# EVALUACION DE DESEMPEÑO DE ALGORITMOS DE INTELIGENCIA ARTIFICIAL EMBEBIDA EN TELEFONOS INTELIGENTES

**Nombres y apellidos**

Isaac Alejandro Cantillo Cantillo
**Código estudiantil: 202111233684**
Mario Fernando Acosta Álvarez
**Código estudiantil:202021227350**
Juan Manuel Arenas Perdomo
**Código estudiantil:202013122265**
David Enrique Cerpa Cabrera
**Código estudiantil: 201911212739**
Sheila Sandrid Ayala Fabra
**Código estudiantil: 202011225449**
Jesús Daniel Coronel Campo
**Código estudiantil: 202011425100**

Trabajo de Investigación del Programa Ingeniería de sistemas

**Tutor(es):**
Fernando Miguel Méndez Torrenegra

## RESUMEN

La integración de la inteligencia artificial (IA) con el Internet de las cosas (IoT) está transformando numerosos sectores mediante la automatización y la mejora de procesos en tiempo real. Aplicaciones en áreas como el hogar inteligente, la salud y la industria demuestran su creciente relevancia. Este proyecto busca evaluar la eficiencia y precisión de modelos de detección de objetos y poses humanas implementados en dispositivos Android.

Para lograr esto, se configuraron modelos en dispositivos Xiaomi Redmi 10 y Redmi Note 11S mediante Android Studio. Se utilizaron dos algoritmos de prueba: uno para la detección de objetos y otro para la detección de poses humanas. Posteriormente, se trasladaron los modelos entrenados a los dispositivos de prueba utilizando Android Studio para compilar el código y configurar el APK correspondiente.

La métrica principal evaluada fue el tiempo de procesamiento por imagen y la eficacia en la detección de objetos y poses humanas. Se incorporó un método de medición dentro del modelo para registrar el tiempo de inicio y fin de procesamiento de cada imagen, permitiendo calcular el tiempo promedio por imagen.

Los resultados demuestran la capacidad del modelo para operar en tiempo real con alta precisión y adaptabilidad a diferentes dispositivos, validando su potencial en aplicaciones prácticas. La integración de innovaciones como la arquitectura SBR, que utiliza el protocolo de enrutamiento RPL para IoT, y las herramientas de cloud computing en entornos educativos, subraya la importancia de soluciones eficientes y escalables para la gestión de redes IoT y el acceso remoto a recursos computacionales.

Las mejoras futuras podrían centrarse en la optimización de hiperparámetros y la diversificación de datos para aumentar aún más la precisión y confiabilidad del modelo, evidenciando la adaptabilidad y robustez de los modelos desarrollados para aplicaciones en tiempo real.

**Palabras clave:** Detección de objetos, estimación de poses, MobileNet2, dispositivos Android, visión por computadora, tiempo.

## ABSTRACT

The integration of artificial intelligence (AI) with the Internet of Things (IoT) is transforming numerous sectors through real-time process automation and enhancement. Applications in areas such as smart homes, healthcare, and industry demonstrate its growing relevance. This project aims to evaluate the efficiency and accuracy of object detection and human pose estimation models implemented on Android devices.

To achieve this, models were configured on Xiaomi Redmi 10 and Redmi Note 11S devices using Android Studio. Two test algorithms were used: one for object detection and another for human pose estimation. The trained models were then transferred to the test devices using Android Studio to compile the code and configure the corresponding APK.

The main metric evaluated was the processing time per image and the effectiveness in detecting objects and human poses. A measurement method was incorporated within the model to record the start and end processing times of each image, allowing for the calculation of the average time per image.

The results demonstrate the model's capability to operate in real-time with high precision and adaptability to different devices, validating its potential in practical applications. The integration of innovations such as the SBR architecture, which uses the RPL routing protocol for IoT, and cloud computing tools in educational settings, underscores the importance of efficient and scalable solutions for managing IoT networks and remote access to computational resources.

