Time Optimization of Data Collection Techniques on IOT Networks

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology
in

Computer Science and Engineering/Information Technology

By

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CERTIFICATE

Candidates' Declaration

I hereby declare that the work presented in this report entitled **" Time Optimization of Data Collection Techniques on IOT Networks"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2018 to December 2018 under the supervision of Mr. Arvind Kumar (Assistant Professor-CSE).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Dhruv Mohan Kapil   Swastik Chugh

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Mr. Arvind Kumar

Assistant Professor

Department of Computer Science and Engineering/Information Technology

Dated:

Acknowledgement

We wish to express our profound and sincere gratitude to Mr. Arvind Kumar, Assistant Professor, Department of Computer Science and Engineering/ Information Technology, Jaypee University of Information Technology, who guided us into the intricacies of the project non-chalantly with matchless magnanimity. He constantly cooperated and helped us with the research work. He also evinced keen interest and invaluable support in the field of Neural Networks for the progress of our project work.

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LIST OF ABBREVIATIONS

IoT	Internet of Things
EUR	European Utility Requirement
ANN	Artificial Neural Network
BS	Base Station
WSN	Wireless Sensory Network
FCFS	First Come First Serve
LNSF	Least Nodes Serve First
LNHF	Least Number of Hops First
ES	Enterprise System
NDP	Number Distance Product
BFS	Breadth First Tree
CDS	Connected Dominating Set
CDG	Connected Dominating Grid
RFID	Radio Frequency Identification
GPS	Global Positioning System
UID	Unique Identification
SMS	Short Message Service
HR	Human Resource
IIS	Integrated Information System
GIS	Global Information System
DBS	Database System
ES	Expert System
EIS	Electronic Image Stabilization
RODB	Real time Operational Database
QoS	Quality of Service
DCP	Data Collection Process
DADCNS	Delay Aware Data Collection Network Structure

ABSTRACT

With the increasing demand for IoT and related fields, there is an urgent need to look into the issues that this field faces. A major problem witnessed by systems using IoT technology is related to collection, transmission and management of data collected from various sources. Data collected from different devices needs to be made compatible for fusion in order to achieve efficient transmission. The reduction of time required to collect data will go a long way in reducing the overall time taken by the system to complete its processes and functions. Hence a new concurrent data collection mechanism is proposed to reduce the data collection time.

LIST OF FIGURES

CHAPTER 1

PROJECT OBJECTIVES

1.1 Introduction

What is IoT?

The Internet of Things (IoT) is the system of numerous electronic and/or electrical gadgets, for example, physical gadgets, vehicles, gadgets, and different components that coordinate with hardware, programming, sensors, actuators, and network between these gadgets We can share these as a framework. This association offers the likelihood to interface, gather and trade information. This makes open doors for a more straightforward mix of the physical world into digital frameworks, which adds to expanding effectiveness, accomplishing financial advantages, and along these lines to a general decrease in general human exertion

The quantity of IoT gadgets expanded by 31% year-on-year to EUR 8.4 billion. It is assessed that 30 billion gadgets will be associated with such frameworks by 2020.

IoT not just includes associating gadgets generally associated with the Internet or different systems, for example, cell phones, tablets, PCs, PCs, and so forth., yet in addition interfacing gadgets that are customarily viewed as imbecilic gadgets, for example, coolers, siphons, and water and so on lights, fans, and other comparable gadgets, and when you consider it, the association between these gadgets opens up numerous new ways to the administrations that the IoT can give to diminish individuals' infringement, increment by and large solace and give surprising administrations. a couple of years back

Thoughts like control lights, enthusiasts, fountains, and so forth., have turned into a reality that was beforehand part of sci-fi, or just conceivable with innovations that were past the scope of the majority, yet now they are available and moderate.

What are Neural Networks?

Artificial neural systems (ANNs) are a sort of PC framework that ought to be motivated by the organic neural systems found in living creatures. The frameworks accordingly shaped are for the most part ready to gain from themselves from their condition, and they can settle on choices by perception and induction, contingent upon their condition and the different factors the framework can discover in that.

These frameworks are frequently alluded to as interconnect frameworks in light of the fact that these frameworks are by and large a blend of numerous components or hubs through which the information streams or is gathered.

Truth be told, neural systems are not an independent calculation, but rather a structure that permits numerous calculations, such For instance, machine learning calculations, which might be available in the different associated gadgets and which all met up to process and process complex information inputs

These frameworks inalienably figure out how to perform undertakings, that the framework can get directions without the requirement for a particular program for how each errand can be performed. It takes a gander at models of past undertakings that run the framework, and after that attempts and separates the assignment in a large number of these less difficult errands of the unit, making each work an accumulation of alleged "small scale occupations." From your past experience.

Data Collection on Neural Networks

The gathering of information in neural systems should be possible in two different ways:

• Snapshot information accumulation

This includes gathering information from the required hubs in the meantime, so we get the qualities of diverse hubs for a given time, which can be assembled to get a solitary record or even a depiction. This kind of information accumulation works in a solitary variable, the time-slip by. This variable characterizes the term between each ensuing preview and consequently characterizes the length to which a specific depiction in a specific domain is precise. This is a vital constraint on the grounds that every framework is in an alternate domain. Along these lines, it is critical to design this variable accurately on the grounds that depictions in a framework can turn out to be extremely off base after a specific time, bringing about computations. The framework might be totally unusable.

• Continuous information gathering

This procedure includes the persistent accumulation of information with the goal that the record gotten by the framework is constantly exact, so the computed outcomes are constantly solid. In any case, this reality of giving greatly precise outcomes has its own inconveniences, as it adds noteworthy expense to the life of the hub's battery and fundamentally diminishes the general existence of the hub.

1.2 Problem Statement

There are two principle perspectives to think about when discussing information gathering in hubs in a neural system. These are:

• Hub battery

It takes a battery to gather information from the hubs, and a few investigations say that get-together information requires double the vitality to run the hubs for a moment, as these hubs are frequently found in conditions that require a great deal of information Nodes for the most part have a restricted measure of battery, so this is a critical thought. What's more, it must be viewed as that the battery of a hub must be supplanted when the battery of a hub is ended. This is never alluring in a framework in light of the fact that the hub isn't just disconnected amid this period. We lose information around there amid this period, yet additionally need to reconfigure our system associations. At the point when the hub is dynamic once more, the framework association design ought to be refreshed once more.

• Accuracy of the gathered information

Another essential factor that decides the significance of a system is the way that the information gathered must be precise at most, if not all occasions. To do that, we require a hub that continues onward. In this manner, we ceaselessly send your information signals, keeping precise data in our server farm. In any case, this thought has its own concern: the more information we gather, the quicker the hub's battery keeps running off, which makes the hub's battery life short. This requires consistent human intercession, as bunch change.

We presume that the two past contemplations are associated, and it is along these lines critical to organize which thought is most important for the task, and in this way to strike a harmony between the two.

1.3 Objectives

Our task is to build up another calculation for making a more proficient information accumulation plot in neural systems. We will endeavor to take the idea of α-rings and β-rings, as expressed in Chi-Tsun Cheng. Nuwan Ganganath; Kai-Yin Fok Parallel Data Acquisition Trees for IoT Applications IEEE Industrial Computing Transactions (Volume: 13, Number: 2, April 2017), Date of Issue: September 15, 2016, Page (s): 793 - 799 Refine this plan for neural systems ,

We will probably decrease the general information accumulation time of these systems by lessening the time required to gather information from the base station and endeavoring to keep information transmission from the base station to the present one consistent.

1.4 Methodology

The expected information collection plan is executed in the concurrent data collection trees. An IoT arrangement with N = {n1, n2 ,. . , n | N |} together with an arrangement of base stations (BSs) S = {s1, s2 ,. . , s | S |} ought to be considered in the accompanying plan. It is trusted that all these | N | IoT hubs can transmit to one another and finally achieve the path to the base stations. The information gathered by various IoT components is viewed as impeccably fusible, so different got information bundles can be converged into a solitary parcel before being sent to the ace hub.

The transmission of a solitary information unit has an underlying term of a period interim, and it is accepted that the length of an information combination process is zero. Each simultaneous information accumulation process utilizes a different BS to get to the IoT organize and the aggregate number of simultaneous streams is thought to be k.

Presently, two new devoted system topologies, known as α-ring and β-ring, are proposed to accomplish the coveted execution in information gathering forms. For situations with umax = 1, the base station of every datum stream can yield information from | N | IoT hubs utilizing star topologies (i.e., T = | N |). For systems with umax = 2 and umax = 3, information total procedures can be accomplished by fitting organizing of the hubs in a α ring and a β ring.

α-Ring

An α-ring is a group of nodes arranged in such a manner that the minimum number of nodes in the group is 2k. Considering a case that umax=2, data stream can utilize atmost 2 nodes for data transmission. An given data stream will use τ1 time slots to accumulate the data and then 1 time slot to transmit the accumulated data to a base station, where τ1= number of nodes -1.

β-Ring

A β-ring is a group of nodes arranged in such a manner that the minimum number of nodes in the group is 3k. Considering a case that umax=3, data stream can utilize atmost 3 nodes for data transmission and accumulation(2 for transmission and 1 for accumulation).

Multiple Rings

Multiple rings are formed in cases where umax>3 and the ordering takes place in a way that a combination of both the rings are formed, i.e α-ring and β-ring.

- umax is an even number ≥ 4:
  α-ring formed = umax/2 with all the remaining nodes allocated to each ring.

- umax is an odd number ≥ 5:
  A single β-ring along with an nα = umax−3/2 number of α-rings are generated. First, the β-ring will be allotted 3k nodes, while each α-ring will be allotted 2k nodes. The remaining |N| − 3kBS − n'α (2kBS) nodes will be allotted to the β-ring.

CHAPTER 2

LITERATURE SURVEY

2.1 Scheduling on Wireless Sensor Networks Hosting Multiple Applications

The paper strives to find the best way to plan a WSN consisting of N sensors with the simulation model shown below.

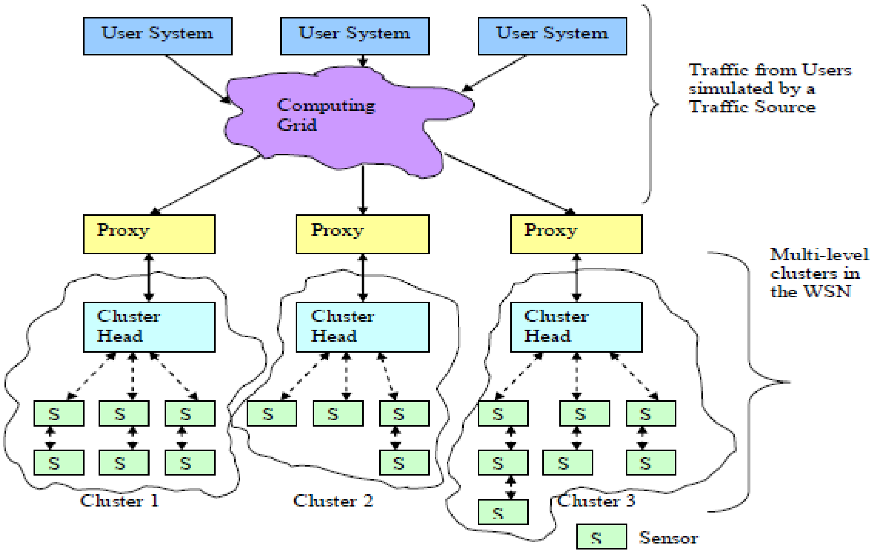


Fig 1 The Simulation Model

The four algorithms are:

2.1.1 Whoever comes first must be served first(FCFS)

In most cases this is the most used scenario. Thus, the job is scheduled in the order in which it arrives at the planner.

