Block Chain Based AI Agent Model for Pharmaceutical Knowledge Engineering

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ABSTRACT

BlockChain technology supports distributed digital ledger that manages secured transactions over network of computers. Those data records are transparent, immutable and resistant to cyber attacks. AI agents are transforming the pharmaceutical industry by facilitating automation in management. They are very efficient in improving the drug production and marketing. In this paper we proposed a fusion model of BlockChain technology associated with AI agent model to improve decision making and data analysis in this domain. The proposed layered model organizes the effective modules that focus on data privacy and data security along with expert system abilities. The knowledge discovery and representation with this AI agent model supports versatile platform for both customer and company's knowledge experience benefits.

Keywords: - AI-Agent, Inference Engine, Chat bots, Block Chains.

LITERATURE STUDY

Dalila Ressi, et. al., (2024) Contributed survey on integration of BlockChain with AI for improving efficiency, security and reliability of BlockChain based applications. Some of the vital integration algorithm solutions are described in their work.

Wasim Akram et. al., (2024) - Focused on pharmacy supply chain management effective services using AI powered BlockChain technology. The modern supply chain management system needs security and traceability with ease of access. The Block Chains support distributed immutable data records management with efficient cryptographic security to data. Integration of AI automates the SCM processes with high accuracy and reliability.

A. Akther et. al., (2025) - Explored the integration of BlockChain with AI with a framework maintaining transparency. The adoption of AI into BlockChain systems increases traceability, accountability, data protection, authentication and scalability.

Md. Ahmer Raza et. al., (2022) - highlighted the application of AI in pharmaceutical domain which improved data efficiency and decision making ability in diagnosis, medical tools usage, drug prescriptions, therapies and medical marketing. The adoption of AI improved the quality of pharmacology domain services.

Ritik kumar et. al., (2022) - conducted a review on BlockChain technologies with an integration of AI in health services. The EHR management with CNN and RNN algorithms improves the knowledge management and discovery with greater decision support.

MODEL ARCHITECTURE

The BlockChain Layer under Ethereum public networks connects the global medical professionals, medical colleges, pharmacy industries and government medical associations into a distributed BlockChain networks. Maintain the ledgers for individual domains which are highly transparent and immutable. The contracts governed by specific territorial governments and nodes can share and use various knowledge resources in hyper secured mode.

Medical Professional BCN

This is a global distributed network of doctors, health workers, medical supervisors and nurses to manage various drug prescriptions to various patients. The recommendations of medicines based on symptoms of diseases maintained into ontology structures. Major services supported are

- Secure Data storage and exchange
- Enhanced Data Integrity
- Improved Collaboration and Information Sharing
- Increased Transparency and Accountability
- Reduced Costs and Administrative activities
- Medical research and data sharing

