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The urgency of robot trading regulation in Indonesia: Between innovation and investor protection

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Abstract
The purpose of this research is to examine the urgency of implementing specific regulations on robot trading in Indonesia to ensure investor protection and maintain market stability, as well as to identify the most suitable regulatory framework to balance the advancement of robot trading innovation with the need for a safe, transparent, and fair trading ecosystem in Indonesia. This study employs a normative legal research method with a statutory approach. To address these challenges, Indonesia requires a regulatory framework that balances innovation with protection. Such a framework should begin with a clear legal definition of robot trading, establish a tiered licensing and registration system, and set rigorous technical standards for algorithm testing, transparency, and operational safeguards. Investor protection must be prioritized through mandatory risk disclosures, truth-in-advertising rules, and public education programs that improve financial and technological literacy. The inclusion of regulatory sandboxes and industry collaboration will ensure that innovation is nurtured rather than stifled, while international cooperation can close cross-border enforcement gaps. Effective enforcement is essential, supported by modern regulatory technology and strong sanctions to deter misconduct. By embedding principles of safety, transparency, and fairness into all stages of robot trading activity, Indonesia can create a resilient and trustworthy market environment. This approach will not only protect current investors but also position the country as a competitive player in the global fintech landscape, ensuring that technological progress supports sustainable and equitable financial growth.

Keywords: Urgency, robot trading, regulation, financial growth, clear legal definition, robot trading

1. Introduction
The development of information and communication technology has brought significant transformation to various aspects of life, including the financial and trading sectors. One innovation that has become increasingly popular in recent years is robot trading, also known as Automated Trading Systems (ATS). Robot trading refers to software or algorithms designed to automatically execute the buying and selling of financial instruments based on predetermined parameters or strategies. With the ability to carry out orders quickly, precisely, and without human emotional influence, robot trading is touted as a tool capable of providing efficiency and high profit potential for market participants, whether in the capital market, forex, or digital assets. This phenomenon has also begun to penetrate Indonesia's financial markets, driven by widespread internet penetration, increasing technological literacy, and the growing ease of access to digital trading platforms [1].

However, behind its great potential, the use of robot trading in Indonesia also presents a number of complex issues, particularly regarding legal aspects and investor protection. One of the main concerns is the absence of specific regulations governing the use and distribution of robot trading in Indonesia's financial markets. To date, relevant authorities such as the Financial Services Authority (Otoritas Jasa Keuangan/OJK), the Commodity Futures Trading Regulatory Agency (Badan Pengawas Perdagangan Berjangka Komoditi/Bappebti), and the Indonesia Stock Exchange (Bursa Efek Indonesia/BEI) have issued several regulations related to electronic transactions and technology-based trading. However, these regulations tend to be general in nature and have yet to address the technical aspects and specific risks arising from the use of robot trading. Consequently, this legal gap has been exploited by irresponsible parties to market robot trading products that lack transparency, operate without licenses, and even involve elements of fraud or Ponzi schemes that harm the public [2].

The history of robot trading in Indonesia is closely intertwined with the global evolution of financial technology and the gradual digitalization of trading activities. Although automated trading systems had been in use internationally since the 1990s, particularly in the forex and futures markets, their presence in Indonesia only began to be noticeable in the early 2000s. At that time, most trading activities in Indonesia, whether in the capital market or commodities market, were still conducted manually, and the idea of algorithmic or automated trading was largely unfamiliar to local traders. The initial exposure came through international forex brokerage platforms that began offering Expert Advisors (EAs) for the MetaTrader 4 platform. These EAs, essentially early forms of robot trading, were marketed to Indonesian retail traders via online forums, small community gatherings, and early-day financial seminars. Adoption during this period was limited to a niche group of technologically adept traders, as internet access was still uneven, and digital literacy among the general public remained relatively low.

