Magna Scientia Advanced Biology and Pharmacy

eISSN: 2582-8363

Cross Ref DOI: 10.30574/msabp

Journal homepage: https://magnascientiapub.com/journals/msabp/

(RESEARCH ARTICLE)

Check for updates

Scanning of dried or fresh plant materials with Isik Kutusu System, transfer to computer and preparation of van basin virtual herbarium

Nasip DEMİRKUŞ *

Department of Biology, Faculty of Education, Van Yüzüncü Yıl University, Tuşba, Van, Turkey.

Magna Scientia Advanced Biology and Pharmacy, 2025, 15(01), 029–033

Publication history: Received on 02 April 2025; revised on 10 May 2025; accepted on 12 May 2025

Article DOI: https://doi.org/10.30574/msabp.2025.15.1.0040

Abstract

The Isik Kutusu (Light Box is a specialized imaging system designed to digitize non-moving macroscopic organisms and physical objects smaller than A3 size, depending on the quality of the flatbed glass scanner used. When integrated with various scanner models, this system has demonstrated excellent performance in transferring semi-dimensional (2D to 2.5D) images and printed materials of non-moving specimens to a computer with high accuracy and consistency. The system can magnify physical details of real-world macroscopic entities up to 60 times, enabling in-depth digital observation and analysis. To ensure precision, a formula has been developed to calculate how many times the real size must be enlarged and at what dpi images should be captured. The device has received both national and international patents for its innovation and utility. However, in a unique act of scientific contribution, the full construction methodology has been openly published and the patent rights were donated to humanity, promoting open access to technological advancement. This system was also utilized in creating the high-resolution image archive for the Van Province Virtual Herbarium, whose outputs can be viewed on the following platforms:

- Van Herbarium – Yüzüncü Yıl University
- Nadidem Virtual Flora – English Index
- Virtual Herbarium of Lake Van (VHLV)

Overall, the *Isik Kutusu* System offers a reproducible, cost-effective, and high-resolution alternative to conventional photographic and scanning tools, significantly advancing the digitization of macroscopic biological and physical specimens for scientific and educational use.

Keywords: Isik Kutusu; Light Box; Van Province; Virtual Herbarium; Scanning Fresh Plant (Mattarama)

1. Introduction

This study introduces a custom-developed Light Box (Jardine et al., 2022) System (Isik Kutusu) designed to digitize museum specimens—such as plants, insects, fungi, and antique artifacts—by producing high-resolution, low-file-size images suitable for digital archiving.

The system specifically targets the efficient digitization of herbarium materials (De Smedt et al., 2024), including both dry and fresh plant specimens, in accordance with international virtual herbarium standards.
By minimizing physical handling and eliminating travel costs, the system facilitates remote, non-destructive access to scientific collections, promoting broader participation in global research networks.

Note: A part of this work was presented as a poster under the name "P0534. The Scanning-Transferring; Dried and Fresh Plant Materials to the Computer with Isik Kutusu" at the VII International Botanical Congress (IBC 2005/ Austria Center Vienna 17 – 23 July 2005)

* Corresponding author: Nasip DEMİRKUŞ: Orcid No: 0000-0003-4195-070X E-mail: nasipdk@hotmail.com

Van province is located in East Anatolia according to P.H.Davis grid square in B9. It has a surface area of about 19069 km" with altitude 1500-3660m. The boundaries of the Van basin are surrounded by high mountains, between mountains, mainly volcanic plateau, highlands with step vegetation and rarely green areas are located. There are some areas such as Bahçesaray, Çaldıran, Erciş and Muradiye have different topographic and climatic characters and lower altitude than the other Van basin areas. Most of the endemic plant species have been located around Güzeldere pass-Çuh pass, Artos, Kavuşşahap and Ispiriz mountains respectively (see Figure 1). https://en.nadidem.net/vanre/index.htm

