Düzce Üniversitesi Bilim ve Teknoloji Dergisi

Araştırma Makalesi

HungerHash: A Distributed Network for Child-Hunger Relief Based on Hedera Hashgraph

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ABSTRACT

This paper proposes a hunger relief network based on crypto-currency and a hybrid mix of centralized and decentralized databases which is totally formed by the volunteers and donors and is out of control of centralized organizations. The centralized part of the database maintains non-sensitive information with less need to security features, mainly providing motivative information for donors and giving feedback to know that how their gifts were spent. The decentralized part of the design is based on a third-generation Distributed Ledger Technology which contains sensitive information of payments and receipts and flow of supply chain, which is designed to be fast, secure and fault tolerant.

Keywords: *Child-hunger, Distributed Ledger, Blockchain, Hashgraph*

HungerHash: Hedera Hashgraph'a Dayalı Çocuk Açlığını Gidermek için Dağıtılmış Bir Ağ Mekanizması

ÖZ

Bu makale, kripto para birimine dayalı bir açlık yardım ağı sistemi oluşturmayı öne sürmektedir. Bu sistem tamamen gönüllüler ve bağışçılar tarafından oluşturulan ve merkezi kuruluşların kontrolü dışında olan ve merkezi olmayan veri tabanlarının karma bir karışımını önermektedir. Veri tabanının merkezileştirilmiş kısmı, hassas olmayan bilgileri güvenlik özelliklerine daha az ihtiyaç duyarak tutar, esas olarak bağışçılar için motive edici bilgiler sağlar ve bağışların nasıl harcandığını bilmek için geri bildirimde bulunur. Tasarımın merkezi olmayan kısmı, hızlı, güvenli ve hataya dayanıklı olacak şekilde tasarlanmış, ödemeler ve makbuzlar ve tedarik zinciri akışına ilişkin hassas bilgileri içeren üçüncü nesil Dağıtılmış Defter Teknolojisine dayanmaktadır.

Anahtar Kelimeler: *Çocuk Açlığı, Dağıtık Defter Teknolojisi, Blok zincir, Hash*

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I. INTRODUCTION

A child under 15 dies every five seconds around the world, mostly of preventable causes. In the same time, globally about 41 million children under five years old were overweight or obese [1]. According to reports, about 155 million children under five years old were chronically undernourished [2]. Eradicating hunger and malnutrition are one of the great challenges of our time. Almost %50 of child mortality in Africa stem from hunger [3]. World Food Program (WFP) itself used to claim that a child died of hunger every six seconds. According to reports approximately 3.1 million children die from undernutrition each year and number of primary school children that attend classes hungry in the developing countries is around 66 million [4]. It is apparent that the indirect effect of this hunger is that it impacts children ability to learn. Hunger and undernutrition contribute to more than half of global child deaths and people in conflict-affected regions are up to three times more undernourished than people living in more stable developing countries [5].

In 2020 conditions became worst due to pandemic outbreak. According to 2019 statistics enough food is produced in the world to feed everyone, but because of the conflicts and mismanagement of the governments, around 821 million people are sleeping with an empty stomach each night. The consequences of lack of food not only violates health, but also slows progress in many other areas of development like education and employment. Global community adopted 17 goals in 2015 for sustainable development to improve people's lives by 2030. The second goal in this program is zero hunger. This program is established to improve food security and nutrition, and to promote sustainable agriculture to end hunger [6].

With no practical hope to governments in today's harder economic conditions, citizens, civil society, NGOs, and private organizations must collaborate to make innovations and create better solutions with less bureaucratic complexities, more transparency and higher speed and security. Distributed Ledger Technologies are now getting synergy to become one of the pillars of the modern society, including social, security, juristic, economic and many others. Cryptocurrency is its most dominant application, but the opportunities to use benefits of Distributed Ledger Technologies are much wider and is not limited to financial applications. There are also other architectures of Distributed Ledger technologies besides blockchain. In this paper, we analyze the deficiencies of the current solutions and propose a trusted decentralized design to solve the current situation regarding new emerging technologies based on new generation of Distributed Ledger Technology (DLT).

II. METHODS

The first question that should be answered in this research is why activities of big organizations like World Food Program (WFP) and OXFAM is not sufficient for hunger relief? To enter the discussion, it is necessary to first look at the dysfunctionalities of common methods.

There are many deficiencies that causes people and donors having not enough attention or trust on centralized and gigantic organizations including but not limited to the following:

Overhead:
About 64% of the donations go to the recipients and remaining is an overhead spent for fundraising and organizational costs. For every $1 you give, 64 cents will be spent on programs for hungry people, 28 cents will be spent to raise another $1 and 8 cents are spent to process your donations and run the organization and programs [7].

Corrupt governments:
Every year a considerable amount of humanitarian aids is lost because of corruption. The statistics about corruption are hard to verify, but by evaluating the outcomes, it is estimated that between 10 to 70 percent of the $161 billion global aid funds are stolen due to corruption [8]. Some independent research

show that in average %30 of the aids donated by OECD countries each year simply disappears through global corruption [9].

