A Multimodal Approach for Trend-Adjusted Offset Prediction between Price and News via Dynamic Gated Fusion for Non-Stationary Stock Market

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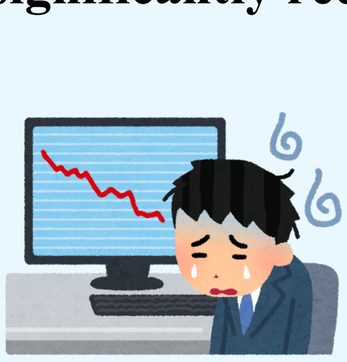
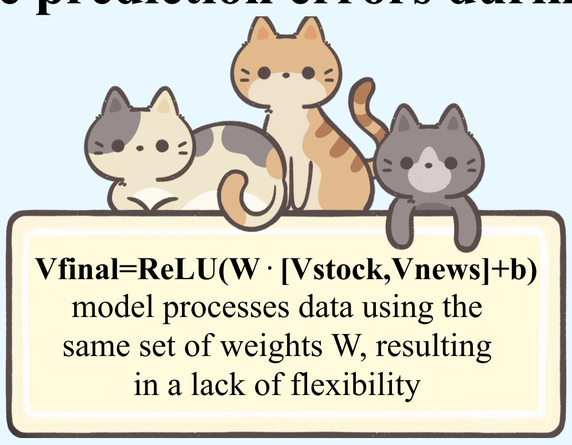
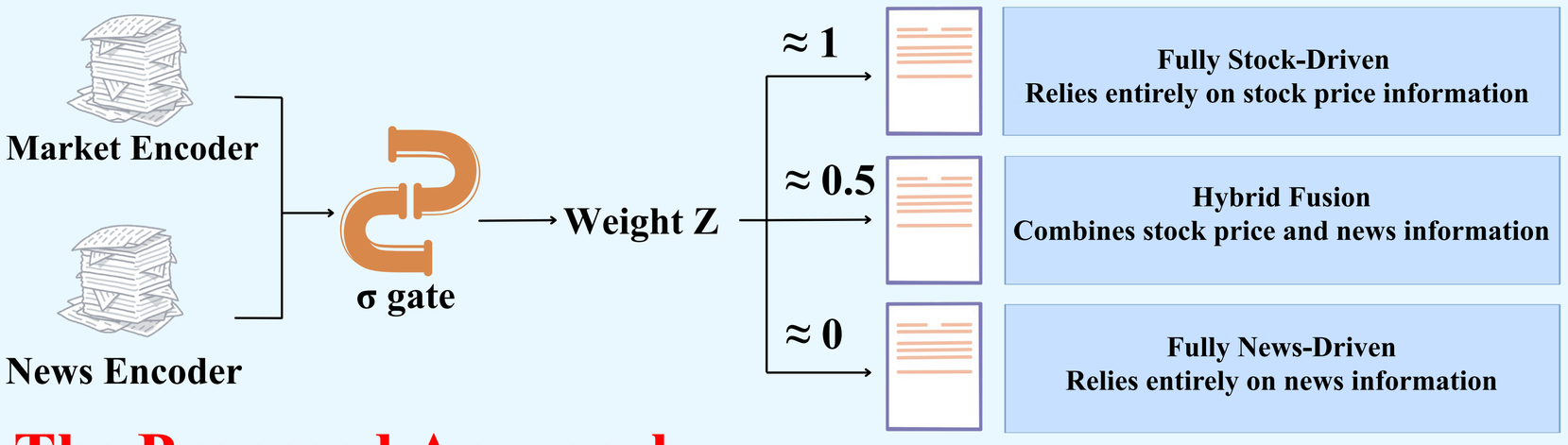
Introduction

Main Contribution: **To overcome the lag effect of technical indicators through a regime-aware dynamic gated fusion mechanism that can adaptively balance multimodal information to significantly reduce prediction errors during market turbulence.**





