

The Revolution Will Not Be Centralized

Decentralized Technologies & The Future Of Historical Narratives.

Exploring community representation through decentralization.

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Abstract

The understanding of historical narratives has long been under the dominion of centralized perspectives, often marginalizing diverse viewpoints. In response to this issue, this research investigates whether and how the tenets of decentralization can empower digital spaces to promote inclusive representation and challenge centralized narratives.

Decentralized technologies, employing mechanisms of peer-to-peer interactions, transparency, and community governance, are identified as potential solutions to overcome the representation issues inherent in centralized digital platforms. These platforms have revolutionized information sharing but have, paradoxically, often perpetuated the same biases we seek to eliminate.

Drawing from case studies of community-driven platforms like Wikipedia and Mastodon, and decentralized systems like Bitcoin and InterPlanetary File System, this research explores the challenges and successes of implementing decentralization. Key findings indicate that optimal decentralization requires a careful balance of inclusivity, scalability, security, and sustainability, shedding light on the design complexities in decentralized systems.

The implications of this research extend beyond academia, providing a roadmap for creating digital spaces that foster empathy and mutual understanding through a diversity of historical narratives. This study posits that the adoption of decentralized technology can champion digital sovereignty, mitigate centralized discourse and agenda, and challenge the status quo of representation in digital spaces.

In the face of an increasingly digital society, this research serves as a call to action, urging continuous design innovation to rethink and reconstruct our digital landscapes through the lens of decentralization. The research thus initiates an important discourse on the future of digital spaces, inclusivity, and the representation of historical narratives.

Key words: Community participation, social networking, subjective reality, decentralized technologies, consensus mechanisms, blockchain, encryption algorithms, cryptography, machine learning design, reputation systems, design philosophy.

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Introduction

As we delve deeper into our digital maturity, the vast landscape of knowledge and information sharing continues to evolve, rendering the exploration of new paradigms an urgent necessity. This research explores the power of decentralization in digital spaces, specifically examining how it can foster more inclusive representation and challenge dominant centralized perspectives in historical narratives.

1.1 Background & Context

The ubiquitous nature of digital technology and the internet has revolutionized the ways in which we produce, share, and consume information (Castells, 2009). However, these digital spaces often mirror the power structures of our physical world (Sadowski, 2020), with centralized platforms controlling the narratives and information we access (Gillespie, 2019). This research contributes to the growing body of work critiquing these power structures and seeks to explore alternatives that offer more equitable and inclusive spaces for knowledge production.

1.2 Research Question & Objectives

The primary research question guiding this study is:

“How can the design tenets of decentralization empower the creation of digital spaces to promote inclusive representation and challenge centralized perspectives in historical narratives?”

The objectives of this research are to:

1. Investigate the potential of decentralized technologies to empower the creation of more inclusive digital spaces. This will involve critically examining the underlying principles of decentralization, the technologies that enable it (such as blockchain and the InterPlanetary File System), and their relevance to fostering inclusivity and diversity in digital realms.
2. Explore the relationship between decentralization and the representation of diverse historical narratives. This includes analyzing how a decentralized approach can facilitate a multiplicity of perspectives, challenge existing central narratives, and allow for a more inclusive and equitable representation of history.
3. Analyze existing applications of decentralized technologies and their impact on inclusivity and representation. This requires a comprehensive review and evaluation of existing platforms, such as Bitcoin, Wikipedia, Mastodon, and others, to understand how they have leveraged decentralization to foster inclusivity and diverse representation.
4. Develop and present theoretical concepts that leverage the principles of decentralization to enhance inclusivity and representation. This will involve creating and refining a theoretical framework that draws upon the findings of the previous objectives, and will include generating mock user designs and visualizations of the potential system to demonstrate how such a framework might be practically implemented.
5. Critically evaluate the limitations, challenges, and potential future implications of the proposed decentralized system and design philosophy. This includes a reflection on the research methodologies, an assessment of the feasibility and scalability of the proposed system, and a discussion on the potential impact this system could have on fostering inclusivity and diverse representation in digital spaces.

1.3 Chapter Summaries

This research is structured into several chapters, each serving a critical function in the overall study.

Chapter 1 lays the groundwork for the study, defining the context that sparked the investigation. It clarifies the research question and objectives, and provides a broad outline of the research methodology. The chapter also delves into the boundaries of the study, acknowledging the scope and limitations of the research.

Chapter 2 embarks on a cross-disciplinary exploration through a literature review that focuses on the intersection of design, computer science, self-governance, and philosophy as related to decentralized technology. This comprehensive review lays the groundwork to understand the concept of decentralization in digital domains, why it is important, and its potential impact on inclusivity and representation.

Chapter 3 delineates the research methods employed in the study, which include a cross-disciplinary literature review, data analysis and case studies, critical making, and iterative prototyping. Furthermore, this chapter pinpoints the fundamental principles indispensable for the proposed theoretical system, such as decentralized trust and identity, decentralized storage and accessibility, and decentralized consensus and moderation.

Chapter 4 presents a sequence of case studies, offering a tangible look into the application and implications of decentralized technologies. It investigates real-world platforms such as Wikipedia, Bitcoin, InterPlanetary File System (IPFS), and Mastodon, highlighting their successes and challenges in respective decentralization pursuits. This chapter culminates with a comparative analysis of the findings, discussing the implications of the results from these case studies and their contributions to the wider conversation on decentralization, inclusivity, and representation.

Chapter 5 provides a critical exploration of key components within decentralized technologies. The primary focus of this chapter is hashing algorithms and encryption systems, as these are the core mechanisms that maintain privacy and security within the decentralized realm. In addition, the chapter examines the fundamental functions of IPFS, emphasizing the role it plays in data storage and retrieval in decentralized contexts.

Chapter 6 undertakes the creation of fictional personas, using artificial chatbots to illustrate various perspectives within a simulated user design. This innovative approach aids in conceptualizing and clarifying the theoretical framework being proposed by providing a fictional window into what the user experience within this system might look like, further contextualizing the potential implications of the research.

Chapter 7 materializes the proposed theoretical concept by generating a mock user interface with the aid of digital design tools. This chapter serves to visualize the potential look and function of the proposed system, giving readers a more tangible understanding of its practical implementation.

Chapter 8 explores the details of the proposed system, leveraging logic structures to illuminate its potential inner workings. This chapter explains key features such as reputation systems and decentralized moderation mechanics, providing a blueprint for the envisioned decentralized ecosystem.

Chapter 9 offers a holistic review of the design findings, addressing the key issue that the research aims to resolve. This chapter discusses the contextualization of the proposed system, synthesizing all preceding research elements to portray a unified, cohesive concept; it eloquently articulates how the diverse facets of the research coalesce to form a potential solution to the overarching problem.

Chapter 10 delves into the potential future implications of the proposed system and the broader design philosophy that underpins the research. This chapter not only explores the prospective impact and potential real-world applications of the proposed design

but also critically assesses the limitations of the study. By considering critiques of the research, it ensures a balanced perspective and encourages continual refinement and progression of the research findings.

1.4 Scope & Limitations

This research takes on an exploratory approach, acknowledging the fluidity and complexity of the subject matter. Consequently, the structure is designed to facilitate a comprehensive and multi-faceted exploration of the research question, ensuring a rich and nuanced understanding of the potential of decentralized technologies in fostering more inclusive digital spaces.

The study is primarily concerned with the utilization of decentralization in the context of digital spaces for historical narratives, recognizing that the principles and practices of decentralization can be applied to a multitude of other fields. Therefore, the insights generated here may not be directly applicable to those disparate areas, though they may indeed provide a foundational understanding of the mechanisms and potential impacts of decentralization.

Moreover, the nature of decentralization and digital technology implies a constantly evolving landscape. This fluidity, while integral to the philosophy of decentralization, also poses a potential limitation. This thesis captures a snapshot in time of an ever-changing field, and its findings should be interpreted with an awareness of this dynamism.

Finally, while this research proposes a promising exploration into decentralized digital spaces, it does not purport to offer a one-size-fits-all solution for inclusivity and representation issues. It aims to contribute to a broader conversation and inspire further research and experimentation in the field. It posits the notion that the path to more inclusive digital spaces is not to be found in a single design approach, but rather in an ongoing process of adaptation, critique, and redesign.

1.5 Methodology Overview

This thesis adopts a meticulously crafted methodological foundation, designed to tackle the intricate and interconnected facets of decentralization, digital spaces, and historical narratives. The methodology encompasses four principal research methods, each chosen to furnish both a comprehensive and complementary analysis of the research question.

The initial phase of the investigation will start with a cross-disciplinary literature review (Cooper, 1998), concentrating specifically on academic writings that employ co-design and participatory design methodologies to shed light on the pervasive lack of inclusivity in centralized historical narratives (Caswell et al., 2017). Following this, the review will then pivot to examine literature that provides an understanding of the foundations inherent in decentralized technologies, along with an exploration of their potential to disrupt entrenched centralized narratives and foster greater inclusivity.

Supplementing the literature review will be a combination of quantitative data analysis and case study examination. The quantitative component is designed to measure the efficacy and inclusivity of existing decentralized technologies, focusing on the real-world applications that have implemented varying degrees of decentralization. It aims to provide empirical evidence to support qualitative observations made during the literature review, and help further identify trends and patterns that illuminate the research question. Complementing this, case studies will delve into the practical application of theories and concepts derived from the literature review, providing a deeper understanding of the successes and challenges faced by decentralized technologies in promoting inclusive representation (Yin, 2014; Flyvbjerg, 2006).

Additionally, I will employ critical making techniques to thoroughly examine imperative mechanisms within decentralized technologies, such as hashing algorithms and encryption systems. This critical engagement will help me develop a deeper understanding of the underlying concepts and their implications (Ratto, 2011). This stage will also involve the development of logic structures to aid in the visualization of the theoretical mechanisms within the proposed application.

The final element of the methodology is iterative prototyping (Buxton, 2007). I will employ digital design tools to create a mock user interface that embodies the established elements of decentralized technology. This prototyping phase is intended to visually represent how a decentralized platform for historical storytelling may function. To illustrate this, I will generate a variety of artificial personas and perspectives, aiming to represent a diverse user base and depict how the system could operate inclusively (Biskjaer et al., 2010; Grudin & Pruitt, 2002).

Literature Review

Inclusive contextualization of history, community participation, and decentralized technologies.

2.1 Introduction

While recorded history is crucial to our comprehension of cultural identity, traditional centralized archiving methods have historically marginalized vulnerable communities by excluding their perspectives. This has led to a narrative of history that primarily reflects the viewpoint of those in power, which perpetuates inequality and reinforces existing power dynamics.

To address this issue, there's a growing movement to expand historical narratives to include diverse perspectives and experiences. Community participation is key, as community members can be involved in curating and contextualizing history. Activists and archivists have utilized this approach to record and communicate a depiction of events that challenges the centralized narrative of those in power.

Digital spaces, such as social media and online forums, offer platforms for sharing perspectives and experiences in real-time, promoting a more inclusive understanding of events and issues. However, decentralized technologies are necessary to ensure a fair sharing of perspectives and prevent centralized regulation of the narrative.

Decentralized technologies are increasingly recognized for their transformative potential, particularly in how they shape our understanding of trustless systems, data storage, and moderation mechanisms in the digital sphere. By diffusing authority and power from a central entity to the collective, these technologies promise greater transparency, security, and inclusivity.

While decentralized technologies offer unique possibilities, they are also associated with challenges including scalability, usability, and accessibility, which require further exploration and understanding. This literature review aims to delve into the core aspects of decentralized technologies, exploring their theoretical underpinnings, practical applications, and potential implications. It will focus on three primary facets of these technologies: decentralized trust, storage, and moderation.

In the context of trust, I will examine how cryptographic techniques enable secure and reliable transactions without the need for a centralized authority. I will then turn to decentralized storage, focusing on how peer-to-peer sharing networks and distributed ledger technologies offer a robust, censorship-resistant alternative to traditional data storage systems. Lastly, I will explore decentralized moderation mechanisms, considering how they facilitate distributed decision-making and promote community participation.

Through this review, I also aim to highlight the significance of these technologies in fostering a more holistic understanding of reality. By allowing for the integration of diverse perspectives and experiences, these technologies can potentially contribute to a more comprehensive and inclusive view of the world.

While the promise of decentralized technologies is exciting, they exist in infancy; as such, it is necessary to maintain a critical perspective. I will discuss the limitations and challenges associated with these technologies, and identify areas where further research is needed.

It is my hope that this review will serve as a foundation for future investigations into the multifaceted world of decentralized technologies, thereby contributing to the ongoing discourse in this rapidly evolving field.

2.2 Centralized History

History is a branch of knowledge which attempts to chronologically record and explain significant events of the past, often including an explanation of their causes (Merriam Webster, 2023).

The right to protect and promote one's culture is recognised in international human rights instruments and case law (Lacovino, 2014). Culture as a living entity is inclusive of cultural heritage and within international law intangible heritage is also covered, which includes archives. Cultural identity is a specific aspect of cultural rights (Zavala et al 2017). There is a personal, and a collective dimension (Lacovino, 2014).

Centralisation refers to the concentration of an organization's decisions and actions (Merriam Webster, 2023). Centralized perspectives in history are those that focus on the experiences and perspectives of a specific group, often one that is in power or prevailing in a particular society; this can include perspectives from the ruling class, the majority ethnic group, or other dominant groups. The result is a narrative of history that reflects largely the experiences of the group in power, marginalizing the perspectives of vulnerable communities.

Caswell et al (2017) show through qualitative semi-structured interviews that inclusive representation in both mainstream media and archive records are fundamental to the development and appreciation of representational belonging. The experiences revealed through these interviews illustrate how being excluded and misrepresented in mainstream media, libraries, archives and museums has resulted in acutely negative consequences to people's sense of belonging in the world.

2.3 The Missing Narratives

This centralized narrative of history reinforces the existing power dynamics and perpetuates inequalities. For example, by engaging solely with the perspectives of the group in power, ethnocentric textbooks have often focused specifically on the experiences of the ruling class, cementing the notion that this group's perspective is inherently superior to others (Tagle, 2021).

This centralized approach gives little attention to the experiences of marginalized groups such as women, racial minorities, and the working class. The result is a narrow and

incomplete view of history that fails to accurately represent the full range of complex social, economic, and political factors that have shaped our world (Caswell et al., 2017).

Canterbury Museum has shown four life-sized dioramas since 1989 depicting Māori ancestors engaging in 'traditional' practices. A year after its creation, it won the New Zealand Tourism Board's Award for *best contribution to cultural understanding*. Meanwhile, for almost its entire existence Māori iwi have advocated for its removal, expressing that it does not depict their ancestors correctly and harms the public perception of Māori people (Broughton, 2020).

After over a decade of complaints, the diorama was finally removed last year. Members of Ōhākī o Ngā Tīpuna, the Museum's iwi liaison group, gathered with a group of Museum staff to share karakia and waiata before beginning the removal process (Museum Makes Changes in Māori Galleries, 2022).

Caswell et al., (2017) interviewed several community archive practitioners who detail how the lack of representation for vulnerable communities in mainstream archives has a major impact on both individuals in those communities and for the communities as a whole.

"I felt that it was just such a disadvantage to the generations that's coming [to not know about the history of Compton], because history is very, very important. If you don't know your history, it's like, 'Where do I come from, I'm lost. Who do I belong to?' And I think that, in my opinion, some of the things that's going on with our younger generation [joining] gangs [is because they] do not have a solid base of knowledge of where they actually come from; they're trying to find an identity to put their foot. I feel that the lack, of them not knowing what their history's all about, has somewhat to do with how they're reaching out or trying to become involved in society"

- Pauline Brown, Compton 125 Historical Society

Several respondents noted that they were inspired to create or become involved with their organizations because of the common misperception that materials about their communities did not exist at all, simply because they were not held in archives.

“I went into a ... [LGBT repository], and what I found there [on transgender history] was devastating. Our materials weren’t being preserved, they weren’t cataloged, they weren’t described. So literally, when I found some boxes, what I found were like records of death that were crumbling in my hands ... So death and pathology ... women dying, trans women dying and then being identified in publications, such as newspapers, by the names that they hadn’t chosen for themselves, which were their legal names. And then the sort of medicalization, the pathological terms used by the medical establishment to sort of describe them as crazy, or unstable. They weren’t records of lives worth living, basically.”

- Kelly Besser of the Transgender Living Archives.

“In many ways it was also very demoralizing, because I saw that none of this history was that important. ‘This is real, this is history,’ and that Vietnam is a country, and not a war, and there is a culture and people. And so, if there had been an archive or repository of these primary sources to back me up, to give me legitimacy, I wouldn’t have had to fight as hard.”

- Thuy Vo Dang of the UC-Irvine Southeast Asian Archives

2.4 Community Participation

Community participation can be a valuable tool in addressing the issue of centralized history perspectives. By involving members of marginalized communities in the process of creating and sharing historical narratives, their perspectives and experiences can be accurately represented and integrated into mainstream historical understanding.

This helps to counter the dominant, often biased, perspective of the ruling class and other powerful groups, creating a more inclusive and accurate understanding of the past. One way to achieve this is through community-based participatory research, where members of a community actively participate in the design, implementation, and evaluation of projects (Minkler & Wallerstein, 2008).

Caswell et al (2017) found that this co-design methodology can help to ensure that the perspectives and needs of marginalized communities are taken into account, and that the research findings are relevant and useful to them. Another approach discussed was the use of community archives, which are created, managed, and controlled by community members. These archives can provide a space for marginalized communities to share their own histories, narratives and memories. They can also serve as a tool for preserving and promoting cultural heritage, and for promoting community empowerment and self-representation.

Here in New Zealand, the ongoing “Living Heritage” project, initiated by Heritage New Zealand Pouhere Taonga, provides a platform for communities to contribute their stories and perspectives. This initiative encourages individuals and communities to share their unique histories and cultural heritage, thereby enriching New Zealand’s collective historical narrative (Living Heritage, 2023).

In a striking demonstration of community participation techniques, activists have effectively employed grassroots mobilization to protest against instances of lethal police brutality in America. By leveraging the power of online communities, they captured and shared the stark reality of violence, amplifying voices that might have otherwise been silenced. This inclusive approach to documenting events presented a narrative that expanded beyond traditional channels, shedding light on important perspectives (Edrington & Lee, 2018). Social media platforms and other online spaces help empower and develop genuine connections among participants through what Paulo Freire refers to as “armed love”. These emotional connections can extend the community’s reach, so that the most marginalized and oppressed are included through the act of communal ‘armed love’ (Schuschke & Tynes, 2016).

