Final Report

A Blockchain Payment System in Enhancing Hong Kong Philanthropy Transparency

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Date of submission: 21st April 2025

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Abstract

Hong Kong's charity sector has faced recurring scandals involving fund mismanagement, largely due to weak oversight and insufficient transparency. These incidents have eroded public trust, leaving donors uncertain about which organizations handle contributions responsibly. Many charities fail to provide clear, accessible records of fund allocation, further exacerbating skepticism. To tackle these issues, this project introduces a blockchain-powered payment system designed to track donations transparently. By leveraging distributed ledger technology, the system aims to strengthen accountability, restore donor confidence, and encourage greater support for Hong Kong's charitable causes. A functional prototype has already been developed, with its effectiveness assessed through user feedback, comparative analysis, and system performance data. While comprehensive government regulations may take time to materialize, this blockchain-based approach offers an interim solution to enhance trust and ensure proper fund utilization. The findings of this work provide a more credible framework for local charitable donations, addressing the sector's transparency and credibility challenges.

Acknowledgements

We would like to extend our heartfelt thanks to our supervisor, Prof. Yiu Siu Ming, for his invaluable guidance, feedback, and support during this project. We would also like to appreciate the Department of Computer Science for providing us with the opportunity to explore such an interesting topic.

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1. Introduction

1.1 Background

Philanthropy originated from the Greek word “philanthropia”, which means love of mankind (National Philanthropic Trust, 2016). It is defined as “private giving for public purposes” (Barman, 2017, p.272), and refers to the actions taken by a private citizen, or groups of citizens to improve the lives of those who are less fortunate or have special needs (Gonzalez, 2013). This practice of kindness and philanthropic organizations have been around since ancient times, and their legacy lives on in today's world.

Charitable organizations are perhaps the most familiar form of philanthropy for many people. In Hong Kong, there are around 10,000 charities in 2023, and approved charitable donations have reached US$560 million from business donors and around US$1 billion from individual donors in the financial year 2020-21 (Lee, 2023). Being a highly philanthropic city, as shown in Figure 1 (Lau, 2020), the number of registered charities for tax exemption and public donations has surged in recent years. Hong Kong also ranked 18th out of 146 in a global ranking of propensity to donate in 2018 (Lau, 2020).

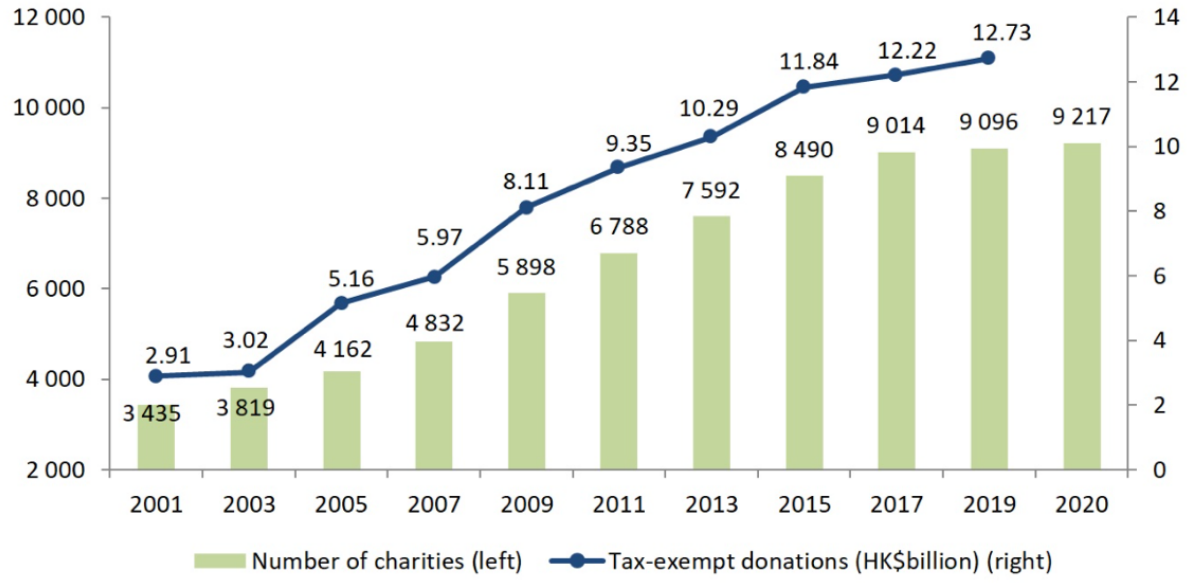

Figure 1 Charities and tax-exempt donations in Hong Kong (Lau, 2020)

Despite the high volume of philanthropic activities, there is currently no official registration system for charitable organisations in Hong Kong (The Law Reform Commission of Hong Kong, 2024), and no law or single regulatory authority dedicated to charities (Lau, 2020).

Charitable organizations generally have the freedom to report whatever they consider appropriate, and are not required to disclose details about their charity programs, internal controls, or how senior executives utilize funds (Young, 2024).

1.2 Motivation

The lack of a compulsory regulatory and reporting framework for tax-exempted charities creates loopholes and opportunities for misconduct. In 2017, at least six charities were found to have improper use of funds, with one paying its directors a total of HK$13 million within three years (Lau, 2020). Recent scandals involving the Christian Zheng Sheng Association and the Hong Kong Society for the Protection of Children also highlight the alarming issue of fund misappropriation, with the Christian Zheng Sheng Association using less than 10 percent of the HK$45 million donations for the development of its college (The Standard, 2024). These high-profile scandals erode donor trust towards the whole sector, raising public concerns and undermining the credibility of charitable organizations in Hong Kong.

When examining the root cause of public mistrust in charities, it appears that a lack of transparency in the donation process and the use of funds that leads to scepticism among donors. To address this, a more transparent and accountable system is needed for charitable organisations in Hong Kong. Blockchain, a decentralized distributed ledger technology that enhances transparency, immutability and traceability, may provide a solution.

1.3 Objectives, scope and deliverables

In this project, we aim to propose a blockchain-based payment system for charitable organizations in Hong Kong to enhance transparency, accountability, and trust in local charities. This project aims to:

- Enhance transparency and trust among stakeholders in the charitable donation process by making donations traceable for all parties through a blockchain system.
- Ensure accountability by utilizing digital signatures to authorize transactions and informing donors about the responsible person.

The scope of this project contains four key parts, the development of a blockchain framework for real-time donation tracking, the implementation of a digital signature mechanism for transaction accountability, the design of the user interface for donors, and the evaluation of the proposed system’s effectiveness.

1.4 Project contribution

The proposed blockchain-based payment system aims to address the unique challenges faced by local charities in Hong Kong, particularly in the absence of specific regulations governing their operations. Without clear standards and rules, charities struggle to provide donors with clear visibility into how their contributions are utilized, making it difficult for donors to identify trustworthy ones to support. Trust is crucial in philanthropy, and lack of trust leads to a reduction in available funds, hindering charities' ability to fulfill their missions in impacting the community. Considering that it may take time for the government to establish effective regulations for charities, this blockchain system can help build trust and accountability during the interim. It ensures that funds are used appropriately and fosters greater donor confidence in local charities. Additionally, the system would be especially beneficial for small and medium-sized local charities, which often face difficulties in gaining visibility and building trust. By enhancing their credibility, the system can attract more support for these organizations.

All in all, it is hoped that the proposed blockchain payment system will allow a more transparent and credible way of overseeing fund movements, holding charities accountable, and alleviating donors' concerns regarding the whereabouts of their donations. Ultimately, it is expected to encourage more individuals and organizations to donate to charities and engage in philanthropy, fostering a stronger culture of giving and improving the overall perception of charitable organizations in Hong Kong.

1.5 Report outline

This report is organized into five chapters. The remaining parts of this paper is as follows. Chapter two provides an in-depth literature review on the technologies involved, existing studies and solutions, highlighting gaps and providing a foundation for this project. Chapter three discusses the methodology used to develop the blockchain-based payment system for Hong Kong charities. Chapter four presents the deliverables and findings of the project, including potential challenges and outlines future plans moving forward. Chapter five concludes the project, summarizing key progress and contributions of the project.

2. Literature review

This section is to provide a better understanding of blockchain technology's potential usage in enhancing transparency and accountability of charitable donations in Hong Kong. It will explore the features of blockchain and digital signature that solves the existing issues within the Hong Kong's philanthropic landscape and review existing blockchain-based donation studies and solutions.

2.1 Blockchain

Blockchain is a distributed data structure that securely links blocks of information in chronological order through cryptographic methods (El-Rewini et al., 2020). Each block contains time-stamped transactions, with data encrypted for secure transport. By maintaining copies of transactions across multiple locations, blockchain prevents any single point of failure, enhancing its reliability. This decentralized distributed ledger relies on a consensus mechanism to ensure data integrity without the need for a central authority. Common algorithms, such as Proof of Work and Proof of Stake, facilitate this process. Another major component of blockchain is smart contracts, which are self-executing agreements stored on the blockchain (International Business Machines Corporation, 2024). They play a crucial role by automatically enforcing terms once predefined conditions are met. This eliminates the need for intermediaries, streamlining transactions and reducing delays.

Blockchain technology provides the foundation for diverse applications, including cryptocurrency, a digital form of payment that operates on blockchain. One prominent example is Bitcoin, which enables users to transfer credit between one another in the form of computer codes. Each transaction is then documented by a cryptographically signed transaction on the blockchain (Federal Office for Information Security, 2022).

The key features of blockchain further enhance its functionality. Its immutability ensures that data cannot be altered once recorded, providing a reliable history of transactions. Transparency is another significant benefit, as all participants can access the ledger of transactions that are verifiable and traceable. Given these strengths, blockchain presents a compelling solution for charity donation platforms, effectively addressing the critical issues of transparency and trust in the management of funds.

2.2 Digital signature

A digital signature utilizes cryptographic techniques and asymmetric cryptography to sign data, ensuring origin authentication, data integrity, and preventing the signer from denying their involvement (Lin, W., 2023).

With origin authentication, it confirms that transactions originate from authorized individuals, preventing unauthorized usage of funds. In addition, the non-repudiation feature ensures that signers cannot deny their involvement in a transaction, holding charity representatives accountable for their actions in the event of discrepancies.

These characteristics of digital signatures make them an effective solution for enhancing accountability in charitable organizations.

2.3 Existing studies and solutions

Recent studies show an increasing academic interest in blockchain applications for donation management systems. A study by Lee et al. (2018) revealed that blockchain implementations can enhance three critical aspects of philanthropic transactions: transparency, security, and efficiency. Findings by Christie (2020) further prove that blockchain is able to address the trust and accountability issues faced by charitable organizations.

Some studies have also proposed comprehensive frameworks for blockchain-based donation tracking systems. Table 1 below shows three systems proposed by different papers, what stakeholders they involved, and the features that enable transparency and accountability in their proposed systems.

Table 1 Proposed blockchain-based donation systems

Paper	**System**	**Stakeholders**	**Transparency and Accountability Features**
Smart Donations: Event-Driven Conditional Donations Using Smart Contracts On The Blockchain (Trotter et al., 2020)	• Private Permissionless Ethereum Blockchain • Mobile app	• Donor • Trustees • Beneficiary • Validators	• Mobile app real-time tracking • Smart contract • Escrow system
Blockchain-based donations traceability framework	• Public Permissioned Ethereum Blockchain	• Donor • Needy party • Trustee	• System grants specific functions to authenticated parties

(Almaghrabi & Alhogail, 2022)	• Web page		• Tracing feature reveals each case's status, donation amount, and by whom it is being managed
Smart Blockchain Networks: Revolutionizing Donation Tracking in the Web 3.0 (Nairi et al., 2024)	• Ethereum Blockchain • Web page	• Donation event owner • Donor • Validators	• Transaction ID for tracking • Smart contract • Escrow system

Nairi et al. (2024) presented a suggested workflow that illustrates the donation tracking system of their platform which integrates transparency, traceability, and an escrow mechanism, as shown in Figure 2.

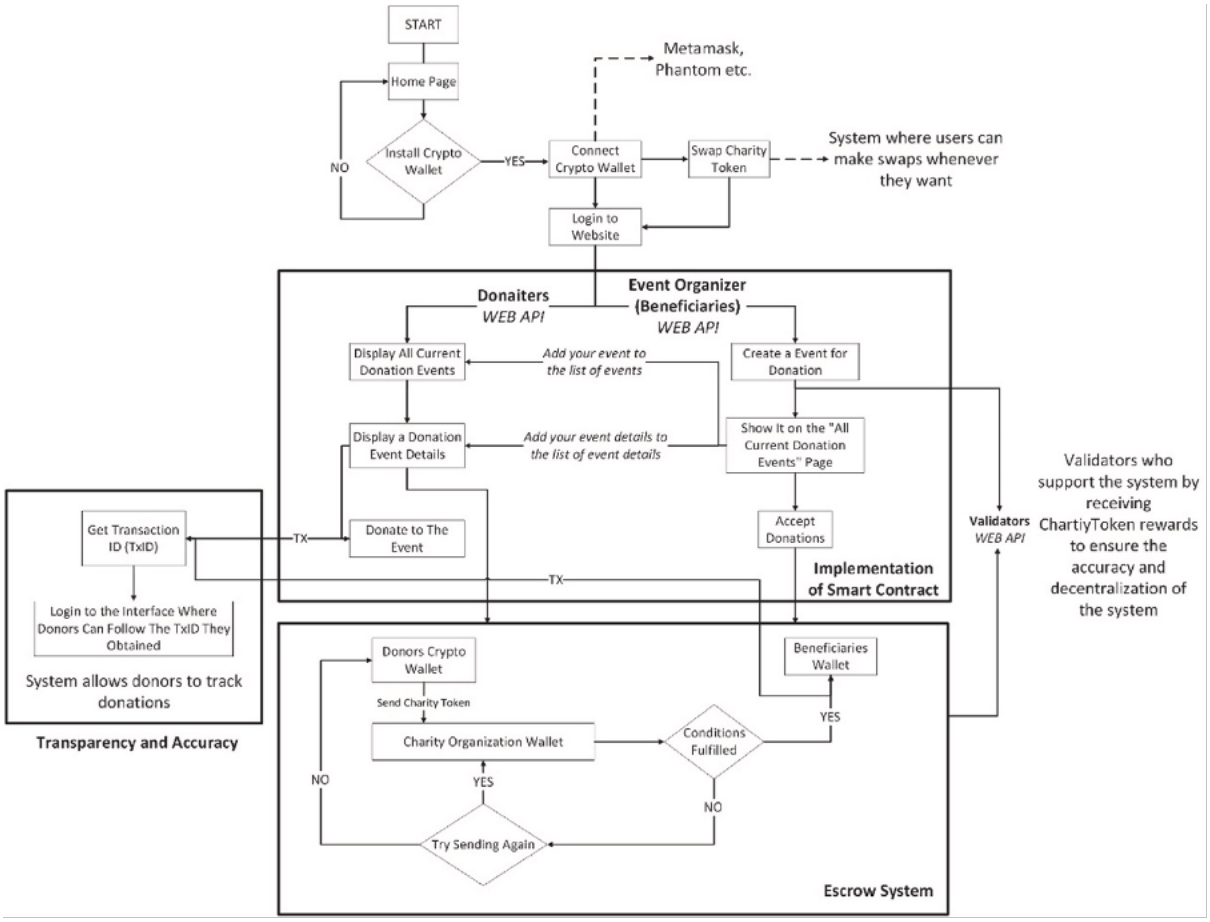

Figure 2 Donation tracking system workflow diagram (Nairi et al., 2024)

Each donation is assigned a unique transaction identity to enable tracking of funds. Through recording transaction details on the blockchain, the system ensures real-time updates and

transparency. Moreover, the escrow system safeguards the donations, releasing funds only when predefined conditions are met by the beneficiaries (Nairi et al., 2024).

