GenAi based Shariah Compliance Stock Trade Advisor for PSX

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Declaration

We Fizza Razzaq CUI/FA22-BCE-100/ATD and Hamza Jadoon CUI/FA22-BCE-012/ATD hereby declare that I have produced the work presented in this thesis, during the scheduled period of study. I also declare that I have not taken any material from any source except referred to wherever due that amount of plagiarism is within acceptable range. If a violation of HEC rules on research has occurred in this thesis, I shall be liable to punishable action under the plagiarism rules of the HEC.

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Certificate

It is certified that Fizza Razzaq CUI/FA22-BCE-100/ATD and Hamza Jadoon CUI/FA22-BCE-012/ATD has carried out all the work related to this thesis under my supervision at the Department of Computer Engineering, COMSATS University Islamabad, Abbottabad campus and the work fulfills the requirement for award of BS degree.

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DEDICATION

We dedicate this project to **Almighty Allah**, whose countless blessings granted us the strength, patience, and perseverance to complete this work. We also dedicate it to the **Holy Prophet Muhammad (S.A.W.)**, whose teachings of honesty, justice, and ethical conduct continue to guide us in both academic and professional life.

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ABSTRACT

GenAi based Shariah Compliance Stock Trade Advisor for PSX

Stock market investment is a vital component of modern financial systems; however, Muslim investors face additional challenges due to the requirement of compliance with Islamic financial principles. Conventional stock advisory platforms primarily focus on financial performance and profitability while neglecting Shariah constraints such as the prohibition of interest (Riba), excessive uncertainty (Gharar), and involvement in non-permissible business activities. Moreover, existing Shariah screening practices are largely manual, rule-based, and difficult for common investors to understand, especially in dynamic market environments like the Pakistan Stock Exchange (PSX).

This project presents a **GenAI-based Shariah Compliance Stock Trade Advisor for PSX**, designed to assist investors in making informed and ethical investment decisions. The proposed system integrates **Large Language Models (LLMs)** with established **AAOIFI Shariah screening standards** to evaluate stock compliance and provide intelligible investment guidance. The system processes stock-related financial information and market indicators, assesses Shariah compliance, and generates clear, human-like explanations and recommendations such as Buy, Hold, or Avoid.

Unlike traditional advisory systems, the proposed solution emphasizes **explainability, accessibility, and ethical decision-making** by leveraging Generative AI for advisory and reasoning purposes. The system aims to reduce reliance on manual analysis, enhance transparency in Shariah screening, and make Islamic stock investment more approachable for non-technical users. The outcomes of this project demonstrate the potential of Generative AI in supporting ethical finance and intelligent decision-support systems within the context of Islamic capital markets.

TABLE OF CONTENTS (14, Bold)

LIST OF FIGURES (14, Bold)

List of Tables (14, Bold)

ABBREVIATIONS

AI	Artificial Intelligence
ANN	Artificial Neural Network
AAOIFI	Accounting and Auditing Organization for Islamic Financial Institutions
API	Application Programming Interface
FinTech	Financial Technology
GenAI	Generative Artificial Intelligence
LLM	Large Language Model
NLP	Natural Language Processing
PSX	Pakistan Stock Exchange
S&P	Standard and Poor's
SVM	Support Vector Machine
ROI	Return on Investment
UI	User Interface
ML	Machine Learning
XAI	Explainable Artificial Intelligence

Chapter 1

Introduction

1.1 Introduction

The stock market plays a critical role in economic growth by enabling capital formation, wealth creation, and efficient allocation of financial resources. In Pakistan, the Pakistan Stock Exchange (PSX) serves as a key platform for investors seeking long-term and short-term financial returns. However, stock market investment involves complex decision-making due to volatile price movements, financial uncertainty, and rapidly changing market conditions. For individual investors, especially those without financial expertise, making informed trading decisions remains a significant challenge.

For Muslim investors, stock market participation becomes even more complex due to the requirement of **Shariah compliance**. Islamic finance strictly prohibits interest (Riba), excessive uncertainty (Gharar), and investment in non-permissible business activities. Traditional stock advisory tools primarily focus on profitability and ignore ethical and religious constraints, making them unsuitable for Shariah-conscious investors. Furthermore, manual Shariah screening methods are time-consuming, static, and difficult for non-technical users to understand.