The second phase of robot trading's history in Indonesia unfolded in the late 2000s to early 2010s, as internet penetration improved significantly and the Indonesian economy began experiencing rapid growth. During this period, the forex market, regulated under the supervision of Bappebti, became a popular entry point for retail investors seeking alternative investment opportunities. Alongside this trend, foreign and local brokers started actively marketing automated trading solutions, including customizable trading robots, to Indonesian clients. These robots were typically designed to execute strategies in currency pairs, gold, and crude oil futures, operating on simple algorithmic rules such as moving average crossovers, breakout strategies, and martingale-based position sizing. Many Indonesian traders, still in the early stages of understanding financial risk management, viewed robot trading as a shortcut to achieving consistent profits without the need for extensive market analysis. This perception set the stage for both the rapid adoption of automated systems and the growing vulnerability of retail investors to misleading claims [2].

In the mid-2010s, robot trading in Indonesia entered a more commercialized phase, with its marketing no longer confined to trader communities but extending to the general public. This was fueled by two converging factors: the rise of social media as a marketing tool and the emergence of multi-level marketing (MLM)-style schemes disguised as technology investment opportunities. During this time, certain companies began selling robot trading packages bundled with expensive training programs or "lifetime licenses" that promised fixed monthly returns. These offers were often accompanied by aggressive recruitment incentives, encouraging buyers to bring in new members for additional rewards. Many of these schemes operated in a regulatory grey area, exploiting the fact that there was no specific Indonesian law addressing the sale or operation of trading robots. While some of these products were genuine, others functioned primarily as Ponzi schemes, using funds from new members to pay earlier investors. This period saw a surge in public awareness of robot trading, but also a corresponding increase in cases of fraud and financial losses [3].

Parallel to the retail market's exposure to robot trading, the institutional and semi-institutional use of automated trading strategies began to develop as well. On the Indonesia Stock Exchange (IDX), algorithmic trading was introduced by certain brokerage firms and proprietary trading desks, primarily for high-frequency order execution and arbitrage opportunities. However, these systems were tightly controlled, and their operation required compliance with the IDX's technical and operational guidelines. Unlike the retail-oriented robot trading systems, institutional algorithmic trading in Indonesia was regulated under existing market infrastructure rules, with strict monitoring to prevent market manipulation. This created a dual-track development of robot trading in Indonesia: One within the formal, regulated space, and another in the loosely monitored retail sector where most misuse and fraud occurred.

The late 2010s marked a turning point in the history of robot trading in Indonesia. The growth of the cryptocurrency market, which operated largely outside of traditional financial regulations until Bappebti began issuing specific rules in 2019, opened new avenues for the marketing and deployment of trading robots. Cryptocurrency exchanges, both domestic and international, provided open APIs that allowed developers to create trading bots capable of executing arbitrage, market-making, or trend-following strategies. This technological openness led to a boom in robot trading products targeting cryptocurrency traders. Once again, the promise of high, consistent returns often advertised as "passive income" with little to no effort attracted large numbers of inexperienced investors. Unfortunately, this environment also gave rise to some of the largest fraudulent schemes in Indonesia's financial history. Notable cases involved robot trading companies that collected hundreds of billions of rupiah from members, only to collapse when recruitment slowed, revealing the Ponzi-like nature of their operations. These scandals drew significant media attention and prompted calls for clearer regulations.

Regulatory authorities began to respond more visibly around 2020-2022, following a wave of high-profile fraud cases involving robot trading platforms such as Fahrenheit, DNA Pro, and Net89. Investigations revealed that many of these companies had no registered trading licenses, their robots were either non-functional or operated in a highly risky manner, and profit claims were fabricated. The Indonesian National Police's Criminal Investigation Agency (Bareskrim Polri) arrested several key figures, and Bappebti issued public warnings listing unlicensed trading platforms and prohibited robot trading products. These events marked the first time robot trading had been placed firmly on the radar of both law enforcement and financial regulators. However, despite enforcement actions, the absence of a specific, comprehensive legal framework meant that regulation was still reactive rather than preventive. The fragmentation of regulatory authority where OJK oversaw capital markets and financial services while Bappebti regulated commodities and forex complicated coordinated oversight, especially as robot trading products often straddled multiple asset classes [4].