Another paper by Farooq et al. (2020) proposed a framework that also leverages smart contracts to prevent misuse of funds. As illustrated in Figure 3, the donations will be locked by smart contracts until there is approval from authorized parties, then the payment will be unlocked.

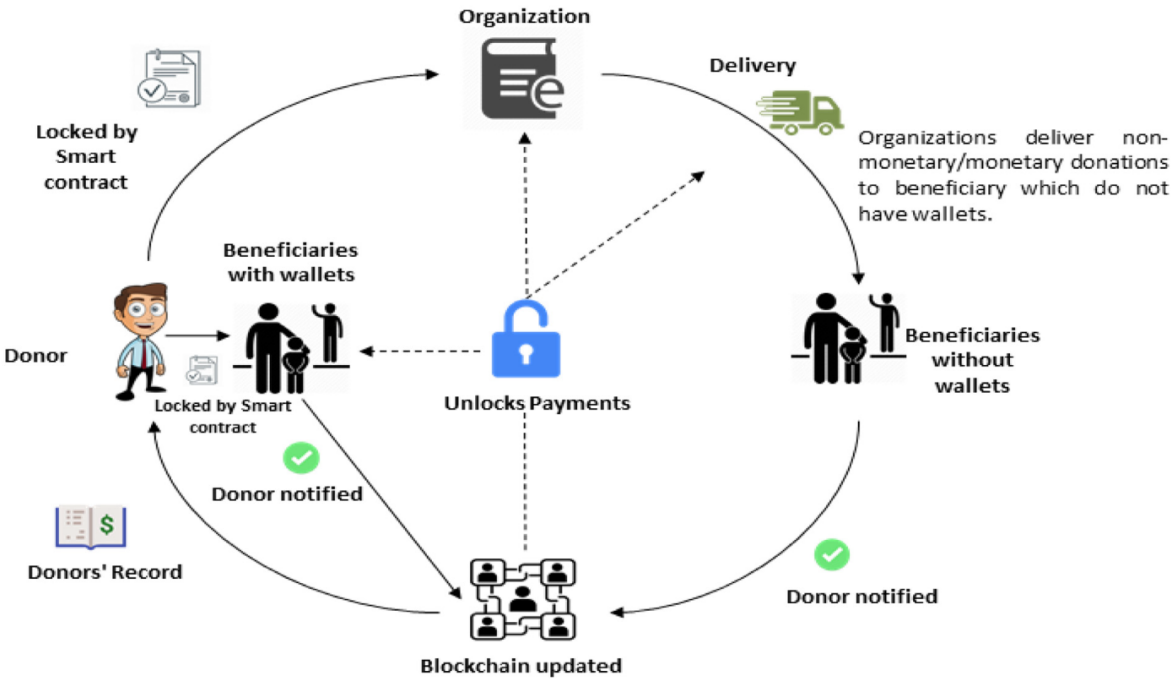

Figure 3 Proposed framework (Farooq et al., 2020)

Previous research shows that blockchain technology can significantly improve the tracking and management of donations in the non-profit sector, and provides this project a foundation to work on.

Based on prior studies, the proposed blockchain payment system will be built on a public permissioned Ethereum blockchain. Additionally, a digital signature mechanism will be implemented to enhance accountability.

Looking at real-life applications, several blockchain donation systems are currently available in the market. For instance, Binance Charity utilizes smart contracts to ensure that donations are allocated for their intended purposes, providing donors with real-time updates on their contributions' impact (Nairi et al., 2024). GiveTrack is also an example for utilizing blockchain technology to provide real-time tracking of funds (BitGive Foundation, 2022). However, both

platforms do not cover projects or charities based in Hong Kong, and are primarily project-based rather than charity-based.

While some international charities have started accepting cryptocurrencies as a method of donation, Hong Kong charities do not accept cryptocurrencies. There are also no local platforms available for donors to track their donations. Studies specifically focusing on blockchain solutions for donations within the Hong Kong context are lacking as well. Therefore, this research will work to combine previous findings with local insights, concentrating on developing a blockchain payment system tailored for Hong Kong charities.

3. Methodology

This chapter presents the methodology in order to develop the blockchain-based payment system for local charitable organizations. The project implements two stages of methodology:

- Section 3.1 covers the development of the blockchain system prototype.
- Section 3.2 presents a performance analysis of the system.

3.1 Prototype development

To develop a prototype for the proposed blockchain payment system, two main components will be required: the system framework, which includes user-related functions and journey, as well as the blockchain system workflow and architecture; and the user interface design for donors.

A comprehensive system framework is required to provide a solid foundation for the proposed system. An initial high-level overview of our project workflow is shown in Figure 4. The workflow is broken down into 3 user parties — Donors, Beneficiary and Trustee. Trustee is referred to as an organization within the blockchain system that has the list of Beneficiary. The charity donation chain begins with the donor and ends with the beneficiary party which will be elaborated in the following.

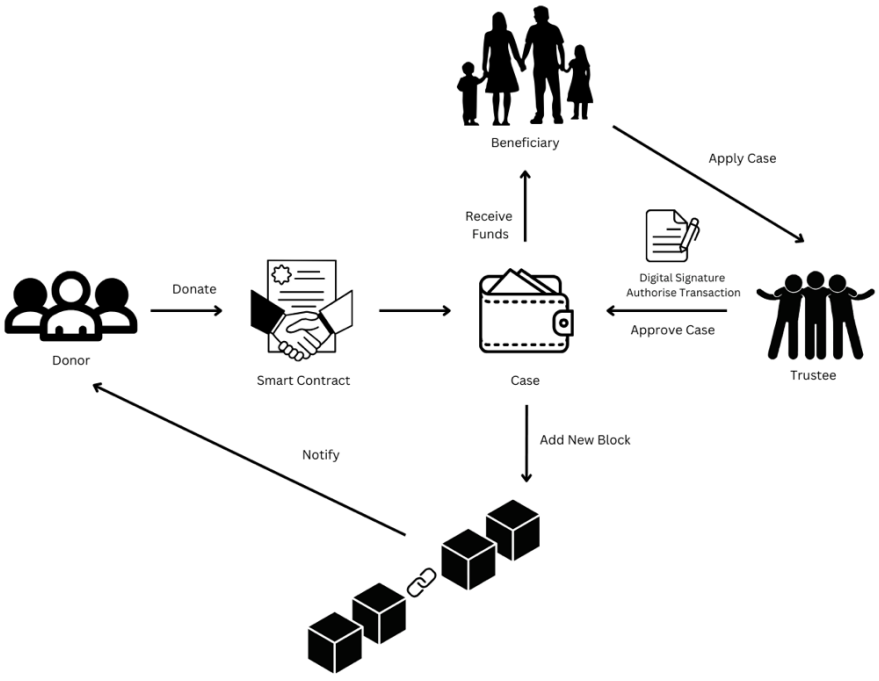

Figure 4 High-level overview of system workflow

This workflow is built on a public-permissioned blockchain where only verified participants are allowed to join the network, ensuring the authenticity of user identities (Almaghrabi & Alhogail, 2022). Each user is an account holder with a cryptocurrency wallet in the blockchain network and each of them can be uniquely identified in the network through their account address. Any participants who want to join the network will require validation of their information to prevent fraudsters.

The donation process initiates when a donor contributes funds through an autonomous smart contract. These self-executing contracts store and automatically enforce predefined donation terms without requiring intermediaries (Ølnes, S et al., 2017), establishing a trustless verification layer. Beneficiaries submit funding requests through the system, which trustees evaluate against established criteria. Upon meeting all requirements, trustees authorize disbursements using cryptographic digital signatures, ensuring organizational accountability. All transactions are immutably recorded on the blockchain, allowing donors to verify how their donations are utilized by specific charities (Trustee) or projects (Case). Additionally, only designated individuals will have the authority to approve fund transfers, reducing the risk of unauthorized transactions. The system enables real-time traceability, allowing donors to track their contributions throughout all stages of the donation process.

Donors can donate, track their contributions, and access information about transaction histories and accountability. Trustees will have the ability to trace donations, create cases, approve or reject requests from the needy, and withdraw funds. Meanwhile, the beneficiary can create cases and request withdrawals, subject to approval from the trustee. This comprehensive design ensures transparency and accountability within the donation process.

For the user interface design, as the effectiveness of the proposed system in enhancing transparency, trust, and accountability in charities largely depends on the perceptions and interactions of donors, this project will focus solely on the donor experience. By prioritizing the user experience of the donors, it creates a user-friendly interface that addresses their needs and concerns, aiming to encourage greater engagement and increase donations.

3.2 Performance evaluation

As this project aims to solve public mistrust in charities due to transparency issues in the donation process and the use of funds, donors' perception on the proposed system is a key

factor in improving transparency, trust, and accountability in charities. To gather insights from Hong Kong donors, questionnaires focused on their experiences and perceptions regarding local charities and the proposed system will be distributed. This will help to gather feedback to evaluate the system's effectiveness and identify areas in that require tuning.

Comparisons with other donation systems will be conducted to assess the relative effectiveness of the proposed system. It will help to check if it addresses gaps in existing solutions and in the Hong Kong context. Additionally, a performance analysis in terms of transparency, accountability, trust, and immutability of the system will be carried out.

4. Results and Discussion

This chapter outlines the results and findings of the project. A comprehensive system structure has been developed, which includes a user functions table, system's front-end flow and back-end donation flow, digital signature mechanism, and user interface design for donors. The evaluation of the system, challenges moving forward will also be discussed.

4.1 System Framework

4.1.1 Users' roles

A comprehensive system should be capable of performing multiple functions to accommodate all users' needs. The functions outlined in Table 2 were identified through literature review and an analysis of the framework proposed previously.

Table 2 User functions in system

Donor	Charity	Beneficiary
Browse charities and projects	Set up donation projects	Create Account
Connect crypto wallet to donate	Approve beneficiary applications	Validate identify by uploading personal information
Donate using smart contract template provided	Issue Smart Contract templates for donation projects	Apply for program eligibility (approved by Charity)
Track donations	Track projects and monitor donations	Check status

4.1.2 Front-end workflow

A front-end flowchart of the system is shown in Figure 5. When visiting the platform's homepage, existing users must authenticate themselves by entering their login details, establishing a secure access protocol designed to mitigate potential fraud. For first-time users, the system requires completion of a registration procedure where they must identify themselves as either a Donor, Beneficiary, or Trustee. Following registration, all system features and interfaces are dynamically tailored according to the user's designated role, ensuring appropriate access and functionality for each account type.

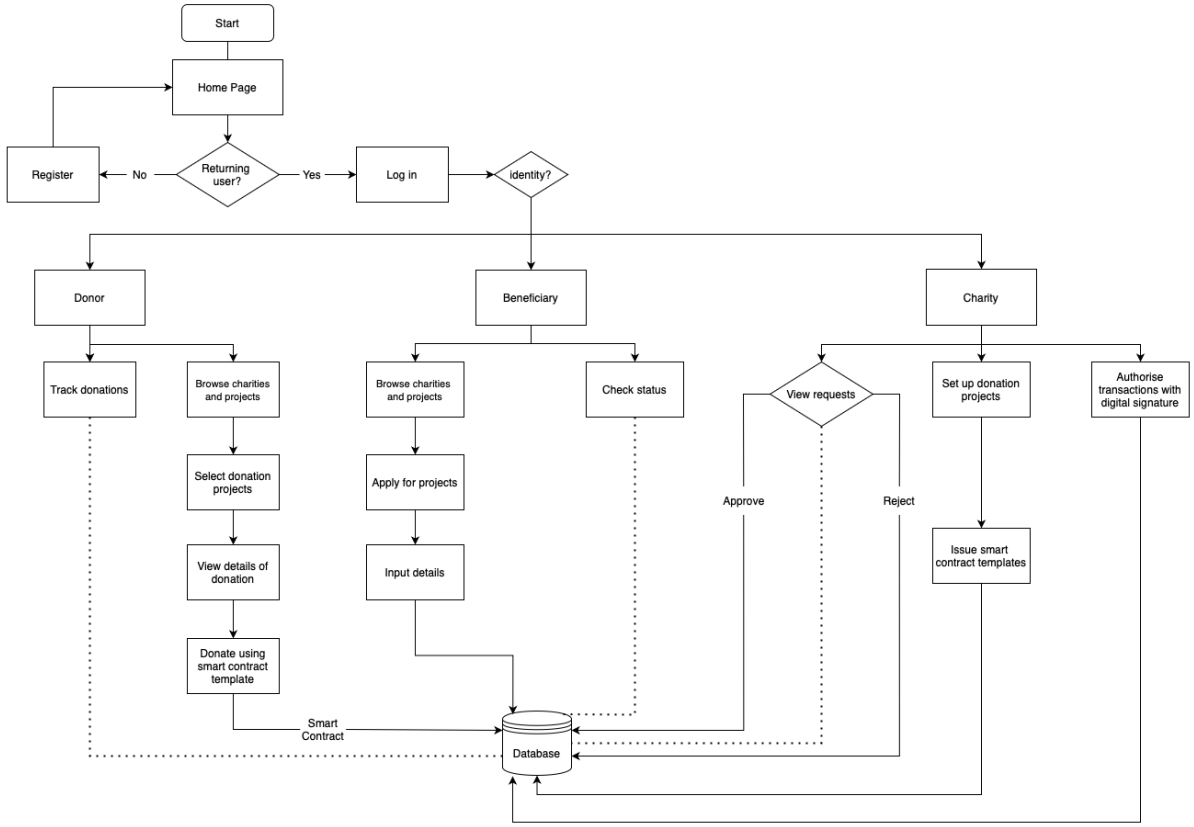

Figure 5 Front-end flowchart of system

Following a successful login, donors can navigate through available charity cases and view detailed information. When selecting a case for contribution, the system initiates a secure donation process where donors connect their digital wallet to execute the transaction through the charity's predefined smart contract template. This contract functions as an immutable ledger, recording key details such as the donor’s account information and the donation amount. The smart contract is stored in the case database, enabling donors to track their contributions by accessing the relevant records.

Eligible beneficiaries may apply to enroll in available programs once they meet all specified requirements. Each application requires submission of verified personal information, such as proof of address, income documentation, and age verification, to ensure program compliance. Following submission, the charity reviews all applications for approval. Data is securely stored in the case database, allowing beneficiaries to monitor the status of their applications directly through the system.

The charity will either approve or reject requests submitted by beneficiaries after evaluating the documents. Their decisions are subsequently recorded in the database, and notifications are sent to inform the applicants of the outcomes. The charity is also responsible for setting up donation programs and smart contract templates, as well as constantly monitoring donations. For authorizing transactions, the charity will append a digital signature to ensure accountability.

4.1.3 Back-end donation flow

Figure 6 shows the back-end donation flow designed, illustrating the donation process through the proposed system. There are two paths: one for donors and one for charities.

For charities, when setting up the donation project, they will need to create a smart contract template for that specific project. The template may include fields such as the donation amount, conditions set for the donation, donor address, recipient address, and transaction deadline.

