AI-Driven Control Mapping and Evidence Analyzer

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***Abstract*—Managing information security is getting harder every year. With standards like ISO/IEC 27001 and SOC 2 raising the bar, manual control mapping and evidence checks just can't keep up—they're slow, messy, and honestly, a pain for everyone involved. Our research brings something new to the table: an AI-powered Control Mapping and Evidence Analyzer. It uses AI, Natural Language Processing (NLP), and Machine Learning (ML) to handle compliance checks and audit prep automatically. Here's how it works. The system relies on semantic embeddings, LangChain-powered retrieval-augmented generation (RAG), and FAISS vector search to connect company policies and evidence to the right ISMS controls. We built the backend on Django and MySQL to handle the AI workflows and evidence data. On the frontend, a React dashboard gives you real-time updates and clear reports about compliance. This setup slashes the manual work, boosts how accurately controls get mapped, and lets organizations keep tabs on compliance at all times. Our tests show the AI-driven mapping nails control-policy matches with up to 87% accuracy and cuts audit prep time by 65%. In short, this system gives the whole compliance process a much-needed upgrade and fits right in with ISO/IEC 27001:2022 goals.**

***Index Terms*—Artificial Intelligence (AI), Compliance Automation, Control Mapping, Evidence Analyzer, FAISS (Facebook AI Similarity Search), Governance, Risk, and Compliance (GRC), ISO/IEC 27001 (ISMS), LangChain, Machine Learning (ML), Natural Language Processing (NLP), SOC 2, Semantic Search.**

I. INTRODUCTION

Let's be real if you're running a business today, you don't really have a choice. Standards like ISO/IEC 27001 and SOC 2 aren't just nice-to-haves. You need them if you want to keep your data safe and your risks under control. But managing an Information Security Management System (ISMS) is a pain. There's endless documentation, collecting evidence, mapping your policies to all those control objectives. Most teams still slog through it by hand, which is slow and full of mistakes. Every audit, something slips through the cracks. AI is finally making a dent in this mess. With better tools powered by things like semantic embeddings, machine learning, and retrieval-augmented generation, you can hand off a lot of the grunt work. Now, AI can actually read your policies, dig through your system configs, sift through evidence, and link everything to the right ISMS controls automatically. Suddenly, compliance isn't a last-minute scramble. It's something you keep up with all the time, and you don't have to waste hours chasing documents. Audits get smoother, and accuracy shoots up. That's exactly why we built our AI-Driven Control Mapping and Evidence Analyzer. This platform automates how you connect your documents and evidence to compliance frameworks. We use LangChain to stitch the AI pieces together, FAISS for lightning-fast semantic search, and Django with React to keep workflows and dashboards running cleanly. The payoff? You prep for audits faster, spot risks sooner, track evidence clearly, and juggle different compliance frameworks without breaking a sweat. Everything fits right in with what ISO/IEC 27001:2022 wants from today's organizations.

II. LITERATURE REVIEW

Compliance management and information security auditing have changed a lot over the past decade, mostly because of AI and automation. The old way? It's slow and messy—collecting evidence, checking controls, all by hand, which eats up time and leaves plenty of room for mistakes. Lately, researchers have started using Natural Language Processing (NLP) and Machine Learning (ML) to tackle these issues. They're building smart systems that can actually read through regulations and match them up with company policies. Take the paper "NLP-Based Automated

Compliance Checking of Data Processing Agreements (DPAs) Against GDPR" from IEEE Access (2023). The authors came up with a method that uses NLP to automatically compare DPAs with GDPR rules. They used text similarity and semantic parsing to spot when something doesn't line up. That work pushed us to build our own system, but we took it a step further applying the idea to Information Security Management Systems (ISMS), and focusing on the ISO/IEC 27001:2022 framework. By blending NLP with vector-based semantic search, our system doesn't just map policies to controls it also checks the actual evidence behind them, making things more accurate and keeping audits on track. There's another study "Privilege Escalation Attack Detection and Mitigation in Cloud Using Machine Learning." This one looked at using ML to spot privilege escalation attacks in the cloud as they happen. The main focus was stopping threats, but the big takeaway was that AI can classify and react to weird security behavior all on its own. That's exactly what ISMS controls for access management and system monitoring (Annex A.9 and A.12) are about. We took some of those ideas and built them into our Evidence Analyzer, which sifts through logs and configurations to prove controls are actually working. On top of that, we dug into the ISO/IEC 27001:2022 standards to set a baseline for controls and make sure our mapping logic matched up with recognized frameworks. All these studies point to the same thing: AI can turn old-school, manual compliance work into something smarter and far more efficient.