2.1.2 Minimum number of sensors first(LNSF)

In this proposed algorithm, the job that requires the minimum number of sensors is first served by the problem of hunger (the condition in which a job can never be selected by a scheduling algorithm and should wait forever). In addition, this algorithm can also serve multiple requests simultaneously.

2.1.3 Least Number of Hops first (LNHF)

In this planning algorithm, jobs are served in view of the distance between the sensors that the job requires. Therefore, this algorithm favors the jobs where the sum of the distance between the sensors is the lowest. This node-to-knot distance is measured in jumps (the number of node-to-knot transfers that the scheduler must perform to run the job). The greatest advantage of this algorithm is the fact that in some cases it provides better average response times, which may be performed faster with less communication delays.

2.1.4 least product distance number first

In practice, the execution of an application depends on two factors: the average distance to all nodes and resource requirements in the application. The answer to an application can only be given if the data has already been received by all sensors. Therefore, it is only advisable to consider these two considerations.

So we calculate product of the two and then do the jobs that have the lowest product under each product.

Performance Metric

Average total response time: This is the average time the algorithm takes to get data for a specific number of applications.

The following is the graph created after the simulation of the four algorithms

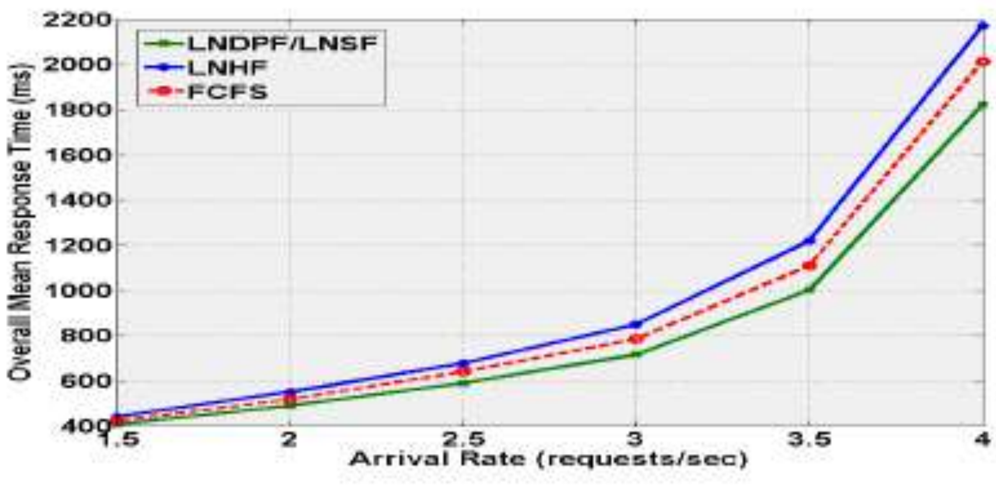


Fig 2 Overall Mean Response time vs arrival rate

This graph finally shows that the proposed algorithm for the minimum number of remote products first from the simulated algorithms is one of the most effective.

2.2 Internet of Things for Enterprise Systems of Modern Manufacturing

The production system incorporates planning and executing diverse kinds of basic leadership at explicit dimensions and spaces. A precise framework has countless chances and the basic leadership process necessitates that information be gathered from machines, procedures and business situations.

A production paradigm must generate value-added goods with the aid of various production tools such as machines, tools and jobs.

In every system or subsystem, a decision-making process can be represented as a series of design activities:
1) Determine the scope and limitations of a design constraint and its purpose.
2) prepare accurate models for inputs and outputs and system variables.
3) collect and manage data in states of individual systems.
4) Make rational decisions according to the design restrictions given.

An ES is to collect and process data and act as a subsystem of decision making within a company. Therefore, the characteristics of an ES can be studied from the point of view of decision-making processes.

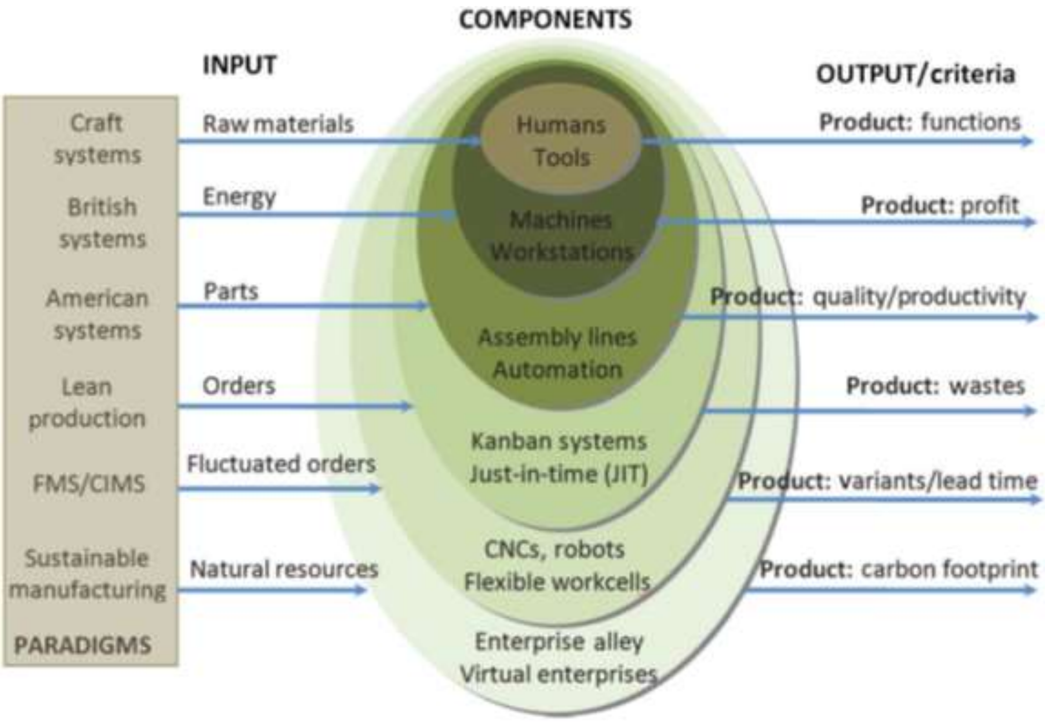


Fig 3 Input/output with respect to system components

2.2.1 Description of the manufacturing company

The complexity of the operation of the system corresponds directly to the number and type of inputs, outputs and other system variables. Many researchers have studied the evolution of the producer. The differences in approach and limitations of a production company should be studied.

2.2.2 Models of reference systems.

The models of reference systems explain the constitutional parts and their relationship within a system according to a desirable performance of the system. A business model represents elementary elements, relationships and refinements of the system at the necessary level of detail. The conceptual models and the structure of the production companies must be thoroughly studied.

2.2.3 Data collection and management

The design variables represent the states and the differences of inputs and outputs according to time. Collecting the values or states of the variables is important to support decision making in a closed circuit. The collection of data is to obtain data by sensors or other measuring equipment.

Although data collection includes manual monitoring and modification, such as physically inspecting a product or measuring an object, data collection generally refers to the use of electronic sensors and equipment for data collection.

Acquisition of data:

> Sensors or devices for data collection are important for the efficient operation of new devices. The instrumentation usually contains some generic elements to collect, process and send to objects. The hardware systems for collecting and processing data are arranged in the following figure.

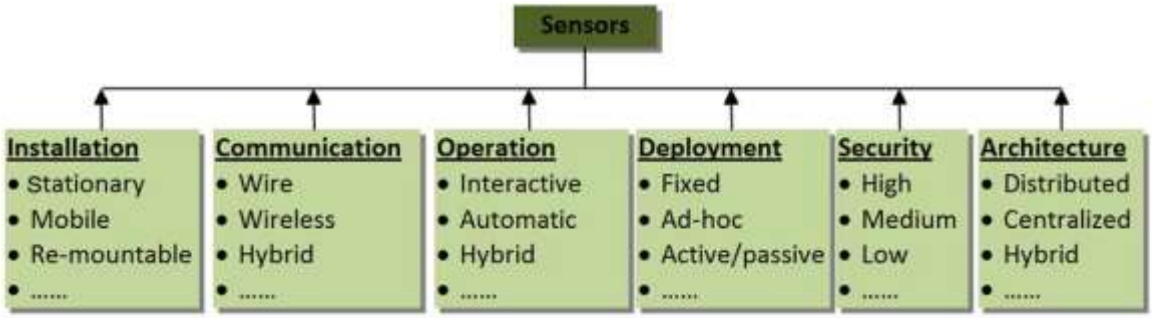


Fig 4 Different processes interfacing with sensors

Communication to share data:

Data communication involves transferring data to different devices using a transmission medium, such as cables and wireless networks. In a system of a production company, data is transmitted locally or remotely and exchanged between the decision nodes. The performance and efficiency of data transfer can be studied by evaluating delivery, accuracy, timeliness and instability.

2.2.4 Critical requirements to adapt new environments.

A complete ES usually includes the units of data collection, transmission, data processing and decision-making. The ES must be designed to meet the conditions of modern companies that produce these functions. It can be a summary of the new requirements in the following way, which are important challenges for the ES.

1) Complexity: increasing complexity is determined by two important factors:
First, modern products are made differently, they need more units and partly fulfill their needs criteria. Means of production must be assimilated to make these products.
Second, the production of complex products includes numerous production activities.

2) Dynamics and uncertainties: production systems are constantly changing. The conventional ESs divide the time domain into sub-periods, so that the subsystem variables involved in a decision process can be treated analytically within an individual time interval, the complexity of the decision making can be adjusted. When a business model becomes simple, complex decisions need to be taken within a shorter timeframe.

2.3 System and Application Knowledge Based Scheduling of Multiple Applications in a WSN

The paper strives to find the best way to plan a WSN consisting of N sensors with the simulation model shown below.

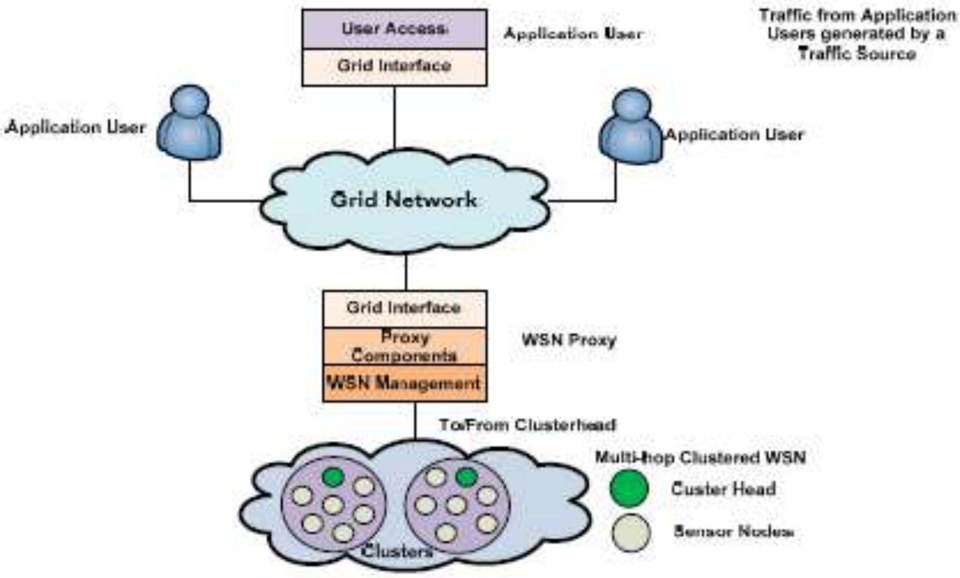


Fig 5 The simulation model for different algorithms

The three algorithms are:

2.3.1 Least Number Distance Product First

The Number-Distance-Product (NDP) for an application is the product of the number of sensors an application needs and the average distance of sensors required by an application from the cluster head. The distance of a sensor from the cluster head is measured in relation to the number of cracks between the sensor node and the cluster head. Application applications are being planned incrementally as NDP increases.

