

Development of Optical Imaging in Medical Applications

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ABSTRACT

Modern technological advances have provided great opportunities for the development of optical fields such as optical imaging, sensing, and devices. The development of optical imaging and sensing is also related to the use of optical devices such as lasers and image sensors. Laser technology and image sensors play an important role in various applications such as optical imaging, optical security, remote sensing, and three-dimensional (3D) reconstruction (When Chen, et al. 2023). Optics is a science that studies the propagation of light or photons when passing through a medium. The fundamental phenomena encountered in optical studies are reflection, refraction, transmission, diffraction, interference and coherence as well as polarization.

Keywords: *Optical Imaging, Optik, Medical*

1 Introduction

Since the birth of image theory, to understand, analyze, and optimize optical imaging systems from a news-theoretical point of view has become a crucial sub-field of research in optical imaging, accompanied by a series of synchronous advances. In an era where technology continues to develop rapidly, the field of medicine is no exception. One of the most eye-catching discoveries is the development in the field of optical imaging, which has shown significant advances in medical diagnosis and therapy.

By utilizing light and related technologies, optical imaging has opened up new vents for medical professionals to see and know more about the patient's health conditions. One area where the development of optical imaging has made significant consequences is in disease assessment. For example, in oncology, techniques similar to Optical Coherence Tomography (OCT) have allowed doctors to detect and monitor cancer using a high level of resolution, facilitating early detection and more effective treatment.

Optical Imaging is serious about the use of light, both visible and near-infrared, to create a visual illustration of the structure and function of biological networks. This method provides a number of advantages over other imaging techniques, including non-invasive, does not require real differentiating substances, and has a lower radiation risk. As a result, Optical Imaging has become a major emphasis on research and development on a large number of medical software.

2 Research Methodology

Optical imaging is a medical technique that uses light to study the structure and function of an object or subject. It is widely used in various fields, including medicine, chemistry, as well as materials. The development of optical imaging technology has significantly affected medical applications, such as the digitization of Arabic text and the use of optical character recognition (OCR) in medical data processing.

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3 Results and Discussion

Optical Imaging is an imaging technique that uses light, both visible and near-infrared, to obtain an illustration of the structure and function of the object or subject being observed. This technique is often used in a variety of fields, including medicine, materials science, and biological sciences (Shi et al., 2019).

The history of optical imaging can be traced back to the early 20th century when photography technology began to develop rapidly, but, in a medical context, the development of optical imaging technology has experienced significant progress along with the innovation and development of various imaging techniques, such as optical tomography and fluorescence microscopy (Hu & Han, 2022).

One of the applications of issue technology means translation software that is widely used in the religious field. Examples are Al-Quran translation software and Al-Quran interpretation software. The digitization of Arabic fiqh books is expected not only for documentation purposes, but also to facilitate the development of religious uses that require the translation of books into Arabic (R. Sandhika Galih A 2014).

Optical Character Recognition (OCR) technology has many software for document processing. e-KTP reader software uses the web-based Optical Character Recognition (OCR) method, using this method, e-KTP will be extracted using recognizing letter patterns on images. The Optical Character Recognition (OCR) method is used because it is relatively easier and the result of extraction is more accurate (Muhammad Rizal Toha, Agung Triayudi 2022).

One of the methods used to increase the contrast in color contrast is Histogram Equalization (HE). HE can be used in the initial preprocessing term to obtain a clearer picture (Peter Pangestu 2015).

SiTani software faces challenges in collecting farmer data because it still uses manual recording. This results in a data collection process that takes a long time, difficulty in updating data, and data input errors. The solution is to develop Android-based SiTani software with Optical Character Recognition (OCR) technology to speed up and simplify the process of input and processing farmer data. (Nurlatif Ardhi Pratama, et al. 2022).

Application Model of Optical Imaging in Medical

- Radiographs or X-ray images are photographic results designed by X-rays that penetrate an object or body and are recorded by analog radiograph films or digital radiograph files (Susilo 2013).
- The imaging system is a process that involves changing or transferring images from paper or film form, such as radiography or medical images such as Electrocardiography (ECG), Electro Encephalography (EEG), Cardio Topography (CTG), Ultrasonography (Ultrasound), Echo Cardiography, and others, into digital formats through devices such as scanners or imaging. To achieve a high standard of service in the field of radiology, it is important that the radiographic images obtained are of good quality and able to convey thorough diagnostic information (Diana Wahyusyafitri 2018).
- One of the roles of artificial intelligence development in the field of Occupational Health and Safety (K3) is to detect potential hazards, such as identifying workers who do not use Personal Protective Equipment (PPE) using technologies such as Neural Network, Computer Vision, and Object Recognition, or to detect soil conditions that will be used for grounding with Fuzzy logic (Jacob 2020).
- The use of optical-based computed tomography (CT) imaging is one promising option in the detection of COVID-19 with a high level of sensitivity. In addition, the development of optical biosensors based on Fiber Bragg Grating (FBG) also needs to be expanded so that they can be used effectively and accurately in the detection of COVID-19 (Taufik 2020).
- PCV is often difficult to diagnose or even often misdiagnosed because the establishment of the diagnosis is highly dependent on imaging (Fredy Ciputra 2020).

Advantages and disadvantages of optical imaging

A. Advantages of Optical Imaging

- Non-invasive: Optical imaging is usually a non-invasive technique, which means it does not require penetration or exclusive hegemony into the patient's body (Pogue, 2011: 283 - 291).
- High Resolution: Optical Coherence Tomography (OCT), offers high resolution that allows visualization of tissue structures in excellent detail (Fujimoto, 1999: 9-25).
- No Contrast Required: Reduces the risk of side effects and allergic reactions in patients, making it a safer and more convenient option in medical imaging procedures (Weissleder, 2003: 123-128).
- Real-time Imaging: Optical endoscopy, allows real-time visualization of the origin of the body's internal structures. It facilitates precise as well as rapid medical mechanisms, similar to surgery or personal assessment during endoscopic mechanisms (Wallace, 2010: 2140 - 2150).

B. Disadvantages of Optical Imaging

- Limited Depth of Penetration (Zhu, L., 2017 47-54).
- Limitations of Resolution in Dense Networks (Kiselev, 2003: 3349 - 3355).
- Limitations on Detecting Spectral Deflection (Zeng, H., , 2017: 1 - 4).
- Limitations in Penetration in Diffuse or Refractive Materials (Swartling, 2008: 6408 - 6421).

4 Conclusion

By utilizing light and related technologies, *optical imaging* has opened a new window for medical professionals to see and understand more deeply the health condition of patients. One area where the development of *optical imaging* has produced a significant impact is in disease diagnosis. The benefits of optical imaging in medicine are Non-invasive, High Resolution, No Contrast Required, and Real-time Imaging. Meanwhile, the weaknesses of optical imaging are Limited Depth of Penetration, Limited Resolution in Dense Networks, Limitations in Detecting Spectral Deflection and Limitations in Penetration in Diffuse or Refractive Materials.

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