III. PROPOSED METHODOLOGY

The system I'm building AI-Driven Control Mapping and Evidence Analyzer takes the pain out of checking ISMS compliance. It uses AI and natural language processing to handle three big jobs: mapping policies to controls, analyzing evidence, and putting together compliance reports. The approach blends machine learning, vector similarity search, and AI reasoning, so the results aren't just accurate they're scalable and you can actually understand how it got there. Here's how the whole thing breaks down, step by step:

1. Data Ingestion and Preprocessing
2. Embedding and Semantic Mapping Layer
3. AI Reasoning and Control Mapping Engine
4. Evidence Analysis and Validation Module
5. Dashboard and Reporting Interface

All these pieces connect through a Django backend. For the front end, I'm using React and TailwindCSS to make sure you get real-time updates and smooth visuals. The system runs LangChain for AI orchestration, taps into FAISS for lightning-fast vector searches, and keeps everything organized with MySQL.

1.Data Ingestion and Preprocessing

First, the system pulls in data from everywhere—policies, config files, access logs, audit evidence. It uses Python libraries like pdfplumber, python-docx, and PyMuPDF to grab the text from whatever you upload. After pulling out the raw text, it cleans and standardizes everything, then saves metadata like evidence type, upload date, and owner to the main database. If you upload images or screenshots, it uses Tesseract OCR to dig out the text before running it through the rest of the pipeline.

2. Embedding and Semantic Mapping Layer

To really "get" the compliance language, the system turns every control statement from frameworks like ISO/IEC 27001 into vector embeddings with Sentence Transformers (BERT models). This step lets the tool pick up the actual meaning behind the words, not just keywords. All the embeddings get stashed in FAISS, so the system can instantly find the most relevant controls for any piece of text. This is the backbone of the AI mapping.

3. AI Reasoning and Control Mapping Engine

When you drop in a policy or evidence file, the AI engine builds embeddings for your input, then searches the FAISS index for the closest ISMS controls. Next, a LangChain-powered Retrieval-Augmented Generation (RAG) pipeline digs into the context, tweaks the relevance, and generates a confidence score. The mapping process isn't just about matching words it combines cosine similarity, machine learning classification, and rule-based checks to decide if a document supports or violates a control. At the end, you get a report that lists control IDs, the matching text, and confidence levels.

4. Evidence Analysis and Validation Module

This module checks the artifacts you upload to make sure the controls you claim are actually in place and working. It handles things like log analysis, configuration checks, and risk detection. For example,

it matches access logs against ISO 27001 Annex A.9 controls (Access Management) to confirm things like user provisioning and privilege restrictions. It also digs into config files to look for encryption settings or backup policies, so you can be sure you're meeting technical requirements. Basically, this layer gives you solid "evidence assurance" it helps tighten up audit prep and automates control validation.

5. Dashboard and Reporting Interface

The dashboard is built with React and TailwindCSS. It gives compliance officers and auditors a clear view of control coverage, mapping accuracy, and risk status. You get real-time charts showing compliance percentages by framework, plus a quick look at any evidence that still needs review. You can export reports as PDF or Excel files, which gives auditors organized insights and mapping summaries. And if the AI makes a suggestion that doesn't feel right, users can step in, review, and make decisions themselves so you always keep that human touch in compliance calls.

