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Incorporating Blockchain and Arweave Technologies into Archival Practices: An Exploration of

the Rohingya Project's R-Archive

A thesis submitted in partial satisfaction

of the requirements for the degree of Master of Library and Information Studies

by

Hall Frost

2024

ABSTRACT OF THE THESIS

Incorporating Blockchain and Arweave Technologies into Archival Practices: An Exploration of

the Rohingya Project's R-Archive

by

Hall Frost

Master of Library and Information Studies

University of California, Los Angeles, 2024

Professor Anne Jervois Gilliland, Chair

The Rohingya Project was founded with the goal of creating self- sufficiency for the

displaced and persecuted Rohingya people through creation of the R-Archive, a blockchain

based initiative to help the Rohingya gain control of their own lives, documents, and history

through digital preservation and archiving. This thesis examines the potential of blockchain and

blockweave technologies in archives by means of a study of the R-Archive using interviews with

members of the R-Archive team, as well as information studies researchers studying applications

of blockchain in the field. Despite the R-Archive development being put on hold to prioritize

other Rohingya community preservation projects while this thesis was being written, its progress

shows that with cooperation and development of the use of blockchain -type implementations in archival practice, this technology could be an asset for community archives, minority groups facing oppression, and other non-traditional archival initiatives that could benefit from the security and authenticity the technology offers.

The thesis of Hall Frost is approved.

Michelle Caswell

Noopur A. Raval

Anne Jervois Gilliland, Committee Chair

University of California, Los Angeles

2024

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Preface

A note on the usage of "Burma" versus "Myanmar":

During the British occupation of the Kingdom of Burma (1885 - 1948), the official name of the country was declared to be "Burma." This name was chosen because the dominant ethnic group of the region is the Bamar people. Following a military coup in 1989, the name of the country was changed to Myanmar. The military cited diversity as the reasoning behind the name change; pointing out that there were many other people in Burma besides just the Bamars. The government's subsequent oppressive treatment of the Rohingya would suggest that this was not the real reasoning behind the change. In the Burmese language "Myanmar" is just the formal version of "Burma." In fact Kim Tong-Hyung of the Associated Press wrote in an article for PBS that the name change "was linguistic sleight-of-hand. But few people were fooled. Much of the world showed defiance of the junta by refusing to use the new name."[1]

Instead, the speculation on the name change is simply that the new government of Burma wanted to overhaul its image and become more accepted on a global scale. Accepting the new name meant accepting a military government that some claim is illegitimate and thus doesn't have the authority to change the name of the country.

Many in opposition to the military junta continue to use "Burma" as an act of defiance and to claim the government of Myanmar is illegitimate. Additionally, the Burmese government changed the names of historic Rohingya locations, such as changing Arakan, the ancestral home

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[1] "Myanmar, Burma and Why the Different Names Matter," PBS NewsHour, February 3, 2021, https://www.pbs.org/newshour/world/myanmar-burma-and-why-the-different-names-matter.

of the Rohingya, to Rakhine state in 1990. This is a blatant attempt to separate the history of the region from the Rohingya, who still refer to the area as Arakan. If the government will not call the region its rightful name, why should dissenters of the authoritarian regime call it what they wish? In solidarity with the Rohingya and others standing in opposition to the government, I will refer to the country as "Burma" except where direct quotes use Myanmar.

<p align="center">*</p>

There's a song by Neutral Milk Hotel called Holland 1945. It's upbeat and fast, the kind of song I'd sing out loud at the top of my lungs as I rode my bike home late at night, not really paying much attention to the lyrics. And yet, it's a song about the Holocaust. About Anne Frank. About genocide and war. Jeff Mangum sings loud over distorted guitar and trombone about deep seated and furious hatred, singing "it's so sad to see, the world agree, that they'd rather see their faces filled with flies." There are many words that attempt to describe the fire behind genocide, that try to understand the reasons humans do the horrible things they do. To me, there is no better distillation than that lyric.

I heard that song in my head with every turn of the page of Habiburahman's memoir. A book in which he describes his life in Burma during the ethnic cleansing campaigns carried out by the government against the Rohingya people. I heard it as he described being called *kalar* , an anti-muslim slur, as a young Rohingya boy living in Arakan, when he detailed crossing borders and hiding his identity just to get an education. As he was pulled off a rickety boat filled with immigrants that had endured a storm and open ocean only to be thrown into an Australian prison.

I heard it when I read about Muhommad Noor's mother and her family walking thousands of miles from Arakan to Saudi Arabia; when he detailed intentionally getting thrown

into prison in order to be deported to Pakistan, where he had family, and might have a path to a passport. All because he wanted an education.

I hear it every time I look at photographs of the overcrowded conditions of the Cox's Bazar Rohingya refugee camp in Bangladesh, and I hear it when I see Twitter posts with zero engagement from the Maia school, an all girls school run within the Cox's Bazaar camp, detailing what it takes to educate girls in the camps.

I hear it when I mention my work and almost everyone I talk with has no idea who the Rohingya are or the terrible reality they are currently facing.

It's been stuck in my head for months.

Although this thesis addresses a novel use of Blockchain technology within the archival studies field, I don't want to compartmentalize the technology as distinct from or more important than the Rohingya people who are struggling to maintain their identities, their lives, and their collective culture and history. It is essential to center their lives and lived experiences as we contemplate how to protect their identities, records, and historic documents with technology.

Acknowledgments

When I decided I wanted to write a thesis about blockchain in the archives mere months before graduation, my advisor and committee chair, Dr. Anne J. Gilliland, encouraged me rather than urging me to play it safe. Thanks to her support and guidance, and the additional guidance by my committee members, Dr. Michelle Caswell and Dr. Noopur Raval, I was able to learn a new technology and talk to people doing important work the world over. I am incredibly grateful to everyone who took the time to talk with me, often through multiple and distant time zones, as well as answer all my emails and help me understand this complex technology and how we can use it to help the Rohingya and hopefully, with time, others in need. This includes Muhommod Noor, Phillip Kothe, Dr. Victoria Lemieux, Dr. Greg Rolan, Amber Gallant, Dr. James Lowry, and Dr. Will Maxwell. I am grateful to The New Humanitarian for their support and permission to use their images.

I am especially indebted to Saqib Sheikh who met with me numerous times and gave me much to think about as I wrote. Thanks must of course be extended to my friends and family, who listened to my thoughts on the subject even without knowing what blockchain is, as well as those in the background that helped support me to the finish line, Amy Gershon, Emily Bilbao, Amarin Enyart, and everyone at the New Mexico History Museum Photo Archives and Fray Angelico Chavez History Library, as well as Dr. David Johnson and Dr. Katrine Barber for helping me envision the finish line in the first place. And finally, I could have never gotten to where I am today without the continued and reliable support of my partner, Dr. Alisha Berry.

Introduction
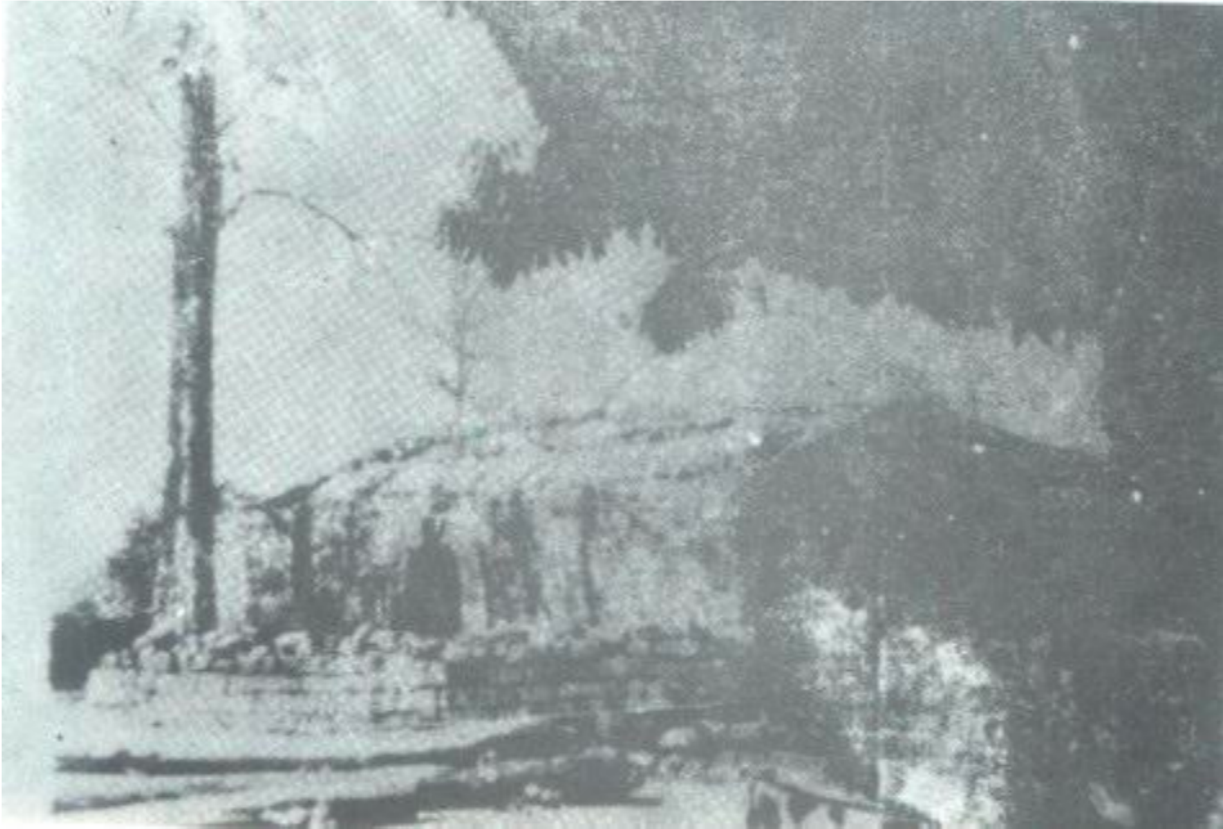
Sandhi Khan Mosque, unknown artist.[2]

In 1433, the Sandhi Khan Mosque was constructed in Mrauk U, the capital of the Kingdom of Mrauk U, Arakan. Over the years, the mosque became a symbol of the Rohingya presence in Arakan; a marker that Muslims and Buddhists and Hindus, and later, animists and Christians, had at one time peacefully lived side by side.

In 1996, the military junta took Rohingya peoples into the woods and forced them to dismantle the Sandhi Khan mosque. Habiburahman grew up in Burma and remembers the

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[2] "In-Depth: Rohingyas: Myanmar's Most Senior Indigenous Race Is Also World's Most Persecuted – AAS Blog," accessed December 11, 2023, https://aungaungsittwe.com/amp/in-depth-rohingyas-myanmars-most-senior-indigenous-race-is-also-worlds-most-persecuted/.

dismantling, writing in his memoir: "Rohingya who have prayed all their lives in this mythical and mystical place [were] forced to dismantle each stone and each piece of teak and load it onto ox carts to be taken to the monastery in the Buddhist village of Shwe Taung."[3]

The dismantling of this historic and important mosque is, of course, damaging to the morale of the Rohingya people. But beyond that, this erasure of the historic presence of the Rohingya people throughout Burma allowed the military junta to claim Rohingya history as false, to assert that the Rohingya are not from Burma and never were; allowing them to rewrite the region's history. Without physical evidence of their history and existence in the region, it corroborated the junta's assertions that the Rohingya are illegally invading Bengali immigrants, and thus convinced the non-Rohingya citizens of Burma to hate them too.

Years of attempts to "purify" the population of Burma into one of only ethnic Burman and Buddhists led to more and more restrictive policies on Rohingya citizens. Through ever changing identification card requirements, the Rohingya were eventually stripped of all legal documentation, effectively left stateless.

Without the proper documentation of citizenship, the Rohingya are unable to legally leave Burma, unable to work, vote, have bank accounts, or be educated. Beginning in 1978, over 1.3 million Rohingya people were displaced and left Burma as refugees or by illegally entering neighboring and nearby countries such as Malaysia, Thailand, Pakistan, and Saudi Arabia. 600,000 people were displaced in 2017 alone, many ending up in the overcrowded refugee camp,

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[3] Habiburahman et al., *First, They Erased Our Name: A Rohingya Speaks.*, 2019, 82, https://nla.gov.au/nla.obj-1575406565.

Kutupalong, in Cox's Bazaar, Bangladesh.[4] With over 910,000 refugees, the Cox's Bazaar camp

is the largest refugee camp in the world.[5]

"Two Rohingya women walk into the Kutupalong refugee camp near Cox's Bazar. Women and girls make up more than half of the 900,000 Rohingya refugees in Bangladesh."[6]Photo courtesy of Farzana Hossen, The New Humanitarian.