At the same time, there was growing recognition that not all robot trading systems were harmful. Many legitimate traders and developers in Indonesia were building automated trading strategies as part of a broader push toward fintech innovation. The challenge, therefore, was to distinguish between legitimate algorithmic tools and fraudulent investment schemes disguised as technology products. This

distinction became particularly important as Indonesia sought to strengthen its position in the digital economy and attract fintech investment. By the early 2020s, discussions among policymakers, industry groups, and academics increasingly emphasized the need for a regulatory framework that could support innovation while providing robust investor protection. The conversation began to shift from outright prohibition toward structured licensing, testing, and transparency requirements for robot trading providers.

In the current decade, robot trading in Indonesia stands at a crossroads. On one side, there is significant potential for technology-driven efficiency in both retail and institutional markets, with opportunities to leverage artificial intelligence, machine learning, and big data analytics to enhance trading performance. On the other side, the scars left by years of fraud and misuse have made regulators and the public wary. The ongoing challenge is to craft regulations that are adaptive to technological change, enforceable across different market segments, and capable of closing legal loopholes without stifling innovation. As of now, the history of robot trading in Indonesia is a story of rapid adoption, unregulated expansion, widespread misuse, and a regulatory system struggling to catch up. It reflects the broader tension in emerging economies between embracing technological progress and safeguarding public interests in the face of new and complex risks. The trajectory of robot trading in Indonesia will likely depend on how quickly and effectively the country can implement a coherent legal framework, promote digital and financial literacy, and foster collaboration between regulators, industry players, and consumer advocacy groups. Only then can the promise of robot trading be fully realized while minimizing the risks that have defined much of its history in the country [4].

Cases of fraud disguised as robot trading schemes in Indonesia have become increasingly prevalent in recent years. Some involve losses reaching hundreds of billions of rupiah and affect thousands of victims across various regions. The methods used vary, from selling robot trading licenses with the promise of fixed monthly returns, to managing investor funds through auto-trading systems controlled unilaterally by operators without adequate oversight mechanisms. In many cases, there is no transparency regarding how the robot operates, the potential risks of losses, or the existence of official licenses from regulators. This situation not only causes financial harm but also erodes public trust in technology-based trading and the financial market as a whole.

Furthermore, the existence of robot trading systems operating without adequate oversight poses potential systemic risks to market stability. Poorly designed algorithms can trigger flash crashes or extreme price fluctuations in a short period, especially when used simultaneously by many market participants. On the other hand, the dominance of automated trading without sufficient human participation can reduce market liquidity quality and make the market more vulnerable to price manipulation. Therefore, the urgency to regulate robot trading is not only based on the need to protect individual investors but also to safeguard the integrity and stability of the national financial market [5].

From an international perspective, several countries have taken proactive steps to regulate the use of robot trading. The European Union, for instance, through the Markets in Financial Instruments Directive II (MiFID II), requires providers of algorithmic trading services to register their systems, ensure the existence of risk controls, and provide transparent audit trails. The United States, through the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC), also enforces strict rules on the registration, testing, and supervision of trading algorithms. Japan, Singapore, and Australia have adopted similar regulatory frameworks emphasizing transparency, risk management, and consumer protection. This comparison highlights that Indonesia is lagging behind in regulating robot trading, thereby increasing the risk of technology misuse in its domestic market.

In Indonesia, the fragmentation of financial market oversight authority adds another layer of challenge. The OJK oversees the capital market and the financial services industry, while Bappebti is responsible for commodity futures and forex trading. In practice, however, many robot trading systems market themselves across multiple segments, such as claiming to be usable in international forex markets, Cryptocurrency trading, as well as stocks or futures indices. This ambiguity in jurisdiction is often exploited by unscrupulous operators to evade oversight, arguing that their products do not fall entirely under the regulation of any single authority. As a result, consumers who lack legal and technical understanding become the most vulnerable to harm.

