INNOVATIVE ERGONOMIC ARMCHAIR ATTACHMENT: ENHANCING POSTURE CORRECTION

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ABSTRACT

Poor posture among college students has become an increasing health concern due to prolonged sitting and the widespread use of standard classroom furniture that does not adequately support proper body alignment. Extended periods of sitting in ergonomically unsuitable chairs may contribute to musculoskeletal discomfort, spinal misalignment, reduced mobility, and decreased academic performance. This study aimed to develop and evaluate the acceptability of an innovative ergonomic armchair attachment designed to enhance posture correction among college students. The study employed a descriptive-developmental research design involving licensed physical therapists with at least three years of professional experience and Physical Therapy students from the University of Perpetual Help – Dr. Jose G. Tamayo Medical University. Participants evaluated the prototype using a modified Cornell Ergonomic Seating Evaluation Questionnaire focusing on ease of use, chair adjustment, seat comfort, design and appearance, and overall acceptability. Data were analyzed using frequency, percentage, and weighted mean. Results revealed that the ergonomic armchair attachment achieved a high level of acceptability, particularly in seat comfort and ease of use, while chair adjustment received a moderately acceptable rating, indicating areas for further improvement. The findings suggest that the ergonomic armchair attachment provides practical support for posture correction and may help reduce discomfort associated with prolonged sitting. The study highlights the importance of incorporating ergonomic principles and anthropometric considerations into classroom furniture design to promote healthier sitting posture and improve students' overall comfort and well-being.

Keywords: Ergonomic armchair attachment, posture correction, ergonomics, college students, musculoskeletal health

Poor posture has become an increasingly significant concern among college students because of prolonged sitting, sedentary lifestyles, and extended academic activities. Students commonly spend several hours each day seated inside classrooms, studying, or using computers, increasing their risk of developing musculoskeletal disorders, spinal misalignment, neck pain, back pain, and reduced mobility. These posture-related problems not only affect physical health but may also impair concentration, productivity, and overall academic performance.

INTRODUCTION

One of the major contributors to poor posture is the mismatch between students' anthropometric measurements and the dimensions of conventional classroom furniture. Standard school armchairs are generally designed using fixed dimensions that fail to accommodate variations in students' body sizes and proportions. Consequently, students often adopt compensatory postures such as slouching, forward head posture, and rounded shoulders to reduce discomfort during prolonged sitting. Over time, these postural adaptations increase

mechanical stress on the spine and surrounding musculature, potentially leading to chronic musculoskeletal conditions. Ergonomics plays a critical role in preventing posture-related disorders by designing furniture that promotes comfort, efficiency, and proper body alignment. Previous studies have demonstrated that ergonomically designed seating improves spinal support, reduces muscle fatigue, and enhances sitting comfort. However, most existing interventions focus on replacing classroom furniture rather than improving existing school armchairs through affordable ergonomic modifications. Additionally, many available ergonomic seating solutions do not adequately address the anthropometric characteristics of Filipino college students, limiting their applicability in local educational settings.

To address these limitations, this study developed an innovative ergonomic armchair attachment intended for use with standard school armchairs. The attachment was designed to improve sitting posture while maintaining compatibility with existing classroom furniture. Its acceptability was evaluated in terms of ease of use, chair adjustment, seat comfort, design and appearance, and overall usability based on assessments from licensed physical therapists and Physical Therapy students.

Specifically, the study sought to answer the following research questions:

1. What problems are commonly encountered when using ordinary school armchairs?
2. What recommendations do experts provide regarding the ergonomic armchair attachment?
3. What is the level of acceptability of the ergonomic armchair attachment in terms of:
   - Design
   - Ease of use
   - Adjustability
   - Comfort
4. What is the overall level of acceptability of the ergonomic armchair attachment among licensed physical therapists and Physical Therapy students?

LITERATURE REVIEW

Poor posture among students has become a significant public health concern due to prolonged sitting and increasing sedentary behaviors associated with classroom learning and technology use. Several studies have consistently reported that students spend a substantial portion of their day sitting, placing them at greater risk of developing musculoskeletal disorders (MSDs), neck pain, back pain, and postural deformities. These conditions not only affect students' physical health but may also reduce learning efficiency, comfort, and overall academic performance.

