Developing a Smart Banking Edge Model Based on Block Chain and Lora Technology

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ABSTRACT

With the rapid growth of the Internet of Things (IoT) market and its requirements, low power wide area (LPWAN) technologies are becoming popular. Long-distance wide area network (LoRa WAN) is mainly operated by private companies or organizations, in order to solve two major problems, the trust of private network operators and the lack of network coverage. This study aims to propose a conceptual architecture design for an embedded blockchain solution for LoRa network servers to solve the mentioned problems. Blockchain technology was created and merged with LoRa technology by programming the blockchain in the Java coding language and creating interfaces so that the client may dictate the data within to enable transferring activities to another person without the need of a third party, i.e. Blockchain technology is an open, trustworthy, decentralized, and tamper-resistant system, the most important process in the blockchain, and it is the hashing process, i.e. the encryption of the block. This encryption prevents the data in this block from being modified during any coming period in the future. after filling out the interface, it is distributed to the rest of the nodes in record time using LoRa technology. The delivery of vital and confidential data was implemented and tested using blockchain software and LoRa devices of the type TEL0114, at a frequency of (433) MHZ ,Two-way communication, transparent serial data transmission.. several tests were carried out in order to confirm the efficacy of the proposed system, The data was transmitted over various distances, and the speed of data exchange was increased by eliminating the need for an intermediary; it is a direct procedure from sender to recipient, and it will take much less time to transfer funds between individuals while maintaining the confidentiality of the transfer process.

Keywords: *LoRa, IoT, blockchain, LPWAN.*

1- Introduction

Low-power, wide-area (LPWA) technologies have gained popularity due to the IoT market's rapid expansion and demand. Narrow-band IoT (NB-IoT) and long-range (LoRa) are two primary leading competitive technologies in various LPWA technologies. LoRa wide area networks (LoRaWAN) are primarily run by private firms or organizations in contrast to NB-IoT networks, which are primarily developed and controlled by mobile network operators. This raises two concerns: a lack of network coverage and a lack of trust in private network operators [1].

As the Long Range LoRa infrastructure for IoT applications has evolved, efficiency and security have become critical concerns. The centralized working mechanism of the LoRa system, which processes and stores all packages in a single cloud, makes it difficult to fully utilize the resources of LoRa gateways and leaves it vulnerable to security issues such as data loss or falsification. The blockchain, on the other hand, has the potential to provide the LoRa system with a secure, decentralized architecture. It is, however, extremely difficult to deploy blockchain at LoRa gateways with limited edge computing capabilities [2].

Related works

Numerous studies have been conducted on the topic of a Smart Banking Edge Model.

Kazm et al. affirmed in 2017[3] the importance of developing a proof of concept to enable low-power, resource-constrained IoT end-devices to connect to a blockchain-based infrastructure To do this, an IoT gateway is set up as a blockchain node.

Dorri, et al. proposed in 2017[4] a conceptual architecture for an incorporated blockchain solution for LoRaWAN network servers to construct an open, trustworthy, decentralized, and tamper-resistant system with an unmistakable mechanism to confirm that transaction data existed in the network at some point.

D. Puthal, et al. proposed in 2018 [5] used LoRa science to safeguard and carry data as it collects fitness information from the human body via a wearable

healthcare device. Because the proposed blockchain architecture makes use of smart contracts, Ethereum technology is used.

Joao et al. (2018)[6] touched to deal with the needs of smart cities and how networks must service and manage them. The LoRa network is also stated to be used for effective asset and resource management (such as traffic, power stations, waste management, water supply, etc.).

Sergey Mosin (2018)[7] stated that wireless sensor networks (WSN) must be organized with IoT, and LoRa can provide effective WSN design and a lifespan assessment of the proposed sensors.

Nancy et al. (2018)[8] considered LoRa a component of LPWAN technologies that are appropriate for vast regions and have become desirable for IoT technologies with high-security monitoring applications.