Limited access to Insecure areas and logistic difficulties:
Almost half of the necessary materials supplied by WFP, are in the country or region where the crisis is located [10]. Unfortunately, most of the hunger emergencies in the world occurs in the conflict regions. Most chronically food-insecure people live in regions affected by conflict [4] Lack of financial infrastructure and physical access in high-risk areas limits effectiveness of formal centralized organizations to reach the people in urgent needs. In addition, last mile relief aid distribution by centralized organizations has many difficulties and inefficiencies due to ad-hoc nature of the work [11]. It had been studies that siloed management of relief aid can delay urgent responses because permission must be granted by donors and programs to relocate assets and fulfill emergency needs [12, 13].

Unilaterality:
For most of the donation paths prepared by big organizations, there is no feedback for the donors to know with confidence that how their donation was spent. Sending feedback will provide more motivation and trust for the donors to continue and increase their cooperation and sympathy.

III. RELATED WORKS

As a result of pandemic outbreak there is a dramatic shift towards a digital world, decentralized solutions that address critical needs of societies are getting more important than ever. To overcome dysfunctionalities of the centralized methods, several pilot projects started in recent years to evaluate possibility of using distributed approaches in humanitarian activities. Among all these activities, in most of the startup projects and pilots we can see inclination towards blockchain technology. The UNICEF Innovation Fund is pays $100K investment packages to provide early-stage financing for technology start-ups that have the potential to benefit humanity [14]. The following projects are some implemented cases that are close to our approach, it should be noted that although they use Distributed Ledger Technologies, but each project has its own weakness that causes bottlenecks or weak links in generalizing their application in a global context.

Building Blocks (BB)
This pilot project is running by the WFP as an example of humanitarian blockchain in action. The main goal of this project is facilitation of cash distribution over the globe [15]. With current systems, distributing cash depends on local financial institutions but in practice they observed that financial service providers are either unreliable or insufficient. To overcome these problems, UN started "Building Blocks" project. This project serves both as a coordination body among organizations providing aid as well as a distribution mechanism for various types of aid like food and cash. WFP offers Building Blocks service free of charge to humanitarian organizations which become equal operators of the network upon joining. The technical architecture of the project can also accommodate other applications like digital identities and supply chain management. A pilot of the BB was implemented in two refugee camps. In this pilot, the beneficiary account is maintained on the blockchain and cash value from WFP is stored in this account. Using this cash, about 100,000 refugees in the camps can purchase their fundamental needs.

The main weakness of this project will be essentially its dependency on the centralized financial service providers. In this pilot, the cash received by beneficiaries or spend on goods and services is paid to the buyers or to the retailers through a financial service provider. By this way the bottleneck of the financial process is still dependent on the central organizations.

Women's cash for work
UNWomen and the WFP, are utilizing innovations to improve women's economic power through blockchain technology. Using this technology, UN provides women secure access to their funds and

savings through blockchain assistance. It is a member of "Building Blocks" project partnership enabling Syrian women participating in the UN's Program to access their salaries and withdraw cash at a supermarket through an iris-scanning system in a refugee camp [16]. It is reported that the system's security is increased since WFP and UNWomen both validate other side's transactions via their own blockchain nodes.

This approach utilizes distributed security facilities of the blockchain technology, but dependency of the whole process to the iris scan system provides a weak link that limits the coverage of the project to the confined areas like refugee camps.

Unblocked Cash

Australian Blockchain fintech SEMPO has secured €1 million in funding from the European Commission to fuel digital aid projects in partnership with Oxfam [17]. The idea of the "Unblocked Cash" project is to provide a decentralized model to connect people and stores to the platform, allowing for digital cash purchases at times of crisis. The start-up follows a decentralized approach for providing aid to people, particularly those who don't have access to a bank account but do have a smartphone. SEMPO uses a suite of cryptocurrencies, with one acting as the 'global reserve'. It seems that SEMPO use blockchain technology for a digital wallet system that uses mobile application to rapidly transfer money just like a credit card. They claim that they built an open-sourced blockchain-enabled system to enable everyone to transparently deliver relief funds to beneficiaries in hours, rather than days or weeks. In the "unblocked Cash" project all transactions are recorded on the Ethereum Blockchain, this creates an immutable and third-party auditable record for donors, but dependency on smartphone is one of the weaknesses of this project that limits its usage to wealthy-enough people that can afford a smart phone. Another weakness of the project is the lack of evaluation and feedback over the donations. Unilaterality in donations process is one of the main weaknesses that decrease trust of donors.

Start Network and Disberse

To develop blockchain in humanitarian financing, Disberse company has entered into a partnership with the "Start Network" [18]. In 2016, "Start Network" received a €50,000 grant from the government of Estonia, that enabled it to start a pilot project using blockchain for humanitarian financing. Using this fund, "Start Network" made a partnership with Disberse start-up to push forward plans to test blockchain in the delivery of humanitarian finance. Disberse system uses Distributed Ledger Technology and smart contracts based on Ethereum Blockchain to automate transactions. In fact, they have built a DLT-based platform as a financial service [19].