2.5 Coordination in a Digital Space

Both activists and archivists benefit from the use of digital space, such as social media and online forums, as a form of contextualisation that helps to promote a more diverse and inclusive understanding of events and issues (Dijck, 2013). In general, digital space provides

a platform for community contextualisation, where users can share their perspectives and experiences in real time across various social media platforms like Instagram and Twitter, creating a more nuanced and inclusive understanding of the world. Although, it's important to note that digital space is often centralized in its ownership and therefore moderation and control (Zuboff, 2015). This centralization can lead to a concentration of an organization's decisions and actions, which may limit the diversity of voices and perspectives that are represented in digital spaces.

Moreover, centralized control of user data and information is a growing concern, as it can be used against us by those in power. Companies that specialize in facilitating social discourse in online space specialize in data, manipulating social connections and opinions being shared within digital realms. For example, in *Surveillance: The DNA of Platform Capital – The Case of Cambridge Analytica Put into Perspective* (Manokha, 2018), argues that data has become a commodity which can be sold, bought and gathered to drive an agenda. This paper demonstrates that Cambridge Analytica, a political consulting firm, intentionally gathered personal data from uninformed users via Facebook, Google and other platforms. Which, through targeted advertising, was used to influence the outcome of the 2016 American elections for financial profit (Manokha, 2018; Rehman, 2019).

Although this scandal originated in the United States, it affected New Zealanders as well. Cambridge Analytica harvested personal data from millions of Facebook users, including approximately 64,000 New Zealanders, without their consent (Reidy, 2018). It was later revealed through email leaks that Cambridge Analytica had been discussing global countries it could potentially target for election sales, The New Zealand National party's website was linked in the emails (Macfarlane & Whyte, 2020).

This situation highlights the potential for misuse of power in digital spaces, where personal data and information can be manipulated to suit the agendas of those in power. The ramifications extend beyond the immediate contexts in which they operate. With the ability to operate seamlessly across borders and leverage the digital landscape, these entities could *hypothetically* infiltrate foreign electoral processes without the need for direct collaboration with local political actors. The consequences of such meddling could encompass a range of

objectives, including the preservation of economic interests, geopolitical advantages, or the manipulation of international alliances.

This emphasizes the need for decentralized technologies, which can help to prevent the centralization of control, allowing individuals to maintain sovereignty of their own data, while also ensuring a fair sharing of perspectives within the digital spaces (Findlay, 2017). This is especially important for marginalized communities, as it can enable them to share their perspectives and experiences without fear of censorship or manipulation.

Furthermore, while digital spaces have opened up new avenues for sharing perspectives and experiences in real-time, their centralized storage and control present additional drawbacks. One such concern revolves around the potential for accidents and unintended consequences within centralized systems. For instance, in a notable case in 2012, the Ministry of Social Development (MSD) in New Zealand unintentionally released personal information of over 8,000 clients to a blogger. This inadvertent breach exposed sensitive details such as names, dates of birth, and payment information, prompting an investigation by the Privacy Commissioner. The findings revealed that MSD had failed to adequately safeguard the personal information of its clients (MSD lax security exposed, 2023; Ng, 2012; Deloitte, 2012)

The rise of these digital spaces, including social media and online forums, have undoubtedly offered new platforms for real-time sharing of perspectives and experiences, helping to foster a more inclusive understanding of the world around us. However, the concern persists regarding centralized control and regulation of the information and narrative, as it has the potential to skew the interpretation of events in favor of those in power. This calls for careful consideration of alternative approaches, such as decentralization, which can mitigate the risks associated with concentrated control and promote a fairer distribution of viewpoints.

2.6 Decentralized Technologies

Decentralization refers to a system or network in which power and authority is distributed among multiple actors, rather than being centralized in a single entity (Tapscott & Tapscott,

2016). Decentralized technologies, such as blockchain and peer-to-peer networks, offer a potential solution to the issue of centralized control in digital spaces (Mougayar & Buterin, 2016).

These technologies can provide a platform for sharing perspectives and experiences in a way that is not controlled by a single organization or group, thereby promoting a more inclusive and diverse understanding of events and issues, enriching our knowledge of the world around us. This section of the literature review will explore the role of decentralized technologies in expanding historical narratives, specifically focusing on decentralized trust, decentralized storage, and decentralized moderation mechanisms.

2.6.1 Decentralized Trust & Identity

Decentralized trust is a foundational aspect of decentralized technologies that enables secure and transparent transactions without relying on intermediaries or central authorities. Cryptographic techniques such as public and private key encryption are used to facilitate secure transactions and verify the integrity of information (Nakamoto, 2008).

Public and private key encryption is a fundamental cryptographic technique used to establish trust in decentralized systems. In this technique, a pair of keys - one public and one private - are generated for each user. The public key is used to encrypt messages, while the private key is used to decrypt them. This ensures that only the intended recipient, who possesses the corresponding private key, can read the message. (Stallings, 1995).

Decentralized digital identity is another key feature underpinning the concept of decentralized trust. It allows users to take control over their own personal data and privacy, eliminating the need for reliance on centralized identity providers. Social referral systems, akin to the trust networks we use in our everyday interactions, could be utilized to validate identities in a decentralized manner, without the need for a central authority (Reed, 2016).

Indeed, another crucial pillar supporting decentralized trust is reputation-based systems. These systems take advantage of the inherent transparency of decentralized technologies to

record and manage reputations, adding an additional layer of trust among users.

Reputation-based systems function on the principle of historical behavior patterns, attributing credibility scores to individuals based on their past actions. In a decentralized environment, these actions could be anything from successful transactions to trustworthy behavior in a peer-to-peer network (Jøsang et al., 2007). Users with high reputation scores are deemed trustworthy, facilitating an ecosystem where individuals are incentivized to act honestly and uphold the community's standards. It's important to note the challenges associated with reputation-based systems. Potential pitfalls include the difficulty in managing identities in pseudonymous systems and the threat of Sybil attacks, where an entity creates multiple false identities to manipulate their reputation score (Douceur, 2002).

Decentralized trust is critical for the success of decentralized technologies, as it ensures that transactions and communication are secure and transparent, and that information can be trusted without a third party. It also empowers individuals to maintain control over their personal data and identity, without the need to lean on centralized authorities (Zyskind et al, 2015).

2.6.2 Decentralized Storage

Decentralized storage is a key aspect of the broader decentralization movement, aiming to nurture greater transparency and accountability within the digital realm. Centralized storage, such as those offered by big tech companies, has been demonstrated to be susceptible to data breaches and cyberattacks, leaving user data vulnerable to exploitation (Zyskind et al, 2015; Manokha, 2018).

Decentralized storage systems seek to alleviate this by eliminating the need for a centralized authority to govern data storage and management. Tor, a renowned peer-to-peer sharing network that prioritizes privacy, and the InterPlanetary File System (IPFS), a distributed file system designed to facilitate decentralized data sharing, both provide a distributed storage infrastructure (The Tor Project | Privacy & Freedom Online, 2006) (IPFS Powers the Distributed Web, 2015). These networks ensure data security and resilience by avoiding reliance on a single point of failure.

An illustrative case of the value of decentralized storage is the uploading of the Turkish Wikipedia page to IPFS after the Turkish government banned access to the site, labeling it as a 'national threat' (Block of Wikipedia in Turkey, 2023) (Uncensorable Wikipedia on IPFS, 2017). This act of resistance demonstrates how decentralized storage networks can preserve and maintain access to information in the face of oppressive censorship.

Furthermore, distributed ledger technologies, which entail the consensus of shared data synchronized and replicated across multiple databases, such as blockchain, have emerged as a significant storage solution, notably within the financial sector. Bitcoin, for instance, utilizes blockchain technology to create a decentralized store of value, removing the need for traditional banking intermediaries (Nakamoto, 2008).

A Merkle tree, also known as a hash tree, is a binary tree structure where each leaf node represents a data block, and each non-leaf node represents the hash of its child nodes. The hash function used in constructing a Merkle tree ensures that any changes in the data will propagate up the tree, resulting in a different root hash. This property enables efficient verification of data integrity, as it only requires comparing a small number of hashes instead of the entire data set (Dagher et al, 2018; Merkle, 1988; Popa et al, 2013).

In Bitcoin, Merkle trees are used to efficiently verify the integrity of transactions within a block. Transactions are grouped into a Merkle tree, and their hashes are combined until a single root hash, called the Merkle root, is obtained. The Merkle root is included in the block header, ensuring that any change in a transaction would result in a different Merkle root. This allows for efficient verification of transaction inclusion by reconstructing the Merkle root from a requested branch of the tree, without the need to process all the transactions individually. Merkle trees provide a compact representation of transaction data, reducing computational overhead and ensuring the security and integrity of the Bitcoin blockchain (Nakamoto, 2008).

Decentralized storage holds particular significance for individuals and communities subjected to censorship and surveillance, as it offers an alternative means of storing and sharing information beyond the reach of government or corporate interference. The

implementation of decentralized storage can also stimulate greater inclusivity and access to information, especially in regions where internet access is limited and/or controlled.

While these storage alternatives are promising, challenges persist, such as guaranteeing the reliability and accessibility of decentralized storage solutions, especially in terms of ensuring that the data stored remains secure and accessible. These technologies are young, and it is essential that research and development continue in this area to ensure that decentralized storage can become a viable alternative to centralized storage, particularly in the context of a more decentralized internet (Tenorio-Fornés et al, 2021).

2.6.3 Decentralized Moderation & Consensus

In traditional centralized systems, moderation and governance are predominantly controlled by a central administration, leading to a concentration of power and decision-making authority. Contrarily, decentralized moderation mechanisms provide an alternative approach to governance, facilitating a distributed decision-making process.

A rudimentary example of a distributed, though not entirely decentralized, moderation effort is Wikipedia. Community members collaborate to ensure the accuracy of information, making collective decisions about content inclusion, revisions, and removal (Jemielniak, 2014).

Proof of Work & Proof of Stake

Within the realm of decentralized technology, moderation mechanisms pertain to the methods used to enforce network rules and ensure consensus. A fundamental mechanism used in decentralized technology is Proof-of-Work (PoW), exemplified in the Bitcoin network. PoW necessitates network participants to perform computational work to validate and append new transactions to the blockchain, securing the network against fraudulent transactions (Nakamoto, 2008).

The Bitcoin mining process, a manifestation of PoW, has generated significant debate regarding its environmental implications (Stoll, Klaaßen, & Gellersdörfer, 2019).

Supporters point out that Bitcoin mining has the potential to make use of surplus energy from power grids, thereby reducing waste. This is linked to the fact that power grids are typically designed to accommodate peak demand, resulting in excess capacity during off-peak periods. Enthusiasts highlight the ongoing advancements in the efficiency of Bitcoin mining equipment, suggesting that the energy consumption of Bitcoin mining is proportionally small given the computational power it yields. The debate also touches on the broader implications of Bitcoin as a decentralized and uncensorable form of currency (Lo et al, 2019).

While it's acknowledged that Bitcoin's energy usage is substantial, some argue that the benefits of a decentralized financial system, such as increased transparency and security (Kshetri, 2018), could potentially outweigh these costs (Schneider & Pullmann, 2021).

Detractors, conversely, express concerns over the significant energy consumption required for Bitcoin mining, predominantly sourced from non-renewable sources like coal and natural gas. They view Bitcoin mining as an environmentally detrimental process, contributing to climate change, and argue that this energy could be more beneficially directed towards other societal needs. Additionally, concerns persist regarding the long-term environmental impact as Bitcoin's value surges, potentially incentivizing increased mining activities (Mora et al, 2018).

Additional decentralized consensus mechanisms exist within blockchain infrastructure, with Proof-of-Stake (PoS) being a primary alternative to Proof-of-Work (PoW). Ethereum, a leading blockchain platform, has transitioned from PoW to PoS, indicating a significant shift in the landscape of cryptocurrency mining (Ethereum.org, 2023).

Ethereum's transition to PoS is a notable development, addressing the energy-intensive nature of traditional PoW systems. This shift aims to reduce the environmental impact of cryptocurrency mining while maintaining a decentralized framework. PoS mechanisms, as exemplified by Ethereum 2.0, rely on participants staking their cryptocurrency holdings to validate transactions and secure the network, as opposed to the resource-intensive computational work demanded by PoW (Ethereum.org, 2023).

One of the primary advantages of Ethereum's transition to PoS is the significant reduction in energy consumption compared to PoW-based systems, such as Bitcoin. By eliminating the computational competition among miners, PoS consumes considerably less energy, rendering it more environmentally friendly (Ethereum.org, 2023).

Despite these advancements, concerns regarding increased centralization have emerged within the Ethereum ecosystem. As the network relies heavily on a service provider called Infura for consensus and infrastructure support, a potential concentration of power arises. Infura's central role extends to the operation of the nodes used by numerous Ethereum wallets, including the popular MetaMask. Notably, Infura is owned by Joe Lubin, a partner of Ethereum's co-founder Vitalik Buterin. (Infura, 2019)

This concentration of infrastructure ownership raises questions about the degree of decentralization in Ethereum's ecosystem. Instances of service outages at Infura have led to disruptions in Ethereum transactions, indicating the platform's reliance on this centralized service (The Block, 2020). Furthermore, Infura's ability to change configurations that affect access to assets in certain regions of the world raises additional concerns about the level of centralization (Twitter, 2023).

Moreover, there has been a notable increase in Ethereum blockchain blocks conforming to the regulations set forth by the Office of Foreign Assets Control (OFAC), which is an agency operating under the United States Department of the Treasury. This rise in compliance can be observed through MEV Watch, a monitoring tool designed to analyze the presence of Miner Extractable Value (MEV) on the Ethereum blockchain. MEV refers to the additional profit or value that miners can extract by strategically ordering and including transactions within a block. Consequently, this surge in OFAC-compliant blocks, as indicated by MEV Watch (2023), appears to signify a discernible inclination towards centralization. Additionally, Ethereum's co-founder, Vitalik Buterin, has demonstrated the capacity to make significant changes to the blockchain's operation, further indicating a level of centralization (Our Status, 2023; Siegel, 2022). This trade-off between reduced energy consumption and potential centralization in Ethereum's transition to PoS necessitates a careful evaluation of the network's overall goals and values.

Alternative Consensus Mechanisms

In addition to Proof-of-Work (PoW) and Proof-of-Stake (PoS) consensus mechanisms, other decentralized approaches have emerged within the realm of distributed systems. These alternatives aim to address the limitations and concerns associated with traditional centralized systems and provide innovative solutions for achieving consensus and moderation where the state of the system is not in an objective state. Among these alternatives, Distributed Hash Tables (DHTs) and Directed Acyclic Graphs (DAGs) have gained attention for their unique characteristics and potential applications in decentralized governance and decision-making.

A Distributed Hash Table (DHT) is a decentralized data structure that allows nodes in a network to store and retrieve data efficiently and in a scalable manner. DHTs utilize a hash function to distribute keys, which correspond to data items, across the participating nodes in the network. This design ensures that data can be stored and retrieved even if nodes join, leave, or fail, maintaining the system's functionality.

In a DHT, data is typically organized as key-value pairs, where the key is often a hash of the corresponding data item. This hashing process ensures a random and uniform distribution of keys across the network. Each node in the DHT network is responsible for storing a subset of the key-value pairs, determined by the output of the hash function. When a node needs to retrieve a specific data item, it queries the network using the corresponding key. The network then routes this query to the node responsible for that key, which returns the requested data item. (Stoica et al, 2001).

DHTs incorporate mechanisms to handle node failures and ensure fault tolerance. To address node failures, DHTs commonly employ data replication, meaning multiple copies of each key-value pair are stored on different nodes. This redundancy ensures data availability even if some nodes become inaccessible. DHTs find extensive applications in decentralized systems, including peer-to-peer file sharing networks, blockchain networks, and decentralized databases. For instance, IPFS utilizes a DHT to enable decentralized content addressing and file retrieval across its network (San Román Guzmán et al, 2022).

A Directed Acyclic Graph (DAG), on the other hand, is a finite directed graph with no directed cycles. DAGs provide a graphical representation of causal relationships and are used in a variety of fields, including data processing, scheduling, and data compression. They can also be used in distributed ledgers as an alternative to blockchain technology. In a DAG, causal relationships are represented by arrows between the variables, pointing from cause to effect. DAGs must obey two rules: they must be acyclic, which means that there can be no feedback loop where a variable causes itself, and the causal relationship between two variables must be unidirectional. (Williams et al, 2018)

IPFS serves as an example of both DHTs and DAGs in action. IPFS utilizes a DHT for decentralized content addressing, allowing files to be located and retrieved using their unique content hashes. Additionally, IPFS incorporates a MerkleDAG (a combination of the aforementioned Merkle tree and a DAG) data structure to represent files and their relationships, enabling efficient storage, retrieval, and synchronization of data across the IPFS network. The integration of DHTs and DAGs within IPFS showcases how these decentralized approaches contribute to achieving scalable and efficient distributed systems (Distributed Hash Tables (DHT) | IPFS Docs, 2023) (Merkle Directed Acyclic Graphs (DAG) | IPFS Docs, 2023).

Moderation as Consensus

Decentralized moderation mechanisms proffer a novel approach to governance, promoting community participation, distributing decision-making authority, and resisting centralization. Yet, challenges persist, such as potential manipulations and scalability issues. Privacy concerns also arise due to the high level of security and transparency blockchain technology provides, potentially exposing sensitive information.

Another approach to decentralized moderation involves social consensus mechanisms, which rely on collective decision-making by network participants. These mechanisms encourage community participation and enable a distributed decision-making process resistant to centralization. Decentralized Autonomous Organizations (DAOs) exemplify this, operating autonomously via smart contracts on the blockchain and enabling democratic decision-

making (Tapscott & Tapscott, 2016).

MakerDAO, for instance, is a successful DAO that operates autonomously via smart contracts on the Ethereum blockchain. It manages the DAI stablecoin, a cryptocurrency whose value is pegged to the US dollar. The governance of MakerDAO is decentralized, with MKR token holders voting on various aspects of the protocol, including risk parameters. This democratic decision-making process encourages community participation and enables a distributed decision-making process resistant to centralization (Christensen, 2014). Similarly, the Assange DAO is an organization that operates on the principle of collective decision-making. It encourages community participation by allowing token holders to vote on decisions related to the organization's operations and objectives, which are mainly to free Julian Assange (AssangeDAO, 2021).

However, the decentralized decision-making process is not without its challenges. 'The DAO', a venture capital fund operating on the Ethereum blockchain, was exploited due to a vulnerability in its code, leading to a loss of around \$50 million worth of Ether at the time (Finley, 2016).

Some argued that this was not a 'hack' in the traditional sense, as the attacker merely exploited the rules encoded in The DAO's smart contracts. This incident illustrates that while DAOs can democratize decision-making, they also require robust security measures and careful consideration of their governing rules (Siegel, 2022).