2.3.2 Least Farthest Number Distance Product First

Remote distance is the distance from the remote sensor that requires application from the cluster head. The remote virus removal (FNDP) product for an application is the product of the number of sensors. The time taken by a sensor to reach the head is proportional to the distance from the head of the cluster. The average overall response time for an application request and, therefore, the average overall response time to be determined. Further from the head of the cluster. First, the application requirements are scheduled, which contains at least FNDP.

2.3.3 Least Weighted Farthest Number Distance Product First

In a WSN, messages to and from sensors farthest from the cluster head have greater delays than sensors closer to the cluster
Cluster head.

Because the sensors share wireless support, each hop experiences delays in transmitting a message due to interference from nearby sensors. The greater the jump distance of a sensor from Head of the group, the greater the delay of the message from and to the sensor. Various studies have shown that the transmission speed on multi-hop paths is lower compared to lower Single-hop routes. In, the authors show that a two-hop route has only half the capacity of a route to a hop and a three-hop route has a capacity of one-third of a single hop Itinerary.

The achievable capacity of a wireless network is significantly affected by the size of the network, traffic and network capacity detailed radio interactions. Besides, the news, the are further forwarded to and from the sensor nodes further away in the network experience, with the main delays occurring when they experience delays when sent and received at each interstitial due to interference received from other nodes. Based on this logic, this algorithm assigns weight to each jump distance. The higher jump distances are assigned a higher weight than the lower jump distances.

The FNDP for each application is multiplied by the corresponding weight in that particular hop to account for the major Interference with messages to and from sensors located a greater distance from the cluster Head.

This gives the product a weighted heavier weighted distance (WFNDP). With the LWFNDPF algorithm (LWFNDPF) with the least weighted farthest distance, the requirements of the different applications are programmed in ascending order WFNDP.

Performance Metric

Average total response time: This is the average time the algorithm takes to get data for a specific number of applications.

Results of Simulations
The results were computed taking into account 4 different parameters with respect to the performance metric, the average total response time.

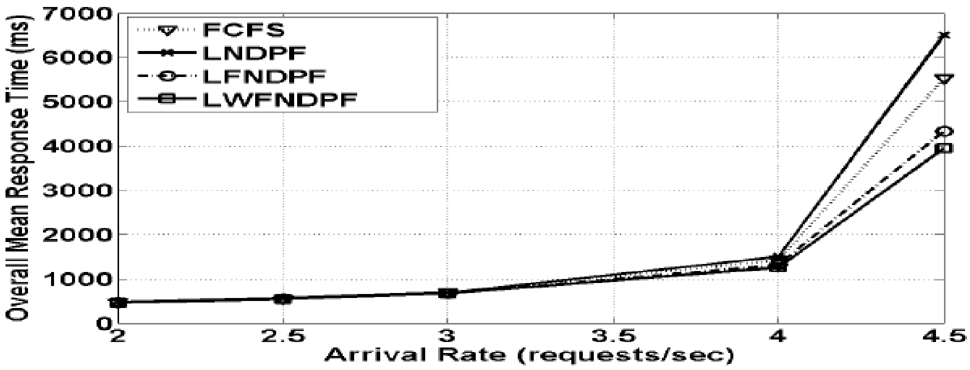


Fig 6 Effect of arrival rate on performance of algorithms

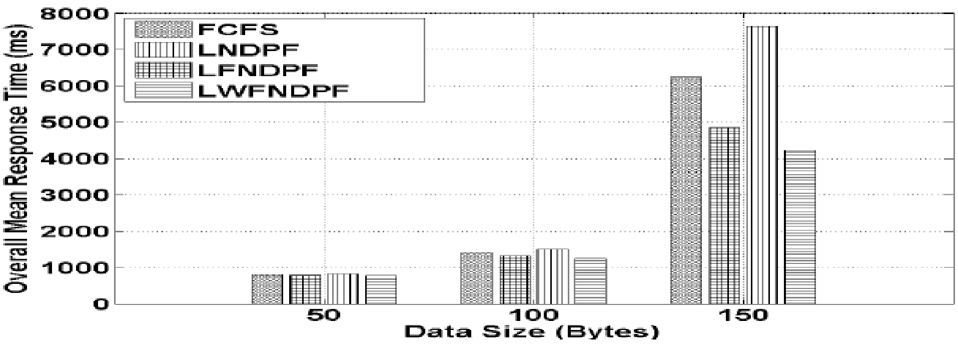


Fig 7 Effect of data size on performance of algorithms

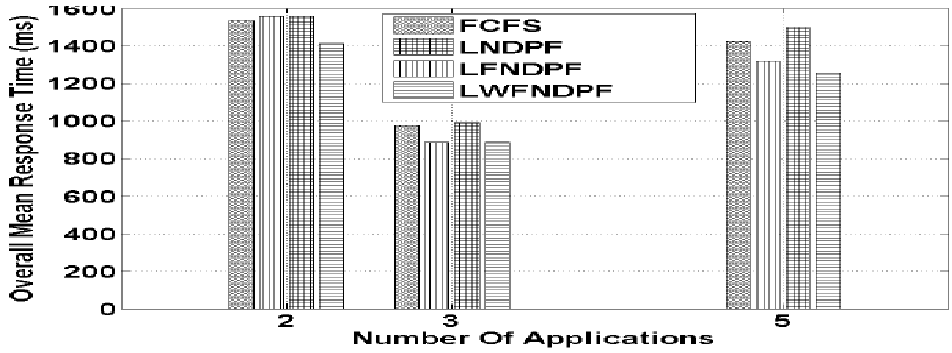


Fig 8 Effect of number of applications on algorithms

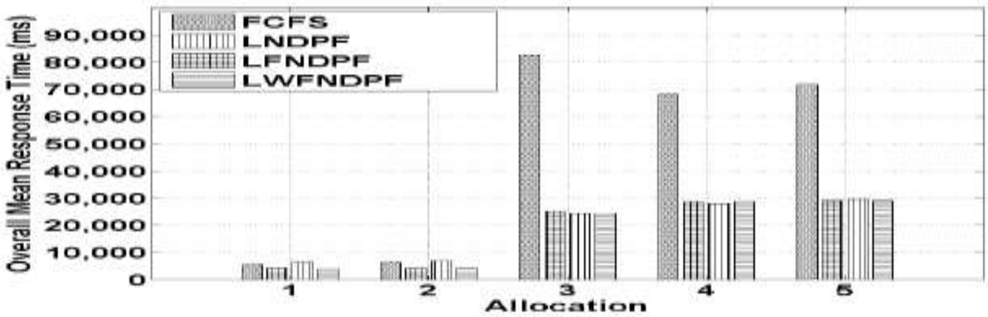


Fig 9 Effect of allocation on performance of algorithms

2.4 A Delay-Aware Data Collection Network Structure for Wireless Sensor Networks

Wireless sensor networks consist of a variety of wireless sensor nodes, compact and battery-powered instruments that can be used in virtually any environment. Because of these particular characteristics, sensor nodes are commonly used in the vicinity of the target of interest to perform proximity detection.

THE PROPOSED NETWORK STRUCTURE

The proposed network structure is somewhat similar to a tree structure. A later section shows that this restriction can be loose ideas. Each member of the cluster, a rank is assigned, which is an integer between 1 and p. A node with rank k forms k-1 data connections with k-1 nodes, these nodes have different ranks from the beginning from 1.2, ... to k-1. All these k-1 nodes become child nodes of the node of rank k. Thus, continuously rank levels help establish connections at higher levels thus helping in creating a nodal network with each node having a rank. Now, the highest level of any network is reserved for the base station and the highest level node at the top is then at the end connected to the base station. The time to generate this structure is thus,

$$t(N) = \log_2 N + 1.$$

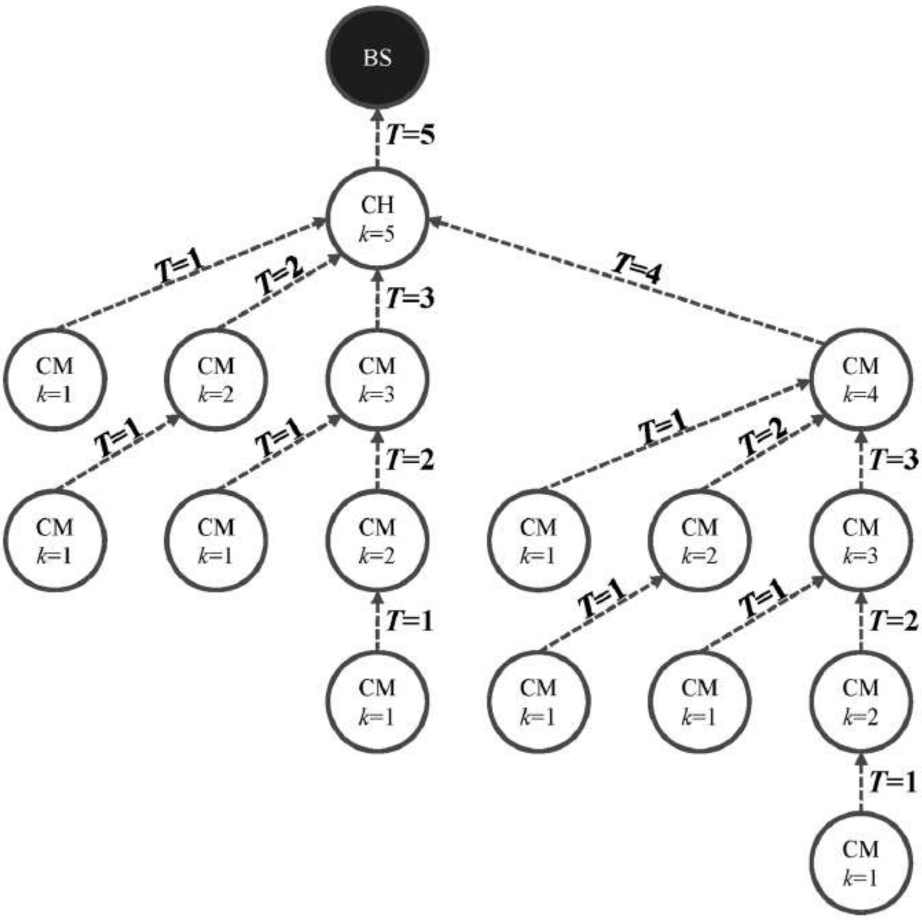


Fig 10 Network structure with N=16

There are 2 ways to form this structure.

1. Top-Down Approach
   This approach is one of the central control approach in which the top BS are used to communicate and relay information to all the other nodes for them to be able to locate other nodes and form a kind of hierarchical structure. The multiple layers are thus formed and finally the node locations are communicated for establishment of connections between the nodes.
2. Bottom-Up Approach
   The bottom-up way consists of connecting sizeable number of nodes of the same size. The bottom-up approach is scalably reversible compared to the top-down approach. It can be implemented centrally or remotely. The main advantage that we have of this method is the fact that the creation of links at higher levels is generally considered

simpler since we move from the nodes to the lowest level because it is not necessary to find the nodes that must be disconnected.

2.5 Lower Bounds on Data Collection Time in Sensory Networks

The data acquisition, i.e. the aggregation of the information collected by the sensor nodes in the position of the user, is a fundamental function of the sensor networks. In fact, most sensor network applications rely on data collection capabilities, so an inefficient data collection process can negatively impact network performance.
The paper considers seven types of network structures.