The outcome of this partnership is a distribution platform for aid funding to track and limit the money losses. The weakness of this project lays on this fact that the money distributed on the platform is not itself cryptocurrency, but e-money issued by Disberse for which transactions were recorded on the Ethereum. This approach produces a single point of failure on e-money system with all shortcomings of centralized approaches especially availability of banking infrastructure.

Russian Federation's Project

This project titled "Development of a platform for hosting and tracking donations of funds for charitable purposes using distributed registry technologies" as described in the paper [20] is a platform that is based on blockchain technology for tracking donations. The main concern of the project is tracking of charitable foundations. They say that according to Rosstat research, in 2017 there were more than 9600 charitable foundations and about 1700 charitable organizations (movements, institutions) in Russia. Donors have every reason to fear that charitable funds will not reach people who really need them. According to this survey in 2017, 68% of citizens are willing to donate more if there is evidence of where and what they are going. Therefore, in this project Russia government tries to evaluate a social platform based on blockchain technology that can help non-profit organizations, foundations, volunteers, and social entrepreneurs in their work and make donation processes transparent and understandable for all parties (donors and charitable funds).The project is based on Ethereum's smart contracts for tracking of donations and uses charity organizations websites and their own web site for providing reports for the donors. In this project, the developers use ready-made tools and blockchain

platforms, and do not create a blockchain from scratch. The weak link of this project may be laid on this fact that the front-end of the process can be the charity organization's web page which can be easily exploited by untrusted organizations.

UK's Ox-Chain Project
This project titled "Towards secure and trustworthy circular economies through distributed ledger technologies" proposes a conceptual architecture design [21] that uses Distributed Ledger Technologies to automate the process of donation based on a conditional and data-driven model. In the blockchain domain, this architecture is very similar to Russian federation's project which uses smart contracts on permissionless Ethereum environment. Again, there is some weak spots in this design that is already mentioned in the paper. For example, Ethereum does not offer scheduling functionalities to invoke functions on a smart contract based on date and time or block number and the proposed architecture supports time-dependent functionalities using an off-chain scheduling module that regularly pushes the current date and time to the blockchain.

Menoufia University of Egypt
This project [22] uses the same concept of the Russian federation's project and focuses on implementation of tracking on blockchain but again this design doesn't eliminate need for charity organization that are needed to be trustable.

Some other design structures are proposed by researchers from Turkey and Europe [23] also consider the use of DLT for charity and energy donation. These concepts are based on robust blockchain technology for charity tracking, but their weak point is that at least a minimum Telecom and Electricity infrastructures is needed in the region of the beneficiaries to transfer digital donations to the target recipients. Other projects mainly from China also started their pilots from 2017 in which some of them are initiated by famous companies like Alibaba (Alibaba 2018) and Binance (Binance 2018) and some from the academia [24]. A review of the design and services provided by the mentioned projects shows that they are mainly focused on Trusted exchange instead of total process of donation. Similar projects like Unitedway, Givetrack and Givecrypto recently started in the United States by centralized organizations that are inclined towards using cryptocurrency but as they are mainly initiated by old-styled charity sector, they follow the same old-fashion donation process which has weak control dynamics. For instance, they only focus on using digital currency with the same old centralized procedures without any improvement on speed, donation loss, feedback reports or energy consumption. By these samples, we show the current state of the technology in humanitarian activities facing child hunger and some similar active projects that try to secure donations using blockchain technology. All the mentioned works are compared in Table I. To overcome the deficiencies of big, centralized organizations and flaws of blockchain-based technologies which makes them hard to penetrate in practical large-scale humanitarian applications we proposed an agile decentralized design based on emerging new Distributed Ledger Technologies available from 2019: the Hedera Hashgraph.

Table 1. *Comparison of the current studies on DLT-based charity*

Project	Project Base/ Application Area	Underlying Blockchain Technology	Scope of performance	Speed/ Energy Efficiency	Limitations/ downsides
-Building Blocks (BB) -Women's cash for work	UN initiated/ Refugee camps	Ethereum	Open-loop donation exchange, no track	Low	Dependency on the centralized financial service providers and special authentication technologies/hardware
Russian Federation's Project	Russia/ Russian federation	Ethereum	Donation Tracking	Low	Open loop dependance on charity organizations

