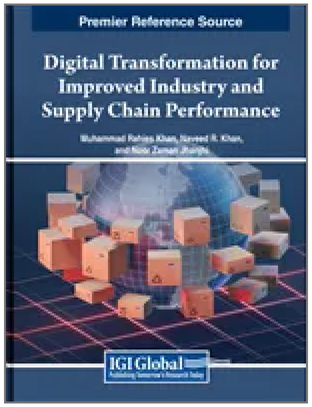


Towards Sustainability in Agriculture: Smart Data Logger for Solar Indirect Dryer

Muhammad Arslan (/affiliate/muhammad-arslan/469892/), Muhammad Mutasaddiq Ali (/affiliate/muhammad-mutasaddiq-ali/469893/), Muhammad Burhan (/affiliate/muhammad-burhan/469894/), Syeda Mariam Muzammal, NZ Jhanjhi, Ruqia Bibi

Source Title: Digital Transformation for Improved Industry and Supply Chain Performance (/gateway/book/339902)
 | Pages: 20
ISBN13: 9798369353752 | ISBN13 Softcover: 9798369353769 | EISBN13: 9798369353776
DOI: 10.4018/979-8-3693-5375-2.ch009

Cite Chapter   Favorite ★

View Full Text HTML > (/gateway/chapter/full-text-html/346172) View Full Text PDF > (/gateway/chapter/full-text-pdf/346172)

Abstract

Solar indirect dryer technology has long been recognized for its historical significance and cost-effectiveness in agricultural practices. Solar dryers are being developed as a sustainable solution for reduction of food scarcity particularly for drying food and storing it for longer durations. Among the various solar drying methods, solar indirect dryers stand out for their efficiency and economy, offering a reliable means of preserving food quality and availability during off-season periods. Despite their effectiveness, the current monitoring and control procedures for solar indirect dryers heavily rely on manual site visits by researchers, mainly due to the limitations of sensor-based systems in operation. In response to these challenges, this research proposes a transformative approach by integrating advanced sensors for continuous monitoring of temperature and humidity at multiple points within the solar indirect dryer. Additionally, the implementation of a smart data logger is introduced to automate the monitoring and recording processes,

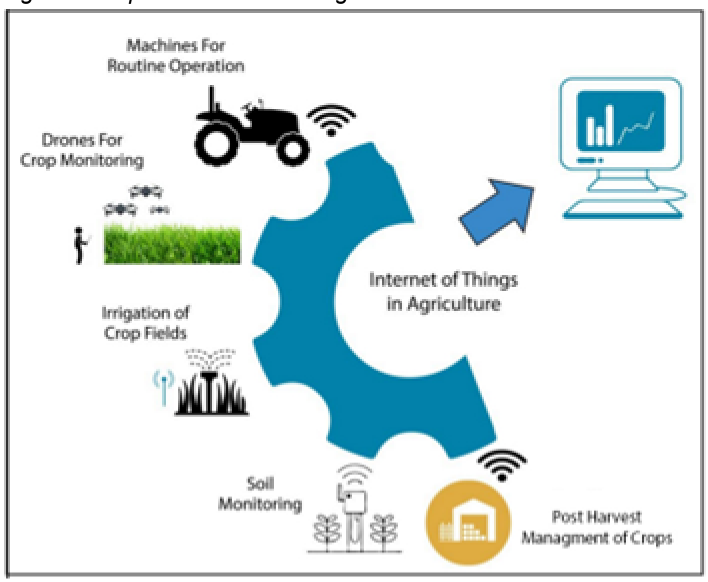
Full Text Preview

Introduction

To align population growth with the current food supply and maintain a healthy equilibrium, it is imperative to minimize food loss during harvesting and post-harvest processes. The utilization of outdated processing methods and insufficient storage facilities has been identified as contributing to a decline in both the quality and quantity of agricultural products (Petrunina et al., 2023). Horticultural crops, characterized by their high water content, are susceptible to drying, shriveling, wilting, and mechanical stress, necessitating their cultivation in greenhouses (Firdous, 2021).