These DAOs can be seen as a form of collective consciousness, where the decisions made reflect the collective will of the participants. This ties into the concept of Object-Oriented Ontology, which posits that all entities, human and non-human, experience reality in unique ways. Just as a DAO operates based on the collective input of its participants, a comprehensive understanding of reality requires encompassing all perspectives, acknowledging the inherent disagreements that reside within individual experiences (Harman, 2018).

In conclusion, decentralized moderation mechanisms, while providing an innovative approach to governance, are not without their challenges. These range from environmental

concerns to potential manipulations and privacy issues. Nevertheless, the exploration and development of these mechanisms remain crucial in the pursuit of a more decentralized internet, where power is distributed, information is democratized, and individual perspectives are acknowledged and respected.

This leads us to the concept of localized federation. Decentralized social media platforms, like Mastodon, embody this by allowing users to create, curate, and share perspectives in an unbiased manner, free from a single controlling entity's potential agenda (Caelin, 2022; Valens, 2019). The concept of Proof-of-Contribution further enhances this, rewarding users based on the value of their contributions to the network (Bentov et al, 2014; Xu et al, 2021).

While these technologies offer potential solutions, they also pose new challenges. For instance, the lack of central control can make it difficult to regulate content and prevent the spread of misinformation or harmful content. Moreover, the technical complexity of these technologies can create barriers to entry, potentially excluding those who lack the necessary skills or resources.

2.7 Conclusion

In the quest for a more comprehensive understanding of our world, the role of individual perspectives and experiences cannot be understated (Caswell et al., 2017). It is the multitude of these views that enrich our collective comprehension, allowing us to relate to the world in a more nuanced manner. The concept of decentralized technologies can be seen as an embodiment of this principle. By harnessing community consensus, they facilitate a richer and more comprehensive view of reality, akin to tapping into the collective unconscious, thereby fostering an inclusive and holistic worldview.

Decentralized technologies challenge the traditional centralized power structures that have historically monopolized control over information and narratives (Findlay, 2017; Manokha, 2018). In doing so, they promise a more equitable society, where marginalized communities can voice their perspectives and contribute to a collective understanding. This literature review has delved into the critical elements of decentralized technologies, namely,

decentralized trust, decentralized storage, and decentralized moderation mechanisms.

Decentralized trust, made possible by cryptographic techniques, assures secure transactions and data sharing without the reliance on any central authority (Stallings, 1995). Decentralized storage, on the other hand, allows for a resilient, censorship-resistant approach to data storage through peer-to-peer sharing networks and distributed ledger technologies (Nakamoto, 2008; Block of Wikipedia in Turkey, 2023).

Lastly, carefully crafted decentralized moderation mechanisms, such as social consensus, promise a community-driven approach to moderation, fostering a fair and inclusive decision-making process (Siegel, 2022; Bentov et al, 2014; Xu et al, 2021).

However, it is imperative to understand that decentralized technologies are not a panacea. They carry inherent challenges, including issues around scalability, usability, and accessibility (Douceur, 2002; Jemielniak, 2014; Tenorio-Fornés et al, 2021; Stoll, Klaaßen, & Gallersdörfer, 2019). Despite these obstacles, the potential benefits they offer – particularly to marginalized communities – and their potential to develop a more equitable and democratic society make them a worthy subject of continued exploration and development.

From the perspective of truth, decentralized systems could potentially offer a more accurate reflection of reality by considering multiple perspectives and experiences. However, the concept of truth is inherently subjective and can vary based on individual perspectives (Harman, 2018). Furthermore, the complexity and multifaceted nature of reality poses an inherent challenge to any attempt at comprehending it in its entirety.

While decentralized systems (like DHTs and DAGs) could facilitate a more comprehensive approach to understanding truth, it is essential to remember that they do not guarantee accuracy. These systems are still under research and development, and it is crucial to continue scrutinizing their limitations and opportunities.

Cryptographic techniques can indeed establish trust and reliability in human interactions (Nakamoto, 2008). However, social proof, personal relationships, and reputation also

play crucial roles in establishing trust and reliability in the real world, which are difficult dynamics to mimic online. In summary, the consideration of multiple perspectives enriches the narrative (Caswell et al., 2017). A centralized narrative risks the omission of crucial voices (Tagle, 2021).

Community participation underscores the power of the people, and while online spaces have the potential to foster more connections and inclusivity, this potential cannot be fully realized under centralized ownership (Zuboff, 2015; Manokha, 2018; Rehman, 2019). Decentralized technologies offer us the capacity to create digital spaces, share perspectives, and control narratives without centralized interference (Tapscott & Tapscott, 2016; Mougayar & Buterin, 2016).

In conclusion, this literature review posits that decentralization, the collective knowledge of the community, and community consensus could significantly shape our understanding of reality by creating a more accurate, inclusive, and holistic view of the world. Further research is needed to understand how these concepts can be practically applied and how they can address the limitations of traditional forms of knowledge. As we transition towards a more digital and interconnected world, the role of decentralized technologies in shaping our future becomes increasingly significant.

Methodologies

The research will focus on understanding three essential elements of a low-fidelity prototype system, which have been established through the literature review, namely:

Decentralized trust & identity:

To avoid censorship shifting to a new centralized area, decentralized trust & identity is pivotal in creating an inclusive space for exploring decentralized historical narratives.

Decentralized storage & accessibility:

Centralized data storage permits the controlling entity to dictate the narratives stored and shared; hence, a decentralized approach is essential to prevent such control.

Decentralized moderation & consensus:

Centralized moderation and consensus could lead to biased censorship. A decentralized approach ensures more balanced content control.

3.1 Cross-disciplinary Literature Review

Given the intersection of design, computer science, community, self-governance, and philosophy in the realm of decentralized technology, a comprehensive literature review is crucial. This review will be conducted following the guidelines provided by Cooper (1998), who emphasizes the importance of a systematic and comprehensive approach to synthesizing research. Themes discovered through this literature will be discussed in depth, and will be developed throughout the thesis. Cooper's approach ensures that all relevant literature is considered, providing a holistic view of the existing knowledge in this field. This methodology will allow for a thorough exploration of the intersectionality of these disciplines and how they contribute to our understanding of decentralized technology.

3.2 Data Analysis & Case Studies.

This study adopts a case study research methodology following Robert K. Yin's principles (Yin, 2014) and incorporating Flyvbjerg's concept of a properly designed and conducted case study (Flyvbjerg, 2006). It aims to evaluate the viability of existing decentralized technologies in addressing the identified issues through multiple case studies. Examples include Wikipedia for decentralized moderation and inclusivity, the Bitcoin blockchain for decentralized storage, trust, and consensus mechanisms, IPFS for decentralized storage and accessibility, and Mastodon for decentralized reputation and federated moderation.

These case studies substantiate the theoretical achievability of decentralized storage, trust, identity, reputation, and moderation. Quantitative data analysis methods, such as content analysis, will be used to gather information on these technologies and their potential for promoting inclusive representation. This information will include, edit counts and histories, transaction data and node distribution, datasets, performance metrics, and instance data

3.3 Critical Making.

In this study, critical making will be used as a method to engage with and critique decentralized technology in relation to the promotion of inclusive representation in historical narratives. According to Ratto (2011), critical making involves "using hands-on, creative practices to engage with and critique technology," which aligns with the goals of this study. Specifically, I will explore the integration of cryptographic keys in digital systems, and the process of solving the SHA256 hash by hand will be used as a means of gaining a deeper understanding of the security behind consensus mechanisms such as PoW, which can otherwise feel alien as they involve numerous computation steps which computers handle in a matter of seconds. By engaging with the technologies in this way, I will illuminate some of the imperative processes behind these systems in a more grounded light. I will also employ this method to examine the role IPFS plays in data storage and retrieval in decentralized contexts. The aim of these experiments is to identify key features of decentralized technology

that may facilitate or hinder the promotion of inclusive representation. These features will be expanded into logic structures for the proposed system, detailing the potential inner workings of the system.

3.4 Iterative Prototyping & User Personas.

Mock-up UI/UX:

Drawing upon the principles outlined in Bill Buxton's 'Sketching User Experiences', the methodology will employ iterative prototyping techniques, utilizing digital design tools to create a speculative prototype of a decentralized platform for historical storytelling. This iterative process, akin to Buxton's concept of sketching, will allow for the exploration and refinement of ideas, leading to a mock-up UI/UX that serves as a tangible representation of the application. The design will prioritize user-friendliness and inclusivity, reflecting Buxton's emphasis on experience-centered design. (Buxton, 2007)

Personas and perspectives:

The development of personas and perspectives, integral to the exhibiting of the theoretical plausibility of the proposed decentralized application, will be informed by a combination of secondary research, imagination, machine learning, and insights from Creativity methods in interaction design by Michael Mose Biskjaer, Peter Dalsgaard and Kim Halskov (2010), as well as Personas, Participatory Design and Product Development: An Infrastructure for Engagement by Jonathan Grudin and John Pruitt (2002). This approach will involve a thorough analysis of existing research studies, reports, and publications to gain a comprehensive understanding of diverse perspectives surrounding cultural artifacts. Simultaneously, imagination and machine learning will be employed to fill the gaps and create fictional personas, echoing the methods advocated by Biskjaer, Dalsgaard, Halskov, Grudin, and Pruitt. These personas will represent a wide range of perspectives, further enhancing the inclusivity and user-centered focus of the design process.

Case Studies

Framework:

The following case studies seek to contribute to answering the overarching research question:

“How can the design tenets of decentralization empower the creation of digital spaces to promote inclusive representation and challenge centralized perspectives in historical narratives?”

The case studies are divided into relevant sections to reflect the decentralized nature of different platforms such as Wikipedia, Bitcoin, IPFS, and Mastodon. The relevance of these case studies is underscored by the emergence of decentralized technologies that are redesigning the power dynamics in areas such as inclusivity, storage, trust, consensus, reputation, and federated moderation.

The subjects of these case studies—Wikipedia, Bitcoin, IPFS, and Mastodon—were chosen due to their distinct decentralized structures and potential for rich data across the areas of interest. The case studies are exploratory by design, as they aim to investigate the potentials of these decentralized platforms in creating fair and inclusive digital spaces and how they disrupt traditional centralized models in their respective areas.

Data collection across all case studies will involve information gathered from the literature review, additional scholarly sources and industry insights, and the analysis of public data available for each platform (including Wikipedia edit histories, Bitcoin transaction data, IPFS datasets, and Mastodon instance data). This approach offers a multi-faceted perspective on the structures, functionalities, and real-world implications of these platforms.

The protocol for data collection involves selecting relevant academic, industry, and user sources, data extraction, and thorough documentation. Guidelines for analyzing public data

are platform-specific, ensuring the collection of relevant and comprehensive data.

Data analysis across all case studies involves key themes developed from the literature review, namely decentralized trust and identity, storage and accessibility, moderation and consensus. The analysis requires analyzing the collected data to understand the degree of inclusivity, equity, and effective governance within each platform's ecosystem.

Conclusions will be drawn for each case study based on the data analysis, addressing the research question and objectives. The conclusions will be grounded in the case study's evidence, taking into account the potential biases or limitations in each platform's case study.

The observations of the findings will be evaluated, considering whether the insights can be applied to similar decentralized platforms outside of these case studies, shared between each platform of the case studies, or if they are context-specific to Wikipedia, Bitcoin, IPFS, or Mastodon.

Across all case studies, alternative explanations for the observed phenomena will be critically evaluated, acknowledging potential biases or limitations in the case study design. Counter arguments or challenges to the findings will be taken into account, ensuring a well-rounded analysis.

The findings from all case studies will be compiled into individual comprehensive reports, adhering to established guidelines for academic writing, ensuring clarity, coherence, and proper citation of sources. The reports will be compared in a comparative analysis across various factors such as identity, governance, inclusivity, scalability, security, storage, and sustainability of each technology. This comparative analysis aims to provide a comprehensive understanding of the strengths and weaknesses in the design tenets of these decentralized technologies, within their respective areas.

4.1 Wikipedia: Decentralization in Pursuit of Inclusive Representation

Introduction:

Wikipedia, the globally recognized online encyclopedia, is a unique example of a decentralized platform that encourages inclusive representation. With millions of articles in English alone (Wikipedia:Statistics, 2023), it is a testament to the power of collaborative knowledge creation. Wikipedia's model of decentralized moderation and inclusivity has been widely studied and discussed (Benkler, 2006; Tkacz, 2014). This case study aims to examine the effectiveness of Wikipedia's model in fostering digital spaces that are inclusive and representative.

Objective:

The primary objective of this case study is to analyze the capacity of Wikipedia's decentralized and cooperative model to foster digital spaces that enable and encourage inclusive representation.

Data Collection:

Data for this case study will be collected from various academic sources, including the book "Common Knowledge? An Ethnography of Wikipedia" by Dariusz Jemielniak (2014), which provides an in-depth look at Wikipedia's community of contributors. Other sources of data will include public data available from Wikipedia, such as edit histories and discussion pages. The pseudonymous nature of Wikipedia presents a challenge in discerning and tracking the diversity of the editors (Ford, 2017). Therefore, additional data will be collected from external studies on Wikipedia's gender gap (Qaiser et al., 2022).

Data and Findings:

Wikipedia's community structure is unique, with different language Wikipedias having different communities of editors who developed different rule sets (Jemielniak, 2014). This overarching decentralized structure allows for a diverse range of perspectives to be included in the platform's content. For instance, the 'Talk' page for the 'Climate Change' article reveals extensive dialogue and rule negotiation among editors from various backgrounds (Talk:Climate change, 2023).

Conflict resolution on Wikipedia is typically achieved through consensus building, as exemplified by the ‘Gdańsk versus Danzig’ edit war (Jemielniak, 2014). This conflict, spanning from 2003 to 2005, involved over 1,400 edits and centered on the naming of the city in English: “Gdańsk” (Polish) or “Danzig” (German). Despite initial resistance, the community gradually recognized the validity of each side’s arguments, grounded in credible sources. A community-wide vote in 2005 resulted in the consensus to primarily use “Gdańsk” in the English Wikipedia, with “Danzig” used in historical contexts (Talk:Gdańsk/Vote, 2022). This decision has largely been upheld since then, with experienced editors and administrators defending it against attempts to reverse it (Jemielniak, 2014).

Wikipedia operates on a system of pseudonymity, where users establish an on-wiki identity that may be different from their offline identity (Jemielniak, 2014). The community trusts that when people follow the established procedures, their actions will meet the needs of the community (O’Neil, 2015).

Despite its decentralized nature, Wikipedia has a level of regulation that surpasses many traditional concepts of bureaucratic control (Jemielniak, 2014). This is achieved through version control and a permanent, public log of all activity (Reagle, 2012).

The Wikipedia Diversity Observatory project provides insights into the inclusivity and representation within the platform. It measures and analyzes the diversity of content and editors on Wikipedia, highlighting the platform’s commitment to inclusive representation (Wikipedia Diversity Observatory, 2023). However, it also reveals areas where representation could be improved, such as the underrepresentation of women and minority groups among editors and in content (Qaiser et al., 2022).

Conclusion:

This case study reveals that Wikipedia’s decentralized, collaborative model has indeed given rise to a diverse knowledge base. The platform has created a space that promotes inclusive representation and challenges centralized perspectives (Jemielniak, 2014). Its unique community structure, conflict resolution process, and trust in procedures contribute to its success as a platform for open collaboration. However, it has not been entirely successful in eliminating biases or addressing gaps in representation, particularly in terms

of gender and minority representation (Qaiser et al., 2022). These findings imply that while decentralization can foster inclusivity, it does not automatically guarantee it and should be coupled with active efforts towards equitable representation (Halfaker, 2017).

Generalization of Findings:

The findings from this case study can be applied to other decentralized platforms that aim to promote inclusive representation. A strong community structure, effective conflict resolution processes, and trust in procedures are key insights that can be generalized to enhance the inclusivity of other platforms (Benkler, 2006). Additionally, active efforts to address representation gaps, as highlighted in this study, are crucial for any platform aiming for inclusivity.

Consideration of Alternative Explanations:

While the decentralized structure of Wikipedia has many benefits, it also has potential limitations. The open nature of the platform can sometimes lead to issues with the accuracy and reliability of information (Wikipedia:What Wikipedia is not, 2023). Also, the success of Wikipedia's representation could be partially attributed to its longevity and the sheer size of its contributor community (Forté, 2008). Furthermore, the digital divide or access to technology could also play a role in the representation and inclusivity on Wikipedia (Brake, 2014; Graham et al., 2015).

Reporting:

This case study provides a comprehensive understanding of how Wikipedia, as a decentralized platform, promotes inclusive representation and challenges centralized perspectives. It highlights the importance of a strong community structure, effective conflict resolution processes, and trust in procedures in achieving these goals (Jemielniak, 2014). Simultaneously, it underscores the complexities and challenges inherent in such an approach, particularly in terms of representation gaps (Qaiser et al., 2022). Future research could explore the dynamics of underrepresented groups within the Wikipedia community, as well as methods for enhancing their participation and visibility (Lam et al., 2011).

4.2 Bitcoin: A Decentralized Solution for Financial Inclusion

Introduction:

The Bitcoin Blockchain, introduced in 2008 via the Bitcoin Whitepaper (Nakamoto, 2008), presents an innovative use of decentralized technology. As a global, decentralized ledger that enables peer-to-peer transactions, Bitcoin challenges centralized financial structures and embodies unique trust and consensus mechanisms (Böhme et al., 2015). This case study will examine the efficacy of Bitcoin's model in fostering an inclusive, trust-based digital space.

Objective:

The primary objective of this case study is to assess how the Bitcoin Blockchain's decentralized model fosters digital spaces that enable inclusive representation and trust, based on its decentralized design and global user base.

Data Collection:

Data for this case study is drawn from various academic and industry sources, including the Bitcoin whitepaper (Nakamoto, 2008), industry reports on Bitcoin's distribution and adoption, and public data available from the Bitcoin network. The case study also considers studies on Bitcoin's environmental impact, and issues related to the trade off between decentralization and power consumption (Mora et al., 2018; Sun et al., 2022).

Data Analysis:

The collected data will be analyzed to understand the degree of inclusivity, trust, and effective governance within the Bitcoin ecosystem. This analysis will reflect key themes developed from the literature review, specifically decentralized trust, and consensus mechanisms.

Data and Findings:

Decentralization and Inclusivity: The Bitcoin network represents a global system with 16,716 reachable nodes across 128 countries, with a total estimation of 44370 nodes including unreachable nodes (Bitnodes, 2023). This worldwide spread indicates a robust and inclusive

network that operates outside conventional, centralized banking systems (Böhme et al., 2015; Coin Dance, 2023).

Trust and Consensus Mechanisms: As of 2023, Bitcoin's blockchain contains over 750,000 blocks (mempool - Bitcoin Explorer, 2023), which hold over 1.6 billion transactions validated by the community (Liu et al., Y., 2022). This volume attests to the robustness of its trust mechanism (Blockchain.com, 2023; Böhme et al., 2015). Bitcoin's trust model is unique, with its consensus mechanism based on proof-of-work, thereby ensuring transactional trust without the need for a central authority. This process is facilitated by miners who use computational power to solve complex mathematical problems. The miner who solves the problem first gets to add the next block of transactions to the blockchain and is rewarded with Bitcoin (Nakamoto, 2008).