According to a 2019 survey of 201 Bangladeshi citizens of Cox's Bazar, support of the

Rohingya people is mixed, with 50.5% of respondents answering yes to the question "do you

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[4] Patrick Hein, "The Re-Ethnicisation of Politics in Myanmar and the Making of the Rohingya Ethnicity Paradox," *India Quarterly* 74, no. 4 (2018): 378.
[5] "Cox's Bazar: A Displaced People Longing for a Sense of Home," United Nations Population Fund, accessed October 5, 2022, https://www.unfpa.org/coxs-bazar-displaced-people-longing-sense-home.
[6] "The New Humanitarian | Dwindling Aid Leaves Rohingya Women Exposed to Rising Violence," May 9, 2023, https://www.thenewhumanitarian.org/news-feature/2023/05/09/aid-rohingya-women-violence-bangladesh.

want the local people (Ukhiya, Cox's Bazar) to support the Rohingya?" and 48% answering

"no."[7] However, recent attitudes have begun to shift as local resources become scarce, living

costs rise, and job opportunities dwindle;[8] all valid complaints in a region that saw such a large

shift in the local population that the area is now 76% Rohingya.[9]

As much as the Bangladeshis wish for the Rohingya to move on, so, too, do the Rohingya

wish for an end to their refugee camp way of life. "'How long will we live like this?' Hasina

[Hatsu, a Rohingya man living in the camps in Cox's bazar] said. 'I don't think the world will

solve our condition.'"[10]

And yet, despite UN and US reports from 2012 - 2017 warning that violence was on the

horizon, there was no intervention for fear of derailing Burma's path to democracy.[11] In a 2021

talk discussing the International Inaction Over the Rohingya Crisis by YPF and Harvard

UNICEF, Muhammad Noor, founder of the Rohingya Project, points out that the "Rohingya are

designed to beg in every country. There's no pathway to a better life."[12]

Rather than wait while his fellow Rohingya are murdered and assaulted within Burma, or

"sold like fish"[13] as they attempt to cross the border and leave the country, Noor decided to take

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[7] Ismat Jerin and M. Mozumder, "Exploring Host Community Attitudes towards Rohingya Refugees in Bangladesh," *Intervention* 17 (November 28, 2019): 169–73, https://doi.org/10.4103/INTV.INTV_27_19.
[8] Nazmul Ahasan, "5 Years on, Rohingyas in Bangladesh Face Hostility and Dwindling Aid," Devex, August 25, 2022, https://www.devex.com/news/sponsored/5-years-on-rohingyas-in-bangladesh-face-hostility-and-dwindling-aid-103860.
[9] Jerin and Mozumder, "Exploring Host Community Attitudes towards Rohingya Refugees in Bangladesh."
[10] "Myanmar: No Justice, No Freedom for Rohingya 5 Years On," *Human Rights Watch* (blog), August 24, 2022, https://www.hrw.org/news/2022/08/24/myanmar-no-justice-no-freedom-rohingya-5-years.
[11] Justin Lynch, "Western Officials Ignored Myanmar's Warning Signs of Genocide," *Foreign Policy* (blog), 11, accessed October 6, 2022, https://foreignpolicy.com/2018/08/30/western-officials-ignored-myanmars-warning-signs-of-genocide/.
[12] *International Inaction Over the Rohingya Crisis by YPF and Harvard UNICEF*, 2021, https://www.youtube.com/watch?v=quV6XqvN0eE.
[13] "'Sold like Fish': Crimes against Humanity, Mass Graves, and Human Trafficking from Myanmar and Bangladesh to Malaysia from 2012 to 2015 - Malaysia | ReliefWeb," accessed October 6, 2022, https://reliefweb.int/report/malaysia/sold-fish-crimes-against-humanity-mass-graves-and-human-trafficking-myanmar-and.

action and come up with innovative ways to address the myriad of problems plaguing the Rohingya. His vision soon became realized when he founded the Rohingya Project and the R-Archive, a blockchain based initiative to help the Rohingya gain control of their own lives, documents, and history. In his memoir about the motivations behind the Rohingya Project, Noor says: "We cannot afford to wait forever for the generosity of the Burmese government or the international community while we are left to rot in statelessness."[14]

The Rohingya Project was founded with the goal of creating self- sufficiency for the displaced Rohingya people. Mohammad Noor further remarked that, for the Rohingya, "a birth certificate is a luxury, a passport is a super luxury."[15]

Burma saw a brief glimmer of a return to democracy following Aung San Suu Kyi's rise as leader of the nation in 2012. But by 2016, the military again took control, returning the country to censorship, and crushing any hope of relief for the Rohingya population.

And yet, the resistance is still fighting back. On April 11, 2023, a crowd gathered outside to celebrate the opening of a new resistance administration building in the small village of Pazi Gyi. The military junta jets swept overhead, dropping two 500lb bombs onto the gathering, intentionally destroying the new building and targeting the onlookers directly. When survivors rushed in to help the wounded, a combat helicopter flew overhead and shot at them. The attack killed 175 civilians, more than 40 of them children.

The massacre was traumatic, bloody, and violent. Shocked citizens across Burma began to express sadness, grief and solidarity with the victims by means of social media. Will Phyo changed his profile picture to a black square; pop singer "May Melody" May La Thanzin posted

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[14] Mr Muhammad Noor, *Born To Struggle: The Child of Rohingya Refugees and His Inspiring Journey*, ed. Mr Saqib Sheikh (Independently published, 2019).
[15] *International Inaction Over the Rohingya Crisis by YPF and Harvard UNICEF*.

a message of sadness on a black background; Poe Kyar Phyu Khin posted a video entitled "Daw Aung San Suu Kyi (Our True Leader)" to TikTok. And all of them were arrested within days. Some of them within hours.

The swiftness of the arrests is thanks to a channel on the messaging app Telegram. Telegram was founded in Russia in 2013 by two brothers, Pavel and Nikolai Durov. The pair was made famous (and exceptionally rich) by first creating the Russian social media platform Vkontakte (VK). But when Kremlin officials banded together to buy a majority of stock in the company, Pavel Durov was forced out as CEO. He sold his shares and fled to Germany. The Kremlin stunt was initiated because, according to Pavel, he would not relinquish user data to the government or stifle information being shared about Putin opposition leader Alexei Navalny.[16]

Telegram was created as an extension of the free speech services the Durovs sought to offer. As of 2023, Telegram has over 550 million active users and is one of the top ten most popular social networks in the world. The company is now based in Dubai.[17] In addition to messaging capabilities, Telegram users can also send secret, private messages as well as create open channels that any user can join. Despite Telegram's efforts to protect free speech, Han Nyein Oo, a supporter of the Myanmar junta and military rule, created a "snitch channel" to report any activity critical of the regime. The channel uses hive mind networking in the form of communal groupthink to reveal the identities of dissenters, leading to their immediate arrests. Since 2021, the military has arrested some 24,005 dissenters, of whom 19,618 are still detained.

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[16] "What Is Telegram? What You Need to Know about WhatsApp Alternative. | Mashable," accessed August 3, 2023, https://mashable.com/article/what-is-telegram-app.

[17] "How Many People Use Telegram in 2023? 55 Telegram Stats," Backlinko, March 27, 2023, https://backlinko.com/telegram-users.

"The crackdown in Myanmar, or Burma, shows once again how authoritarian regimes are turning the digital revolution to their own ends."[18]

Similarly, Facebook has been under fire for its promotion, or lack of crackdown, on hate speech against the Rohingya. Because of the government suppression of free speech as well as overt censorship, internet use in Burma is low despite widespread use of mobile phones. In 2011, after democratic elections were allowed to take place, mobile penetration was at 2%, with internet penetration at just .023%. By 2017, mobile penetration was at 93% and internet penetration at 26%. Despite low access to the internet, by 2014 Facebook had hundreds of thousands of users in Burma. Thanks to internet cafes and programs designed to help offer free data usage, Facebook became a main source of interaction and news for citizens of Burma. By 2018, Facebook users in Burma had skyrocketed to an estimated 20 million.[19]

> "Under decades of military rule, the population of Myanmar was denied access to diverse media and news sources, and opportunities to express their ideas and opinions were severely curtailed. The rapid transformation of Myanmar's telecommunications landscape and the sudden dominance of the Facebook platform occurred in a context in which digital media literacy was extremely low. As an American platform populated by trusted friends and family, Facebook was widely perceived as a reliable source of news and information. The IIFFMM [Independent International Fact-Finding Mission on Myanmar] observed that 'the Government's use of Facebook for official announcements and sharing of information further contributes to users' perception of Facebook as a reliable source of information.'"[20]

It therefore comes as no surprise that disinformation posted and spread about the Rohingya people in Burma was taken as fact by many within the country. These posts call the

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[18] "Opinion | First Came a Bloody Massacre. Then the Junta Silenced the Mourners.," Washington Post, July 28, 2023, https://www.washingtonpost.com/opinions/2023/07/28/myanmar-junta-telegram-resistance-snitch/.

[19] "Myanmar: The Social Atrocity: Meta and the Right to Remedy for the Rohingya - Amnesty International," accessed August 3, 2023, https://www.amnesty.org/en/documents/ASA16/5933/2022/en/.

[20] "Myanmar: The Social Atrocity: Meta and the Right to Remedy for the Rohingya - Amnesty International," 27.

Rohingya "Bangladeshi invaders" and sought to unite anti-Rohingya/Pro-Buddhist citizens in a push for their removal from the country.

An example of the spread of these hateful posts can be demonstrated in a post made by Dr. Tun Lwin, a meteorologist with over 1.5 million followers on Facebook, who "called on the Myanmar people to be united to secure the 'west gate' and to be alert 'now that there is a common enemy.' He further stated that Myanmar does not tolerate invaders. As of August 2018, the post had 47,000 reactions, over 830 comments, and nearly 10,000 shares. Several comments called for immediate 'uprooting' and 'eradication' of the Rohingya, citing the situation in Rakhine State as a "Muslim invasion.'"[21]

Such inflammatory posts are being made by both citizens and military officials alike. International human rights organizations such as Amnesty International are linking and documenting how the spread of online hate speech has contributed to actual violence. Intervention from multiple figures and organizations began in 2012 and involved several meetings with Meta, Facebook's parent company. David Madden, the founder of the Phandeeyar Foundation, made a presentation to Facebook staff members in May 2015. Afterwards he commented:

> "I drew the analogy with what had happened in Rwanda. There had been genocide in Rwanda, and radios had played a really key role in the execution of this genocide in Rwanda. And my concern was that Facebook would play a similar role in Myanmar, meaning it would be the platform through which hate speech was spread and incitements to violence were made. And so, I said very clearly to them that Facebook runs the risk of being in Myanmar what radios were in Rwanda. I said that very clearly; I said it very explicitly. It wasn't the last time that I said it. I said it on many occasions after that. But I think that was the first time that I had said it to them."[22]

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[21] "Myanmar: The Social Atrocity: Meta and the Right to Remedy for the Rohingya - Amnesty International," 28.
[22] "Myanmar: The Social Atrocity: Meta and the Right to Remedy for the Rohingya - Amnesty International," 52.

Despite the meetings, Facebook chose profit over regulation and the hateful posts continued. In response to the harm caused by the spread of misinformation and hate speech, Rohingya victims of violence and displacement now living in the UK and US are suing Facebook for £150 billion.[23]

Facebook and Telegram aren't the only purveyors of misinformation and hate. Twitter has seen a significant rise in hate speech since Elon Musk took over the company, touting his support for free speech and no censorship.[24] The Center for Countering Digital Hate compiled statistics showing Twitter's hate speech problem and released them online, only to be sued by Elon Musk for defamation.[25]

While technology has proven at times to be beneficial to the oppressed–Facebook and Twitter were essential tools during Egypt's 2011 uprising[26], for example– the lackluster responses of social media companies to the ways their platforms are used to promote human rights abuses, suggests they lack the will to counter such behavior, making it clear they prioritize their own profits and the collection of exploitable data over the wellbeing of an oppressed minority.

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[23] Dan Milmo and Dan Milmo Global technology correspondent, "Rohingya Sue Facebook for £150bn over Myanmar Genocide," *The Guardian*, December 6, 2021, sec. Technology, https://www.theguardian.com/technology/2021/dec/06/rohingya-sue-facebook-myanmar-genocide-us-uk-legal-action-social-media-violence.

[24] "Hate Speech's Rise on Twitter Under Elon Musk Is Unprecedented, Researchers Find - The New York Times," accessed August 3, 2023, https://www.nytimes.com/2022/12/02/technology/twitter-hate-speech.html.

[25] "Twitter Threatens to Sue Center for Countering Digital Hate Over Research - The New York Times," accessed August 3, 2023, https://www.nytimes.com/2023/07/31/technology/twitter-x-center-for-countering-digital-hate.html.

[26] Killian Clarke and Korhan Kocak, "Launching Revolution: Social Media and the Egyptian Uprising's First Movers," *British Journal of Political Science* 50, no. 3 (July 2020): 1025–45, https://doi.org/10.1017/S0007123418000194.