Research organizations estimate that, post-harvest, a significant portion (20 to 30 percent) of fresh horticultural produce is lost, posing substantial economic and societal consequences (Dhatt & Mahajan, 2007). Employing diverse preservation techniques, such as drying, cooling, fermentation, canning, pasteurization, freezing, irradiation, and the use of various chemicals, extends the storage lifespan of agricultural products, mitigating losses and enhancing overall food security. Adopting modern preservation methods is essential for sustaining food availability and addressing the challenges posed by traditional practices and inadequate storage infrastructure.

Figure 1. Importance of IoT in agriculture sector



(https://igiprodst.blob.core.windows.net:443/source-content/9798369353752_339902/979-8-3693-5375-2.ch009.f01.png?sv=2015-12-11&sr=c&sig=FHiuA6rJBTnEginUqZC65urMEiscoO5OLI1MSzfPdFM%3D&se=2024-05-13T11%3A38%3A07Z&sp=r)

Drying is the method of reducing moisture in a product to an optimal level, inhibiting the growth of yeast, mold, and bacteria and thereby extending the product's shelf life (Saikia et al., 2023). This enables prolonged storage of the product. Among the pivotal steps in preserving fruits and vegetables, the drying process offers versatility in its implementation. Energy for drying can be sourced from various outlets, including fossil fuels, electricity, natural gas, biomass, and solar energy. The increasing popularity of renewable energy sources among farmers is seen as a means to enhance productivity (Pestisha et al., 2023).

The imperative to transition to renewable energy sources for drying arises from the rapid depletion of fossil fuel supplies (Gautam et al., 2023) and the escalating cost of electricity (Almasoodi, 2023). Solar dryers exemplify the use of renewable energy. These dryers, employed in the drying of agricultural products, are acknowledged for their cost-effectiveness and minimal environmental impact (Hussain & Lee, 2023). The primary advantage of solar dryers lies in ensuring that dried items maintain specifications, dried in a secure environment. Most solar dryers boast low maintenance costs, no expenses related to biofuel usage, time efficiency, high-quality dried products with minimal space requirements, and the ability to regulate air conditions. Therefore, when applied in drying agricultural products, solar dryers emerge as both highly cost-effective and environmentally beneficial.

Furthermore, the Internet of Things (IoT) is transforming the agricultural sector by offering a diverse array of services across multiple domains (Muzammal & Murugesan, 2018, 2021). Figure 1 vividly illustrates the paramount role of the Internet of Things (IoT) in the agricultural sector, highlighting its significance in optimizing and augmenting the efficiency of diverse processes (Humayun et al., 2020). Through the integration of IoT technologies, farmers and agricultural enterprises can leverage real-time data, automation, and connectivity to enhance productivity, optimize resource utilization, improve crop quality, and mitigate risks (Alberti et al., 2019; Muzammal & Murugesan, 2020; Yu et al., 2022). The effectiveness of a solar dryer is contingent upon various conditions and parameters, including meteorological factors, collector orientation, cover material type and size, collector length and depth, and the nature of the absorber material. There is an urgent need to enhance the overall productivity of the industry by expanding the use of agricultural engineering and technology for more precise monitoring and management of environmental conditions (Sujatha et al., 2021).

Continue Reading (/gateway/chapter/full-text-html/346172)

References

Abakarov, A., Jiménez Ariza, H. T., Correa Hernando, E. C., Diezma Iglesias, B., Arranz Saiz, F. J., García-Hierro, J., Robla Villalba, J. I., & Barreiro Elorza, P. (2012). Control of a solar dryer through using a fuzzy logic and low-cost model-based sensor. *Porceedings of International Conference of Agricultural Engineering.* CIGR. http://cigr.ageng2012.org/comunicaciones-online/htdocs/principal.php?seccion=home (http://cigr.ageng2012.org/comunicaciones-online/htdocs/principal.php?seccion=home)

Follow Reference

Aggarwal R. K. (Ed.). (2012). Indirect Solar Drier for drying of Hill products. *Asian Journal of Agriculture and Rural Development*.10.22004/ag.econ.197960

Follow Reference

Alberti A. M. Santos M. A. S. Souza R. Da Silva H. D. L. Carneiro J. R. Figueiredo V. A. C. Rodrigues J. J. P. C. (2019). Platforms for Smart Environments and Future Internet Design: A Survey.IEEE Access : Practical Innovations, Open Solutions, 7, 165748–165778. 10.1109/ACCESS.2019.2950656