This mechanism ensures that all transactions are transparent and cannot be tampered with, thereby fostering trust among users. The consensus mechanism plays an indispensable role in a blockchain-enabled IoT system, enabling peer-to-peer trading in a decentralized manner without the involvement of any third party (Cao et al., 2019).

Power Consumption: The proof-of-work consensus mechanism is energy-intensive (Jones et al., 2022). Although Bitcoin's environmental impact is a point of criticism, the decentralized nature of Bitcoin has also successfully created a global currency operating independently of central authorities (Mora et al., 2018; Sun et al., 2022).

Security: The decentralization of Bitcoin's network, with its widespread distribution of nodes, enhances resilience to censorship attacks, ensuring the overall integrity of the system (Gervais et al., 2014).

Conclusion:

This case study highlights that the Bitcoin Blockchain, with its decentralized, peer-to-peer model, has significantly challenged traditional centralized financial systems. It has successfully fostered a space that promotes inclusive representation and trust, despite challenges related to power consumption. The Bitcoin Blockchain's unique consensus

mechanism, decentralized node distribution, and resilience to attacks contribute to its role as an innovative model for other digital platforms aiming to decentralize and democratize their structures.

Generalization of Findings:

The insights from this case study have implications beyond Bitcoin and can be applicable to other decentralized platforms that aim to promote inclusivity and trust. The features of decentralization, trust without intermediaries, and community-based consensus, all represent important factors for the design of inclusive, trust-based digital spaces.

Consideration of Alternative Explanations:

The success of the Bitcoin network can be partially attributed to its first-mover advantage, and its subsequent wide acceptance and adoption (Böhme et al., 2015). Also, while the decentralization of the Bitcoin network offers several benefits, it also presents challenges such as high energy consumption. Furthermore, the potential for unequal distribution of mining power could lead to a concentration of control, posing risks to the decentralized nature of the network (Gervais et al., 2014; Sun et al., 2022).

Reporting:

This case study provides a comprehensive understanding of how the Bitcoin blockchain, as a decentralized platform, fosters an inclusive, trust-based digital space. It highlights the potential of decentralized systems in disrupting traditional financial models and presents valuable insights for designing future decentralized platforms. Future research could explore how to balance the benefits of decentralized systems with environmental considerations, as well as how to mitigate risks related to the concentration of control in such networks (Mora et al., 2018; Gervais et al., 2014; Sun et al., 2022).

4.3 IPFS: A Decentralized Solution for File Sharing and Content Distribution

Introduction:

The InterPlanetary File System (IPFS) is a peer-to-peer distributed file system that aspires to connect all computing devices through a global network of shared files. By replacing the centralized structures of traditional web protocols with a distributed network, IPFS represents an innovative step forward in digital communication (Cristea et al., 2020). This case study aims to examine the potential of IPFS's decentralized design in creating robust, efficient, and inclusive digital spaces for information sharing and storage.

Objective:

The primary objective of this case study is to analyze the capacity of IPFS's decentralized structure to foster digital spaces that offer improved data access and storage while also addressing issues of data sovereignty.

Data Collection:

Data will be collected from several academic sources, including the original IPFS whitepaper (Benet, 2014), subsequent studies evaluating the technology (Trautwein et al., 2022), and a comprehensive review of IPFS and its potential applications (Xu et al., 2021). Publicly available data from the IPFS network, such as file hashes and network statistics, will also be used (Network-measurements, 2023). Additionally, Escaping the Evils of Centralized Control with self-certifying pathnames by Mazières & Kaashoek (1998) will provide insights into some of the foundational principles the IPFS system is built on top of.

Data and Findings:

IPFS is used by more than 230,000 peers per week and serves tens of millions of requests per day (Doan et al., 2022; Network-measurements, 2023). The core technology underlying IPFS is the concept of content-addressed storage. This technology enables data to be fetched from multiple sources simultaneously, creating a highly efficient, resilient, and distributed

network. Content Identifiers (CIDs) provide a globally unique, cryptographic hash of a file that not only ensures data integrity but also offers significant advantages for content addressing and retrieval (Benet, 2014).

While the IPFS network is technically decentralized, not all nodes in the network are equal. Certain nodes, known as ‘pinning’ nodes, are responsible for permanently storing data on the network, serving a role similar to servers in more traditional architectures. This creates a certain degree of centralization within the network, challenging the strictly decentralized model (Trautwein et al., 2022).

One key aspect of IPFS’s design is its use of Distributed Hash Tables (DHTs), which enable efficient, decentralized storage and retrieval of data. DHTs provide a way of creating consensus around data location without requiring the explicit agreement of the entire network. They demonstrate that decentralized systems can cater to subjective values or opinions, thus challenging conventional models of data storage and consensus (Benet, 2014).

Conclusion:

This case study shows that IPFS, through its innovative use of decentralized structures like content addressing and DHTs, has created a robust digital platform that promotes data access, storage, and sovereignty. However, it also reveals that the reliance on pinning nodes introduces a level of centralization, demonstrating that full decentralization of peer to peer systems can be challenging to achieve in practice (Trautwein et al., 2022). These findings suggest that while decentralization provides many benefits, it must be carefully managed to ensure it does not inadvertently reintroduce centralization.

Generalization of Findings:

The insights from this case study can be applied to other decentralized platforms. Key findings, such as the advantages of content addressing and the use of DHTs for subjective consensus-building, provide valuable lessons for the design of similar systems. However, the challenges associated with pinning nodes highlight the importance of considering potential reintroduction of centralization in the design of decentralized systems (Manoj Athreya et al., 2021).

Consideration of Alternative Explanations:

While the IPFS model offers many benefits, it also has potential limitations. The need for pinning nodes could create potential bottlenecks or points of failure in the network, somewhat contradicting the principles of decentralization (Trautwein et al., 2022).

Additionally, the benefits of IPFS's approach could be partially attributed to the growing interest in and adoption of decentralized technologies, which could change over time. The concept of self-certifying pathnames, as discussed by Mazières & Kaashoek (1998), provides an alternative perspective on the principles of decentralization and how they are applied in IPFS.

Reporting:

This case study provides a comprehensive understanding of how IPFS, as a decentralized platform, improves data access, storage, and sovereignty. It highlights the importance of content-addressing and DHTs in achieving these goals (Benet, 2014).

At the same time, it underscores the complexities and challenges inherent in maintaining decentralization, particularly in the context of pinning nodes (Trautwein et al., 2022).

Future research could explore strategies to manage these challenges and further enhance the efficiency and resilience of the IPFS network. The integration of IPFS with other technologies like blockchain, as discussed by Xu et al. (2021), could also be a potential area of exploration.

4.4 Mastodon: A Decentralized Social Networking and Federated Moderation

Introduction:

Mastodon is an open-source, decentralized social media platform where users can communicate in a federated system, a network of independently operated servers. This structure is part of a larger ‘federated universe’ of applications known as the ‘fediverse’. It enables distinct communities with individualized moderation policies (Zulli et al., 2020). This case study seeks to investigate the role of federated moderation within the Mastodon network and how it contributes to creating an inclusive and diverse digital space.

Objective:

The primary objective of this case study is to analyze how Mastodon’s decentralized structure and federated moderation foster a digital space that caters to the subjective perspectives of its diverse user base.

Data Collection:

This research will draw on both academic studies and news articles to grasp the intricacies of Mastodon’s structure and functioning. Key resources include scholarly works such as Rethinking the ‘social’ in ‘social media’ (Zulli et al., 2020), The digital covenant: non-centralized platform governance on the Mastodon social network (Gehl & Zulli, 2022), and Decentralized Networks vs The Trolls (Caelin, 2022), along with news articles like Mastodon is crumbling—and many blame its creator (Valens, 2019) which offer valuable insights into the real-world challenges and dynamics of Mastodon’s operation.

This research will also consider data from individual Mastodon instances (Mastodon, 2023). However, due to Mastodon’s decentralized nature, precise usage statistics across the entire network are challenging to gather. The data is primarily instance-based, as opposed to the comprehensive statistics offered by centralized services like Facebook or Twitter. To mitigate this challenge, the research will leverage external websites that use APIs to provide estimated usage metrics for Mastodon (lostinlight, 2023; lostinlight, 2023). These estimations, while not definitive, offer a broader perspective on Mastodon’s network activity.

Data and Findings:

Mastodon's decentralization enables it to function as part of the fediverse — an interconnected network of servers where each server (or 'instance') establishes its own moderation policies. This leads to the formation of distinct communities, each carrying a unique set of norms and values, and thereby allowing a multitude of subjective realities and perspectives to coexist (Zulli et al., 2020). For example, as of 2023 the mastodon.social instance boasts an active user base of approximately 219,000 (Mastodon, 2023).

In a broader scope, as per fediverse.party, Mastodon houses an estimated population of around 6.47 million accounts, with an active user count of roughly 4.21 million people across more than 12,573 instances (lostinlight, 2023). However, the decentralized structure of Mastodon also presents challenges; while instances have the autonomy to dictate their moderation policies, the lack of centralized control can incite disagreements and conflicts across instances. This sometimes results in instances 'defederating' from others, posing threats to the unity of the 'fediverse' (Gehl & Zulli, 2022; Caelin, 2022).

Despite its federated structure being devised to curb the proliferation of harmful content through localized moderation, Mastodon is not completely impervious to misuse. Bad actors and harmful users can manipulate the platform's decentralization to dodge moderation efforts (Caelin, 2022). In the context of the larger fediverse, fediverse.party reports a population of roughly 7.91 million accounts and an active user count of about 4.51 million people distributed over more than 19,576 instances (lostinlight, 2023). This illustrates the scale and diversity of these decentralized platforms, but it also underscores the complexities involved in maintaining coherence and integrity across such a vast and decentralized network.

Conclusion:

Mastodon's decentralized structure and federated moderation approach provide a unique digital space that caters to diverse perspectives and subjective realities. It represents an important step towards creating more inclusive digital communities. However, it also highlights the challenges of maintaining unity and addressing harmful behavior in a

decentralized system (Gehl & Zulli, 2022). These findings indicate that while federated moderation can cater to subjectivity, it also requires effective mechanisms to manage conflicts and harmful content.

Generalization of Findings:

The findings from this case study offer insights for other decentralized platforms seeking to foster diverse, inclusive communities. Key takeaways include the benefits of federated moderation, the importance of managing conflicts in a decentralized system, and the need for mechanisms to address harmful content (Zulli et al., 2020; Gehl & Zulli, 2022).

Consideration of Alternative Explanations:

The success of Mastodon's approach could also be influenced by other factors, such as the platform's open-source nature, which fosters a collaborative and inclusive community (Valens, 2019). Additionally, Mastodon's unique position as an alternative to mainstream social media platforms could contribute to its appeal (Braun, 2023).

Reporting:

This case study provides an in-depth analysis of how Mastodon's decentralized structure and federated moderation enable a digital space that caters to diverse perspectives and subjective realities. It highlights the complexities of maintaining such a structure and underscores the need for effective conflict and harm mitigation strategies (Gehl & Zulli, 2022).

4.5 Comparative Analysis of Decentralized Technologies

The community-driven model of Wikipedia fosters inclusivity and scalability, yet the representation of true diversity is contingent on the level of user involvement (Jemielniak, 2014; Qaiser et al., 2022). This highlights a critical challenge in decentralized systems: fostering a willingness to participate. The extent to which a system can capture true diversity is inherently linked to the willingness of individuals to engage with the system, a factor that is often overlooked but is of paramount importance. In comparison, Bitcoin and Mastodon, with their respective incentives and community moderated space, may have more success in encouraging active participation (Böhme et al., 2015; Zulli et al., 2020).

Bitcoin, through its Proof of Work (PoW) consensus mechanism, exemplifies the potential of true decentralization. It provides a stark contrast to Wikipedia's more open system, offering robust security and governance. However, the necessity of tokenization and monetary incentives may limit its applicability in systems where consensus is subjective, a challenge that IPFS addresses with its use of Distributed Hash Tables (Benet, 2014). IPFS introduces a novel approach to decentralization, catering to systems with subjective consensus. However, its reliance on semi-centralized servers may limit its decentralization, particularly in peer-to-peer sharing and storage (Trautwein et al., 2022). This highlights the inherent tension between decentralization and efficiency, a challenge that is not as present in Bitcoin's blockchain technology (Bitnodes, 2023). Mastodon's federated consensus and moderation model enhances governance and inclusivity within decentralized systems. Its approach to moderation provides a contrast to Wikipedia's more open system, potentially offering more nuanced community controlled environments. However, its scalability and identity verification mechanisms may need further exploration (Valens, 2019; Caelin, 2022).

To conclude, each platform offers unique insights into the design challenges and potential of decentralized technologies. The path to optimal decentralization may not lie in a single design approach but in a combination that balances inclusivity, scalability, security, and sustainability. This comparative analysis underscores the need for continuous design innovation and experimentation in the field of decentralized technologies.

Critical Making

5.1 SHA256

SHA256, an abbreviation for ‘Secure Hashing Algorithm 256-bit’, is a cryptographic hash function that produces a 256-bit (or 32-byte) hash. This function forms the backbone of Bitcoin’s proof-of-work system, ensuring the integrity and security of the blockchain. Additionally, it finds applications in various other cryptographic domains, including asymmetric cryptography. Before we delve into the intricacies of SHA256, it’s crucial to clarify that it’s not possible to “solve” or reverse-engineer a hash function of this nature. In the realm of Bitcoin mining, the objective is not to break the hash, but rather to discover a hash output that fulfills certain predetermined criteria. This process involves continuously re-computing the hash with slightly altered inputs until the desired hash output is achieved, a method often referred to as “mining” or “proof of work”.

The following is an abstracted step by step process, developed as I performed the SHA256 function by hand (National Institute of Standards and Technology, 2014). The purpose of this experiment was to understand how cryptographic functions work by engaging with the function by hand, and then abstracting the process through a personalised graphical lense.

1. Input Conversion:

Any input given to the SHA-256 algorithm is first converted into binary. For instance, the string “Decentralize” is converted into the ASCII values of the characters and then into a binary string, represented here using black squares as ‘1’ and white squares as ‘0’.

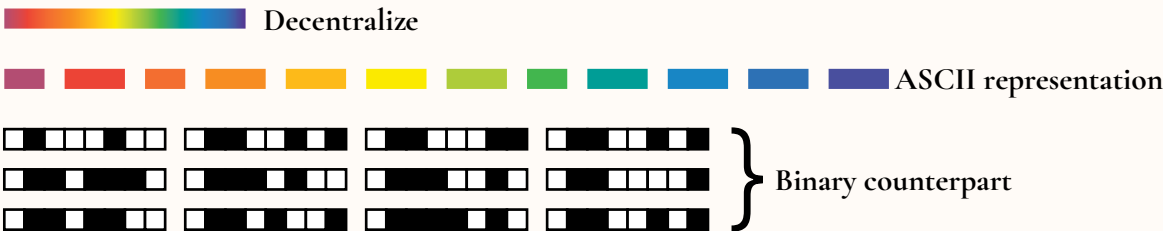


Figure 1.
Abstract representation of an input conversion being translated into binary.
Author’s own illustration.

2. *Pre-processing:*

The SHA-256 algorithm requires that the input is a multiple of 512 bits. If the input isn't long enough, it gets padded. First, a single '1' bit is appended to the end of the input string. Then, '0' bits are appended until the length of the input is 64 bits less than a multiple of 512 (in our case this is just 512, as our input message was short).

The remaining 64 bits are used to store the length of the original, unpadded input, in binary (96 bits in our case).

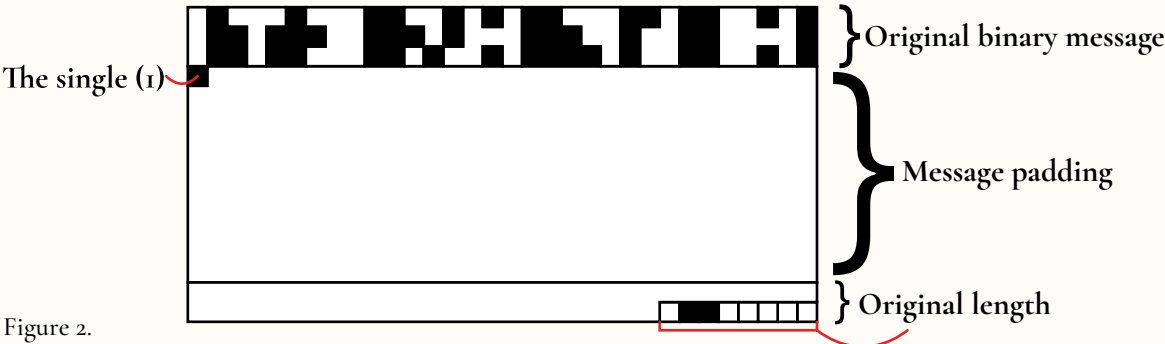


Figure 2.
Abstraction of pre-processing, represented in binary.
Author's own illustration.

Block Creation:

3. The padded input is then divided into blocks of 512 bits. Each 512-bit block, which we have just one of, is divided into sixteen ($M_0 - M_{15}$) 32-bit words.

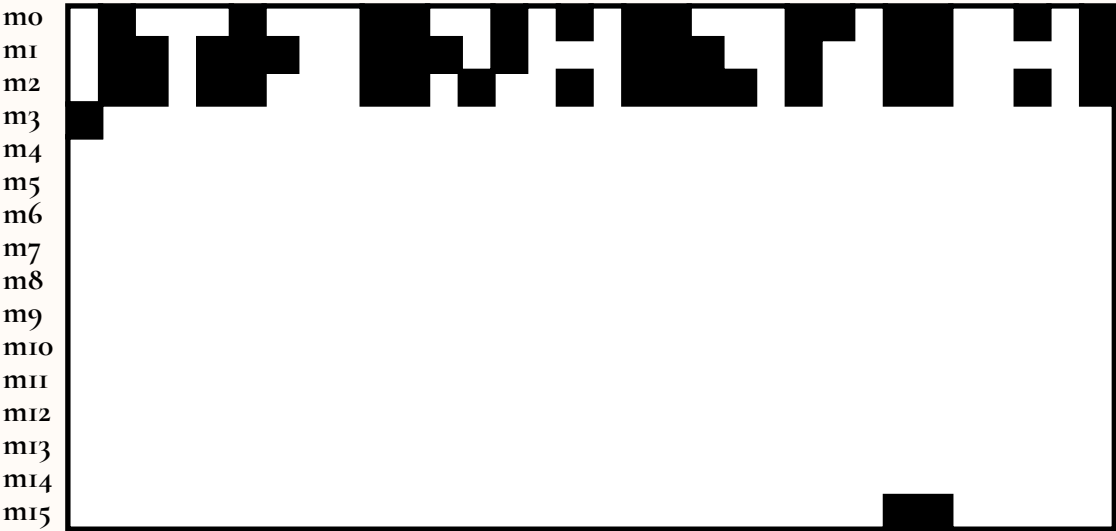


Figure 3.
Abstraction of a 512 bit block, represented in binary.
Author's own illustration.