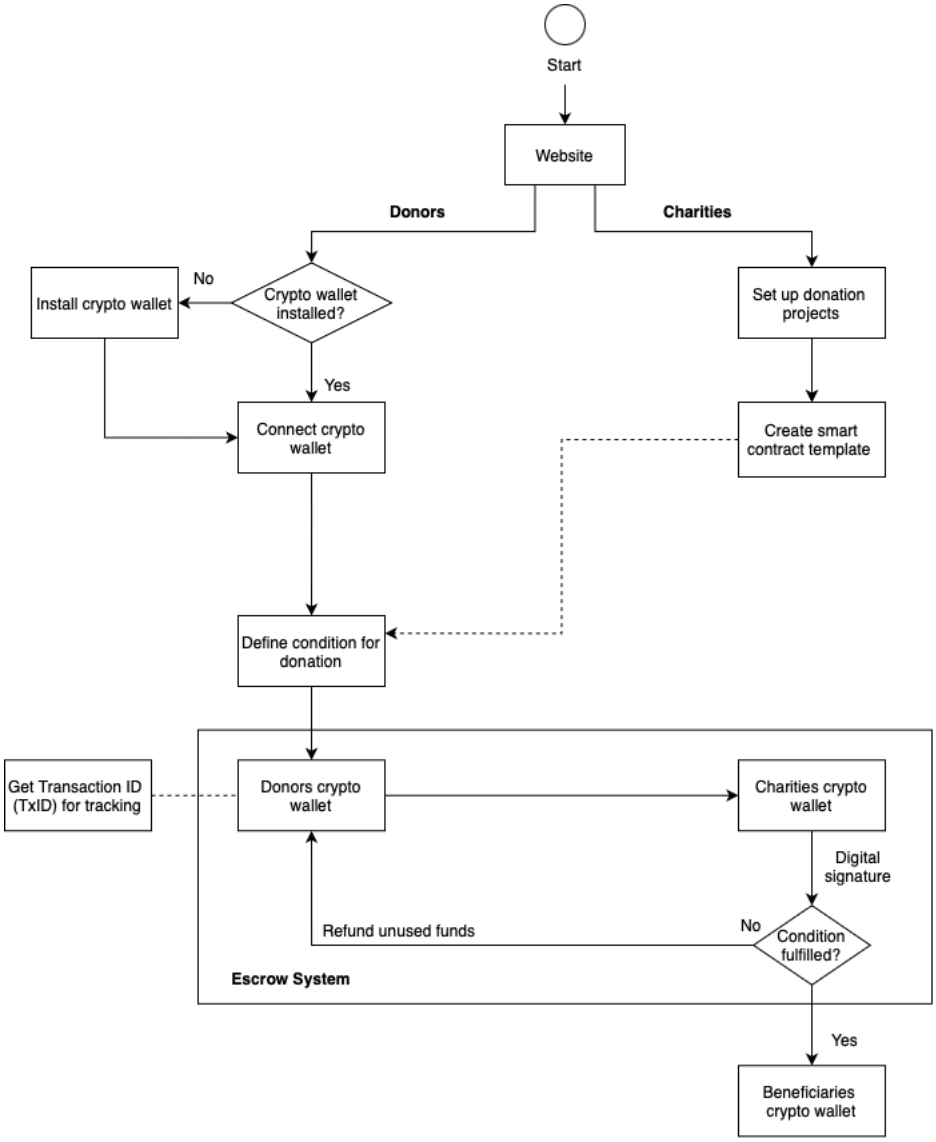

Figure 6 Back-end donation flow of system

As for donors, after selecting the donation project, they will first be prompted to check if a crypto wallet is installed. Once connected to their crypto wallet, they can donate to the project. They can then use the smart contract template provided by the charities to define the conditions for donation. When the token is transferred from the donors' crypto wallet to the charities' crypto wallet, the donation is made, and a transaction ID (TxID) is provided to the donor for real-time tracking.

Inside the escrow system, when charities would like to transfer the funds, they must authenticate with a digital signature through the system. The system will then check if the defined conditions are fulfilled. If they are, the funds will be sent to the designated beneficiaries' crypto wallet. Conversely, if the conditions are not met, the funds will be refunded back to the

donors' crypto wallet. This helps to ensure that funds go exactly where the donors intend them to.

4.1.4 Digital signature

The digital signature in the proposed blockchain system rely on public-key cryptography, which involves a pair of mathematically linked keys: a private key that the owner keeps secure and a public key available to anyone in the network (Nervos Network., 2025). The private key is used to generate the digital signature and the corresponding public key is used for verification. Due to this mechanism, only the legitimate owner can create a valid signature for a specific transaction. Meanwhile, anyone with access to the public key can confirm the authenticity of that signature without needing to know the private key.

The Ethereum blockchain the proposed system is built on uses digital signature scheme Elliptic Curve Digital Signature Algorithm (ECDSA), which utilizes elliptic curve cryptography and offer strong security with shorter key lengths, making it extremely difficult to derive the private key from the public key, ensuring that forging a signature without the correct private key is impossible (Nervos Network., 2025).

In the system, when a charity wants to approve a transaction, a transfer of funds to beneficiaries, they will first run the transaction details through the cryptographic hash algorithm used by Ethereum, Keccak-256 (Liu, J., 2023). A unique digital fingerprint of the original data will be generated, and any minor change in transaction details will result in a complete different fingerprint, ensuring authenticity and integrity. The charity can then use its private key to sign this hash and a digital signature will be attached to the transaction data. If the signature is valid, the transaction is authenticated and will be added to the blockchain.

To verify the authenticity of the digital signature, any participants in the blockchain can apply the charity's public key to the digital signature and recompute the transaction's hash. If the computed hash matches the one attached to the transaction, it proves that the transaction was indeed signed using the charity's private key, confirming their authorization, and shows that the transaction data is unchanged.

As all participants in the blockchain will be able to see who authorized the transactions, in case there is misuse of funds, the person who authorized the transactions will be held accountable.

The digital signature mechanism ensures that only authorized users can approve transactions and provides accountability, enhancing transparency and trust in the donation process.

4.2 User interface for donors

Based on the backend system design, the user interface for donors is designed to showcase how they will navigate the webpage, make donations, and track their contributions.

4.2.1 Home page

As shown in Figure 7, the home page includes a header that allows navigation to key pages, including “About” for background information, “Donations” to view ongoing donation opportunities, “Charities” to showcase all participating charities, and a “Log In” button.

When users arrive the home page, they will be able to have a look at the recent projects and the corresponding donation progress. If users would like to check out other donation programs, they can search in the home page and filter according to different types of donation, for example Education or Childcare.

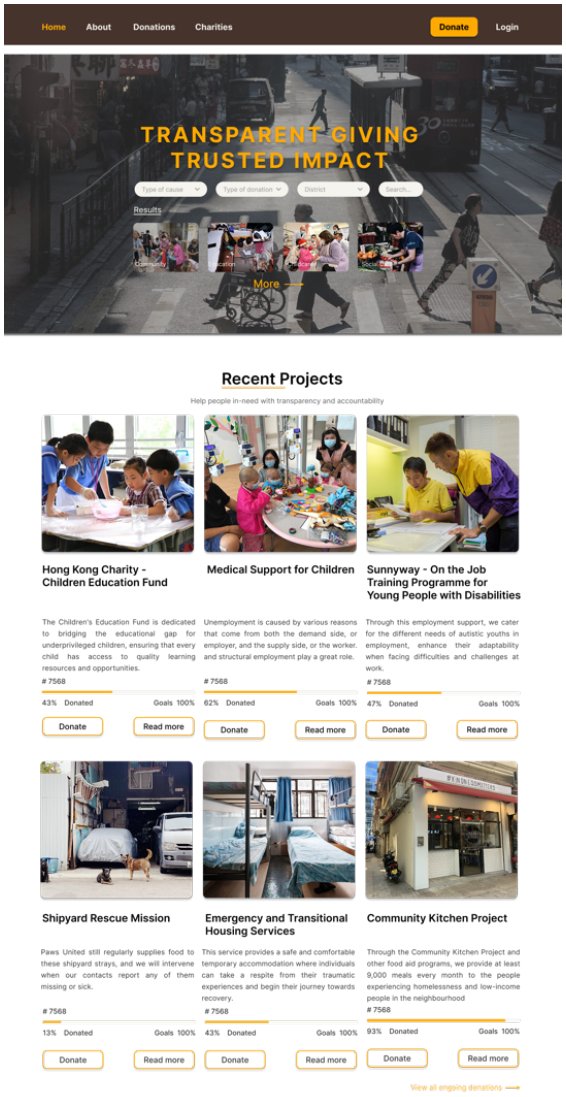

Figure 7 Home page of website

4.2.2 About Page

An "About" page has been created to give visitors an overview of the project's mission and values. As shown in Figure 8, this page features an introduction to the initiative, emphasizing the motivation to tackle transparency and trust issues in Hong Kong charities by utilizing blockchain technology.

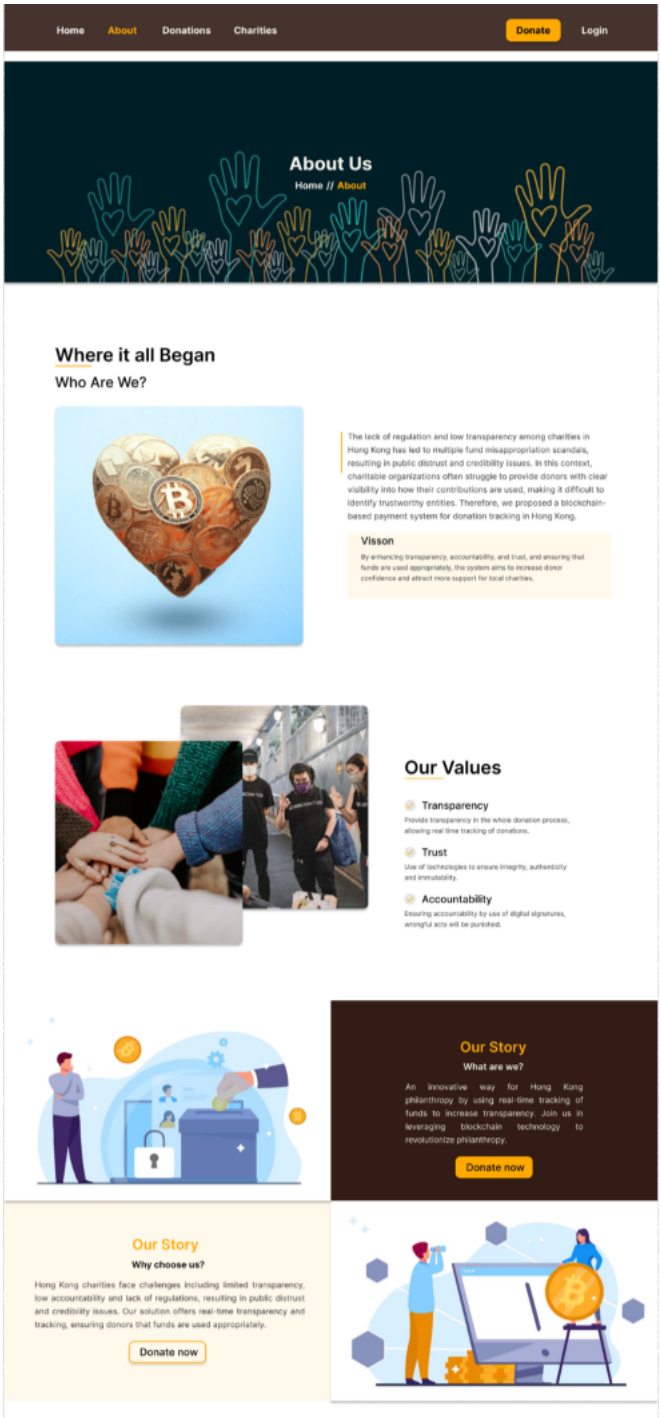

Figure 8 About page of website

4.2.3 Donation Details Page

When donors want to learn more about the donation project, they are directed to the donation page, which provides detailed information about the project (Figure 9). This details page includes an overview of the organization, helping donors understand how their contributions will be used to support it. A progress chart is prominently displayed at the top, allowing donors to easily track the project's progress.

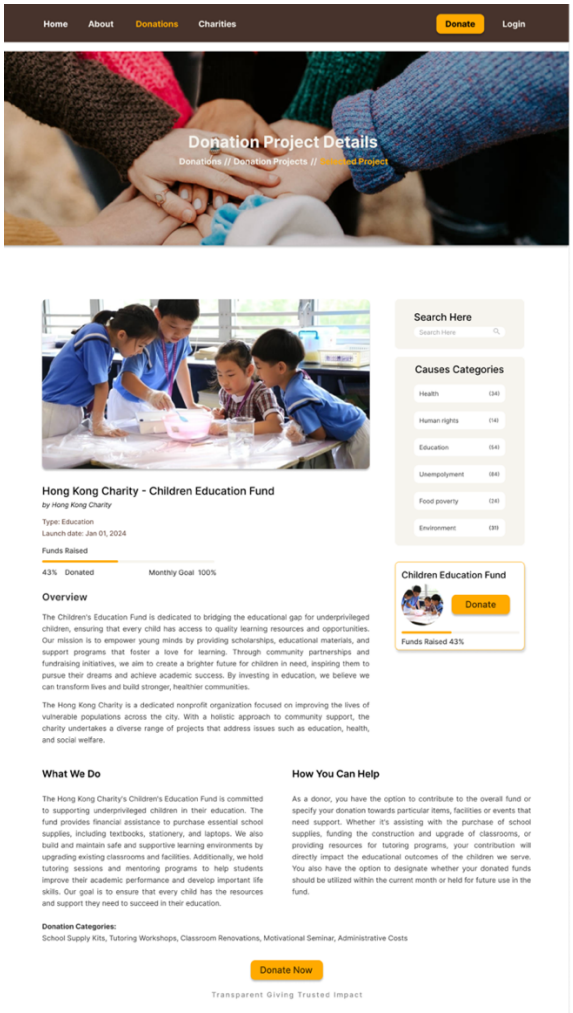

Figure 9 Donation project page of website.

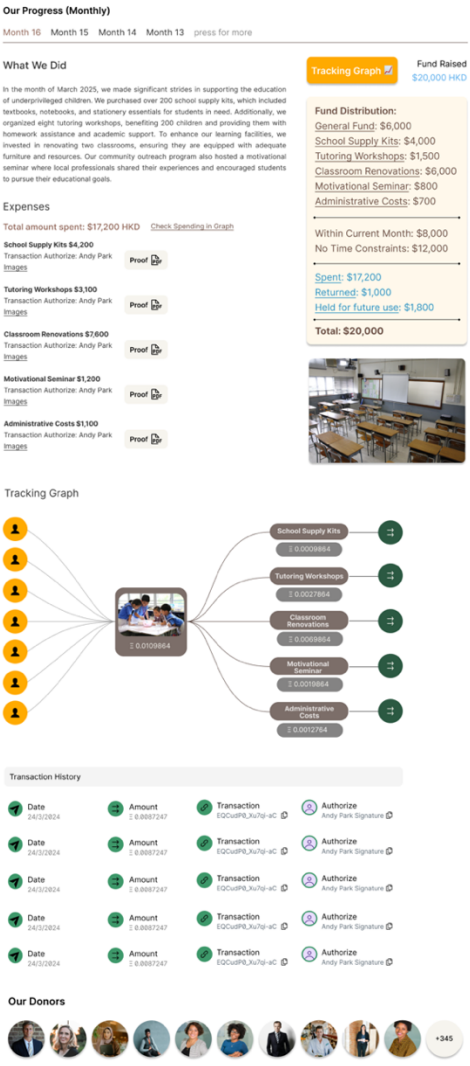

Figure 10 Donation progress tracking

Below the project details, monthly progress updates are provided (Figure 10). Each month, the charity refreshes the page to report on activities undertaken, such as the acquisition of new supply kits and tutoring workshops. All expenses incurred are listed, along with the corresponding invoices, to ensure transparency for donors. Additionally, the authorizer of each

transaction is displayed to maintain accountability. For donors interested in verifying blockchain transactions, a tracking graph is available, documenting all transaction history for the respective month. By clicking on a transaction arrow within the graph, donors are redirected to a transaction detail page that presents comprehensive information about the transaction (Figure 12).