Almasoodi, I. A. K. (2023). *Technical and Economic Feasibility Study for Supplying a Remote Village in Iraq with Different Energy Sources* [Thesis, Karabuk University]. http://acikerisim.karabuk.edu.tr:8080/xmlui/handle/123456789/2745 (http://acikerisim.karabuk.edu.tr:8080/xmlui/handle/123456789/2745)

Follow Reference

Azeem, M. R., Muzammal, S. M., Zaman, N., & Khan, M. A. (2022). Edge Caching for Mobile Devices. *2022 14th International Conference on Mathematics, Actuarial Science, Computer Science and Statistics (MACS)*, (pp. 1–6). IEEE. 10.1109/MACS56771.2022.10022729

Follow Reference

Benhamza A. Boubekri A. Atia A. Hadibi T. Arıcı M. (2021). Drying uniformity analysis of an indirect solar dryer based on computational fluid dynamics and image processing.Sustainable Energy Technologies and Assessments, 47, 101466. 10.1016/j.seta.2021.101466

Dhatt, A. S., & Mahajan, B. V. C. (2007). *Horticulture postharvest technology harvesting, handling and storage of horticultural crops*. Punjab Horticultural Postharvest Technology Centre Punjab Agricultural University Campus, Ludhiana. https://nsdl.niscpr.res.in/bitstream/123456789/314/4/Revised%20Harvesting,%20Handling%20and%20Storage.pdf (https://nsdl.niscpr.res.in/bitstream/123456789/314/4/Revised%20Harvesting,%20Handling%20and%20Storage.pdf)

Follow Reference

El-Sebaey M. S. Mousavi S. M. T. Shams El-Din Sh. Essa F. A. (2023). An experimental case study on development the design and the performance of indirect solar dryer type for drying bananas.Solar Energy, 255, 50–59. 10.1016/j.solener.2023.03.023

Elmehri, A. Mohamed. (2019). *Design of a Control System for an Indirect Solar Dryer* [Doctoral dissertation, Instituto Politecnico de Braganca]. https://www.proquest.com/openview/6b794436bb3fa02152eb50e55f9e902b/1?pq-origsite=gscholar&cbl=2026366&diss=y (https://www.proquest.com/openview/6b794436bb3fa02152eb50e55f9e902b/1?pq-origsite=gscholar&cbl=2026366&diss=y)

Follow Reference

Etim P. J. Eke A. B. Simonyan K. J. (2020). Design and development of an active indirect solar dryer for cooking banana.Scientific African, 8, e00463. 10.1016/j.sciaf.2020.e00463

Follow Reference

Firdous N. (2021). Post-harvest losses in different fresh produces and vegetables in Pakistan with particular focus on tomatoes.Journal of Horticulture and Postharvest Research, 4(1), 71–86. 10.22077/jhpr.2020.3168.1125

Follow Reference Gautam K. Nakarmi A. M. Shakya S. R. (2023). Future Energy Supply Possibilities and their Implications on Nepal's Energy Security.Strategic Planning for Energy and the Environment, 405–430. 10.13052/spee1048-5236.4231

Follow Reference Güler H. Ö. Sözen A. Tuncer A. D. Afshari F. Khanlari A. Şirin C. Gungor A. (2020). Experimental and CFD survey of indirect solar dryer modified with low-cost iron mesh.Solar Energy, 197, 371–384. 10.1016/j.solener.2020.01.021

Follow Reference Humayun M. Jhanjhi N. Hamid B. Ahmed G. (2020). Emerging Smart Logistics and Transportation Using IoT and Blockchain.IEEE Internet of Things Magazine, 3(2), 58–62. 10.1109/IOTM.0001.1900097

Follow Reference Hussain M. I. Lee G. H. (2023). Concentrated solar powered agricultural products dryer: Energy, exergoeconomic and exergo-environmental analyses.Journal of Cleaner Production, 393, 136162. 10.1016/j.jclepro.2023.136162

IoT Protocols for Making Seamless IoT Data Communication. (2023, July 8). Intuz. https://www.intuz.com/blog/iot-protocols-making-iot-data-communication-seamles