Wu Longfei, et al., proposed a blockchain-based architecture in 2019[9]. The Ethereum blockchain was used to validate the proposed architecture, throughput, and latency performance. The proposed blockchain architecture is a low-cost solution for a LoRaWAN network that requires only a few network servers and a single LoRa device and does not require high throughput or latency.

The residuum of this paper is summarized as follows: In Section 2, the proposed system's methodology and model are presented. The main function of the proposed system is explained in Section 3. Section 4 displays the obtained results, and Section 5 concludes this work with a summary of the main findings.

2. Methodology

2.1 Blockchain technology

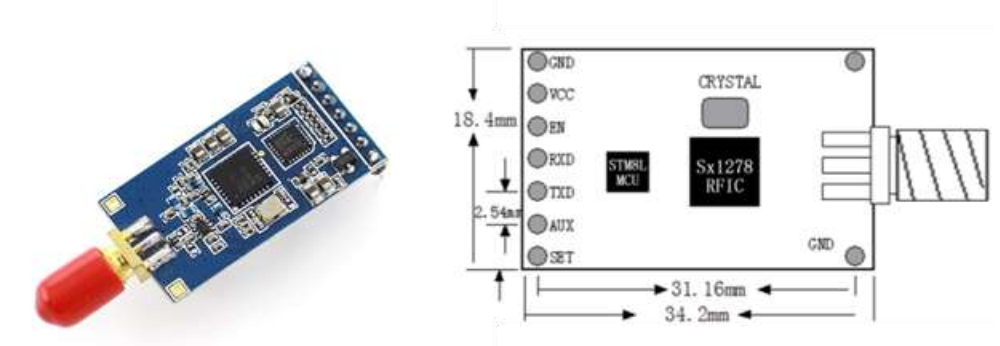
Block aggregation is the blockchain's main objective. Because all submitted transactions are maintained in a list of so-called blocks, it is often referred to as a "public ledger" (nodes). It is a group of records—often referred to as "blocks"—that are used to hold particular data and that can expand with time and use. These blocks relate to the idea of cryptography, commonly referred to as hashing. [10].

2.2 LoRa Technology

The LoRa MESH Radio Module is a high-performance, low-power, long-range micro-power RF module with inbuilt wireless MESH MANET protocols that enables users to quickly construct wireless ad hoc networks without altering current devices or protocols. RF chip module technology is based on spread spectrum frequency hopping, spread spectrum calculations, and cutting-edge internal automatic CRC error correction processing. Better than other types of modules in terms of stability, anti-interference capability, and receive sensitivity. API mode, translucent mode, and AT command mode are additional features supported by the module. The user can set up our PC program in these modes. ,Depending on the factors of the actual demand for flexible module design, straightforward operation, convenience of use, and robust adaption, you might also send AT commands through the microcontroller. Use the USB-to-TTL converter to set the module parameter. as shown in Figure 1 [11].

2.3 Arduino Uno Microcontroller Board:

The open-source Arduino platform is used to create electronic creations. An Integrated Development Environment (IDE), which runs on a computer and is used to write and upload code to the Arduino board, is one of the programming components of the Arduino. The Arduino is made up of a microcontroller, a programmable circuit board, and this component. Arduino boards have become quite popular, and for good reason, among those just learning electronics. As opposed to all previous Arduino programmable circuit boards, the Arduino doesn't need a separate piece of hardware (known as a programmer) to upload code to the board. A reduced version of C++ is also used by the Arduino IDE, which makes learning to program easier. [12].



Pin No.	Pin Symbol	Description
1	GND	GND
2	VCC	Power supply(3.3v ~ 5v)
3	EN	No connection, Customized for the module
4	RXD	UART Input, CMOS 3.3v or TTL 5v
5	TXD	UART Output, CMOS 3.3v orTTL 5v
6	ACT	No connection, Customized for the module
7	SET	No connection, Customized for the module

Figure 1: LoRa device [14]

2.4. Proposed System Block Diagram Design

The fundamental characteristics and parameters of the proposed system allow it to be divided into three main units: the computer unit, which contains the data graphical user interface; the data controller, which uses the Arduino microcontroller; and the LoRa. Data or text is delivered from the first computer via Arduino 1 and LoRa1, and this data is received by LoRa2 and LoRa3 on the other side, in other words, the process of receiving data is based on what was received by PC2 or PC3, as shown in Figure 2.