I. Line Networks
Here we assume a structure in which
d is the distance between any two nodes
To send packets from the BS, the BS first sends the packets to the farthest node and then the second farthest and then so on.
Therefore, the minimum collection time on directional network is

$$T_u(\boldsymbol{\nu}) \geq \max_{1 \leq i \leq n-1} \left(i - 1 + \nu_i + 2 \sum_{j \geq i+1}^{n} \nu_j \right)$$

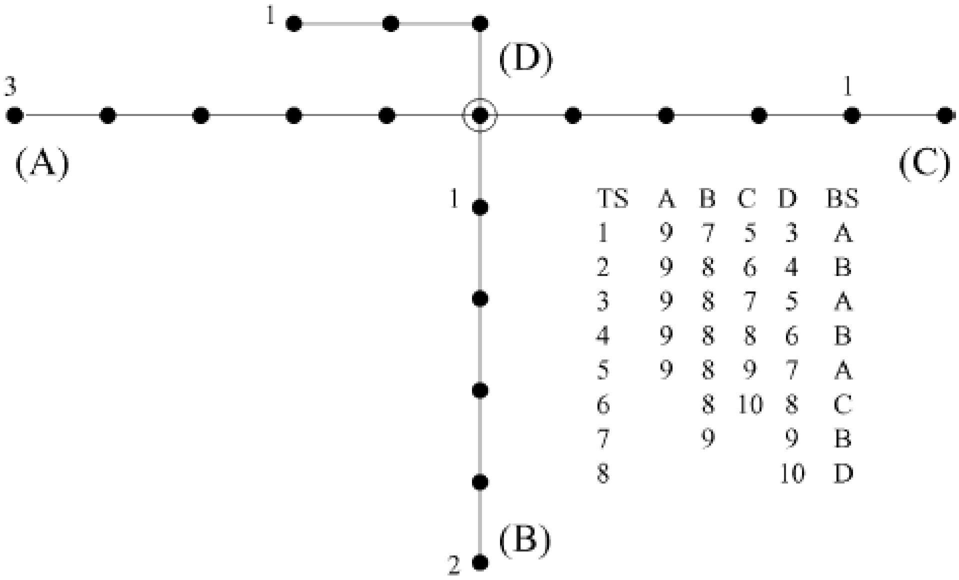
II. Two Line Networks
The least collection time on a directed two-line network of sensors is

$$T_u(\boldsymbol{\mu}, \boldsymbol{\nu}) = \begin{cases} \max\left(T_u(\boldsymbol{\nu}) + 1, \sum_{i \geq 1} \mu_i + \nu_i\right), \\ \quad \text{if } T_u(\boldsymbol{\mu}) = T_u(\boldsymbol{\nu}) \\ \max\left(T_u(\boldsymbol{\nu}), \sum_{i \geq 1} \mu_i + \nu_i\right), \\ \quad \text{if } T_u(\boldsymbol{\nu}) > T_u(\boldsymbol{\mu}). \end{cases}$$

III. Multiline Networks
The direction of transmission in such a case is greedily decides, in general, and is based on the estimates of the completion time of the transfer of data.
If in such a case a direction is not chosen, then new estimate is taken as old estimate + one.

Ne for the following characteristics:
1) same total number of data packets as N.

2) each line carries the same load as its corresponding line in N.
3) node i>1 carries 01 data packet.
4) two nodes with data packets are separated by at least 1 node with no data packets.



TS	A	B	C	D	BS
1	9	7	5	3	A
2	9	8	6	4	B
3	9	8	7	5	A
4	9	8	8	6	B
5	9	8	9	7	A
6		8	10	8	C
7		9		9	B
8				10	D

Fig 11 Optimal distribution of BS on 4-line network

IV. Trees & Graphs

The minimum data collection time is

$$\mathcal{T}_u(T) = \max_{1\leq i\leq n}\left(i - 1 + \sum_{j\geq i}^{n} \nu'_j\right)$$

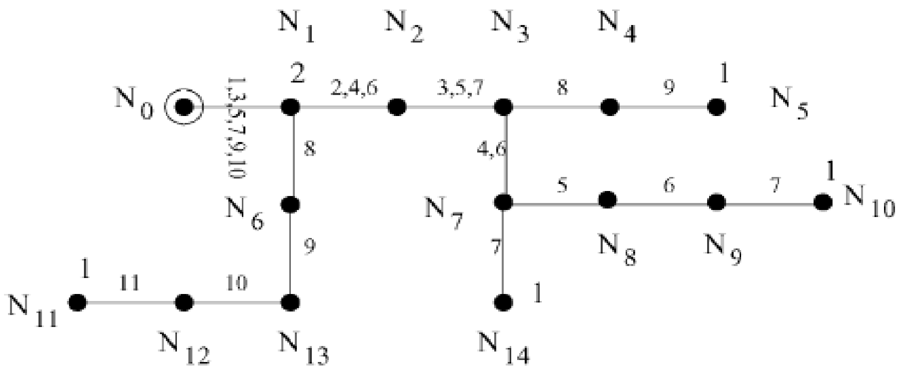


Fig 12 A 15 node tree network with degree of BS=1

V. Tree Sensors General Case

Algorithm for this case involves two steps:

1. Linearize the sub trees
2. Apply multiline algorithm

2.6 Continuous Data Collection Capacity of Dual Radio Multichannel WSN

There exist two issues in increasing the channel capacity of any WSN

1) Radio confliction

This means that any sensor can work in either transmission or receiving mode at any given time, i.e. in half-duplex mode.

2) Channel interference

This means that at any times, if two nodes are transmitting simultaneously then the packets are bound to face some interference due to presence of the other one in the WSN.

Network Model

N sensors

1 sink

H orthogonal channels

B is the size of the packet

W bits/s transmission rate

SDC $\Upsilon \doteq \frac{nb}{\tau}$

CDC $\Upsilon = \frac{Nnb}{\tau}$

Routing Trees

1) BFS tree
2) Dominating Set
3) Connected Dominating Set(CDS)

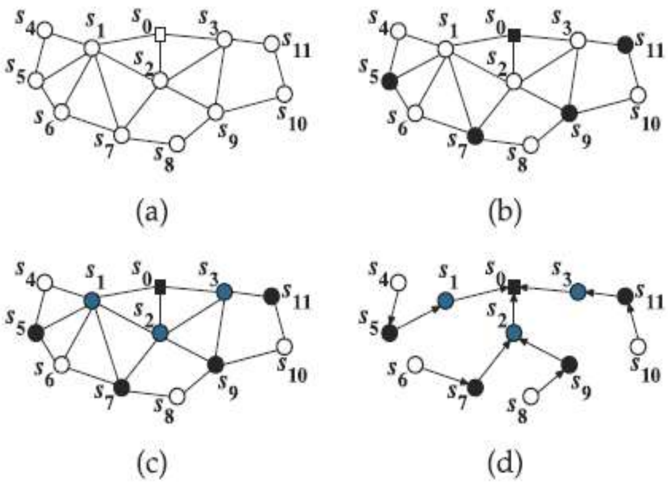


Fig 13 The construction of CDS based routing tree

Algorithm

1) Find dominators
2) Find connectors
3) Compute minimal cover

CDG

Multiply with ϕ and add

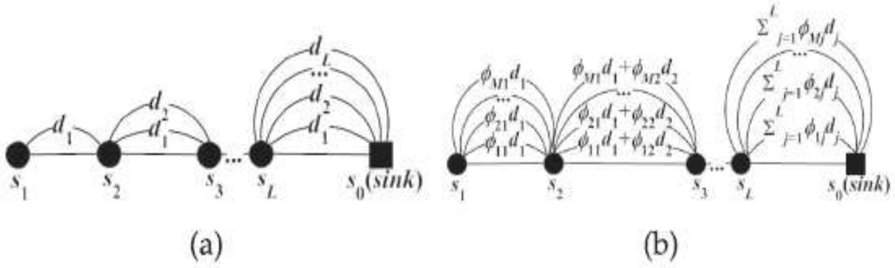


Fig 14 Comparison between a) normal data collection and b) CDG

Pipeline

1) The nodes at dominating level transmit data packets to their parent nodes snapshot by snapshot in CDG way
2) After the nodes at each dominator level receive all the data packets of the jth snapshot, they transmit the data of the jth snapshot their parents in CDG way.
3) After the nodes at each connector level receive all the data packets of the jth snapshot, they transmit the data of the jth snapshot to their parent in a CDG way.
4) The sink restores the data of the snapshot in the CDG way after it receives all the packets of the screenshot.

2.7 IoT-Based Smart Rehabilitation System

The developing pattern in populace development conveys numerous difficulties to society, which must be tended to in an opportune and compelling way. One of the most serious issues is the recovery of the elderly, which requires time, assets and labor.

The possibility of restoration treatment in the network has turned out to be powerful as of late with the point of creating keen urban areas. Contrasted with the customary recovery of neighborhood doctor's facilities, clever network based restoration means to give a simple, compelling and auspicious treatment, adequate collaboration and an opportune reconfiguration to make the most ideal utilization of therapeutic assets accessible to the network.

2.7.1 Rehabilitation System Methodology

A rehabilitation system using Wi-Fi and radio frequency identification (RFID) should be developed based on short-range radio transmission and communication technologies, global positioning system (GPS) technologies, identification technology based on unique identification data (UID) and service-oriented technology.

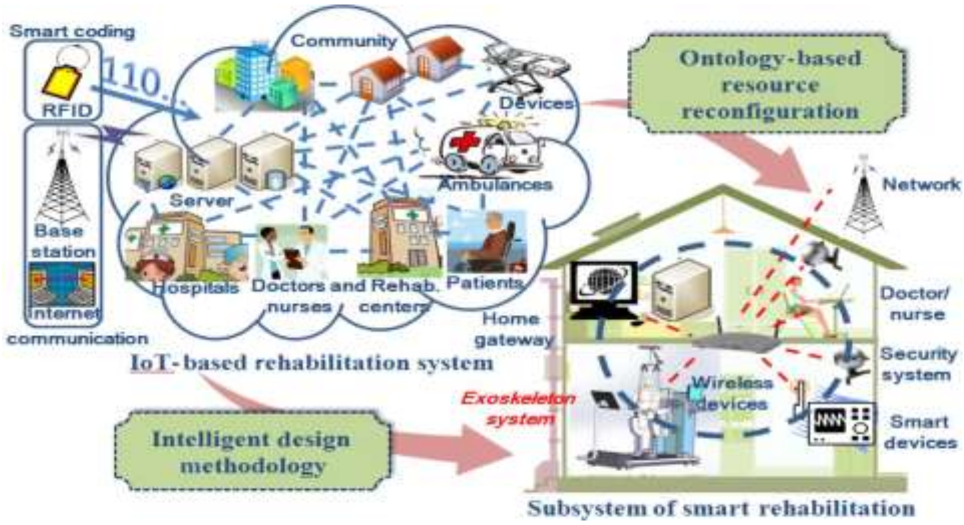


Fig 15 Rehabilitation system methodology

The structure of the IoT-based restoration framework is appeared in fig. below The framework is clarified with three segments: the ace, the server and things. The medicinal services application ascertains the assurance of the prerequisite of a restoration framework and this is additionally considered as the instructor. The instructor speaks to specialists, medical attendants and patients who concede uncommon consents to the framework through gadgets, for example, a cell phone, (PC) or tablet. Things in the framework incorporate clever IoT gadgets, patients and HR that are associated with one another and to the server through WAN, mixed media innovation or short message benefit (SMS).

