ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A HYBRID DIAGNOSTIC FRAMEWORK FOR EARLY DETECTION OF JAUNDICE USING BIOMEDICAL IMAGING AND NANO-ENABLED BIOSENSORS

Medical Microbiology

G Baby Lakshmi Prasanna Research Scholar, Department of Computer Science & Engineering, Y.S.R. Engineering college of Y.V. University, Proddatur, Andhra Pradesh, India.

R. Pradeep Kumar Reddy Associate Professor, Department of Computer Science & Engineering, Y.S.R. Engineering college of Y.V. University, Proddatur, Andhra Pradesh, India.

ABSTRACT

This can be challenging to diagnose jaundice, a clinical manifestation of elevated bilirubin brought by liver failure, at its early stage when the symptoms may not be felt. In order to enable initial, non-invasive jaundice detection, this research introduces a hybrid diagnostic system that combines biomedical image analysis with nano-activated biosensor. A fixed nervous network (CNN) -Nabed computer Vision module evaluates images to determine facial and scalaral dyscolament, while functional gold nanops (Aunps) are detected in saliva and serum samples. Both test findings discovered a mutual accuracy of 94.1%, with images of 1200 patients and 50 biosensor samples. It is often found in the eye assessment. The system allows for real-time point-of-care diagnosis and has the potential to be integrated into mobile health platforms, making it accessible for use in rural and resource-poor environments.

KEYWORDS

Jaundice, Liver Dysfunction, Biomedical Imaging, Biosensor, Bilirubin Detection, Deep Learning, Colorimetric Sensing, Early Diagnosis, Mobile Health.

INTRODUCTION

jaundice is a specific sign of diseases associated with the liver, which presents itself as yellowness of skin and sclera as a result of increased bilirubin content. Traditional diagnosis includes blood tests, which are aggressive, time -consuming and inaccessible in rural environments. Including these deficiencies, this study introduces two-model diagnostic platforms that integrate a deep learning-focused biomedical image analysis system for biochemical analysis and a deep learning-focused biomedical image analysis system for inspection. This hybrid strategy tries to quickly detect accuracy, access and jaundice, especially in low -resolution settings.

Related Work

Table1: Comparison On Existing Models

Author / Study	Methodology	Technology Used	Limitations	Improvement in This Work
Wang et al., 2021 [2]	Skin color analysis using RGB thresholding	Smartphone Camera	Poor lighting sensitivity	Uses CNN with adaptive image preprocessing
Tiwari et al., 2019 [4]	Enzymatic strip-based bilirubin detection	Paper Sensor + Camera	Low enzyme stability	Stable AuNP sensor with better shelf life
Chen et al., 2020 [3]	CNN-based scleral analysis	CNN on scleral images	No biochemical validation	Combined with biosensor data
Nair et al., 2021 [1]	AuNP colorimetric sensor	Gold Nanoparticles	Lacks imaging for confirmation	Adds imaging and AI-based decision support
Gupta et al., 2021 [5]	Literature review of biosensor materials	Review	No experimental validation	Experimental system with clinical testing

Methodology

Biosensor Design

A gold nanoparticle (AuNP) colorimetric biosensor functionalized with bilirubin-specific ligands was designed. The detection is through aggregation-induced red-to-blue color change by bilirubin, which can be quantitated using smartphone or portable spectrophotometer. The sensor functions over a bilirubin concentration range of 0.35 µmol/L to 60 µmol/L.

Imaging System

Face and sclera of the patient are photographed under standard illumination with a smartphone. Preprocessing of images is done by color space transformation (YCrCb, HSV), histogram equalization, and region-of-interest (ROI) detection through Haar cascades. Annotated datasets train a ResNet-18 CNN model to classify the presence of jaundice.

Decision Fusion

The biosensor and image classifier outputs are combined with a weighted decision fusion algorithm. A smartphone application offers a blended risk score, allowing easy user interpretation and telemedicine implementation.