Centralized digital platforms have previously failed to protect Rohingya culture and

legacy. Even centralized archives lack documentation of the genocide in Burma. The Visual

History Archive by the USC Shoah Foundation, for example, holds over 50,000 files related to

the Holocaust but only 11 related to the Rohingya.[27] Our current structure of digital data storage

mostly relies on corporate social media sites or cloud storage, essentially relying on private

companies with no obligation to protect the rights of its users. A decentralized digital platform

and trust technology may be the key to preserving the records that are some of the only

remaining evidence of Rohingya presence and culture within Burma.

Historically, professional codes of ethics have sought to maintain neutrality in archives,

representing them as trustworthy places that are inherently apolitical, although this could not be

further from the truth. Records are inherently political, especially if they back up a history that an

oppressive regime wishes to suppress or erase. In the case of a persecuted minority, mundane

records such as house titles, land deeds, and driver's licenses can become problematic evidence

of long-term presence and prior recognition within a nation or geographic space. In the case of

the Rohingya, both mundane records and social media have been used to pursue, mischaracterize

and sabotage them. And yet, despite digital resources frequently being used as a tool to

perpetuate hate and erase Rohingya records, Mohammad Noor and the Rohingya Project see a

potential answer in developing an online digital archive to collect and preserve records of their

existence.

In this thesis, I examine the Rohingya Project's Arweave-based R-Archive and argue

that, while the R-Archive may have shifted strategies and goals away from blockweave, the use

of this technology is a creative solution to the erasure of Rohingya culture, records, history, and

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[27] "Rohingya Historical Archive Pilot Report," Rohingya Project – Financial and Social Inclusion Platform for Stateless, March 11, 2022, 4, https://rohingyaproject.com/rohingya-historical-archive-pilot-report/.

existence and may serve as an important model for future uses of blockweave. While this particular usage of the technology is novel, bringing with it ethical considerations as well as technological barricades, it is also an act of resistance to choose a technology that puts the control of the archive's contents directly into the hands of the Rohingya.

This thesis first provides an overview of the history of the Rohingya people within Burma, and of the ways in which recordkeeping and documentation have been used to erase and replace their identities. It then introduces the R-Archive project and discusses the Blockchain-based Arweave technology upon which it is based, presenting an analysis of the technology based on interviews and conversations with those working with the R-Archive and information professionals working in the field of blockchain in the archives. It raises several outstanding concerns about the use of Arweave, including accessibility, the ethics of using a complicated technology in an area where digital literacy is low, permanent digital data storage, and its future as quantum computing presents the real risk of breaking encryption. It goes on to outline the potential benefits, including putting the control of the archive into the hands of those using it, specifically in this case, the Rohingya. And finally, it explores the future of the technology as the R-Archive shifts away from a blockchain based solution.

Research design

In order to understand the technology, as well as the ongoing persecution in Burma, I interviewed members of the R-Archive team, and information professionals outside of the Rohingya Project who are exploring the many potential archival uses of blockchain and blockweave technology. Interviews occurred over Zoom and through asynchronous conversation

through email and WhatsApp. WhatsApp uses end-to-end encryption, meaning the messages are encrypted on both the side of the receiver and the sender, and WhatsApp does not allow back door access of data and messages to law enforcement or government officials. This ensured the security of the interviewees, in particular Rohingya Project founder Muhammad Noor. For this reason, interviews were also not recorded.

Through these conversations, I sought to understand the challenges faced by the R-Archive team, how data collection in the refugee camps had been conceptualized and designed, the ethical considerations of using this technology, and get both an inside and outside perspective on the use of this technology in the field of information science.

Prior to the interviews, I wrote a set of questions[28] to ask each person I spoke to. However, once I began speaking to each person, I realized my questions didn't go deep enough, and each interview organically evolved into more casual conversations based on each interviewee's strengths, especially as I gained a better understanding of the technology. I initially sent these questions to interviewees associated with the R-Archive, including Saqib Sheikh, Muhammad Noor, and Phillip Kothe. However, after initial conversations, I discontinued sending these questions prior to the interviews.

In addition to interviews, I watched recorded talks on blockchain in the archives, Arweave, and the Rohingya, many given by those I interviewed, as well as read their works on the topic.

Dr. Anne Gilliland, professor of archival studies at the University of California, Los Angeles, as well as my thesis committee chair and advisor, works directly with the Rohingya Project and the R-Archive. She introduced me to those working directly with the project, or who

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[28] See Appendix B for the list of questions.

were studying the use of blockchain in archives, including Mohammad Noor, founder of the Rohingya Project; Saqib Sheikh, co-founder of the Rohingya Project; Phillip Kothe, blockchain architect for Datarella, a Web3 company builder, and the Rohingya Project; Dr. Victoria Lemieux, professor of archival science at the School of Information at the University of British Columbia and lead of the Blockchain research cluster, Blockchain@UBC; Dr. Greg Rolan, fellow in the Artificial Intelligence for Law Enforcement and Community Safety (AiLECS) Lab in the Faculty of Information Technology at Monash University; and James Lowry, founder and director of the Archival Technologies Lab, and Assistant Professor at the Graduate School of Library and Information Studies, Queens College, City University of New York.

Victoria Lemieux connected me with Amber Gallant, project manager of the Guardians of the Record Lab at Blockchain@UBC; And Dr. Bea Ellis, assistant professor of mathematics at Texas State University connected me with Dr. William Maxwell, postdoctoral fellow in Quantum Computing at Sandia National Laboratories.

In addition to these interviews, I watched recorded talks given by Phil Mataras, CEO of Ar.io, a decentralized network of gateways and permanent domains for Arweave; Sam Williams, founder of Arweave; Victoria Lemieux; Mohammad Noor; Anne Gilliland; and Saqib Sheikh.

I also compared the R-Archive project's goals of a private, decentralized archive to Arweave's own public, decentralized collection of records pertaining to the Russian invasion of Ukraine. While both projects had similar goals–to collect data that is in danger of being lost and evidence of war crimes and wrongdoing by a government and its military–Arweave's collection of Ukrainian documents and records was crowdsourced and didn't require the encryption needed for safety reasons by the R-Archive's private version. It was therefore important to consider both of these projects' difficulties and successes in relation to traditional archiving methods.

Finally, I read extensively on Blockchain, Arweave, Burmese history, and the plight of the Rohingya, as well as the memoirs of Habiburahman, a Rohingya refugee currently living in Australia, and Mohammad Noor.

As I was writing this thesis, the Rohingya Project shifted development priorities from the Arweave-based R-Archive to developing an Open Library that was modeled on a similar Palestinian initiative and using another software environment, FileCoin. In order to understand this shift and the future of the R-Archive project, and to discuss further the future of Rohingya archiving using the blockchain or blockweave, I sent an additional short list of questions to Saqib Sheikh and Mohammad Noor.[29]

Background

History

Arakan is situated along the coast of the Bay of Bengal, separated from the Kingdom of Burma by a treacherous, nearly impassable coastal mountain range. Historically, Arakan was not particularly powerful and wavered between dependance on Burman rule, independence, or control of the Bengal region. In 1784, it was officially annexed by the Kingdom of Burma[30] after Burmese invasion.

This takeover was in direct conflict with the British, who had their eyes on Arakan due to its proximity to India. After the British defeated Burma in the first Anglo-Burmese war in 1826,

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[29] See Appendix A for the list of questions.
[30] Azeem Ibrahim, *The Rohingyas: Inside Myanmar's Hidden Genocide* (London: Hurst & Co., 2018), 56.

Arakan was handed over to the British. By 1880, the British had also conquered Burma and occupied the entire region.

Arakan was the home of the Rohingya, as well as the Rakhines, a Buddhist population that speaks Rakhine, a language very close to Burmese. In 1989 the military junta changed the name of Arakan to Rakhine state. The government recognizes the Rakhines as citizens.

Burma, in comparison to Arakan, was militarily aggressive and had conquered and controlled areas of modern day Thailand, Laos, Bangladesh, and India. Its defeat by the British was demoralizing, but "the ultimate humiliation for many Burmese Buddhists at this time came when the British, during December 1885, exiled the last Burmese king, Thibaw, to India."[31] Burmese resentment of the British was further deepened as they tended to favor Muslims for roles within the colonial administration. This of course contributed to a resentment of Muslims in general, of which the Rohingya bore the brunt.

While some Indian Muslims did migrate to Burma during British rule, the Rohingya had already been there. British census reports, done during their occupation to better understand the people of the region, list individuals who referred to themselves as "Rovingaw" or "Rooinga." Even earlier still, Scottish physician Francis Buchanan made reference to 'Rooinga' as he surveyed the area in 1799.[32]

Therefore, Burmese claims that the Rohingya were immigrants that came to the region during the British occupation are untrue; knowing this history is vital to understanding why the Rohingya are in the position of denied citizenship and forced displacement today. Trying to understand hatred is often futile; it certainly is in this case. We can analyze the history of the

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[31] Ronan Lee and José Antonio González Zarandona, "Heritage Destruction in Myanmar's Rakhine State: Legal and Illegal Iconoclasm," *International Journal of Heritage Studies* 26, no. 5 (May 3, 2020): 519–38, https://doi.org/10.1080/13527258.2019.1666294.

[32] Ibrahim, *The Rohingyas*, 56.

region, understand that the Rohingya language is Indo-Aryan, from the Bengali-Assamese branch and that it descended from pre-ninth century inhabitants of the region. We can know that the Buddhist Rakhine Burman peoples did not arrive in the region until the ninth century,[33] much later than the Rohingyas. And yet, Burmese resentment of the economic advancement enjoyed by the Indian Muslims who traveled to Burma during British occupation is still directed at the Rohingya people.

Burma broke free of British rule following Japanese invasion, which caused a collapse of the British governmental presence in Burma. Following the end of World War II, the British again took control over Burma until an independence movement pushed the British out in 1948. For the brief period of 1948 - 1962, free Burma was a democratic and diverse nation that acknowledged and appreciated its multicultural, multiethnic qualities. The independence movement had been led by Aung San, father of future ruler of Burma, Aung San Suu Kyi. However, their free democracy was short-lived. In 1962 a military coup ended with General Ne Win rising to power. The military set Burma on a path to socialism, locked the borders, imprisoned 8000 intellectuals, and plunged the country into poverty.[34]

Burma then became a single party system. "Who might be considered foreign was determined by the military-led government not by reference to existing citizenship laws but based on the military government's view that Bamar ethnicity and the Buddhist religion ought to be considered the norm of national identity."[35] In 1974, the Burman government began requiring ethnicity-based identity cards; the Rohingya were only eligible for Foreign Registration cards. In 1982, the Burmese Citizenship Law was enacted. This law dictated Burmese citizenship based

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[33] Ibrahim, 61.

[34] Mark Tallentire, "The Burma Road to Ruin," *The Guardian*, September 28, 2007, sec. World news, https://www.theguardian.com/world/2007/sep/28/burma.uk.

[35] Lee and González Zarandona, "Heritage Destruction in Myanmar's Rakhine State," 525.

on presence in the country prior to British rule in 1823.[36] Despite indisputable evidence proving

the long presence of the Rohingya, the government declared them foreign invaders, claiming

they had come from Bengal during British rule.

From 1974 onward, the military enacted operations to "purify" the population, striving to

create a more Burman and Buddhist population. Habiburmam remembers in his memoir:

> "Over the years, the names of the operations have become increasingly
> pompous and outlandish. In 1959, the army baptised the operation Shwe
> Kyi (Pure Gold). In 1966, it was Kyi Gan (Crow), followed by Ngazinka
> (Conqueror) and Myat Mon (More Purity) between 1967 and 1971. 1973
> witnessed the launch of Operation Major Aung Than (Millions of Success),
> followed by Sabae (Purify and Whiten like the Jasmin Flower) a year later.
> From 1978 to 1979, the terrifying Operation Nagamin (Dragon King) was
> implemented, followed by many others. And finally in 1982, the despotic,
> irrevocable citizenship law. 'Rohingya' has become a forbidden word,
> never to be uttered, sentencing the men and women who bear this name to
> capital punishment."[37]

The history of the region helps explain the origins of the conflict, but certainly not the

hatred. When I first learned of the plight of the Rohingya, I knew they were often referred to as

"the most persecuted people on earth." I was not prepared for the details, the individual stories

that are often confined within the borders of Burma due to tight regulations and censoredship.

Stories of Rohingya walking all the way from Rahkine state to Saudi Arabia; of men gathered

and put onto boats and sunk; of homes burned, women raped, and men murdered in the streets.

Aung San Suu Kyi had long been a source of hope for democracy and equality in Burma.

After military dictator General Ne Win stepped down on August 8, 1988 (8-8-88), calls for

democracy exploded around the country. In response, Aung San Suu Kyi started the political

party the National League for Democracy (NLD). But the uprisings were quashed and a new

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[36] Ibrahim, *The Rohingyas*, 123.
[37] Habiburahman et al., *First, They Erased Our Name*, 76.

military junta was installed. Two years later, in 1990, despite the NLD winning a majority of the vote, the military refused to hand over power. From 1989 - 2010, Aung San Suu Kyi was frequently under house arrest by the military junta, totaling nearly 15 years of the 21 year span.