4.2.4 Donation Payment Page

When donors click the "Donate" button, they are taken to the donation payment page. Here, they have the option to choose specific streams for their funds, allowing for more customization. For instance, donations can be limited to school supply kits and motivational seminars only. Donors can also specify that their contributions be used within the current month, giving them greater control over how the funds are allocated. Once their donation preferences are set, donors are prompted to enter the amount they wish to contribute in Hong Kong Dollars, which is then converted to its equivalent value in Ethereum. After confirming the donation amount, donors will have to connect their digital wallets to complete the transaction.

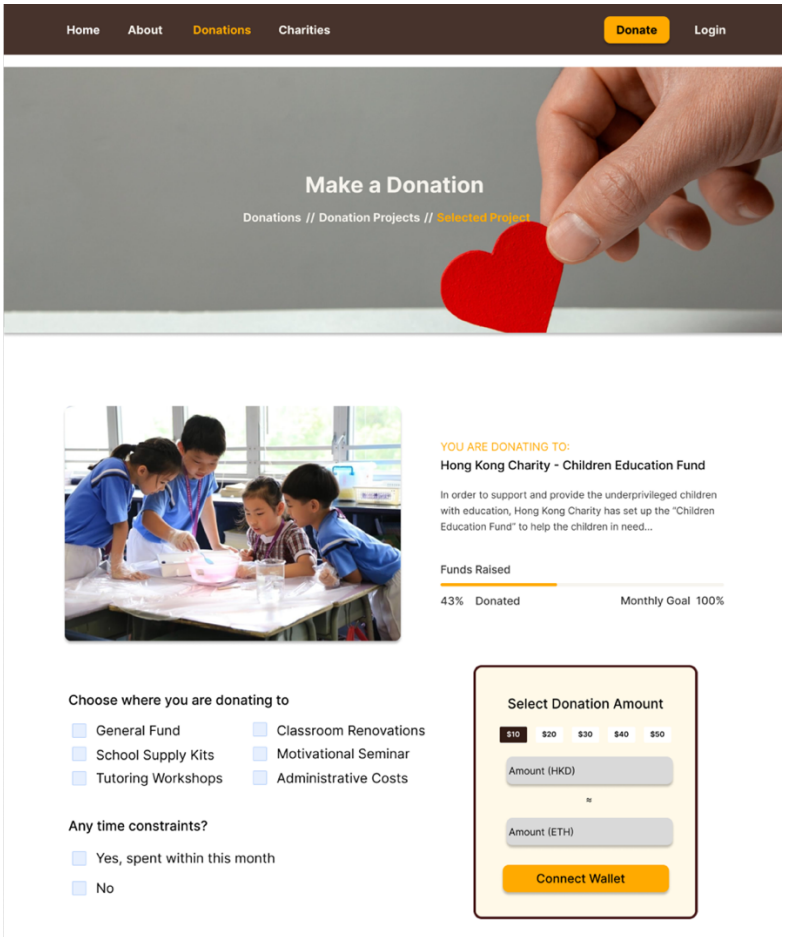

Figure 11 Donation payment page of website

4.2.5 View My Donation Page

Donors can track their contributions on the "My Donation" page, which provides detailed information about their donations. This includes transaction IDs (TxID), amounts in Ethereum, dates, and types of donations, all of which are accessible for review (Figure 12). The most recent transaction history of the project is also displayed below this section.

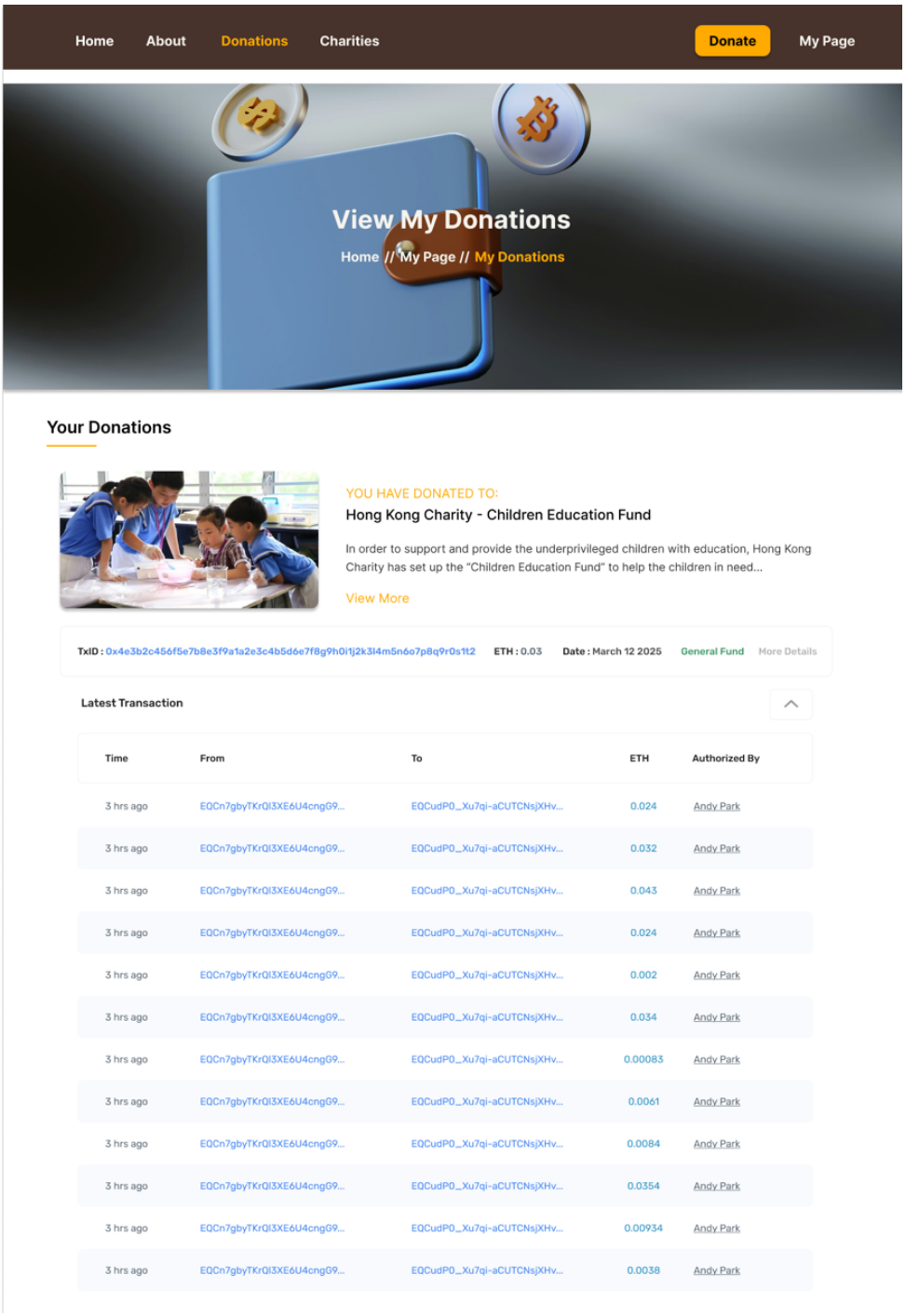

Figure 12 View My Donation Page

When donors click on an address, they can view detailed information about it (Figure 13). This includes the name and role of the recipient associated with the address, ensuring transparency among all participants.

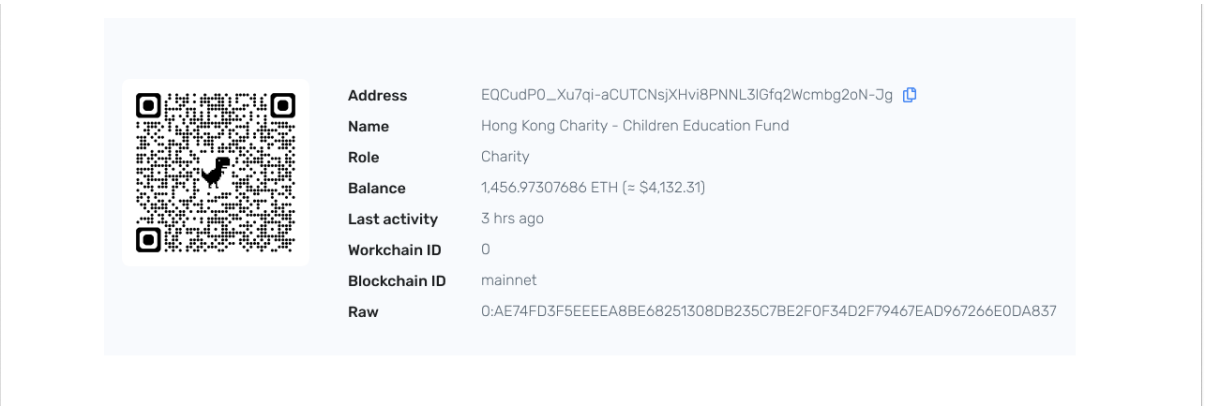

Figure 13 Address Details

If donors want to view the details of a specific transaction, they can click on the Ethereum amount within each transaction, which redirects them to an Ethereum Tracker page (Figure 14). This page provides all relevant transaction details. The upper section showcases block information, including the transaction hash, block ID, and timestamp. Additionally, donors can copy the address for later reference within the Ethereum Tracker. The lower section presents specific transaction details, such as the transaction amount, fees, and gas price.

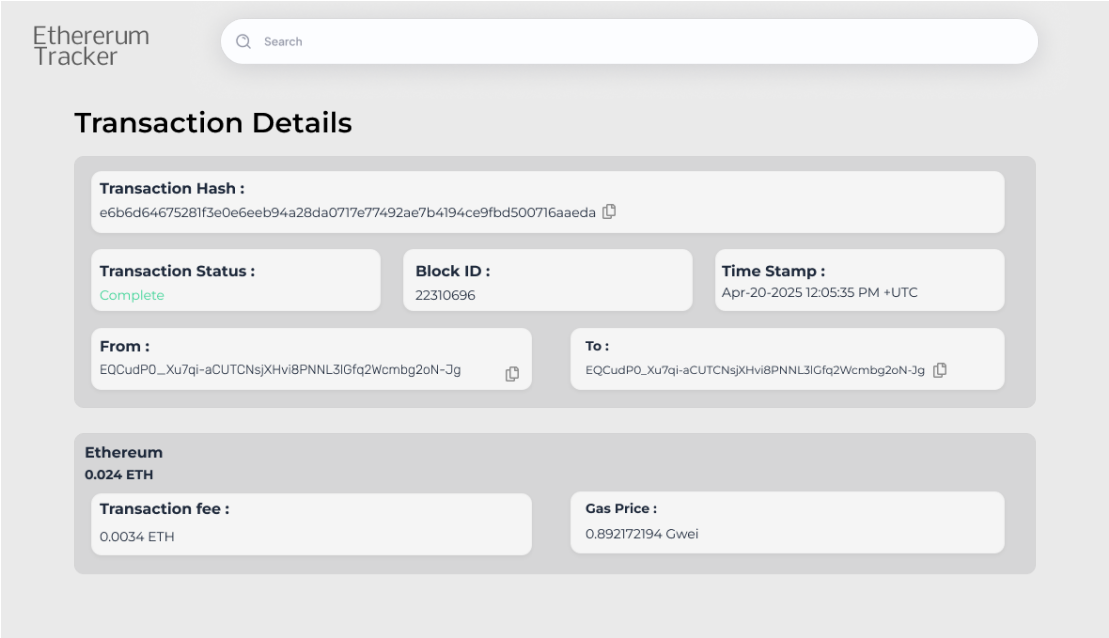

Figure 14 Ethereum tracker page

4.3 Questionnaire Feedback

An online questionnaire is conducted to gather feedback on the design and performance of our system. We received a total of 127 responses, with participants' ages ranging from 20 to 64. The survey consisted of two main sections: the first addressed respondents' views on blockchain technology and local charities, while the second focused on their impressions of the project demonstration.

Regarding local charities, most respondents expressed concerns about transparency and the use of donated funds. Over 87% indicated that they had withheld from donating due to uncertainties about how funds were used and overall transparency. This result shows the critical need for transparency in fund management, aligning with the issues our project seeks to resolve.

Regarding improvements for local charities, many respondents asked for better financial reporting and more effective communication with donors (see Appendix A). Additionally, when asked about whether a traceable record of fund movements would boost their confidence in donating, 67% answered yes, while another 29.92% responded with "maybe." These findings emphasize that traceability is essential for building donor trust.

To assess our system's performance, the survey included questions about user feedback. A significant majority of respondents (81.1%) agreed that the system effectively demonstrated how donations are tracked and used. Furthermore, over 88% of participants believed that the system could improve transparency in charity donations in Hong Kong. 77% and 72% of respondents felt that the system would enhance their trust in Hong Kong charities and their fund usage, respectively. Additionally, 79.53% indicated that the system would encourage them to donate more to local charities, and 65.35% expressed support for using a blockchain-based donation system for future contributions after viewing the project demonstration. These results shows that the key objectives of our project, transparency and trust, is quite successfully achieved by the proposed system.

However, there were also concerns regarding blockchain technology. In terms of familiarity, 78% of participants reported that they were not well-acquainted with blockchain, and only 17.32% owned cryptocurrency. This suggests that a lack of knowledge and the relatively low popularity of blockchain may hinder donor participation. Nonetheless, when asked if they believed blockchain could improve the transparency of charity donations, 86.61% responded positively. Furthermore, 46.64% indicated they would be willing to donate through a blockchain payment system if offered by a charity.

4.4 Benchmarking

To evaluate the proposed donation system's relative effectiveness in enhancing transparency and accountability in Hong Kong charities, a benchmarking analysis will be conducted by comparing it with existing solutions in the market, specifically Binance Charity and Givetrack, as well as Hong Kong charities' online platforms.

Binance Charity (Binance Charity, n.d.) and Givetrack (GiveTrack, n.d.) are both global donation platforms built on blockchain technology, offering references for comparing features related to transparency, traceability, and accountability. On the other hand, online donation platforms of Hong Kong charities, such as the Community Chest (The Community Chest of Hong Kong, n.d.) and Po Leung Kuk (Po Leung Kuk, n.d.), provide references for evaluating the proposed system within the specific context of charitable giving in Hong Kong.

As shown in table 3, the proposed system is compared with existing solutions across various features. The proposed system, together with Binance Charity and Givetrack, enables real-time tracking of donations through blockchain technology, a feature that Hong Kong charities currently lack. Both the proposed system and Givetrack clearly display fund movements on their front-end webpages, allowing donors to see exactly how the donations are used, such as the exact amount of donations used in buying equipment with the transaction date and proof. Digital signature, personal tracking graph and escrow system are unique features included by the proposed system, further enhancing transparency, traceability and accountability in the donation process.