To allow the user to enter data, trade it with other components and apply the blockchain algorithm, an interactive visual interface has been created. Arduino is used to connect LoRa to a PC. The data is first added to an array and given a key before it is translated into a JSON string. SHA256 is used to generate a key from a JSON script. It is a standard cryptographic security algorithm for the "256-bit Secure Hash Algorithm". Cryptographic hashing algorithms produce unique results. The higher the possible hash, the less likely it is to generate two values for the same hash). The receiving party adds the newly created key to the data array, then uses the new key to convert the array to a JSON string, sends the JSON string to the rest of the nodes, and finally compares the newly generated key as shown in Figure 3.

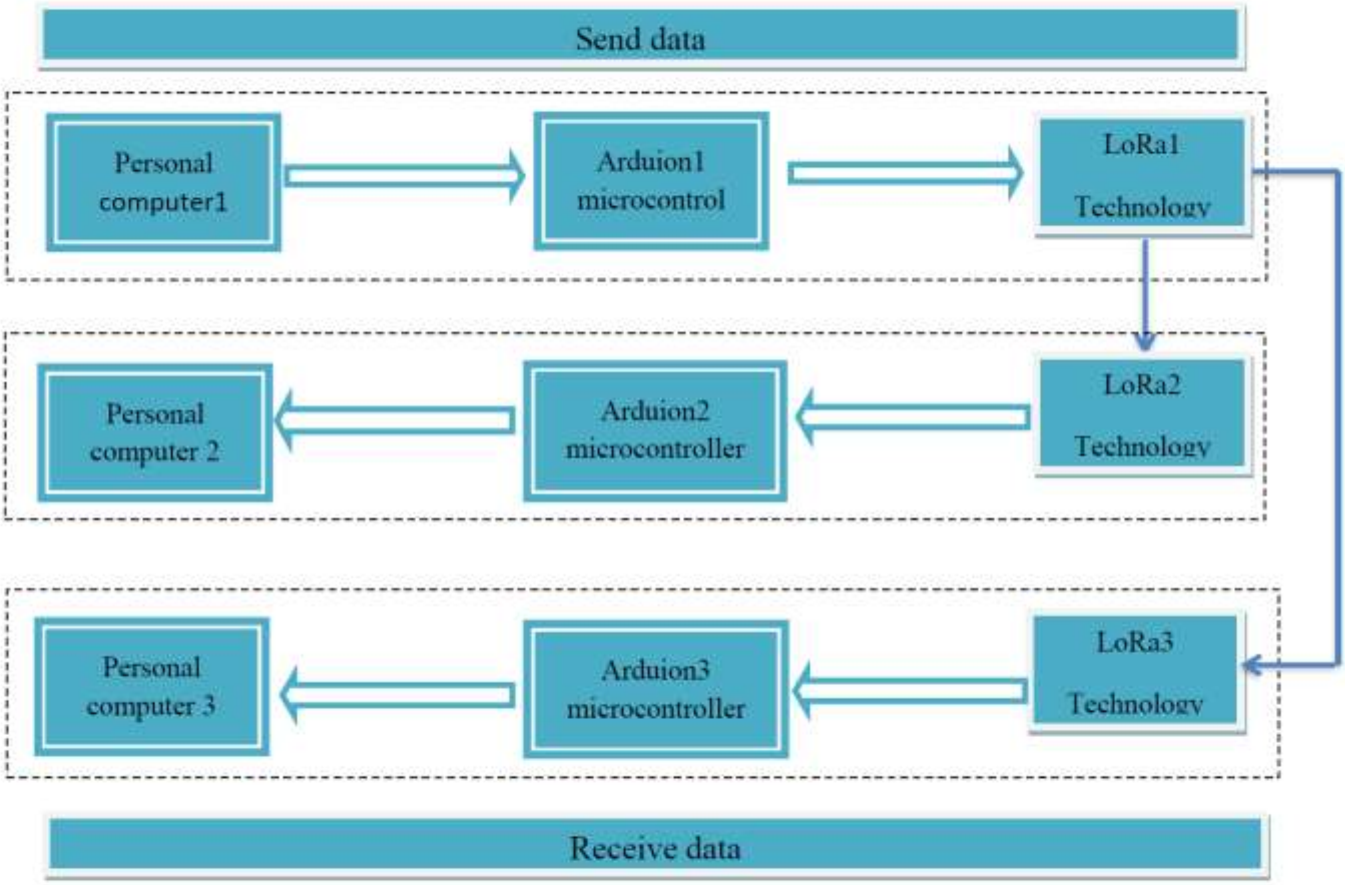


Figure 2. System Layout sending and receiving data

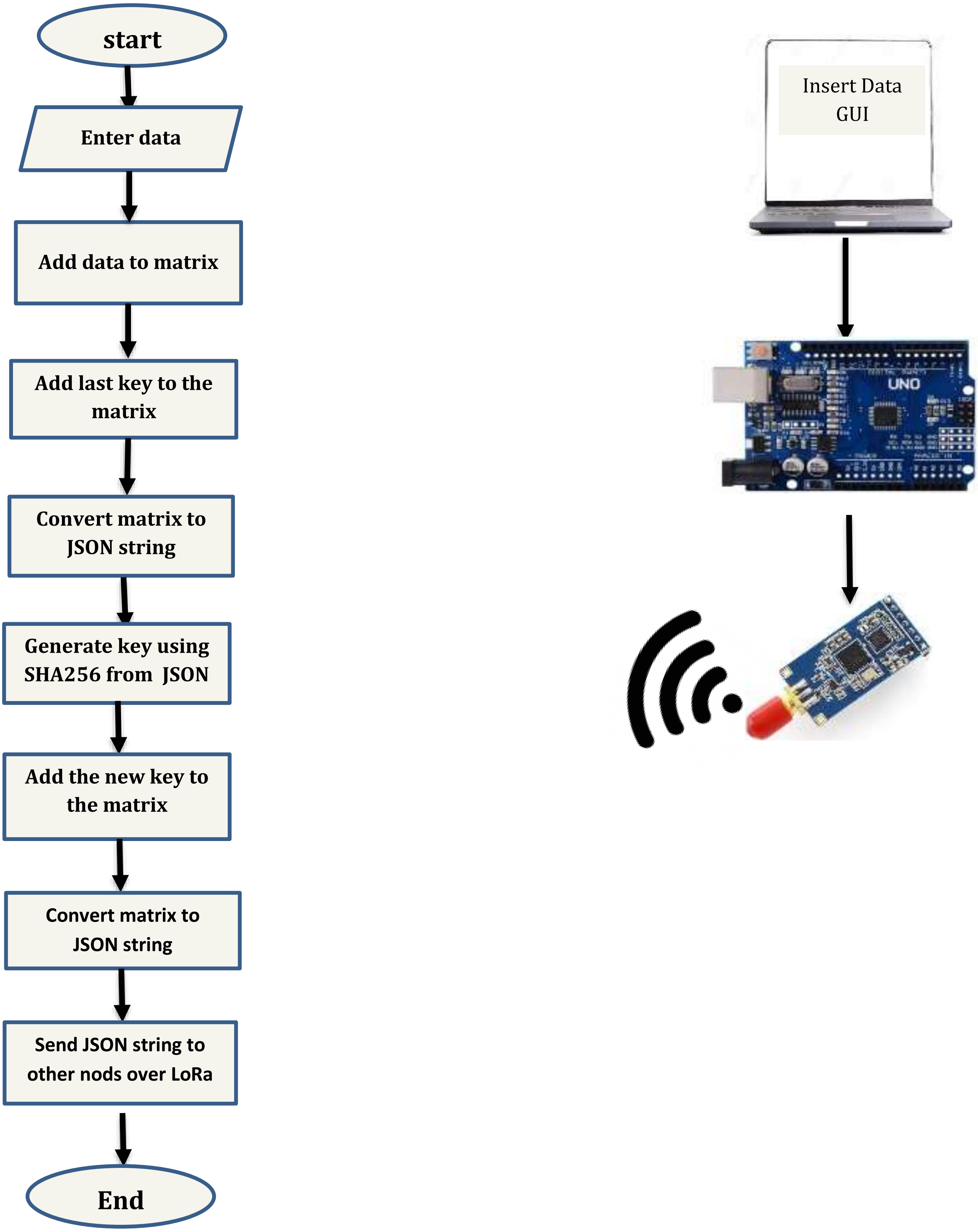


Figure 3. System Layout For LoRa and Bloackchain

3. Major Tasks of the Proposed System

An interactive visual interface was created for the user to enter data, exchange it with other components, and apply the blockchain algorithm. It is as follows.

The first interface is to enter the username and password, indicating the way to enter the blockchain, as shown in the figure 4.

