

Agriculture Field Monitoring Using Block Chain Technology

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Abstract: This research titled “Agriculture Field Monitoring Using Block Chain Technology” has been designed to satisfy the needs of the farmer. In India, Agriculture is the backbone of the human survival. In order to satisfy food requirement in day to day life, according to the growing population the farmer has to produce sufficient raw materials in his farm field. Some of the major issues faced by farmers in India are climatic changes, watering plants frequently, and controlling fire in farm field. Another major issue faced by farmers in farm field monitoring using smart device in rural area is network coverage. By using Block chain technology helps to solve the network connection flow throughout the day to day process that takes place. This research helps in solving farm field issues, network flow and network security. The ESP8266 is a low cost Wi-Fi chip, helps to connect all the devices in the farm field with TCP/IP and MCU (Micro-Controller Unit) that process on through transport layer of the network to transfer message from sensor to smart device.

Keywords: Block-chain, IoT, Network security, Monitor Temperature, fire, water sprinkler, transport layer.

1. Introduction

A. Overview of the Research

Now-a-days many farmers step down from farming and step onto cities for another job. It leads to scarcity of production of food products such as grains, vegetables and fruits. In order to increase the production in an adequate quantity of food products for growing population in this situation is very hard. This research deals with monitoring the temperature around the farm field, detection of fire if catches in the farm field, sprinkling of water to the plants in the farm field. Mainly it concentrates on device communication in rural area even in shortage of power supply, power cut even. These also help in monitoring the active and deactivate state of devices that are connected in the farm field. Block chain technology device helps in monitoring the active state of the devices that are connected in the farm field. IoT is used to connect the devices in the farm field.

IoT refers to the network of connected physical objects that can communicate and exchange data among themselves without the desideratum of any human intervention. Block-chain helps in performing it in a secured manner without intrusion of third-party at any cost.

B. Block Chain and IoT

- In the past few years the Block-chain has gained

popularity in the core technology in growing fields such as Internet of Things (IoT), banking sector, medical centre and so on.

- To transfer money and to monitor the process and to monitor the process that currently goes on can also be monitored from where ever we are like smart cities, smart home, open area and so on.
- Unfortunately in IoT to operate on the limited amount of devices such as sensor, smart phone, laptops, PC's and so on, it is capable accessing on address significant security issues in contradiction be operated devices throughout the world.
- But the implementation of block chain secures our network transfer of data that is transmitted on the network [1].
- The IoT has gained wide acceptance in-between each frame as it uses the standard called Low-power Lossy networks (LLNs) to transmit data between the networks.
- Devices can remotely controlled and access between networks. Data sharing between the networks that are transmitted in-between standard protocols of communication.
- The well-connected devices under the devices, integrated huge machines and detector (Sensor) chips and connected into chain into the frame-work into the decentralised network.
- Each sensor functionally depends on the purpose that has been created.
- Only authenticated person is able change its functionalities and performance of the device that are fixed in the farm field.
- As the connected devices increases gradually it leads to network traffic this paves the way for the hackers to hack the message in network.
- Sometimes it may lead in crack of message or command that are transmitted in the network.
- But Block chain technology does not allow the message blockage that is transmitted there exist a continuous chain supply to transfer message in the network.
- Block-chain one of characteristic is distributed database between the networks and solves detected issue faced

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by IoT [2].

- Network transaction gets attracted by trusted by public IoT network.

The block-chain follows a sequence order for connecting devices either horizontally or vertically but not diagonally. A Consortium Network acts as the backbone of blockchain technology. It has two main system such as open and private blockchain connection to communicate between devices. Some of its properties include shared platform, resources and sharing software platforms with its power of its number of devices that are connected on the series of path. A block contains header, body, transaction counter. The blockchain technology main feature of decentralization, Block header contains: [3]

1. Block version – This displays the version of the block and the software that has been installed to block transmitted.
2. Merkle Tree root hash – It represents the root value in the hash value in the base node.
3. Timestamp – It displays the date/time currently in the nodes that has to be transmitted since 1970.
4. N-Bits – It defines that the ‘n’ number of bits transmitted in the block.
5. Nonce - It is 4-byte number started from 0 and it has hash value.
6. Parent block hash – It is the root value of the hash in the block.

C. Block-Chain Properties

Device communication place a major role in block-chain, it has two key values such as private and open. Mainly Blockchain supports private key values to handle device transmission and process the command received by the authority.

