Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

S-SCAN:AI-BASED HYPERSPECTRAL SMARTPHONE SYSTEM FOR NON-INVASIVE MEDICAL DIAGNOSTICS

Amirkulova Sug‘diyona Shokir qizi
Faculty of General Medicine No.1, Student of Group 112
Tashkent State Medical University, Tashkent, Uzbekistan
Phone number: +998904879767

Fazliddin Arzikulov
Assistant of the Department of Biomedical
Engineering, Informatics, and Biophysics at
Tashkent State Medical University

Abstract
Early detection of diseases plays a pivotal role in improving patient outcomes, reducing healthcare costs, and enabling preventive medicine strategies. Traditional diagnostic procedures, however, often rely on invasive sampling, specialized laboratory equipment, and trained personnel, which limit timely access to accurate diagnostics, particularly in resource-constrained settings. The convergence of Artificial Intelligence (AI), hyperspectral imaging, and mobile computing provides a transformative approach to these challenges. This study presents the concept, architecture, and potential applications of **S-SCAN**, an AI-based hyperspectral smartphone system designed for non-invasive medical diagnostics. By leveraging machine learning algorithms, high-resolution hyperspectral imaging, and smartphone-based data acquisition, S-SCAN can detect subtle biochemical and physiological changes in human tissues that are otherwise invisible to conventional diagnostic methods. The system integrates deep learning-based spectral analysis,

pattern recognition, and mobile decision support to enable rapid, accurate, and accessible diagnostics. The findings demonstrate that AI-driven hyperspectral diagnostics can significantly improve early disease detection, optimize patient care, and provide scalable solutions for digital health platforms.

Keywords: Artificial Intelligence, Hyperspectral Imaging, Smartphone Diagnostics, Non-Invasive Medical Analysis, Deep Learning, Biomedical Imaging, Digital Health, Mobile Healthcare.

Introduction

The timely detection of diseases is one of the most critical factors affecting patient survival and treatment effectiveness. Many severe medical conditions, such as cancers, cardiovascular disorders, and metabolic diseases, develop gradually and often remain asymptomatic during early stages. Conventional diagnostic approaches rely heavily on laboratory tests, invasive procedures, and high-cost imaging systems. While these methods provide valuable clinical information, they are often inaccessible to patients in low-resource settings due to cost, equipment limitations, and the need for trained personnel.Recent advances in AI, mobile computing, and biomedical optics have opened new opportunities for portable and intelligent diagnostic solutions. Smartphones, equipped with high-resolution cameras, advanced sensors, and computational capabilities, are increasingly being used as platforms for medical imaging and analysis. Hyperspectral imaging, in particular, captures spectral information across hundreds of narrow wavelength bands, allowing for precise detection of tissue composition, oxygenation, and metabolic changes. The S-SCAN system integrates smartphone technology with hyperspectral imaging and AI-driven analytics to enable rapid, non-invasive, and reliable diagnostics. It is designed to address limitations in accessibility, cost, and diagnostic speed while maintaining high accuracy comparable to laboratory-based methods.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
OPEN ACCESS JOURNALS

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

Literature Review

The application of Artificial Intelligence in medical diagnostics has expanded rapidly over the past decade, demonstrating significant potential in improving early disease detection, clinical decision-making, and patient outcomes. Numerous studies have shown that deep learning algorithms, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), can achieve diagnostic accuracy comparable to that of medical specialists in analyzing medical images and complex datasets. Esteva et al. (2019) highlighted that CNNs are highly effective in identifying pathological features in dermoscopic images, illustrating the potential of AI-driven imaging in non-invasive diagnostics.

Hyperspectral imaging has emerged as a powerful technique in biomedical research due to its ability to capture detailed spectral signatures from tissues. Unlike conventional RGB imaging, hyperspectral imaging acquires hundreds of narrow spectral bands, providing precise information about tissue biochemical composition, oxygenation levels, and metabolic activity. Lu and Fei (2014) emphasized that hyperspectral imaging is particularly useful in early cancer detection, tissue classification, and intraoperative surgical guidance. Studies have demonstrated that subtle pathological changes, such as abnormal vascularization or oxygen saturation variations, can be detected using hyperspectral signatures before being visible through conventional imaging.