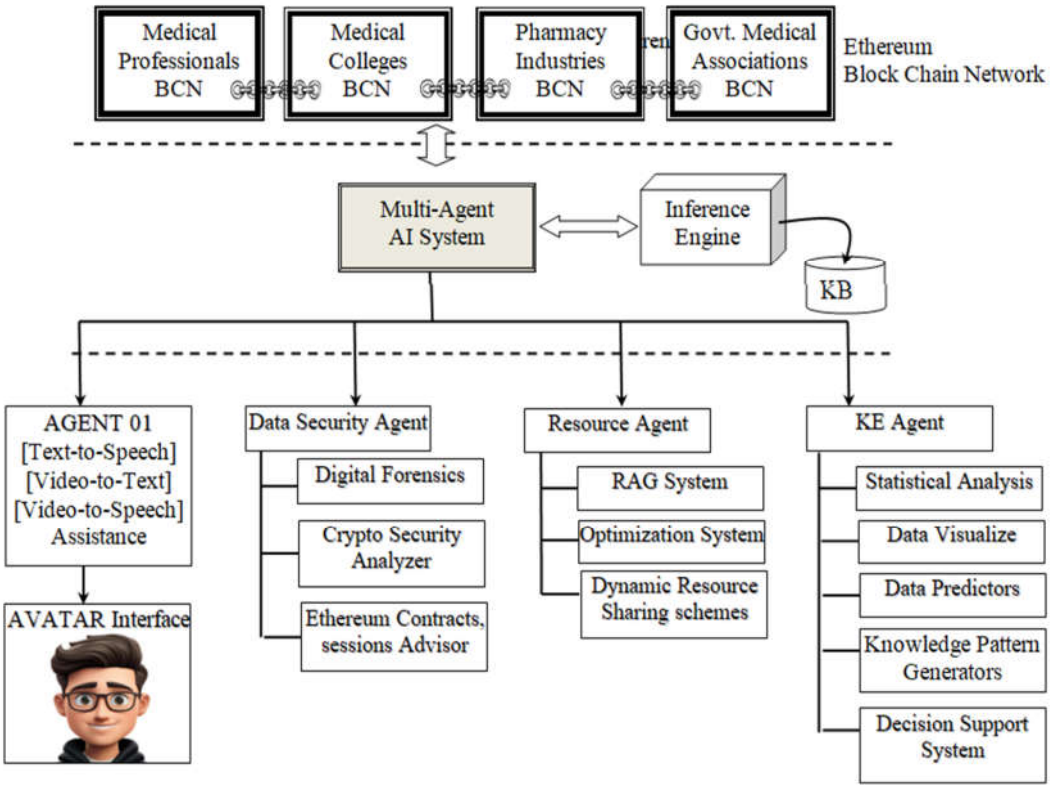

Figure 1: Pharmaceutical BlockChain based AI Agent Architecture

Medical Colleges BCN

A unified platform for medical colleges to securely exchange medical records, enhancing research efficiency and promotes patient centric caring. Some major services offered

- Electronic Medical Records
- Research Data Sharing
- Medical Data Formats
- Patient Centered Caring
- Data Visualization and Analysis
- Collaborative Research
- Streamlined medical processes
- Transparency and Trust

Pharmacy Industries BCN

It is a BlockChain of pharmaceutical industries with high transparency, traceability and security. Improves the SCM (Supply Chain Management) services and automates the processes. Focusing on QoS and decision making over business strategies offers following features

- Traceability and Security among supply chains
- Streamlined Regulatory
- Clinical Trails
- Supply Chain Management
- Secured Data Sharing
- Secured drug formulae management
- Drug Ontology governance
- Contract Management services

Government Medical Associations BCN

The medical association's works under government control and manages the drug production and distribution in Indian territories. The BCN established among pharmacy companies and medical associations facilitate secured data services among trusted parties. Some AI enhanced services offered as follows

- Smart Contract management
- Automated regulations updater
- Drug schemes transparency
- Distributed Fund Services
- Secured Patent Services
- Trusted Inspections
- Transparent Licensing Services
- Government Funding
- Bid Management
- Reward Managers

Multi Agent AI System

The proposed framework supported with Multi-Agent based AI agent system. There are four agent classes to perform various Knowledge Engineering and decision support. The activities of multi agents are given in table 1.

TABLE 1: Multi-Agent Functionalities

AI Agent	Activities
AI Assistant	Offers services like Text-to-Speech, Video-to-Text and Video-to-Speech with NLP functionalities. Behaves like a smart kiosk for user assistance. Effective Avatars to simulate human assistance.
Data Security	Ethereum contracts security, crypto analyzers and Digital forensics to provide modern level security over BlockChain. Medical and Drug Ontologies protection and authentication using AI automation improves quality of data security.
Resource	Supported with RAG system to intelligent resource management. Optimization techniques to time space management. Problem solving with dynamic strategies for effective resource sharing.
Knowledge Engineering	Automated statistical Analysis, Data Visualization, data prediction, pattern recognition, knowledge representation and semantic engineering. Many more AI techniques are available to build an environment for pharmaceutical domain integration with smart devices.