- All the network participants (devices, sensors) have the copy of the process for complete transmission of task assigned.
- Any validated devices and each of its process is monitored and recorded it cannot be irreversible and cannot be changed by any one.
- An activity took place in the network is known as transaction timestamp is recorded on a block [4].
- All network participants should agree and validate the process or command that has given while performing each recorded task.
- All participants should identify whether the participants whom are connected are anonymous or pseudonymous.
- All records that are transmitted on the network are individually encrypted.
- A blockchain the connection that are established are also programmable in such a way its properties and action are not affected at any cost.
- It helps in reducing the cost of establishment of connection.
- There is no single controlling unit to control the device in blockchain.

1) Proof-of-Work

The Proof of Work is necessary in blockchain to secure the

data transmitted on the network which prevents fraud, and ensures the trust that the authority. This ensures the security on independent data processing, altering data transmitted within a time period, maintains the history of each transaction that has to be performed. The amount of work done by the particular device determines that the possibility of the device and capacity to perform its task that has been assigned to it. It is performed by single block of communication. The device used in minimum quantity has the maximum chance to get attack by the third party. But the community bond between the devices is extremely strong so that using hash value it gets validated. Thus the possibility that a device/transaction get hacked is less and as it centralized and time to validate the transaction.

D. Characteristics of Block Chain Technology

- *Immutability:* In Block chain technology, Immutability is considered to set for the permanent network nodes that are unaltered. Block chain nodes that have been once set cannot be altered frequently. In frequent altering of nodes may pave the corrupted by the hackers soon. Private block chain cannot be corrupted easily
- *Decentralised:* The Network is said to decentralised it is the governing authority of the sensors that are connected in the network. Block chain position straightforward in the connecting nodes through the network. It is the most important characteristic of the block chain less failure in accidental failures. In Decentralisation block-chain technology has survive malicious attack. With its nature of being it make the hard time for the hackers to crack the commands that are transmitted through the network.
- *Enhanced Security:* Cryptography added with decentralisation uses a complex mathematical algorithm and creates a layer around the network like a firewall. It helps to secure the data that have been transmitted over the network. Block chain mainly uses hashing cryptography in the network by using this hash key value is exchanged among the network. It is too hard for the hackers to crack the data transmitted digitally.
- *Ownership Verification:* In case of new node has to be added in the networking path all the authority connected in the network should be given green signal then only a new node can be added.
- *Consensus:* Block chain have cleverly designed the concept of Consensus. Consensus algorithm is core architecture of block chain. It consensus is a decision making process of a connected single or multiple node on the network. By using this transmission goes on smoothly and faster compared with other technologies. This algorithm is one among the key responsible for the network being trust less.

E. Multichain in Blockchain

Multi-chain in block chain supports windows, LINUX, UNIX platform. The process can be performed in such a way to

many devices. The communicating devices can have connected using nodes an operation that takes place using this using consortium private blockchain network and transfer the data. It identifies the address action is performed on this state. It verifies the address and the list are generated. To apply all the permission challenges in network the multi chain concept has been applied, transaction in the block is in a sequence order, using round-robin to round up data that has been transfer the data in the network.

Multi-chain node sends the transmission data on the network and permits the data on to the data. The received data is decrypted using metadata using IP address. Only the data gets transfer on the data to process the data on the data in the farm field and all the transfer the data is decrypted on the data. The receiving node verifies and validates the data that has been transmitted on the network path in which the data is executed using hash value [5].

1) *Decentralized exchange*

1. Farmer has to give the command to device that is operated in the farm field through the network block-chain has to take this process of proceeding in this.
2. The message transmitted on the network once it reaches the command fully the device start to process it.
3. The transmitted command in the device in the farm field has to exchange data in the farm field in this process it done privately on the data.
4. Once it validates the process the process is continuously transmitted transaction is comparatively safe.
5. Once the transaction gets completed the traced path report is generated.

F. *Problem Specification*

Indian history says about the climatic changes that occur and its state, natural-resource availability of water to the farm land and watering the spices plants when needy. Plant grows with base of soil, sunlight and water. In that water plays a vital role in farming to in order in monitoring availability of water near to farm field and sprinkling water to farmland from the source of water and turn-on the lawn sprinkler to the plants needy and disconnects it after some time. Again another problem that exist in farm field according to density such as large farm field (Amazon) the fire and lost many herbs and medicinal plants. Due to this forest fire in such a case the initiator not only controlling using aircraft but by using the lawn sprinkler may also be able to control the forest fire at the initial stage [6].