Ergonomic principles have been widely recognized as an effective approach to minimizing posture-related disorders. Ergonomics focuses on designing equipment and environments that fit the user's physical characteristics to maximize comfort, safety, and efficiency. Studies conducted by Remolino et al. (2021), Paradina and Prasetyo (2022), Soltaninejad et al. (2021), and Eldho and Muthukumar (2022) emphasized that ergonomically designed learning environments significantly reduce discomfort and improve posture during prolonged sitting. Their findings suggest that appropriate furniture design, together with ergonomic awareness, can decrease the prevalence of musculoskeletal symptoms among students. One of the most frequently reported ergonomic problems in educational institutions is the mismatch between classroom furniture dimensions and students' anthropometric measurements. Classroom chairs are commonly manufactured using standardized dimensions that fail to accommodate

variations in body size, height, limb length, and sitting posture. Research conducted in different countries consistently demonstrates that these mismatches contribute to poor posture, discomfort, muscle fatigue, and increased risk of musculoskeletal disorders. Students are often forced to adopt compensatory postures, including slouching, forward head posture, and rounded shoulders, to remain comfortable during prolonged sitting. These adaptations may eventually contribute to chronic spinal problems if left unaddressed.

Anthropometric measurements play an essential role in ergonomic furniture design because they provide objective information regarding body dimensions necessary for creating comfortable seating. Studies by Bongo et al. (2023), Prasetyo et al. (2021), Cabugawan et al. (2021), and Villapando et al. (2021) emphasized that furniture designed using local anthropometric data provides better postural support than furniture based on generalized or foreign measurements. Their findings indicate that ergonomic furniture should consider measurements such as popliteal height, buttock-popliteal length, hip breadth, sitting shoulder height, and lumbar support dimensions to accommodate a broader range of users effectively.
Biomechanical research further supports the importance of maintaining neutral spinal alignment during prolonged sitting. Harrison et al. (1999) explained that appropriate lumbar support, controlled pelvic positioning, and proper weight distribution minimize spinal loading and reduce muscular activity required to maintain sitting posture. Conversely, unsupported sitting positions increase disc pressure and muscle activation, contributing to discomfort and fatigue. These biomechanical principles have become the foundation of modern ergonomic chair design and posture correction interventions.

Several ergonomic seating interventions have been developed to improve sitting posture. These include ergonomic classroom chairs, sensor-based posture monitoring systems, adjustable workstations, and posture-correcting seating devices. Previous investigations reported improvements in comfort, spinal support, and posture awareness following the implementation of these interventions. However, many existing solutions require replacing entire chairs or purchasing expensive equipment, limiting their practicality in educational institutions with limited resources. Other designs are intended primarily for office environments rather than standard classroom armchairs.

Despite the growing body of ergonomic research, important gaps remain. Most studies focus on complete furniture replacement rather than developing ergonomic attachments that can be integrated into existing classroom chairs. Furthermore, limited research has evaluated ergonomic armchair attachments specifically designed using Filipino anthropometric measurements. The present study addresses these gaps by developing an innovative ergonomic armchair attachment that can be installed on standard school armchairs and evaluating its acceptability based on expert assessment and user feedback. By combining ergonomic principles, anthropometric considerations, and biomechanical support, the study aims to provide a practical and cost-effective approach to improving posture among college students.

METHODOLOGY

Research Design

This study employed a descriptive-developmental research design to develop and evaluate the acceptability of an innovative ergonomic armchair attachment intended to enhance posture correction among college students. The developmental component focused on the design and refinement of the ergonomic attachment, while the descriptive component evaluated its

acceptability based on expert and user assessments. This research design allowed the researchers to obtain systematic feedback regarding the functionality, usability, comfort, and overall acceptability of the prototype.

Participants

The participants consisted of licensed physical therapists with at least three years of professional experience and students enrolled in the College of Physical Therapy at the University of Perpetual Help – Dr. Jose G. Tamayo Medical University. Licensed physical therapists were selected because of their professional knowledge of ergonomics, posture, and musculoskeletal assessment, while Physical Therapy students served as representative end-users of the ergonomic attachment.

A purposive sampling technique was employed to ensure that participants possessed sufficient knowledge and experience to evaluate the prototype objectively. A total of 30 licensed physical therapists from hospitals and rehabilitation clinics within Laguna and Metro Manila and 30 Physical Therapy students participated in the evaluation.