The NLD boycotted the 2010 elections, proclaiming them to be unfair. In 2011, the military junta was dissolved, and by 2012 the NLD won 43 of the contested seats and 65% of the popular vote. Aung San Suu Kyi won the Nobel Peace Prize in 1991 and was declared one of "The Children of Gandi" by Time magazine in 1999, due to her commitment to nonviolent tactics in promoting democracy in Burma. Citizens rallied behind her and imagined a return to a secular, democratic nation.

Instead, Kyi refused to acknowledge any ill treatment of the Rohingya people. Habiburahman again remembers in his memoir:

> "Murders, rapes, arrests, kidnappings, lootings, houses set ablaze, and mass graves were masked to the world by the joy of finally seeing the grande dame of democracy set free. My people disappeared in the euphoria of a new age of democracy in Myanmar. Genocide was a taboo word, and the Rohingya, once again, did not exist. [...] [Aung San Suu Kyi] had the power to save lives. She was free, and the world was listening. She had the power to choose justice and tolerance, and show people what a democracy was. But Aung San Suu Kyi chose power."[38]

The Rohingya Project and the R-Archive

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[38] Habiburahman et al., 238.

Before his family fled Myanmar last year, Nurul Hoque dug up his grandfather's old ID, taking it with him to Bangladesh along with old photos and his own identification cards. He hopes they will one day help prove where he is from.[39] Photographs and identity cards such as these are what the R-Archive strives to digitize and preserve. Image courtesy Verena Hölzl and The New Humanitarian.

In a conversation with Saqib Sheikh, he said the Rohingya people are easily the "largest victims of centralized institutions." The 1982 Citizenship law effectively made the Rohingya people stateless in their own home country. Dictator Ne Win stated in a speech that "racially, only pure-blooded nationals will be called citizens."[40] The restrictive citizenship law declared who was *ethnically* Burmese, rather than who was nationally so. It was based on the British

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[39] "The New Humanitarian | Identity and Belonging in a Card: How Tattered Rohingya IDs Trace a Trail toward Statelessness," accessed April 19, 2023, https://www.thenewhumanitarian.org/feature/2018/03/01/identity-and-belonging-card-how-tattered-rohingya-ids-trace-trail-toward.

[40] Hein, "The Re-Ethnicisation of Politics in Myanmar and the Making of the Rohingya Ethnicity Paradox," 269.

census done in 1824 upon their annexation of lower Burma. According to Rakhine historian Dr. Aye Kyaw, who worked with Ne Win and legal expert Dr. Maung Maung in developing the citizenship law of 1982, when evaluating the census "we found no such word as Rohingya in the survey;"[41] thus declaring their new law just.

The continuous stripping and revisions of rights, records, and other forms of identification that support the historical and continuing presence of Rohingya by the Burmese government has resulted in their statelessness. Many live in dire conditions in refugee camps and asylum seekers have no clear path to citizenship or a resolution. Without documents proving their identities or their very existence, the Rohingya face huge obstacles preventing them from working, becoming educated, having bank accounts, or legally traveling. As a result, even the Rohingya who have managed to leave Burma are often unable to legally work in the countries in which they settle.

To address these issues, the Rohingya Project has created a number of technology- and education-based initiatives to help the Rohingya directly. These initiatives include R-ID, a digital identity key "based on self-sovereign principles that each individual user should be allowed to control their own data and decide which data or credentials should be accessed by third parties;"[42] R-Coin, a cryptocurrency token intended to pay those living in the camps for their volunteer services using a currency that exists outside of traditional banking; the R-Academy, which offers online education and training resources to those in refugee camps as well as other marginalized populations; and finally, the R-Archive or Rohingya Archive, a blockweave- based, post- custodial digital archive. The R-Archive seeks to protect Rohingya heritage and history,

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[41] Hein, 269.

[42] "R-ID," Rohingya Project – Financial and Social Inclusion Platform for Stateless, accessed October 8, 2022, https://rohingyaproject.com/r-id/.

preserve important documents that can serve as evidence of Rohingya historical presence in Burma, as well as the evidence of oppression and genocide of the Rohingya by the Myanmar government for potential future legal action.[43] Due to the multi-generational dispersion of Rohingya refugees in Bangladesh, Malaysia, Saudi Arabia, Pakistan, and other countries, and the horrific living conditions many Rohingya face, their culture is in danger of being lost.

The R-Archive seeks to collect and preserve any documents that the Rohingya have saved, collected, or carried with them. This includes personal documents, such as photographs and letters, legal documents that may be unrecognized by the Burmese government that show proof of identity, such as birth certificates, old passports or ID cards, and marriage certificates, as well as land and property deeds.[44]

Initially, the R-Archive sought to preserve these documents over the blockchain. However, as the R-Archive was being imagined, cryptocurrencies were booming. With Bitcoin hitting an all-time high of $68,789.63 in 2021, only to crash down to $15,787.28 in 2022, those working on the R-Archive pilot realized that blockchain was too expensive and volatile and did not provide long term financial sustainability. Instead, the project turned to Arweave, which claims to offer permanent, affordable storage of documents forever. Dubbed the "Permaweb," Arweave relies on a variation of blockchain called blockweave.

The R-Archive's pilot began in 2021 and depended on Rohingya refugees living in the camps to serve as paid field workers, gathering records and associated information, digitizing them, and entering them into a database. Due to ongoing conflict, collection of data was focused

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[43] Saqib Sheikh et al., "Distributed Records in the Rohingya Refugee Diaspora: Arweave and the R-Archive," *Journal of Documentation* 79, no. 4 (January 1, 2022): 813–29, https://doi.org/10.1108/JD-08-2022-0174.

[44] "Rohingya Historical Archive Pilot Report."

on countries with significant Rohingya populations outside of Burma, including Bangladesh, Saudi Arabia, and Malaysia.

The data collection forms and workflow were developed by Saqib Sheikh and Muhammad Noor in collaboration with Anne Gilliland and James Lowry. Many issues had to be addressed in the process, including the range of historical documents and issuing authorities, the provenance of documents presented, language and script concerns, and how to validate the reliability of the documents presented for digitizing, as well as of the digitized documents.

This workflow was designed to be completed within refugee camps where electricity, internet, time, and the personal safety of those contributing documents and of the field officers were all key concerns. When field workers reported that, even with these considerations in mind, the questionnaire about the records was too long to be completed in the field, the R-Archive team worked to come up with solutions. This included easier to complete forms, and adding an offsite, dedicated metadata specialist to enter more detailed information at a later date, when translations and documentary details could be checked. Even with those changes, this left the project up to future evidentiary challenges.

Audio or video recordings were also made at the time of digitization with the permission of the Rohingya contributors. As part of the document collection process, the field officers were trained to administer and record a formal informed consent process. 42 documents and 25 video and audio testimonials were initially collected and stored.[45]

Files were uploaded to the blockweave in two transactions–the metadata, in JSON, and the scanned image itself. Arweave uses an interface accessible through a web browser for file management.

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[45] Sheikh et al., "Distributed Records in the Rohingya Refugee Diaspora," 819.
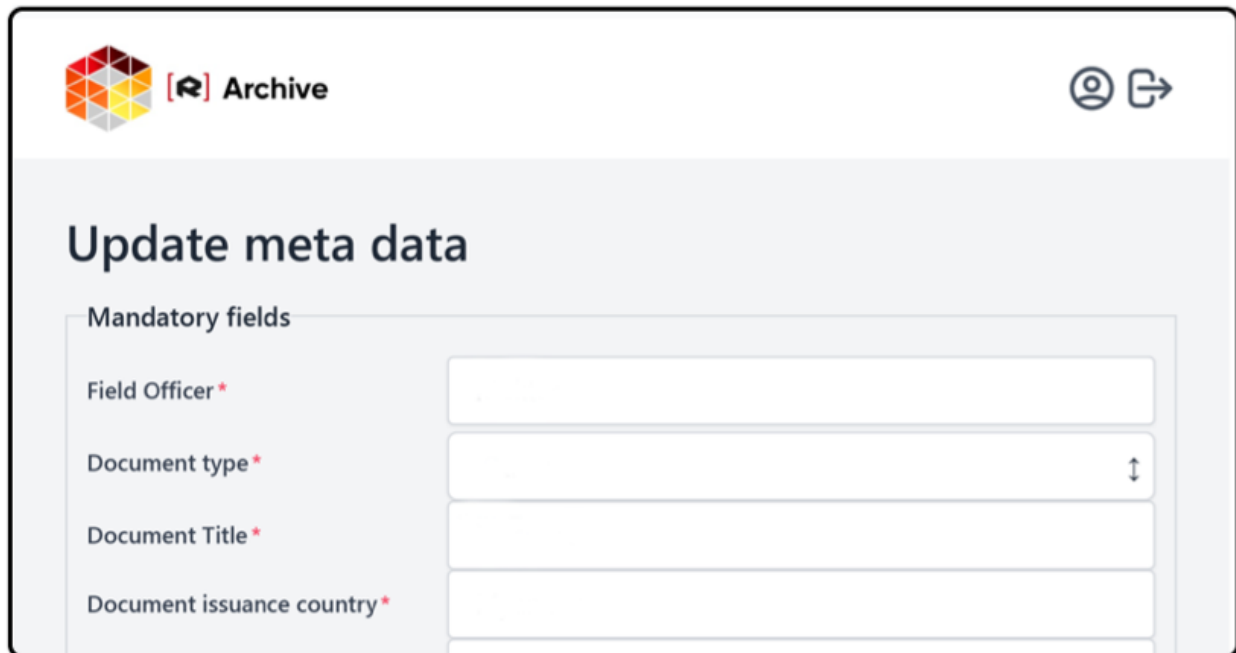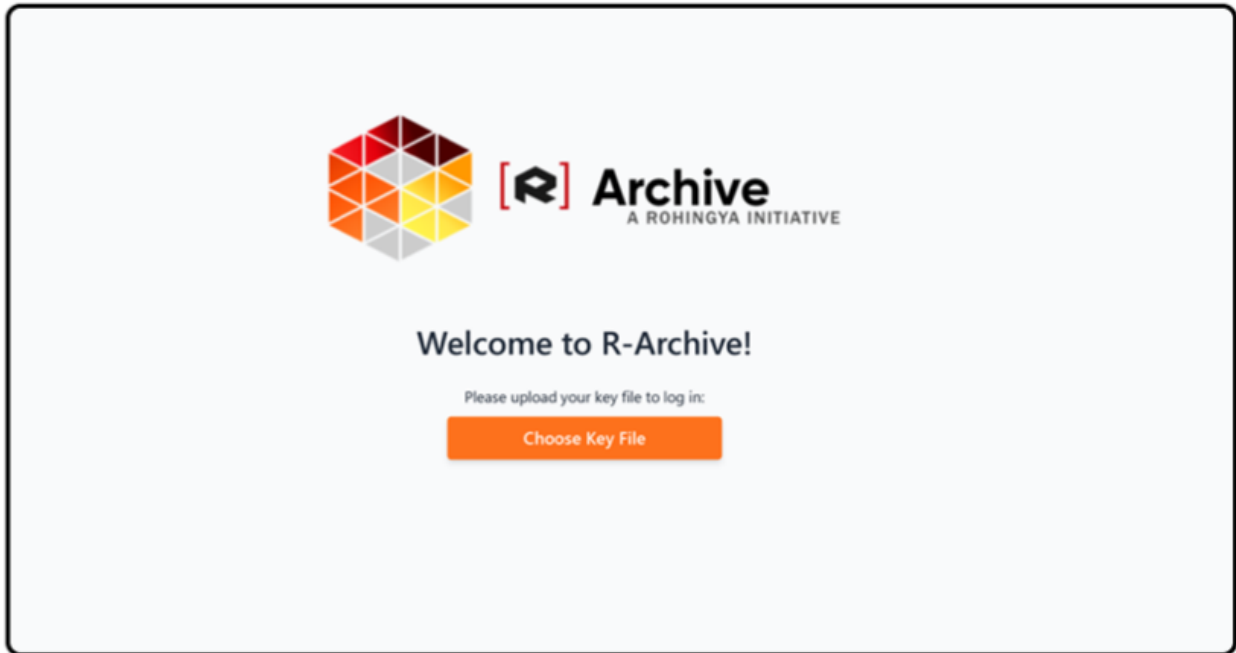
Screenshots from the R-Archive upload page

Files are uploaded fully encrypted, using AES-256-GCM encryption, and can be

decrypted by uploading a key into the R-Archive application at download. Arweave is open

source and boasts the ability to store large amounts of data in each block on the weave. This is in stark contrast to blockchain which holds the history of every transaction in each block, leaving very little room for much else than the ledger and hash information.

If, after upload, an error was found, such as a typo or incorrect piece of metadata, an entirely new transaction must be uploaded to the weave, keeping a clear provenance in place. While uploading files onto the blockweave does not inherently ensure that they are authentic or accurate files, once on the block it can be guaranteed that they have not been altered or tampered with in any way.