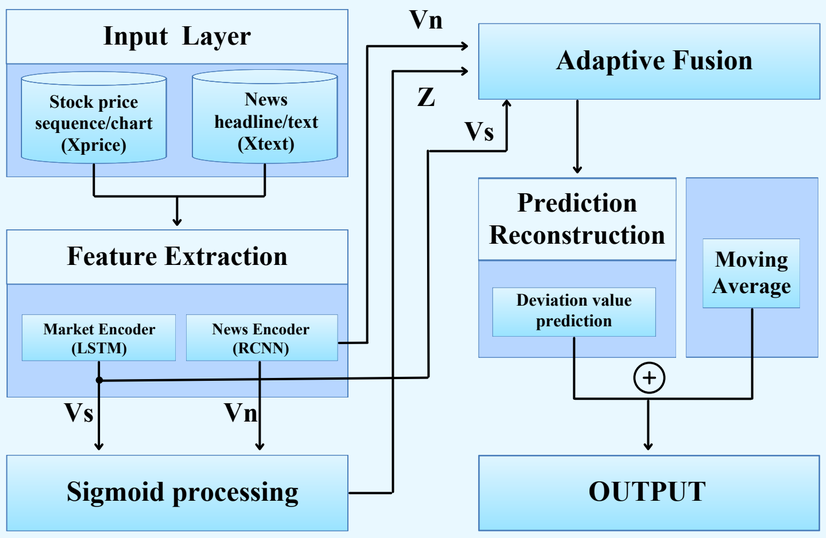
The Proposed Approach



Training Configuration

Hyperparameter	Value	Description
Batch Size	32	Number of samples per gradient update
Learning Rate	0.001	Initial learning rate for Adam optimizer
Optimizer	Adam	Adaptive Moment Estimation algorithm
Loss Function	MSE	Mean Squared Error for regression
Epochs	100	Maximum training iterations (with Early Stopping)
Train/Test Split	80% / 20%	Ratio for training and testing data

The Flowchart



Input

Time : 03/01/2025 ~ 06/01/2025 TSMC stock

Financial News (headline + content)

Stock Price Time Series (OHLCV)

Temporal Alignment to next trading day

Proposed Mechanism

$$V_s = \mathrm{LSTM}(X_{price})|_T$$

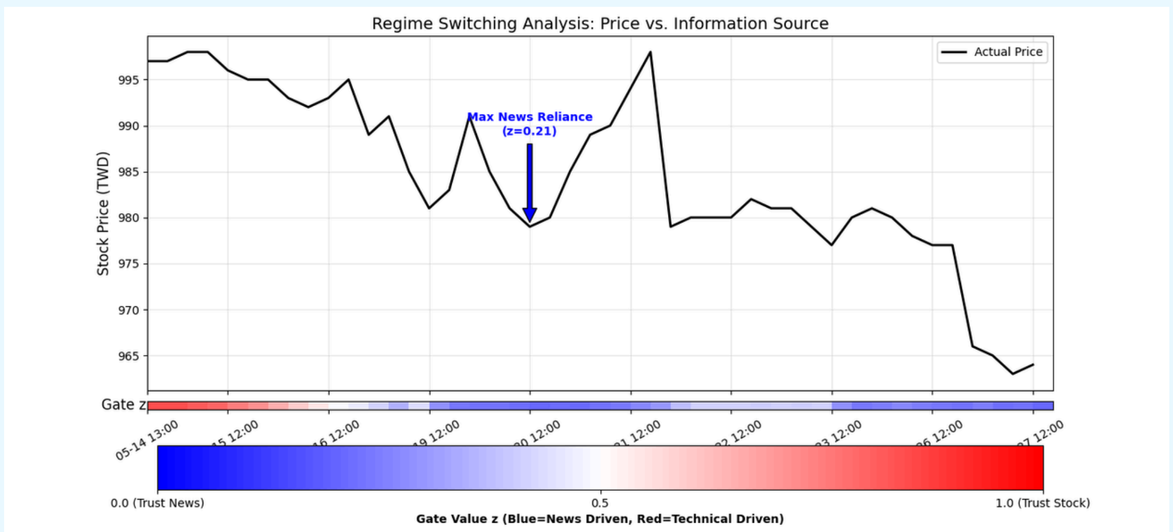
$$V_n = \mathrm{LSTM}\left(\mathrm{MaxPool}\left(\mathrm{ReLU}(\mathrm{Conv1D}(X_{text}))\right)\right)|_T$$

$$z = \sigma(W_g \cdot [V_s; V_n] + b_g) \text{(Gate Calculation)}$$

$$V_{final} = z \odot V_s + (1 - z) \odot V_n \text{(Dynamic Fusion)}$$

Result

Market Regime	Sample Size (N)	Baseline MAE	Gated MAE	Improvement	p-value	Significance
High Volatility (Top 20%)	9	11.14	9.74	+12.60%	0.019	Yes (p<0.05)
Low Volatility (Bottom 80%)	36	4.3	4.22	+1.96%	0.441	No
Overall	45	5.67	5.32	+6.14%	0.156	No



Conclusions

(1) Validated the Dynamic Gate's ability to adaptively shift focus during high-volatility periods, functioning as an effective risk-mitigation mechanism.

(2) Achieved a significant 12.60% error reduction in high-volatility regimes, effectively overcoming the lagging nature of technical indicators.

(3) Adopts Trend-Adjusted Offset prediction to address data non-stationarity, ensuring precise capture of short-term mean reversion signals.

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