ACTION DIAGRAMS

AI Assistant Layout

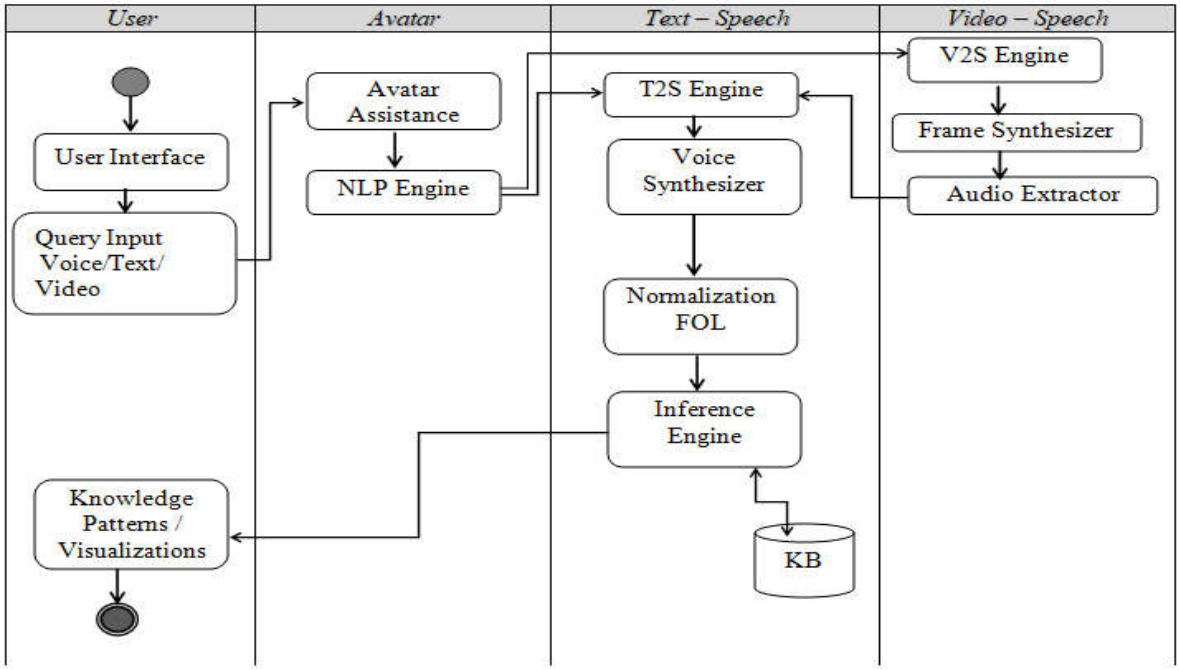

Figure 2: AI Assistance Agent Action Module

Figure 2 show the action model of AI BlockChain based pharmacy assistant.

