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A Secure Node Switching in the Cluster based Distributed Networks using Blockchain Technology

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Abstract: A solution that utilizes trusted computing and blockchain technology to provide secure node switching in the Internet of Things (IoT) for power distribution. To address the issue of mobility in mobile wireless sensor networks (MWSNs), we present two mobility-aware hierarchical clustering methods based on a three-layer clustering hierarchy: the mobility-aware centralized clustering algorithm (MCCA) and the mobility-aware hybrid clustering algorithm (MHCA). Simulation results demonstrate that both algorithms increase the network lifetime, decrease energy consumption, stabilize cluster formation, and increase data throughput in MWSNs. The centralised clustering strategy outperforms the hybrid clustering approach

Index Terms - negative impact of mobility on data throughput, network connectivity, and scalability

I. INTRODUCTION

The Internet of Things (IoT) has become a popular technology due to its ability to connect various embedded devices or "things" that can gather data and transmit it to a central server or cloud for further processing and action. The impact of IoT is being felt in many fields such as healthcare, home automation, agriculture, security and surveillance, and smart grid.

Wireless Sensor Networks (WSNs) are crucial in connecting the IoT to the real world. These networks consist of autonomous sensor nodes that can wirelessly transmit data to a sink or base station. However, these sensor nodes have severe limitations in terms of size, memory, battery life, and radio range, which makes the design of energy-efficient routing methods challenging.

When sensor nodes are mobile, the network is called a Mobile Wireless Sensor Network (MWSN), which presents additional challenges. The mobility of sensor nodes causes significant data loss when clustering is employed in MWSNs, as nodes may get disassociated from their cluster heads. This has a detrimental impact on data rates and energy usage.

To address this issue, mobility-aware hierarchical clustering methods have been proposed based on a three-layer clustering hierarchy: the mobility-aware centralized clustering algorithm (MCCA) and the mobility-aware hybrid clustering algorithm (MHCA). Both algorithms increase network lifetime, decrease energy consumption, stabilize cluster formation, and increase data throughput in MWSNs. However, the centralised clustering strategy outperforms the hybrid clustering approach.

II. LITERATURE SURVEY

Wireless Mobile Sensor :

There has been a shift from traditional static wireless sensor networks to mobile wireless sensor networks (MWSNs) where the sensor nodes can detect various events and change positions within a sensing area. MWSNs are utilized for time-driven, event-driven, on-demand, and tracking-based applications. Designing an energy-efficient MWSN requires considerations such as mobile sensor node architecture, residual energy utilization, mobility, topology, scalability, localization, data collection routing, and Quality of Service (QoS). This chapter provides an overview of MWSNs and discusses significant events in developing an energy-efficient MWSN for large-scale environments.

Different WSNs :

A WSN is often formed through the deployment of sensor nodes on land, underground, and under water environments. A sensor network encounters a variety of difficulties and limitations depending on the placement of the sensor nodes. Terrestrial, multimedia, underground, multi-media, and mobile WSNs are some examples of WSN types. The overview of mobile WSNs is covered in this chapter. An MWSN can be divided into homogeneous and heterogeneous MWSNs based on the resources of the sensor nodes on it [3]. Each mobile sensor node in a homogeneous MWSN is the same and could have a different set of characteristics. Nevertheless, heterogeneous MWSN is made up of a variety of mobile sensornodes with varying capabilities, including mobility, battery life, memory capacity, processing speed, and range of sensing and transmission. Moreover, heterogeneous MWSN nodedeployment is more difficult than homogeneous MWSN.

WSNs take mobile nodes into account :

By exploring the design space of wireless sensor networks, Kay Romer and Friedemann Mattern proposed numerous uses, including zebranet, cattle herding, bathymetry, glaciermonitoring, cold chain management, ocean water monitoring, and bird observation on Great Duck Island. Monitoring of grapes, power, vital signs, avalanche rescue, tracking of military vehicles, part assembly, self-healing minefield, andsniper localisation are some examples. Ten of the fifteen applications are exclusively mobile, while one is partially mobile. As a result, transportable sensor nodes are crucial for human applications in the real world.

MWSN design challenges :

Hardware cost, system architecture, deployment, memory and battery size, processing speed, dynamic topology, sensor node/sink mobility, coverage, energy use, protocol design, scalability, localization, network heterogeneity, node failure, QoS, data fusion/redundancy, self-configuration, cross layer design, balanced traffic, fault tolerance, wireless connectivity, programmability, and security are the main design challenges for MWSNs.

Architecture for portable sensor nodes :

Often, one or more sensors are built into the sensor nodes (such as temperature, light, humidity, moisture, pressure, luminosity, closeness, etc.), a microprocessor, an antenna, a battery, an external memory device, and a radio transceiver with an analogue to digital converter (ADC). Furthermore, due to their compact size, the nodes have restricted on-board storage, battery power, computation, and radio capacity [15]. The architecture of the mobile sensor node is, nonetheless, remarkably similar to that of the standard sensor node. However, several extra components, such as localization/positioning devices, mobilizers, and power generators, are taken into consideration for mobile sensor nodes. Figure 1 depicts the mobile sensor node's architecture. A sensor node's position is determined by the location or position finder unit, and mobility is provided by the mobilizer. The power generating unit is in charge of producing power to satisfy additional energy needs of the sensor node using any special means, like the solar cell.

