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# Smart Farming Using Iot & Data Encryption Standard with Blockchain

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***Abstract:-*** For the next generation to have a better future, technology is crucial. A "Smart City" is a technologically advanced metropolis that collects data using electrical technology to enhance operational effectiveness, educate the populace, and provide improved governmental services and public welfare. Millions of sensors have been installed as a result of advancements in technology, enabling for the monitoring and data collection on the state of many forms of metropolitan infrastructure. Sensors, machinery, and other items are employed with information and communication technologies in sophisticated farm supervision cycles that are network-based have been the focus of "smart farming" research. Modern technology, the IoT, predicted encourages development, adoption robotics and artificial intelligence in agriculture. Thus the proposed system used block chain techniques. Blockchain is viewed as a core disruptive technology. The study of blockchain is still in its infancy, despite the fact that many researchers have realised how important it is the record-keeping technology that powers bitcoin. It acts as an irrevocable ledger, enabling transactions to happen in a decentralised manner. The IoT cloud receives the data from the sensor and transmits via blockchain based hash encryption. After the hashing encryption is completed in received data the hashing value is then encrypted with 64 bit Data Encryption Standard. Thus this techniques makes the proposed system with more safe and secure from third party attacking also prevent the data from hackers. Applications built on the blockchain are growing rapidly in a wide range of industries, including finance, healthcare, agriculture, product management, the IoT, and many more. This essay offers a thorough investigation of Blockchain technology used in smart farming.
***Keywords:*** *Smart farming, Internet of Things, Blockchain, Sensor data, Data Encryption Standard, Key Generation.*

## 1. Introduction

Any nation's agricultural sector greatly contributes to its overall economic development. The increasing need for food and the upkeep of it are what are driving the need for intelligent such as the cloud, and IoT devices. Given that the projected growth in global population we must enhance food production, Berners-Lee, M., et al (2018). We need to enhance production in order to feed these billion people, which can be done by integrating IoT into agriculture. Due to several factors like industrialization, the development of commercial marketplaces, and the construction of homes on those agricultural grounds, the population is increasing while the amount of agricultural land is diminishing. Precision farming is another name for smart farming. However, as communication technology has improved and IoT adoption has expanded, the use of unmanned aircraft has gained significant importance Pradhan, B., Bhattacharyya, S., & Pal, K. (2021). It may carry out a variety of tasks that enhance farming methods. The activities include of soil testing, health monitoring. Indicators of crop health, Sensors, such as thermal, multi-spectral, optical, and 3D cameras, can track all types of measurement Mohamed, E. S., et al (2021).

**Soil pH:** For a certain type of crop, a proper soil pH must be maintained; hence the sensor measures the pH of the soil.

**Soil Moisture:** The server will then take the necessary action after receiving the collected data, such as using spray pumps to moisten the soil if it is dry or adjusting the temperature to raise the moisture level inside the poly home back too humid Shamshiri, R. R., et al (2018).

**Air Temperature Sensor:** The main server can use the information from the air temp sensor to turn on the air conditioner, exhaust fans, and water sprayers as needed. An Internet of Things gadget called the air temp sensor measures the temperature inside the poly home Dagar, R., Som, S., & Khatri, S. K. (2018, July).

**Table 1 Environmental consideration impacting different stages of cultivation**

| Cultivation Stages | Air Temperature | Soil Temperature | Soil Moisture | Humidity |
|---|---|---|---|---|
| Sprouting | 26-33 degrees Celsius (Best).<br><br>At least 18 degree Celsius (Minimum) | 23-28 degree Celsius (Optimum) | according to the water absorbed | - |
| Tillering | Cool nights | Minimum when the soil is warm | Aided by sufficient soil moisture | |
| Growth | 30-33 degree Celsius (Best) and poor when < 20 degree Celsius | 23-29 degree Celsius (Optimum) and poor when < 21 degree Celsius | Ample moisture is necessary | Better |
| Flowering | Preferred warm nights or with 18 degree Celsius | Utmost in warm soil | Best in moist soil and should be avoided during a drought | Better |
| Ripening | Preferred cold nights or Optimum < 15 degree Celsius | Low temperature is best | a minimum of moisture causes | Preferred dry climate |
| Over-Ripening | Provokes at hot season | Favoured by high temperature | Favoured by the presence of water during the dry season | - |

Table 1 provides recommendations from agronomists regarding the ideal environmental elements that influence crop growth. Recent technology developments, like precision-based agriculture, make use of IoT to grow agriculture sustainably. According to Bauer, J., & Aschenbruck, N. (2018, May), IoT in precision farming gathers and transmits a significant amount of field data, analyses it, and makes precise farming decisions.