Data Security Agent Layout

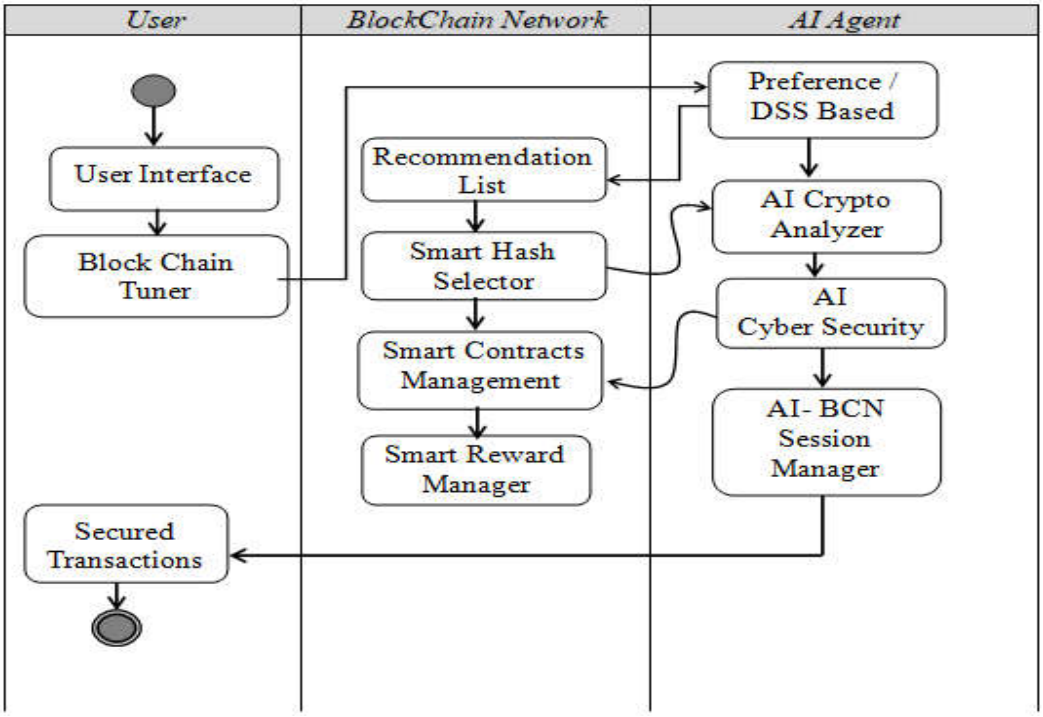

Figure 3: AI Data Security Agent Module

Resource Management AI Layout

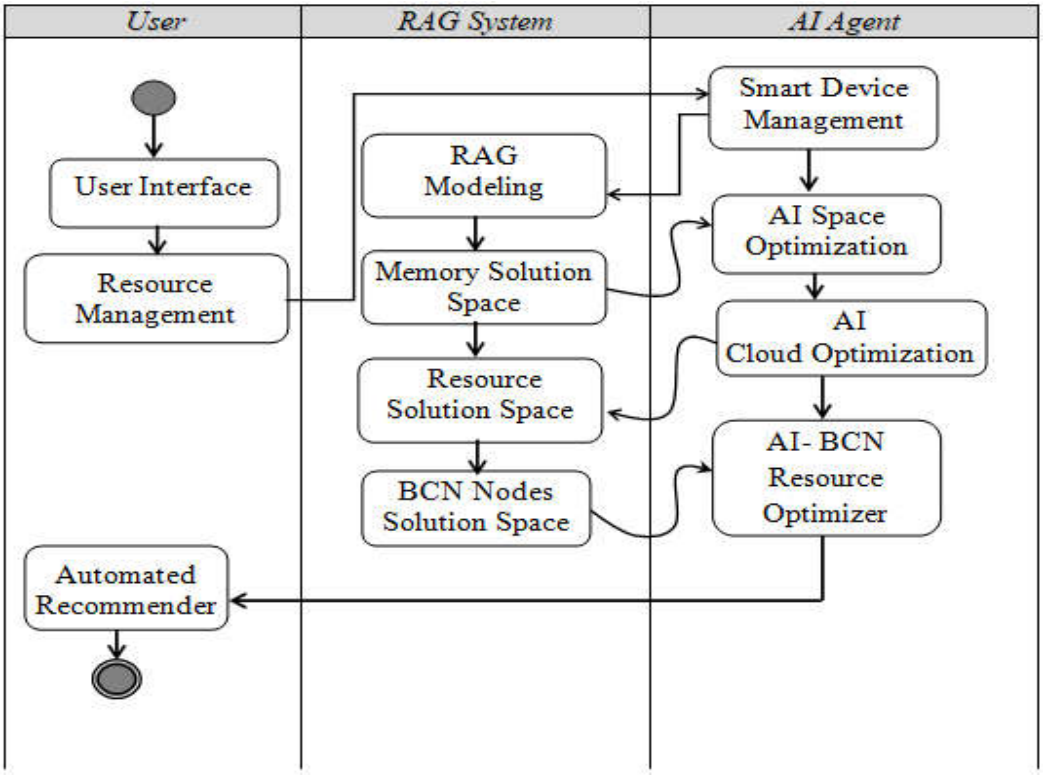

Figure 4: AI Intelligent Resource Management Module

Knowledge Engineering AI Layout

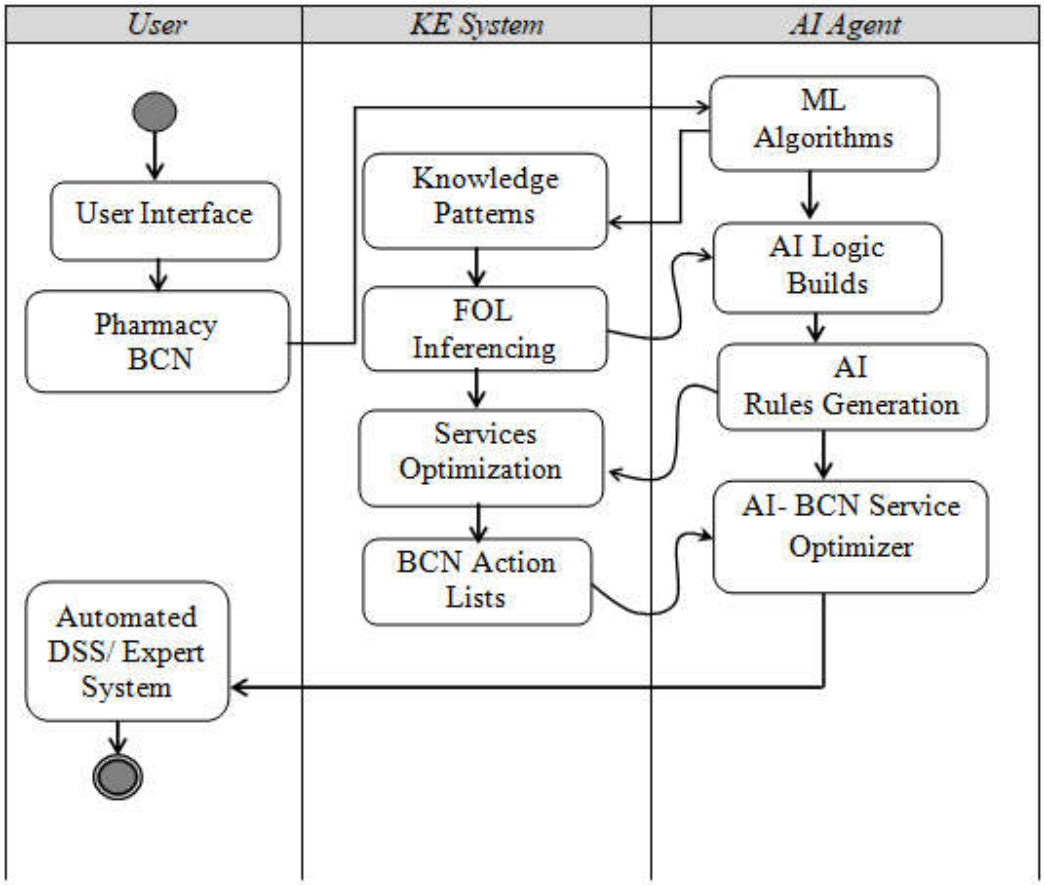

Figure 5: AI Knowledge Engineering Module

Figures 3, 4, 5 shows the activity diagrams of AI sub agents of BCN-AI model. The FOL (First-Order-Language) used to construct logical sentences from natural languages. The availability of inference logic operators used to generate action strategies to reach optimization goals in this model. This approach not only provide solutions for real time goals but also forecasts future challenges and goals to be considered for optimal consistency of BlockChain networks with increased trust, security, transparency and immutability in data management of pharmaceutical domain.

CONCLUSION

The AI Agents are autonomous in nature. They gather knowledge from environments without user intervention or program inputs. In this paper the Pharmacy Block Chain Network is integrated with AI Agents improved the decision making for BCN QoS enhancement. The knowledge patterns extraction and applying inference logic allows this system to act like expert system in this domain. This model facilitates both user and organization in managing their BCN with machine intelligence. Various tasks like validations, audits and activities are performed with more precision and accuracy. These expert systems are capable to handle more challenges in real time environments with expert like decisions.

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