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Advancements in AI and Blockchain on Healthcare for Diabetes Management

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Abstract:
Diabetes is one of the most prevalent and challenging chronic diseases worldwide, affecting millions of people and requiring continuous monitoring, early diagnosis, and proper management of patient health data. Managing diabetes effectively is not only about monitoring blood glucose levels but also about ensuring that patient medical information is stored safely and accessible to healthcare professionals when required. Recent advancements in Artificial Intelligence (AI) and Blockchain technologies have opened new opportunities for building smarter and more efficient healthcare systems that support better diabetes management. Artificial Intelligence techniques such as Machine Learning and Deep Learning enable accurate prediction of glucose levels, early identification of potential complications, and development of personalized treatment recommendations by analyzing large volumes of medical data and detecting hidden patterns beyond traditional methods. At the same time, Blockchain technology provides a secure and decentralized approach for storing patient medical records, ensuring that data remains tamper-proof, transparent, and accessible only to authorized stakeholders such as doctors, hospitals, and healthcare providers. This research proposes an integrated AI and Blockchain-based healthcare framework designed for intelligent diabetes monitoring and management, where health- related data is collected from wearable sensors, electronic health records, and mobile health applications. AI models analyze the collected data to predict disease risks, detect ab- normal patterns, and assist healthcare professionals in making better medical decisions, while blockchain ensures secure data sharing and transparency between patients, doctors, and health- care institutions. Overall, the proposed system improves real-time monitoring, predictive analysis, data security, and patient privacy while enhancing trust, reliability, and interoperability in modern digital healthcare ecosystems.

Keywords: Artificial Intelligence, Blockchain, Diabetes Prediction, Machine Learning, Healthcare Security, IoT Health Monitoring.

I. INTRODUCTION:

Research in healthcare has increasingly focused on improving disease prediction and patient monitoring using advanced technologies. In recent years, artificial intelligence has significantly enhanced the accuracy of blood glucose prediction and diabetes management systems [1]. AI-driven solutions are transforming traditional healthcare practices by enabling faster diagnosis and better decision-making [2].Diabetes management has particularly benefited from these advancements, where machine learning models provide improved prediction capabilities and personalized treatment support [3]. Furthermore, the integration of Internet of Things (IoT) devices allows continuous monitoring of patient health data in real-time. Combining IoT with secure technologies such as blockchain ensures data privacy and integrity in healthcare systems [4][5].

Blockchain technology is gaining importance in medical applications by providing decentralized and secure storage of sensitive patient data [6]. Additionally, explainable AI techniques are being used to enhance the transparency of prediction models, making them more reliable for clinical use [7]. These advancements collectively contribute to developing efficient, secure, and intelligent healthcare systems for diabetes management.

II. RELATED WORK:

Previous studies have explored the use of artificial intelligence for improving diabetes prediction and management. Research shows that AI-assisted systems can significantly enhance glucose monitoring and disease analysis [1][3]. Machine learning and explainable AI techniques have been widely applied to improve prediction accuracy and model interpretability [7].Several works have also focused on integrating blockchain technology with healthcare systems to ensure data security and privacy. Blockchain-based frameworks provide decentralized solutions for storing and sharing patient records securely [4][6]. In addition, IoT-based healthcare systems combined with machine learning have been proposed for real-time monitoring of diabetic patients [5].Other studies highlight the effectiveness of advanced algorithms such as Random Forest in medical predictions, demonstrating improved performance in disease severity analysis [8]. Moreover, alternative approaches using medicinal plants and nutritional methods for diabetes management have also been explored [9].

Recent research emphasizes blockchain-based health record management systems and predictive analytics for improving healthcare efficiency [10][11]. Advanced models such as deep learning integrated with blockchain have been proposed to develop secure and intelligent monitoring systems for diabetes patients [12]. These studies collectively indicate the growing importance of combining AI, IoT, and blockchain technologies in modern healthcare solutions.