Table 3 Comparison of features in different donation systems

Features	Binance Charity	Givetrack	Proposed system	Hong Kong charities' online platforms
Real-time tracking of donations	Yes	Yes	Yes	No
Clear display of fund movements	No	Yes	Yes	No
Digital signature	No	No	Yes	No
Personal tracking graph	No	No	Yes	No
Escrow system	No	No	Yes	No

Targeted donation	No	No	Yes	No
Charity-based	No	No	Yes	Yes
Hong Kong charities and projects	No	No	Yes	Yes

In terms of donation options, the proposed donation system allows donors to make targeted donations, specifying exactly where they want their donations to be used, providing a higher level of personalization compared to the other donation systems. Designed for Hong Kong charities, unlike Binance Charity and Givetrack, the proposed system is charity-based and features local charities and projects.

This benchmarking analysis shows that the proposed system incorporates features from existing solutions in the market and offers additional functionalities that enhance transparency, traceability, and accountability, while addressing the specific needs of charitable donations in Hong Kong, making it an effective solution.

4.5 System Evaluation

This section evaluates the proposed system across four key aspects: transparency, accountability, trust, and immutability, to show that it meets the objectives outlined in Section 1.3.

4.5.1 Transparency

Blockchain technology enhances transparency by ensuring that every step of the donation process is recorded and verifiable. By integrating blockchain into this donation system, the visibility of fund movements has significantly improved. The system includes features such as a tracking graph (Figure 10) and an Ethereum transaction tracker (Figure 14), which allow network participants to continuously oversee the flow of funds. Additionally, monthly progress updates (Figure 10) provide detailed accounts of expenditures and supporting evidence, minimizing the risk of misuse by charities. Survey results show that 88.98% of respondents feel this system boosts transparency in charity donations in Hong Kong, while 65.35% are inclined to donate through a blockchain-based platform. These figures provide strong evidence of the enhanced transparency resulting from the use of blockchain technology.

4.5.2 Accountability

Accountability means ensuring that an individual or organization is responsible for their actions. In this paper, it specifically refers to holding charities or individuals accountable for the use of

donations, particularly in cases of fund misuse. The proposed system incorporates digital signature on top of blockchain, allowing only authorized participants to approve transactions using digital signatures. With Elliptic Curve Digital Signature Algorithm (ECDSA) and cryptographic hash algorithm Keccak-256, it ensures that impersonating an authorized participant and forging a signature is nearly impossible.

All participants can view who authorized the transactions on the blockchain. The "Donation project" page (figure 7.2) and "View My Donation" page (figure 9) show the person who authorized the transaction to donors and other parties. If misuse of donations is discovered, it is easy and efficient to identify who authorized the specific transaction, and that person would be held accountable. Compared to existing donation charity platforms in Hong Kong, which often lack a designated responsible person for the use of donations, the proposed system clearly identifies the responsible individual for each transaction, ensuring accountability.

4.5.3 Immutability

The use of digital signature and blockchain in this system guarantees that no transaction can be altered or deleted once recorded on the blockchain, achieving immutability. When a transaction is authorised and approved, it is recorded on the blockchain. With cryptographic hashing, each transaction is linked to its predecessor, creating a secure chain of records. Thus, any attempt to modify the transaction would require altering subsequent blocks, which is extremely difficult, and would not receive consent from the majority of network participants. As a result, donation transactions within the proposed system would be immutable.

4.5.4 Trust

Blockchain' features, such as tracebility, transparency and immutability, together with digital signature's accountability help to build trust in charitable donations. All parties (donors, charities and beneficiaries) can access the same unchangeable record and independently verify the movement of funds in each transaction, including details about the address and recipient identity (Figure 13). All details of the transaction is transparent and available to all on the blockchain and the webpage. Real-time tracking of the donations provides another level of trust, showing the person holding the funds at all times, making verification easy and efficient. As the digital signature mechanism ensures that the transaction authorizer will be held accountable, it further strengthens trust in the donation process. According to the survey results, 71.65% and 77.17% of respondents believe this system enhances their trust in Hong Kong charities and

their fund usage, showing the effectiveness of the proposed system. This system enabled by blockchain enhances trust, promoting integrity.

4.6 Challenges

Despite the promising performance of the proposed system, several limitations and challenges have been identified during the project. These include the technology acceptance and knowledge of the Hong Kong public regarding blockchain, the adaptability of local charities to the new system, and regulatory challenges within Hong Kong. Addressing these issues is essential for enhancing the system's effectiveness and ensuring its successful integration into the local charity sector.

4.6.1 Blockchain Penetration

One key challenge involves the limited adoption of blockchain technology in Hong Kong. Survey data reveals that nearly 78.84% of participants are unfamiliar with blockchain, while over 80% answered a lack of understanding and the perceived difficulty of the technology as major barriers to using blockchain-based donation systems. Additionally, only about 17.32% of respondents reported owning cryptocurrency, showing the general public's low awareness of blockchain. This knowledge gap hinders broader acceptance of blockchain in charitable giving, which could reduce the system's potential impact.

For blockchain to be successfully integrated, public awareness and comprehension of its advantages are essential. Therefore, educating users and closing this knowledge gap should be a top priority. Interestingly, despite limited familiarity with blockchain, many respondents showed interest in using it for donations after seeing a demonstration. This suggests that reluctance isn't rooted in opposition to the technology itself but rather in insufficient exposure. These findings highlight both the promise of blockchain-based donations and the urgent need for public education on the subject.

4.6.2 Hong Kong charity adaptability

The adaptability of local charities to the proposed blockchain-based system poses another challenge. Many charities in Hong Kong already operate their own established systems and platforms for receiving donations. Transitioning to this new technology would require considerable effort, resources, and commitment, which may not be feasible for all organizations. Additionally, there is uncertainty regarding the willingness of charities to adopt these changes, particularly given that some may lack the necessary knowledge about blockchain technologies, cryptocurrencies, and digital signatures. This knowledge gap could lead to skepticism about

the benefits of the new system, making it difficult to convince them to participate. Furthermore, potential conflicts of interest may arise, complicating the transition and further hindering the adoption of this blockchain platform within the sector.

To address this challenge, communicating with local charities is essential. Through demonstrating how the system works, how it could enhance the credibility of charities and potentially attract more donations, charities will be more interested in participating. Additionally, it is important to understand the specific difficulties local charities face in adapting to the proposed system. By considering their feedback and adjusting the system, charities would be more willing to embrace this change, ultimately fostering a smoother transition and enhancing overall effectiveness.

4.6.3 Regulatory constrains

Blockchain and cryptocurrency are widely recognized as groundbreaking innovations capable of reshaping payment systems. Yet, their adoption comes with regulatory hurdles. A well-defined legal framework can strike a balance, encouraging innovation while safeguarding users and maintaining system reliability. However, Hong Kong currently lacks a comprehensive regulatory structure for blockchain and cryptocurrency payments. Without clear guidelines, donors and charitable organizations may hesitate to adopt the technology, unsure whether it meets established industry norms.

Strong regulation is crucial to clarify legal and compliance requirements, demanding cooperation between authorities and key stakeholders. Notably, in the 2024 Policy Address, the Hong Kong SAR Government signaled its commitment to blockchain adoption as part of its smart city initiatives (Policy Address, 2024). This move is expected to push regulatory agencies to establish clearer standards for blockchain and cryptocurrency use, paving the way for greater trust and integration.

4.7 Next Steps

Through prototyping and evaluation, the proposed system has proven to be effective in enhancing transparency, trust, and accountability within the Hong Kong charity sector. Moving forward, our focus will be on integrating the system into real-life applications. To achieve this, we must create a more comprehensive user experience for all parties involved. The user interface for beneficiaries and charities should be designed, and feedback from both groups should be collected to ensure the platform meets their needs. Additionally, since 80.31% of respondents expressed interest in a mobile application, it will be essential to design the front-

end interface for mobile apps and ensure compatibility across devices. Finally, given that 74.02% of respondents indicated a desire for community engagement features, blogs and discussion forums could be developed to enhance interaction on the platform.

4.8 Project Schedule

The project schedule outlined in Table 3 details the deliverables and milestones to be achieved in different stages. Throughout the months, the project has been progressing on schedule, achieving the desired goals and results. After the submission of this final report, a final presentation and exhibition on the project will be held, together with a video demonstration of the system.

Table 4 Project schedule

Stage	Periods	Deliverables and Milestones
Phase 1: Inception	Aug. - Sep., 2024	Background research: • Local charity issues • Blockchain tracking system
		Phase 1 Deliverables: • ***Detailed project plan*** • ***Project webpage***
Phase 2: Elaboration	Oct., 2024	Literature Review: • Blockchain technology • Donation tracking systems
	Oct., 2024 - Jan., 2025	System Design: • User Interface • Workflow diagram • Backend architecture
		Performance Evaluation: • Draft questionnaire
		Phase 2 Deliverables • ***First presentation*** • ***Preliminary implementation*** • ***Detailed interim report***
Phase 3: Construction	Feb., 2025	Prototyping: • Blockchain • Digital signature mechanism • User interface
	Mar - Apr, 2025	Performance Evaluation and Adjustments: • Distribute questionnaire • Collect and analyse feedback • Adjustment on prototype
	Apr, 2025	***Phase 3 Deliverables*** • ***Finalized tested implementation*** • ***Final report*** • ***Final presentation***
		Project Exhibition

5. Conclusion

Over the years, the philanthropic landscape continues to grow and develop. However, the lack of regulations and oversight has led to instances of fraud and fund misallocation, eroding public trust in local charitable organizations. To address this pressing issue, this project proposes a blockchain-based payment system that aims to enhance transparency, trust, and accountability in charitable organizations. By providing real-time donation tracking, this system could potentially improve the overall transparency of charitable operations, thereby enhancing donor confidence and participation.

Following the completion of literature review, design of the prototype and various evaluations on the proposed system, a comprehensive design for blockchain-based donation system tailored for Hong Kong charities is developed. Moving forward, challenges to be addressed include user adoption and regulatory concerns in Hong Kong. Nevertheless, the proposed system has proven to be effective in enhancing transparency, trust and accountability in Hong Kong charities, paving the way for a more credible framework for local charitable donations.

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Appendix A Questionnaire and Results

Questionnaire on Blockchain Payment System for Hong Kong Local Charity

Hi,

We are final-year BASc(FinTech) students from The University of Hong Kong (HKU), working on our final year project focused on blockchain-based payment system for local charities. We are conducting a survey aimed at understanding public perceptions of charities in Hong Kong and gathering feedback on our proposed system.

Your contributions will be invaluable in shaping our project and ensuring its relevance to the needs of both charitable organizations and their supporters. The survey will address various topics, including trust in charitable institutions, payment preferences, and perspectives on integrating blockchain technology into charitable donations.
All data collected will be handled with the care and will be used solely for research purposes.

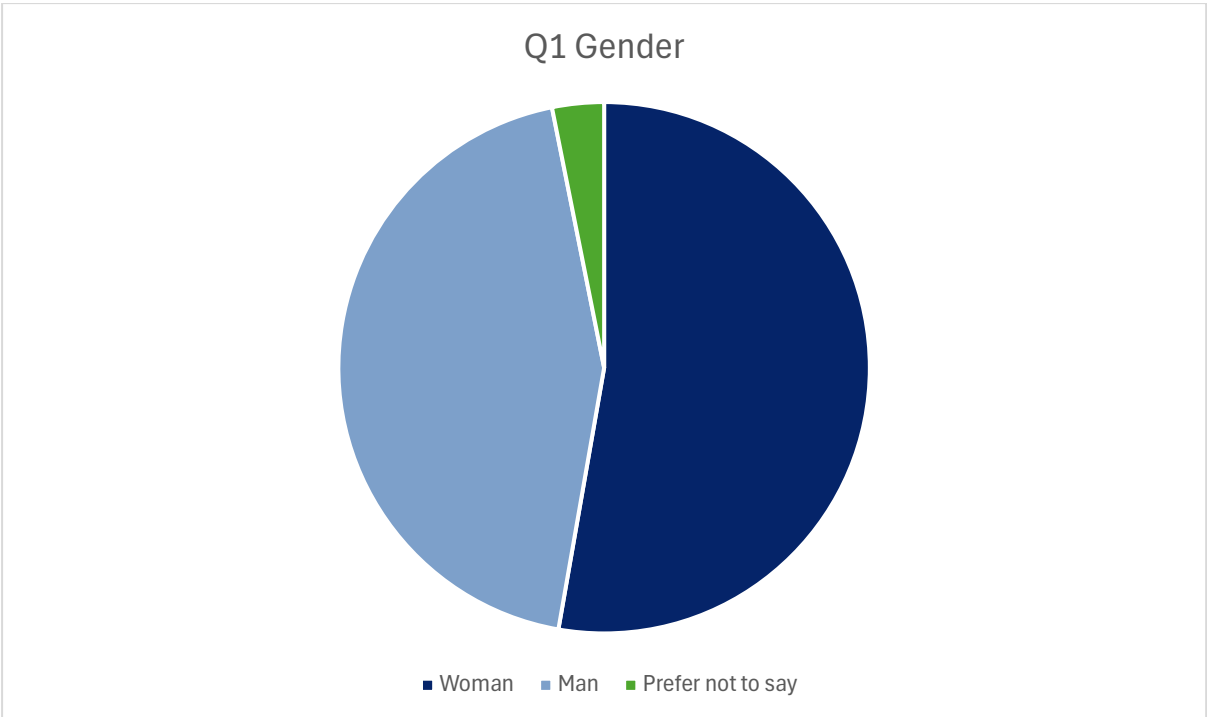
Thank you for your time and support!