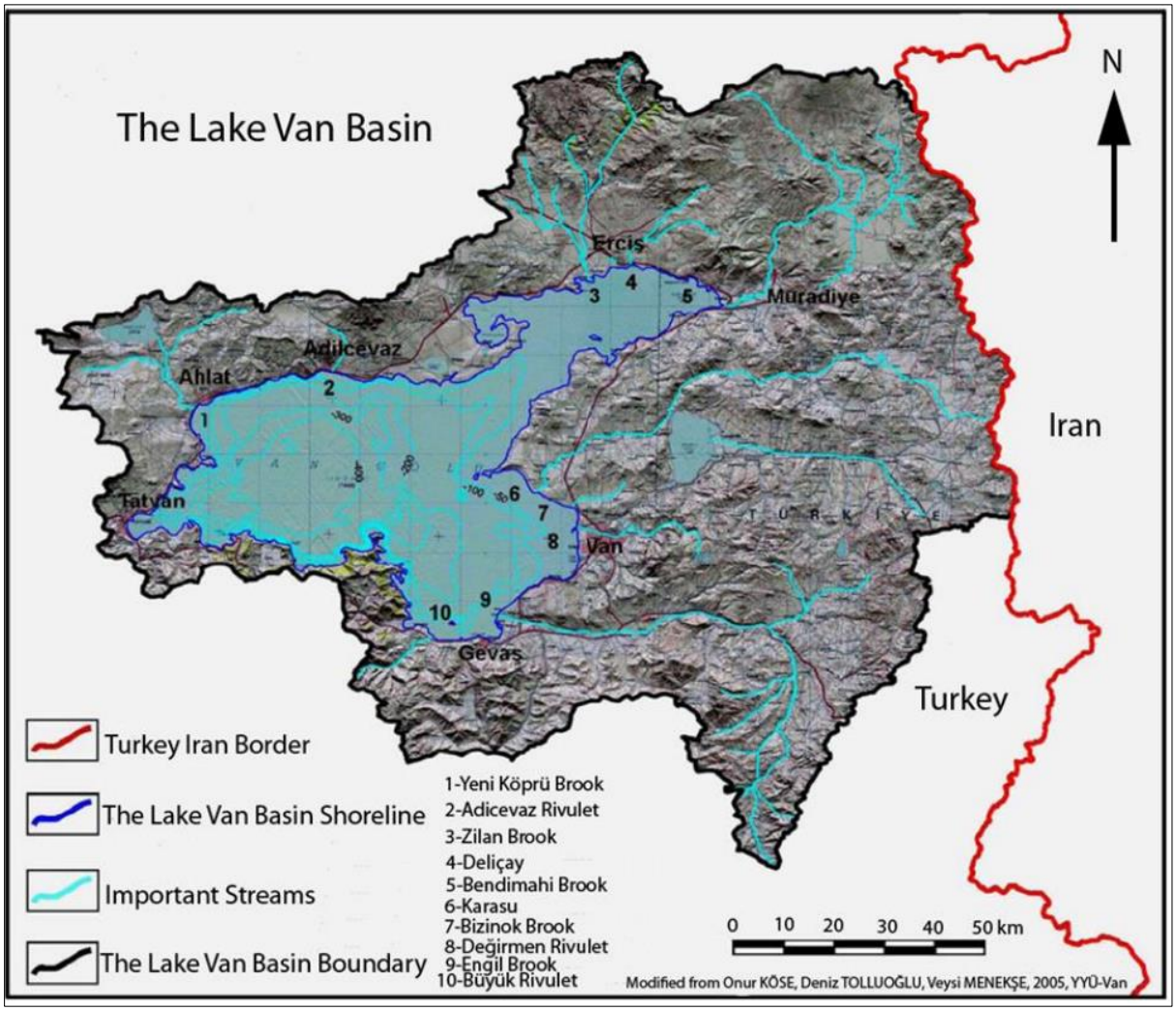

Figure 1 The hydrological border and the main drainage system of the Lake Van basin. (Modified from Çiftçi et al., 2008)

1.1. Importance and purpose of the research

The Light Box (Jardine et al., 2022) (Isik Kutusu) System developed in this study aims to transfer high-quality but low-file-size images of museum objects such as plants, insects, mushrooms, and antique jewelry to digital media and present these images on web pages that comply with international digital museum standards.

The main purpose of the study is to digitize herbarium materials — especially dry and fresh plant specimens — with high resolution and low file size using the Light Box (Jardine et al., 2022) (Isik Kutusu) System developed. It is aimed to publish these images on web pages prepared in accordance with international virtual herbarium standards and make them accessible to the scientific world.