Additionally, the original physical records are not kept by the R-Archive; the documents are scanned, metadata is recorded, and the original is given back to the contributor. This is in contrast to a majority of archives, which are located in a physical location, although some post-custodial digital archives, such as the South Asian American Digital Archive (SAADA), do exist. A post-custodial archive is one that doesn't retain the original records or documents after digitization and storage, instead stewarding a digital surrogate of a record.[46] This approach does raise important issues for an archive that is going to be used for legal purposes, however.

Within traditional archives, the onus of preservation is on the archive that will house, organize, and describe collections that will then be held by the institution, presumably in perpetuity. Housing the physical materials can be a strain on a community archive, which likely relies on funding from donations or grants to pay for both the space and labor to maintain the collections. Additionally, a centralized archive relies on a brick and mortar location; even in the case of a post-custodial archive, servers must be stored somewhere with access to utilities and a team dedicated to preserving its holdings. Considering the Rohingya, who are scattered across

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[46] Michelle Caswell, *Urgent Archives: Enacting Liberatory Memory Work*, Routledge Studies in Archives (Abingdon, Oxon ; New York, NY: Routledge, 2021), 8.

the world, with many in refugee camps, a centralized archive would be nearly impossible to implement and maintain, let alone access. It would also make their documents and records far more vulnerable to destruction or theft by the hands of Burmese government officials, or anti-Rohingya citizens.

Thus a post-custodial option such as Blockweave, which has no concentrated collection of documents and records, is a very attractive alternative to a traditional archive. This is true even when compared to a centralized post-custodial archive, which could still be vulnerable to cyber attacks or hacking due to its centralized storage of data.

Blockchain versus Blockweave

Blockchain technology has not been without its share of controversy. It is associated primarily with cryptocurrencies, which are digital, decentralized currency tokens such as Bitcoin, and non-fungible tokens (NFTs) that tend to be tradable, original, digital art pieces that are minted and stored along a blockchain. It is often associated with those working in the tech or finance industries, and also frequently portrayed as a scam, a pyramid scheme, unregulated, and unstable. Some of blockchain's negative reputation comes from society's inability to envision other uses for the technology besides to support cryptocurrencies, although many other implementations have been developed.[47]

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[47] In fact, there is even a website run by 28 year old Wikipedia editor, software developer and cryptocurrency skeptic, Molly White, with the sole goal of compiling examples of blockchain fitting into the aforementioned negative characteristics called, sarcastically, "Web3 is Going Just Great." "First She Documented the Alt-Right. Now She's Coming for Crypto.," *Washington Post*, accessed May 31, 2022, https://www.washingtonpost.com/technology/2022/05/29/molly-white-crypto/.

Despite the criticism, blockchain is a fairly simple technology with many uses outside of cryptocurrency or NFTs. In essence, it is a glorified ledger system that keeps track of transactions, whether that be buying or selling cryptocurrencies, selling art, or, as in the R-Archive, storing documents in a secured way.

At its core, blockchain is a digital database of records, also known as blocks, that are linked together in a chain-like manner using cryptographic techniques. Each block contains a unique identifier, a timestamp, and a set of transactions. The blocks are linked together in a chronological order, and once a block is added to the chain, it cannot be altered or deleted without the consensus of all the network participants.

The difference between other ledgers, such as bank transaction records, and blockchain is that blockchain is immutable, meaning that it cannot be unilaterally changed, due to its decentralization. It is not controlled by one entity, but rather is owned by everyone that uses the blockchain. The network is maintained and validated by a network of nodes or computers that communicate with each other using a peer-to-peer protocol. Each node on the network has a copy of the entire blockchain ledger, and every time a new block is added to the chain, it is broadcasted to all the nodes on the network. This works well as a security feature, but it also requires a lot of computing power to verify and store the blocks.

To add a new block to the blockchain, the transactions are first verified and validated by Bitcoin miners using complex mathematical algorithms. Once a transaction is validated, it is added to a block, and the block is broadcasted to the network for confirmation. The confirmation process involves other nodes on the network independently validating the block and verifying the transactions within it. Once a sufficient number of nodes have confirmed the block, it is added to the blockchain, and the transactions within it are considered to be finalized. This is how new

Bitcoins are created; the miner who successfully solves the math problem and verifies the transaction is granted Bitcoin as payment.

Each block along the chain stores data within. It's usually a small amount of data, such as the amount of Bitcoin sold. For example: Transfer of .25 Bitcoin from wallet 0001 to wallet 0002 on September 1, 2022 at 2:43pm. The data stored must be small because each node of the blockchain stores the data of the entire chain within. What elevates blockchain from an ordinary storage method to one of high security, however, is the inclusion of its chain neighbor's hash number.
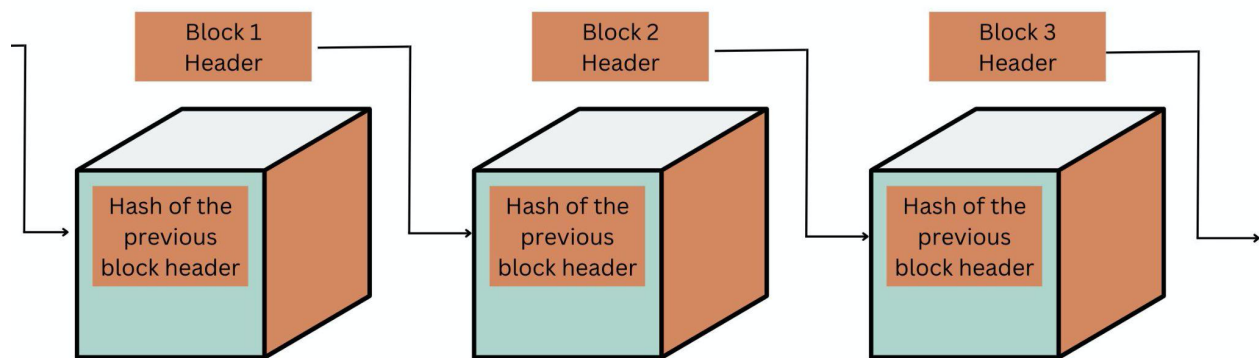

Diagram illustrating the hash number generation and storage in blockchain.

The hash number is generated by a simple algorithm that generates a number based on the contents of the block. If a block were to be tampered with in any way, the neighboring chain's hash number would no longer match, breaking the chain at that block. It would then be incredibly obvious that a block was tampered with and where it's located along the chain. This simple feature makes blockchain an ideal technology for security.

Because every node on the network has a copy of the entire blockchain ledger, it is possible for anyone to view the transactions that have been recorded on the blockchain. This makes it an ideal tool for industries such as finance, where transparency and accountability are crucial, or in this casem archives, where trust in the authenticity of the record is vital.

Once created, a block stored along the chain cannot be altered or edited in any way, meaning that any mistakes must be righted with a new transaction, creating a record of changes to the chain. Continuing with the above example, if the holder of wallet 0001 meant to send .025 bitcoin rather than .25, wallet holder 0002 must send 0.225 bitcoin back in a second transaction. What may seem like a minor inconvenience instead creates a very visible, unchangeable chain of custody, and in doing so, creates a highly secure and digitally preserved database. Every participant on the blockchain holds a bit of the blockchain in their wallets through the hash numbers of the transactions on the other side of each block. Which means that should a chain be tampered with and a hash number altered, the chain would still exist unaltered on the bit of the chain's history that is held by everyone who has ever made a transaction.

Blockchain stores the entire record of the chain in each block. Because of this, storing large amounts of additional data in a blockchain block is not efficient; it is best used as a financial ledger. Arweave, in comparison, stores the hash of a random block, freeing up space and allowing for much more space for storing records and documents. Arweave even touts its ability to store apps, podcasts, and other bulky media.

Blockchain is verified and new tokens/blocks are created by a process called mining. Using either proof of work, which involves computers solving complex math equations, or the more energy efficient and secure proof of stake, in which token/coin holders validate block

transactions at random based on the number of staked coins,[48] miners verify transactions and earn coins in return.

Apart from its association with cryptocurrencies, criticism of blockchain has revolved around the high energy consumption associated with building the blockchain and the cost per transaction. In 2022 it was estimated that "One bitcoin transaction takes 1,449 kWh to complete, or the equivalent of approximately 50 days of power for the average US household. To put that into money terms, the average cost per kWh in the US is close to 12 cents. That means one bitcoin transaction would generate an energy bill of approximately $173."[49]

That is obviously not a feasible solution for a small, community-based archive with limited resources. In part because other Rohingya initiatives were already using the technology, R-Archive developers first investigated the use of blockchain before discovering the innovative, variant form of the technology called blockweave, developed by Arweave.

Arweave's architecture is unique compared to other blockchain-based storage networks. Rather than having the hash numbers in the block sequence relate to the blocks on either side, it instead calculates the hash number of a random block anywhere on the chain. This adds yet another layer of security against attempted hacking or block alteration. Rather than a chain, the blocks are woven together, hence the name blockweave. Blockweave is a combination of blockchain and directed acyclic graph (DAG) technology. This structure enables Arweave to provide fast and efficient storage, as well as a high level of scalability.

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[48] "What Does Proof-of-Stake (PoS) Mean in Crypto?," Investopedia, accessed October 3, 2022, https://www.investopedia.com/terms/p/proof-stake-pos.asp.

[49] Oscar Gonzalez, "Bitcoin Mining: How Much Electricity It Takes and Why People Are Worried," CNET, accessed October 9, 2022, https://www.cnet.com/personal-finance/crypto/bitcoin-mining-how-much-electricity-it-takes-and-why-people-are-worried/.
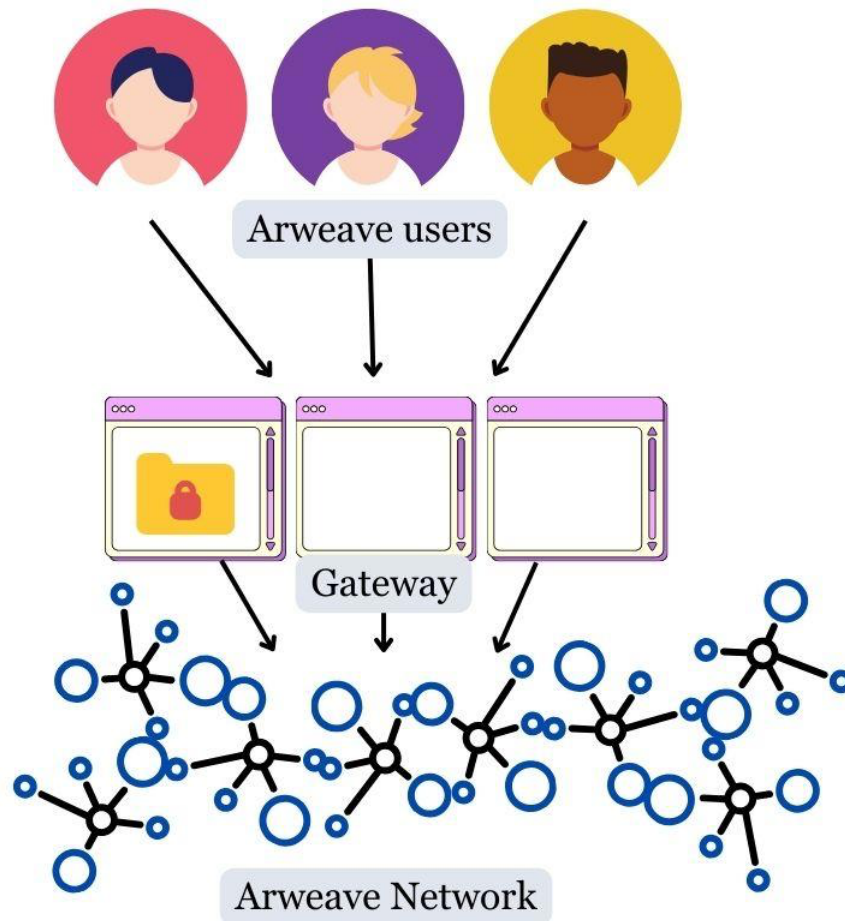
Illustration depicting how user data is uploaded to the Arweave via an app accessible in a web browser (Gateway). Private files will be encrypted before upload to the Arweave network.

The Arweave network is maintained and validated by a network of nodes that communicate with each other using a peer-to-peer protocol. These nodes are incentivized to maintain the network by earning AR tokens, which can be used to pay for storage fees or exchanged for other cryptocurrencies.

The storage of data on the Arweave network involves a one-time fee that is significantly lower than traditional cloud storage services. This low cost makes Arweave an attractive option for long-term storage needs. Arweave assesses the fee based on the size of the data being stored and the amount of time the data needs to be stored.

Arweave's model is based on "paying once, storing forever."[50] When a user stores data on the Arweave network, they pay a one-time fee. This fee is used to incentivize nodes on the network to store the data permanently. As of April 2023, the fee to use Ardrive to store data is $7.50 per gigabyte. This fee will drop over time as the network increases its overall capacity, meaning the more people use Arweave, the cheaper it becomes. Once the data is stored, it is available on the permaweb indefinitely.

