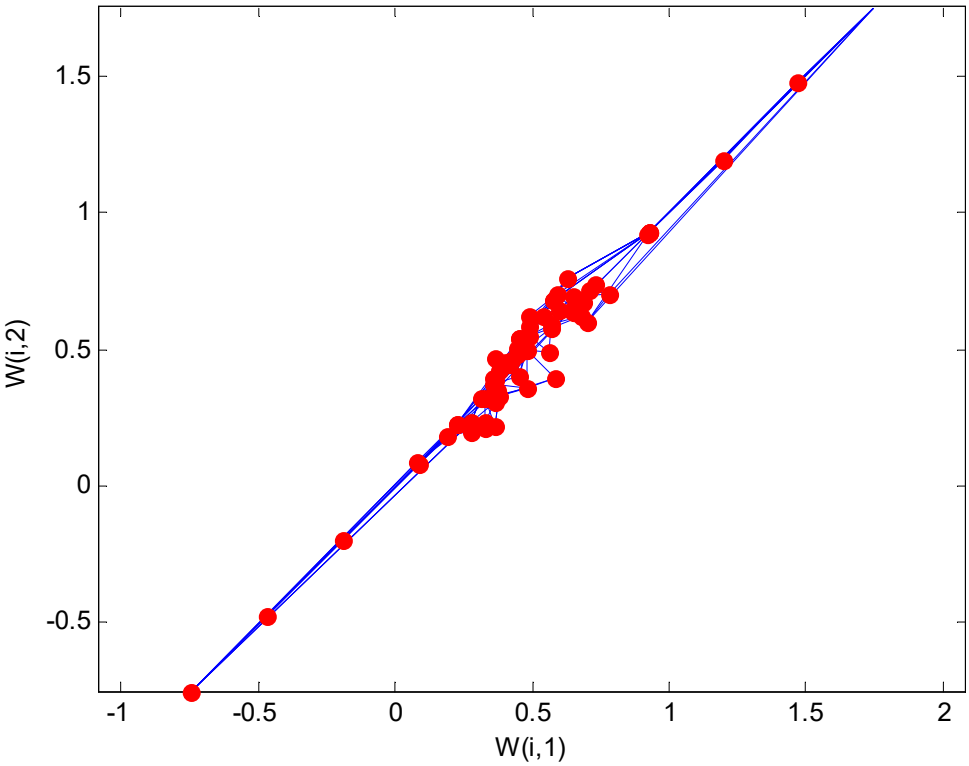

Fig 3 trained ANN in the causes of poor application of ergonomics in engineering machine design for its effective application of ergonomics in engineering machine design

The eight causes of poor application of ergonomics in engineering machine design was trained ten times 8 x 10 = 80 to give eighty neurons that look like human brain.

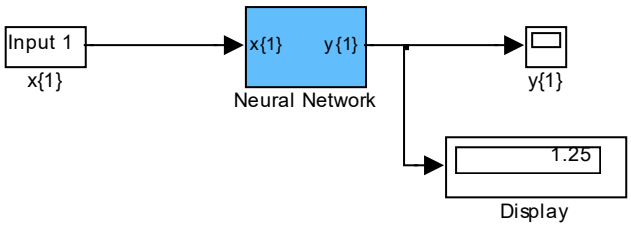

Fig 4 result obtained during the training

To develop an algorithm for the implementation of the process

1. Characterize and establish the causes of poor application of ergonomics in engineering machine design
2. Identify Lack of Awareness and Training
3. Identify Cost Constraints
4. Identify Resistance to Change
5. identify Limited Research and Development
6. Identify Focus on Functionality Over User Comfort
7. Identify Lack of Standardization and Regulations
8. Identify Technological Limitations
9. Identify Time Constraints in Design and Production
10. Design a conventional SIMULINK model for application of ergonomics in engineering machine design and integrate 2 through 9
11. Train ANN in the causes of poor application of ergonomics in engineering machine design for its effective application of ergonomics in engineering machine design
12. Integrate 11 into 10
13. Did the causes of poor application of ergonomics in engineering machine design minimize when 11 was integrated into 10?
14. IF NO go to 12
15. IF YES go to 16
16. Improved application of ergonomics in engineering machine design
17. Stop.
18. End