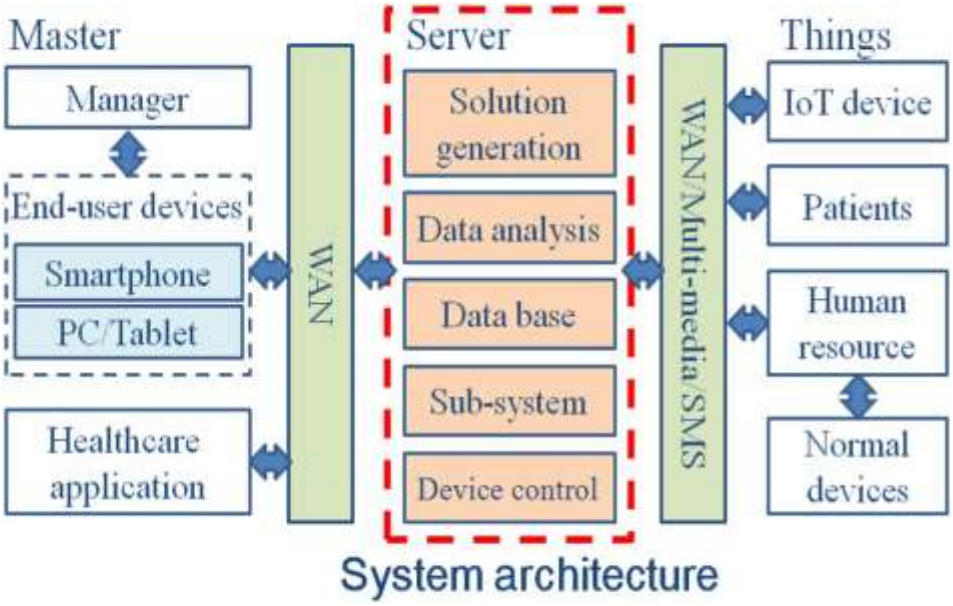


Fig 16 Rehabilitation system architecture

2.8 An Integrated System for Regional Environmental Monitoring and Management Based on Internet of Things

Climate change and environmental monitoring with management have attracted a lot of attention lately and an integrated information system (IIS) is seen as the need of the hour. An efficient IIS that benefits the Internet of Things (IoT), cloud computing, geoinformatics (RS), geographic information system (GIS) and global positioning system (GPS)}, and e-Science for monitor the environment and management must be developed for the task. Web services and multi-sensors should be used to collect information and other related data for the perception layer; Both public network systems and private network systems must be used to open and transmit massive data and other information at the network layer.

2.8.1 Environmental Informatics

The spectrum of environmental informatics can be classified into five categories:

1) database system (DBS)
2) GIS
3) DSS
4) expert system (ES)
5) IEIS

2.8.2 Integrated Informatics System

IIS includes various types of computer and information technology and tools. It offers a good answer to the difficult tasks of monitoring and environmental management. IIS is a matrix of multiple sets of information that are linked together in an organized way. The IIS and associated tools have been widely used in environmental monitoring and management, including ecosystem evaluation and resource use minimization.

2.8.3 System Architecture

Perception Layer

The perception layer is the main layer that collects data, such as the characteristics of physical units and entities in monitoring and environmental management, which generally includes real-time knowledge and its interpretation.

Network Layer

The network layer undertakes the basic functions of data and information communication and its transmission as well as the interconnection of system networks and its platforms. It mainly comprises of access networks and transport networks.

Middleware Layer

The middleware layer can be described as a set of sub-layers for the process of management of data, software/tools, models and platforms, and is traditionally interposed between the network layer and the application layer.

Real-time operational database (RODB) is used in this layer to fulfill the task of efficiently managing huge chunks of data generated by sensors and devices. Furthermore, it is also used for storing, processing and management of models, knowledge, and other information.

Application Layer

The application layer of the IIS which is primarily based on IoT consists of application support platforms along with cloud computing platforms, and e-Science platforms.

It provides to the user the functions of storing, organizing, processing, and sharing the acquired data and other related information which is procured from sensors, devices, and Web services.

Along with that, it also takes the functions of performing professional implementation in environmental monitoring and management.

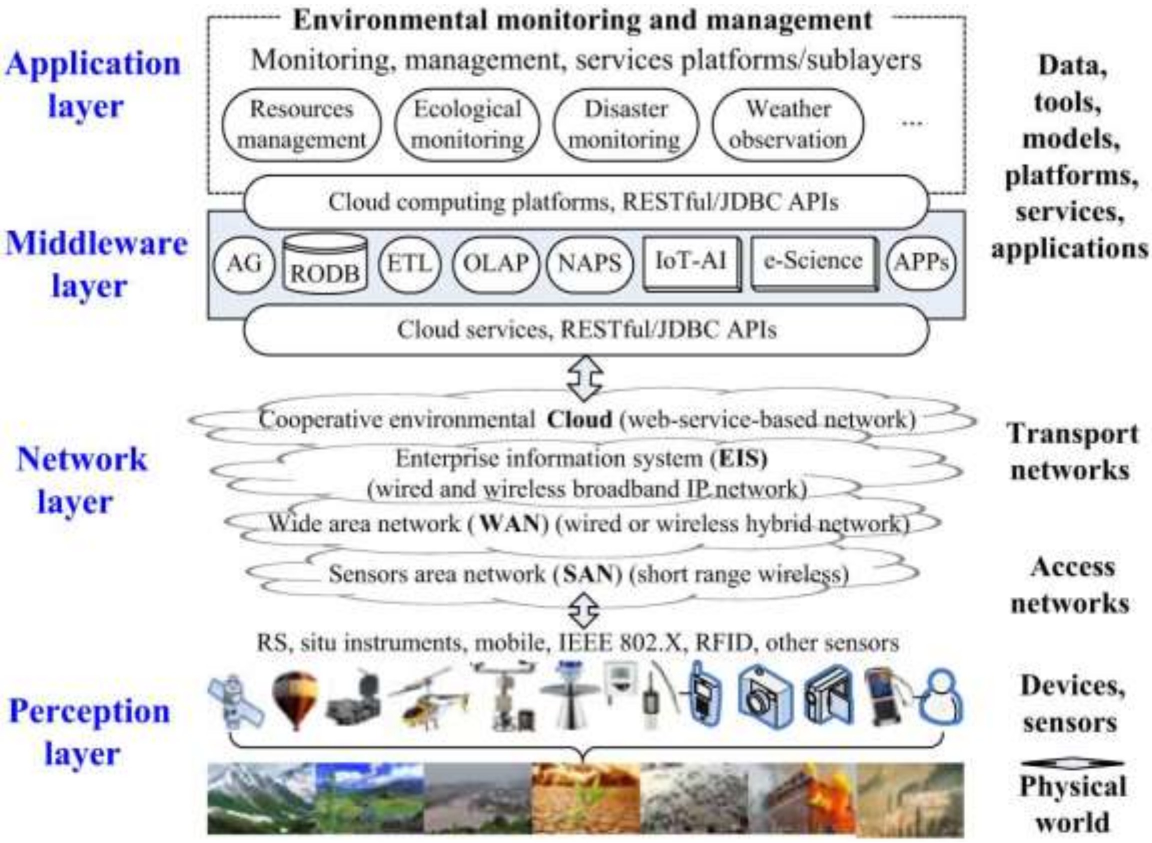


Fig 17 Different layers in the system

2.9 QoS-Aware Scheduling of Services-Oriented Internet of Things

The Internet of Things (IoT) contributes to a wide variety of connected devices and networks, which generate the problem of meeting the different

quality of service (QoS) requirements and the composition and deployment of fast services.
In addition, some QoS IoT services must be transformed and assimilated to services compatible with QoS. A three-level QoS planning system for service-oriented IoT is proposed.

In the application layer, the QoS planning algorithm takes into account the optimal composition of the services that take into account the QoS analyzed by each component service.

In the network layer, the model focuses on dealing with the planning of the connected subnet environment.

The detection layer deals with the planning of the acquisition of information and the allocation of resources for different services.

The enhancement of a three-level QoS demonstrate for administration arranged IoT requires the accompanying capacities:

1) The provisioning of QoS in IoT is examined as far as choice control over the application layer, the system layer and the recognition layer.

2) The QoS show that is the aftereffect of the three-level administration arranged design referenced above works in a best down choice model. This certifications QoS in IoT through subjective strategies.

3) The QoS investigation structure is expected to enhance and further examination administrations, subnets and systems and identification gadgets. These guide the improvement of QoS attributes in IoT.

4)The basic leadership process is given.

2.9.1 Composite QoS in IoT

The architecture should be further explored for the development of IoT networks and systems that encompass the collection and processing of data of different types and configurations of devices, complex types of data and actions such as collection, processing, transmission and storage.

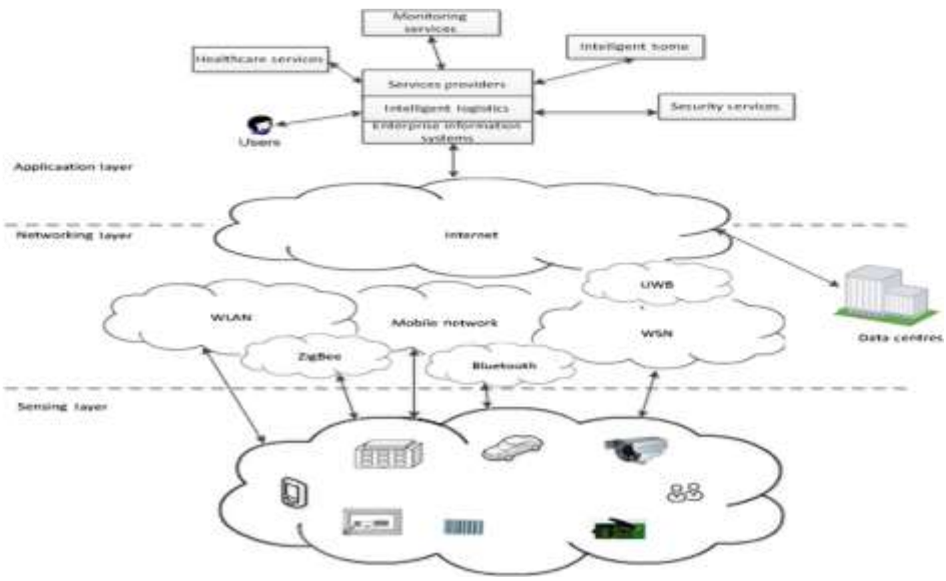


Fig 18 Different layers of QOS aware scheduling

Taking into account a diverse complex system with multiple devices, IoT requires multiple transmission protocols for the simultaneous collection, transmission, processing and storage of data.

A leaf node of IoT (for example, an RFID tag or a sensor node) interacts and acquires data and information and transmits through the network layer to the user / service providers, for which the necessary resources are reserved in an efficient.

The optimization of the quality of the services, the network services and the performance of the final button reduce the complexity of the services of the system.

The proposed architecture for the QoS decision-making process offers flexible and cost-effective services to users / providers, as shown below.

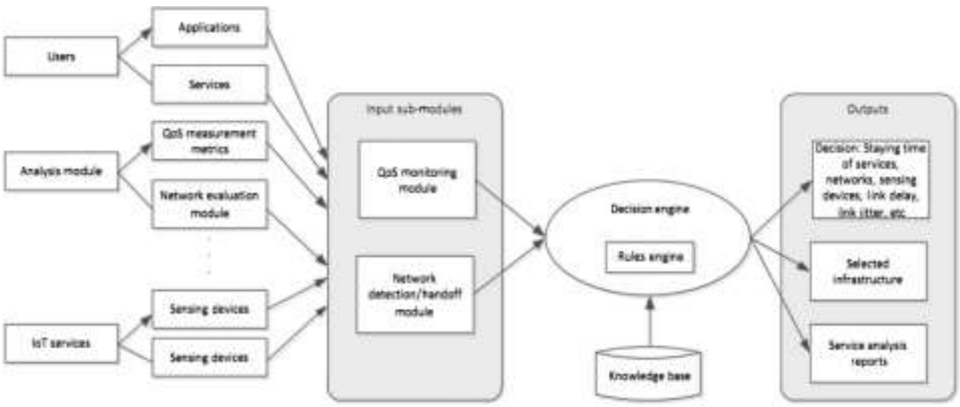


Fig 19 The QOS system divided into modules

The QoS characteristics are planned in an organized three-layer way:

1) In the application layer:
   An application establishes a connection. Then the user and the QoS planning mechanism make the decision.