The permaweb is a permanent and decentralized version of the traditional web. It allows users to store data and web content on the Arweave network permanently, without the need for constant upkeep and maintenance. This makes it an ideal option for businesses and individuals who want to create a permanent and verifiable web presence. In the case of the R-Archive, it provides long term stability for the storage of documents owned by people whose lives are in constant upheaval and lacking consistent access to archives, or other more typical data storage methods.

The permaweb is created by storing the content of a piece of data, in the case of the R-Archive, a photograph or ID card, for example, in a transaction on the Arweave network. The transaction includes the data being stored, as well as metadata that describes the data. The technical metadata includes the content type, content length, and content hash. The content hash is used to identify the data being stored on the network.

To access data on the permaweb, users can use an Arweave Gateway, or Ardrive. The gateway is a decentralized web server that retrieves data from the Arweave network and serves it to users through a traditional web interface. This allows users to access data on the permaweb without the need for any specialized software. The R-Archive uses its own gateway, Ar.io, a web

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[50] Sam Williams et al., "Arweave: A Protocol for Economically Sustainable Information Permanence," 2021, https://www.arweave.org/yellow-paper.pdf.

based access point to the R-Archive's blockweave. A user can access the entry point from anywhere, upload their encryption key, and download their data.

Arweave also provides a developer-friendly platform for building decentralized applications (dApps). The platform provides a range of developer tools and application programming interfaces (APIs), making it easy for developers to create and deploy dApps on the Arweave network. Developers can use the Arweave platform to create decentralized storage applications, decentralized social media platforms, and other decentralized applications.

One of the key features of Arweave is its consensus mechanism, called "Proof of Access." When a user stores data on the Arweave network, they pay a one-time fee to the network. This fee is used to incentivize nodes on the network to store the data permanently.

The Proof of Access consensus mechanism works by randomly selecting nodes on the Arweave network to validate and store new transactions. These nodes are responsible for verifying the authenticity of the transactions and adding them to the network. The nodes are incentivized to perform this function by earning AR tokens. This system also ensures that data stored by Arweave miners is kept active and up to date; those storing data that become inactive do not earn tokens. "In short, Arweave requires each computer taking part in the network to check that a new bundle of transactions also contains a randomly selected marker from an earlier bundle."[51]

A miner can store as much or as little data as they please. However, those storing larger amounts will have a higher chance of mining the next block and earning more AR tokens. The data on the weave is broken into small pieces and dispersed to many miners across the chain

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[51] "What Is Arweave (AR) | Kraken," accessed April 19, 2023, https://www.kraken.com/learn/what-is-arweave-ar.

many times over. This ensures that no one has complete access to the stored data, but that there are plenty of copies of the data should someone stop mining or run into a technical difficulty.

Each miner stores only a small amount of the data uploaded to the blockweave. In contrast to traditional blockchains where every node stores the entire chain, resulting in a massive amount of data with a very high cost. "Storing 1 MB on Ethereum would set you back at least 5000USD in gas fees. In contrast, storing a 1 MB on Arweave will cost you only less than 0,03 USD in $AR."[52]

Anaylsis

I first heard about archival applications of blockchain during a Management of Digital Records class in graduate school in which guest speaker Victoria Lemiuex, professor of archival science at the School of Information and lead of the Blockchain research cluster, Blockchain@UBC at the University of British Columbia, gave a talk on the subject. I was intrigued, but very skeptical of its place in the field. I was working at a small, volunteer-run archive that was struggling to transition from bits of data on hard drives and various spreadsheets to a functioning Digital Asset Management System. Most of its archival holdings were in banker's boxes that were slowly leeching acid into their records. I couldn't help but wonder what place the lofty aspirations of blockchain had in the real world of archives, and especially in community-driven archives that often rely on external funding and volunteer help to stay afloat.

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[52] Philipp Kothe, "The Immutable Rohingya Archive," *DATARELLA* (blog), October 26, 2021, https://datarella.com/the-immutable-rohingya-archive/.

Despite my skepticism, I couldn't stop thinking about it, especially as digital art minted

on a blockchain (non-fungible tokens, or NFTs) and meme-based cryptocurrency tokens such as

Dogecoin were seeing soaring prices and incredible popularity. What had previously deterred

many from using cryptocurrencies was a lack of use in the real world, and while it can certainly

be argued that NFTs and memecoins don't have a real use case, they do provide a tangible

application of the technology and bring awareness of blockchain technology to the forefront.

Lemieux gave an overview of the basics of Blockchain technology– how it works, how

difficult it would be for one person to take down the network, its decentralized and immutable

properties, and how storing files in a verified, tamper proof way increases social trust. After her

talk, Professor Anne Gilliland related the technology to archives that could potentially benefit

from its usage, including PrideCrossing, an LGBTQ refugee archive, and the Rohingya Project's

R-Archive, both of which she was a collaborator.

I thought about using the technology as a resource for minority and oppressed groups and

considered Gilliland and McKemmish's *Rights in Records as a Platform for Participative*

Archiving in which they argue that "there is abundant evidence that archival frameworks,

systems, and services, including professional ethics and rights frameworks, fail many members

of communities with acute memory, identity, and accountability needs."[53] As an answer to this

failure, they presented a human rights framework that assigns individual and collective rights,

particularly to groups of people who have been marginalized, faced human rights violations,

genocide, displacement due to war, forced expulsion, or other atrocities. To this they posit that

the record holders/creators should have the right to participate in the decision making of choices

relating to the storage and preservation of their own records. In their work *Towards a*

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[53] A. J. Gilliland and S. McKemmish, "'Rights in Records as a Platform for Participative Archiving,'" 2015,
https://escholarship.org/uc/item/5g3135n6.

Framework of Human Rights in Records: A Critical Analysis and Comparison of Two Contexts,
they consider these rights through the lens of Australian Indigenous children and the Stolen
Generation.[54]

I also considered the body of work by Dr. Michelle Caswell, professor of Information
Studies at the University of California, Los Angeles, and co-founder of the South Asian
American Digital Archive, in which she calls for radical empathy, feminism, and liberatory work
in the archives. Dr. Caswell is a strong believer and supporter of community archives, which she
defines as "independent grassroots efforts for communities to document their own commonalities
and differences outside the boundaries of formal mainstream institutions." She further argues
that "the creation of community archives can be seen as a form of political protest in that it is an
attempt to seize the means by which history is written and to correct or amend dominant stories
about the past.[55]

I considered blockchain in relation to Gilliland, McKemmish, and Caswell's archival
theories. The R-Archive is led by Mohammad Noor with a team that includes non-Rohingya
members who have done their best to support Noor's plans for Rohingya preservation of records.
This team strived to understand the plight of the Rohingya, including Noor's own experience,
and develop a system of data and records collection and digitization founded on an empathetic
response to the struggles faced by the Rohingya. The archive's plans to decentralize records and
store them on the blockchain, not only as a means of self-preservation, but also as a strategy to
protect the Rohingya and provide extensive evidence of human rights violations falls directly in
line with Caswell's definitions of community archiving and radical empathy in the archives.

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[54] Carbone, Kathy, Anne J. Gilliland, Sue McKemmish and Greg Rolan. "Towards a Framework of Human Rights in Records: A Critical Analysis and Comparison of Two Contexts," iConference 2021.
[55] M. L. Caswell, "Seeing Yourself in History: Community Archives in the Fight Against Symbolic Annihilation," August 4, 2016, 31, https://escholarship.org/uc/item/9gc14537.

In addition to Gilliland, McKemmish, and Caswell's arguments, I considered the work of Dr. Victoria Lemieux, who has written extensively on the potential benefits of using blockchain for archives and records management purposes, particularly in relation to ensuring trust in records. It wasn't until reading Lemieux's work that I started to see the connections between community archiving, rights in records, radical empathy, and trust and security of records that could be made through decentralized blockchain ledgers.

Lemieux argues that in an age of disinformation and easily faked records and video files, Blockchain storage can help restore trust in the authenticity of the record. Of course, the record must first be trustworthy and authentic itself before initially being uploaded to a blockchain.[56] Specifically, she evaluated Blockchain use proposals involving "three pilot blockchain-based land transaction recordkeeping solutions (Brazil, Sweden, and Honduras), one blockchain e-health record keeping solution (Estonia), and one proposed cryptocurrency solution (Sweden)."[57]

In *A Practitioners View on Distributed Storage Solutions,* Michel Legault considers the applicability of blockchain in the information fields by evaluating projects seeking to use blockchain, including Arweave. He draws attention to the conflict between this form of permanent data storage and the European Union's General Data Protection Regulations (GDPR), which protects EU citizens' "right to be forgotten," and thus have data with personally identifiable information removed from the public record.[58] This is a concern that is also raised by Victoria Lemieux in *Searching for Trust.* She raises the issue of illegal content such as child

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[56] Victoria L. Lemieux, "Trusting Records: Is Blockchain Technology the Answer?," *Records Management Journal* 26, no. 2 (January 1, 2016): 120, https://doi.org/10.1108/RMJ-12-2015-0042.

[57] Victoria L. Lemieux, "A Typology of Blockchain Recordkeeping Solutions and Some Reflections on Their Implications for the Future of Archival Preservation," in *2017 IEEE International Conference on Big Data (Big Data)*, 2017, 2272, https://doi.org/10.1109/BigData.2017.8258180.

[58] Michel Legault, "A Practitioner's View on Distributed Storage Systems: Overview, Challenges and Potential Solutions," *Technology Innovation Management Review*, July 6, 2021, 35, https://doi.org/10.22215/timreview/1448.

pornography being permanently stored on the blockchain[59] as an example of a problem of competing needs that doesn't have a clear solution, but must be seriously considered as blockchain technology progresses and use grows.

Coincidentally, as I was considering archival applications of blockchain technology, Arweave started an initiative to collect copies of digital records from Ukraine that were in danger of being lost either due to erasure, physical destruction, or as a result of censorship or propaganda due to the invasion by and ongoing conflict with Russia. This initiative was open for anyone in the general public to contribute to.[60] On February 17th, 2022, only 24 hours after the initiative was announced, Arweave founder Sam Williams wrote on Twitter "Over 430,000 artifacts from the Ukraine-Russia crisis have been streamed onto the Arweave network over the past day. These documents are now stored fully on-chain, never to be forgotten."

As we consider Legault and Lemieux's concerns about illegal content, or content containing personal information unable to be deleted or removed from the blockchain, we must also consider the potential issue of documents being uploaded to Arweave that were altered or potentially contain propaganda or false narratives of the invasion. This is an issue to which Williams responded with "Store_everything_. Let the historians figure out what is true or not. The most important part while an event is on-going is making sure that the data is collected in real time such that it can be effectively analysed later."[61]

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[59] Victoria L. Lemieux, *Searching for Trust*, New edition (Cambridge, United Kingdom ; New York, NY: Cambridge University Press, 2022), 24.

[60] Steven Ehrlich, "A Blockchain-Based Noah's Ark Is Being Used To Preserve A Record Of The Ukraine Conflict," Forbes, accessed May 29, 2022, https://www.forbes.com/sites/stevenehrlich/2022/02/25/a-blockchain-based-noahs-ark-is-being-used-to-preserve-a-record-of-the-ukraine-conflict/.

[61] "Russia-Ukraine Crisis: Arweave Offers $100k Grant to Information," Permaweb News, accessed December 10, 2023, https://permaweb.news/arweave-grant-russia-ukraine.

Despite a response that is, frankly, rather irresponsible – which historians are supposed to be verifying the million plus records uploaded to the project? And, perhaps more importantly, when? -- I was still captivated with the idea of permanent, affordable data storage. A decentralized archive of records (preferably verified before being uploaded to the weave) puts the power of archiving into the hands of minority and oppressed groups and creates a way to securely collect pieces of their culture and shared history. In the case of the Rohingya, it allows a place to collect proof of citizenship, personal documents and photographs, as well as evidence of the atrocities perpetrated by the Burmese military junta.

As I dove into research on the topic and began interviewing and conversing with information professionals working with the R-Archive, in blockchain, or adjacent fields, I met with Dr. Greg Rolan, fellow in Artificial Intelligence for Law Enforcement and Community Safety (AiLECS) Lab in the Faculty of Information Technology at Monash University. He immediately voiced skepticism.

"Why do we need the complexity of blockchain?" He asked. "It seems like a solution looking for a problem." He went on to point out that most recordkeeping needs some form of mutability; even in the case of the R-Archive, for example, there is a trained team responsible for carrying out record ingest and metadata collection processes.

Also present during my conversation with Dr. Rolan was Saqib Sheikh, co-founder of the Rohingya Project. He pushed back on the idea of needed centralization, pointing out that the Rohingya are "victims of centralization whose records have been taken and held hostage," adding that while blockchain or blockweave might not be a solution for the everyday archive, it could be a viable solution in this specific case. Dr. Rolan agreed that the technology could be useful on a case by case basis, with the R-Archive being one of them.