Research Instrument

The study utilized a modified Cornell Ergonomic Seating Evaluation Questionnaire, which was adapted with permission from Dr. Alan Hedge. The original instrument is designed to evaluate ergonomic seating based on comfort, usability, and support using an 11-point rating scale. For the present study, the instrument was modified into a 5-point Likert scale to simplify evaluation while maintaining its ability to measure user acceptability.

The questionnaire evaluated the ergonomic armchair attachment according to four dimensions:

- Ease of Use
- Chair Adjustment
- Seat Comfort
- Design and Appearance

Responses ranged from 1 (Poorly Acceptable) to 5 (Highly Acceptable). The overall acceptability of the prototype was determined using weighted mean scores based on the established descriptive interpretation.

Data Collection Procedure

Following approval of the research proposal, the ergonomic armchair attachment was fabricated and refined through several modifications to ensure compatibility with standard classroom armchairs. Data collection was conducted in selected hospitals, rehabilitation clinics, and the University of Perpetual Help – Dr. Jose G. Tamayo Medical University.
Eligible participants were provided with the ergonomic armchair attachment and the evaluation questionnaire. Licensed physical therapists assessed the prototype based on their professional expertise, while Physical Therapy students evaluated the attachment after using it. Completed questionnaires were collected immediately after the evaluation period and prepared for statistical analysis.

Statistical Analysis

The collected data were analyzed using frequency, percentage, and weighted mean. Frequency and percentage were used to summarize participants' demographic characteristics

and response distribution. Weighted mean was used to determine the level of acceptability of the ergonomic armchair attachment for each evaluation criterion and for the overall assessment.

The interpretation of weighted mean scores followed the established descriptive scale:

Weighted Mean	Interpretation
4.21–5.00	Highly Acceptable
3.41–4.20	Moderately Acceptable
2.61–3.40	Acceptable
1.80–2.60	Fairly Acceptable
1.00–1.79	Poorly Acceptable

Ethical Considerations

Ethical principles were strictly observed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents before data collection. Participants were informed about the objectives, procedures, benefits, and possible risks associated with the study. Confidentiality and anonymity were maintained by ensuring that all collected information was used solely for research purposes.

The ergonomic armchair attachment was inspected and tested before implementation to ensure participant safety during evaluation. Participants were informed that they could withdraw from the study at any time without consequence. Ethical approval for the study was obtained from the Ethics Committee of the University of Perpetual Help – Dr. Jose G. Tamayo Medical University prior to data collection.

RESULTS

The ergonomic armchair attachment was evaluated by licensed physical therapists and Physical Therapy students based on four dimensions: ease of use, chair adjustment, seat comfort, and design and appearance. Weighted mean scores were computed to determine the level of acceptability of the prototype.

Ease of Use

The ergonomic armchair attachment obtained an overall weighted mean of 4.23, corresponding to a Highly Acceptable rating. Among the evaluated items, ease of adjusting the backrest received the highest mean score (4.42), followed by ease of adjusting the chair seat while sitting (4.27). Cleaning the chair components received the lowest mean (4.02), although it remained within the acceptable range. These findings indicate that respondents generally found the prototype easy to operate and suitable for routine use.

Chair Adjustment

Chair adjustment obtained an overall weighted mean of 4.10, interpreted as Moderately Acceptable. The independent adjustment of the seat and backrest achieved the highest rating (4.32), while ease of adjusting the backrest angle obtained the lowest mean (3.80). These results suggest that although respondents appreciated the adjustability features, improvements in the adjustment mechanism could further enhance usability.

Seat Comfort

Seat comfort received the highest overall evaluation among all domains, with a weighted mean of 4.64, indicating a Highly Acceptable level of acceptability. Chair cushion comfort after prolonged sitting recorded the highest individual rating (4.72), followed by backrest cushion comfort (4.62) and seat edge comfort (4.60). These findings demonstrate that the ergonomic armchair attachment effectively provides support and comfort during extended periods of sitting.