In this way, researchers will be able to conduct international scientific studies on digital media without having to bear travel and transportation costs and without physically damaging museum materials. Additionally, the availability of

such digitized collections opens opportunities for advanced analytical approaches; for instance, a recent systematic review highlights the application of computer vision and machine learning techniques in studying herbarium specimen images (Hussein et al., 2021). In addition, confidence-based automated labeling methods have shown promising improvements in dataset accuracy, further facilitating machine learning applications on specimen image archives (Bateux et al., 2024).

2. Materials and Methods

This study introduces a patented system designed for the digitization of stationary specimens, including biological and museum materials, that do not exceed A3 in area and are under 7 cm in height. The system involves placing a specially constructed Light Box (Jardine et al., 2022) on top of a flatbed scanner, allowing the capture of high-resolution images with low file sizes suitable for digital archiving. The system was patented both nationally and internationally between 2000 and 2002.

The related patent documentation is accessible through the following links:

- Patent Document 1
- Patent Document 2
- Patent Document 3

During its development, extensive searches were performed using databases and search engines of the time—Google, AltaVista, Lycos, Excite—as well as the Turkish Patent and Trademark Office (). Key terms such as "scanning a material," "scanning a specimen," and "scanner with Light Box (Jardine et al., 2022)" revealed no existing systems with the same functionality and mechanism, affirming the system's novelty.

2.1. Scanner and System Specifications

- Scanner type: Flatbed
- Scanning element: Charge-coupled device (CCD)
- Light source: Single cool cathode fluorescent
- Hardware resolution: 1200 dpi (super sampling), 600 dpi (optical)
- Selectable resolution: 12 to 9600 dpi
- Scanning modes: 1-bit (B/W) to 36-bit color
- Scaling range: 1% to 400%

Image processing: Includes dithering, thresholding, scaling, interpolation, sharpening, gamma and matrix adjustments

2.2. Structural Components

- Hoop Box (01): Fiberboard frame with non-reflective white inner lining and protective transparent band
- Adjustment Ruler (02): Calibrated wooden ruler with height-positioning holes
- Metallic Attachment Ring (03): Fixed non-corrosive ring for securing vertical components
- Adjustment Plaque (04): It is made of chipboard; its entire surface is covered with 720 dpi paper painted with pure white (lacquer) paint. The aim is to capture the light coming from the scanner according to the height of the adjustment ruler (02) and then prevent it from scattering and make it compatible with the preferred dpi number
- Adjustment Pin and Rope (05, 06): Used to fix and maintain plaque height alignment

2.3. Operating Procedure

The cleaned object is placed on the scanner glass and covered with the Light Box (Jardine et al., 2022). The adjustment mechanism is set to a specific height based on the specimen's dimensions. The light reflection is adjusted via the plaque for optimal background tone and scanning resolution.

Scanning was conducted using an Epson 12000XL and HP ScanJet 6200C, and images were edited in Adobe Photoshop CS and Photoshop CS5 . Resolution settings were:

- General photography: 240 dpi
- Specimens >1 cm: 245–270 dpi

- Specimens <1 cm: up to 9600 dpi

Output was printed using Epson Stylus Color 740 at 360, 720, and 1440 dpi. Files were saved in both JPEG (web) and BMP or TIFF (print) formats. JPEG files were ideal for online display, while BMP or TIFF files preserved zoom and print fidelity.

2.4. Image magnification and Zoom Analysis

Image magnification was tested across various resolutions (Turnbull et al., 2024). The following equation was derived for calculating magnification: $B = D \times U \times Z$

- B: Magnification (%)
- D: Scanner resolution (dpi)
- U: Coefficient (~1.26)
- Z: Zoom ratio

Examples:

1200 dpi at 100% zoom: B = 1512% (15.12×)

To obtain approximately 6000% magnification at 100% zoom, the scanner resolution (D) should be about 7000 dpi.

Compared to digital cameras and slide scanners, this system preserved higher image sharpness, reduced reflections, and maintained consistent lighting. Unlike traditional photographic tools, it ensured reproducibility between scans. Moreover, the images obtained in JPEG format had higher quality and smaller file sizes compared to those from cameras and slide scanners. These results are demonstrated in detail on the following comparison and prototype pages: Comparison Page Prototype Page

2.5. Applicability in Diverse Fields

The system was tested across various disciplines:

- Medicine: Imaging for dermatology
- Forensics: Fingerprint and evidence scanning
- Textiles: Imaging of fabrics, leather, and texture details up to 60×
- museology (Meise Botanic Garden, 2020) & Archaeology: Archiving delicate artifacts and stamps

The device's simplicity, portability, and affordability make it highly accessible, even for resource-limited institutions. It offers a reliable and long-term method for digital preservation and remote research access, as highlighted in previous studies (Majure & Franck, 2022; Meise Botanic Garden, 2020).