**IoT:** IoT refers to the full network of linked devices as well as communication technologies among them, as well as between them and the cloud. IoT smart agricultural solutions are intended to aid in the automation of irrigation systems and the sensor-based observation of crop fields. Consequently, farmers and related businesses can readily and easily check on field conditions from any location. Prathibha S. R., Hongal, A., & Jyothi, M. P. (2017, March). Farms using physical apparatus record data and record it, which is then used to learn valuable knowledge.

**Smart Farming:** In order to reduce waste and boost output, "smart farming" refers auxiliary systems. Intelligent producers, instance, modern instruments to manage soil, irrigation, pest management, plantation monitoring, and other areas of the production process farms Li, X., et al (2022). These resources include, among other things, the temperature, luminosity, humidity, and pressure of the ground. Additionally, they comprise GPS, communication networks, video cameras, unmanned aerial vehicles, agricultural information management systems, and GPS, Boursianis, A. D., et al (2022). By 2023, it is estimated that the precision agriculture industry will generate $10 billion in revenue, Bosompem, M. (2021). Presenting opportunities for farmers, agricultural equipment suppliers, and technological companies. Smart farms should also be able to increase food output by better fertilising the soil, using fewer pesticides, and irrigating with less water.

## 2. Objectives

Due to the decentralised nature of the blockchain for IoT applications, academic peers have conducted much research on it. Modern techniques still have some limits, but by overcoming these obstacles, blockchain technology's capabilities and efficacy can be increased. This technology should be further studied in the near future. Blockchain is the name of the infrastructure that enables numerous shady parties to verify transactions. The given ledger is distributed, safe, auditable, transparent, and immutable. The system provides full access to every transaction that has occurred since the first transaction, public access to the blockchain, which may also be reviewed and compiled at any time by any organisation Ray, P. P., et al (2020). Each block of data produced by the blockchain system contains a group of Bitcoin transactions that took place at a specific moment. When a link between two blocks refers to the block before it, a chain is formed.

## 3. Methods

This section explains about the design of proposed system and its working process. Capturing vast quantities a wide range of activities including various studies and crops, and doing so using heterogeneous data generated by numerous IoT devices (and possibly manual measurements). It is required to enable the integration and usage practically any IoT device in order to establish "bring your own sensor" a system of activities that enables growers, farmers, and scientists utilise less expensive/more powerful IoT sensors as well as financial constraints and personal preferences. The method of hashing using blockchain is depicted in the figure 1.

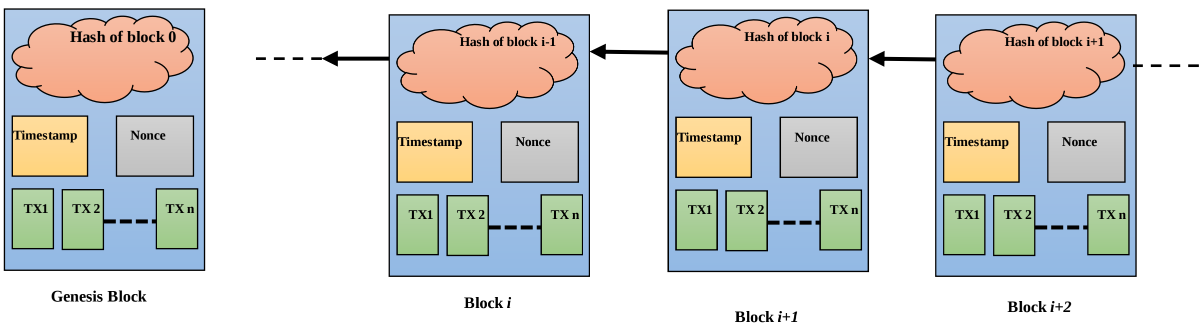


**Figure 1 Block chain data hashing method**

**Block version:** specifies the block validation rules to be used.

**Parent block hash:** an unsigned 256-bit hash value pointing to the preceding block.

**Merkle tree root hash:** The sum of the block's transactions' hash values.

**Timestamp:** current time in seconds since January 1, 1970, 0:00 UTC.

**nBits:** Hashing target's compact representation at this time.

**Step-1-Generation of Key**

- Binary linear code KL is chosen as (h1, h2), It can be used to correct mistakes discovered by the numerous codes.