But by using Wireless sensor network it is not capable to solve this issue and merging it with IoT is also larger issue rather combining IoT with Block-chain may combine together to solve this issue. But in rural area the coverage of network is a major issue, by using block-chain the networking issue and speed rate in communicating through the network. Another major issue in networking is security issues also covered in this research. Combining Block-chain and IoT has some issues in connecting for quit reason all the issues can be solved manually and the process goes on smoothly, and in a secured manner.

G. *Objectives of this Research*

Deeply monitoring several factors the Indian climatic changes and controlling the forest fire with until once it reaches the denser growth, are not able to control the fire at the initial stage itself. But to control the forest fire at the initial stage and sprinkle water to the farm field are the two major issues that are solved in this research eventually, temperature monitoring also plays a vital role. Whereas the temperature monitoring is done to monitor the environmental temperature and climatic changes that occurs that may help us to feed water to the plants in which is need of water and dry land. To solve all these issue at the emerge the block-chain and IoT technologies together helps to solve such as, flow of networking connecting in rural area and tracking the path throughout the process gets quit. All the networking issues can be solved using Block-chain technology.

IoT has some technical issues such as received command cannot be processed, sensor traceability, security all plays a major issue. Eventually to solve this issue IoT Block-chain technology are embedded together. In farm field to monitor all this process and to connect all devices, Multi-chain network is used. IoT devices and established connection through network can operated using Blockchain the person other than authenticated person cannot be to access the data that has been transmitted on the network.

H. *Farm Field Environment Communication*

In case of failure is detected it returns the result to the registered device. Responds that is returned by the device is found incorrect result. It responds with a misleading results such as different result that are transmitted by a different parts of device (i.e) Temperature sensor does not produce the temperature reading rather it displays the flow of water level. The responses receives using “ $Y2 = X3 + aX + b$ ” and the result is generated. To correct all the faults occurred BFT has four phases to solve these, these are as follows: The farmer sends the command that has to be processed in the farm field to the primary (header node) node. The primary node transmits the request that is transmitted by the farmer to all the secondary nodes that are connected in the path. The nodes either primary node or secondary node performs the received command/service from the farmer or then sends back the result that is recorded as a reply to the farmer. In case the request is served successfully the farmer receives “ $m+1$ ” result from different nodes of the devices via network. Where m refers the nodes that are connected (either corrects or fault nodes).

I. *Contribution to the Research*

This research focuses on leads to scarcity of production of food products such as grains, vegetables and fruits. In order to increase the production in an adequate quantity of food products for growing population in this situation is very hard. This research deals with monitoring the temperature around the farm field, detection of fire if catches in the farm field, sprinkling of water to the plants in the farm field. Mainly it concentrates on device communication in rural area even in shortage of power supply, power cut even. These also help in monitoring the active and deactivate state of devices that are connected in the

farm field. Block chain technology device helps in monitoring the active state of the devices that are connected in the farm field. IoT is used to connect the devices in the farm field. IoT refers to the network of connected physical objects that can communicate and exchange data among themselves without the desideratum of any human intervention. Block-chain helps in performing it in a secured manner without intrusion of third-party at any cost.

J. Existing System

Currently wireless sensor network are used in the process of agriculture but exist many disadvantages in using wireless sensor network. WSN compared wired and other technologies are not highly secured [7]. The Hackers can easily hack the network path and trace its activity may even cracked some times. Nodes that are connected with the network path needs to be charged at regular interval of times. Life of the battery is limited and at alternate intervals it has to be replaced. Comparing with other technologies, WSN communication speed is very slow it leads to chance of third party intrusion. Other devices get distracted while use of WSN.

Drawbacks:

- Temperature monitoring range is very narrow and limited.
- Life span of gases that are filled has shorter life span often it leads to be refilled.
- Increases the cost for refilling gases and sensor life-span.

K. Proposed System

In Proposed system, the Blockchain technology has better transparency. Big issues can be solved using block chain because it is decentralised network. There is no need for any centralised authority to control and monitor each and every process that is assigned to the device. Block chain technology is highly secured compared with other technologies. Each transaction is recorded so the path to trace the devices that are connected becomes very easy. According to consensus method the authority are able to sense the device and all the authority are activated. It reduces the cost of devices, battery and sensors. Processes may be automated. Transactions are transparent [8].