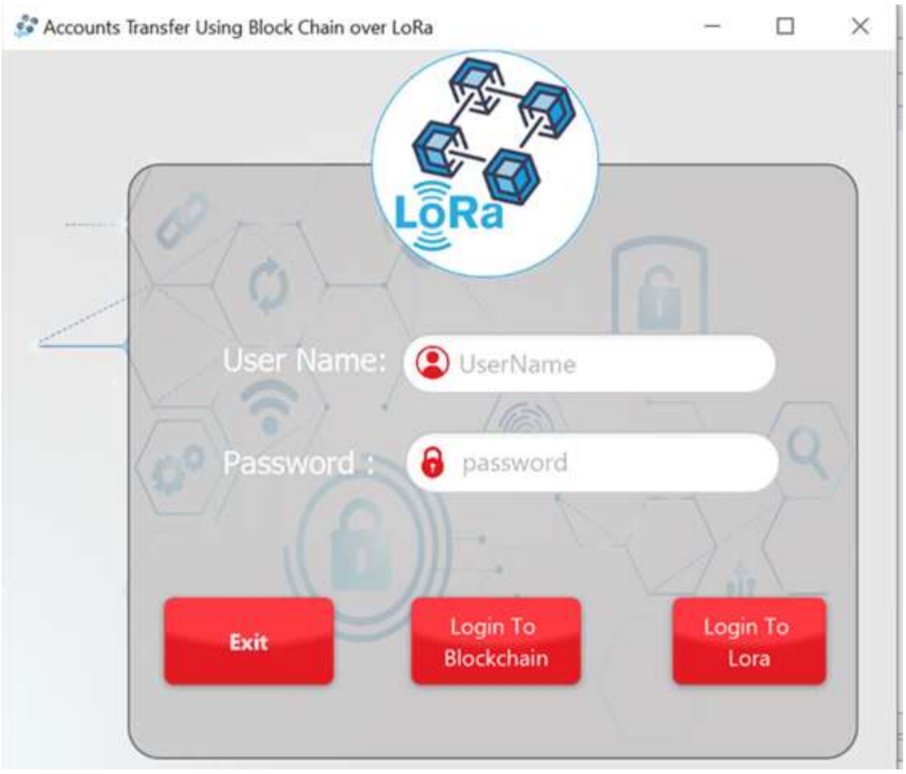


Figure (4): User Interface window

3.1 The following interface appears as shown in the figure 5, through which the data is sent first. Click on the open port, then we choose one of the devices, which is the server, we enter the data, and then we send it in the end. A success statement is displayed if the information is correct. This screen is displayed on all computers including the server.

1- One of the computers is designated as a server.

2- Select an open port

3- Determine the number of machines to which the data will be transferred.

4- Enter the sender's name or ID (Sender ID).