To design a SIMULINK model for improving application of ergonomics in engineering machine design using ANN based system

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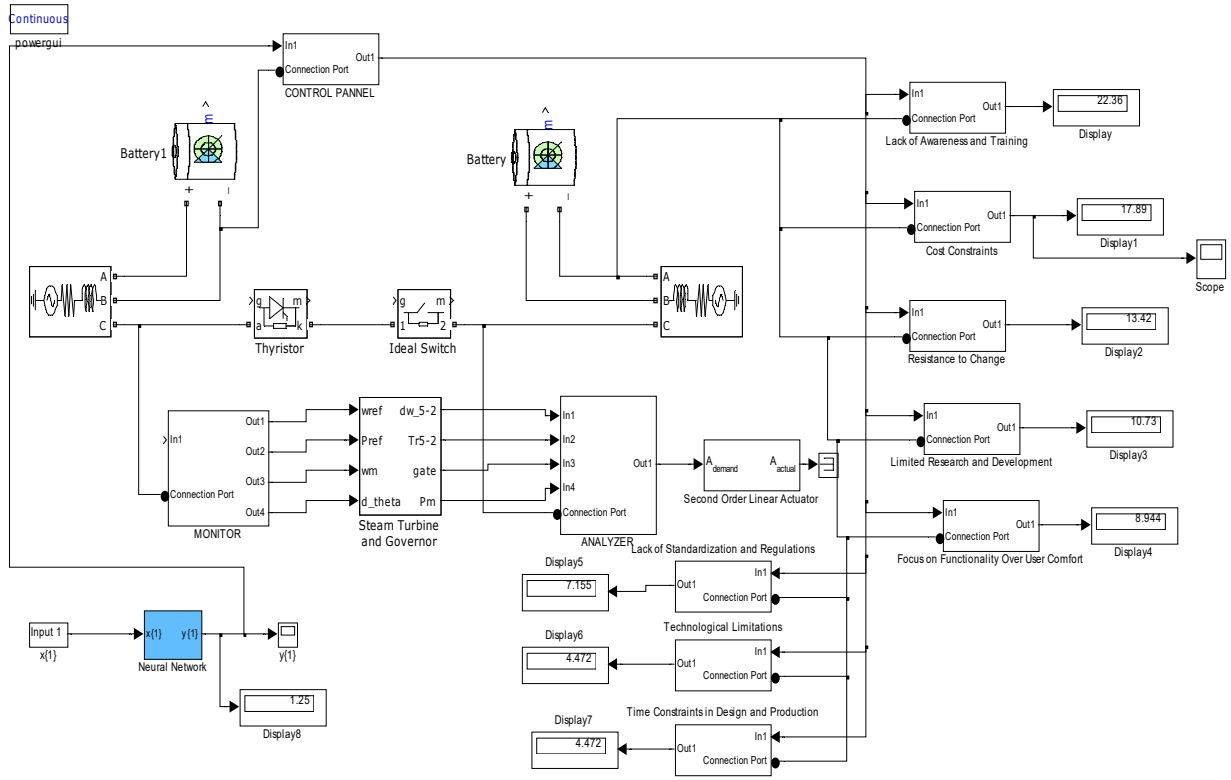

Fig 5 designed SIMULINK model for improving application of ergonomics in engineering machine design using ANN based system

The result obtained were as shown in figures 6 and 7

To validate and justify the percentage improvement in the reduction of poor application of ergonomics in engineering machine design with and without ANN based system

To find the percentage improvement in the reduction of Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system

Conventional Lack of Awareness and Training = 25%

ANN based system Lack of Awareness and Training =22.4%

%improvement in the reduction of Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system=