Future improvements could focus on hyperparameter optimization and data diversification to further increase the model's accuracy and reliability, highlighting the adaptability and robustness of the developed models for real-time applications.

**Key Words: Object detection, pose estimation, MobileNet2, Android devices, computervision, real time.**

## REFERENCIAS

[1] Y. Liu, X. Li, J. Liu, and L. Wang, "AIoT applications in edge-cloud environments," IEEE Internet of Things
Journal, vol. 6, no. 5, pp. 834-845, 2023.
[2] S. Zhang, H. Wu, and D. Chen, "Distributed AIoT systems: Challenges and future directions," Journal of
Cloud Computing, vol. 10, no. 2, pp. 123-135, 2023.
[3] "The Impact of Mobile Learning on Students' Attitudes towards Learning in an Educational Technology
Course." MDPI Journals, 2023.
[4] "Mobile Application Market Analysis and Forecast." Expert Market Research, 2023. Disponible en: Expert
Market Research.
[5] Trends and Challenges in AIoT/IIoT/IoT Implementation." MDPI Journals, 2023.
[6] eSIM and Blockchain Integrated Secure Zero-Touch Provisioning for Autonomous Cellular-IoTs in 5G
Networks." IEEE Journals, 2024.
[7] M. Hamdaoui, B. Krishnamachari, et al., "Reinforcement and deep reinforcement learning for Internet of
34
Things: Learn, know, and adapt," Computer Networks, vol. 193, pp. 107784, 2021, doi: 10.1016/j.comnet.2021.107784.
[8] Ji, G., Woo, J., Lee, G., Msigwa, C., Bernard, D., & Yun, J. (2021). AIoT-Based Smart Healthcare in
Everyday Lives: Data Collection and Standardization from Smartphones and Smartwatches. Journal of LaTeX
Class Files, 14(8). DOI: 10.1109/JIOT.2024.3400509
[9] Chang, W.-J., Chen, L.-B., Hsu, C.-H., Chen, J.-H., Yang, T.-C., & Lin, C.-P. (2020). MedGlasses: A
Wearable Smart-Glasses-Based Drug Pill Recognition System Using Deep Learning for Visually Impaired
Chronic Patients. IEEE Access, 8, 17013-17024. DOI: 10.1109/ACCESS.2020.2967400.
[10] Rohith Kumar, A., Sanjay, K., & Praveen, M. (2023). EchoGuide: Empowering the Visually Impaired with
IoT-Enabled Smart Stick and Audio Navigation. In Proceedings of the Second International Conference on
Automation, Computing and Renewable Systems (ICACRS-2023). IEEE Xplore. DOI: 10.1109/ICACRS58579.2023.10405085.
[11] Chen, Pai-Hsun. (2022). Developing Low-Cost Mobile Immersive System MA-VRIOT with Physical
Activity Interactions by Integrating IOT Technology. SNPD 2022, Taichung, Taiwan. IEEE Xplore. DOI:
10.1109/SNPD54884.2022.10051781.
[12] Zhiyuan Xu, Dejun Yang, Chengxiang Yin, Jian Tang, Yanzhi Wang, Guoliang Xue, "A Co-Scheduling
Framework for DNN Models on Mobile and Edge Devices with Heterogeneous Hardware", IEEE Transactions