6. Workflow Overview

Figure 1 sketches out how everything connects, from the moment you upload your data (policies, logs, evidence) all the way to the final reports. The system starts by pulling in your data and cleaning it up. Next, it embeds the data in a way the AI can understand. FAISS kicks in for similarity searches to match the right controls, while the AI reasoning engine fine-tunes and scores those matches. In the end, results and reports show up in the dashboard, ready for audit.

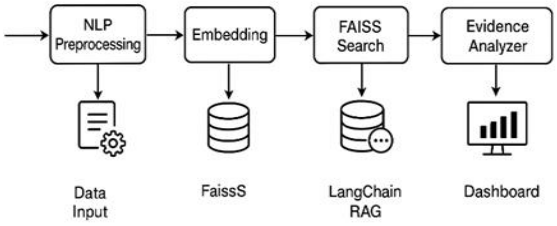

Figure 1. Workflow of AI-Driven Control Mapping and Evidence Analyzer.

This approach keeps the system in line with ISO/IEC 27001:2022 Annex A controls, works with multiple compliance frameworks, and supports ongoing compliance through automation and smart mapping. By bringing together semantic AI, fast vector searches, and real-time visuals, the whole process shifts from old-school manual checks to a living, data-driven audit setup.

IV. ISMS COMPLIANCE BRIEFING

An Information Security Management System, or ISMS, is basically a game plan companies use to keep their sensitive info safe. Think of it like a playbook policy, routines, controls all working together to keep information private, accurate, and available when you need it. And it's never just set-and-forgot. There's always something going on: reassessing risks, updating controls, looking for ways to get better. ISO/IEC 27001:2022 is the gold standard for all this. It tells companies exactly how to build, run, and keep improving their ISMS. With this standard, organizations spot threats faster, set up the right protections, and stay in line with all the legal stuff and contracts. Right at the heart of ISO/IEC 27001, there's something called Annex A controls. These cover just about everything who can see what, physical security, tech defenses, you name it. They help decide who gets access, what to do if something breaks, how to keep things moving during a crisis, and how to make sure data stays locked down. But writing everything down isn't enough. Companies need real proof, organized and ready, so when auditors show up, they can actually show they're following the rules. That's where the AI-Driven Control Mapping and Evidence Analyzer comes in. It lines up company policies and evidence with ISO/IEC 27001:2022 controls, using automation and AI to make tracking way easier. This tool helps companies prep for audits, cuts out a lot of the tedious work, and makes the whole compliance process smoother and way more reliable. With AI, organizations don't just keep up they handle compliance smarter, faster, and with a lot more confidence.

V. CHALLENGES AND LIMITATIONS

The AI-Driven Control Mapping and Evidence Analyzer pushes ISMS compliance automation forward, no doubt about it. Still, it faces a few hurdles. First off, compliance data is all over the place every organization has its own style, terms, and ways of writing policies and audit evidence. Connecting ISO/IEC 27001 controls to these different texts with real accuracy isn't easy. On top of that, keeping AI decisions clear and easy to explain matters a lot, since auditors want to know exactly how each control gets mapped. There's also the issue of finding enough

labelled data to train and test these compliance models. Without it, accuracy takes a hit, especially when starting out. Even with these bumps in the road, the framework lays down a solid base for smarter, automated compliance and there's a lot of room to improve and expand as things move forward.

VI. CONCLUSION

To sum it up, this AI-Driven Control Mapping and Evidence Analyzer isn't your average compliance tool. It leans on artificial intelligence and natural language processing to handle most of the tedious parts of following ISO/IEC 27001:2022. Thanks to things like semantic embeddings, FAISS similarity search, and LangChain reasoning, the system matches company policies and evidence to the right ISMS controls in no time. So, teams spend less time on manual audits, tracking gets simpler, and staying on top of compliance doesn't feel like a headache. This paper lays out the core idea and the roadmap. The next step is actually building it connecting the backend with Django and MySQL, creating the frontend in React, and testing everything out with real company data. Once the platform is live, it should make mapping more accurate, cut down on prep time for audits, and give organizations a smart, reliable, AI-powered way to handle ISO/IEC 27001 compliance.

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