4. Hash Value Initialization:

Eight initial hash values ($H_0 - H_7$) are defined. These values are derived from the first 32 bits of the fractional parts of square roots of the first eight prime numbers.

For instance, for H_0 the first prime number is 2.

Take the first 32 bits of the fractional part of $\sqrt{2}$, which I have represented in binary squares below.

H_1 would be the same, but it is derived from the next prime number: 3, and so on.

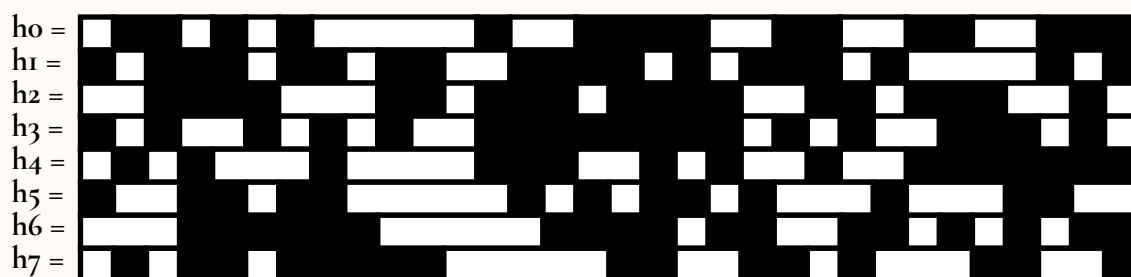


Figure 4.

Abstraction of initial hash values, represented in 32 bit binary strings.

Author's own illustration.

5. Constants:

Sixty-four constant values ($K_0 - K_{63}$) are defined. These constants are derived from the first 32 bits of the fractional parts of the cube roots of the first 64 prime numbers.

This is the same process as we have just done with H_0-7 but with cube roots instead of square roots, and it is done with the first 64 prime numbers instead of the first 7 prime numbers.



Figure 5.
Abstraction of 64 constant values, represented in 32 bit binary strings.
Author's own illustration.

6. Message Schedule Preparation:

A message schedule is prepared for each 512-bit block. This schedule consists of 64 words, labeled W_0 - W_{63} . The first 16 words are just the 16 words of the current 512-bit block.

The remaining words are generated through a combination of bitwise operations and additions on the words in the message schedule.

Because we have only one block our message is 512 bits long, and only one loop is required.

For $i=1$ to N :

{

1. Prepare the message schedule, $\{W_t\}$:

$$W_t = \begin{cases} M_t^{(i)} & 0 \leq t \leq 15 \\ \sigma_1^{\{256\}}(W_{t-2}) + W_{t-7} + \sigma_0^{\{256\}}(W_{t-15}) + W_{t-16} & 16 \leq t \leq 63 \end{cases}$$

Figure 6.

Screenshot of message schedule equation, used to calculate 64 words.

Reprinted from "Secure Hash Standard (SHS)," by National Institute of Standards and Technology, 2014, p.30 (<https://csrc.nist.gov/csrc/media/publications/fips/180/4/final/documents/fips180-4-draft-aug2014.pdf>).

W_0 - W_{15} is the same as M_0 - M_{15} from step 3.

And to get W_{16} - W_{63} we will need to know what σ_0 and σ_1 are, so we use these equations:

$$\begin{aligned} \sigma_0^{\{256\}}(x) &= ROTR^7(x) \oplus ROTR^{18}(x) \oplus SHR^3(x) \\ \sigma_1^{\{256\}}(x) &= ROTR^{17}(x) \oplus ROTR^{19}(x) \oplus SHR^{10}(x) \end{aligned}$$

Figure 7.

Screenshot of equations used to calculate lowercase sigma 0 and lower case sigma 1.

Reprinted from "Secure Hash Standard (SHS)," by National Institute of Standards and Technology, 2014, p.18 (<https://csrc.nist.gov/csrc/media/publications/fips/180/4/final/documents/fips180-4-draft-aug2014.pdf>).

Where 'ROTR' means 'rotate to the right' and 'SHR' means 'shift to the right'. The difference being that when we rotate, the numbers loop back onto the start, whereas shifting does not - this means that the shifting operation deletes some of the original data, contributing to the irreversibility of the SHA256 function.

Below is a binary representation of w16 calculation, this step is repeated for w17-w63.

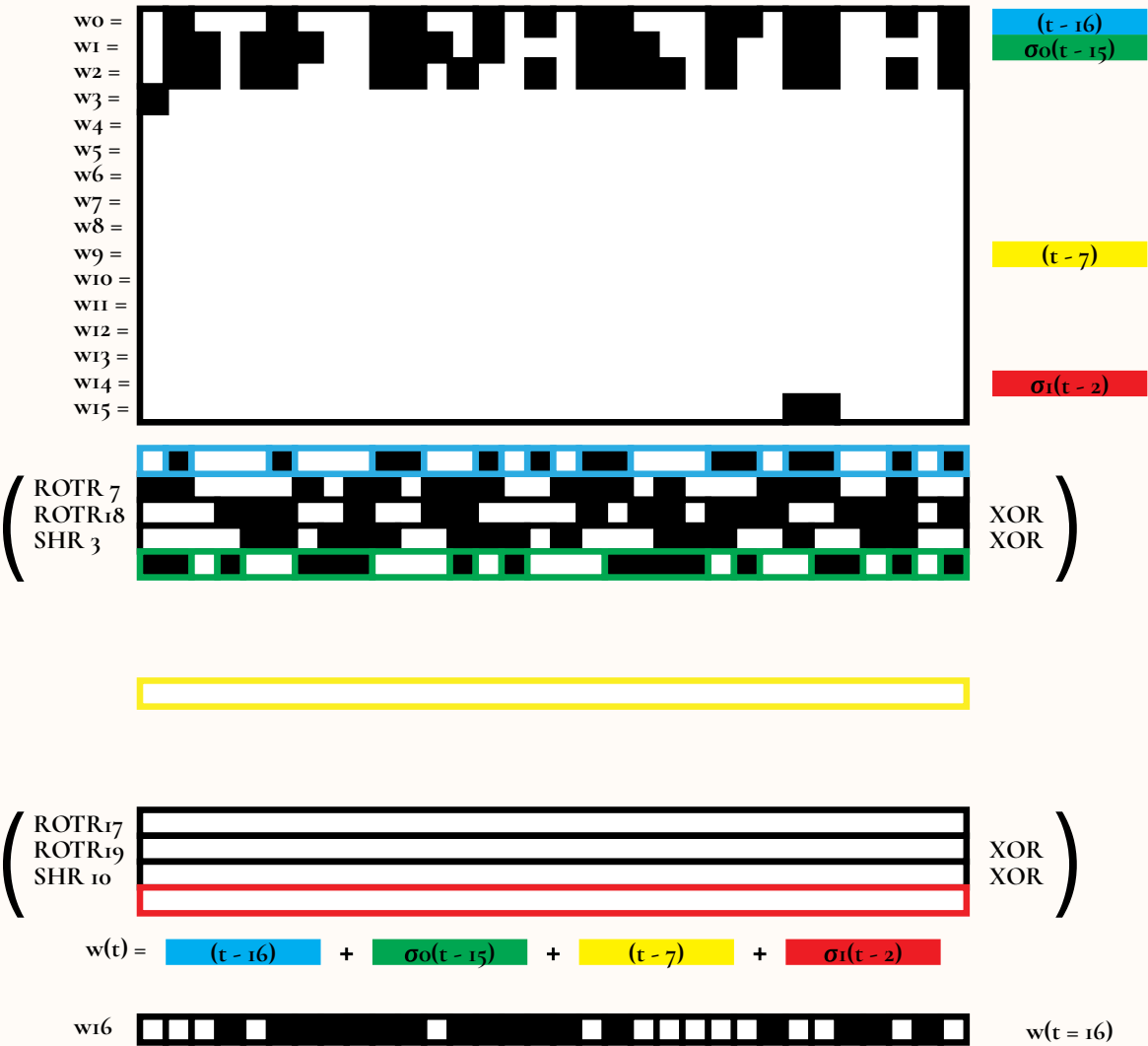


Figure 8.
Abstraction of the creation of w16 represented in 32 bit binary strings.
Author's own illustration.



Figure 9.
Abstraction of the following 46 words (w17 - w63) represented in 32 bit binary strings.
Author's own illustration.

7. Computation:

Eight variables (A - H) are initialized to the current hash values (H₀ - H₇). Then, for each 512-bit block, a series of 64 rounds of computations is performed.

These computations involve bitwise operations, modular arithmetic, logical functions, and use the words from the message schedule and the constants defined earlier.

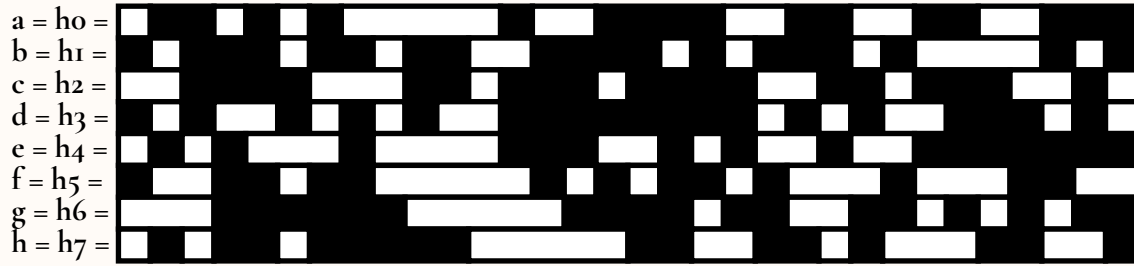


Figure 10.

Abstraction of the first 8 variables, generated from the initial hash values, represented in 32 bit binary strings.

Author's own illustration.

Then we update these values with:

$$a = \text{Temp1} + \text{Temp2}$$

$$b = a$$

$$c = b$$

$$d = c$$

$$e = d + \text{Temp1}$$

$$f = e$$

$$g = f$$

$$h = g$$

Using these equations to calculate temp1 and temp2:

$$\text{Temp1} = \text{h} + \Sigma_1 + \text{Ch}(e,f,g) + \text{ko} + \text{wo}$$

Figure 11.

Abstraction of equation used to calculate Temp1.

Author's own illustration.

Where uppercase sigma(τ) and choice(e,f,g) are calculated like so:



Figure 12.

Abstraction of equation used to calculate uppercase sigma 1 and the corresponding choice function for the first round of calculation.

Author's own illustration.

And where $w(o)$ and $k(o)$ are:

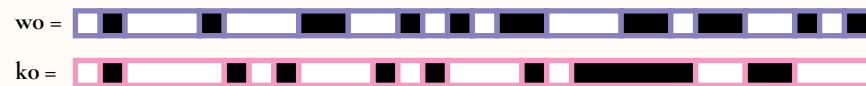


Figure 13.
Abstraction of the first word (w_o) and the first constant (k_o), represented in 32 bit binary strings
Author's own illustration.

$$\text{Temp2} = \Sigma_o + \text{Maj}(a,b,c)$$

Figure 14.
Abstraction of equation used to calculate Temp2.
Author's own illustration.

Where uppercase sigma(σ) and majority(Maj) are calculated like so:

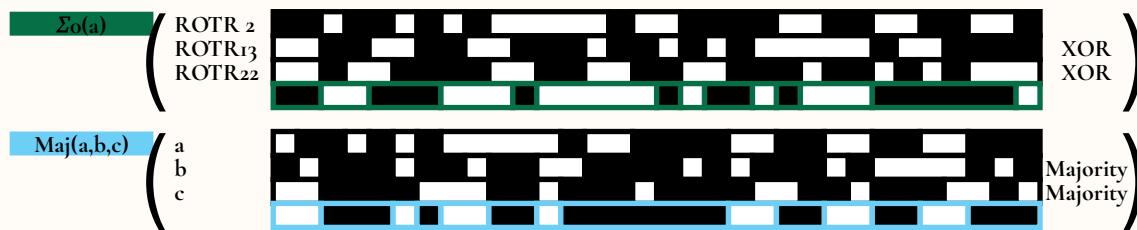


Figure 15.
Abstraction of equation used to calculate uppercase sigma o and the corresponding majority function for the first round of calculation.
Author's own illustration.

Majority and choice functions are calculated as follows:

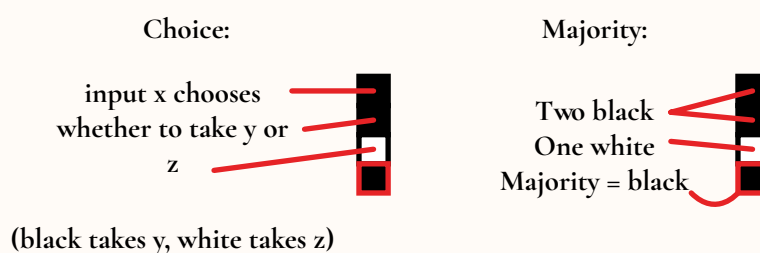


Figure 16.
Abstraction of choice and majority functions, represented in binary.
Author's own illustration.

Majority and choice functions also contribute to making the SHA256 algorithm irreversible of the function, as it is very difficult to reverse the functions if you only have the output binary state.

Using these equations, we update the hash values. The updated (a-h) using $w(o)$ and $k(o)$ create a new hash table like so:

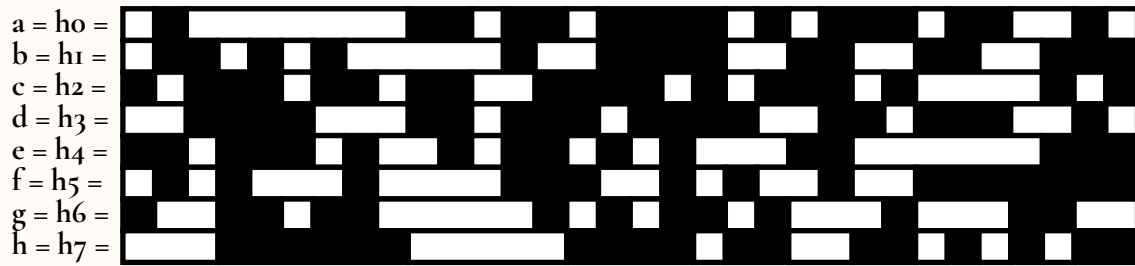


Figure 17.

Abstraction of the updated eight variables after one round of Temp1 and Temp2, represented in 32 bit binary strings.

Author's own illustration.

Then we use these updated (a-h) values to repeat the update but now with $w(1)$ and $k(1)$, and repeat that process through until $w(63)$ and $k(63)$

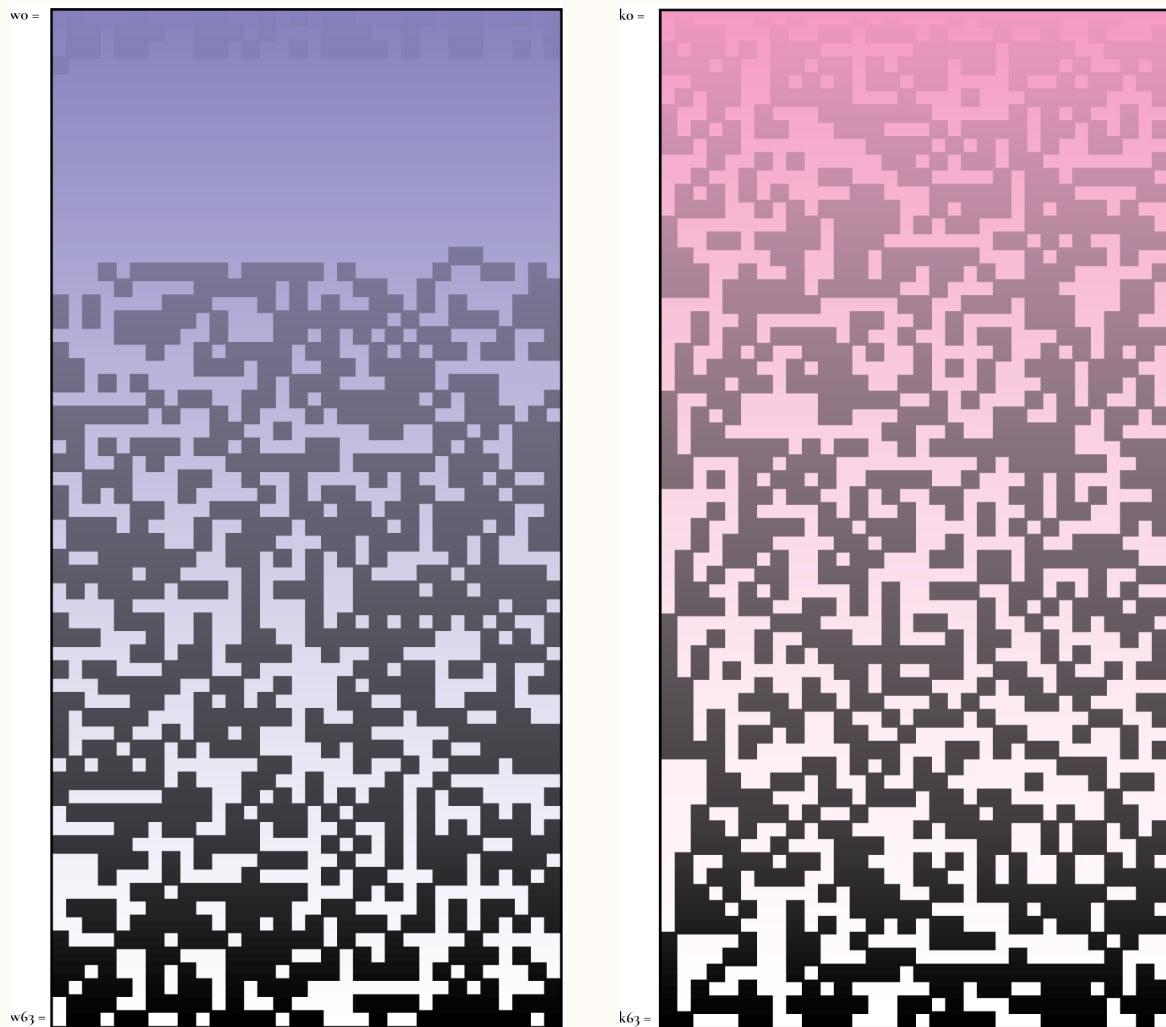


Figure 18.