The urgency of regulating robot trading in Indonesia becomes even more pressing when considering the principles of market fairness and investor protection. On one hand, the state needs to provide space for technological innovation in the financial sector to avoid falling behind in global competition. Innovations such as robot trading, artificial intelligence (AI) in market analysis, and blockchain-based trading have significant potential to improve efficiency, broaden access, and promote financial inclusion. On the other hand, innovations that develop without a clear and firm regulatory framework will present risks that outweigh their benefits. Proper regulation can serve as an enabler for innovation rather than an obstacle, as long as it is designed to strike a balance between investor protection, market integrity, and the freedom to innovate [3].

Therefore, a comprehensive and adaptive regulatory framework is needed. Such regulations should cover aspects such as the registration and licensing of robot trading providers, testing and certification of algorithms before deployment in the market, mandatory transparency of operating methods and risks for users, supervisory mechanisms involving technology (regtech), as well as strict sanctions for violators. Additionally, financial and technological literacy among the public must be massively improved so that prospective users can understand the risks inherent in robot trading and are not easily lured by promises of instant profits. Collaboration between regulators, industry players, academics, and user communities is the key to successful implementation of effective regulations.

Thus, the background of this research is grounded in two main concerns: First, the need to create a safe, transparent, and fair technology-based trading ecosystem; and second, the importance of ensuring that innovations such as robot trading can develop in a healthy and sustainable manner in Indonesia. Without clear regulations, the risks of financial

losses, fraud, and market instability will continue to loom, hindering industry growth and damaging public trust. Therefore, the urgency of robot trading regulation in Indonesia is a strategic issue that must be addressed immediately, either through the creation of new rules or the refinement of existing regulations, in order to accommodate technological developments while protecting the interests of all stakeholders in the financial market.

1.2 Problem Formulation

Based on the background provided above, there are two problem formulations that will be discussed:

- What's the urgency of the specific implementation regulations on robot trading in Indonesia to ensure investor protection and maintain market stability?
- What's the most suitable regulatory framework to balance the advancement of robot trading innovation with the need for a safe, transparent, and fair trading ecosystem in Indonesia?

1.3 Objectives of Writing

In line with the background and problem formulations mentioned above, the objectives of this writing are to examine and understand the is the implementation of specific regulations on robot trading in Indonesia to ensure investor protection and maintain market stability and regulatory framework is most suitable to balance the advancement of robot trading innovation with the need for a safe, transparent, and fair trading ecosystem in Indonesia.

2. Research Methodology

This writing utilizes the normative legal research method, as it requires an analysis of a situation through the lens of relevant legal regulations. Normative legal research involves examining the law as a guide using a statute approach. The journal writing relies on primary legal sources, such as principles and legal norms related to the implementation of specific regulations on robot trading in Indonesia to ensure investor protection and maintain market stability and regulatory framework is most suitable to balance the advancement of robot trading innovation with the need for a safe, transparent, and fair trading ecosystem in Indonesia [6].

3. Results and Discussion

3.1 The Urgency of the specific implementation regulations on robot trading in Indonesia to ensure investor protection and maintain market stability

Robot trading, or automated trading systems (ATS), has a direct and significant influence on market stability due to the way it interacts with market mechanisms at high speed and scale. Unlike human traders who may take seconds or minutes to react to price movements, trading robots can execute thousands of transactions in milliseconds, amplifying price trends or triggering abrupt reversals. This speed advantage, combined with pre-set algorithms that respond mechanically to market signals, can cause chain reactions during periods of volatility. In extreme cases, poorly calibrated algorithms have been known to trigger "flash crashes" sudden, sharp declines in asset prices that recover just as quickly which can disrupt liquidity and undermine investor confidence. Moreover, when large numbers of market participants use similar or identical automated strategies, the risk of herding behavior increases, making the market more sensitive to sudden shifts in sentiment or technical triggers. In Indonesia's still-developing financial markets, where liquidity in certain asset classes remains relatively shallow, the widespread use of unregulated and potentially faulty trading robots heightens the danger of destabilizing price swings. These dynamics illustrate why robot trading is not merely a technological tool but also a potential systemic risk factor that must be addressed through targeted regulation.