2) In the network layer:
   The QoS module selects and assigns inactive resources and presents them with the network to the optimal services.
   The characteristics of QoS in this layer contribute enormously to the decision-making process.

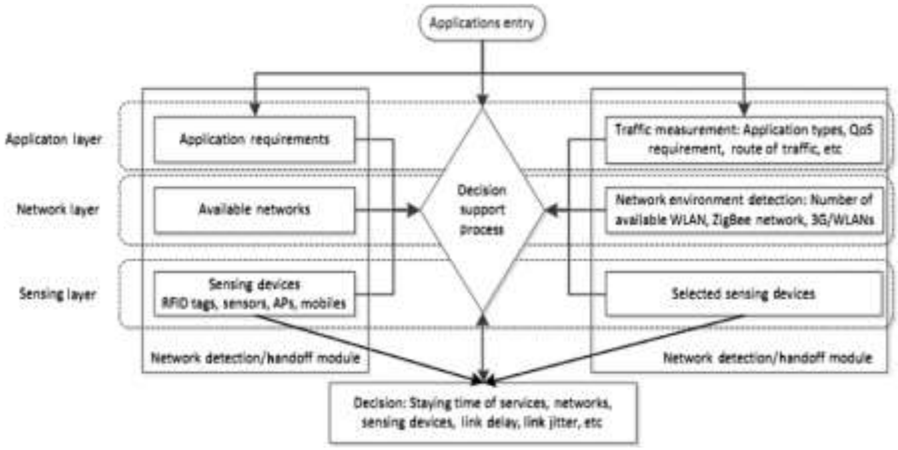


Fig 20 Interconnection between modules in QOS architecture

3) In the detection layer:
   The determination of the essential location foundation assumes a job in satisfying the assignment of the basic leadership process. The choice of the essential identification foundation depends only on the observation and QoS required for the application/client.

   The QoS module in the identification layer is in charge of the choice of the essential recognition hardware.

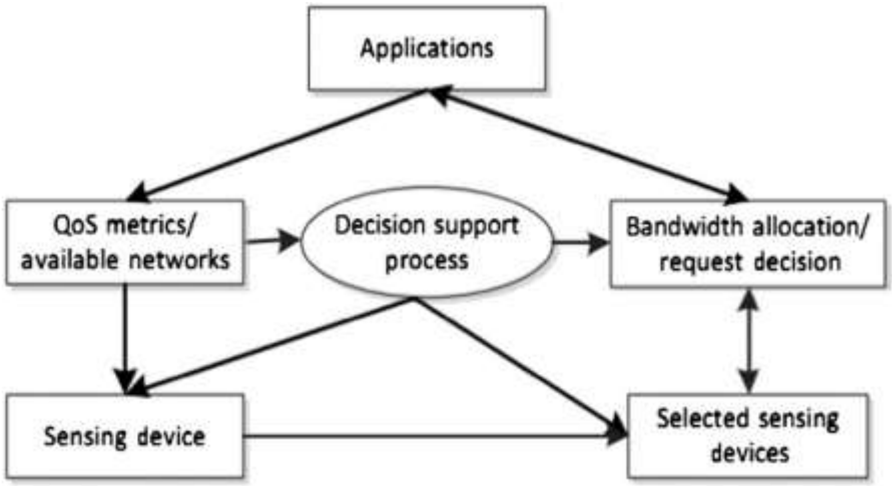


Fig 21 How application interact with the QOS architecture

2.10 A Delay-Aware Network Structure for Wireless Sensor Network with Consecutive Data Collection Processes

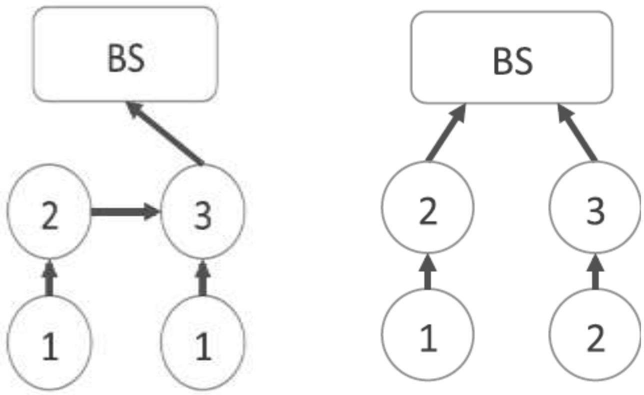
For wireless sensor networks (WSN), a large number of wireless sensor nodes are required to enable and complete short-range detection. Therefore, the recognition quality improves eventually. The data packets are transmitted in a many-to-one structure from the sensory nodes to the base stations.

In order to limit the detection delay of events on the lower side, the scenario that explains the occasional data collection and also for a minimalistic time, it is recommended to limit the time intervals of a data acquisition process (DCP).
Conversely, for continuous monitoring, the amount of DCP completed in a given period of time is essential to accurately and accurately predict the trend of the data.
Therefore, a delay-sensitive network structure for WSN with successive DCPs is proposed. The proposed network structure can increase the number of DCPs per unit time without imposing an additional delay on each individual DCP.

In a network with N wireless sensor nodes, it is assumed that the nodes are organized in the DADCNS using the bottom-up approach. The DADCNS is designed for scenarios in which a FAD is occasionally called. However, once called, it must be completed in a short time.

Below an organization of sensory nodes is shown

a) For DADCNS
b) For an optimized network structure for consecutive DCPs



(a) (b)

Fig 22 Organization of nodes according To different algorithms

Transmission Schedule for Network (a):

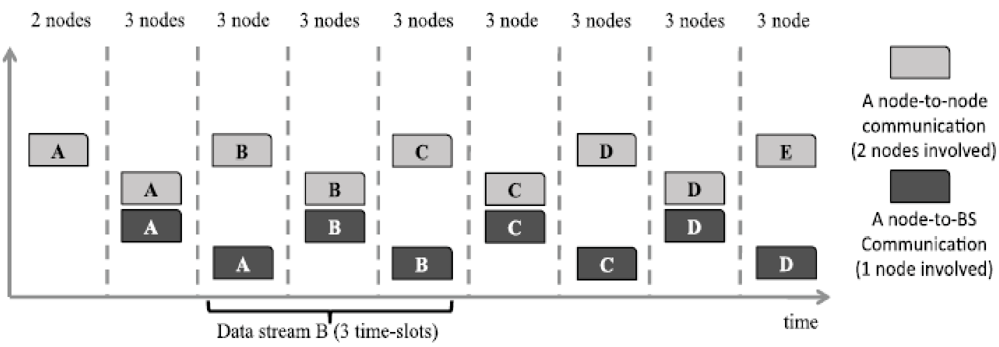


Fig 23 Transmission schedule for network a

Transmission Schedule for Network (b):

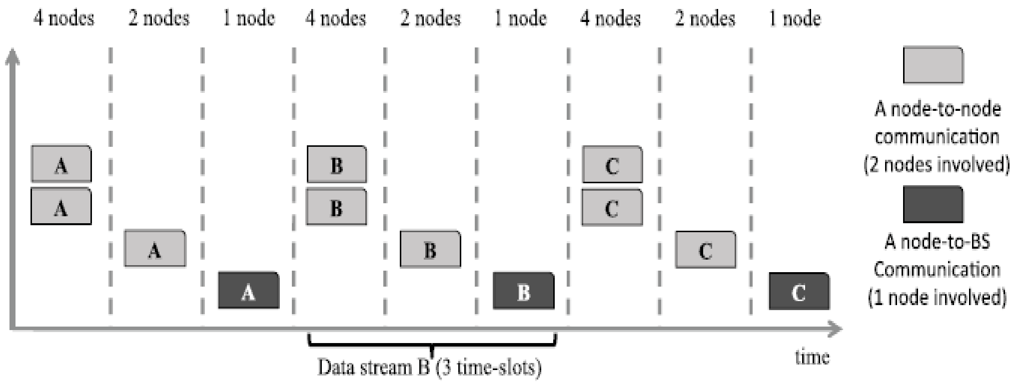


Fig 24 Transmission schedule for network b

It can be noted that the optimized network structure is efficient for transmission scheduling.

CHAPTER 3

SYSTEM DEVELOPMENT

3.1 Design

3.1.1 New proposed algorithm:

The paper cited above states conclusively that if the same number of nodes are used to form an α ring as well as a β ring, then it takes less time to accumulate data across all nodes in a β ring.

Going forward with this logic, our algorithm attempt to achieve the minimum value of required time slots by forming the maximum number of β rings possible along with at most 2 α rings. After this, all the remaining nodes are then distributed across all the β rings.

Algorithm Steps:

Step 1: Calculate the value of μmax by taking the floor of N/k.

Step 2: Calculate the number of β rings formed based on the value of μmax mod 3.

Step 3: Calculate the number of α rings formed based on the value of μmax mod 3.

Step 4: Calculate the number of remaining nodes that are not in any of the rings.

Step 5: Calculate the number of nodes in an α ring.

Step 6: Calculate the number of nodes in a β ring.

Step 7: Calculate the minimum number of nodes in both α and β rings.

Step 8: The value of t1 can now be calculated by using the results of step 7.

Here
N = number of nodes in the network
k = number of concurrent data streams
μmax = maximum number of nodes that can be utilized in a single time slot