Recent advancements in **Artificial Intelligence (AI)**, particularly **Generative Artificial Intelligence (GenAI)** and **Large Language Models (LLMs)**, provide an opportunity to modernize stock market advisory systems. This research focuses on developing a **GenAI-based Shariah Compliance Stock Trade Advisor for PSX** that assists investors by combining automated Shariah screening with intelligent, explainable trading guidance.

1.2 Project Background

The increasing participation of individuals in stock markets has created a demand for intelligent advisory systems that can assist investors in making accurate and ethical decisions. In Pakistan, many investors rely on informal advice, manual analysis, or incomplete online tools, which often leads to poor financial outcomes. Additionally, most available platforms lack Shariah compliance checks, forcing Muslim investors to independently verify compliance using complex financial statements and Shariah guidelines.

Traditional Shariah screening frameworks, such as those defined by the **Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI)**, are rule-based and require expert-level interpretation. These methods do not provide explanations or guidance for borderline cases and are

not integrated with real-time market data. As a result, investors face difficulties in understanding why a particular stock is permissible or non-permissible.

This project addresses these limitations by integrating **Generative AI** with **AAOIFI Shariah standards** to automate compliance checking and generate understandable trading advice. The system is designed to analyze PSX stock data, evaluate Shariah compliance, and provide advisory recommendations in natural language, enabling investors to make informed decisions with confidence.

1.3 Role of Artificial Intelligence in Financial Systems

Artificial Intelligence plays a significant role in modern financial systems by enabling data-driven decision-making, automation, and intelligent analysis. In stock market applications, AI models analyze historical and financial data to identify trends, patterns, and risk factors that are difficult for humans to detect manually.

Generative AI, powered by **Large Language Models (LLMs)**, extends traditional AI capabilities by enabling systems to understand context, generate explanations, and interact with users in a human-like manner. Unlike conventional rule-based systems, LLMs can interpret financial indicators, Shariah rules, and user queries simultaneously, producing transparent and understandable advisory outputs.

Figure 1.1: Role of Artificial Intelligence in Financial Advisory Systems

1.4 Shariah Compliance in Stock Market Trading

Shariah compliance is a fundamental requirement in Islamic finance. A stock is considered Shariah-compliant if the company's core business activities are permissible and its financial ratios fall within acceptable limits defined by Islamic principles. AAOIFI standards provide guidelines for evaluating compliance based on factors such as interest-based income, debt ratios, and liquidity thresholds.

However, applying these standards manually is complex and requires access to updated financial information. Many investors lack the expertise to interpret these ratios correctly, leading to confusion and inconsistent investment decisions. Automating Shariah compliance evaluation ensures consistency, accuracy, and transparency in stock screening.

The proposed system embeds AAOIFI standards into an AI-driven framework to evaluate stock compliance efficiently and reliably.

Filters	**Ratio**
Halal Ratio	**<95%**
Debt Ratio	**>30%**
Interest Ratio	**>5%**

1.5 Generative AI-Based Stock Trade Advisory

Stock trade advisory systems assist investors by providing recommendations such as Buy, Hold, or Avoid. Traditional advisory systems rely on static rules or numerical outputs, which are often difficult for users to interpret. Generative AI introduces explainability by generating natural language explanations for each recommendation.

The proposed GenAI-based advisor analyzes stock information, evaluates Shariah compliance, and generates advisory responses tailored to the investor's needs. This human-centric approach improves user understanding and supports ethical decision-making.

1.6 Explainable AI for Ethical Investment Decisions

Explainability is a critical requirement in financial and ethical systems. Investors must understand the reasoning behind AI-generated recommendations to trust the system. Explainable AI ensures transparency by clarifying how decisions are made and which criteria are applied.

In this project, explainability is achieved through Generative AI, which provides reasoning-based explanations aligned with Shariah principles. This reduces ambiguity and strengthens investor confidence.

1.7 Motivation

The motivation behind this project stems from the growing demand for **ethical and Shariah-compliant investment solutions**. Muslim investors often struggle to balance profitability with religious obligations due to the lack of intelligent advisory platforms tailored to Islamic finance.