The urgency of implementing specific regulations on robot trading in Indonesia stems from both technological and structural realities of the local financial ecosystem. On the technological side, the rapid growth of financial technology adoption, fueled by increased internet penetration, mobile trading applications, and the popularity of speculative investment instruments such as forex, commodities, and crypto currencies, has brought automated trading into the mainstream far faster than regulators anticipated. Structural realities, on the other hand, include the fragmented nature of Indonesia's regulatory oversight, where the Financial Services Authority (Otoritas Jasa Keuangan/OJK) supervises capital markets and financial services, while the Commodity Futures Trading Regulatory Agency (Badan Pengawas Perdagangan Berjangka Komoditi/Bappebti) regulates commodities and derivatives. This fragmentation has created jurisdictional gaps that opportunistic actors exploit, marketing robot trading products that fall outside the effective reach of any single regulator. As a result, unlicensed or fraudulent robot trading schemes have proliferated, often targeting retail investors with promises of high, fixed returns and minimal effort, while concealing the true risks and operational details of the underlying algorithms [7].

The impact of such schemes on investor protection has been severe. In recent years, Indonesia has witnessed multiple high-profile cases of fraud involving robot trading companies that collected massive sums from thousands of investors, only to collapse when recruitment slowed or market conditions turned unfavorable. Investigations revealed that many of these platforms did not actually operate legitimate trading algorithms, or that the algorithms were programmed in ways that generated consistent losses for users while enriching the operators through hidden commissions or misappropriation of funds. These incidents not only caused substantial financial harm to individuals but also eroded public trust in technology-based financial products more broadly. In a country where financial literacy levels remain modest, particularly among retail investors drawn to the allure of quick profits, the absence of clear, enforceable rules for robot trading exacerbates vulnerability to predatory practices [8].

From the perspective of market stability, the proliferation of unregulated robot trading systems compounds systemic risk. In an orderly and well-regulated environment, algorithmic trading can enhance liquidity, tighten bid-ask spreads, and improve price discovery. However, in an environment where oversight is weak and risk controls are absent, the same technology can magnify volatility, distort market signals, and facilitate manipulation. For example, coordinated or poorly programmed bots can engage in "quote stuffing," flooding the market with orders that are rapidly canceled to create false impressions of supply and demand. In thinly traded markets, a single aggressive algorithm can dominate short-term price action, potentially misleading human traders and other algorithms alike.

Furthermore, because robot trading systems operate automatically, errors or unexpected market conditions can lead to runaway trading loops that drain liquidity and exacerbate downward or upward spirals in asset prices. Such instability can have knock-on effects beyond the immediate market, affecting investor sentiment, increasing margin calls, and prompting premature liquidation of positions, all of which undermine broader financial stability.

The international experience provides a clear precedent for the importance of regulation in mitigating these risks. Jurisdictions such as the European Union, the United States, Japan, and Singapore have already introduced comprehensive frameworks for algorithmic and high-frequency trading. These frameworks typically require the registration of automated trading systems, pre-deployment testing, ongoing performance monitoring, transparent disclosure of operational parameters, and mandatory risk controls such as "kill switches" to halt trading in emergencies. In contrast, Indonesia currently lacks a unified, detailed regulatory structure for robot trading, relying instead on general provisions related to electronic transactions, investment services licensing, and anti-fraud laws. While these provisions provide some recourse after violations occur, they are insufficient for preventive oversight a gap that allows harmful practices to spread unchecked until they cause significant damage.