- Sensor node A chooses a random value dimension (h1x h2), and non-singular binary matrix *B*.

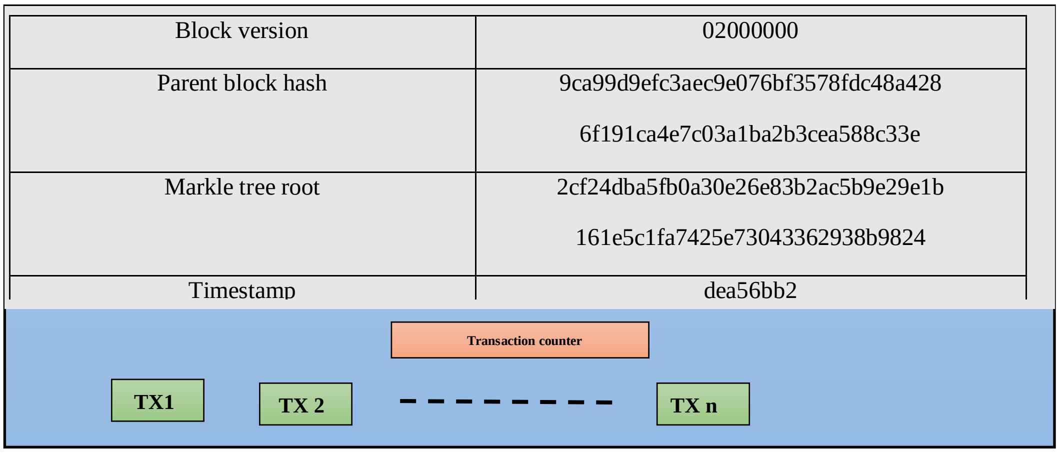


**Figure 2 Blockchain Architecture**

The architecture of blockchain system technology is explained in the figure 2.

**Step-2: Encryption of H_IoT data**

- The sensor node -B encodes a message msg into a string with a length of b2 in binary form.
- The sensor node-B computes an encrypted message as $K_L = K_{L1} + z$.

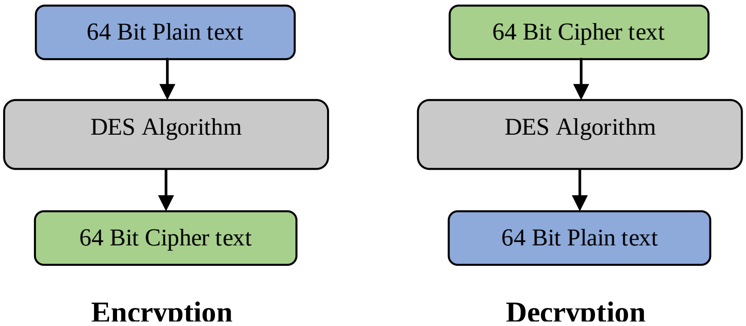


**Figure 3** Data Encryption Standard (DES)

The above figure 3 explained about the Data Encryption Standard (DES) algorithm. It is clearly explained the working concept of encryption and decryption.

**Step-3: Decryption of H_IoT data**

- Sensor node-A determines an enhanced linear code as $K_{L1} = K_L\,(1/P)$.
- Sensor Node A uses the decoding method to retrieve $Lc1$ to *msg1*.

$$Lc1 = Lc.\,(1/P) = msg.F1.(1/P) + z(1/P) = msg.B.F + z(1/P) \qquad (3.1)$$

Finally, the NEC algorithm also carries out proof of decryption of verify the data integrity of the message received by the end-sensor node. For this reason,

$$msg = msg1.(1/B) = msg.B.(1/B) \qquad (3.2)$$

The message msgBF is situated at a distance of t from $K_L(1/P)$ in this case, making it possible for Goppa code F to correct the t faults. The system can therefore obtain corrected code as msg1=*msg*.B.