3. Results and Conclusion

From 1994 to 2000, plant specimens were collected from the Van province by Mehmet KOYUNCU, Nasip DEMİRKUŞ, and Mehmet FIRAT. These included both fresh and dried samples, photographs, and slides. All materials were digitized using the Light Box (Isik Kutusu) (Jardine et al., 2022) System developed in this study.

The result was the successful digitization of more than 9000 plant specimens representing approximately 1300 taxa. These were processed with high image fidelity and saved in formats optimized for both print and web dissemination.

The digitized content is available through the following herbarium web portals:

- Van Herbarium – Yüzüncü Yıl University
- VHLV – Virtual Herbarium of Lake Van,
- Nadidem Flora Archive

These platforms demonstrate the system's value in supporting scientific accessibility and long-term preservation, facilitating the remote study of specimens and the construction of digital natural history archives.

While preparing these web pages, herbariums in Türkiye, scientific collections, and both national and international databases were thoroughly reviewed.

The main resources consulted include the following:

- **National Sources:** VANF – Yüzüncü Yıl University Herbarium,
- **International Sources:** Royal Botanic Garden Edinburgh (RBGE),Royal Botanic Gardens, Kew,JSTOR Global Plants,Europeana,Euro+Med PlantBase,International Plant Names Index (IPNI),Chinese Virtual Herbarium (CVH),Altai State University Herbarium

Compliance with ethical standards

Acknowledgments

I would like to thank the students of Van Yüzüncü Yıl University, Faculty of Education, Department of Biology Teaching for their contributions to the process of transferring dry and fresh plant samples to digital media between 2005 and 2010. Best regards. https://en.nadidem.net/san/index.htm

Disclosure of conflict of interest

The author declared that they have no competing interests.

References

[1] Bateux, Q., Koss, J., Sweeney, P. W., Edwards, E., Rios, N., & Dollar, A. M. (2024). Improving the accuracy of automated labeling of specimen images datasets via a confidence-based process. arXiv preprint arXiv:2411.10074. https://arxiv.org/abs/2411.1007

[2] Çiftçi Y, Işık MA, Alkevli T, Yeşilova Ç (2008). Van Gölü Havzasının çevre jeolojisi. Jeoloji Mühendisliği Dergisi 32(2): 45-77.

[3] De Smedt, S., Bogaerts, A., De Meeter, N., Dillen, M., Engledow, H., Van Wambeke, P., Leliaert, F., & Groom, Q. (2024). Ten lessons learned from the mass digitisation of a herbarium collection. PhytoKeys, 244, 23–37. https://doi.org/10.3897/phytokeys.244.120112.

[4] Hussein, B. R., Malik, O. A., Ong, W.-H., & Slik, J. W. F. (2021). Application of Computer Vision and Machine Learning for Digitized Herbarium Specimens: A Systematic Literature Review. arXiv preprint arXiv:2104.08732. https://arxiv.org/abs/2104.08732

[5] Jardine, M. D., Lohonya, K., Welton, L., & French, L. (2022). NHM Herbarium Sheet Mass Digitisation Workflow. Natural History Museum. https://dissco.github.io/HerbariumSheets/NHMHerbariumSheetDigitisationWorkflow.html

[6] Majure, L. C., & Franck, A. R. (2022). Imaging Workflow – University of Florida Herbarium (FLAS). Florida Museum of Natural History. https://www.floridamuseum.ufl.edu/herbarium/research/seusbiohotspot/imaging-workflow/

[7] Meise Botanic Garden. (2020). Designing an Herbarium Digitisation Workflow with Built-In Image Quality Management. Biodiversity Data Journal, 8, e47051. https://bdj.pensoft.net/article/47051/

[8] Turnbull, R., Fitzgerald, E., Thompson, K., & Birch, J. L. (2024). Hespi: A pipeline for automatically detecting information from herbarium specimen sheets. arXiv preprint arXiv:2410.08740. https://arxiv.org/abs/2410.08740