Design and Appearance

The design and appearance of the ergonomic armchair attachment achieved an overall weighted mean of 4.23, corresponding to a Highly Acceptable rating. Durability received the highest score (4.45), while material quality (4.18) and overall appearance (4.05) received slightly lower evaluations. Although respondents expressed confidence in the durability of the prototype, the results suggest opportunities to improve its aesthetic appeal and material finish.

Overall Acceptability

Table 5 summarizes the overall acceptability ratings of the ergonomic armchair attachment. Seat comfort ranked first with a weighted mean of 4.64, followed by ease of use and design and appearance, which both obtained weighted means of 4.23. Chair adjustment ranked lowest with a weighted mean of 4.10. Nevertheless, the prototype achieved an overall weighted mean of 4.30, corresponding to a Highly Acceptable rating among both licensed physical therapists and Physical Therapy students. These findings indicate that the developed ergonomic armchair attachment satisfies the essential ergonomic requirements for promoting proper posture and improving user comfort during prolonged sitting.

DISCUSSION

The present study evaluated the acceptability of an innovative ergonomic armchair attachment designed to promote posture correction among college students. Overall, the prototype achieved a Highly Acceptable rating (weighted mean = 4.30), indicating that both licensed physical therapists and Physical Therapy students considered the attachment to be an effective ergonomic intervention for improving sitting posture and comfort.

Among the evaluated dimensions, seat comfort received the highest rating. Respondents particularly appreciated the comfort provided by the chair cushion and backrest during prolonged sitting. These findings support previous studies emphasizing that adequate cushioning and lumbar support reduce musculoskeletal strain and improve sitting tolerance during extended academic activities. Al-Hinai et al. (2018) demonstrated that ergonomically designed seating promotes proper spinal alignment and minimizes discomfort during prolonged sitting, while Alojado et al. (2015) similarly reported that ergonomic seating reduces physical strain associated with sustained postures. The present findings reinforce these conclusions by demonstrating that an ergonomic attachment, rather than complete chair replacement, can provide meaningful improvements in seating comfort.

The ease of use of the ergonomic armchair attachment was likewise rated highly acceptable, indicating that respondents found the prototype easy to install, adjust, and operate. Ease of adjusting the backrest received the highest evaluation within this category, suggesting that the design successfully incorporated user-friendly ergonomic features. These findings agree with previous research by Remolino et al. (2021) and Eldho and Muthukumar (2022), who

emphasized that ergonomic interventions should not only improve posture but also remain simple and practical for everyday use. User-friendly designs encourage consistent utilization, thereby increasing the likelihood of achieving long-term postural benefits. The design and appearance category also achieved a highly acceptable rating, with durability receiving the highest individual score. This suggests that respondents considered the prototype sufficiently robust for routine use. The findings correspond with Chainey (2022), who emphasized that material selection and structural durability are fundamental characteristics of effective ergonomic furniture. Although respondents rated the prototype favorably, slightly lower scores for appearance and material quality suggest opportunities for improving aesthetics without compromising functionality. Such refinements may further increase user acceptance in educational settings.

Although all evaluation domains achieved favorable ratings, chair adjustment received the lowest mean score and was interpreted as moderately acceptable. Respondents reported greater difficulty in adjusting the backrest angle and height compared with other features. This observation is consistent with Dumas et al. (2008), who noted that ergonomic devices must balance adjustability with ease of operation to avoid creating additional physical strain. Similarly, Pineda (2023) emphasized that ergonomic products should accommodate users with varying anthropometric characteristics through efficient adjustment mechanisms. The findings therefore indicate that improving the adjustment system should be prioritized in future prototype development.

The favorable overall evaluation of the ergonomic armchair attachment demonstrates the practical application of anthropometric and biomechanical principles in ergonomic furniture design. Unlike many existing interventions that require replacing entire classroom chairs, the present prototype offers an attachment that can be integrated into conventional school armchairs while still promoting improved posture and comfort. This addresses an important gap identified in previous studies, which highlighted the limited availability of affordable ergonomic solutions specifically designed for Filipino students. The use of local anthropometric considerations further strengthens the potential applicability of the prototype within Philippine educational institutions.

Overall, the findings indicate that the innovative ergonomic armchair attachment represents a practical and acceptable approach to posture correction. By combining ergonomic design, anthropometric measurements, and biomechanical support, the prototype demonstrates considerable potential as a classroom-based intervention that may contribute to reducing posture-related musculoskeletal discomfort among college students.