Follow Reference Islam M. Nooruddin S. Karray F. Muhammad G. (2023). Internet of Things: Device Capabilities, Architectures, Protocols, and Smart Applications in Healthcare Domain.IEEE Internet of Things Journal, 10(4), 3611–3641. 10.1109/JIOT.2022.3228795

Follow Reference Khan N. A. Jhanjhi N. Z. Brohi S. N. Usmani R. S. A. Nayyar A. (2020). Smart traffic monitoring system using Unmanned Aerial Vehicles (UAVs).Computer Communications, 157, 434–443. 10.1016/j.comcom.2020.04.049

Follow Reference Lingayat A. B. Chandramohan V. P. Raju V. R. K. Meda V. (2020). A review on indirect type solar dryers for agricultural crops – Dryer setup, its performance, energy storage and important highlights.Applied Energy, 258, 114005. 10.1016/j.apenergy.2019.114005

Liu, H. (2023). *Cross layer Design in Software Defined Networks -Various Issues and Possible Solutions*.

Follow Reference Madadi Avargani V. Abdlla Maarof H. Zendehboudi S. (2023). Multiphysics CFD modeling to assess performance of a perforated multi-plate indirect solar dryer with a V-corrugated absorber surface.Applied Thermal Engineering, 227, 120387. 10.1016/j.applthermaleng.2023.120387

Follow Reference Madhlopa A. Ngwalo G. (2007). Solar dryer with thermal storage and biomass-backup heater.Solar Energy, 81(4), 449–462. 10.1016/j.solener.2006.08.008

Follow Reference Mahadevappa, P., Muzammal, S. M., & Murugesan, R. K. (2021). *A Comparative Analysis of Machine Learning Algorithms for Intrusion Detection in Edge-Enabled IoT Networks* (arXiv:2111.01383). arXiv. https://doi.org//arXiv.2111.0138310.48550

Follow Reference Moheno-Barrueta M. Tzuc O. M. Martínez-Pereyra G. Cardoso-Fernández V. Rojas-Blanco L. Ramírez-Morales E. Pérez-Hernández G. Bassam A. (2021). Experimental Evaluation and Theoretical Optimization of an Indirect Solar Dryer with Forced Ventilation under Tropical Climate by an Inverse Artificial Neural Network.Applied Sciences (Basel, Switzerland), 11(16), 16. 10.3390/app11167616

Follow Reference Murali S. Alfiya P. V. Aniesrani Delfiya D. S. Harikrishnan S. Kunjulakshmi S. Samuel M. P. (2022). Performance evaluation of PV powered solar tunnel dryer integrated with a mobile alert system for shrimp drying.Solar Energy, 240, 246–257. 10.1016/j.solener.2022.05.028

Follow Reference Musembi M. N. Kiptoo K. S. Yuichi N. (2016). Design and Analysis of Solar Dryer for Mid-Latitude Region.Energy Procedia, 100, 98–110. 10.1016/j.egypro.2016.10.145

Follow Reference Muzammal, S. M., & Ali Shah, M. (2016). ScreenStealer: Addressing Screenshot attacks on Android devices. *2016 22nd International Conference on Automation and Computing (ICAC)*, (pp. 336–341). IEEE. 10.1109/IConAC.2016.7604942

Follow Reference Muzammal S. M. Murugesan R. K. (2018). A Study on Leveraging Blockchain Technology for IoT Security Enhancement.2018 Fourth International Conference on Advances in Computing, Communication & Automation (ICACCA), (pp. 1–6). IEEE. 10.1109/ICACCAF.2018.8776806

Follow Reference Muzammal S. M. Murugesan R. K. (2020). A Study on Secured Authentication and Authorization in Internet of Things: Potential of Blockchain Technology. In AnbarM.AbdullahN.ManickamS. (Eds.), Advances in Cyber Security (pp. 18–32). Springer. 10.1007/978-981-15-2693-0_2

Follow Reference Muzammal S. M. Murugesan R. K. (2021). Enhanced authentication and access control in Internet of Things: A potential blockchain-based method.International Journal of Grid and Utility Computing, 12(5–6), 469–485. 10.1504/IJGUC.2021.120090

Follow Reference Muzammal S. M. Murugesan R. K. Jhanjhi N. Z. Humayun M. Ibrahim A. O. Abdelmaboud A. (2022). A Trust-Based Model for Secure Routing against RPL Attacks in Internet of Things.Sensors (Basel), 22(18), 18. 10.3390/s2218705236146400