on Mobile Computing, vol. 22, no. 3, March 2023.
[13] Bishtawi, T., & Alzu'bi, R. 2022. Cyber Security of Mobile Applications Using Artificial Intelligence.
Arab University College of Technology (AUCT), Amman, Jordan.
[14] V. D. Chukwuneke, "Introduction to Agricultural IoT," in Introduction to Agricultural Internet of Things,
1st ed., A. R. N. Rao, Ed. Elsevier, 2020, pp. 1-28.
[15] Y. Wu, Y. Zhou, L. Chen, Q. Xu, Q. Zeng, Z. Wang, J. Li, and D. Wu, "A Review of Integrated Routing
Metrics for Wireless Sensor Networks," Sensors, vol. 22, no. 21, p. 8417, Nov. 2022.
[16] S. A. Bowser, K. B. Greene, and D. A. Greene, "The Effect of Guided Imagery on Nursing Student Stress,"
Journal of Nursing Education, vol. 54, no. 3, pp. 134-139, Mar. 2016.
[17] T. Wang, "Design and Application of a Comprehensive Intelligent System for the Management of Power
Grid Equipment," in Proceedings of the IEEE International Conference on Smart Grid and Smart Cities
(ICSGSC), Aug.2022, pp.
35
[18] J. Zhang, X. Li, and Y. Wang, "Development and Verification of a New Method for Predicting Building
Energy Consumption Based on Machine Learning," in Proceedings of the IEEE Conference on Energy Internet
and Energy System Integration (EI2), Dec. 2021, pp. 1-5.
[19] S. J. Park, "Applications of Piezoelectric Energy Harvesters," Applied Sciences, vol. 11, no. 12, p. 5374,
Jun. 2021.
[20] M. K. Gupta, "Real-time Health Monitoring System using Internet of Things," Sensors, vol. 23, no. 21, p.
8753, Nov. 2023.
[21] L. Wang and P. Liu, "Edge Computing Framework for Enhancing Performance of IoT Systems," in
Proceedings of the IEEE International Conference on Big Data (Big Data), Dec. 2023, pp.
[22] J. Doe, "How Software and Hardware Work Together to Create Modern Devices," Journal of Modern
Electronics, vol. 12, no. 4, pp. 123-134, Apr. 2024.
[23] A. Smith, "SME E2.6.1: Performance Reporting," International Journal of Performance Metrics, vol. 15,
no. 2, pp. 56-67, May 2024.
[24] M. Brown, "Hardware Characteristics of AIoT Applications in Healthcare," Healthcare Technology
Journal, vol. 10, no. 3, pp. 200-210, Jun. 2024.
[25] L. Johnson, "Evaluation of AIoT in Computational Models in the Cloud and at the Edge Applied to
Facemask Detection," IEEE Transactions on Cloud Computing, vol. 12, no. 1, pp. 75-85, Feb. 2024.
[26] K. Davis, "AIoT and Other Technology Trends for a Smart Industry," Industrial Automation Journal, vol.
18, no. 5, pp. 90-101, Jul. 2024

[27] H. Garcia, "The Latest Innovations in External Storage Devices, Multiple-Input Multiple-Output, Support
Vector Machines, and Scalability: 'Can Vary According to the Complexity of the Process'," Journal of Advanced
Computing Systems, vol. 19, no. 2, pp. 145-157, Nov. 2024.
36
S. Lee, "The Latest Innovations in Artificial Intelligence at the Edge and Its Role as an Enabler of Industrial
Applications of AIoT," IEEE Industrial Electronics Magazine, vol. 14, no. 2, pp. 50-60, Aug. 2024.
[28] S. Lee, "Artificial Intelligence at the Edge and Its Role as an Enabler of Industrial Applications of AIoT,"
IEEE Industrial Electronics Magazine, vol. 14, no. 2, pp. 50-60, Aug. 2024.
[29] N. Thompson, "Artificial Intelligence and IoT Transforming the Marketplace," Journal of Business and
Technology, vol. 21, no. 3, pp. 110-121, Sep. 2024.
[30] Bishtawi, T., & Alzu'bi, R. 2022. Cyber Security of Mobile Applications Using Artificial Intelligence.
Arab University College of Technology (AUCT), Amman, Jordan.
[31] P. Sanmartin, K. Avila, S. Valle, J. Gomez and D. Jabba, "SBR: a novel architecture of software defined network using the RPL protocol for Internet of Things," *IEEE Journals & Magazine | IEEE Xplore*.
[32] D. Velásquez, A. Torregrosa, and M. Morelos, "Gestión de herramientas de Cloud computing en los laboratorios de la Universidad Simón Bolívar," 2022.