This project aims to bridge the gap between modern AI technologies and Islamic financial principles by providing an accessible, accurate, and explainable stock advisory system. The motivation is to empower investors with a tool that supports ethical investing while simplifying complex financial and Shariah concepts.

1.8 Problem Statement

Despite advancements in AI-driven financial systems, there is no comprehensive stock advisory platform for PSX that simultaneously provides Shariah compliance evaluation, real-time advisory, and understandable explanations. Existing systems either lack Shariah screening or rely on static, non-explainable rule-based approaches.

This highlights the need for a GenAI-based Shariah-compliant stock trade advisor that integrates AI reasoning with Islamic finance principles to support informed and ethical investment decisions.

1.9 Objectives

The main objectives of this project are:

- To develop a GenAI-based advisory system for PSX stocks

- To automate Shariah compliance evaluation using AAOIFI standards
- To generate explainable Buy, Hold, or Avoid recommendations
- To enhance transparency and accessibility for non-technical investors
- To promote ethical and sustainable investment practices

1.10 Scope of Work

The scope of this project includes the analysis of selected PSX-listed companies using financial and market data. The system focuses on Shariah compliance evaluation, AI-based advisory generation, and user interaction. The project is intended as a decision-support tool and does not guarantee financial returns.

1.11 Thesis Structure

This thesis is organized as follows:

- **Chapter One** presents the introduction, background, motivation, and objectives of the project.
- **Chapter Two** provides a detailed literature review of existing research related to AI-based stock prediction, Shariah compliance, and robo-advisory systems.
- **Chapter Three** describes the proposed methodology, system architecture, and implementation details.
- **Chapter Four** discusses system evaluation, results, and analysis.
- **Chapter Five** concludes the thesis and outlines future research directions.

Chapter 2

Literature Review

2.1 Literature Review

This chapter presents a comprehensive review of existing research related to artificial intelligence–based stock market prediction, Shariah-compliant investment frameworks, and automated robo-advisory systems. The literature is structured into three major areas:

1. machine learning and statistical models for stock return prediction,
2. AI-driven robo-advisory systems for financial decision-making, and
3. Shariah compliance standards and their integration into automated financial systems.

This organization provides a clear understanding of how traditional machine learning methods have evolved toward intelligent, automated, and ethically compliant financial advisory systems. The reviewed studies also highlight existing limitations, which form the foundation for the proposed GenAI-based Shariah-compliant stock trade advisor for the Pakistan Stock Exchange (PSX).

2.2 Artificial Intelligence Based Algorithms

Artificial Intelligence (AI) refers to computational techniques that enable systems to simulate human intelligence, including learning, reasoning, and decision-making. In financial markets, AI is widely used for price prediction, trend analysis, portfolio optimization, and risk management. Machine Learning (ML), a core subset of AI, allows systems to learn patterns from historical financial data and make predictions on unseen data.

Machine learning algorithms are broadly classified into four categories, as illustrated in Figure 2.1.

Figure 2.1: Classification of Machine Learning Algorithms

2.2.1 Supervised Learning

Supervised learning is a machine learning paradigm in which models are trained using labeled datasets, where both input features and corresponding outputs are known. The objective is to learn a mapping function that accurately predicts outputs for new, unseen inputs.

In stock market applications, supervised learning is commonly used for:

- stock return prediction,
- price movement classification (up/down),
- risk categorization.

Common supervised learning algorithms include:

- Linear Regression
- Logistic Regression
- Artificial Neural Networks (ANN)
- Support Vector Machines (SVM)

Several studies reviewed in this chapter employ supervised learning models for PSX stock prediction, demonstrating their effectiveness in structured financial datasets.

2.2.2 Unsupervised Learning

Unsupervised learning uses unlabeled data to identify hidden patterns or structures within datasets. Instead of prediction, the focus is on clustering, grouping, or dimensionality reduction.

In financial systems, unsupervised learning is used for:

- clustering stocks based on similar behavior,
- identifying hidden market regimes,
- portfolio diversification.

Examples include K-Means clustering and Principal Component Analysis (PCA).

2.2.3 Semi-Supervised Learning

Semi-supervised learning combines both labeled and unlabeled data during training. This approach is useful when labeled financial data is limited but large volumes of unlabeled market data are available.

In stock market analysis, semi-supervised learning improves prediction accuracy by leveraging additional market structure information without full labeling.