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**DES algorithm Pseudocode:**

```
Cipher (plainBlock[64], Roundkeys[16, 48], cipherBlock[64])
{
        Permute (64, 64, plainBlock, inBlock, Initial Permutation Table)
        split (64, 32, inBlock, leftBlock, rightBlock)
        for (round = 1 to 16)
        {
                mixer (leftBlock, rightBlock, RoundKeys[round])
                if (round!=16) swapper (leftBlock, rightBlock)
        }
        combine (32,64, leftBlock, rightBlock, outBlock)
        permute (64,64, outBlock, cipherBlock, Final Permutation Table)
}
```

**Figure 4** Pseudocode for DES algorithm

The figure 4 depicts about the pseudocode for Data Encryption Standard (DES) algorithm, and the detailed step-by-step instructions are provided. This study performs encryption and decryption experiments on data of sizes 20KB, 40KB, 60KB, 80KB, and 100KB in order to evaluate the effectiveness of the built-in encryption standard. Nearly all IoT devices are small, low-power, and computationally slow. As is well knowledge, complicated algorithms are used in encryption techniques like the Data Encryption Standard (DES). Therefore, IoT devices cannot use these conventional encryption algorithms.

## 4. Results

This section shows about the result obtained by the proposed system using IoT in smart farming technology with ARM quad-core 64-bit Raspberry PI 4B+ devices with 1GB of RAM were used for the experiments. The switch that connects each device to the others assigns a standard static IP address to each one. Each device is equipped with complete Remote Procedure Calls (RPC) capabilities and runs the Raspbian operating system to receive connect to IoT server with wireless medium.

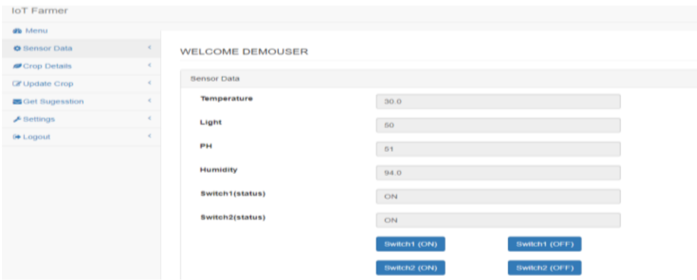



**Figure 5 Sensors data in IoT server**

The proposed system sensor data and the receiving data, including temperature, light, PH, humidity, and status of two switches in a farming field, as well as the operational status of four more switches that are integrated with the hardware situated in the specific field, are explained in the aforementioned figure 5.

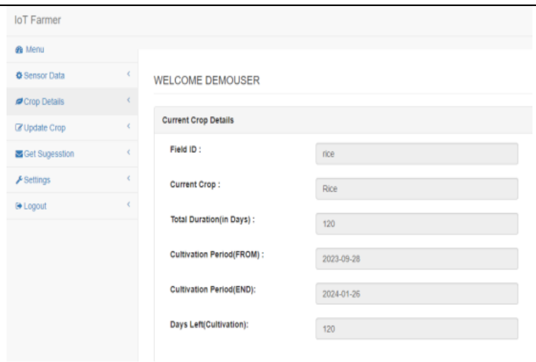



Figure 6 a. Crop cultivation for smart IoT Farming

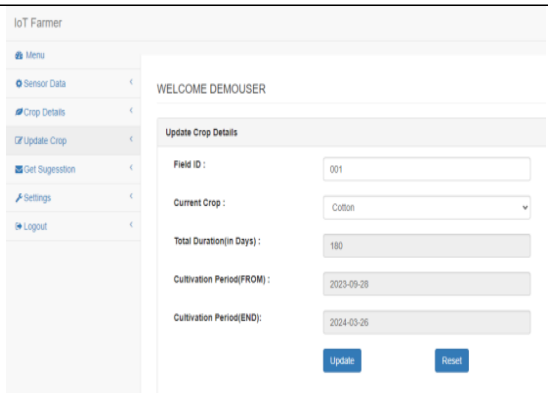
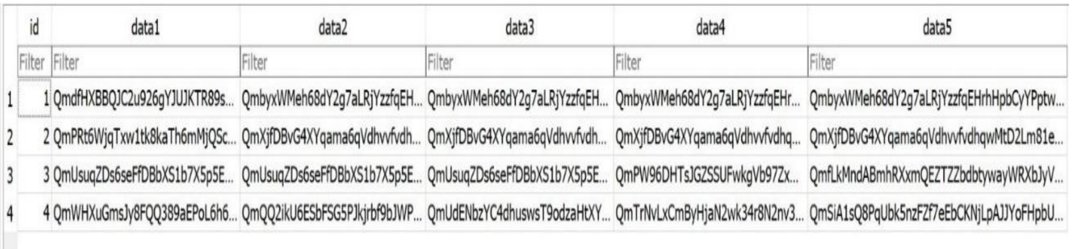