Conventional Lack of Awareness and Training - ANN based system Lack of Awareness and Training

%improvement in the reduction of Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system=25% - 22.4%

%improvement in the reduction of Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system= 2.6%

To find the percentage improvement in the reduction of Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system

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Conventional Lack of Resistance to Change =15 %

ANN based system Lack of Resistance to Change =13.4%

%improvement in the reduction of Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system=

Conventional Resistance to Change - ANN based system Resistance to Change

%improvement in the reduction of Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system=15% - 13.4%

%improvement in the reduction of Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system= 1.6%

3.0 RESULT AND DISCUSSION

Table 2 comparison of conventional and ANN based system Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system

Time(s)	Conventional Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system (%)	ANN based system Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system (%)
1	25	22.4
2	25	22.4
3	25	22.4
4	25	22.4
10	25	22.4

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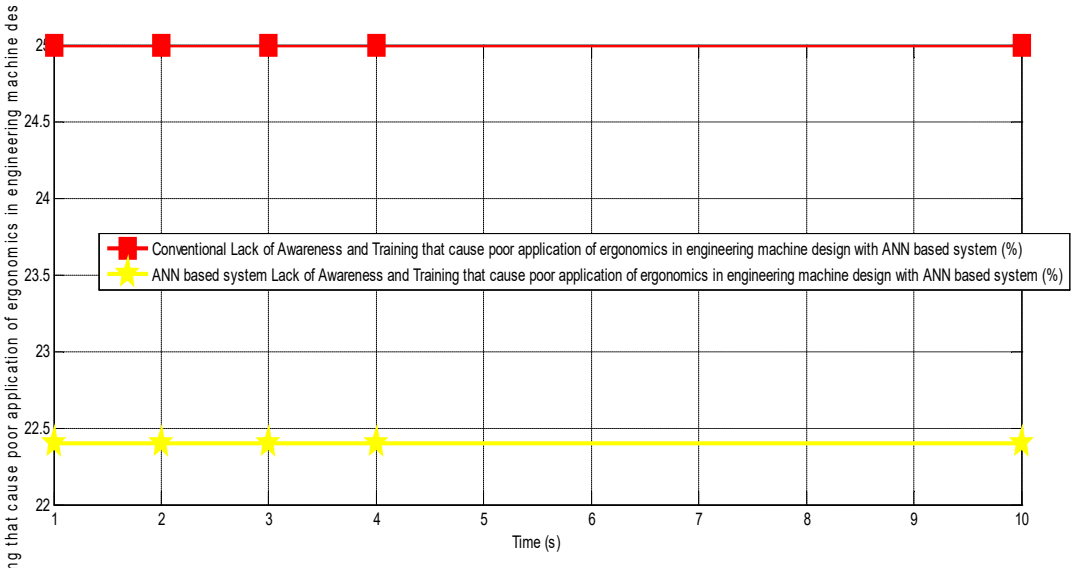

Fig 6 comparison of conventional and ANN based system Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design with ANN based system

The conventional Lack of Awareness and Training that cause poor application of ergonomics in engineering machine design was 25%. On the other hand, when an ANN based system was incorporated into the system, it drastically reduced it to 22.4%.

Table 3 comparison of conventional and ANN based system Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system

Time(s)	Conventional Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system (%)	ANN based system Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system (%)
1	15	13.4
2	15	13.4
3	15	13.4
4	15	13.4
10	15	13.4