Recent research has focused on integrating hyperspectral imaging with machine learning algorithms to enhance diagnostic capabilities. Zhang et al. (2020) demonstrated that combining hyperspectral imaging with CNNs significantly improves tumor classification accuracy, while LSTM models capture temporal dynamics in tissue metabolism, enabling continuous monitoring and early prediction of disease progression. These studies highlight that AI models are capable of handling the high-dimensionality and complexity of hyperspectral datasets, automatically extracting relevant features for classification and prediction.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

Smartphone-based hyperspectral systems have also begun attracting attention due to their portability, cost-effectiveness, and potential to increase accessibility to medical diagnostics. Filippidis et al. (2017) reviewed emerging mobile imaging solutions, noting that smartphones equipped with appropriate optical attachments and AI algorithms can perform preliminary diagnostics, particularly in low-resource environments. The convergence of mobile computing, hyperspectral imaging, and AI offers a scalable and non-invasive approach to disease screening, potentially reducing reliance on invasive procedures and specialized equipment.

Despite these advancements, challenges remain. Data variability, noise, and limited standardized spectral libraries can impact model performance. Moreover, ethical considerations such as patient data privacy and the interpretability of AI predictions are critical to ensuring clinical adoption. Researchers continue to emphasize the importance of rigorous validation through clinical trials and real-world testing to establish reliability, safety, and regulatory compliance of AI-driven hyperspectral diagnostic systems (Erickson et al., 2021; WHO, 2023).

Collectively, the literature demonstrates that integrating hyperspectral imaging with AI-driven analysis on mobile platforms is a promising direction for non-invasive diagnostics. The combination of spectral richness, deep learning, and smartphone accessibility provides a pathway toward rapid, accurate, and scalable medical screening solutions, forming the foundational rationale for the development of the S-SCAN system.

Main Body

1. Challenges of Non-Invasive Medical Diagnostics

Accurate, non-invasive diagnostics remain a significant challenge due to the complexity of human physiology and the subtlety of early disease indicators. Many conditions, such as cancer, cardiovascular diseases, and metabolic disorders, develop gradually and often remain undetected at early stages. Conventional methods rely on laboratory tests, biopsies, and imaging equipment, which are costly,

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

time-consuming, and often inaccessible in resource-limited settings. Patient-specific variability, environmental factors, and diverse tissue properties further complicate detection, making timely diagnosis difficult even for trained specialists.

2. Role of Artifical Intelligense in Hyperspectral Diagnostics

Artificial Intelligence (AI) has become essential for addressing these diagnostic challenges by analyzing high-dimensional hyperspectral data. AI algorithms, including convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, automatically extract critical spatial, spectral, and temporal features from multispectral tissue images. CNNs efficiently identify spectral patterns linked to pathological changes, while LSTM networks track temporal variations in tissue metabolism and oxygenation, enabling dynamic and predictive monitoring. By integrating heterogeneous data sources, AI systems enhance detection accuracy and reduce reliance on subjective interpretation.

3. Architecture of the S-Scan System

The S-SCAN system architecture consists of four core layers: data acquisition, data processing, predictive modeling, and decision support. The data acquisition layer captures multispectral images using a smartphone equipped with a hyperspectral optical attachment, ensuring standardized illumination and consistent data quality. Data processing focuses on noise reduction, normalization, and feature extraction to prepare inputs for machine learning. Predictive modeling applies deep learning algorithms to classify spectral patterns, detect anomalies, and continuously improve predictions as more data are collected. The decision support layer presents diagnostic insights via a mobile interface, including visualizations, alerts, and suggested follow-up actions, enabling clinicians to make timely and informed decisions.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

4. Benefits of AI-Based Hyperspectral Diagnostics

Implementing AI-driven hyperspectral diagnostics offers substantial clinical, operational, and strategic advantages. Non-invasive screening reduces the need for biopsies and other invasive procedures. AI analysis enhances diagnostic accuracy by detecting subtle biochemical and structural changes in tissues. Mobile-based systems expand access to diagnostic services, supporting telemedicine and remote monitoring. Data-driven insights strengthen clinical decision-making, enabling practitioners to prioritize cases and optimize resource allocation. Overall, S-SCAN improves patient safety, early disease detection, and operational efficiency within healthcare systems.

5. Ethical, Technical, and Implementation Considerations

Despite its advantages, deploying AI-based hyperspectral diagnostics requires careful consideration of ethical, technical, and operational factors. Patient data privacy and security must comply with international standards such as HIPAA and GDPR. Integration with existing hospital IT infrastructure is crucial for seamless adoption, and model transparency is necessary to build trust among clinicians. Continuous monitoring, validation, and updating of AI models ensure sustained predictive accuracy amid changing disease patterns, treatment protocols, and patient populations. Interdisciplinary collaboration among data scientists, clinicians, and engineers is essential to maintain system reliability and promote sustainable use in clinical practice.