Personal Details

1

Gender *

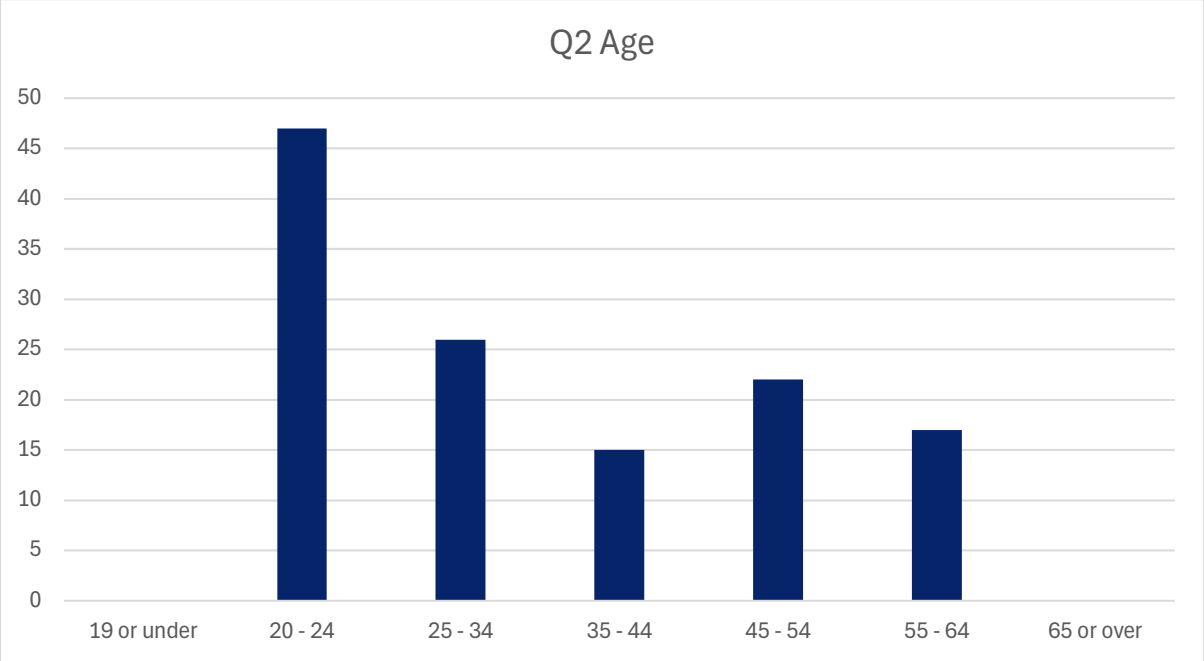
- ◯ Woman
- ◯ Man
- ◯ Prefer not to say



2

Age *

- 19 or under
- 20 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65 or over

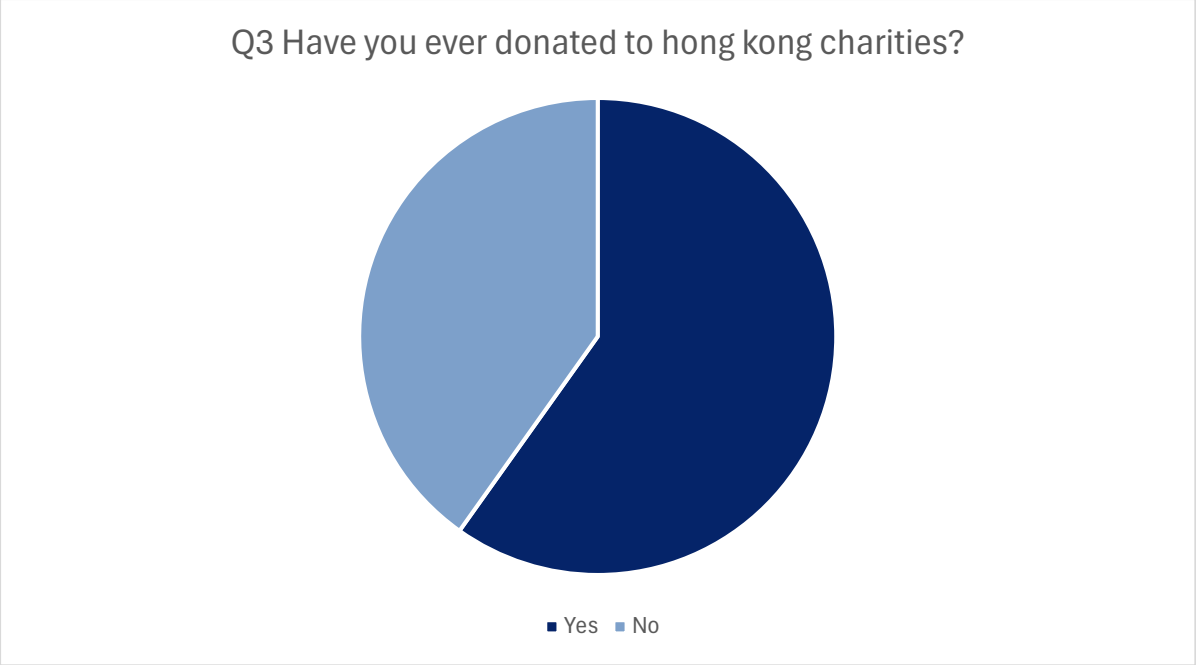


Impression towards Hong Kong Charities

3

Have you ever donated to hong kong charities? *

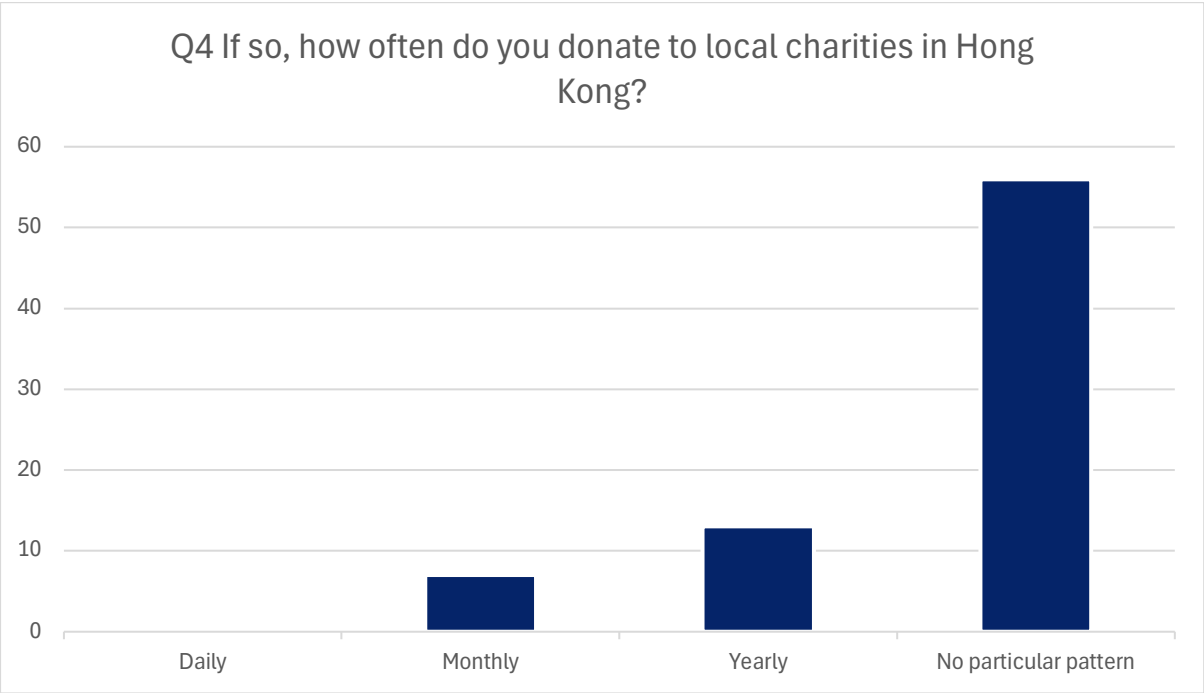
- Yes
- No



4

If so, how often do you donate to local charities in Hong Kong?

- Daily
- Monthly
- Yearly
- No particular pattern

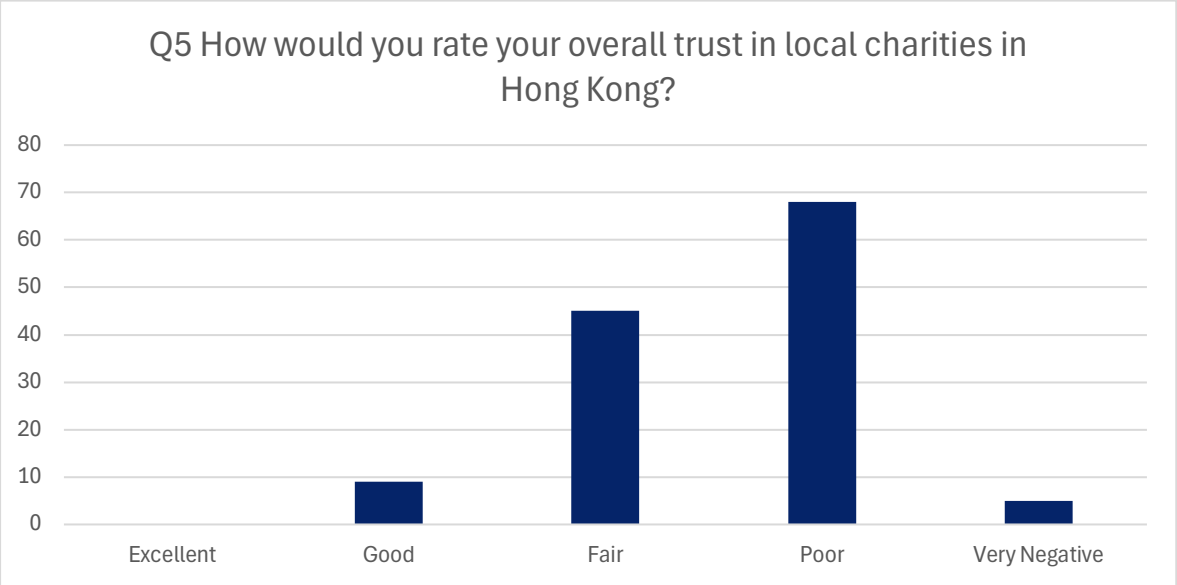


5

How would you rate your overall trust in local charities in Hong Kong?

*

- ◯ Excellent
- ◯ Good
- ◯ Fair
- ◯ Poor
- ◯ Very Negative

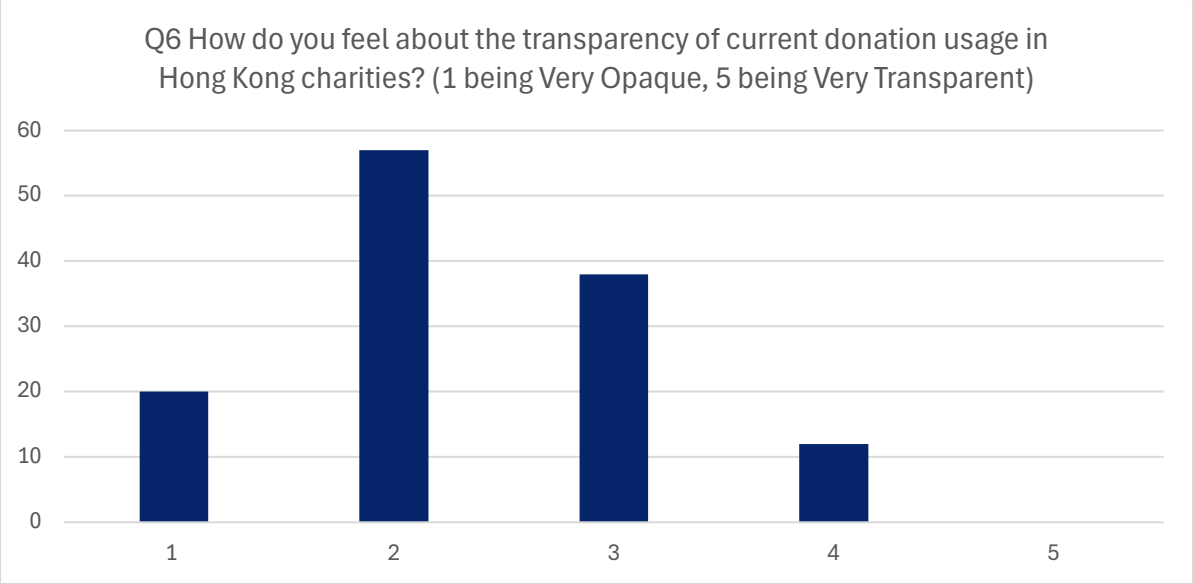


6

How do you feel about the transparency of current donation usage in Hong Kong charities? (1 being Very Opaque, 5 being Very Transparent)

*

	1 (Very Opaque)	2	3	4	5 (Very Transparent)
	◯	◯	◯	◯	◯

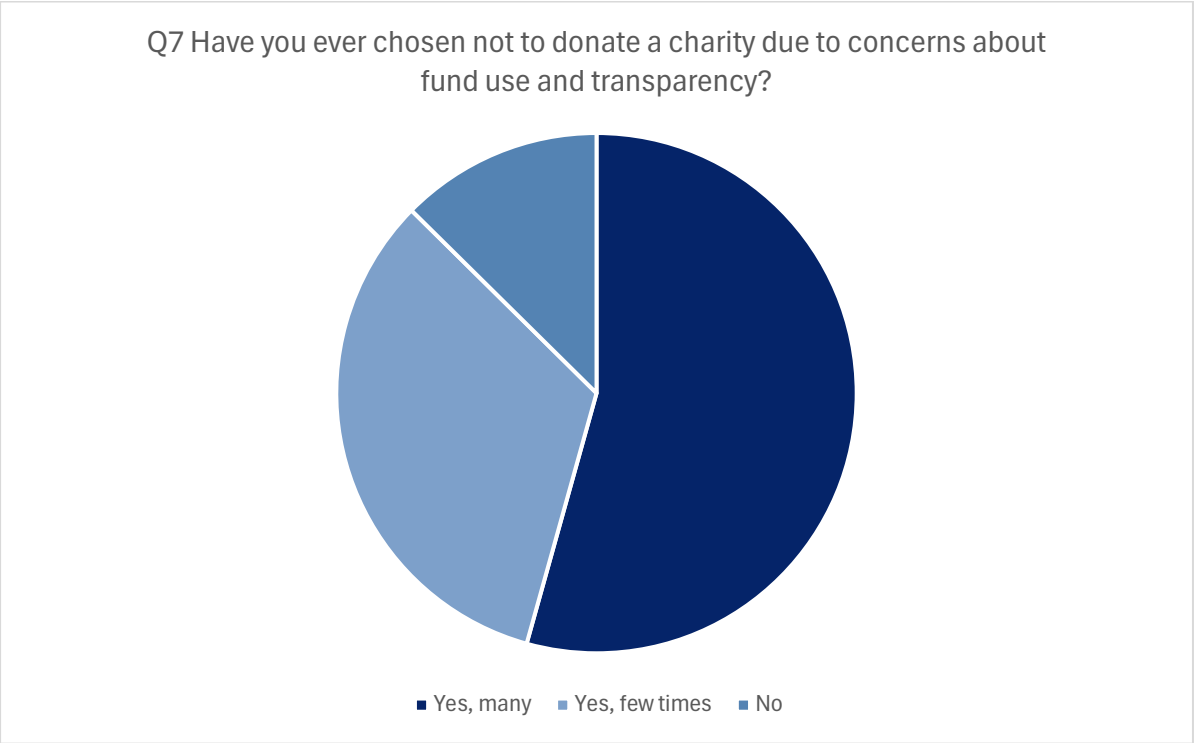


7

Have you ever chosen not to donate a charity due to concerns about fund use and transparency?