5- Provide the name or ID of the recipient (Recipient ID).

6- The amount to be sent is determined by us.

7- If necessary, notes are taken.

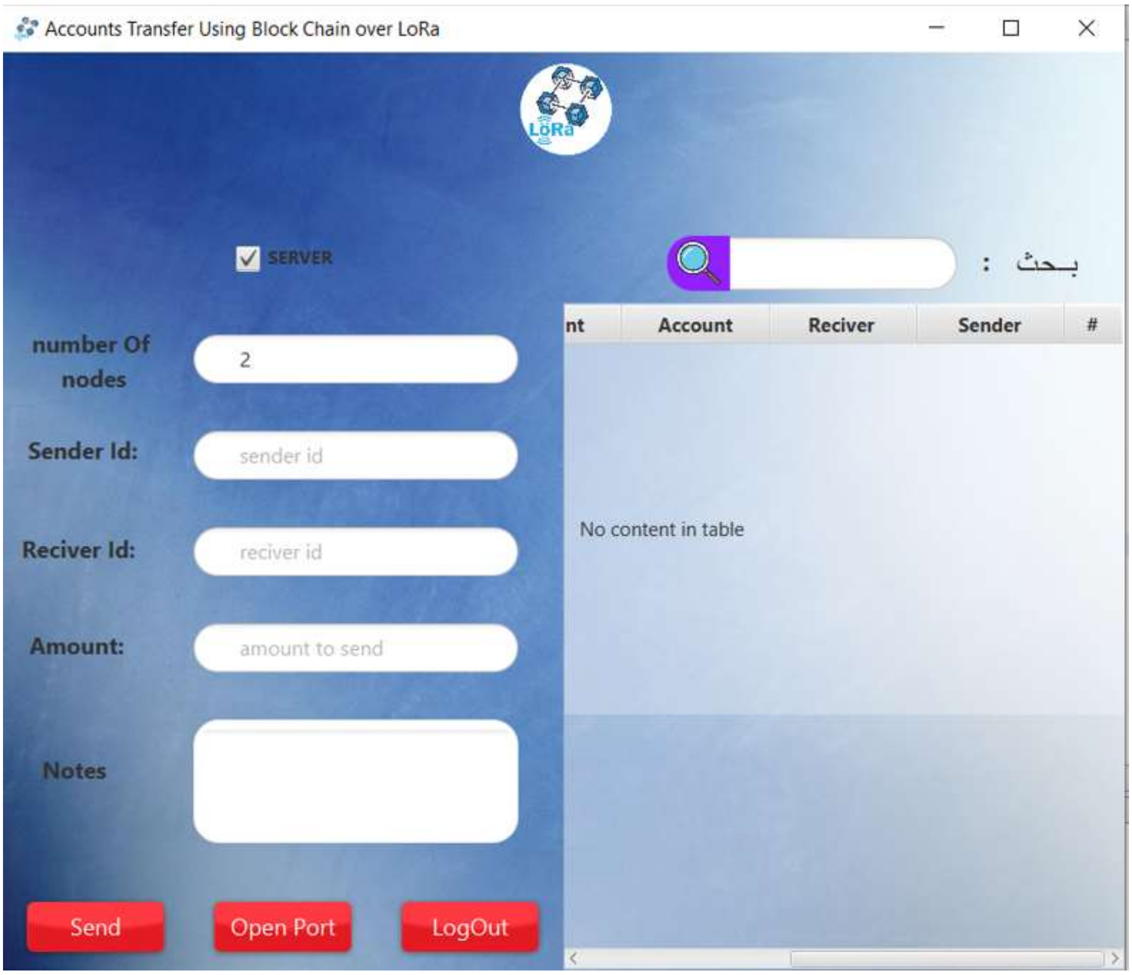


Figure (5): Data transmission window

The data will be transmitted after the points necessary to convey the data have been established. Figure 6 shows a notice indicating the data has been submitted. The user interface also includes a search engine that searches the databases for blocks containing the text to be searched.