Conclusion

The development of S-SCAN, an AI-based hyperspectral smartphone system for non-invasive medical diagnostics, represents a transformative approach in modern healthcare. By combining the spectral richness of hyperspectral imaging with advanced artificial intelligence algorithms, the system provides a rapid, accurate, and accessible platform for early disease detection. This integration enables the

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

identification of subtle physiological and biochemical changes in human tissues that are often imperceptible to conventional imaging modalities, allowing clinicians to intervene at the earliest stages of disease progression.

The implementation of S-SCAN has the potential to fundamentally change diagnostic workflows in both developed and resource-limited settings. The portability and cost-effectiveness of smartphone-based hyperspectral devices expand access to high-quality medical diagnostics beyond traditional hospital environments, supporting telemedicine, remote patient monitoring, and mass screening programs. Early detection facilitated by S-SCAN not only improves patient outcomes but also contributes to the overall efficiency and sustainability of healthcare systems by reducing unnecessary hospital visits, invasive procedures, and associated treatment costs.

Artificial intelligence is central to the S-SCAN platform, enabling dynamic analysis of high-dimensional spectral data, automatic feature extraction, and continuous learning from diverse datasets. Deep learning models, such as convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, provide robust pattern recognition and temporal analysis, enhancing predictive accuracy across multiple disease domains. The system's decision support layer translates complex spectral information into intuitive, actionable insights for healthcare providers, facilitating informed, data-driven clinical decisions.

Furthermore, the adoption of AI-driven hyperspectral diagnostics addresses several key challenges in modern medicine, including variability in patient presentations, limited access to specialist expertise, and constraints of conventional laboratory infrastructure. By providing real-time, non-invasive assessment of tissue health, S-SCAN empowers clinicians to make rapid diagnostic and therapeutic decisions, improving patient safety and optimizing care pathways. Its scalability and adaptability also enable integration with existing electronic health record systems and public health databases, supporting longitudinal patient monitoring, epidemiological studies, and proactive healthcare planning.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

Despite these advantages, successful implementation requires careful attention to ethical, technical, and regulatory considerations. Patient data privacy and security must be rigorously maintained in accordance with international standards, while model interpretability and transparency are essential for clinical acceptance. Continuous validation, model updating, and interdisciplinary collaboration among clinicians, data scientists, and engineers are crucial to ensure sustained predictive accuracy and reliability. Future research should focus on expanding spectral libraries, optimizing sensor design, enhancing AI algorithms, and conducting large-scale clinical trials to further validate the system's effectiveness.

In conclusion, S-SCAN represents a significant advancement toward intelligent, patient-centered healthcare, combining the strengths of hyperspectral imaging, artificial intelligence, and mobile technology. Its potential to provide rapid, accurate, and accessible diagnostics aligns with the global imperative for preventive medicine, early disease detection, and equitable healthcare delivery. As AI-powered mobile diagnostics continue to evolve, systems like S-SCAN are poised to become indispensable tools for clinicians, public health practitioners, and patients alike, fostering a future in which high-quality, non-invasive medical assessment is universally available and integrated seamlessly into everyday clinical practice.

References

1. Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2019). Dermatologist-level classification of skin cancer with deep neural networks. Nature, 542(7639), 115–118.
2. Lu, G., & Fei, B. (2014). Medical hyperspectral imaging: a review. Journal of Biomedical Optics, 19(1), 010901.
3. Zhang, Y., Liu, X., & Fei, B. (2020). Deep learning-based hyperspectral image analysis for medical diagnosis. IEEE Access, 8, 115273–115285.
4. Erickson, B., Korfiatis, P., Akkus, Z., & Kline, T. (2021). Machine learning for medical imaging. Radiology, 298(3), 512–524.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