Advantages:

- Better tracking of devices that are connect in the network.
- Any new drivers on boarding with the carrier services happen with in fraction of seconds.
- Vehicle to vehicle communication takes place and the processes help in streamline the information that is transmitted in the network path.
- Monitoring all the data from this entire device are transmitted in a secured manner even for Internet of Things (IoT).

2. Methodology and Analysis

A. Problems Faced by Farmers

In real life the farmers face many problems in a day to day

life to do farming many people leave farming and move to cities for their survival. Every process of farming takes certain duration for process it. If seed germination takes two to three months' time for harvesting it depends on the plant. Till that the farmer has to daily monitor the temperature and sprinkle water to the plants that are planted. The technology paves a way in monitoring the place from where ever farmer already there exist many agricultural research as wireless sensor communication, Digital image processing and IoT. The farmer can monitor the temperature and water the plants even from home by transfer of messages using mobile devices of the farmer. In rural area the network slows down so that the hacker may easily able to modify the instruction given by farmer.

In India climatic changes play a vital role. Any people may able to predict the seasonal changes. Watering the plants in sufficient quantity is required water in high quantity may damage the root of the plants sometimes. In rainy season over flow of water in the farm field spoils the plants that have been cultivated in the farm field. By fixing the temperature sensor the farmer predicts the rain and water level. According the farmer may be able to save the plants that have been cultivated.

B. Multi-Chain Network

Multi-chain connection is the main feature in block chain technology to connect the devices through the network. So that many devices can be connected under the single roof. There is no centralised authority to control the process that takes place in the block chain network. Using this technique many devices are connected either horizontally or vertically and even peer to peer communication. Block chain uses the consensus algorithm to trace the path of the device that connected using multi chain network. The instructions are transmitted using transport protocol using common gateway and single server, and mobile devices. Block chain transmit data very fast through the network path.

C. Authenticated Centralised Authority

Block chain technology is decentralised network there exist no centralised authority to control and monitor the process that place. But in the process of farm field the farmer acts as the centralised authority. The farmer manages the entire the process such as temperature monitoring, fire detection and water sprinkling to the plants. All the devices are connected near the root of each plant. Centralised authority differs in each stage of the process that takes place such as temperature sensor, fire detector, and water sprinkler. In temperature sensor the Single board computer is the centralised authority. In Fire detector and Water Sprinkler multi-board computer is the centralised authority.

D. Configuration Management

The main aim of the Configuration management allows consensus network to trace the path of the devices and the board that are connected to it. The farmer in the network may able to modify the hardware and software configuration of the device that are connected in the farm field. This configuration management helps to identify the active state of the device that is connected in the network. Wire and wireless gateway and

board computers that are connected can be monitored according to the situation.

Table 1
Configuration Management

Configured Device	Authority	Device Connected
Temperature sensor	Automated	Single board computer
Fire detector	Automated	Multi board computer
Water sprinkler	Manually controlled	Multi board computer

E. Integrated Wireless and Wire Connected Network

In peer to peer communication leads in connected to the mobile using the consensus algorithm of the block chain. With the help of it the mobile the farmer may be able to trace the path of sensors and device that are connected to the network. A Home gateway that allows the Practical Byzantine Fault Tolerance (pBFT) is a consensus algorithm is an application that includes distributed computing in block-chain. This method helps in monitoring the devices that are connected in the network area. This helps tracing the path of the device that are connected, as well as helps in decision making. Once the transactions that is process finds and fault and found any mismatches in the result that has been obtained. An issue occurs while connecting with nodes is the transmitted transaction is correct and the node that transmitted in a faulty state case an error. The BFT is used to safeguard the device path that transmits the decision making. It aims collective decision making and to reduce the faulty nodes and correct the nodes that transmit message through network path.

F. Modules

In their farm field monitoring system, three modules have been designed. Multi-chain connection is the main feature in block chain technology to connect the devices through the network. So that many devices can be connected under the single roof. There is no centralised authority to control the process that takes place in the block chain network. Using this technique many devices are connected either horizontally or vertically and even peer to peer communication. Block chain uses the consensus algorithm to trace the path the path of the device that connected using multi chain network. The instructions are transmitted using transport protocol using common gateway and single server, and mobile devices. Block chain transmit data very fast through the network path.

The implementation of blockchain and IoT devices paves a way in communication that places between the devices. This supports peer-to peer communication is one of its major advantages. In this research there exist the three modules such as Temperature sensor, fire detector and water sprinkler.