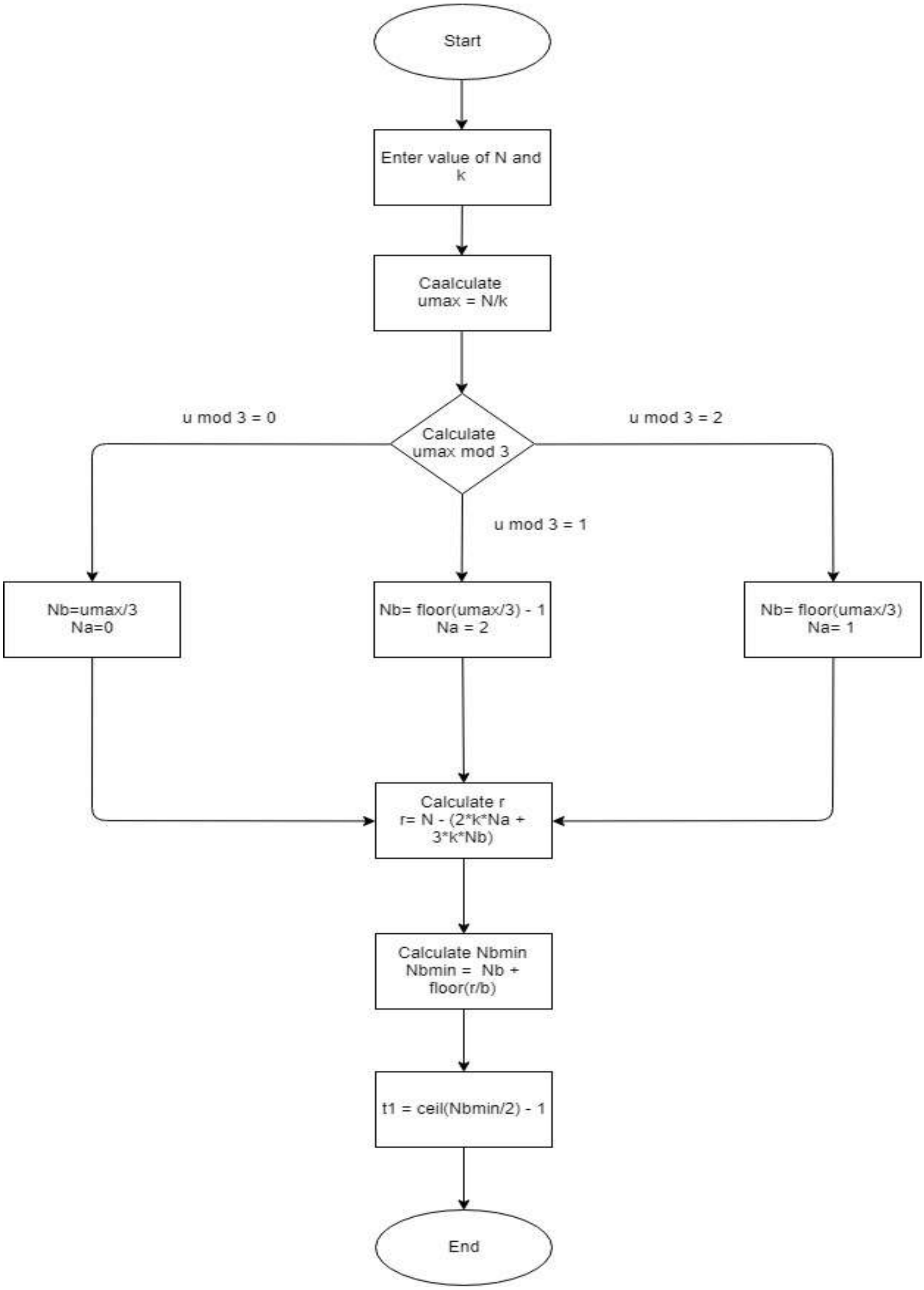


Fig 25 Flowchart of proposed algorithm

3.1.2 Theorem: All remaining nodes will only go into the β rings and never into the α rings.

Proof:

Since μmax = $\lfloor \frac{|N|}{k} \rfloor$

Thus at any time the maximum value of r, the number of remaining nodes, will be k-1.

Considering the worst care wherein we have only 1 β ring, nodes in the β ring = 3 * k

Time taken to aggregate data across the ring = (2 * k) – 1

Thus we can keep inserting nodes into the β ring until the time to aggregate data across the β ring remains less than this time.

Time taken to aggregate data from the new β ring = $\lceil (3k + k - 1) / 2 \rceil - 1$

Taking the worst case the floor function will return a value greater, thus time taken to aggregate data from the new β ring = (3k + k − 1) / 2 + 1 − 1

And we know that this value should be less than (2 * k) – 1

Solving the above equation, we get $(2 * k) - 1/2 \leq (2 * k) - 1$ which we find to be true for all cases, thus all the nodes will be inserted into the β rings only.

3.2 Analysis

Comparison between original algorithm and new proposed algorithm:

Eg.
Suppose that N=34 and k=4 for an IOT network.

Using algorithm given in cited paper

Na=4, Nb=0

α rings are created such that each has nodes equal to 2*k=2*4=8, thus number of α rings created are 34/8=4.
Now the number of remaining nodes will be 34-(8*4)=2.
Thus, the two extra nodes will be allocated and the nodes in α rings will be 9,9,8,8.
T1=7.

Using proposed algorithm

Na=1 , Nb=2(both with 1 extra node)

In our algorithm first β rings are created wherein each will have 3*k=3*4=12 nodes, so the number of β rings =34/12=2.

α ring will be created with 2*k=2*4=8 nodes.
So, number of α rings= 10/8=1.
Now we have 2 extra nodes. These nodes are divided amongst the 2β rings and each will get 1 extra node.
T1=6.

CHAPTER 4

ALGORITHM

$$\mu max = \left\lfloor \frac{|N|}{k} \right\rfloor$$

Where N = total number of nodes
k = total number of concurrent data streams

$$\beta = \begin{cases} \mu max / 3 & \text{, if } \mu max \bmod 3 = 0 \\ \lfloor \mu max / 3 \rfloor - 1 & \text{, if } \mu max \bmod 3 = 1 \\ \lfloor \mu max / 3 \rfloor & \text{, if } \mu max \bmod 3 = 2 \end{cases}$$

$$\alpha = \begin{cases} 0 & \text{, if } \mu max \bmod 3 = 0 \\ 2 & \text{, if } \mu max \bmod 3 = 1 \\ 1 & \text{, if } \mu max \bmod 3 = 2 \end{cases}$$

Where β = number of β rings
α = number of α rings

After the formation of α and β rings, the number of remaining nodes, r, will be:

$$r = N - (\alpha . N\alpha + \beta . N\beta)$$

Where Nα = the number of nodes in an α ring = 2*k
Nβ = the number of nodes in a β ring = 3*k

The β ring with minimum number of nodes will have

$$N\beta min = N\beta + \lfloor r / \beta \rfloor$$

The α ring with minimum number of nodes will have

$$N\alpha min = N\alpha + \lfloor r / \alpha \rfloor$$

Thus, $t1 = \lceil N\beta min / 2 \rceil - 1$, if $\beta \neq 0$
or $t1 = N\alpha min - 1$, if $\beta = 0$

And t2 = Nαmin - t1
Total Time, T = t1 + t2

CHAPTER 5

TEST PLAN

Taking the above mentioned algorithm as basis, it needs to be determined that how many time slots precisely are required for the completion of data collection process.

Arbitrarily, for any set of values of N and k, μ_{max} = N/k.

Here the test cases are taken as a range of N and taking into account different values of k, we make multiple cases. The value of N ranges from 0 to 300 with jumps of 15 and the value of k is varied from 2 to 9, this in effect gives us 20 values of N for each value of k and in effect 180 (N,k) value pairs, which help us to show the efficiency boost that our algorithm provides.

The value for t1 is then calculated for each of these value pairs using both the original as well as the proposed algorithm and then the graphs are plotted with the values received, to show the difference between the two algorithms.

CHAPTER 6

PERFORMANCE ANALYSIS

The precise difference in performance in terms of time slots taken by the system to collect data from the tree and then transmitting it to the Base Stations can be computed only after determining accurate and precise values of time taken for the new proposed algorithm to transmit and share data.

But as clearly mentioned in the original algorithm, the time taken by an β ring to collect data and transmit it to BS is less than time taken by an α ring.
Using this as the basis, we can arrive at an estimated result.

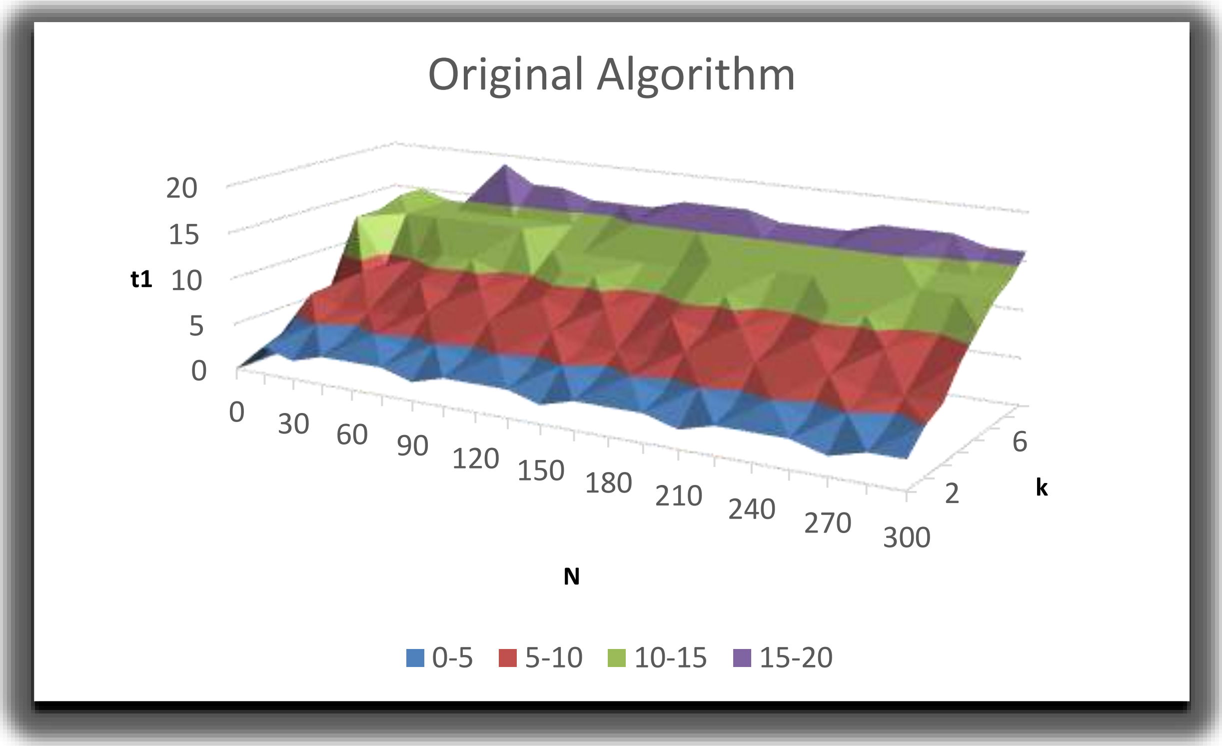
The original algorithm, in case of multiple rings, aims to generate as many number of α rings as possible under the conditions of N and k, and in any given case will produce at most one β ring.
The new proposed algorithm heavily differs from the original one as it is exactly opposite. In any given case, it aims to produce maximum number of β rings for a given value of N and k, while forming at most one α ring if necessary.

Since the new proposed algorithm produces far more number of β rings and less number of α rings, hence it is self-explanatory that the new proposed algorithm will be much more efficient as a β ring is more efficient than an α ring.

But the exact difference between the two algorithms will be clear once the precise time slots required to collect data are computed.

The execution of the proposed system structure is additionally examined utilizing PC recreations. In the recreations, the term of an information gathering process T with k simultaneous streams is utilized as the execution marker. T is communicated as the all out number of timeslots required by the BS of various streams to gather information from every one of the hubs in the system. In every reenactment, a system with IoT hubs is considered. In the tests, execution of the first the original algorithm will be utilized as a source of perspective. So as to assess the impact of and k to the execution of systems with various system structures, is fluctuated from 0 to 300 with a stage size of 15 while k is shifted from 2 to 10. Results are appeared in the figures beneath.