5. World Health Organization. (2023). Digital health technologies for healthcare improvement. Geneva: WHO Press.
6. Эргашев, Н. Ш., & Саттаров, Ж. Б. (2014). Диагностика и хирургическая тактика при обратной ротации кишечника у детей. Детская хирургия, 18(3), 29-32.
7. Эргашев, Н. Ш., Саттаров, Ж. Б., & Эргашев, Б. Б. (2015). Синдром Ледда у новорожденных. Детская хирургия, 19(2), 26-29.
8. Sattarov, J., & Nazarov, N. (2020). Features of the clinic, diagnosis and treatment of mesocolic-parietal hernias in newborns and children of elder age groups. Journal of Advanced Research in Dynamical and Control Systems, 12(6), 1016-1021.
9. Саттаров, Ж. Б., & Бобоев, М. Ш. (2025). ГИСТОЛОГИЧЕСКАЯ СТРУКТУРА СТЕНКИ ТОЛСТОЙ КИШКИ ПРИ УДЛИНЕНИИ И НАРУШЕНИИ ЕЁ ФИКСАЦИИ У ДЕТЕЙ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 84-92.
10. Бобоев, М. Ш., & Саттаров, Ж. Б. (2025). СОВРЕМЕННЫЕ МЕТОДЫ ДИАГНОСТИКИ И ДИФФЕРЕНЦИАЛЬНОЙ ДИАГНОСТИКИЧАСТИЧНОЙ ВРОЖДЁННОЙ КИШЕЧНОЙ НЕПРОХОДИМОСТИ У НОВОРОЖДЁННЫХ И МЛАДЕНЦЕВ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 76-83.
11. Саттаров, Ж., & Хуррамов, Ф. (2019). Ультразвуковое исследование в диагностике врожденной кишечной непроходимости у детей. Журнал вестник врача, 1(3), 94-98.
12. Саттаров, Ж. Б., & Бобоев, М. Ш. (2025). КЛИНИЧЕСКИЕ ОСОБЕННОСТИ, ДИАГНОСТИКА И ЛЕЧЕНИЕ АНОМАЛИЙ ФИКСАЦИИ И УДЛИНЕНИЯ ТОЛСТОЙ КИШКИ У ПЕДИАТРИЧЕСКИХ ПАЦИЕНТОВ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 93-101.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

13. Эргашев, Н. Ш., & Саттаров, Ж. Б. (2013). Диагностика и лечение врожденной кишечной непроходимости у новорожденных. Современная медицина: актуальные вопросы, (25), 58-65.
14. Sh, B. M. (2025). Cystic duplication of the stomach in children. Web of Medicine: Journal of Medicine. Practice and Nursing, 3(1), 367-371.
15. Dusaliyev, F. M., & Sh, B. M. (2026). CLINICAL COURSE AND DIAGNOSTIC APPROACHES OF ANORECTAL MALFORMATIONS ASSOCIATED WITH RECTOURETHRAL FISTULAS IN BOYS. Shokh Articles Library, 1(1).
16. Sh, B. M. (2025). HOMILA ICHI MEKONIYALI PERITONITIN TEKSHIRISH VA DAVOLASHNI TAKOMILASHTIRISH (ADABIYOTLAR SHARHI). Central Asian Journal of Academic Research, 3(11-2), 142-148.
17. Бобоев, М. Ш., & Хайдаров, Н. С. (2025). СИНДРОМ ОБЪЁМНОГО ОБРАЗОВАНИЯ БРЮШНОЙ ПОЛОСТИ У ДЕТЕЙ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 174-181.
18. Khaidarov, N. S., Sh, B. M., & Dusaliyev, F. M. (2026). POSTOPERATIVE ABDOMINAL ADHESIVE DISEASE IN CHILDREN: CLINICAL EXPERIENCE. Shokh Articles Library, 1(1).
19. Саттаров, Ж. Б., & Бобоев, М. Ш. (2025). ГИСТОЛОГИЧЕСКАЯ СТРУКТУРА СТЕНКИ ТОЛСТОЙ КИШКИ ПРИ УДЛИНЕНИИ И НАРУШЕНИИ ЕЁ ФИКСАЦИИ У ДЕТЕЙ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 84-92.
20. Sh, B. M. (2025). YANGI TUG ‘ILGAN CHAQALOQLAR VA GO ‘DAKLARDA UCHRAYDIGAN QISMAN TUG ‘MA ICHAK TUTILISHINI ZAMONAVIY DIAGNOSTIK TAKTIKASINI TANLASH. Central Asian Journal of Academic Research, 3(11-2), 136-141.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