-Unblocked Cash -Start Network and Disberse -Ox-Chain Project	UK based/ Global	Ethereum	Trusted Exchange And donation control dynamics	Low	-lack of evaluation and feedback over the donations -Trust on NGOs -Off-chain scheduling
Menoufia University	Egypt/ Africa	Ethereum	Closed-loop donation transfer and exchange	Low	Trust on NGOs
Cali & Çakir's Design	Energy Poverty/Global	Ethereum	Trusted Energy donation	Low	Need for infrastructures and dependency on local aggregator
China based Alibaba, Binance and Guilin university Project [23]	China/ Global	Multiple	Mainly focused on Trusted Exchange	Depends on used blockchain tech.	Weak control dynamics
Unitedway, Givetrack, Givecrypto	US based/ Global	Bitcoin	Open-loop donation exchange, no track	Very low	Weak control dynamics
Proposed work: HungerHash	Turkey based/ Global	Hashgraph	Closed-loop Tracking, Delivery & Report	High	Based on newly developed technology, not tested by the public

IV. HUNGERHASH

This paper observes one of the newest technologies as a very strong alternative to Blockchains. The Hedera Hashgraph is promising to outperform Blockchains in many specifications [25]. Before discussing about the architecture, we need to mention that unlike most of the Blockchain humanitarian projects, in the HungerHash concept we use the Hedera HBAR, a real digital currency using Hashgraph technology that is claimed to be the third generation of digital currencies which is much cheaper and efficient than Bitcoin with no energy waste.

To minimize the cost and delays of the network the HungerHash system uses a hybrid database that consists of two parts. The first part consists of cloud-based software and databases that contains less sensitive general information about the main players of the donation process and their activities and the link of some promotional data that provides feedback of donations to donors. The second and main part of the system is a distributed database which contains sensitive data of payments, coupons, IDs, location/time, and supply chain tracks that needs more security and independence.

The payments of the HungerHash are based on the concept of micropayments by digital currency. The strongest reason that we use this kind of payment is since in most of the urgent cases, we have lack of banking infrastructures for paper-based currencies as most of the geographical regions with urgent hunger are in conflict. Regarding these facts, this methodology prevents frauds and terrorists to gain access to the donations. Micropayment with digital currency also eliminates the intervention of corrupt governments into the donation process and makes the process free from any political obtrusions [26].
By this way we can manufacture strong trust in a distributed hybrid network to perform the functions of the following factors:

1-Reliable storage of sensitive information
2-Fast, Low-cost, and low-energy use of cryptocurrency
3-Trackable feedback of donation expend

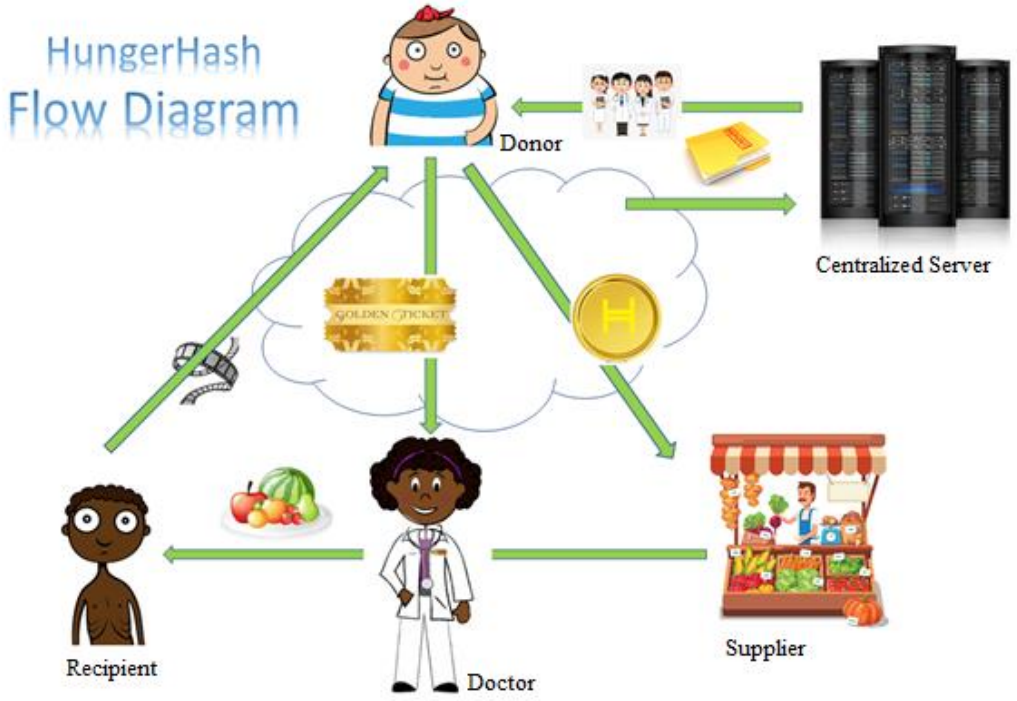

Figure 1. *HungerHash diagram showing the information flow and digital currency between main elements*

A. OPERATIONS FLOW DIAGRAM

Figure 1 shows the main elements of HungerHash. Each operation cycle in this flowgraph is initiated by a donor. All connections and message transfers are based on the Internet online of offline. The loop operation starts by a donor which sends digital currency and Tickets. The process also ends to donor node by receiving a multimedia donation report. The workflow of the HungerHash has the following main elements:

1-Donors

Are real or legal persons which register in the network with a unique identity which send their donations to the target ***recipients*** through ***doctors*** and ***suppliers*** by using HBAR digital currency. The amount of each donation cannot exceed a predefined maximum value.