Figure 6 b. Crop updates in field

The field ID of a specific field is shown in figure 6 a) above, together with the crop that is currently being cultivated there and the total Day count for the crop will full growth. The beginning and ending times of a certain crop's cultivation as well as the number of days left in cultivation figure 6 b) represent the crop updates of that particular field.



| | id | data1 | data2 | data3 | data4 | data5 |
|---|---|---|---|---|---|---|
| | Filter | Filter | Filter | Filter | Filter | Filter |
| 1 | 1 | QmdfHXBBQJC2u926gYJUJKTR89s... | QmbyxWMeh68dY2g7aLRjYzzfqEH... | QmbyxWMeh68dY2g7aLRjYzzfqEH... | QmbyxWMeh68dY2g7aLRjYzzfqEHr... | QmbyxWMeh68dY2g7aLRjYzzfqEHrhHpbCyYPptw... |
| 2 | 2 | QmPRt6WjqTxw1tk8kaTh6mMjQSc... | QmXjfDBvG4XYqama6qVdhvvfvdh... | QmXjfDBvG4XYqama6qVdhvvfvdh... | QmXjfDBvG4XYqama6qVdhvvfvdhq... | QmXjfDBvG4XYqama6qVdhvvfvdhqwMtD2Lm81e... |
| 3 | 3 | QmUsuqZDs6seFfDBbXS1b7X5p5E... | QmUsuqZDs6seFfDBbXS1b7X5p5E... | QmUsuqZDs6seFfDBbXS1b7X5p5E... | QmPW96DHTsJGZSSUFwkgVb97Zx... | QmfLkMndABmhRXxmQEZTZZbdbtywayWRXbJyV... |
| 4 | 4 | QmWHXuGmsJy8FQQ389aEPoL6h6... | QmQQ2ikU6ESbFSG5PJkjrbf9bJWP... | QmUdENbzYC4dhuswsT9odzaHtXY... | QmTrNvLxCmByHjaN2wk34r8N2nv3... | QmSiA1sQ8PqUbk5nzFZf7eEbCKNjLpAJJYoFHpbU... |

**Figure 7 Encrypted sensor data in IoT server**

Figure 7 above explains how data is transferred from the sensor to an IoT server using a Raspberry pi kit and then saved in a real-time database after being hashed. By using a simple encryption technique to secure data transfer and communication in the IoT environment, the aforementioned problem can be fixed. The main objective of this investigation carrying out encryption methods cloud and IoT systems. Thus proposed system plays a better role in data secure in IoT.

## 5. Discussion

### Time consumption

| Algorithm | Time values | |
|---|---|---|
| | Decryption | Encryption |
| DES | 0.355 | 0.365 |
| Twofish | 0.546 | 0.456 |
| Blowfish | 0.852 | 0.772 |
| RSA Security | 1.652 | 1.232 |

**Table 2 time consumption for Encryption and Decryption**

The table 2 shows the time consumption of proposed and existing system in encryption algorithms while encrypting and decrypting data. Also the below figure 8 a) and b) explain the time comparison of the table 2 in graph.

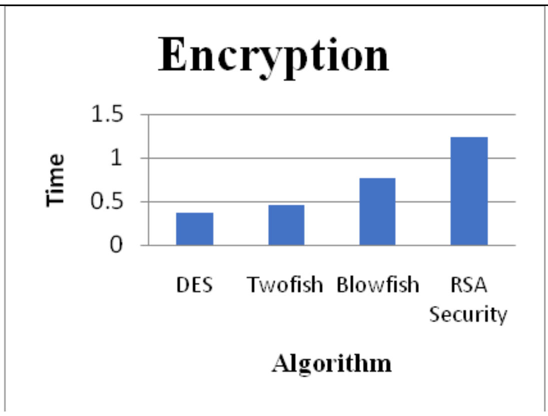
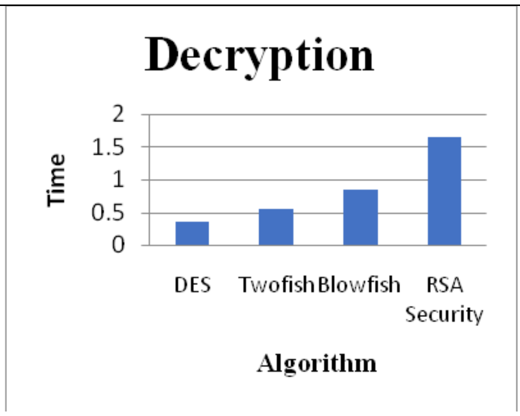



**Figure 8 a) Encryption**




**b)** Decryption

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