Given these realities, the urgency of implementing specific regulations becomes undeniable. Such regulations should serve multiple objectives simultaneously: Safeguarding investors from fraudulent schemes, preserving the integrity and stability of financial markets, fostering healthy innovation in financial technology, and ensuring that Indonesia remains competitive in the evolving global trading landscape. To achieve these objectives, the regulatory approach must be both comprehensive and adaptive. Comprehensive, in the sense that it covers all relevant asset classes, including forex, commodities, equities, and cryptocurrencies and all stages of a robot trading product's lifecycle, from development and marketing to deployment and ongoing operation. Adaptive, in the sense that it can evolve in step with technological advancements and new trading paradigms, incorporating input from industry experts, academics, and international best practices [9].

One key element of such a framework would be mandatory licensing and registration for all entities that develop, sell, or operate robot trading systems in Indonesia. This process should include a technical audit of the algorithm to verify its functionality, assess its risk profile, and ensure that it complies with established market conduct rules. Another element would be the requirement for transparent disclosure to users, outlining how the robot operates, what strategies it employs, the historical performance (with independent verification), and the specific risks involved. Importantly, regulations should also mandate the implementation of risk control mechanisms, such as position limits, volatility filters, and automated shutdown triggers, to prevent uncontrolled trading activity in abnormal market conditions.

Equally important is the role of investor education in complementing regulatory measures. Even the most sophisticated oversight regime will fall short if investors themselves do not understand the nature of the products they are using. Regulators, industry associations, and educational institutions should collaborate to develop and disseminate accessible resources explaining what robot trading is, how it works, the risks it entails, and how to identify legitimate providers. This effort would not only enhance individual decision-making but also create a more informed market environment that discourages predatory practices.

Collaboration between regulatory bodies is also essential to address the jurisdictional fragmentation that currently hinders effective oversight. A joint regulatory task force between OJK, Bappebti, and other relevant agencies could coordinate licensing, enforcement, and information-sharing, ensuring that no robot trading product can exploit regulatory loopholes by straddling multiple asset classes. Such a task force could also facilitate cross-border cooperation with foreign regulators, particularly in cases where robot trading providers operate internationally or host their infrastructure outside Indonesia.

In conclusion, robot trading holds both promise and peril for Indonesia's financial markets. Its potential to enhance efficiency, improve liquidity, and democratize access to sophisticated trading strategies cannot be ignored. Yet, without specific and enforceable regulations, the risks of investor harm and market instability will continue to overshadow its benefits. The implementation of a targeted regulatory framework is therefore not a matter of optional policy refinement but a pressing necessity to protect the investing public and safeguard the stability of Indonesia's financial system. By acting decisively and collaboratively, Indonesia can harness the advantages of robot trading while minimizing its dangers, creating a safe, transparent, and dynamic trading environment that benefits all stakeholders [10].

3.2 The most suitable regulatory framework to balance the advancement of robot trading innovation with the need for a safe, transparent, and fair trading ecosystem in Indonesia

Designing a regulatory framework that can simultaneously foster the growth of robot trading innovation while ensuring safety, transparency, and fairness in Indonesia's financial markets requires a nuanced and multi-layered approach. Robot trading, as a technological tool, is not inherently problematic; in fact, it can contribute significantly to market efficiency, liquidity, and accessibility when developed and deployed responsibly. However, without clear rules, this innovation can also serve as a vehicle for fraud, manipulation, and systemic risk. The challenge for Indonesian regulators is to craft a framework that encourages legitimate developers, attracts fintech investment, and promotes competitive technological advancement, while at the same time imposing safeguards that protect investors and maintain market integrity. This balancing act demands a regulatory model that is both principle-based and rule-based, flexible enough to accommodate rapid technological change, yet specific enough to address concrete risks and behaviors.