III. PROPOSED SYSTEM:

A. Overview of Proposed System:

Starting off, machine smarts join forces with digital ledgers to build a sharp system that tracks and manages diabetes safely. Data flows in from wearables, blood sugar gadgets, and phone apps—each feeding details into one spot. Once gathered, clever software scans everything, spotting odd trends that might signal trouble ahead. This heads-up lets doctors notice issues sooner rather than later. Meanwhile, every piece of personal health history lands on a tamper-proof chain, spread across many nodes instead of tucked in one central vault. Through smart contracts, permission to view data gets handled automatically. Doctors gain entry when needed; nobody else does. Real-time tracking kicks in the moment info flows through the network. Analytics predict what might come next without waiting weeks. Sharing records happens under lock, no leaks allowed. Patients connect straight to clinics using encrypted paths. Institutions swap insights while staying compliant. Collaboration shifts into higher gear because delays fade. Efficiency climbs as systems talk directly. Outcomes improve simply by cutting clutter out.

B. System Architecture:

The proposed AI-Based Diabetes Monitoring System integrates Artificial Intelligence and Blockchain technologies to collect, process, store, and present secure healthcare data. The system uses intelligent models to analyze patient health information and provides improved monitoring through a unified healthcare platform.

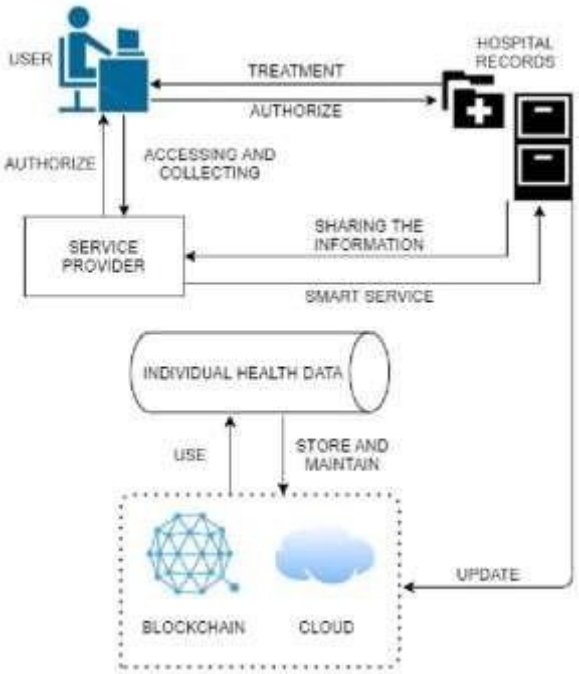

Figure 1: System Architecture for Advancements in AI and Blockchain on Healthcare for Diabetes Management

- **IoT Data Collection Layer:** This module collects real-time health data such as glucose levels and other vital parameters from wearable sensors and monitoring devices. The collected data is transmitted to the system for further processing and analysis.
- **Mobile Application Layer:** This layer allows patients to upload their health data, monitor their condition, and view predictions and reports generated by the system. It acts as an interface between users and the system.
- **AI Processing Layer:** This module uses machine learning algorithms such as Random Forest, Support Vector Machines (SVM), and LSTM models to analyze patient data, predict glucose levels, detect abnormal patterns, and generate healthcare insights.
- **Storage Layer:** This layer stores patient health records securely using blockchain technology. It maintains data integrity, transparency, and prevents unauthorized modifications by storing information in a decentralized ledger.
- **Output / Dashboard Layer:** This module provides a graphical interface for doctors and patients. It displays predictions, health reports, alerts, and monitoring results, enabling better decision-making and continuous healthcare monitoring.

IV. IMPLEMENTATION:

A. Development Environment

The proposed system is implemented using Python-based Artificial Intelligence and Block-Chain technologies. The system utilizes machine learning models for diabetes prediction and data analysis. Tools and technologies such as TensorFlow/PyTorch, Flask/Django frameworks, and database systems are used for model execution, backend processing, and data management. Blockchain platforms such as Ethereum or Hyperledger are used to ensure secure and decentralized storage of patient medical records.