Movable things :

These days, scientists are looking into MWSNs, which have a lot of sensor nodes and sink nodes and are used for large-scale applications. Depending on the needs of the application, mobility can be applied to the sensor nodes or sinks in this case.

The MWSN typically comprises of mobile sensor nodes connected wirelessly to form an arbitrary architecture. It is a self-configuring and self-healing network. A strong coverage network guarantees dependable communication, greaternetwork connectivity, lower energy use, and ultimately longer sensor node lifetime [16]. The movement patterns of the mobile sensor nodes, or the various behavior's of the nodes, are described by mobility models. In MWSNs, a number of mobility models have been taken into account to determine the mobility of mobile nodes. Here, the movements of the sensor nodes are viewed as independent or dependent on one another, respectively.

Models for mobile :

The movement towards and away from mobile sensor nodes, aswell as how the nodes' location, velocity, and acceleration change over time, are all described by the mobility model. When investigating new communication or navigational strategies, mobility models are typically utilised for simulation reasons. The use of mobility models to forecast the sensor. node's future placements is described in mobility management systems for mobile wireless sensor networks.

Both an analytical model and a simulation model can be used to define the movement of the sensor nodes when modelling mobility. The analytical mobility model's input in this case simplifies the presumptions regarding the sensor nodes' movement behaviours. Also, the analytical model will offer Again, the key to examining whether the specified protocol is advantageous in a particular kind of mobile scenario is to ensure that the mobility models appropriately depict the mobile sensor nodes in the MWSN. Trace models, which simulate the deterministic mobility of real-world systems, and syntactic models, which accurately depict the movements towards and away from mobile sensor nodes, can be used to describe mobility patterns. It can be divided into individual and collective mobile movements. Mobility histories and patterns, such as directed, random, and habitual mobility models, can also be taken into account. Based on their distinctive traits, different mobility models are categorised into four main groups: random models, models on temporal dependency, models on spatial dependency, and models on geographical limits. The classification of mobility models according to their areas.

Recent Studies :

Effectively, a Wireless Sensor Network (WSN) serves as the interface between the Internet of Things and the real world. The WSN is made up of a sizable number of autonomoussensor nodes that are able to wirelessly transmit the data they have sensed to a base station or sink despite being severely constrained in terms of size, memory, battery life, and radio range. A WSN containing mobile sensor nodes is known as a Mobile Wireless Sensor Network (MWSN). The design of energy-efficient routing methods for the restricted sensor networks is made more difficult by the mobility of sensornodes in MWSNs because Tie Qiu served as the assistant editor who oversaw the assessment of this submission and gave final approval for publication. mobility's negative impact on network connectivity, data rates, and other.

Limitations :

Inefficient in big networks due to the development of large- sized clusters that overwhelm the cluster head and its nearby nodes. Two-layer clustering hierarchy.Clustering techniques were created for static WSNs and struggle to function in mobile sensor networks.

III. Proposed Model

The two mobility-aware clustering algorithms we suggest are the Mobility-aware Centralized Clustering Algorithm (MCCA) and the Mobility-aware Hybrid Clustering Algorithm(MHCA), both of which are based on three-layered clustering. At two levels of the clustering hierarchy, the MCCA uses gridding that is based on the fuzzy C-Means method and is mobile-aware. Mobility-aware distributed clustering is used at the lower level while mobility-aware gridding is used at the top level of the MHCA. Our proposed algorithms draw inspiration from the HHCA algorithm, but unlike HHCA, our algorithms were created for mobile WSNs. In MHCA,distributed clustering inspired by LEACH-Mobile is applied atthe bottom tier while fuzzy C-Means approach based centralized gridding is implemented at the higher tier. Themobile sensor nodes can operate in one of three modes: sensing mode, cluster head, or grid head.Reducing the negative effects of mobility on MWSN's data rates and energy usage.The network's lifespan, energy usage, cluster distribution, time, and the quantity of packets at the base station that were received.

Benefits :

Energy-efficient clustering with three layers Minimizing data loss performance parameters for straightforward mathematical computations. Using mathematical calculations, these models can provide the operational restrictions for straightforward events. On the other hand, simulation models are thought of as a clearly defined actual mobility scenario, and that produces the useful answers to more complex problems.

MODULE DESCRIPTION:

1) Energy Dissipation Model:

The primary cause of a node's energy depletion is data transmission and reception, as per the energy dissipation model. The most suitable energy dissipation model for low-power radio is the First Order Radio Energy Model, which is used to simulate the energy consumption of data transmission and reception by sensor nodes. When the distance between the transmitter and receiver exceeds a certain limit, the Multipath Fading Channel Model (power loss proportional to d4) is used, while the Free Space Model (power loss proportional to d2) is used when the transmitter and receiver are within distance (d0) from each other, according to the First Order Radio Model.