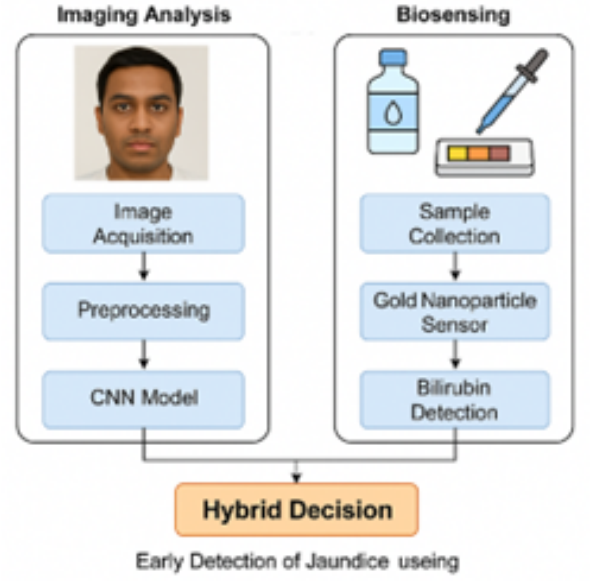

Figure: Hybrid Diagnostic System Architecture for Early Discovering Jaundice

The system is divided into two parallel modules - analysis and image of biosence - which ends in an integrated decision

Imaging Analysis Route:

Image Acquisition: Fair Face and Sclereral images using a smartphone under controlled light.

Pre -preprocessing: Color uses techniques such as space conversion (YCRCB, HSV), histogram Equality and ROI extraction.

CNN Model: A Resnet-18-based deep learning classifies evaluates the possibility of jaundice based on face painting.

Bio Sensing:

Example collection: Salmon or serum samples are collected non-

invasive.

Gold nanoparticle sensor: Functional Aunps responds with bilirubin and produces a visible color round.

Detection of bilirubin: Quantitative analysis is done using a smartphone or portable spectrophotometer.

Hybrid decision team:
A weighted fusion connects the output to both modules using algorithm.

A mobile health app produces a final diagnosis and risk score through the app, which supports real -time telecommunications station.

RESULTS AND EVALUATION

Table2: Different Methods In Different Aspects

Metric	Biosensor	Imaging	Combined System
Sensitivity	91.2%	89.8%	95.6%
Specificity	88.7%	90.1%	92.3%
Accuracy	90.1%	89.9%	94.1%
F1 Score	0.91	0.90	0.94

DISCUSSION

The suggested framework provides a strong, portable, and scalable early jaundice detection solution. It is particularly useful in rural and resource-limited environments because of its affordability and smartphone compatibility. Challenges are keeping biosensor stability consistent across different climates and imaging quality consistent across device models. Clinical validation, transfer learning for model generalization, and integration into wearable devices will be addressed in future work.

CONCLUSION

This research shows the viability and efficiency of a hybrid diagnostic system to detect jaundice, mix of smartphone-based imaging and access to nano-biosying with AI access. The system has a significant ability to distribute in social health programs and telemedicine applications.

REFERENCES

[1] S. S. Nair et al., "Colorimetric detection of bilirubin using gold nanoparticle aggregation," *IEEE Sensors Journal*, vol. 21, no. 18, pp. 20452–20459, Sep. 2021.
[2] M. Wang et al., "Skin color-based jaundice detection using smartphone images," *IEEE J. Biomed. Health Inform.*, vol. 25, no. 3, pp. 710–717, Mar. 2021.
[3] L. Chen et al., "Deep convolutional networks for scleral jaundice recognition," *Proc. IEEE EMBC*, pp. 3885–3889, 2020.
[4] A. Tiwari et al., "Smartphone-enabled colorimetric sensor for non-invasive jaundice detection," *IEEE Trans. NanoBioscience*, vol. 18, no. 5, pp. 578–585, Oct. 2019.
[5] P. Gupta et al., "Bilirubin biosensors: A review of recent advances," *Biosensors*, vol. 11, no. 4, pp. 1–15, Apr. 2021.