B. Data Input and Acquisition

Patient health data is collected using wearable sensors, glucose monitoring devices, and IoT- based healthcare systems. The collected data includes glucose levels and other health parameters, which are transmitted to the mobile application or healthcare platform. The system processes this data for further analysis and monitoring.

C. AI-Based Disease Prediction

Machine learning models such as Random Forest, Support Vector Machines (SVM), and LSTM are used to analyze patient health data. These models predict glucose levels, identify abnormal patterns, and detect potential risks associated with diabetes. The AI system improves decision- making by providing accurate predictions and insights for healthcare professionals.

C. Blockchain Data Storage and Security

Blockchain technology is used to securely store patient medical records in a decentralized ledger. Each record is encrypted and stored as a block, ensuring data integrity and prevent- ing unauthorized modifications. Smart contracts are used to control access permissions and enable secure data sharing among authorized users.

D. Monitoring and Alerts

The system continuously monitors patient health data and generates alerts when abnormal glucose levels or risky patterns are detected. Notifications are sent to both patients and healthcare providers, enabling timely medical intervention and improving patient safety.

E. Dashboard Visualization

The system provides an interactive dashboard that displays patient health reports, glucose trends, and predictive insights. The dashboard helps doctors and patients monitor health conditions, analyze data visually, and make informed decisions for better diabetes management.

V. ALGORITHM:

INPUT: Real-time patient health data (from wearable sensors and inputs).

OUTPUT: Improved prediction with risk identified and monitoring outcomes shown on the dashboard.

```
import pandas as pd import numpy as np
from sklearn . model_selection import train_test_split from sklearn . preprocess
ing import Standard Scaler from sklearn . ensemble import Random ForestClas sifier ,
Gradient Boosting Classifier
from sklearn . tree import Decision Tree Classifier from sklearn . linear_mode l import
LogisticRegression from sklearn . svm import SVC
from sklearn . metrics import accuracy_score import hashlib from cryptography . fernet import Fernet
# Load  Dataset
data = pd. read_csv (" diabetes . csv") data = data . drop_d uplicates ()

cols = [" Glucose "," Blood Pressure "," Skin Thickness "," Insulin "," BMI"
]
for c in cols:
data [ c] = data [ c]. replace (0 , np. nan ) data = data . fillna ( d ata . median ())
X = data . drop (" Outcome ", axis =1) y = data [" Outc ome "]

scaler = Standard Scaler ()
X_scaled = scaler. fit_transform ( X)
X_train , X_test , y_train , y_test = train_test_split ( X_scaled , y, test_size =0.2) models = {
" RF": Random Forest Classifier (), " GB ": Gradient Boo sting Classifier (), " DT": Decision Tree
Classifier (), " S VM ": SVC (),
```

```
" LR ": Logistic Regression ( max_iter =1000)
}

best_model = None best_acc = 0

for model in models. values (): model. fit( X_train , y_trai n ) pred = model. predict( X_test)
acc = accuracy_score ( y_test , pred ) if acc > best_acc: best_acc = acc best_model = model

sample = X_test [0]. reshape (1 , -
1) prediction = best_model . predict( sample )

key = Fernet. generate_key () cipher = Fernet( key)
with open (" diabetes . csv", " rb") as f: file_bytes = f. read () encrypted = cipher. encrypt( file_bytes )
file_hash = hashlib . sha256 ( file_bytes ). hexdigest ()
block_hash = hashlib . sha256 (( file_hash + " BLOCKCHAIN "). encode ()). hexdigest ()

decrypted = cipher. decrypt( encrypted )
verify_hash = hashlib . sha256 ( decrypted ). hexdigest ()

if verify_hash == file_hash : status = " Verified " else :
status = " Tampered "
```

VI. RESULTS:

The proposed system was evaluated using healthcare datasets such as the PIMA Indian Dia- betes dataset along with simulated patient health records. The results demonstrated that the AI models effectively predicted diabetes risk and glucose level fluctuations with high accuracy, particularly using algorithms such as Random Forest and XGBoost. The system was able to analyze patient data in real time and detect abnormal patterns, enabling early identification of potential health risks.