Dr. Rolan may not be wrong here; there certainly is a long list of drawbacks to blockchain that need to be resolved before we can see widespread adoption. Even Lemieux, a champion of the technology, said in a conversation with me and Sheikh, that we are a "long way off from a perfect solution."

As I searched for a comparable project using blockchain, I continued to come up empty-handed. The R-Archive was ambitiously taking on the role of blazing the path in the field. Acknowledging the gap in the knowledge of blockchain-based archiving, Lemieux stressed the importance of finding others working with the technology in order to collectively build and share resources, tools, and knowledge.

There are many reasons to collectively put the work in and develop blockchain for archival functions, even if we aren't sure if it will work. Mainstream methods of collecting and archiving often fail the communities that need them the most. This is apparent in the growing movement towards community archives created and maintained by oppressed and minority communities. Exploring blockchain and blockweave technology in cooperation can only broaden the available tools for these archives. As Caswell argues, "If community archives are to fulfill their liberatory potential they must be activated for resistance rather than assimilation or integration into the mainstream."[62]

In an Open Web Foundry Deep Dive talk, Arweave founder Sam Williams emphasized the need for a decentralized, permanent form of storage by looking at mainstream methods currently in use and incentivized by capitalism, creating a built in imbalance.

> "In cyberspace we always access someone else's private property when we want to use a web app. [...] These are places owned by other people and by law they are allowed to do whatever they want there, which has led to a lot of issues we see in society right now. Essentially, it creates centralization of power with people that are incentivized by financial gain, when the services they offer

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[62] Caswell, *Urgent Archives*, 7.

are more or less public utility. They are so vital to our world now that we really can't do without them. [...] So we don't have any rights."[63]

He continues with examples of centralized data storage failing those that use it, in particular YouTube demonetizing queer content[64] and episodes of Joe Rogan's podcast being pulled from Spotify.[65] Both queer YouTube users and Joe Rogan have no recourse against a private company. I will point out that the political leanings of those two groups are on opposite sides of the spectrum, highlighting that, while minority groups can be victims of centrality, so, too can mainstream content creators. In short, the current model has the ability to harm anyone. As I mentioned in my introduction, the Rohinga are facing similar issues with centralized data and social media companies in Burma, further highlighting the importance of the R-Archive and its need for decentralized and permanent storage.

The Ethics of Storing Data Permanently on the Permaweb

While some elements of permanent data storage are exciting- the price, the accessibility, no longer needing to continuously upgrade storage devices-, the truth is that the permanent storage of data is risky and a little bit scary. While true that traditional archives also seek to hold their collections permanently, the Permaweb is different in that the data is stored in a way that quite literally cannot be changed, deleted, or destroyed.

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[63] Williams, Sam. *Open Web Foundry 7 | Deep Dive #1*, 1:25:35. October 5 2022, https://www.youtube.com/watch?v=ytlyRYAtJ3l.

[64] "YouTubers Claim the Site Systematically Demonetizes LGBTQ Content - Vox," accessed December 11, 2023, https://www.vox.com/culture/2019/10/10/20893258/youtube-lgbtq-censorship-demonetization-nerd-city-algorithm-report.

[65] "Spotify Confirms Joe Rogan Removed Episodes with Racially Offensive Language - CNET," accessed December 11, 2023, https://www.cnet.com/tech/services-and-software/spotify-confirms-joe-rogan-removed-episodes-with-racially-offensive-language/.

While Arweave's current encryption algorithm works well to secure the files, a healthy amount of skepticism is important for ensuring those encryptions stay working. As technology quickly evolves, we see computers grow more powerful. The possibility that Quantum computing could one day break these encryptions is very real.

Arweave uses AES-256-GCM encryption, which it claims to be quantum proof, a hefty claim considering that quantum computing is still being developed and is likely to solve more and more complex mathematical equations as it does.

When asked if anything can truly be quantum proof, Dr. William Maxwell says "no one actually knows, and an answer to this would win you a Fields medal (the Nobel prize of mathematics)." He compares quantum computing to cooking: any kitchen can be equipped to make a dinner, but a kitchen with more tools can make a more complex recipe. This is true with quantum computing as well. He goes on to point out that "An algorithm can be thought of as a step-by-step process for solving a problem (usually a math problem), whenever you cook a dish by following a recipe, you are performing an algorithm." AES-256-GCM may currently be quantum proof, but that doesn't mean it will forever be so.

Breaking the encryption of the R-Archive could have severely detrimental consequences, especially as the archive grows to house more Rohingya records. Were any file's encryption to be broken, the data could permanently be made available to the general public, including the Burmese government. And say someone intentionally destroyed or lost the encryption key to their files in an attempt to hide the documents, they would now have no recourse against the hacking.

While overall the novel use of Blockweave employed by the R-Archive is exciting, hesitations remain around the concept of permanent data storage. How ethical is it to use this

type of technology with a population that may not understand how it works? Or where forever literally means forever? Both Phillip Kothe and Saqib Sheikh point out that people use technology every day that they don't understand. While it is true that the average user might not really grasp what's going on behind the scenes when they post on Twitter, they are also not expecting those posts to live forever, or for an oppressive regime to potentially use the posts in a way that could endanger their lives.

That being said, the R-Archive employs a human rights framework in its operation, which at its core strives to place those being oppressed in control of their records and personal data. Contributors must consent to participate.

While most of the supporting work on the R-Archive is being done by non-Rohingya people, the program itself is being led by Muhommed Noor, a Rohingya man. Because it is not entirely possible to consult with many Rohingya people living in refugee camps, Noor's voice must stand in for the millions of people in displacement. His experience is one of many, but it's not uncommon, and he seeks to amplify the voices of his community. About using blockchain as a method for lifting up the Rohingya he says "for a lot of people, blockchain is sexy right now. For us, it is about survival."

The Rohingya that choose to store documents on the blockweave will have full control over decision-making in regards to their records. They choose who to share records with, if anyone, as well as make decisions about what is and isn't preserved. While a document can never be deleted from the blockweave, they can choose to intentionally lose or delete their encryption keys, essentially making the file permanently inaccessible. Because Arweave stores data in a decentralized manner, records can be accessed at any time, from any place, thus creating no boundaries for document or record viewing outside of a lack of access to the

technology, which to be clear, can be a very real deterrent. But access from anywhere allows members of the Rohingya community to contribute from anywhere in the diaspora. And allows permanent access should further displacement or relocation occur. Records stored in the R-Archive are private, and therefore shield the record owners from exploitation, identity exposure, and retraumatization.

Conversely, those working to build the R-Archive from the backend are also working within the human rights in records framework, deliberately working to understand and empathize with the Rohingya's history while trying to pave a safe path for document and cultural preservation. By working together to develop a novel archival use of Blockweave, every member of the team has worked to center the Rohingya's unique situation and history in the functioning of the archive.

"The research team is investigating how to push this participatory ethos even further by examining the potential of Rohingya people in diaspora owning and operating the computing power that makes the R-Archive possible. This might potentially even lead to the development of a financial model that would compensate Rohingya blockweave miners and thereby directly contribute to economically sustaining and advancing a community where dispossession and financial precarity have been characteristic since targeting by the state began."[66]

Searchable Metadata in Private Blockchain Data Storage

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[66] Sheikh et al., "Distributed Records in the Rohingya Refugee Diaspora," 826.

A major drawback to using Arweave to store Rohingya documents is siloed information. Modern archival theory asserts that linked open data is essential for connecting data to other data, as well as making information accessible to the end users. Siloed data, or data that is disconnected from other data, makes searching and finding information much more difficult. Because all records on the blockweave are kept private and encrypted, it's nearly impossible to search the archive.

Phillip Kothe says "Arweave is best suited for public data, which should be preserved forever. Storing private data on a decentralized and immutable data structure is a headache. Yes, you can encrypt the data first, so the plain data never make it onchain, but then you need to worry about storing the encryption keys."

Additionally, in order to search private data, all records must be decrypted, downloaded and then searched. While the records do have metadata recorded in English at the time of document scanning, the metadata is stored within the record and is thus also encrypted. Keeping the records private and encrypted is imperative in protecting the assets from the Burmese government, who won't be able to access them to alter or destroy records; however this also means the history and documents contained within the archive will not be publicly accessible. This could be a real problem if the Rohingya diaspora stays dispersed and disconnected. How are people separated from their families and ancestral land supposed to connect to their history or find information about family members if the archive is unsearchable and off limits to those lacking encryption keys?

Of course this could be remedied by following in the footsteps of Arweave's collection of Ukrainian documents at the beginning of the Russian invasion. This collection was open to the public; anyone could upload files and work to save cultural heritage documents, news articles,

social media posts and the like. Not only would these records be protected should the physical copies or repositories be destroyed, but, similar to the R-Archive, so too would evidence against the Russian government.[67]

The major difference between the R-Archive's strategy and Arweave's, however, is that the Ukrainian collection is open to anyone: the data is public and accessible. The general public answered the call to arms and within days had uploaded nearly 50 terabytes of data to the archive. But one has to ask, how much of that data was propaganda, spam, or falsified documents uploaded by Russian sympathizers? How much of the data is reliable?

Arweave believes that it's much more important to save as much as possible and sort out the records in the future. But the most important feature of an archive is its trustability. If an archive or repository can't be trusted and is not reliable, what is its purpose? How useful can the records truly be if some will always doubt their authenticity? While overall the collection process, searchability, and encryption of the R-Archive may indeed be a headache, at least in the long run it is trustworthy.

Lemieux writes "Through cryptographically securing records and distributing copies that can be compared, it is possible to protect and validate the integrity of records as one of the key elements necessary to be able to trust them."[68]

The Future of the R-Archive

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[67] Ehrlich, "A Blockchain-Based Noah's Ark Is Being Used To Preserve A Record Of The Ukraine Conflict."

[68] Lemieux, "A Typology of Blockchain Recordkeeping Solutions and Some Reflections on Their Implications for the Future of Archival Preservation," 2271.

As I wrote this thesis, the Rohingya Project decided to put the R-Archive on hold and shift their focus from a private, blockweave based archive, to a public online cultural facility, OpenLibrary, that can be of more immediate use to the Rohingya people in general in learning about and maintaining their culture. According to Saqib Sheik and Anne Gilliland, the Rohingya Archive will still be needed for eventual legal proceedings, but the evidentiary issues are hard to carry out under current conditions and ahard to explain to Rohingya populations who do not have that background. The Open Library will be using FileCoin. The shift came from difficulties collecting sensitive documents, such as identity cards, from refugees living in camps. While they are still working in Cox's Bazar, field agents collecting digital surrogates questioned if the risk of collecting for the project was worth the end goal. Meanwhile, the Rohingya themselves voiced that it is more important to them to collect and preserve items with cultural relevance, such as photographs, videos, songs and anthems, and the Rohingya language.

I talked with Saqib Sheik about the shift. Saqib is pursuing a PhD at S. Rajaratnam School of International Studies (RSIS), Singapore, researching the use of blockchain as a form of legitimization of stateless communities. I was surprised when he recommended a time to talk that was nearly 2am in Singapore.

Mere minutes into our conversation, I learned that he was not actually in Singapore, but instead was currently doing field work with Rohingya refugees in Pakistan for the new Open Library. He had just been talking with a family who had been in Pakistan for several generations now and found themselves losing their connection to their Rohingya culture, yet were not integrated into Pakistani life. Instead, they lived in a strange limbo of disconnection.

Collecting sensitive materials such as identity cards would certainly benefit the Rohingya as they navigate a stateless reality and could provide important documentation of the war crimes

committed against them by Burma. But in the here and now, maintaining a connection to their collective Rohingya identity may take precedence; the OpenLibrary could, for example, help that Rohingya family in Pakistan connect with their past and strengthen their identities.

One of the biggest drawbacks to using Arweave was the private nature of the archive. It provided secure document storage, but records were also hard to access, especially if an encryption key was lost or missing. Saqib referred to it as "a static archive for storage."

The new OpenLibrary approach strives to be, in many ways, the opposite of the Arweave approach and the R-Archive; interactive and ever changing instead of static. It will be a public archive, and the Rohingya Project strives to have better functionality and be as easy as possible to navigate, so even someone with limited technology literacy can contribute to and access the archive.

The OpenLibrary will use FileCoin, which is built on the InterPlanetary File System (IFPS). It has blockchain elements, but is not blockchain. Similar to Arweave, IPFS stores bits of data across a network of users who benefit financially from storing data. But unlike blockchain, IPFS relies on peer-to-peer (P2P) connections. This keeps the data storage decentralized; when a user is searching for a piece of data, they connect directly to the users that are storing it for retrieval. IPFS does not use location to find the file, which means there are no broken links. Instead, data is searched by hash number, a static number based on an algorithmic computation of the data being held.

Saqib considers the shift from the R-Archive to the OpenLibrary difficult, but ultimately a "blessing in disguise." And while working hard on a project only to place it on hold and move forward by a different route can be demoralizing and frustrating, Saqib thinks of it as a process

they needed to go through to help answer the question at the root of the archive, "how do we present this information to people?"