2-Doctors

Are volunteer registered doctors that are living in geographic regions highly affected by hunger. Each ***doctor*** must have a smart phone with internet connection and a personal social network page in which he/she uploads the multimedia contents about the hunger in the region and his/her activities for hunger-relief in that region. Each ***doctor*** must cover at least one ***recipient*** and overlap of the coverage is also possible. It means that a ***recipient*** can be covered with more than one ***doctor***.

3-Suppliers

Are sellers of food and nutrition. They should be connected to one or more ***doctors*** and should accept the HBAR digital currency. Each ***supplier*** must have a smart phone with internet connection. The ***suppliers*** are not supposed to feed the ***recipients*** directly by their own decision and each feed needs a digital Ticket from a ***doctor***.

4- Recipients
Are real persons under age 15 with identity and contact info that is under coverage of a ***doctor***. There is no need for a ***recipient*** to have smart phone or internet connection. The maximum amount of donations that a ***recipient*** can receive is a fixed value that is defined for each month and each year for each specific geographic region as a default value by the HungerHash network.

In the first glance it seems that the process of donations in HungerHash can be simplified by using direct transfer of money from ***donors*** to ***recipients***. But after several reviews and discussions with experienced experts we found this solution as the most reliable one because inclusion of suppliers and doctors and digital currency in the chain provides very strong multi-factor security and reliability which prevents any speculation that may be occurred by the parents, or any other brokers with abuse intents. In addition, sending the HBARS to ***suppliers*** instead of ***doctors*** provides additional level of security and trust that prevents ***doctors*** to become monopoles without any proctorship and making single points of failure in the network. In addition to digital currency, the ticket mechanism also provides another trust level which prevents Suppliers to become unattended.

B. DONATION PROCESS

Each donation process consists of 4 steps that starts from registration and ends with delivery. However, it has been tried for the process to be as simple as possible, but also the utmost care was taken into account to make the network secure against any abuse or monopolism.

Step1-Registration:
The process starts with a simple registration for ***donors***. After the ***donor's*** decision for donation, he is forwarded to a donation page. In the first section of the donation page is a branch in which if he has HBAR currency he is forwarded to the next step and if he has no HBAR, he is forwarded to a page in which he/she can buy HBAR.

Step2-Orientation:
In the next step the process continues with supplying the information of volunteer ***doctors*** to the ***donors***, this information is kept in the database of the cloud server. A potential ***donor*** can select a specific geographical region and see a sorted list of volunteer ***doctors***. This database contains the following information for each ***doctor***:

- Name, contact info and documents and affiliations of ***doctors***
- Name, address and contact info of ***recipients*** under coverage of each ***doctor***
- A link to the **doctor's** personal social network page that contains multimedia contents of the potential ***recipients*** and previous donations and conditions of recipients before and after donation
- Contact info of ***Suppliers***
- Statistics of activity of the volunteer ***doctor*** and his ***suppliers***

Step3- Donation:
In this step the ***donor*** decides to select a specific ***doctor*** or a group of ***doctors*** and optionally selects a ***recipient*** or groups of ***recipients***. Then he/she sends a ticket which presents a portion of ***donor's*** HBAR asset to doctor. This ticket contains two metadata: location, time and amount of aid and the target ***recipient*** in which here the first one is mandatory and the second one is optional.

Step4- Delivery:
After reception of the ticket by a ***doctor*** he/she calls the relevant ***supplier*** to supply the food and nutrition to the recipient(s) which is selected by ***donor*** or ***doctor***. The priority of selection of ***recipient*** is arranged in a way that the ***donors*** have higher priority than ***doctors*** and if the ***donor*** doesn't select a specific ***recipient***, then the ***doctor*** will make the decision according to his knowledge about the most urgent ***recipients***.

To support the logistic and transfer cost of the foods and nutrition from ***supplier*** to the ***recipient*** the supplier can include the cost of dispatch in the calculations of the goods that is paid by ***donor's*** HBAR.

After delivery, a photograph or video of delivery is sent to the ***doctor*** as a ***recipients*** confirm which can be uploaded to his/her social media page to provide a feedback and trust for the ***donors***. Including this kind of receipt in the network is a strong inducement that increases the rank and trust of the ***doctors*** in the network. All these steps are summarised in flow diagram in Figure 2.