Abstraction of using the following 63 words and constants, represented as 32 bit binary strings

Author's own illustration.

8. Final Hash Value:

After the 64 rounds are complete, the variables (A - H) are added (using modular 32-bit addition) to the initial hash values (Ho - H7) to produce the new hash values.

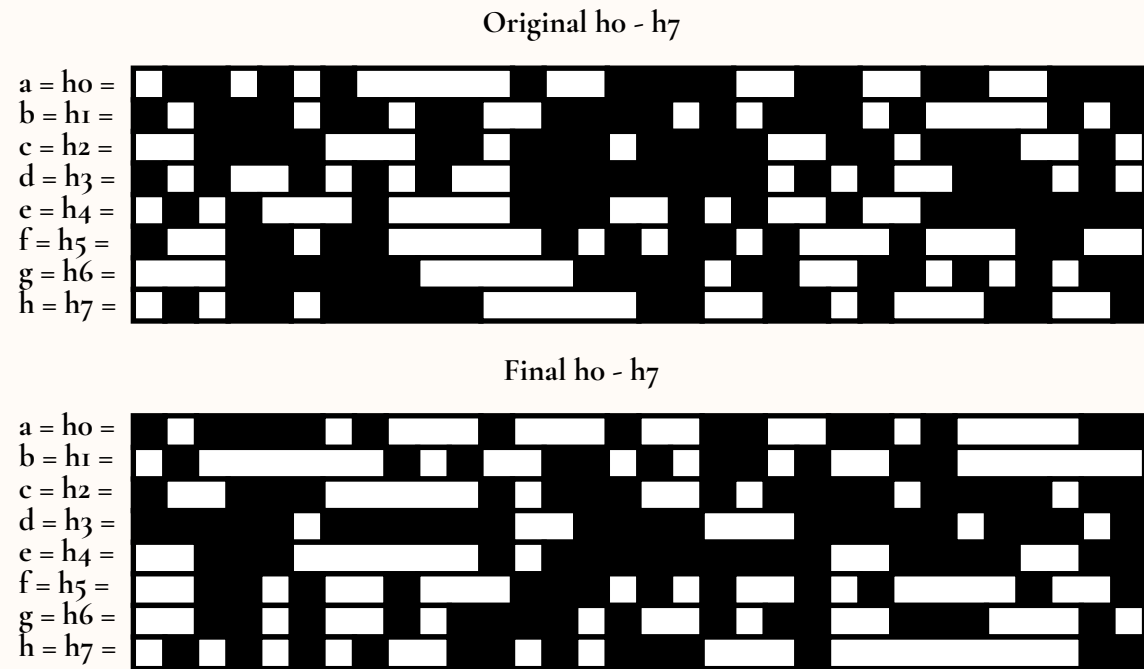


Figure 19.
Abstraction of the initial hash variables, and the final hash variables, represented in 32 bit binary strings.
Author's own illustration.

9. Output:

Finally, the new hash values are concatenated together to produce a single 256-bit output. This is the SHA-256 hash of the input.

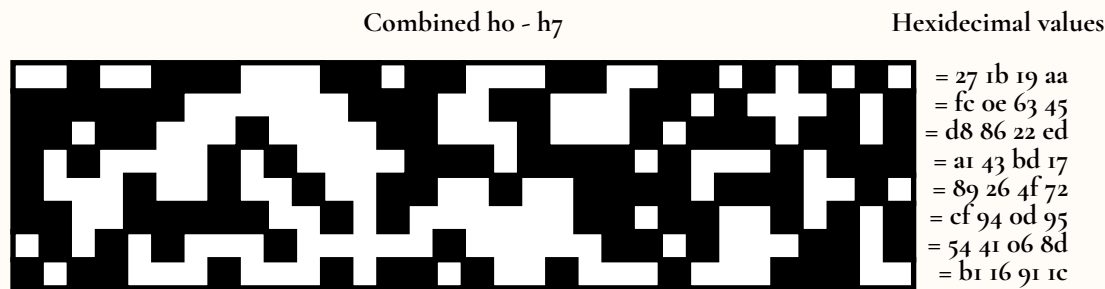


Figure 20.
Abstraction of the combined hash values, i.e the final hash, represented in 32 bit binary strings.
Author's own illustration.

Final hash: 271b19aafcoe6345d88622eda143bd1789264f72cf940d95441068db116911c

5.2 Asymmetric Cryptography

Asymmetric cryptography involves a pair of keys, one public and one private. The public key can be freely distributed while the private key remains secret. In a community setting, asymmetric cryptography can be used to verify the authenticity and integrity of user perspectives. When a user publishes a post, they create a message hash of the content using a hash function such as SHA256, sign it with their private key, and attach the signed hash to the added perspective.

When other users are viewing the added perspective, they can use the poster's public key to decrypt the attached signature, producing the original message hash. They can also generate a new hash from the received perspective, and by comparing the two hashes, the application can confirm the post's integrity—if they match, the post hasn't been altered. Additionally, successful decryption with the public key verifies the post's authenticity, confirming it came from the user it's attributed to, as no one else could have signed the hash with the user's private key. This way the user's identity outside of their posts can be anonymous or pseudonymous; the unique key pair ensures authenticity without sharing any real life private data, only linking the author to their various perspectives.

5.2.1 Key Pairs

RSA keys provide a method for producing pairs of private and public keys. One of these keys originates from one of two selected prime numbers, which is not only smaller than the totient of a specified semi-prime number (where the totient is computed by subtracting one from each of the two prime numbers, then multiplying the results.) but also not a divisor of that totient (Rivest et al., 1978). The complementary key must meet a condition wherein the multiplication of this key with the initial key, divided by the totient, yields a remainder of one (Rivest et al., 1978). The security of the keys lies in the difficulty of factoring very large semiprime numbers; given a large enough number it is very difficult to extract the prime factors for that number. As of 2015, a 2048 bit RSA key is the recommended standard (Dulay, 2023). That is a semiprime number with 617 decimal digits.

5.2.2 Quantum Computing & Cryptography

Quantum computing, which leverages quantum mechanics, could disrupt cryptography. If large-scale quantum computers are built, they could break many public-key cryptosystems, including RSA encryption (Computer Security Division, 2017). This is due to algorithms like Shor's, which can factor large numbers exponentially faster on a quantum computer, breaking RSA encryption (Shor, 1994; Bernstein & Lange, 2017).

While quantum computing does threaten encryption techniques, it also offers opportunities. The field of post-quantum cryptography aims to develop encryption systems secure against both quantum and classical computers (Computer Security Division, 2017). Transitioning to these systems is a complex task requiring new hardware, software, standards, and migration of legacy systems (Mosca & Piani, 2022). The timeline for quantum computing's advent is uncertain, but preparations for its potential impact on information security systems are already underway (Computer Security Division, 2017).

5.2.3 Example

Norma Revés contributes a perspective to the network. To ensure its authenticity, the system first hashes her perspective and then encrypts this hash using Norma's private key (N-R key).

To validate Norma's authorship, the system rehashes the perspective, then decrypts the originally encrypted hash using Norma's corresponding public N-R key. This process yields a second hash which the system then compares to the rehashed perspective.

When someone views Norma's perspective, they can trust its authenticity. This confidence stems from the asymmetric cryptographic technique, which confirms that Norma contributed the perspective by matching the two hash values. This way, the integrity and authenticity of Norma's contribution is secured without sharing any private data or relying on a third party.

5.3 IPFS

The following series of screenshots provides an empirical examination of the operation of an InterPlanetary File System (IPFS) node, established and run on my personal laptop. Each image offers a visual representation of the distinct functionalities of the IPFS framework.

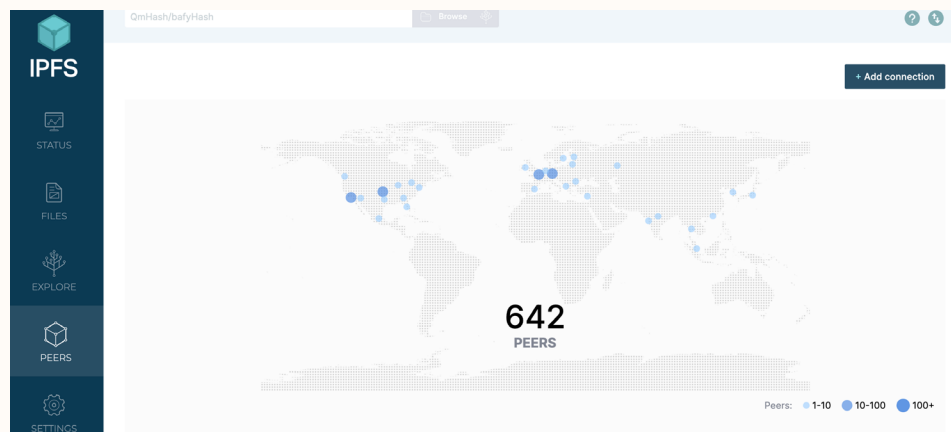


Figure 21.

Screenshot displaying active peers connected to the IPFS node on my laptop.

From IPFS Desktop (Version 0.28.0) [Computer software]. (2023). IPFS. <https://docs.ipfs.tech/install/ipfs-desktop/>

The initial screenshot (Figure 21) manifests the peer-to-peer architecture integral to IPFS. It showcases a diagram of the interconnected pairs or 'nodes', demonstrating the decentralized nature of the network and the direct interactions between individual nodes.

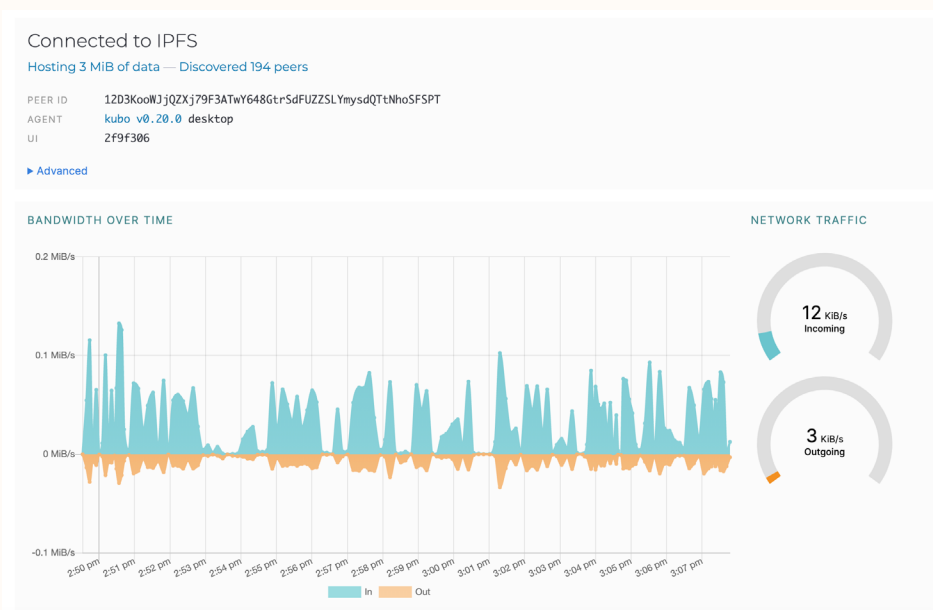
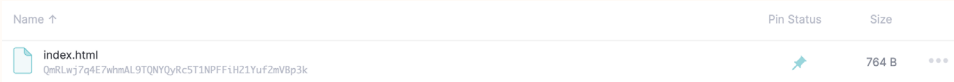


Figure 22.

Screenshot displaying incoming and outgoing data from the IPFS node running on my laptop.

From IPFS Desktop (Version 0.28.0) [Computer software]. (2023). IPFS. <https://docs.ipfs.tech/install/ipfs-desktop/>

This image (Figure 22) presents the dynamic data interchange that occurs within the IPFS node. The incoming and outgoing data flows, depicted here, emphasize the node’s participation in the broader IPFS ecosystem. It serves as an intermediary in the data sharing process, hosting and disseminating data - operations that transpire regardless of whether the user uploads new data or not.





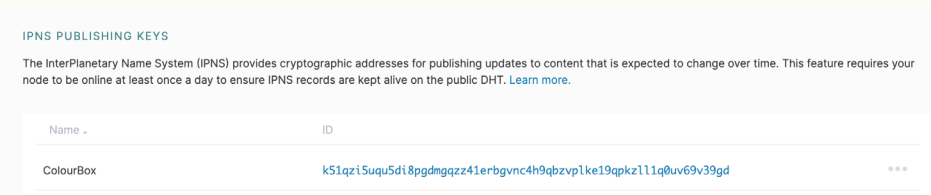
Name ↑	Pin Status	Size
 index.html <small>QmRLvj7g4E7whmAL9TQNYQyRcSTJNPFF1HZ1Yuf2mV8p3k</small>		764 B ***

Figure 23.
Screenshot displaying the pin status of a test file hosted on my IPFS node.
From IPFS Desktop (Version 0.28.0) [Computer software]. (2023). IPFS. <https://docs.ipfs.tech/install/ipfs-desktop/>
This image (Figure 23) highlights the process of ‘pinning’ a test HTML file to the node. Pinning ensures the perpetual accessibility of the uploaded data as long as the node is operational. This image thus illustrates one of the fundamental attributes of IPFS - the persistent availability of data.



IPNS PUBLISHING KEYS	
<small>The InterPlanetary Name System (IPNS) provides cryptographic addresses for publishing updates to content that is expected to change over time. This feature requires your node to be online at least once a day to ensure IPNS records are kept alive on the public DHT. Learn more.</small>	
Name ↓	ID
ColourBox	kS1qzi5uqu5di8pgdmqzz41erbgvnc4h9qbzvp1ke19gpkz1l11q0uv69v39gd ***

Figure 24.
Screenshot showing the creation of a generated IPNS key called ‘ColourBox’.
From IPFS Desktop (Version 0.28.0) [Computer software]. (2023). IPFS. <https://docs.ipfs.tech/install/ipfs-desktop/>
This image (Figure 24) captures the generation of an InterPlanetary Naming System (IPNS) publishing key, a crucial step in establishing data mutability within IPFS. The screenshot serves to visually document the key creation process, reinforcing the intricate workings of the IPFS system.

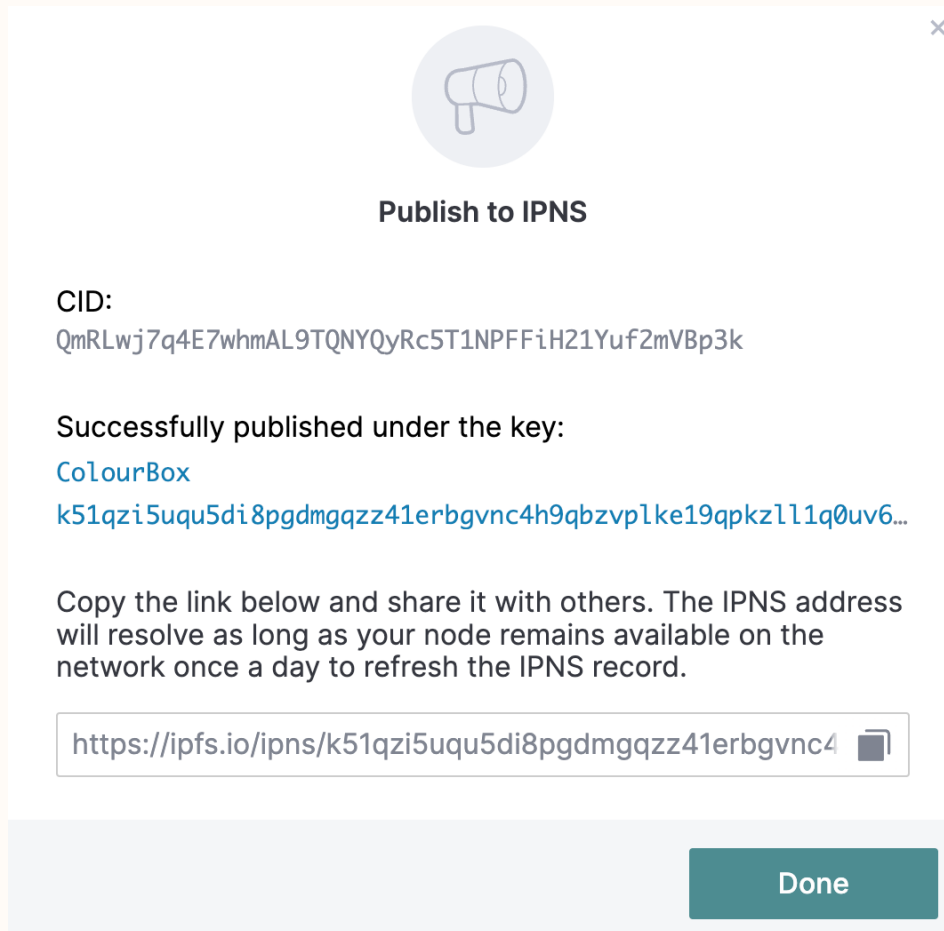


Figure 25.
Screenshot showing the test file being published via the 'ColourBox' IPNS key.
From IPFS Desktop (Version 0.28.0) [Computer software]. (2023). IPFS. <https://docs.ipfs.tech/install/ipfs-desktop/>

Displayed in this image (Figure 25) is the use of the previously generated IPNS key to publish the test HTML site. By linking the site to a mutable Content Identifier (CID) through the IPNS key, the image alludes to the functional application of IPNS in uploading mutable data.



Figure 26.

Screenshot displaying the test file being accessed via the IPNS key it was published under.

From ColourBox (2023). <https://ipfs.io/ipns/>

[k51qzi5uqu5di8pgdmgqzz41erbgvnc4h9qbzvp1ke19qpkz%7Cl1qouv69v39gd](https://ipfs.io/ipns/k51qzi5uqu5di8pgdmgqzz41erbgvnc4h9qbzvp1ke19qpkz%7Cl1qouv69v39gd)

This final image (Figure 26) demonstrates the retrieval of the test HTML site via the IPNS gateway. This visually affirms the successful execution of the IPNS operation, culminating in the site's accessibility through the network.

The corresponding IPNS gateway key will be provided for citation purposes, however as the validity of the link will be contingent on the status of my IPFS node on my laptop which will not be continuously operational, the link may not work.

Personas & Perspectives

6.1 Creation of Personas & Perspectives to Populate Theoretical Design Concepts

Framework

The persona creation in this study draws heavily from two seminal works in the field of interaction design. The first, *Personas, Participatory Design and Product Development: An Infrastructure for Engagement* by Grudin and Pruitt (2002), provides a framework for the creation of fictional personas. This approach is particularly relevant to this study given its focus on the use of machine learning in persona creation. The personas, developed with the assistance of OpenAI's generative pre-trained transformer chatbot (OpenAI, 2023), serve to facilitate engagement between designers and fictional users, helping to effectively convey the theoretical design concepts created in the mock design section of this thesis.