*

- ◯ Yes, many
- ◯ Yes, few times
- ◯ No

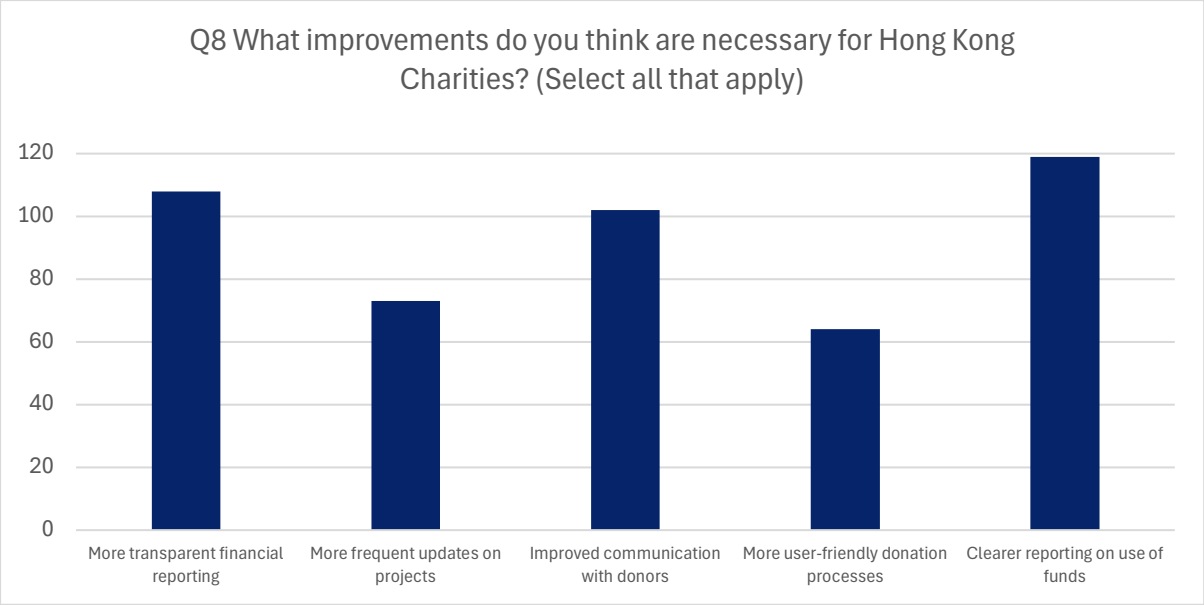


8

What improvements do you think are necessary for Hong Kong Charities? (Select all that apply)

*

- [ ] More transparent financial reporting
- [ ] More frequent updates on projects
- [ ] Improved communication with donors
- [ ] More user-friendly donation processes
- [ ] Clearer reporting on use of funds



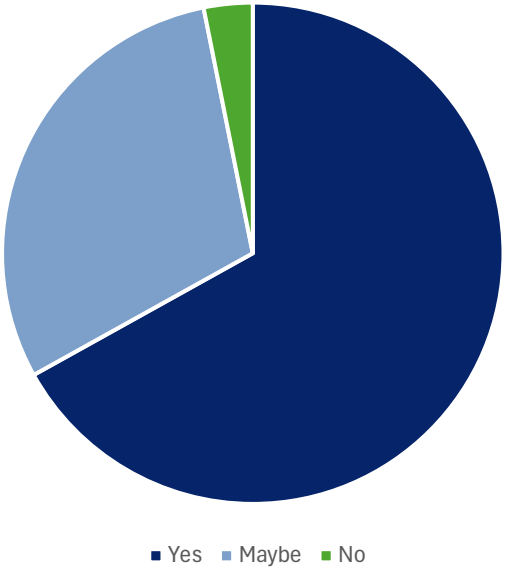
9

Would you feel more confident in donating if you could see a trace record of the fund movement?

*

- ◯ Yes
- ◯ Maybe
- ◯ No

Q9 Would you feel more confident in donating if you could see a trace record of the fund movement?



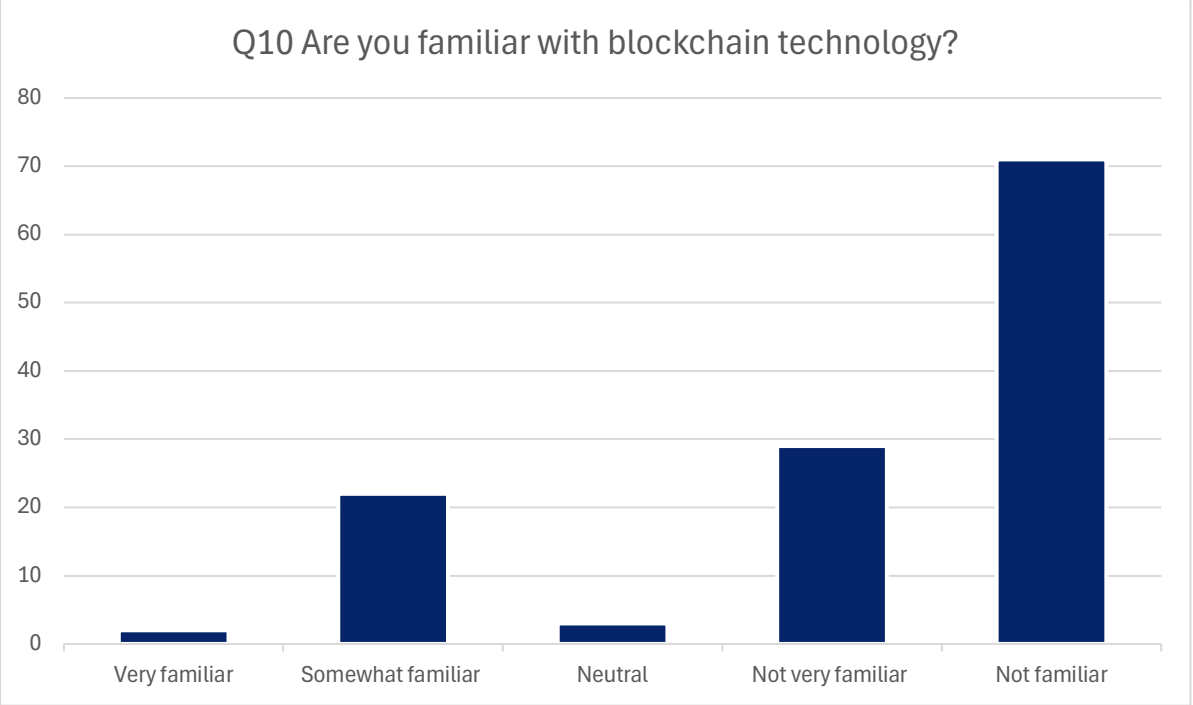
Blockchain and Cryptocurrency

Blockchain is a distributed ledger that maintains a secure and decentralized record of transactions.
Transactions are permanently recorded (immutable) and can be viewable to anyone.
Cryptocurrency, such as Bitcoin and Ethereum, is a decentralized digital currency that runs on blockchain.

10

Are you familiar with blockchain technology?
*

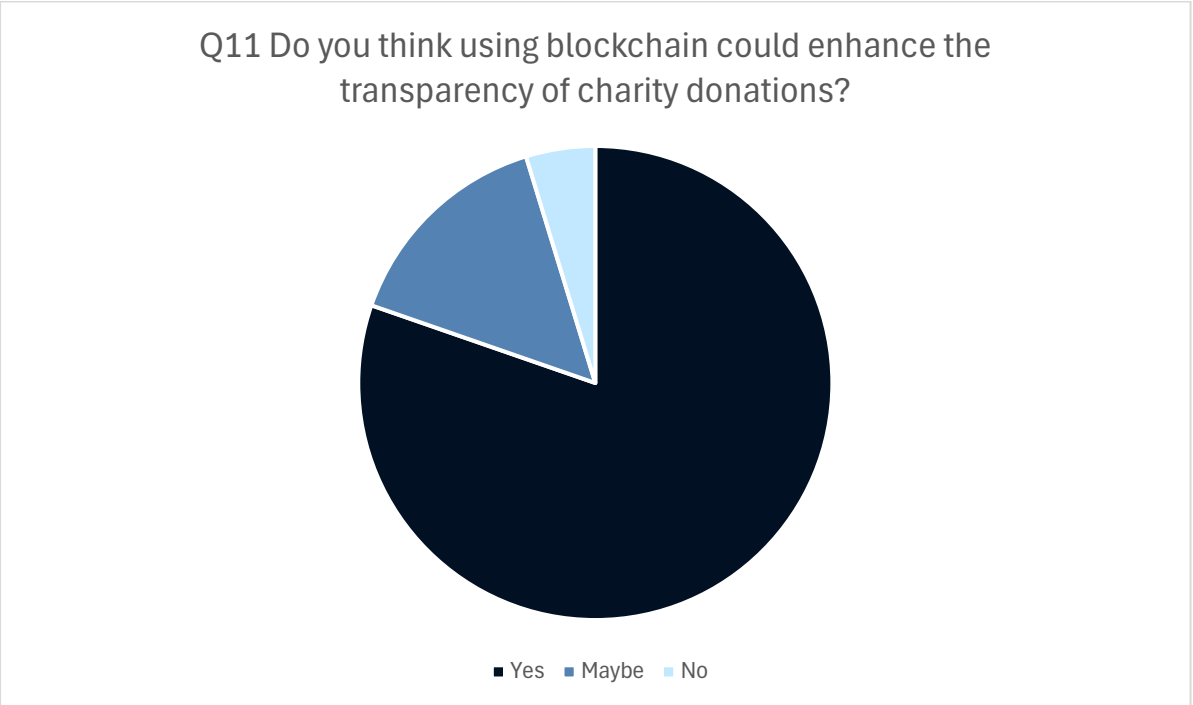
- ◯ Very familiar
- ◯ Somewhat familiar
- ◯ Neutral
- ◯ Not very familiar
- ◯ Not familiar



11

Do you think using blockchain could enhance the transparency of charity donations? *

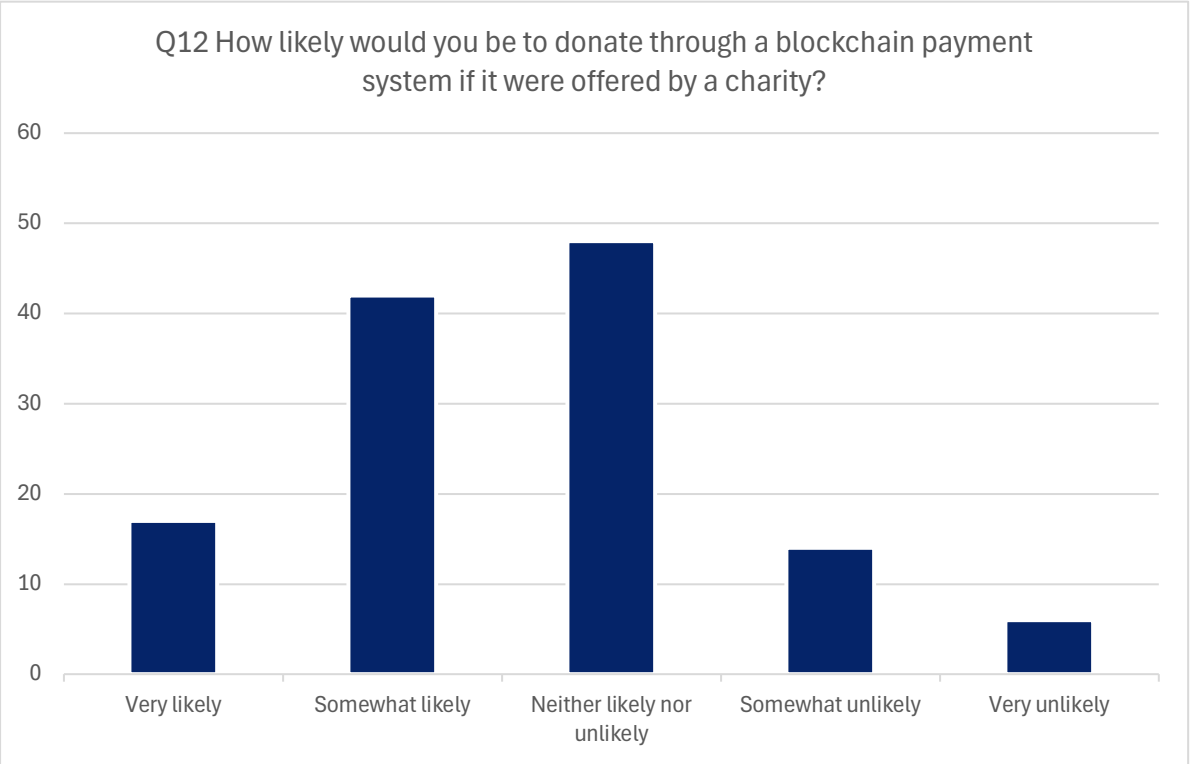
- Yes
- Maybe
- No



12

How likely would you donate through a blockchain payment system if it were offered by a charity? *

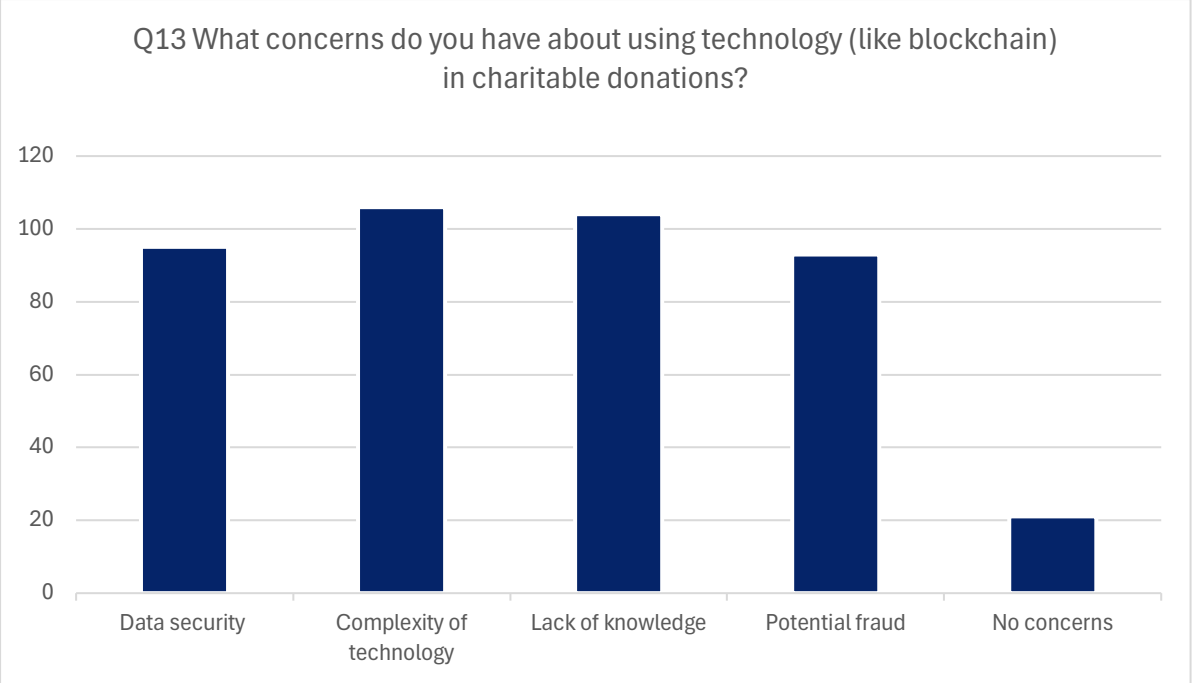
- ◯ Very likely
- ◯ Somewhat likely
- ◯ Neither likely nor unlikely
- ◯ Somewhat unlikely
- ◯ Very unlikely



13

What concerns do you have about using technology (like blockchain) in charitable donations? *