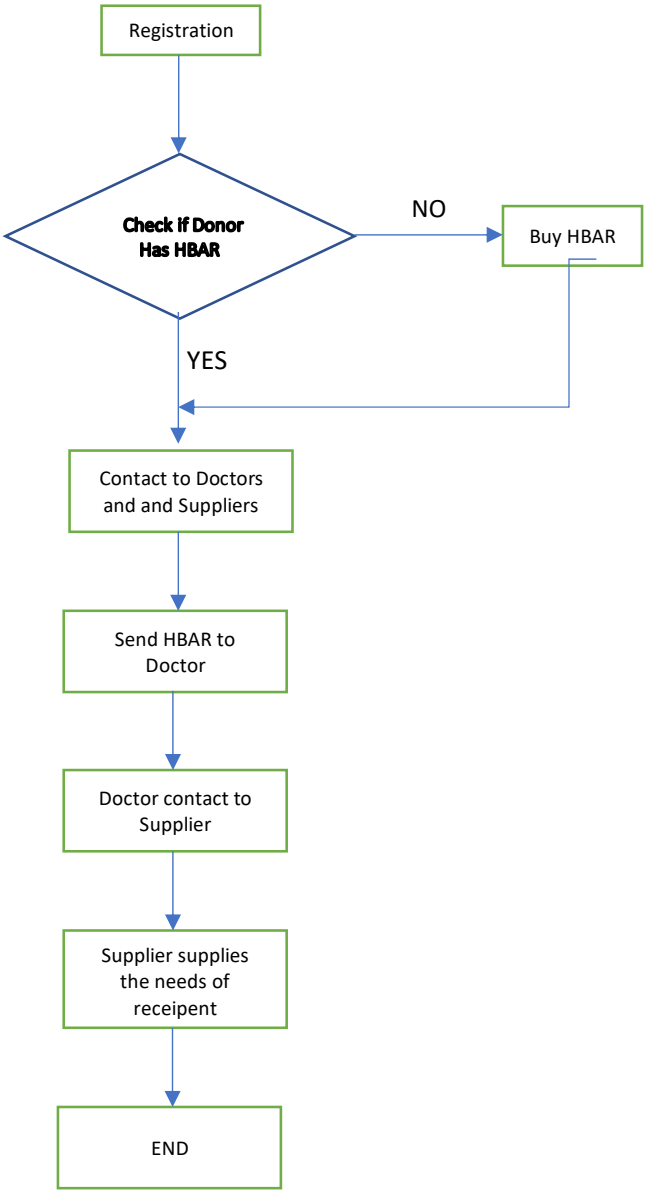

Figure 2. *HungerHash's donation Flow diagram*

C. UNDERLYING TECHNOLOGY AND ARCHITECTURE

The structure of the system is mainly based on the Hashgraph Distributed Ledger Technology. In fact, we can say that Hashgraph is an alternative to blockchain technology that is swiftly entering the fields of humanitarian and development aid [27]. While it is necessary to pay attention that Blockchain is a first-generation technology with severe constraints in terms of speed, fairness, cost, and security. We displayed a brief comparison between first, second and 3rd generation distributed ledger technologies in Table 2.

C.1. Protocol

Based on a virtual voting algorithm Hashgraph is an asynchronous consensus mechanism combined with the gossip protocol. It achieves consensus quickly, fairly, efficiently, and securely. The main innovation of this technology that reduces time of transactions and electrical power requirements is based on this fact that there is no need to use miners for transaction validation. Instead Hashgraph uses directed acyclic graphs to time-sequence transactions without bundling them into blocks . By this way it provides the benefits of Blockchain without its limitations. In addition, Hashgraph uses "gossip about gossip" a combination of the gossip protocol with a voting algorithm to reach consensus quickly and securely without proof of work. Each node shares new information that other nodes don't know using the gossip part of the protocol, and the gossip about gossip includes nodes that new information originated.

The Hashgraph algorithm is inexpensive efficient, fast, timestamped, fair, Byzantine fault tolerant, ACID compliant, and DoS resistant [28]. The proof-of-stack mechanism of the system shows Byzantine convergence when 2n/3 of the members are honest [29].

Table 2. *Distributed Ledger technology comparison shows benefits of 3rd generation technology [30]*

Generation	**1**	**2**	**3**
Sample Digital Currency	Bitcoin BTC	Ethereum ETH	Hedera HBAR
Transaction Per second	3+ TPS	12+ TPS	10,000+ TPS
Average Fee	0.20 USD	0.13 USD	0.0001 USD
Transaction Confirmation	10-60 Minutes	10-20 Seconds	3-5 Seconds

C.2. Transaction speed

A fundamental bottleneck in the first-generation technology has been the performance; in the first generation, the applications that can run on a database can just do 5 transactions per seconds. The Hashgraph network can achieve consensus on transaction order and timestamps for instances distributed across the world, with speeds larger than 100,000s of transactions per second. By the way it has surpassed transaction speeds of current centralized e-money networks like VISA. The speed of Hashgraph is around 250,000 TPS. Comparing with VISA which has around 24000 TPS capacity [31]**,** the Hashgraph is more than 10 times faster than VISA.