The foundation of such a framework should be a clear definition of what constitutes "robot trading" within the Indonesian legal and financial context. This definition must be broad enough to cover all forms of algorithmic or automated execution systems, whether deployed in forex, commodities, equities, cryptocurrencies, or other emerging asset classes, while distinguishing them from basic order management tools that do not make autonomous trading decisions. By establishing a consistent definition, regulators

can avoid jurisdictional confusion between Otoritas Jasa Keuangan (OJK), which oversees capital markets and financial services, and Badan Pengawas Perdagangan Berjangka Komoditi (Bappebti), which regulates futures and derivatives. A unified terminology would also help ensure that robot trading products cannot evade oversight simply by claiming to operate in a different asset category [11].

Once defined, the framework should implement a tiered licensing and registration system for robot trading providers. Licensing should be mandatory for any entity that develops, markets, or operates trading robots on behalf of clients in Indonesia. The licensing process should require technical audits of the algorithm, verification of the developer's identity and business legitimacy, and proof of compliance with relevant market conduct rules. For transparency, a public registry of licensed providers should be maintained, allowing investors to verify the legitimacy of any robot trading system before committing funds. This licensing system should be risk-sensitive, for example, high-frequency trading algorithms with significant market impact would require more rigorous testing and monitoring than small-scale retail-focused robots [12].

Technical standards are another critical element of a balanced framework. These standards should include requirements for pre-deployment testing in simulated market environments, stress-testing under extreme volatility conditions, and ongoing monitoring of performance to ensure that algorithms behave as expected. Providers should be required to maintain detailed audit trails of all trades executed by the robot, which regulators can review in the event of suspected misconduct or market disruption. Additionally, mandatory kill switches should be implemented in every licensed robot trading system, allowing operators or regulators to halt activity immediately if abnormal behavior or market instability is detected. These controls not only protect investors but also reduce the likelihood of robot-induced flash crashes or liquidity shocks [13].

Transparency obligations should form a central pillar of the regulatory framework. Investors must be provided with clear, accurate, and comprehensible disclosures before engaging with a robot trading product. These disclosures should include a plain-language explanation of the trading strategy, historical performance data verified by independent audits, detailed risk warnings, and the specific market instruments involved. Importantly, all marketing claims should be subject to truth-in-advertising standards, with severe penalties for misleading statements about returns, risk levels, or "guaranteed" profits. To further protect retail investors, regulators might also impose leverage limits, minimum capital requirements, or suitability assessments to ensure that clients have the financial capacity and knowledge to engage with certain high-risk automated strategies.

Investor education initiatives should run in parallel with regulatory requirements. Even the most robust framework will be undermined if investors themselves do not understand the basics of how robot trading works, what it can and cannot do, and how to distinguish legitimate providers from fraudulent ones. Public awareness campaigns, online courses, and collaboration with universities, industry associations, and community organizations can help build a baseline of literacy. These initiatives should address common misconceptions, such as the belief that automation eliminates all risk, and teach investors how to verify licensing, check disclosures, and monitor their own accounts effectively.

Another important consideration is fostering collaboration between regulators and the fintech industry. Regulation should not be designed in isolation; instead, it should be informed by ongoing dialogue with developers, traders, and technology experts. Regulatory sandboxes, controlled environments where new robot trading products can be tested under supervision, offer a way to balance innovation with oversight. In such sandboxes, developers can experiment with novel strategies or technologies without exposing the broader market to undue risk, while regulators can gain firsthand insights into emerging trends and potential vulnerabilities. This approach has been adopted successfully in countries like Singapore and the UK, and could be adapted for Indonesia's context.