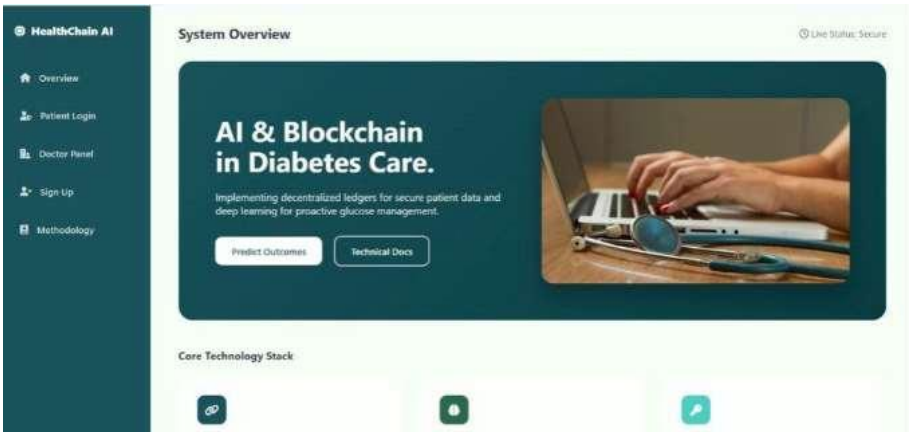

Figure 1: System Overview Dashboard of Healthcare AI.

Figure 2: Clinical Model Evaluation comparing predictive healthcare algorithms.

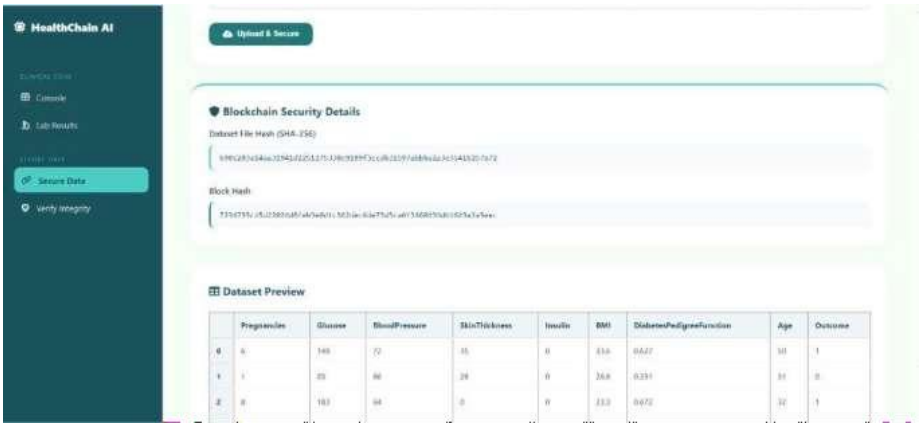

Figure 3: Blockchain Security Details showing dataset file hashing and block verification.

The integration of blockchain technology ensured secure storage and controlled access to patient medical records, preventing unauthorized modifications and maintaining data integrity. Additionally, the system successfully generated alerts and provided timely notifications to patients and healthcare providers when abnormal conditions were detected. Compared to traditional healthcare systems, the proposed approach improved prediction accuracy, enhanced data security, increased transparency, and enabled efficient real-time monitoring, thereby supporting better healthcare decision-making and patient management.

VII. CONCLUSION:

This research presents an integrated Artificial Intelligence and Blockchain-based healthcare framework for improving diabetes monitoring and management. The proposed system com- bines machine learning algorithms with blockchain technology to enable intelligent prediction of glucose levels, early detection of potential complications, and secure management of pa- tient medical records. By utilizing AI models, the system provides accurate analysis of patient health data and supports better clinical decision-making, while blockchain ensures data integrity, transparency, and controlled access to sensitive information. The system enhances real- time monitoring, improves patient safety, and reduces dependency on manual healthcare processes. Overall, the proposed approach increases efficiency, reliability, and trust in modern healthcare systems. Future enhancements may include integration with advanced wearable de- vices, large- scale healthcare datasets, and cloud-based platforms to further improve scalability, prediction accuracy, and real-world healthcare applications.