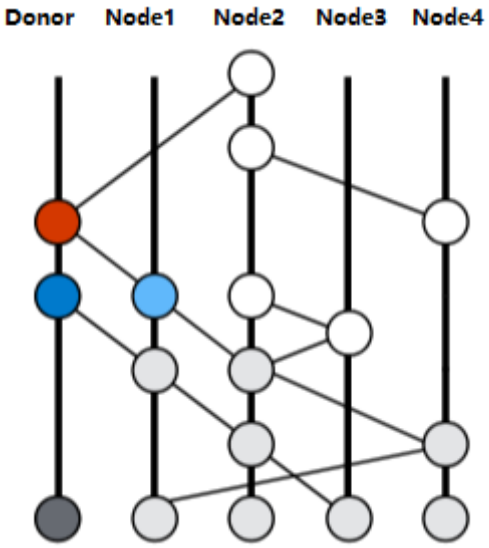

Figure 3. *The Hashgraph Data structure [32]*

C.3 Data structure

Hashgraph only include the bare minimum of two hashes, the hash of the last message created by a node, and the hash of the last node talked to last. The graph will be formed by flow of the algorithm that is able to connect everything. When the new messages include the hash of previous messages into one, the entire history and the order of the nodes talked to other nodes in the network is available.
Figure 3 shows an example to clarify the data structure of the Hashgraph. In this case the ***Donor*** creates an event (Red) saving the occurrence of Node1 performing a gossip sync to her and sending her all information he has. This event has a hash of two parent events (Blue): the self-parent (dark Blue) by Node1 which is the same creator, and the other parent (light Blue) by Node1. In addition, it contains a payload of new transactions that Donor wants to create at that time, and a digital signature by Donor. The other predecessor events (Gray) are not saved in the red event, and they are defined by all hashes. The other self- predecessors (dark Gray) are those accessible by sequences of self-parent links, and the others (light Gray) are not.

One of the strong aspects of this approach is that a participant is the equivalent of a miner in blockchain, and each member can create new transactions, and put them inside new events.

C.4. Reliability

Hashgraph has a Governing Council. The Governing Council will host the initial network nodes. They will fund a global governance backbone for supervision. This Council will consist of 39 organizations from 18 different business sectors and all geographies including Europe, Japan, India, Australia, US, and South America. They will collectively represent the entire market of potential use cases with a term-limited memberships that means that they cannot remain members for unlimited time. In the whole network, each member will run a node and each node will start off with 10,000 TPS [33]. At present time, the current Council members include Google, Boeing, IBM, Tata Communications, DLA Piper (Global Law Firm in 40+ Countries), FIS Global (US), Nomura Holdings (Japan), Deutche Telekom (Germany), Magazine Luiza, Swisscom Blockchain AG (Switzerland).

C.5. Services

The network provides the following services for the application level of HungerHash network through an open SDK:

Cryptocurrency – Enables Fast, low fee payments. The fast speed and low network fees make microtransactions a possibility. HungerHash will use this facility that will circulate like the blood in body.

Smart Contracts – Tokenize and exchange assets. The Hedera ledger can run smart contracts written in Solidity. This makes it easier to manage sensitive long-term contracts with grand members like country-wide ***suppliers*** in HungerHash.

File Storage – Sign and verify files. An example of this would be for user identification like a driver's license. We will use this facility to store identity of ***doctors*** and ***suppliers***. Governing body of the HungerHash can sign the IDs and others can verify if it's correct.

Consensus Service – Build directly on Hashgraph. This allows ***donor*** organizations to create a private network, like an ERP, while using Hedera's system and relying on its integrity.