Given the cross-border nature of many trading platforms and robot trading providers, the framework should also include provisions for international cooperation. Many robot trading systems used in Indonesia are developed abroad or operate on servers located outside the country, making unilateral enforcement challenging. Memoranda of understanding (MOUs) with foreign regulators, participation in regional fintech forums, and harmonization with international best practices can strengthen Indonesia's ability to oversee offshore providers serving its citizens. This cooperation would also make it harder for fraudulent operators to simply relocate operations to jurisdictions with weaker oversight while continuing to target Indonesian investors online [14].

Importantly, the framework must be enforceable. This requires not only well-drafted regulations but also the institutional capacity to monitor compliance, investigate violations, and impose sanctions. Regulatory agencies should invest in regtech tools, software and analytics systems capable of monitoring trading activity in real time, identifying suspicious patterns, and flagging potential breaches of rules. Enforcement should be proactive rather than reactive, with periodic audits and unannounced inspections of licensed providers. Penalties for non-compliance must be substantial enough to deter misconduct, including license revocation, financial fines, public blacklisting, and, where applicable, criminal prosecution.

The design of a fair trading ecosystem also depends on ensuring that robot trading does not create an uneven playing field between technologically sophisticated traders and the broader investing public. To this end, the framework could incorporate measures that prevent excessive market concentration of automated trading strategies or unfair exploitation of latency advantages. While encouraging innovation, regulators should ensure that no group of market participants can dominate price movements or liquidity provision in ways that undermine fairness. This could involve monitoring order-to-trade ratios, capping certain high-frequency behaviors, or requiring algorithms to include randomness in order placement to avoid predictability that could harm market stability [15].

In balancing innovation and protection, it is vital to recognize that regulation is not about stifling technological progress but about creating the conditions under which it can flourish sustainably. A well-crafted framework sends a clear signal to legitimate developers and investors that Indonesia is a safe and attractive environment for fintech

growth. At the same time, it warns bad actors that misuse of technology will be met with swift and decisive consequences. By combining clear definitions, licensing, technical standards, transparency obligations, investor education, industry collaboration, international cooperation, and strong enforcement, Indonesia can achieve the dual goals of advancing robot trading innovation and safeguarding the integrity of its markets.

Ultimately, the most suitable regulatory framework is one that treats robot trading not as a novelty to be tolerated until problems arise, but as a permanent and integral feature of modern financial markets. By embedding principles of safety, transparency, and fairness into every stage of a robot trading system's lifecycle, from conception to retirement, Indonesia can ensure that automation serves as a driver of progress rather than a source of instability. This approach will not only protect current investors but also lay the foundation for a resilient, innovative, and globally competitive trading ecosystem in the years to come [16].

4. Conclusion

The rapid emergence of robot trading in Indonesia presents both opportunities and risks that demand immediate regulatory attention. On one hand, automated trading systems offer the potential to enhance market efficiency, broaden investor participation, and drive financial innovation. On the other, the absence of clear and specific regulations has left gaps that unscrupulous actors exploit, leading to fraud, financial losses, and potential threats to market stability. These risks are amplified by the capacity of poorly designed or unmonitored algorithms to trigger rapid price fluctuations, liquidity imbalances, or systemic disruptions. To address these challenges, Indonesia requires a regulatory framework that balances innovation with protection. Such a framework should begin with a clear legal definition of robot trading, establish a tiered licensing and registration system, and set rigorous technical standards for algorithm testing, transparency, and operational safeguards. Investor protection must be prioritized through mandatory risk disclosures, truth-in-advertising rules, and public education programs that improve financial and technological literacy. The inclusion of regulatory sandboxes and industry collaboration will ensure that innovation is nurtured rather than stifled, while international cooperation can close cross-border enforcement gaps. Effective enforcement is essential, supported by modern regulatory technology and strong sanctions to deter misconduct. By embedding principles of safety, transparency, and fairness into all stages of robot trading activity, Indonesia can create a resilient and trustworthy market environment. This approach will not only protect current investors but also position the country as a competitive player in the global fintech landscape, ensuring that technological progress supports sustainable and equitable financial growth.

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