CONCLUSIONS

This study developed and evaluated an innovative ergonomic armchair attachment designed to enhance posture correction among college students. Based on the findings, the prototype achieved a Highly Acceptable overall rating, demonstrating its potential as an effective ergonomic intervention for improving sitting posture and comfort in educational settings. Among the evaluated dimensions, seat comfort received the highest acceptability rating, indicating that the ergonomic features of the attachment effectively provided support during prolonged sitting. Ease of use and design and appearance also achieved highly acceptable ratings, suggesting that respondents considered the prototype practical, durable, and user-friendly. Although chair adjustment received a comparatively lower rating, it remained within the moderately acceptable range, indicating opportunities for further refinement of the

adjustment mechanism. The findings demonstrate that integrating ergonomic principles, anthropometric measurements, and biomechanical considerations into the design of classroom seating attachments can significantly improve user acceptability. Unlike conventional ergonomic interventions that require replacing existing furniture, the developed attachment provides a practical and potentially cost-effective alternative that can be incorporated into standard school armchairs.

Overall, the study supports the feasibility of implementing ergonomic armchair attachments as an intervention to promote proper posture, reduce discomfort associated with prolonged sitting, and contribute to healthier learning environments for college students. Continued refinement and evaluation of the prototype may further improve its effectiveness and expand its application within educational and clinical settings.

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REFERENCES

Alojado, R., Custodio, B., Lasala, K. M., & Marigomen, P. L. (2015). Designing an ergonomic chair for pedicurists and manicurists in Quezon City, Philippines. *Procedia Manufacturing, 3*, 1812–1816. https://doi.org/10.1016/j.promfg.2015.07.220

Al-Hinai, N., Al-Kindi, M., & Shamsuzzoha, A. (2018). An ergonomic student chair design and engineering for classroom environment. *International Journal of Mechanical Engineering and Robotics Research, 7*(5), 534–543. https://doi.org/10.18178/ijmerr.7.5.534-543

Corner Chiropractic. (2020, July 23). *5 long-term complications of poor posture*. https://www.cornerchiropractic.com/5-long-term-complications-of-poor-posture

Hello Doctor. (2022, July 20). *Ano ang papel ng good posture sa kalusugan?* https://hellodoctor.com.ph/fil/orthopedics-fil/magandang-tindig/

Cabugawan, R., Laguador, H., Lim, K., Janice, M., & Gumasing, J. (n.d.). *Ergonomic design of computer workstation for college students studying at home*. IEOM Society International. https://ieomsociety.org/proceedings/2021rome/345.pdf

Chainey, K. (2022, January 12). *The chair guide: Construction and materials. Home Trends & Design*. https://www.htddirect.com/blog/the-chair-guide-construction-and-materials/

Chua, M. H. G., et al. (2023). An interplay of chair dimensions, anthropometric measures, posture, and comfort among students. In *2023 IEEE 15th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)* (pp. 1–6). https://doi.org/10.1109/HNICEM60674.2023.10589241

Dumas, G. A., Upjohn, T. R., Leger, A., Delisle, A., Charpentier, K., Plamondon, A., & Salazar, E. (2008). Effect of a desk attachment board on posture and muscle activity in women during computer work. *Ergonomics, 51*(11), 1735–1756. https://doi.org/10.1080/00140130802277539

Eldho, Z. C., & Muthukumar, K. (2022). Ergonomic risk assessment of students in digital learning. In *Advances in Behavioral Based Safety* (pp. 161–177). Springer. https://doi.org/10.1007/978-981-16-8270-4_12

Fidelis, O. P., & Ogunlade, B. (2022). Anthropometric perspective to classroom furniture ergonomics and the need for standards in Nigerian schools. *Work, 72*(1), 279–289. https://doi.org/10.3233/WOR-205317

Fujita, K., Suzuki, A., Takashima, K., Ikematsu, K., & Kitamura, Y. (2021). *TiltChair: Manipulative posture guidance by actively inclining the seat of an office chair*. https://doi.org/10.1145/3411764.3445151

Gabriel, R., Cadiz, D., James, C., Guerrero, J., Janice, M., & Gumasing, J. (n.d.). *Ergonomic design of computer workstations of high school students studying at home*. IEOM Society International. https://ieomsociety.org/proceedings/2021rome/498.pdf