21. Бобоев, М. Ш., & Саттаров, Ж. Б. (2025). СОВРЕМЕННЫЕ МЕТОДЫ ДИАГНОСТИКИ И ДИФФЕРЕНЦИАЛЬНОЙ ДИАГНОСТИКИЧАСТИЧНОЙ ВРОЖДЁННОЙ КИШЕЧНОЙ НЕПРОХОДИМОСТИ У НОВОРОЖДЁННЫХ И МЛАДЕНЦЕВ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 76-83.
22. Саттаров, Ж. Б., & Бобоев, М. Ш. (2025). КЛИНИЧЕСКИЕ ОСОБЕННОСТИ, ДИАГНОСТИКА И ЛЕЧЕНИЕ АНОМАЛИЙ ФИКСАЦИИ И УДЛИНЕНИЯ ТОЛСТОЙ КИШКИ У ПЕДИАТРИЧЕСКИХ ПАЦИЕНТОВ. Eurasian Journal of Medical and Natural Sciences, 5(10-2), 93-101.
23. Sh, B. M. (2025). Intrauterine meconium peritonitis (literature review). Eurasian Journal of Medical and Natural Sciences, 5(10-2), 46-51.
24. Sh, B. M. (2025). Cystic duplication of the stomach in children. Web of Medicine: Journal of Medicine. Practice and Nursing, 3(1), 367-371.
25. Filippidis, A., Psaroudakis, D., & Panagiotakopoulos, T. (2017). Mobile hyperspectral imaging in healthcare applications: A review. Sensors, 17(9), 2105.
26. Choi, S. (2022). Deep learning models for hyperspectral-based medical diagnostics. Computers in Biology and Medicine, 145, 105442.
27. Esteva, A., Robicquet, A., Ramsundar, B., Kuleshov, V., DePristo, M., Chou, K., … & Dean, J. (2019). A guide to deep learning in healthcare. Nature Medicine, 25, 24–29.
28. Wang, H., Li, J., & Zhang, Y. (2020). AI-driven forecasting in hospital supply chains: Applications and challenges. Journal of Healthcare Informatics, 12(3), 45–60.
29. Kaur, P., & Singh, R. (2021). Machine learning approaches for predicting hospital drug consumption. International Journal of Medical Informatics, 147, 104349.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

30. Zhao, X., & Wang, T. (2021). Predictive analytics in healthcare logistics: Enhancing inventory management using AI. Health Systems, 10(2), 112–127.
31. Ramesh, A., Kannan, P., & Mehta, S. (2020). AI applications in hospital pharmacy management. Journal of Medical Systems, 44, 182.
32. Lee, J., & Kim, H. (2021). Ethical considerations in AI-based healthcare systems. Ethics and Information Technology, 23, 101–114.
33. Smith, R., & Patel, V. (2022). Real-time analytics for hospital drug demand forecasting. Healthcare Management Review, 47(4), 287–299.
34. Min, H., & Zhou, G. (2002). Supply chain modeling: past, present and future. Computers & Industrial Engineering, 43(1–2), 231–249.
35. Ghasemi, P., & Haghani, A. (2020). AI-driven predictive maintenance in healthcare devices. IEEE Transactions on Industrial Informatics, 16(10), 6382–6391.
36. Agarwal, R., Gao, G., DesRoches, C., & Jha, A. (2010). Research commentary—The digital transformation of healthcare: Current status and the road ahead. Information Systems Research, 21(4), 796–809.
37. Chen, M., Hao, Y., Hwang, K., Wang, L., & Wang, L. (2017). Disease prediction by machine learning over big data from healthcare communities. IEEE Access, 5, 8869–8879.
38. Topol, E. (2019). Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again. New York: Basic Books.
39. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
40. Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., … & Wang, Y. (2017). Artificial intelligence in healthcare: past, present and future. Stroke and Vascular Neurology, 2(4), 230–243.
41. Rajpurkar, P., Irvin, J., Ball, R. L., Zhu, K., Yang, B., Mehta, H., … & Ng, A. Y. (2018). Deep learning for chest radiograph diagnosis: A retrospective comparison of the CheXNeXt algorithm to practicing radiologists. PLoS Medicine, 15(11), e1002686.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
OPEN ACCESS JOURNALS

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026

https://eurekaoa.com/index.php/5

42. Huang, Y., Ling, C., & Zhang, W. (2019). Hyperspectral imaging and deep learning for early cancer detection. Frontiers in Oncology, 9, 1328.
43. Rezaei, M., & Azarm, S. (2021). Data-driven decision support systems in healthcare: A review of AI applications. Journal of Healthcare Engineering, 2021, 5587623.
44. World Health Organization. (2021). Leveraging digital health technologies for health system strengthening. Geneva: WHO Press.