2.2.4 Reinforcement Learning

Reinforcement learning (RL) involves an agent that learns optimal decision-making strategies through interaction with an environment using reward-based feedback. In financial trading, reinforcement learning is applied to:

- automated trading strategies,
- portfolio optimization,
- risk-aware decision-making.

Although RL is powerful, it requires extensive data and careful reward design, making it complex for Shariah-compliant trading systems.

2.3 Neural Network Based Algorithms

Neural networks are biologically inspired models designed to recognize complex patterns in data. They consist of interconnected layers of neurons that process inputs through weighted connections.

In financial forecasting, neural networks are widely used due to their ability to model nonlinear relationships in stock prices and returns.

2.3.1 Artificial Neural Network (ANN)

Artificial Neural Networks (ANNs) consist of an input layer, one or more hidden layers, and an output layer. ANNs use forward propagation to compute outputs and backpropagation to adjust weights based on prediction error.

ANNs have been extensively used for:

- stock return prediction,
- market trend classification,
- volatility analysis.

Their ability to capture nonlinear dependencies makes them suitable for financial data modeling.

2.3.2 Logistic Regression

Logistic Regression is a statistical supervised learning algorithm used for binary classification. In stock market applications, it is commonly used to predict:

- price movement direction (increase or decrease),
- buy/sell signals.

Despite its simplicity, logistic regression provides interpretable results and performs well in structured financial datasets.

2.3.3 Generative Artificial Intelligence (GenAI)

Generative Artificial Intelligence refers to advanced AI models capable of generating human-like text, insights, and recommendations. Large Language Models (LLMs), such as LLaMA and GPT-based architectures, fall under this category.

In financial advisory systems, GenAI enables:

- natural language explanations of investment decisions,
- automated financial advice generation,
- integration of regulatory and ethical rules into decision-making.

This research leverages GenAI to combine predictive insights with Shariah compliance reasoning.

2.4 Shariah Compliance Standards

Shariah-compliant investing follows Islamic financial principles, prohibiting:

- interest (Riba),
- excessive uncertainty (Gharar),
- gambling (Maisir),
- investment in non-halal industries.

2.4.1 AAOIFI Shariah Standards

The Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) provides globally recognized Shariah standards for Islamic finance. These standards define financial screening criteria based on:

- business activity screening,
- financial ratio thresholds.

AAOIFI standards are essential for ensuring that automated investment systems remain compliant with Islamic finance principles.

2.5 Related Work

This section reviews relevant studies related to stock prediction models, robo-advisory frameworks, and Shariah-compliant investment systems.

2.5.1 Stock Returns Prediction Using Artificial Neural Networks

In the study *"Stock Returns Prediction by Using Artificial Neural Network Model for Pakistan Stock Exchange"* [1], the authors applied ANN to predict stock returns using historical PSX data. The results showed that ANN outperformed traditional statistical models by capturing nonlinear market patterns. However, the study lacked real-time advisory capabilities and ethical investment constraints.

2.5.2 Stock Performance Prediction Using Logistic Regression

The research titled *"Prediction of Stock Performance Using Logistic Regression: Evidence from PSX"* [2] utilized logistic regression to classify stock movements. The study demonstrated reliable classification accuracy but was limited to binary predictions and lacked intelligent advisory features.

2.5.3 Deep Learning Robo-Advisor for Shariah-Compliant Investment

The paper *"A Deep Learning Robo-Advisor Framework for Shariah-Compliant Investment into Chinese Markets"* [3] proposed an AI-driven robo-advisor incorporating Shariah screening rules. While effective, the system was limited to a specific market and lacked generative explainability.

2.5.4 AAOIFI-Based Shariah Screening Framework

AAOIFI standards [4] provide formal guidelines for Islamic financial compliance. Although widely accepted, most existing systems apply these rules manually rather than integrating them into intelligent automated advisors.

2.6 Research Gap

From the reviewed literature, it is evident that:

- existing PSX prediction models lack ethical and Shariah compliance,
- Shariah-compliant systems lack real-time intelligence,
- GenAI-based explainable advisory systems are largely unexplored.

This research addresses these gaps by proposing a **GenAI-based Shariah-compliant stock trade advisor for PSX**, combining predictive analytics, AAOIFI screening, and natural language advisory.

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