Yet this shift had me considering the difficulty of implementing blockchain technology in the archives. Is one method of storage better or easier to use? I came back to one of my original research questions: Should archives steer clear of a potentially unstable and new technology like blockchain?

The answer that, I considered the R-Archive, which is in many ways intended for future use: to collect evidence against Burma should a human rights trial come to pass, to prove citizenship if the government of Burma changes hands, or proving refugee status, or for future generations reclaiming land. Users may not see their individual selves in the archive, but they will see a collective past.

Conversely, The OpenLibrary is intended for now: to connect the Rohingya living in diaspora with their collective identity and history and prevent a loss of their culture. In this case users of the archive will see their individual selves in the archive as well as in a collective past.

Both the R-Archive and the Open Library have goals to preserve Rohingya culture and support the community through preservation of their history and collective identity. The OpenLibrary strives to take a more community archive driven approach. And while the OpenLibary may seem like a better option for a community living in diaspora with limited access to technology, there is still no guarantee that it will not be sabotaged or damaged by the Burmese government. Especially a government that does not want a global refugee demographic organizing in diaspora.

There is really no argument for one over the other, the Rohingya need both.

Conclusion

The R-Archive strives to rebuild what's been taken from the Rohingya– even if an Arweave based solution didn't work, perhaps the future OpenLibrary will. Or perhaps the technology can work for future use cases. Especially when Westerners–and the rest of the world honestly,--don't care about preserving the history of certain groups; Arweave can allow the creation of archives even by non-IS professionals, even on the fly with little resources.

In Sven Lindqvist's *Exterminate All the Brutes*, he pondered the history of violence and genocide committed across the globe by Europeans & Westerners. About them, he wrote: "We do not want to remember. We want genocide to have begun and ended with Nazism. That is what is most comforting."[69]

This mindset is extensively evident in modern western culture. American citizens fight against allowing refugees into the country; instead of offering support, they urge government officials to force those seeking asylum to stay in inhumane and dangerous conditions in their home countries while they wait for admission. They build walls and put children in cages as they come up with excuses involving the stealing of jobs or housing concerns or taxes. They do this while flying the Ukrainian flag during the Russian invasion because, they say, "Ukrainians are just like us." When asked why Ukraine should be supported and those fleeing Syria or Honduras or Burma should not, the answers vary along the lines of "well, those areas are *always* war torn." Perhaps the assumption is that those living in areas of unrest have somehow adapted and accepted the situation; As if that is a reason to turn our backs, to declare that some people deserve to struggle more than others.

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[69] Sven Lindqvist, *"Exterminate All the Brutes": One Man's Odyssey into the Heart of Darkness and the Origins of European Genocide* (New York: New Press, 2007), 141.

Additionally, the west has a long history of an unchecked acceptance of any government that declares itself "democratic," regardless of who is in power, or their intentions, or who gets stepped on along the way. Burma's claims of moving towards democracy under Aung San Suu Kyi made it easy for western governments to turn their back on the atrocities committed against the Rohingya, as if a democratic nation could not intentionally harm its own citizens.

As a result, the Rohingya have been left on their own, scattered across the region, living in refugee camps, stateless, with no path to citizenship, no idea if they will ever return home. Or if they ever want to return home.

Rather than allow their history to be dismantled, torn down, destroyed, brick by brick like the Sandhi Khan Mosque, Muhommad Noor and the Rohingya Project have chosen to find their own way to support the Rohingya using innovative and novel methods. Specifically, using Arweave and blockchain technologies, and now, IPFS and FileCoin with their OpenLibrary, to archive valuable documents, photographs, and other records before they are lost, destroyed, or further separated from the Rohingya community in diaspora.

Through all of the conversations I had as I wrote this thesis, what stuck with me the most was the overarching call for cooperative development of the technology. Dr. Victoria Lemieux and Amber Gallant, through their work at Blockchain@UBC, created a survey to send to various groups archiving in conflict affected areas.[70] While the survey isn't specific to projects using blockchain, it does gather information in an attempt to better understand a variety of approaches to archiving in non-traditional environments. Sharing what does and doesn't work can only make development of alternative archiving technologies easier, more accessible, and more successful.

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[70] See Appendix C for a copy of this survey.

Despite the R-Archive facing difficulties collecting data, encryption holding back search functionality and creating siloed data, and the ultimate shift of the main focus from Arweave to FileCoin occurring as I wrote this thesis, I nonetheless came to the conclusion that the R-Archive can serve as an important model for future uses of the technology. As more groups work to tailor blockchain or blockweave to the needs of archives, and more information is shared about these attempts, effective standards for use can be developed and implemented on a case-by-case basis where appropriate.

Does this study answer the questions I have of blockchain being a useful tool in the archives? Maybe not entirely, but it has given us a first step into what it could look like and what we would need to sort out for future implementation. I strongly believe there is a place for blockchain and blockweave in archival applications as a tool for decentralized, secure, and affordable storage. Success of future applications of the technology in our field will rely heavily on the education of the general public – not only on how the technology works and what it's capable of, but there must also be a pretty significant shift from the pessimistic view of blockchain having no real use in the world- as well as discovering solutions for blockchain based archives that are both secure and accessible without being easily manipulated while being searchable.

Thus, the R-Archive is an important step in understanding blockchain in archives. With collaboration across the information studies field, blockchain and blockweave could have unlimited potential for long term, secure, and inexpensive storage of records and archival documents in the future. Despite what lies in the future, the R-Archive has been successful; even if only in that it attempted such a project in the first place.

Appendices

Appendix A - Initial questions for interviewees working with the Rohingya Project

- What is daily life like for Rohingya refugees?

- What kinds of documents is the project seeking to preserve for the Rohingya people?

- How will digital preservation of their assets/documents/etc help them in the long run? What are the goals of the project?

- How do you address issues of access when working with a population that maybe does not understand what blockchain/blockweave is or have much access to technology in general? Or in some cases may also face language barriers?

- How do you gain trust from a population that is right to not trust those outside their community?

- How did you come to consider blockchain/blockweave as a solution to some of the issues facing the Rohingya people?

- What are the problems you've faced in implementing the technology?

- Why did you ultimately choose blockchain/blockweave?

- Has the project been difficult to implement?

- What are the long term technology goals of the project, as in, how do you plan to maintain access for the Rohingya people to their assets?

Appendix B - Additional questions asked after the R-Archive shifted its strategy away from Arweave

- What is the future of the R-Archive?

- Why do you think Arweave didn't work for this project?

- What were the difficulties faced?

- Was Arweave beneficial for the R-Archive?

- Do you still think blockweave has a future as an archival tool or storage solution?

PART 1 – Background information about organization

1. What country(ies) or region(s) does your organization operate in?

1a. Does your organization operate from a country or countries that is not the primary country of focus for your organization? Please describe. (F*or example, organizations operating from Turkey with a focus on other countries in the Middle East and North Africa.)*

2. When was your organization established?
3. What is the mission of your organization?
4. Is your organization registered with the national government your organization is operating from?
5. Are you registered as a non-governmental organization? (Yes/No)
6. Does your organization receive external funding? (Yes/No)

6a. If so, from whom does your organization receive funding?

7. Does your organization operate from a physical location? (Yes/No)
8. Have any of your organization's operations shifted online? (Yes/No)

6a. If yes, what necessitated your organization's operations being shifted online? Eg, a conflict, the COVID-19 pandemic.

9. Does your organization rely on volunteers or staff based outside your country of operation? (Yes/No)
10. Are the primary beneficiaries of your organization a marginalized group (e.g., women, ethnic minorities)? (Yes/No)

    8a. If so, is your organization led by the people it seeks to benefit? (e.g., women-led organizations) (Yes/No)

    8b. What is the marginalized group your organization seeks to benefit?

PART 2 – Archival focus of organization

1. Is archiving (of information, documents, images, etc.) part of your organization's mission and operations? (Yes/No)
2. What is the objective of archival work for your organization? Select as many as apply.

   § Archiving with the goal of recording violations of human rights

   § Archiving with the goal of recording instances of election or post-election violence?

   § Archiving with the goal of recording destruction of homes, lands, or properties during conflict?

   § Archiving with the goal of cultural or historical preservation, or to combat historical revisionism?

§ Archiving with the goal of gathering evidence for the purpose of reparations, including monetary reparations?

§ Archiving with the goal of gathering evidence for any other purpose? (Please specify the purpose.) (short answer text box)

3. Why did your organization start archiving? (ex. Sudden onset of conflict, demand from community)

4. Does your organization have staff dedicated to archival work? (Yes/No)

    4a. If so, are they archivists by profession? (Yes/No)

    4b. Have they received any training in archives administration? (Yes/No)

    4c. If so, has that training specifically addressed archiving in the context of conflict? (Yes/No)

5. What kinds of information is your organization creating, capturing and/or preserving to fulfill your mission and operations in terms of your archival work? (Eg, individual copies of land rights titles, videos documenting human rights protests, digital copies of cultural materials). Please describe below.

6. How has this information been created and/or collected? Eg, what tools are used by your organization to create records or document evidence supporting the nature of your organization's archival work? Please describe these tools.

7. Does your organization work with digital archives, physical archives, or both digital and physical archives? Select as many as apply.

    a. Digital

    b. Physical

    c. Both digital and physical

8. Are you undertaking digitization of physical records? (Yes/No)

9. Are you capturing and preserving digital records?

    a. Please select the types of digital records your organization is capturing and preserving.

        i. Websites

        ii. Previously digitized records

        iii. Digital photographs

        iv. Other (please specify).

10. When starting your archival work, did your organization undertake any consultation with other organizations, or conflict archiving experts (e.g., WITNESS, Bellingcat, Ushahidi)? (Yes/No)

    11a. If so, which organizations did you consult? Please list them below.

11. Does your organization use any external online resources (e.g., toolkits, guidelines) to guide your archival work? (Yes/No)

    12a. If so, which online resources were used? Please describe these resources.

12b. Were any of these online resources available in the language(s) used by your organization? (Yes/No)

12. Does your organization use any specific digital applications or software to do your archiving work? (Yes/No)

13a. If so, how were you introduced to these digital applications or software? Please describe.

13. Has your organization created any specialized databases, repositories or other repositories to store the records you have created? (Yes/No)

14a. Did your organization follow any specific external guidelines in setting these databases up? Please describe.

14b. Who, within your organization, was responsible for setting these databases or repositories up? Please describe.

14. Has your organization created any special tools or resources to assist your archival work? (Yes/No)

15a. Did you follow any specific external guidelines in setting these up? Please describe.

15b. Who, within your organization, was responsible for creating or choosing these tools? Please describe.

Part 3 – Experiences using archival tools

1. An authentic archival record or document is free from tampering or corruption, and contains the information it says it contains. An archival record with integrity is one that is unaltered and complete. Both of these characteristics are necessary for the preservation and safeguarding of evidence contained within the record.

1a. If your organization is currently conducting archival work, or has done so in the past, how do you preserve and safeguard the information you have created and/or collected? What practices do you use to ensure the authenticity and integrity of this information? Please describe.

2. What gaps or open challenges did you experience, if any, in safeguarding the authenticity and integrity of these records?

2a. Do you face any challenges related to the accessibility of technology and/or connectivity? If so, please describe.

2b. Do you face any challenges related to the linguistic availability of resources? If so, please describe.

2c. Do you face any limitations connected to the cultural context in which you operate? If so, please describe.

3. What are the main challenges or concerns our organization has experienced while creating an archive of documentation?

3a. Does your organization face challenges related to the longevity of evidence or sustainability of your work? Please describe.

3b. Does your organization face challenges related to securing adequate funding to maintain activities? Please describe.

3c. Has your organization faced challenges related to personal or organizational security and safety? Privacy? Please describe.

4. Do you feel that your organization had sufficient experience and knowledge to fulfill your mission and operations in relation to archiving information? (Yes/No).

§ If not, please specify what you were missing or found most challenging.

Part 4 – extra-organizational engagement with, and perception of archival work

1. How has your organization worked to build the trust needed for the collection of such records?

2. At the community level:

2a. Do you feel that your target community is willing and/or enthusiastic to participate in your organization's archival work?

2b. Would you say that your target community views your organization's archival work as valuable and/or needed?

2c. Has your organization faced any challenges in collecting sensitive or private records from community members?

3. With other stakeholders:

3a. Have governments or other entities, like NGOs or international bodies, reached out to your organization for your records for purposes such as providing services, improving public awareness about a particular conflict, or for transitional justice processes? (Yes/No)

3b. If so, what challenges or concerns, if any, did your organization experience in sharing this information? Please describe.

3c. If used in legal processes, were there concerns about admissibility of evidence? (Yes/No)

3d. Were your records deemed admissible? (Yes/No)

4. Have you experienced any challenges in retrieving records, or accessing them later? Please describe.

5. Have you experienced any concerns about the integrity or authenticity of these records? Please describe.

6. Are there any other challenges you have experienced related to your archiving work that you would like to mention? Please describe.

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