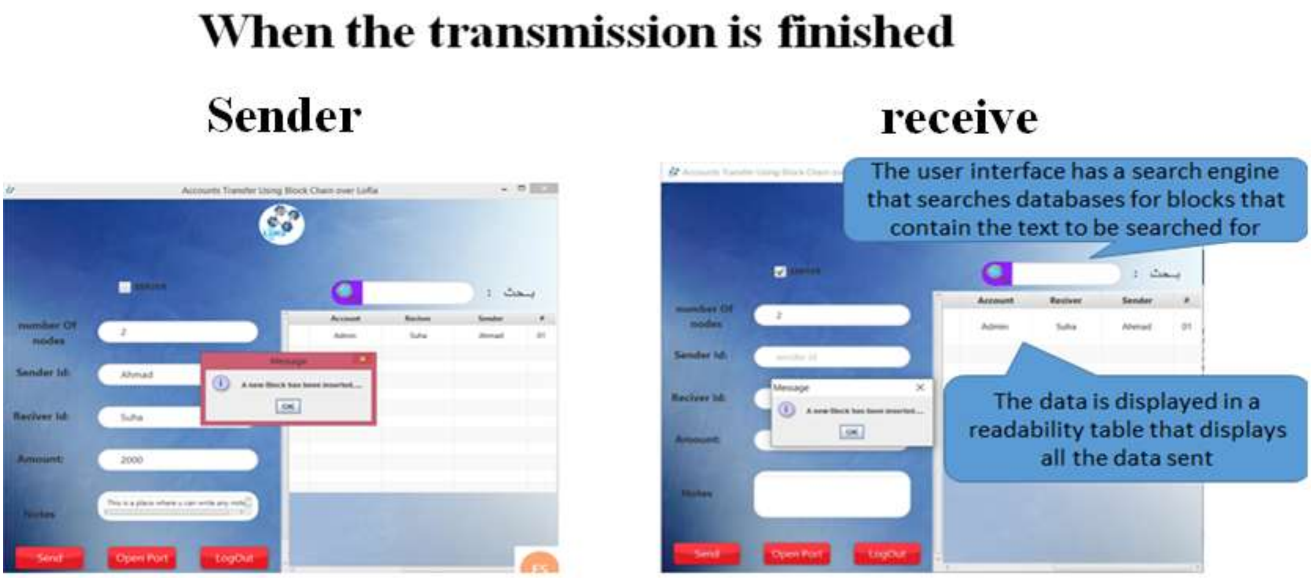


Figure (6): Window for sending and receiving data

4. Results

Figure 7 shows how the technologies of blockchain and LoRa have been merged. Arduino was used to connect the LoRa to the computer:

The LoRa technology uses low-energy RF waves to connect devices over great distances. the Arduino acts as a bridge between the LoRa device and the computer, connecting first to the LoRa and then to the computer from which the data is to be transferred. The sending and receiving protocols are as follows:

1-Data is transported between computers using an Arduino connected through a USB connection, a microcontroller that separates the data into packets of 200 bytes each and sends them from PC1 to PC2 and PC3.

2- This information is gathered by the other LoRa components, which then transmit it to the Arduino, which finally sends it to the computer via the USB connection.

The total results obtained by implementing the practical part of the proposed system are shown in Table 1, where the first column represents the distance between the transmitter and receiver, the second column represents the size of the data sent, the third column represents the time (in milliseconds) required for the receiver to receive the data, and the fourth column represents the total Data/Byte it takes to transmit the information.

Data/Byte= time (ms) / data size

The graph in Figure 8 shows how long it takes for the data to arrive. It was attained after sending data in various sizes (190,299,711,924) and putting it through various distance tests (within the building, 100m, 1000m, 2000m, 3000m).note that the data reception time distance is almost unaffected because the bit rate is low.