Comparative graphs for different values for N and k



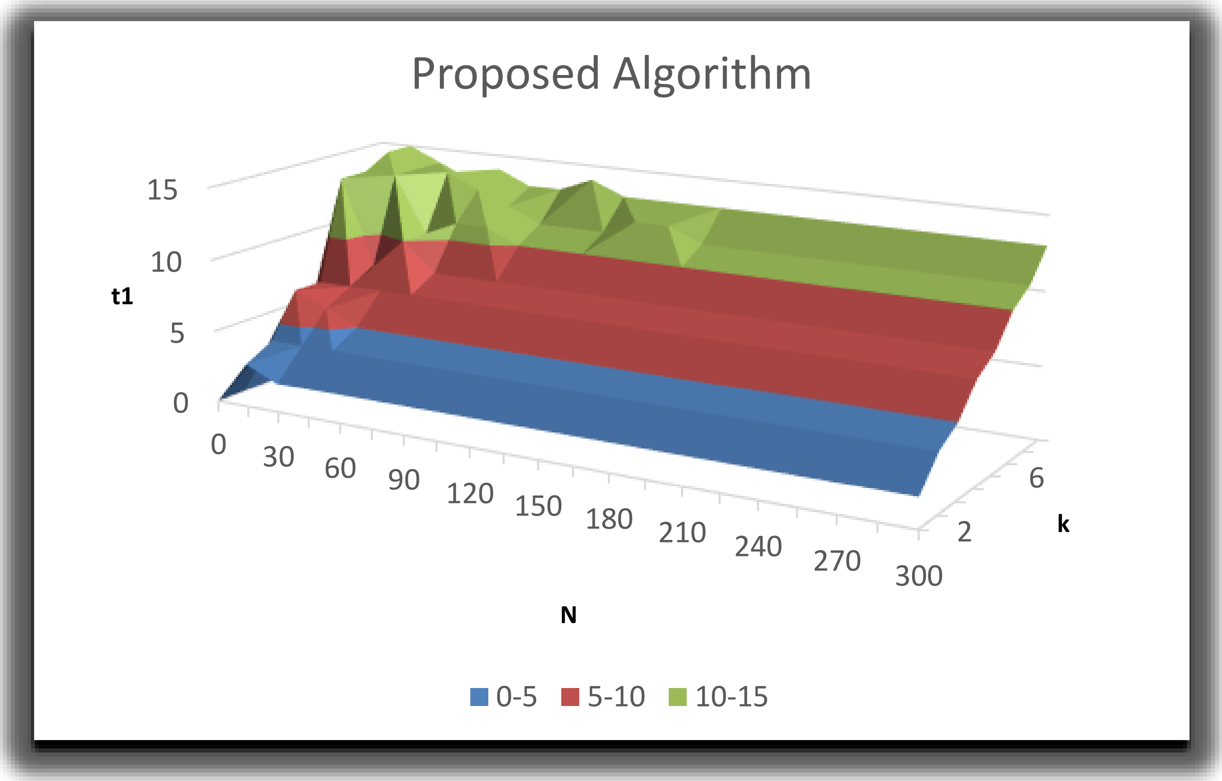


Fig 26

The above graphs represent the time taken for initial accumulation of data (t1) for the original as well as the proposed algorithms and it shows conclusively that for the variety of values of N and k taken and the cases considered, keeping all other factors constant, the proposed algorithm performs better than the original algorithm and saves upto 30% time in the data aggregation process, which for any WSN is a huge efficiency boost.

The graph for time of the proposed algorithm flat lines after a time for any number of nodes, keeping the value of k as the same and this shows the overall efficiency of the algorithm and its ability to handle high-density networks

The time taken by the two algorithms to accumulate the data can be compared more clearly by fixing the value of k and then calculating the time taken as a function of N.

The time taken (t1) is plotted against the number of nodes (N) for 3 different values of k, i.e k=4, k=6 & k=9.

Time comparison of original and proposed algorithms for different values of N keeping k constant

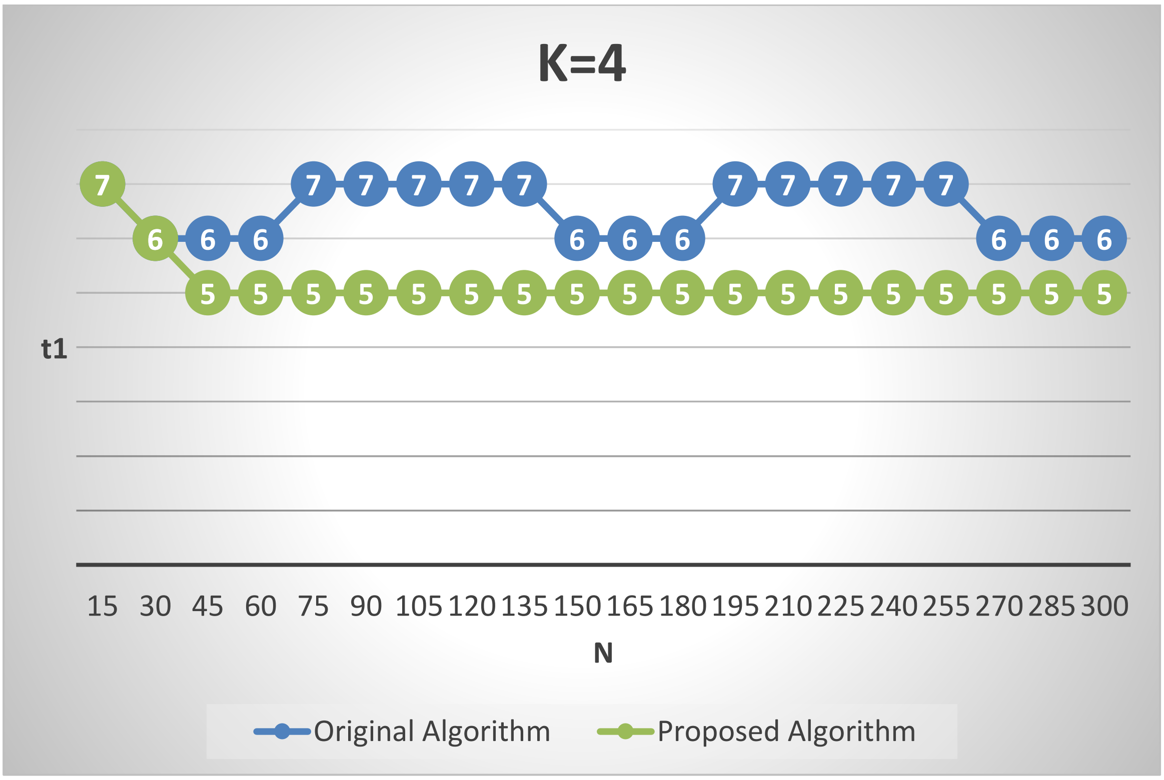


Fig 27 (a) K=4

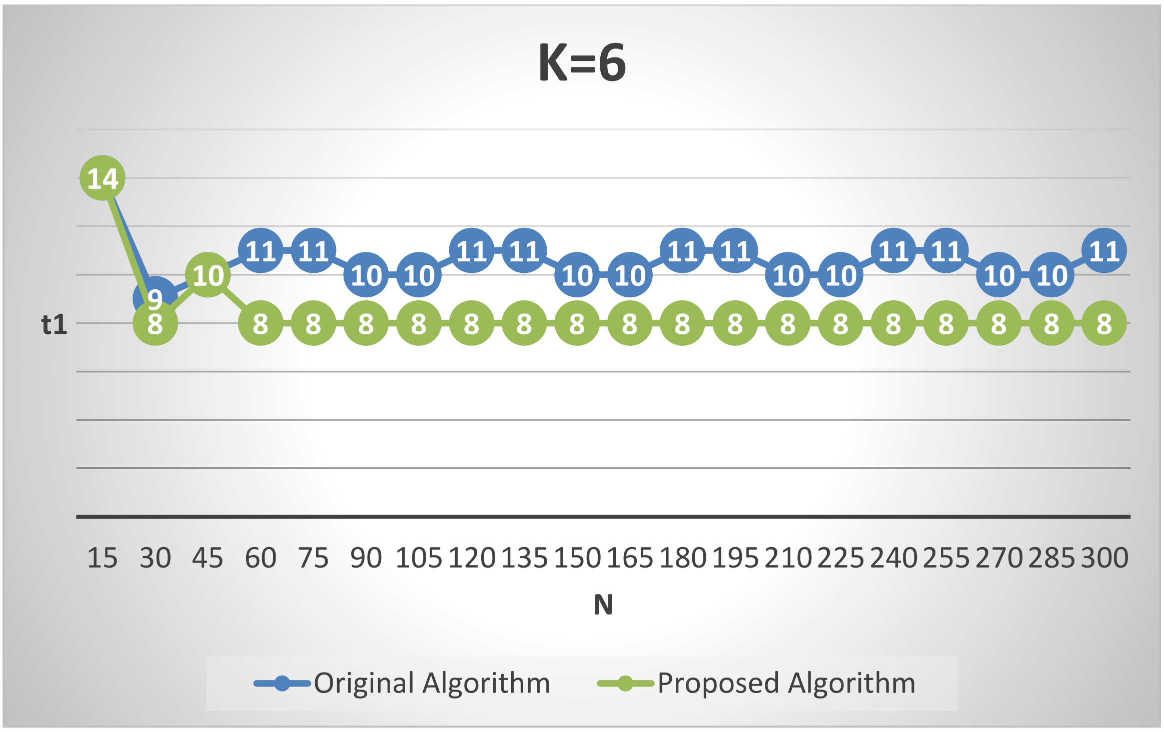


Fig 27 (b) K=6

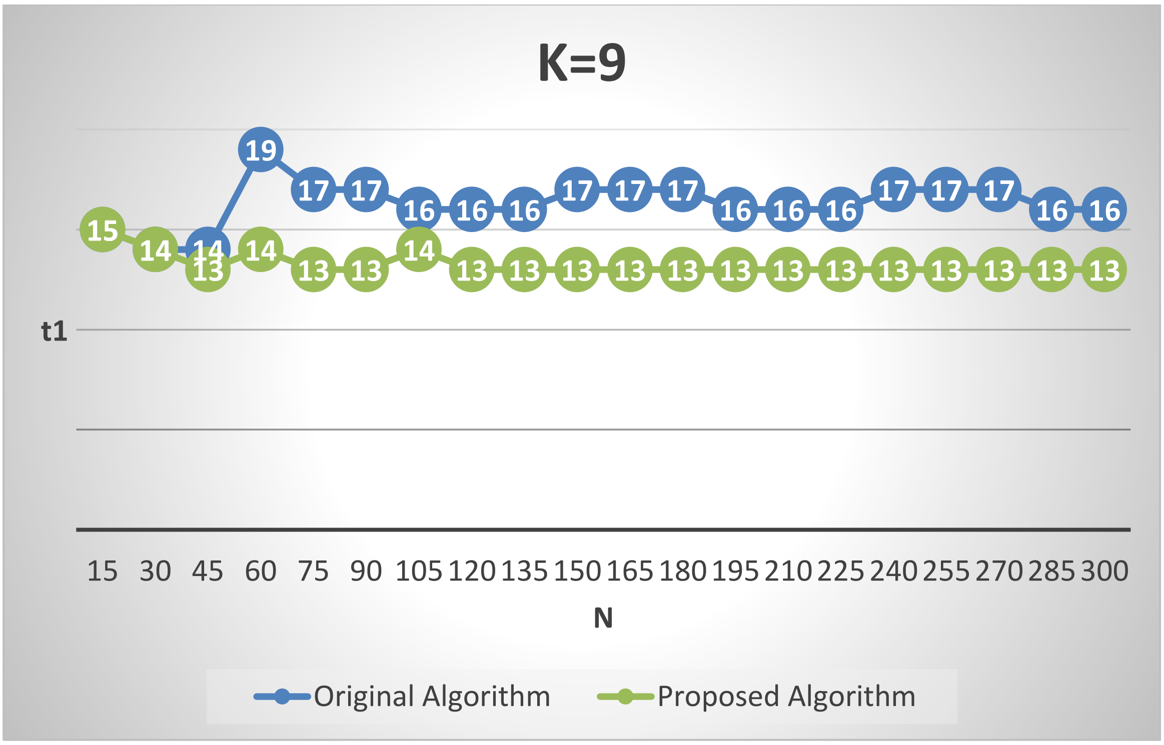


Fig 27 (c) K = 9

CHAPTER 7

CONCLUSION

Hence the original algorithm, that has established a new concept to efficiently collect data from IOT networks using special kinds of rings, has been modified and working on the similar principal a new set of procedure is proposed that differs in the structure and distribution of these special rings to further improve the time requirement of the process.

Future Scope:

It has been established that the new proposed algorithm is more efficient than the original one based on the basic principles that are formulated to design these algorithms.

Furthermore, some work may be done to improve the time required to collect aggregated data from all nodes and send it across to the base station.

CHAPTER 8

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