REFERENCES:

[1] Yuan L, Wang Y, Xing M, Liu T and Xiang D (2025) Global research trends in AI-assisted blood glucose management: a bibliometric study. Front. Endocrinol. 16:1579640. doi: 10.3389/fendo.2025.1579640
[2] Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. Future Health J. 2021 Jul;8(2):e188-e194. doi: 10.7861/fhj.2021-0095. PMID: 34286183; PMCID: PMC8285156.
[3] Guan Z, Li H, Liu R, Cai C, Liu Y, Li J, Wang X, Huang S, Wu L, Liu D, Yu S, Wang Z, Shu J, Hou X, Yang X, Jia W, Sheng B. Artificial intelligence in diabetes management: Advancements, opportunities, and challenges. Cell Rep Med. 2023 Oct 17;4(10):101213. doi: 10.1016/j.xcrm.2023.101213. Epub 2023 Oct 2. PMID: 37788667; PMCID: PMC10591058.
[4] Hennebelle A, Ismail L, Materwala H, Al Kaabi J, Ranjan P, Janardhanan R. Secure and privacy-preserving automated machine learning operations into end-to-end integrated IoT-edge-artificial intelligence-blockchain monitoring system for diabetes mellitus prediction. Comput Struct Biotechnol
[5] J. 2023 Nov 23;23:212-233. doi: 10.1016/j.csbj.2023.11.038. PMID: 38169966; PMCID: PMC10758733.
[6] Pranav Ratta, Abdullah, Sparsh Sharma,A blockchain-machine learning ecosystem for IoT-Based remote health monitoring of diabetic patients, Healthcare Analytics, Volume 5,2024,100338,ISSN 2772-4425.
[7] Abid Haleem, Mohd Javaid, Ravi Pratap Singh, Rajiv Suman, Shanay Rab ,Blockchain technology applications in healthcare: An overview ,International Journal of Intelligent Networks, Volume 2,2021.
[8] Tasin I, Nabil TU, Islam S, Khan R. Diabetes prediction using machine learning and explainable AI techniques. Healthc Technol Lett. 2022 Dec 14;10(1-2):1-10. doi: 10.1049/htl2.12039. PMID: 37077883; PMCID: PMC10107388.
[9] Hong W, Lu Y, Zhou X, Jin S, Pan J, Lin Q, Yang S, Basharat Z, Zippi M, Goyal H. Usefulness of Random Forest Algorithm in Predicting Severe Acute Pancreatitis. Front Cell Infect Microbiol. 2022 Jun 10;12:893294. doi: 10.3389/fcimb.2022.893294. PMID: 35755843; PMCID: PMC9226542.
[10] Yedjou CG, Grigsby J, Mbemi A, Nelson D, Mildort B, Latinwo L, Tchounwou PB. The Management of Diabetes Mellitus Using Medicinal Plants and Vitamins. *International Journal of Molecular Sciences*. 2023; 24(10):9085.
[11] P. Sangwan and B. Banita, "Blockchain Based Health Records Management for Diabetes Patients: Real-World Applications," *2024 First International Conference on Technological Innovations and Advance Computing (TIACOMP)*, Bali, Indonesia, 2024
[12] Desai, M.S.R., Basavarajaiah, N.M. (2025). Blockchain-driven predictive analytics for diabetes and cardiovascular disease management. Ingénierie des Systems information, Vol. 30, No. 7, pp. 1753- 1764.
[13] Monu Bhagat, Ujjwal Maulik ,StaBloCare: Blockchain-secured diabetes monitoring system using stacked deep learning, Biomedical Signal Processing and Control ,Volume 113, Part B,2026.