Figure 7. Connected the LoRa with the computer over Arduino

Table 1: Describes the effect of distance on data transmission

Distance	data size	time(ms)	Data/Byte
inside building	190	4865.785	25.61
inside building	299	8806.2014	29.45
inside building	711	24018	33.78
inside building	924	31701.85	34.31
100 m	190	4865.86	25.61
100 m	299	8806.215	29.45
100 m	711	24002.17	33.76
100 m	924	31685.58	34.29
1000 m	190	4865	25.61
1000 m	299	8802.13	29.44
1000 m	711	24001.1	33.76
1000 m	924	31685.58	34.29
2000 m	190	4862.41	25.59
2000 m	299	8812.97	29.47
2000 m	711	24009.25	33.77
2000 m	924	31690.001	34.30
3000m	190	4863,14	25.60
3000m	299	8814,09	29.48
3000m	711	24006,83	33.76
3000m	924	31691,891	34.30

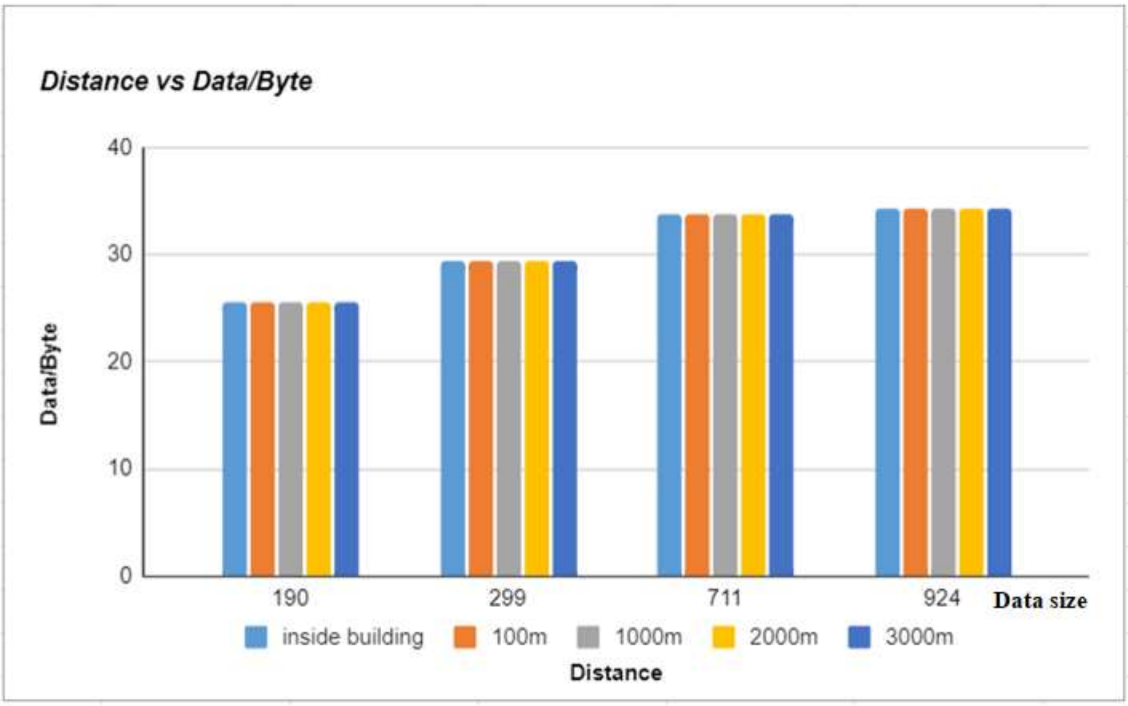


Figure 8 The relationship between distance and Data/Byte in data transmission

5-Conclusion

The proposed system was evaluated, and the expected results were obtained through security, dependability, data and information secrecy safeguards, and their control over not attempting to hack. This strategy could also be used in education, health care, and government elections. This study developed a key component of the data transmission process, which is a scalable technique for distributing data via LoRa and the blockchain system. As many cities around the world strive to adopt LoRa as the critical backbone for communication and data transfer to increase trust and security, this system connects the LoRa network with the Blockchain system.

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