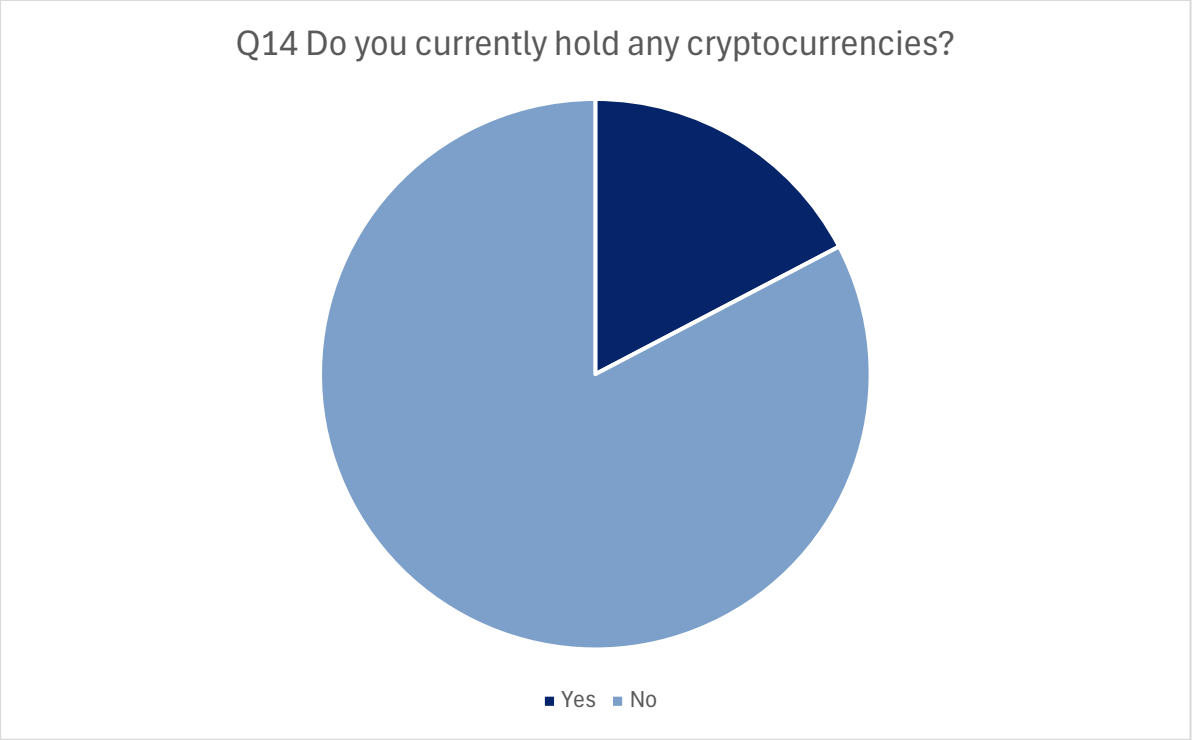
- ☐ Data security
- ☐ Complexity of technology
- ☐ Lack of knowledge
- ☐ Potential fraud
- ☐ No concerns



14

Do you currently hold any cryptocurrencies? *

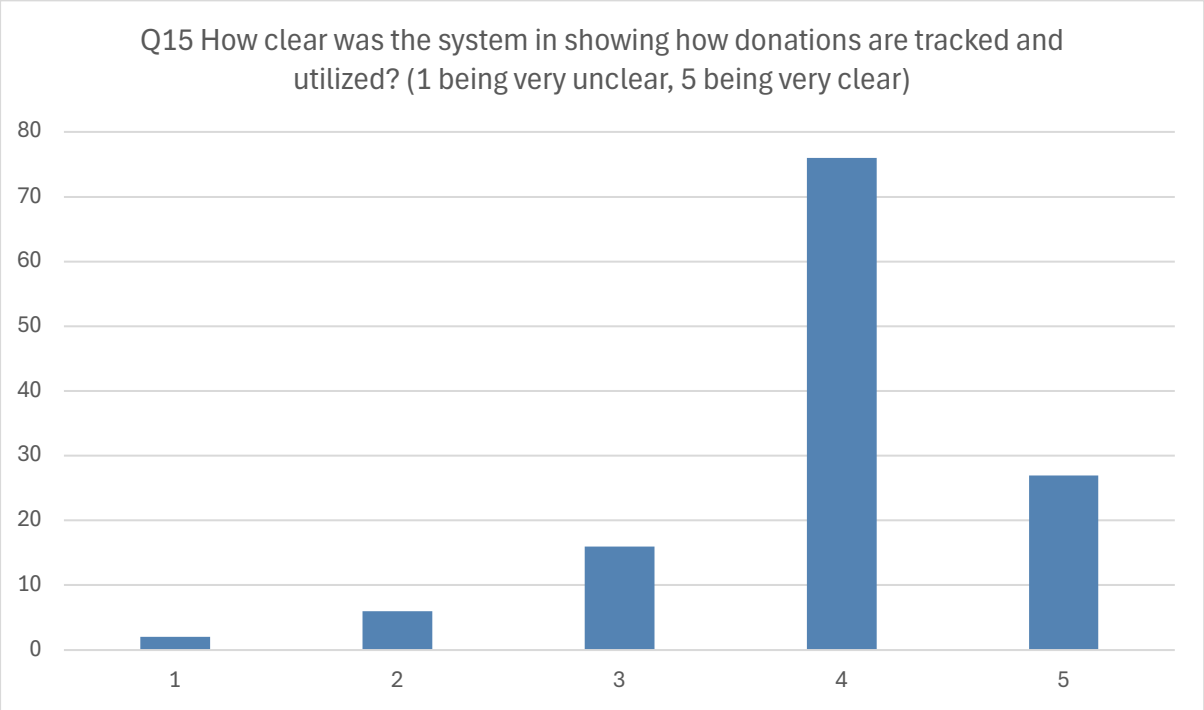
- Yes
- No



15

How clear was the system in showing how donations are tracked and utilized? (1 being very unclear, 5 being very clear) *

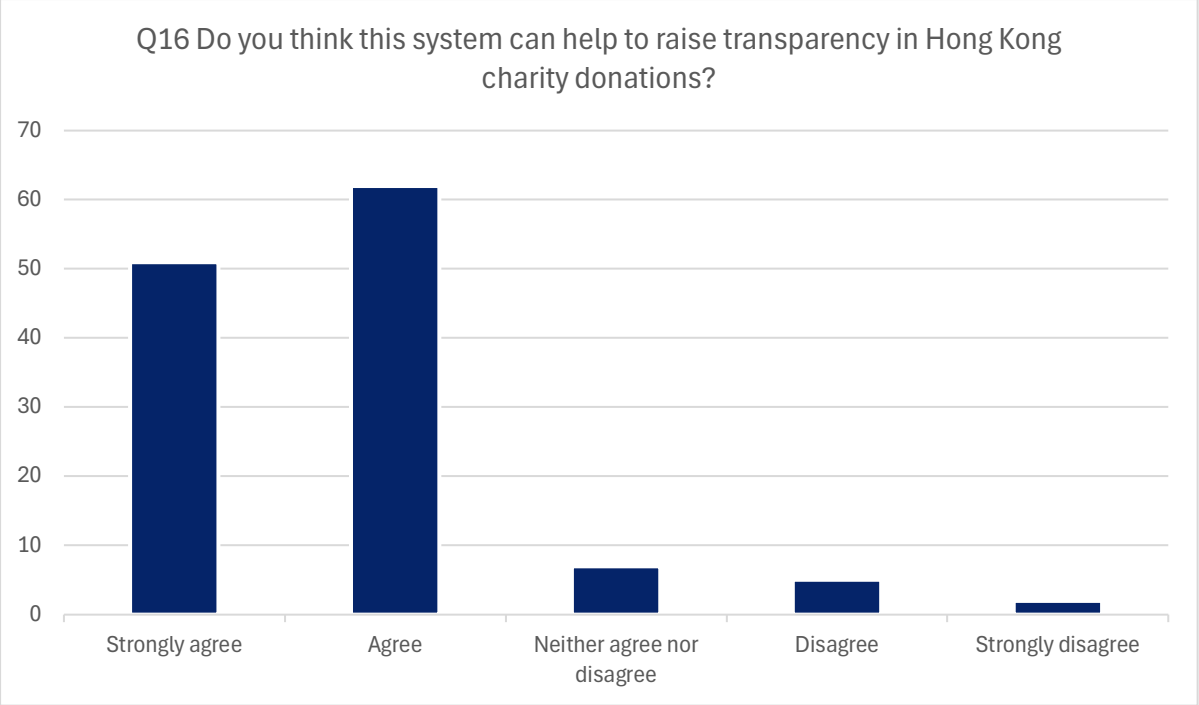
	1 (Very Unclear)	2	3	4	5 (Very Clear)
	○	○	○	○	○



16

Do you think this system can help to raise transparency in Hong Kong charity donations? *

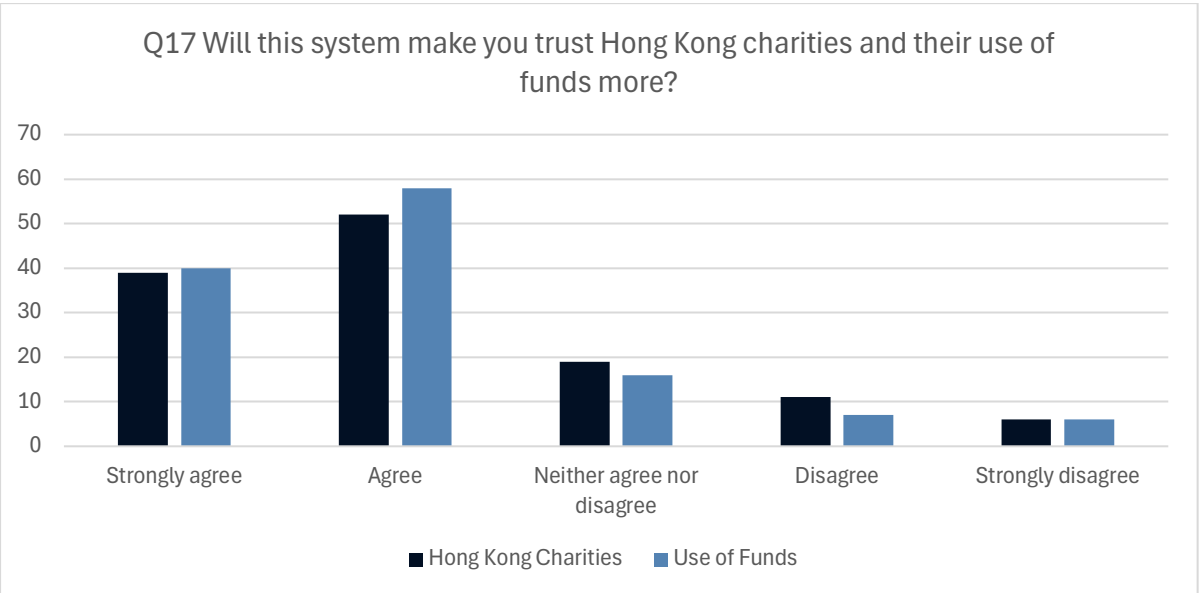
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	○	○	○	○	○



17

Will this system make you trust Hong Kong charities and their use of funds more? *

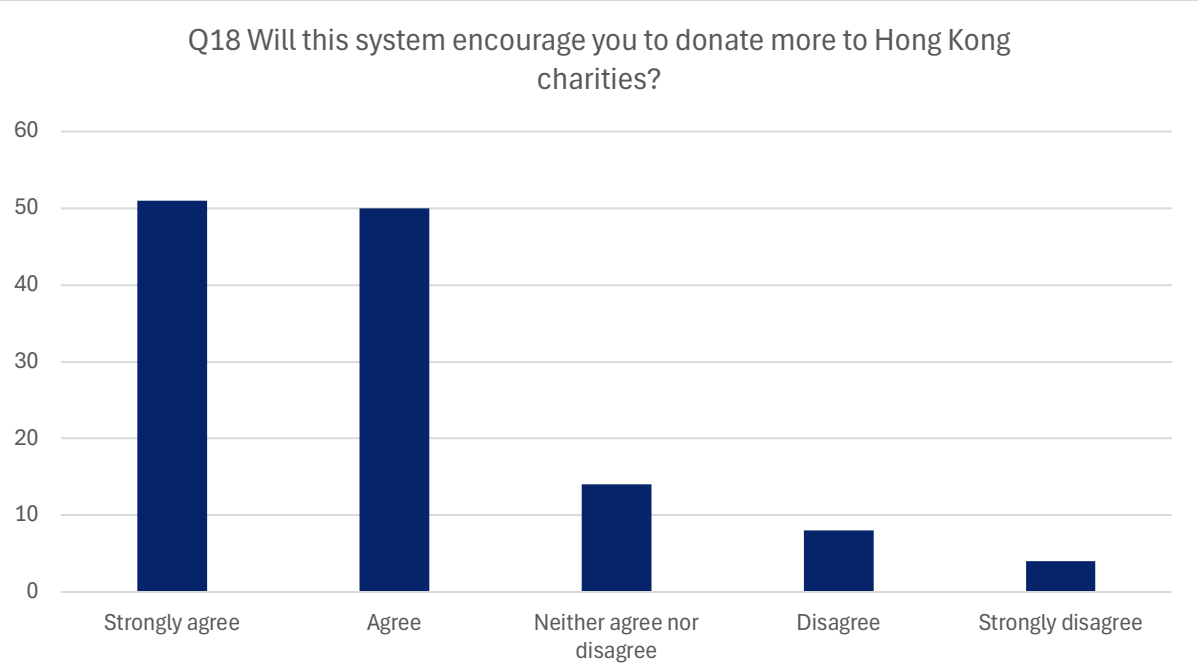
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Hong Kong Charities	○	○	○	○	○
Use of funds	○	○	○	○	○



18

Will this system encourage you to donate more to Hong Kong charities? *

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	○	○	○	○	○



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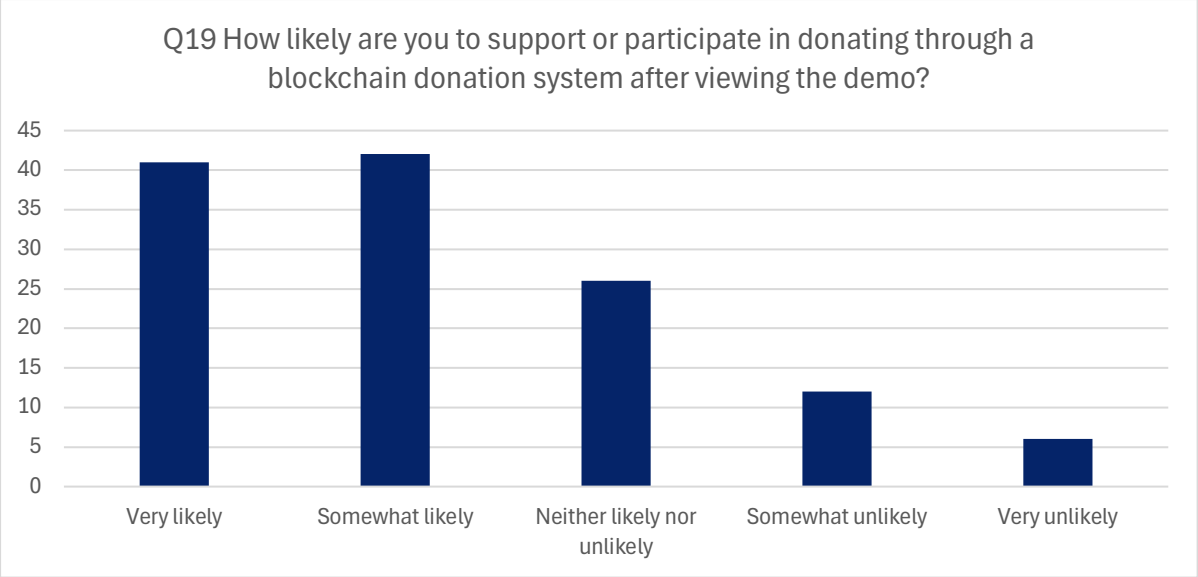
How likely are you to support or participate in donating through a blockchain donation system after viewing the demo? *

	Very likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Very unlikely
	○	○	○	○	○



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What additional features or improvements would you suggest for the blockchain donation system based on the demo?

*

- [ ] More user-friendly interface
- [ ] Mobile application
- [ ] Community engagement features