Follow Reference Ngo V. Do H. Duong T. Tran M. Nguyen S. Tong D. Duong T. (2021). Design and Construction of an IoT Solar Dryer for Semi-Dried Jerky.International Journal of Innovative Research and Development, 10(6). 10.24940/ijird/2021/v10/i6/FEB21023

Follow Reference Pawar A. B. Jawale M. A. William P. Sonawane B. S. (2022). Efficacy of TCP/IP Over ATM Architecture Using Network Slicing in 5G Environment. In AsokanR.RuizD. P.BaigZ. A.PiramuthuS. (Eds.), Smart Data Intelligence (pp. 79–93). Springer Nature. 10.1007/978-981-19-3311-0_8

Follow Reference Pestisha A. Gabnai Z. Chalgynbayeva A. Lengyel P. Bai A. (2023). On-Farm Renewable Energy Systems: A Systematic Review.Energies, 16(2), 2. 10.3390/en16020862

Follow Reference Petrunina I. V. Gorbunova N. A. Zakharov A. N. (2023). Assessment of causes and consequences of food and agricultural raw material loss and opportunities for its reduction.Theory and Practice of Meat Processing, 8(1), 1. 10.21323/2414-438X-2023-8-1-51-61

Follow Reference Saikia D. Nayak P. K. Krishnan K. R. Kondareddy R. Lakshmi D. V. N. (2023). Experimental investigation of modified indirect solar dryer with integrated thermal storage material for drying of dhekia (Diplazium esculentum) fern.Environmental Science and Pollution Research International, 31(12), 18143–18156. 10.1007/s11356-023-25310-336656481

Follow Reference Sharma B. B. Gupta G. Vaidya P. Basheer S. Memon F. H. Thakur R. N. (2022). Internet of Things-Based Crop Classification Model Using Deep Learning for Indirect Solar Drying.Wireless Communications and Mobile Computing, 2022, e1455216. 10.1155/2022/1455216

Follow Reference Sujatha R. Chatterjee J. M. Jhanjhi N. Brohi S. N. (2021). Performance of deep learning vs machine learning in plant leaf disease detection.Microprocessors and Microsystems, 80, 103615. 10.1016/j.micpro.2020.103615

Follow Reference Yao Y. Pang Y. X. Manickam S. Lester E. Wu T. Pang C. H. (2022). A review study on recent advances in solar drying: Mechanisms, challenges and perspectives.Solar Energy Materials and Solar Cells, 248, 111979. 10.1016/j.solmat.2022.111979

Follow Reference Yu W. Liu Y. Dillon T. Rahayu W. Mostafa F. (2022). An Integrated Framework for Health State Monitoring in a Smart Factory Employing IoT and Big Data Techniques.IEEE Internet of Things Journal, 9(3), 2443–2454. 10.1109/JIOT.2021.3096637

Research Tools
Database Search (/gateway/) | Help (/gateway/help/) | User Guide (/gateway/user-guide/) | Advisory Board (/gateway/advisory-board/)

User Resources
Librarians (/gateway/librarians/) | Researchers (/gateway/researchers/) | Authors (/gateway/authors/)

Librarian Tools
COUNTER Reports (/gateway/librarian-tools/counter-reports/) | Persistent URLs (/gateway/librarian-tools/persistent-urls/) | MARC Records (/gateway/librarian-tools/marc-records/) | Institution Holdings (/gateway/librarian-tools/institution-holdings/) | Institution Settings (/gateway/librarian-tools/institution-settings/)

Librarian Resources
Training (/gateway/librarian-corner/training/) | Title Lists (/gateway/librarian-corner/title-lists/) | Licensing and Consortium Information (/gateway/librarian-corner/licensing-and-consortium-information/) | Promotions (/gateway/librarian-corner/promotions/)

Policies
Terms and Conditions (/gateway/terms-and-conditions/)

(http://www.facebook.com/pages/IGI-Global/138206739534176?ref=sgm)

(http://twitter.com/igiglobal)
(https://www.linkedin.com/company/igiglobal)

(https://publicationethics.org/category/publisher/igi-global)