1) Temperature sensor

In Block Chain technology, Temperature sensor helps in monitoring the temperature in and around the farm field environment and generate the output for specific interval of time. A single board computer, temperature sensor, temperature monitors screen and LCD screen are connected using multi chain connection. This helps to monitor the temperature around the farm field and active state of the devices that are connected in the network.

According to the temperature around the environment the

LCD screen displays the reading in temperature monitor screen. When climate changes either in rain or sun beam are monitored and readings are displays temperature on the LCD screen that is connected such as HEAT, COOL or NORMAL temperature in the farm field. The temperature level that has been monitored is recorded in the farm field. If the temperature reading “temp>=520” it is said to be in the cooling state, “temp<480” is said to in the heating state. Other than these are considered as normal temperature and the Single board computer devices whereas is connected to mobile device the is registered in the name of farmer or in the name of the landlord. The authenticated authority can only be able to access the device no one monitors the state of temperature sensor

Table 2
Display State of Temperature Sensor

Enabled	Name	Condition	Action
Yes	Turn-on temperature sensor	If temp >= 520 it is heat mode If temp <480 it turns to cool mode	Set sensor as True
Yes	Turn-off temperature sensor	Temp value remains static	Set sensor as false

2) Fire detector

The farm field the connections are made to detect fire if in catches in the farm field. The devices such as the multi-board computer and other component such as fire detector, fire sprinkler, Siren, Piezo speaker, LCD screen are connected to the board. In this implementation of consensus algorithm sense, the fire if caught in the farm field if caught if alarms and sends a message to the farmer authenticated device. So that fire can be controlled in the initial stage itself. By turning on the water sprinkler the water is sprinkles on the fire and it can be controlled at the initial stage if helps in loss of food crops that is harvested in the farm field.

```
function setup()
{
  setDeviceProperty(getName(), 'IR', 900);
}
```

The above is the python code that has been fixed to trace the fire if catches. Using consensus algorithm displays the trace the path and it may leads not to damage the other devices or sensor that are fixed in the farm field.

Table3
Display state of fire detector

Enabled	Name	Condition	Action
Yes	Turn-on fire detector	In-case fire is detected	Set fire detector true
Yes	Turn-off fire detector	In-case no fire is detected	Set fire detector false

3) Water sprinkler

Block chain technology follows a series of connection while connecting Water sprinkler it helps in sprinkling water to the plants in the farm field. A server, router, lawn sprinkler, water level monitor and a smart device are connected using block chain. This helps in sprinkling water to the plants in the farm field (100 water tap) can be connected either vertically or

horizontally. This fetches the water from where ever the water flows nearby locality (either stored water in tank, well, or underground water...) and sprinkles to the plants for sufficient level. The farmer can turn on and off the tap using the smart device the farmer has such as mobile. This is the smart device that is connected that the farmer has in his hand. First the farmer has to register the device. The registered device shows the details that the connected in the farm land. This displays the state of the device and the water sprinkler can be controlled to turn on and off the water tap whenever the farmer has to sprinkle to the plants.

Table 4
Display state of water level monitor

Enabled	Name	Condition	Action
Yes	Turn-on lawn-sprinkler	Water level level \leq 10 cm	Set sprinkle as True
Yes	Turn-off lawn-sprinkler	Water level level $>$ 10 cm	Set sprinkle as false

3. Conclusion

Hence this research solves the issues faced by farmer such as climatic changes, fire detection in farm field, sprinkling water to the plants at frequent intervals and finally network issues are solved. Even farmer can know the active state of the devices that are connected in farm field can be monitored from where ever the farmer is either in farm land or anywhere around geographical zone. Blockchain helps in communicating throughout the geographical zone, and network security plays a major role in it. It secures the third party authentication and secures the command that has been transmitted on the network. Hence the farming goes on smoothly in growing technical world it leads to production of surplus quantity of raw food materials in growing population.

4. Future Enhancement

In this research block chain and IoT are the two different

technologies are embedded together to perform the functions that are assigned. But there exist some issue while connecting IoT devices with Block chain (i.e.) only limited quantity of devices can be connected. In order to connect more devices the process becomes very difficult to manage. And another major issue that was found in blockchain is while a task is performed the presence of all authority should be given authentication. Then only it is considered as valid transaction else it is not said to valid transaction. Every one's presence is very difficult at all time. In future the technology has to be developed in such a way all the above mentioned technical issues are solved.

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