Gaña, M. (2022). IJAMS 85: Development and validation of InfoSIM for Grade 1 mathematics instruction. *International Journal of Advanced Multidisciplinary Studies, 2*, 79–98. https://ijams-bbp.net/wp-content/uploads/2022/04/IJAMS-JANUARY-85-98.pdf

Ganti, A. (2024). *Central limit theorem (CLT): Definition and key characteristics*. Investopedia. https://www.investopedia.com/terms/c/central_limit_theorem.asp

Gumasing, M. J. J., Rendon, E. R. A., & German, J. D. (2023). Sustainable ergonomic workplace: Fostering job satisfaction and productivity among business process outsourcing (BPO) workers. *Sustainability, 15*(18), Article 13516. https://www.mdpi.com/2071-1050/15/18/13516

Jane, G., Marrie, A., Torion, J. A., & Jabagat, J. C. (2021, November 27). *Ergonomic evaluation of students' posture during synchronous class*. ResearchGate. https://www.researchgate.net/profile/Aila-Marrie-Remolino/publication/35658839

Nikolopoulou, K. (2022, August 11). *What is purposive sampling? Definition & examples*. Scribbr. https://www.scribbr.com/methodology/purposive-sampling/

Kianna, D., Villapando, L., Caday, K. A., Draculan, M., Janice, J., & Gumasing, J. (n.d.). *Mismatch analysis between classroom chair and anthropometric measurements of Mapúa University students*. IEOM Society International. https://ieomsociety.org/proceedings/2021rome/511.pdf

Latalski, M., et al. (2013). Risk factors of postural defects in children at school age. *Annals of Agricultural and Environmental Medicine, 20*(3), 583–587.

Lee, S.-M., Kim, H.-J., Ham, S.-J., & Kim, S. (2021). Assistive devices to help correct sitting posture based on posture analysis results. *JOIV: International Journal on Informatics Visualization, 5*(3), 340. https://doi.org/10.30630/joiv.5.3.673

Paradina, R. M., & Prasetyo, Y. T. (2022). A physical ergonomics study on adaptation and discomfort of students' e-learning in the Philippines during the COVID-19 pandemic. In *Big Data Management and Analysis for Cyber Physical Systems* (pp. 192–200). Springer. https://doi.org/10.1007/978-3-031-17548-0_17

Paul, J., Saguyod, A., Villapando, M., Janice, J., & Gumasing, J. (n.d.). *An ergonomic workstation design for apparel manufacturing workers in the Philippines*. IEOM Society International. https://www.ieomsociety.org/singapore2021/papers/467.pdf

Salac, M. V. (2020, November 19). *PRESENT: An Android-based class attendance monitoring system using face recognition technology*. https://doi.org/10.48550/arXiv.2012.01907

Alexander Technique Education. (2024). *Seven articles on various aspects of the Alexander Technique*. https://ate.org.au/resources/seven-articles/

Soltaninejad, M., Babaei-Pouya, A., Poursadeqiyan, M., & Feiz Arefi, M. (2021). Ergonomics factors influencing school education during the COVID-19 pandemic: A literature review. *Work, 68*(1), 69–75. https://doi.org/10.3233/WOR-203355

Syazwan, A. I., Rafee, S., Hanafiah, J., Azhar, M., & Zailina, H. (2011). Poor sitting posture and a heavy school bag as contributors to musculoskeletal pain in children: An ergonomic school education intervention program. *Journal of Pain Research, 4*, 287–296. https://doi.org/10.2147/JPR.S22281

Yogi Tri Prasetyo, Kumar, A., Alyza, J. P., Timothy, K., Siochi, A. S., & Kester, A. (2021). Evaluation of chair dimensions, anthropometric measurements, and subjective comfort among Filipino high school students: A structural equation modelling approach. *Applied Sciences, 11*, Article 10642. https://doi.org/10.3390/app112210642

Yumang, A. N., Rupido, C. S., & Panelo, F. V. (2023). Analyzing effects of daily activities on sitting posture using sensor fusion with Mahony filter. In *2023 IEEE 15th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)*. https://doi.org/10.1109/HNICEM60674.2023.10589102