2) Mobility Module :

For mobile networks, a variety of mobility models have been developed based on several variables including the type ofapplication, the location, extending the network lifetime, or simplicity. Group and entity (individual) mobility models are the two basic categories into which mobility models in mobile networks are divided [16]. We created our algorithms to fit the entity mobility model category.

3) Clustering Module :

In MHCA, distributed clustering inspired by LEACH-Mobile is applied at the bottom tier while fuzzy C-Means approach based centralised gridding is implemented at the higher tier. The mobile sensor nodes can operate in one of three modes. sensing mode, cluster head, or grid head. Cluster head collects data from nodes in the cluster, compresses it, and delivers it to the grid head. Grid head collects data from the associated cluster.

4) Cluster Head :

The energy usage of each protocol is compared, and MCCA and MHCA exhibit the best performance for two reasons: 1) optimal cluster head selection, which considers node mobility as well as position and energy, and 2) hierarchical clustering, which saves energy in data transmission due to reduced distance between nodes and their cluster heads. MCCA employs centralised clustering, allowing the cluster head to be positioned at the centre of the cluster more frequently.

IV. SIMULATION RESULTS AND DISCUSSION

In this section, we present the results of our simulations aimed at evaluating the effectiveness of MCCA and MHCA. Our main research interests include the network lifetime measured in terms of the number of nodes that remain alive over simulation time, as well as energy consumption, cluster dispersion, and packet reception rate. Various metrics such as First-Node-Dies (FND), Half-the-Nodes Alive (HNA), Last-Node-Dies (LND), or Number of Alive Nodes can be used to quantify the network lifetime [19]. We chose to use the Number of Alive Nodes as it reflects the aging pattern of network nodes and represents the total number of active nodes over the simulation duration.

In this section, we present the results of our simulations to evaluate the effectiveness of MCCA and MHCA. We use the Number of Alive Nodes as a metric to represent the network lifetime, which displays the total number of active nodes with respect to simulation duration. Fig. 4 shows the Number of Alive Nodes as a function of the number of rounds, where MCCA and MHCA outperform LEACH-Mobile after 300 rounds due to their consideration of node mobility and residual energy during cluster head selection and data transfer phases. Although the first node in MCCA dies earlier than in MHCA between 750 and 900 rounds due to the slightly higher cost of cluster head selection in the centralised approach, MCCA performs better overall after 900 rounds. In terms of energy usage, MCCA and MHCA perform the best because of their optimal cluster head selection and hierarchical clustering methods, which result in less energy consumption for data transfer due to shorter distances between nodes and their cluster heads. MCCA's centralised clustering method offers more opportunities for the cluster head to be in the cluster's centre, resulting in lower data transfer energy consumption than MHCA, where the cluster head can be placed anywhere inside the cluster. This is reflected in the energy consumption results presented.

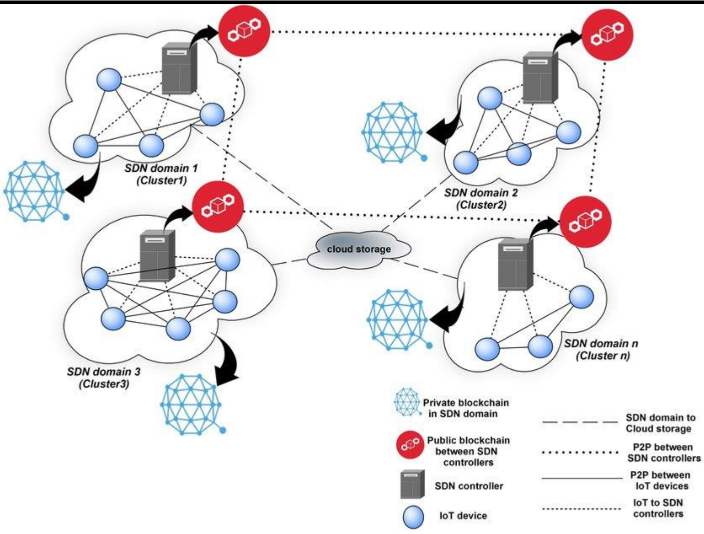

Fig 1: Cluster Inflow

IV. Conclusion

In Mobile WSNs, data loss minimisation and energy efficiency maximisation are two significant clustering challenges. This study proposes two clustering algorithms for Mobile WSN to achieve energy-efficient clustering and reduce data loss. Both methods employ a three-layer hierarchy and enhance node mobility in hierarchical clustering. MCCA, the first method, employs centralised gridding at both clustering levels, while MHCA, the second method, uses distributed clustering at the lower level and centralised gridding at the upper level. The simulation results indicate that the proposed algorithms improve performance in terms of network lifetime, energy consumption, cluster distribution over time, and the quantity of packets received at the base station by reducing the impact of mobility on clustering. The study found that centralized hierarchical clustering outperforms hybrid hierarchical clustering when applied to mobile scenarios.

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