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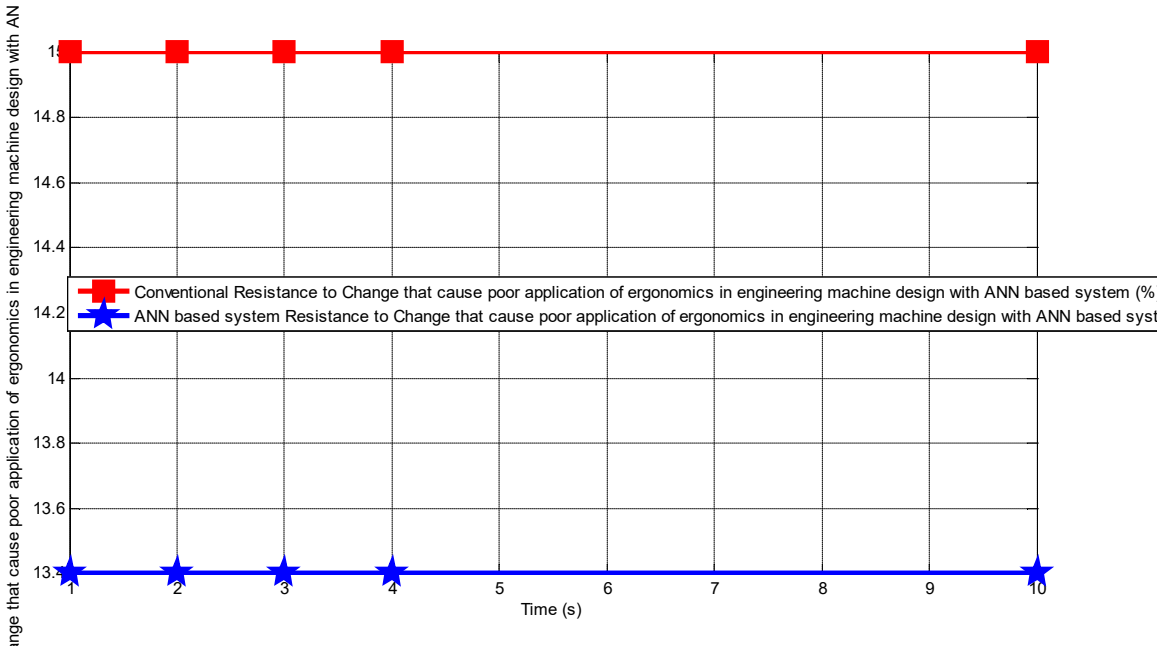

Fig 7 comparison of conventional and ANN based system Resistance to Change that cause poor application of ergonomics in engineering machine design with ANN based system

The conventional Resistance to Change that cause poor application of ergonomics in engineering machine design was 15%. Meanwhile, when an ANN based system was imbibed into the system, it reduced it to13.4%. Finally, the percentage improvement **in application of ergonomics in engineering machine design when an** ANN based system was applied was 1.6%.

4.0 CONCLUSION

The integration of Artificial Neural Networks (ANN) in the application of ergonomics for engineering machine design presents a transformative approach to enhancing user safety, comfort, and productivity. Traditional ergonomic assessment methods, though effective, often lack the adaptability and predictive accuracy required to optimize machine design dynamically. ANN-based systems address these limitations by leveraging intelligent algorithms to analyze complex ergonomic factors, predict risks, and suggest real-time improvements. This study highlights the significance of ANN in refining machine ergonomics by incorporating human-centered design principles, reducing workplace injuries, and improving overall operational efficiency. The ability of ANN to process vast datasets and adapt to changing conditions ensures that engineering machines are designed to meet the evolving needs of users. By bridging the gap between conventional ergonomic evaluation and intelligent automation, ANN-based systems offer a more efficient, precise, and proactive approach to ergonomic optimization.In conclusion, the adoption of ANN in ergonomic machine design holds great potential for advancing engineering practices, ensuring safer work environments, and improving machine performance. Future research should focus on refining ANN models for broader applications, integrating real-time feedback mechanisms, and exploring hybrid AI-driven ergonomic solutions for even greater effectiveness. **The conventional** Resistance to Change that cause poor application of ergonomics in engineering machine design was 15%. Meanwhile, when an ANN based system was imbibed into the system, it reduced it to13.4%. Finally, the percentage improvement **in application of ergonomics in engineering machine design when an** ANN based system was applied was 1.6%.

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