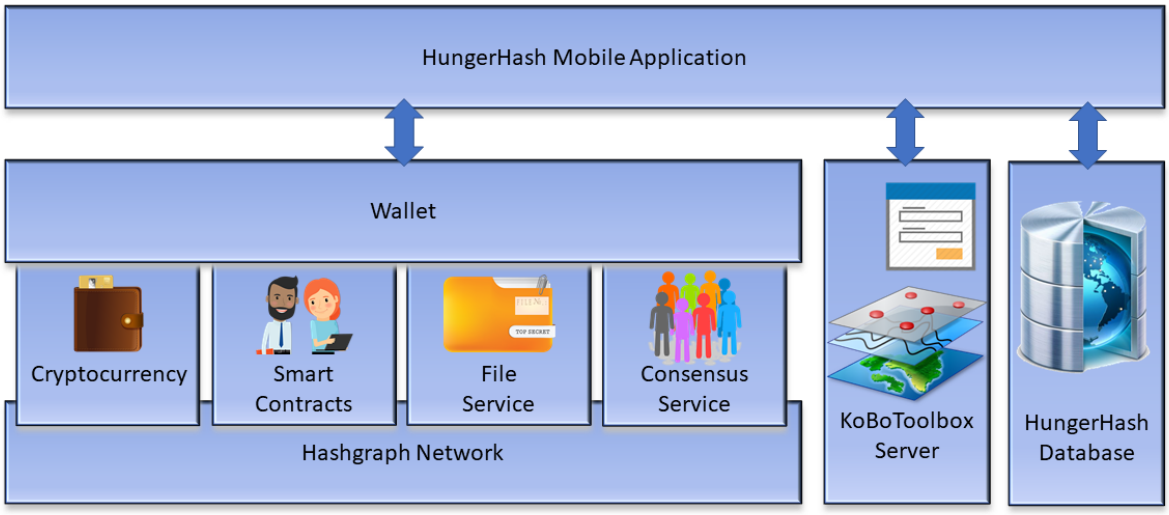

Figure 4. *HungerHash application and network architecture*

Figure 4 shows the HungerHash's network architecture. The HungerHash mobile application will be a portable Java application to be developed and maintained by the developer community of the HungerHash which will be formed by volunteers. ***Donors***, ***doctors,*** and ***suppliers*** can download and use this free application from HungerHash's central server or Google play store. This application runs on top of Hashgraph network and in the first stage uses its cryptocurrency and file services. A very small portion of donations is directly spent for distributed network transactions and hence there is no need for any centralized payment for Hashgraph services by the central organization. The cryptocurrency service is used for transfer of HBARS from ***donors*** to ***suppliers*** and distributed file system is used to maintain tickets, ***doctors***, ***donors***, ***suppliers*** and ***recipients'*** identifiers and transaction records.

A cloud-based service named KoBoToolbox will be used in HungerHash to provide necessary forms and reports for users. KoBoToolbox is an open-source suite of tools for data collection and analysis in humanitarian emergencies and other challenging environments developed by the Harvard Humanitarian Initiative. The analysis section of the KoBoToolbox provides Access to data through an API and will help HungerHash application to create summary reports with tables and graphs, it can visualize collected data on a map, disaggregate data in maps and reports, and export collected data to CSV and Excel formats.

A centralized database is also available in the network, mainly containing project web site, archive, developer info, and promotional data for potential donors.

V. DISCUSSION

As shown in comparison Table 1, our design not only benefits from many advantages of new DLT technologies like speed and energy efficiency but also focuses on every aspect of the donation process from start to end. This process works in a closed-loop control form that provides secure feedback which informs donors about the outcomes of their donations.

By the overall reviews and comparisons, we found that our design not only can be a great supplement to the less efficient massive, centralized approaches that are working around the globe right now, but also can outperform most of the current projects and pilots that are trying to use benefits of Distributed Ledger Technologies by blockchains and are just focusing on one of the aspects of the whole donation process. Our reviews show that most of the newly proposed or developed distributed designs are a kind of donation track network or a currency exchange platform that serves to the NGOs without covering all layers of donation process. On the other hand, if we focus on different layers of HungerHash design, despite all the benefits that was mentioned there may be some doubts about verdancy and infancy of its underlying technology which is not yet well tested by the public in a large scale. This may be the main reason that most of the similar projects and design are based on the Ethereum blockchains. As a reasonable solution for this potential infirmity, we designed the DLT-based section of the project in a modular approach. It means that each of the four DLT-based blocks in the application and network architecture are independent of DLT infrastructure are not necessarily tied to the Hashgraph network. In fact, in this design, we can have a hybrid DLT backbone. For example, the cryptocurrency block can be connected to an Ethereum network and file service, consensus service and smart contracts can operate over Hashgraph backbone. By such a modularity and flexibility, the overall design will not only benefit from energy efficiency and speed of new DLT technologies but also can benefit from popularity and robustness of older DLT backbones with higher technology readiness level.

VI. CONCLUSION

We can conclude by looking at the past and considering current economic crisis, that to have a world free of hunger, there can be no hope for programs of governments around the world. In this paper we sadly shown that with %36 overhead and %30 estimated corruption factor we have globally a loss factor of 0.45 for humanitarian aids for hunger. It means that with current organizations generally less than %45 of the global aids is estimated to reach to the real deserving recipients.

To overcome deficiencies and improve trackability of aids we proposed HungerHash as a global high-tech. distributed network for child-hunger relief, which is promising to be much more agile, efficient, and trustworthy than the current centralized and even most of the recent decentralized approaches. We showed that a hybrid mix of centralized and decentralized databases will provide a scalable, flexible yet secure technology which provides independence from formal and governmental restrictions and dictatorships with minimal supervision requirements. We showed that by using a third-generation Distributed Ledger Technology like Hashgraph, the transparency, security requirements, fault tolerance and high speed and incorruptibility of transactions and supply chain tracking can be achieved with a minimal cost that is much less than the current centralized organizations or emerging concepts based on Blockchain that is a high energy-consuming technology.

As a conclusion, the HungerHash is a self-organizing network that does not dictate the donation recipients to have a smartphone or any communication device or a bank account. The recipients are not needed to have electricity or internet access as well. As it can be easily seen in our approach, The Distributed Ledger Technology is not used as a decoratively secure database for normal currency transfer operations. In the HungerHash, donations are purely based on digital currency using HBAR that is claimed to be the third generation of digital currencies which is much cheaper and efficient than Bitcoin with no need to mining and huge energy consumption.

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