The second work, *Creativity Methods in Interaction Design* by Biskjaer et al (2010), contributes key insights to the persona creation, particularly through its four notions of design. The concept of 'transcendence' underscores the importance of innovation in design practices, which in this study is embodied by the use of chatbots for persona creation. The 'sources of inspiration' notion aligns with the use of chatbots as both an artistic work in the field of language generation and a reflection of current cultural trends (Google Trends, 2023).

The 'degree of structure' notion is manifested in the structured design method employed in this study, which involves the use of prompt engineering with chatbots. Lastly, the notion of 'convergence and divergence' is used to choose between various chatbot outputs. Beyond these four notions, the authors' assertion that creativity in interaction design is often a collaborative process resonates with this study's approach of collaborating with artificial intelligence.

It is important to note that the use of artificial intelligence in persona creation introduces a certain level of inherent bias. However, the aim of this study is not to create perfectly accurate representations of individuals, but rather to generate fictional perspectives for visual effect in a mock interface.

6.2 Chosen Artifact

These personas will be giving their fictional perspectives on an artifact, as if they were interacting with it in a museum, which will help to illustrate the theoretical application being proposed. For this artifact, I have strategically selected the Rosetta Stone artifact due to its broad recognition and historical importance, factors that provide the chatbot with a wealth of information to draw upon and ensure the generation of varied perspectives (Everything you ever wanted to know about the Rosetta Stone, 2023). The Rosetta Stone's value extends beyond its significant role in enabling scholars to decipher Egyptian hieroglyphs, shedding light on previously inaccessible facets of ancient cultures.

Further, its contentious acquisition during the colonial era lends it cultural relevance, as it stands as a focal point in the ongoing discourse surrounding cultural heritage and the repatriation of historical artifacts. Boasting inscriptions in three distinct scripts, it also acts as a poignant symbol of linguistic and multicultural interaction. Although it's unlikely that the chatbot can fully comprehend the intricate significance of this artifact, it is important to note that the perspectives being developed aim to reflect individuals who themselves may not fully grasp the artifact's profound implications.

6.3 Prompting

First prompt:

Your task is to create 4 separate personas that represent a wide range of perspectives and diversity. These personas should have their own backgrounds, behaviors and values, they may have had vastly different upbringings, education and life experiences which shape

the way they perceive the world. They should all have their own preconceived notions of reality, some may not have had the opportunity to learn about or critically engage with certain perspectives or issues, and they may initially hold views that perpetuate negative stereotypes or misunderstandings.

Second prompt:

Four individuals— [input the generated individuals' names here] —are at the British Museum looking at the Rosetta Stone. After observing the artifact, they post their reactions on a community forum. In their posts, each of them emphasizes their personal interpretation of the artifact, informed by their backgrounds, beliefs, and preconceived notions.

Subsequently, each one of them responds to a specific statement made by another, leading to a heated debate. Their responses are initially defensive, as they passionately uphold their perspectives. However, as the conversation progresses, they start finding some common ground, while continuing to challenge each other.

Eventually, after multiple rounds of dialogue, they start to realize that their original perspectives may have been based on incomplete or inaccurate information, or that they may have unintentionally perpetuated negative stereotypes or harmful attitudes. Role play this scenario, maintaining the uniqueness of each persona while guiding the conversation through each round of dialogue towards understanding and growth.

6.4 Summary of Persona Study

(The transcription of the created personas and corresponding perspectives can be found in appendix A)

This study applied a framework for persona creation, influenced by Grudin and Pruitt (2002) and the interaction design notions of Biskjaer et al (2010), to guide OpenAI's ChatGPT in creating fictional personas and facilitating a structured conversation around the Rosetta Stone (OpenAI, 2023).

The AI-generated personas—Cathy Moriarty, Dev Patel, Norma Revés, and Liam O'Reilly—represented diverse backgrounds and perspectives. Their dialogues initially surfaced what might be considered stereotypical views and prejudices, reflecting inherent biases within the AI's dataset. However, over the course of their conversation, the personas demonstrated an ability to challenge and reassess their own biases, providing a demonstration of iterative learning in AI. A key takeaway from this study is the successful application of established interaction design methodologies in AI-mediated persona creation and dialogue facilitation. Notably, the AI personas were able to navigate a complex conversation that initially displayed conflict but ultimately converged towards a common understanding and personal growth.

The artificial personas were able to generate dialogue that reflected an approximation of human-like perspective and introspection, traits that may improve as AI models advance. This result highlights a potential future where the input origin (AI or human) is irrelevant to the value of the contribution in a conversation; value could be found in artificially generated information that enriches discourse around artifacts.

Mock User Interface

7.1 Sketch Prototyping

This section of this thesis presents some preliminary sketches (Figure 27) that form the foundation of the proposed application. The sketches, while conceptual, offer a creative portrayal of the potential interface, functionalities, and the overall structure of the application.

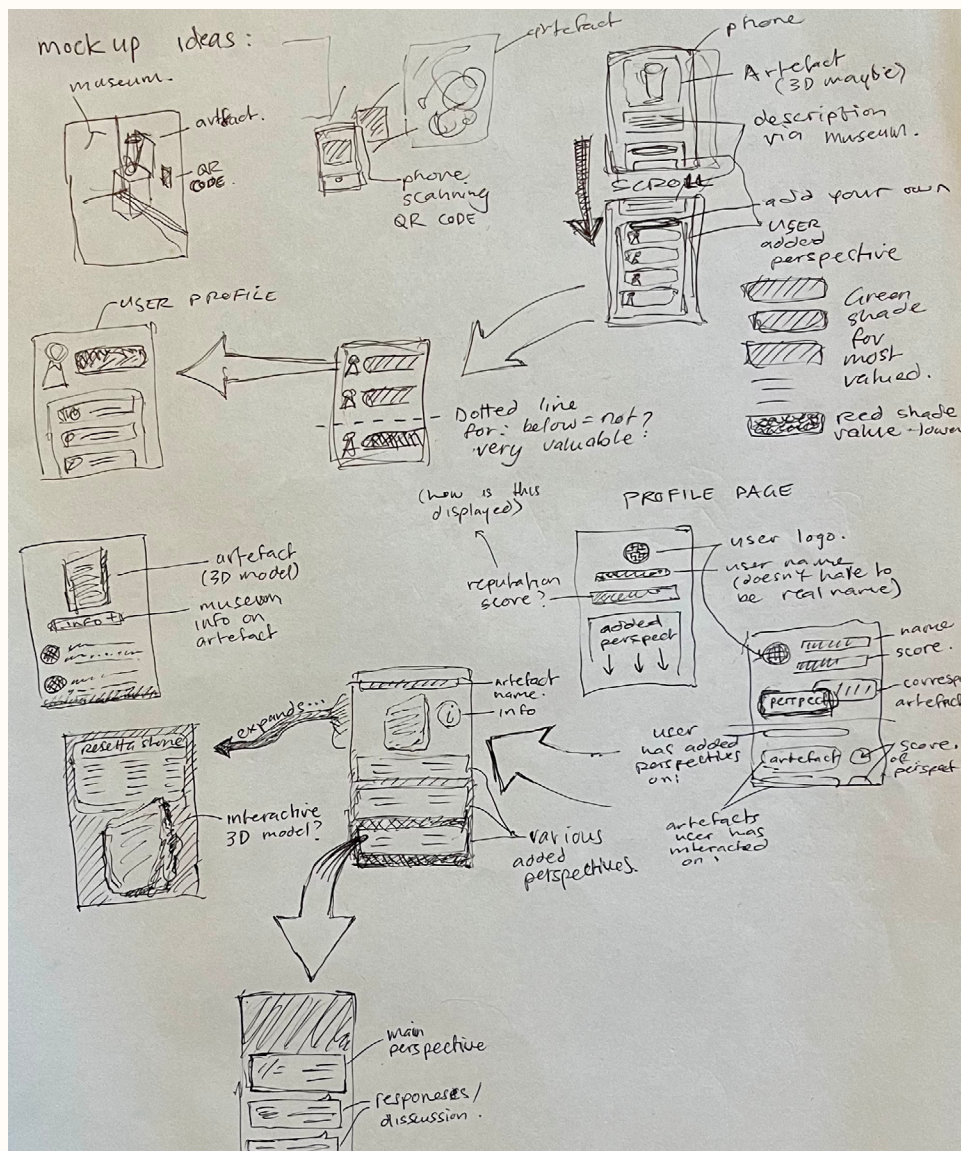


Figure 27.
Preliminary sketches showcasing early mockup concepts.
Author's own illustration.

The following flowchart (Figure 28) represents the critical components of the application, portraying both the conceptual design framework and the operational aspects. While this flowchart is rudimentary in nature, it serves a pivotal role in the development process, facilitating understanding and discussion about the application’s design and functionality, which will culminate in mock ups in the coming section.

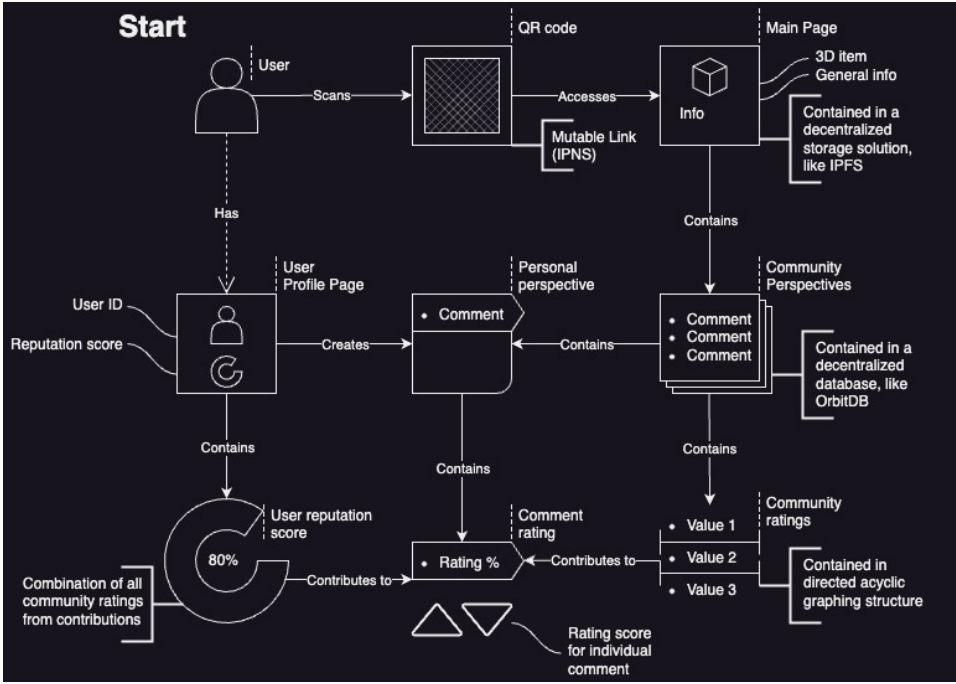


Figure 28.
Flowchart of user interactions and critical components.
Author’s own illustration.

7.2 Design of User Interface

When a museum-goer views an artifact, they can scan the attached QR code with their mobile device. This would direct them to the artifact's IPFS page.

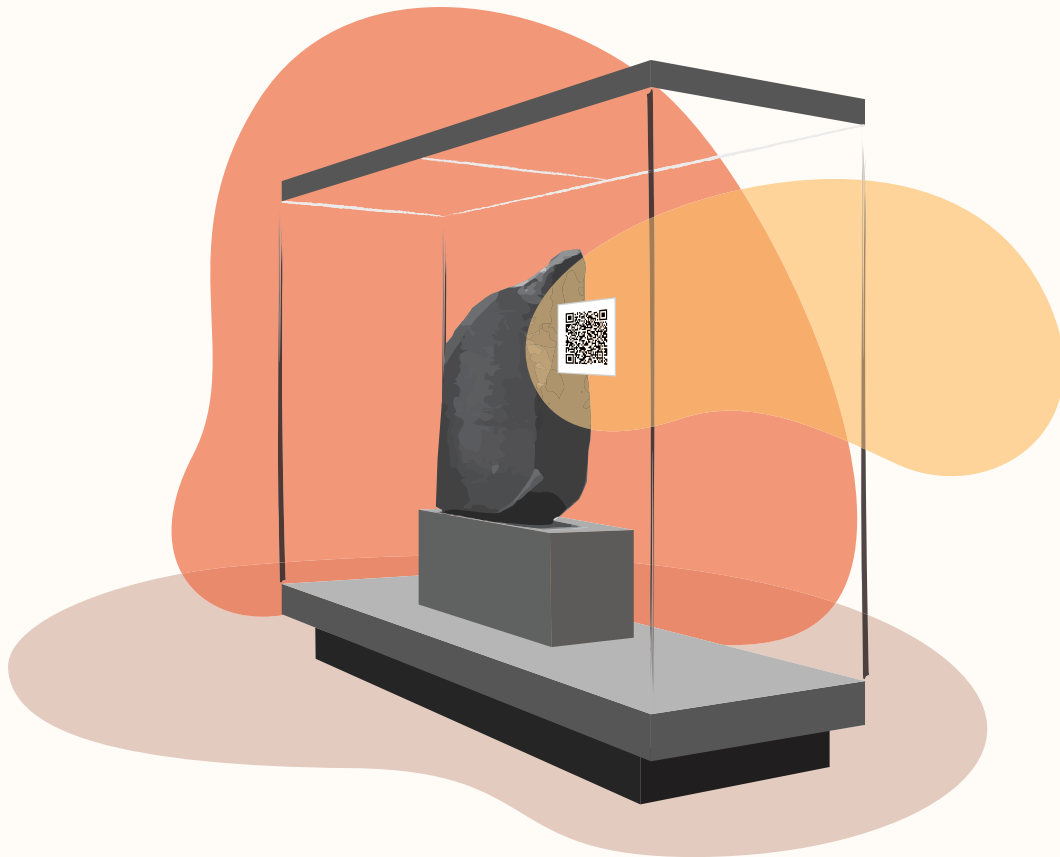


Figure 29.
Illustration of the Rosetta Stone artifact with a QR code.
Author's own illustration.

Here, they can view the digital representation of the artifact, read the general information, and explore other visitors' perspectives.

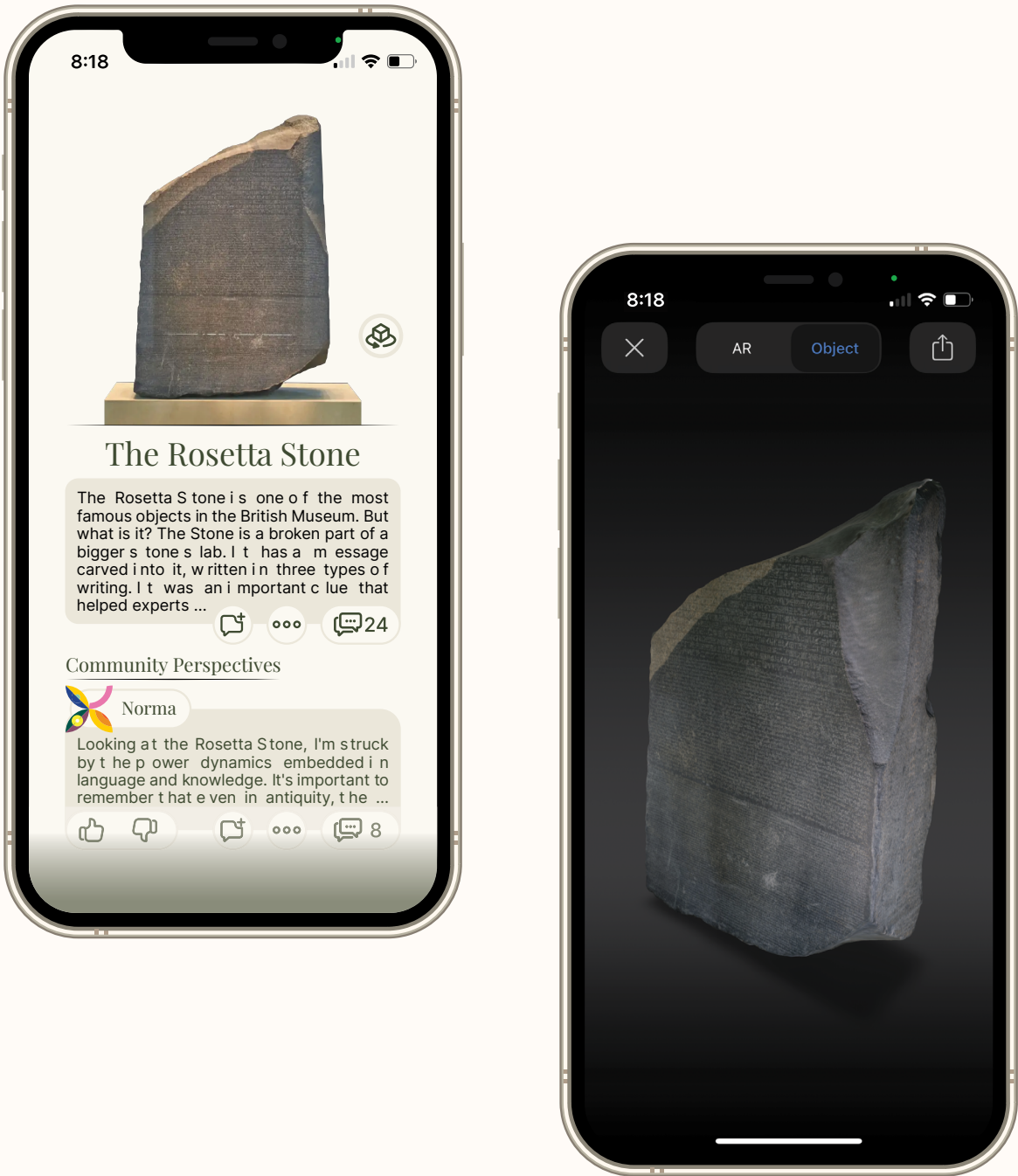


Figure 30.
Illustration of the Rosetta Stone artifact displayed within a theoretical application, along with a 3D representation of the artifact.
Author's own illustration.

They can also add their own perspective or comment on existing ones, which updates the artifact's page. These interactions are then visible to all subsequent visitors, fostering a community discussion around the artifact.



Figure 31.
Illustration of the potential community perspectives within a theoretical application, and their corresponding conversations and profile page.
Author's own illustration.

The user's reputation would be linked to the community's evaluation of the content that user has added.

These mockups are theoretical ideas meant to illustrate potential design pathways and provoke thought about the application's user experience. They are starting points for further refinement and exploration in the development process, and they provide an opportunity for us to envision and consider the complexities and opportunities inherent in the proposed application.

Theoretical Logic Systems

8.1 Logical Reasoning & Structure Behind the Theoretical Application

Each artifact in the museum could have its own unique page on the InterPlanetary File System (IPFS). A specific artifact page could include the general information about the artifact, and could have a digital 3D representation of the artifact. Given that content in IPFS is immutable, the artifact pages would need to be connected to IPNS (InterPlanetary Naming System), which could handle changes or updates. IPNS is a mutable naming system, which enables the creation of persistent links to changing data in IPFS (IPFS Docs, 2023). This is crucial because as visitors add their perspectives, the artifact page would need to be updated. So, the QR code associated with a specific artifact would point to the corresponding IPNS address which, in turn, would resolve to the current IPFS page for that artifact.

When a visitor adds their perspective to an artifact, this information needs to be stored and made accessible in a decentralized manner. OrbitDB, a decentralized database on top of IPFS, could serve this purpose (OrbitDB, 2023). Alternatively a directed acyclic graph (DAG) could be used, as it is a structure that can model many different kinds of information. The versatility of DAGs, as explained by Wang (2013), makes them an ideal choice for modeling complex systems, such as those encountered in community moderation systems. The structure of DAGs allows for the representation of hierarchical and multi-branching data, which aligns well with the nature of information generated through community moderation systems.

Within this theoretical system, the community would collectively moderate the perspectives added via an interconnected voting system to ensure quality and relevancy. In systems without an objective outcome, there's no inherent necessity to arrive at a singular, definitive "value" for a piece of content. Allowing for the value to be in constant flux would align well with the dynamic, evolving nature of historical narratives and personal perspectives. In this

case, the “value” or “influence” of a user’s post would not be a static number, but rather a dynamic assessment that changes over time as more users interact with it and give their input. This could take the form of a real-time popularity index, a reputation score, or some other measurement that updates as more feedback is given.

Implementing a decentralized reputation system might take on the structure where users can value each other’s perspectives, allowing the most agreed upon or thought-provoking perspectives to rise to the top. This voting data can be stored on OrbitDB or within the DAG structure, updating in real-time as users interact with it.

8.2 Proposed Reputation System

The intricate balance of such an interconnected system would require careful implementation, and user testing before deployment, however a proposed reputation system might look like:

1. Web of Trust: In this system, each user can grant a level of trust to other users, which contributes to their reputation within the system. As a user’s contributions are acknowledged by others, their reputation grows. By tying each user’s own reputation to the reputation of those they endorse, you encourage users to be careful and thoughtful about who they grant trust to, as their own reputation is tied to the quality of those endorsements.
2. Proof of Engagement: This system discourages users from creating multiple accounts. To earn a reputation within the community, users need to actively participate in the system in meaningful ways. Simply creating an account and posting content won’t be enough; users will need to interact with other users and contribute valuable content to increase their reputation.
3. Reputation Decay Tied to Contribution Quality: A user’s reputation will only decrease if the quality of their contributions is low, as judged by the community. This

means that users who contribute high-quality content, even sporadically, can maintain a high reputation. This provides an incentive for users to ensure the quality of their contributions.

In regards to the system's potential growth, scalability could be a key concern. As the amount of data stored on IPFS and OrbitDB or within the DAG structure increases, strategies such as data sharding or partitioning could be implemented to maintain performance and manage data volumes. In the context of decentralized systems, sharding is a technique used to distribute the workload and data across multiple nodes (or "shards"), thereby increasing the overall capacity and performance of the system; for instance, Amiri, Agrawal, and Abbadi (2019) introduced SharPer, a scalable permissioned blockchain system that uses DAGs to form the blockchain ledger, enabling parallel processing of transactions and providing deterministic safety guarantees.

Similarly, Saad and Park (2019) discussed a decentralized DAG-based DLT network, further emphasizing the potential of DAGs in such contexts. However, the implementation specifics would likely vary based on the nature of the system and the data it handles. The exact method of sharding or partitioning the data in the proposed system would need to be designed carefully, considering the types of data and the interactions that the system will support. For example, a method that works well for transactional data (as in the case of SharPer) might not be ideal for the type of data in the theoretical system being proposed (artifact information, user perspectives, voting data etc.). Therefore, while the concept of sharding can be applied to this system, the actual implementation details would likely need to be adapted and iterated upon.

Design Findings

9.1 Summary of Findings

The key discoveries made throughout the research are partitioned across the chapters, each unearthing a unique facet of the central theme. Initial chapters underscore the power and potential of decentralization in digital spaces, revealing its capacity to foster inclusivity and challenge predominant centralized narratives that often bolster existing inequalities (Mougayar & Buterin, 2016).

Chapter four provides a variety of in-depth case studies that cover a number of platforms. These studies suggest that achieving robust decentralization may require the careful combination of various design methodologies, underscoring the need for continuous innovation and experimentation in this field (Douceur, 2002; Jemielniak, 2014; Tenorio-Fornés et al, 2021; Stoll, Klaaßen, & Gellersdörfer, 2019). Subsequent findings explore the technical aspects of decentralization.

Chapter five delves into the workings of essential elements within decentralized technologies, with particular emphasis on hashing algorithms and encryption systems used to establish trust without the need for a centralized third party (National Institute of Standards and Technology, 2014; Rivest et al., 1978; Stallings, 1995). This chapter also analyzed IPFS in regards to decentralized data storage and retrieval, highlighting the difficulties surrounding decentralized storage and the need for pinning services to ensure information that is always available (Trautwein et al., 2022).

Chapter six brought forth the potential of utilizing artificial intelligence in the form of chatbots to simulate various user perspectives, thereby aiding the conceptualization of the proposed theoretical framework. An unexpected observation, arising from this exploration, was that value may potentially be found in user contributions regardless of whether the input originated from a human.

The latter chapters breathe life into the theoretical application, creating a tangible representation of the system through a mock user interface; and propose system functions through logic structures, outlining key features such as reputation systems and decentralized moderation mechanics. This provides a potential blueprint for the envisioned decentralized ecosystem. This exploration underscored that high-quality content contributors, even if sporadic, should sustain a robust reputation within the proposed system. The research indicates that this can serve as a powerful motivator, driving users to ensure the quality of their contributions.

9.2 Synthesis of Findings

The research unveiled overarching themes which transcend individual findings, knitting together the intricate tapestry of this study. The themes emerging from the literature review and underpinning the entire research include decentralized trust and identity, storage and sharing capabilities, moderation and consensus. Each theme is pivotal in shaping the potential decentralized digital space, underlining its capacity to drive inclusivity, equity, and effective governance. These patterns trace back to the guiding query: “How can the design tenets of decentralization empower the creation of digital spaces to promote inclusive representation and challenge dominant centralized narratives?”. Through an iterative, exploratory approach, the study delves into the multifaceted complexity of the research question, offering a comprehensive understanding of decentralized technologies’ potential in shaping inclusive digital spaces.

9.3 Reflection on Methodology

The challenges encountered throughout the research process were intrinsic to the complexity and fluidity of the subject matter. The task of structuring the research to ensure an exhaustive exploration, dealing with the intersectionality of the disciplines involved, and navigating through the specific challenges presented by each research methodology posed significant hurdles.

Yet, these obstacles were systematically addressed by grounding the research into distinct, purposeful chapters. This framework offered a structured pathway to navigate the intricacies of the subject. Additionally, the research pivoted on a meticulously crafted methodological foundation, designed to tackle the nuanced facets of decentralization, digital spaces, and historical narratives (Biskjaer et al., 2010; Buxton, 2007; Cooper, 1998; Flyvbjerg, 2006; Grudin & Pruitt, 2002; Ratto, 2011; Yin, 2014).

The incorporation of critical making into the methodology allowed for a hands-on engagement with the technology (Ratto, 2011). This not only provided a more intimate understanding of the security features behind consensus mechanisms but also facilitated the visualization of theoretical constructs and mechanisms within the technology.

9.4 Contextualization of Results

The presented research findings significantly contribute to understanding decentralized technologies, offering insights into their strengths and weaknesses in fostering inclusive digital spaces. By unpacking the intersectionality of the disciplines involved, this study has illuminated new aspects of the broader understanding of these technologies.

These findings challenge traditional notions and assumptions, particularly those concerning power dynamics in digital platforms. Rather than endorsing a power-centric view, the research underscores the importance of understanding, collaboration, and quality (Harman, 2018). The revelation that contributors of high-quality content can maintain a strong reputation, even when contributions are sporadic, reimagines incentive models within digital spaces.

Discussion & Conclusion

10.1 Implications

The implications of this research are profound, extending beyond the academic realm. By offering a roadmap for the creation of digital spaces that promote inclusive representation and challenge dominant narratives, this research contributes towards the flourishing discourse on decentralization, digital sovereignty, community-driven systems, and diverse historical narratives. The findings of this research serve as a call to action for continuous design innovation, encouraging us to rethink our digital landscapes through the lens of decentralization. As we face an increasingly digital society, this research initiates a critical discourse on the future of digital spaces, inclusivity, and the representation of historical narratives (Jemielniak, 2014; Findlay, 2017; Manokha, 2018; Siegel, 2022; Bentov et al, 2014; Xu et al, 2021). Through its critical exploration of decentralized technologies, it illuminates new pathways for digital representation and challenges us to rethink the power dynamics embedded in our digital spaces (Tagle, 2021; Manokha, 2018). The envisioned decentralized application presents a novel pathway to facilitate the sharing and understanding of a myriad of community perspectives, potentially fostering a more empathetic and nuanced societal understanding of one and other (Caswell et al., 2017; Findlay, 2017). This approach could also augment the richness of storytelling and enhance the societal value attributed to cultural artifacts.

10.2 Future Directions

The research offers multiple avenues for future exploration. Notably, the principles and practices of decentralization merit further investigation across a spectrum of disciplines. Given the inherent complexity and dynamism of the subject matter, the findings serve as a springboard for future research, rather than providing definitive answers. There's an explicit need for studies focusing on the practical application of these concepts and addressing

the limitations of traditional forms of knowledge representation in digital spaces. Equally important is the investigation of the effective utilization of these technologies to mitigate inequalities in representation. Future Initiatives should prioritize collaboration with diverse communities, particularly those underrepresented in current systems, to ensure the development of an inclusive and culturally sensitive user interface and experience. Furthermore, the application of this decentralized approach could extend beyond the realm of history to encompass other subjective fields such as art, offering new platforms for shared community perspectives.

10.3 Limitations & Critiques

While the research presents a comprehensive view of the subject matter, it acknowledges the scope for improvements in methods or designs. This understanding is particularly imperative in the face of critiques, ensuring a balanced perspective that catalyzes continual refinement and progression of the research findings.

Emphasizing user-friendliness and inclusivity in design decisions stands out as a key suggestion for improvement. Recognizing that no single design approach provides a panacea for issues of inclusivity and representation, the research posits that the path to more inclusive digital spaces is an ongoing process of adaptation, critique, and redesign. This outlook not only grounds the current research findings in practical reality but also paves the way for future iterative advancements in the field.

10.4 Conclusion

This research embarked on an exploratory journey into the heart of digital spaces, investigating how decentralization might serve as a critical tool in fostering inclusivity and challenging traditional, centralized historical narratives. The conclusion drawn from this comprehensive study is both enlightening and impactful.

It has been established through the course of this investigation that the principles of decentralization carry potential to empower individuals, fostering a space that is more democratic and inclusive (Mougayar & Buterin, 2016; Zyskind et al, 2015; Nakamoto, 2008). Such spaces, as theorized and designed in this research, not only provide an alternative to centralized digital platforms but also challenge the very notions of power dynamics inherent in our understanding of digital and historical narratives.

Through the lens of decentralization, this research envisions a digital world where narratives are shaped by diverse perspectives, facilitating greater empathy and mutual understanding. The case studies of existing community-driven platforms and decentralized systems have not only highlighted the nuances and complexities of implementing these tenets but also signposted the direction for further exploration and design improvements.

Unexpected findings, such as the revelation that artificially created perspectives, while not being authored by real people, could potentially still hold genuine societal significance, bringing into question the definition of value. Moreover, the research underlined that the journey towards more inclusive digital spaces isn't about finding a single perfect design solution (Douceur, 2002; Jemielniak, 2014; Tenorio-Fornés et al, 2021; Stoll, Klaaßen, & Gellersdörfer, 2019). Instead, it involves continuous refinement, adaptation, and redesign, always striving for better representation and inclusivity.

In conclusion, this research asserts that it has opened up new avenues of exploration, from the practical application of decentralized systems to the ongoing design innovations that ensure user-friendly and inclusive platforms. It emphasizes the importance of maintaining an ongoing dialogue and iterative process in the design and development of decentralized digital spaces (Douceur, 2002; Jemielniak, 2014; Tenorio-Fornés et al, 2021; Stoll, Klaaßen, & Gellersdörfer, 2019).

The societal implications of this research are substantial. By providing a roadmap for future digital spaces that champion digital sovereignty and mitigate the tendency for digital echo chambers by challenging the dominant control over social narratives, this study sketches a blueprint for a digital future that is more empathetic, equitable, diverse, and democratic.

In closing, this research serves as a clarion call for change, underscoring the importance of continual innovation and evolution in our digital landscapes. As we stand at the crossroads of an increasingly digital society, this work invites us all to actively participate in the creation and curation of our shared digital history, thereby transforming the very fabric of our collective narratives.

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Appendices

Below is the full transcript of the fictional personas & corresponding perspectives created with OpenAi ChatGPT:

Personas

Catherine “Cathy” Moriarty:

Cathy is a 57-year-old single mother of three who grew up in a small rural town in Kentucky. As a high school dropout, she started working at a local diner at an early age and has continued to work in blue-collar jobs for her entire life. She is a devout Christian, and her faith guides many of her views on social and political matters. She believes strongly in self-reliance, community, and traditional values. Cathy often feels overlooked by modern society, especially by those in urban areas or with university education. She has little direct experience with cultural or ethnic diversity, and her perception of these issues is largely shaped by conservative news outlets and her local community.

Dev Patel:

Dev is a 30-year-old Indian-American tech entrepreneur based in San Francisco. Born to immigrant parents, he has always strived to succeed academically, ultimately graduating from Stanford University. Dev is progressive in his social and political views, reflecting the influence of his Silicon Valley peers. He’s an advocate for universal basic income and believes in the transformative power of technology. However, he’s often criticized for being out-of-touch with the struggles of ordinary working-class people. He lacks a deep understanding of issues like income inequality and the social implications of gentrification, focusing more on innovation and market-driven solutions.

Norma Revés:

Norma is a 42-year-old Afro-Latina woman, a human rights lawyer based in Miami, Florida. Born to Cuban immigrants, Norma was the first in her family to go to college and has dedicated her life to fighting for the rights of marginalized communities. She is deeply committed to social justice, yet she can sometimes be uncompromising in her views. Her experiences have led her to distrust the police and the judicial system, often leading to a bias in favor of defendants over law enforcement. She tends to view issues through a lens of systemic oppression, sometimes dismissing individual responsibility.

Liam O'Reilly:

Liam is a 36-year-old white male, a former military officer now working as a security consultant in Boston. He's from a middle-class family and has a traditional, law-and-order mindset influenced by his military background. He values discipline, respect for authority, and patriotism. Although he is open to other perspectives, he often views social movements such as Black Lives Matter and climate change protests as disruptive and unproductive. His life experiences have led him to view the world as a dangerous place where strength and vigilance are necessary for survival. His views on immigration, gun control, and foreign policy are often seen as hardline and uncompromising.

– OpenAI, 2023

Perspectives

Round 1: Initial Reactions

Cathy's Post:

"Well, isn't this something! This Rosetta Stone thing, written in all these languages by the same person, just goes to show how we're all capable of learning if we put our minds to it. I reckon if folks these days spent less time protesting and more time learning, we'd have fewer problems in the world."

Dev's Post:

"It's mind-boggling how the Rosetta Stone enabled the decoding of ancient Egyptian hieroglyphs! It's a testament to the immense value of data and collaboration in problem-solving. If we could apply this level of cooperation to our modern societal problems, imagine what we could achieve!"

Norma's Post:

"Looking at the Rosetta Stone, I'm struck by the power dynamics embedded in language and knowledge. It's important to remember that even in antiquity, the privileged few controlled knowledge and information. As we appreciate such artifacts, we should also be questioning whose stories aren't being told."

Liam's Post:

"The Rosetta Stone, an artifact of war, seized by the British from the French, a testament to the conquests that have shaped our world. It's a stark reminder that survival and supremacy often go hand-in-hand. We'd do well to remember that in today's world as well."

Round 2: Reactions to Others' Posts

Cathy's Response to Dev:

"Dev, you speak of cooperation, but don't you think it's this obsession with data and technology that's causing some of our problems? People forget how to connect on a human level."

Dev's Response to Norma:

"Norma, I understand your point about power dynamics. But wouldn't you agree that the privileged have always paved the way for progress in some form? Take technology, for example, it's often driven by those with resources, but it can benefit everyone."

Norma's Response to Liam:

"Liam, it's interesting that you see conquest as a part of survival. I believe the world has evolved, and we should now focus more on cooperation than supremacy. Aren't we perpetuating violence with such attitudes?"

Liam's Response to Cathy:

"Cathy, while I see your point about the importance of personal responsibility, isn't it equally important to address systemic issues? Perhaps people wouldn't need to protest as much if their voices were heard in the first place."

Round 3: Finding Common Ground

Cathy's Reply to Liam:

"You're right, Liam. Maybe I was too quick to judge those who protest. It's easy to feel disconnected when you're far away from those big-city problems."

Dev's Reply to Cathy:

"Cathy, I acknowledge that technology can make things impersonal. It's a valid concern and one we need to address as we continue to innovate."

Norma's Reply to Dev:

"Dev, I can see how technology democratizes access to information. You're right that it can be a force for good. But, we should still strive for a more equitable distribution of power and resources."

Liam's Reply to Norma:

"Norma, you have a point. Conquest isn't the only way. Maybe I've been too focused on strength and power, and not enough on understanding and collaboration."

Round 4: Realization and Growth

Cathy's Reflection:

“This discussion made me think. Maybe we’re not as different as I thought. We all want to make the world a better place, just in our own ways. And maybe I should try to understand other perspectives better before forming my opinion.”

Dev's Reflection:

“I’ve realized that while technology can solve many problems, it’s not the answer to everything. Human connection and empathy are irreplaceable, and I need to factor those in when thinking about solutions.”

Norma's Reflection:

“From our conversation, I’ve learned that my views might be too centered on systemic oppression. Individual responsibility does play a role, and I need to remember that not all power is abusive or corrupt.”

Liam's Reflection:

“I see now that the world isn’t just about survival of the fittest. Empathy and cooperation are just as important, if not more so. It’s time for me to reevaluate some of my beliefs.”

– OpenAI, 2023