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# PACKET LEVEL DATA COMPRESSION TECHNIQUES FOR WIRELESS SENSOR NETWORKS

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**ABSTRACT**

Wireless sensor network consist of a set of sensor nodes. The processing capacity varies with each node. Sensors in it have storage capacity which is limited. The main challenge today in this field is to improvise the power and energy management of sensor network. Different techniques have been introduced by various researches. In this paper proposes an algorithm to improvise sensor energy using compression techniques. This is called as packet level data compression techniques. In my previous paper sequential data compression techniques two different techniques were proposed to improve energy in sensors. This paper includes processes called segmentation along with the previously proposed algorithm to improve sensor energy. The compression ratio obtained is higher than the previously proposed method. Along with the proposed method discussed various other standard compression techniques.

**Keywords:** *Wireless Sensor Networks(WSN),Data Compression, Sensors, Fragmentation, Sensor Energy.*

## 1. INTRODUCTION

### 1.1 Sensors

Sensor network that is capable of gathering process able data processing and communicating with various other nodes which are connected in this network. .

Sensors are classified into:

- Passive sensors.
- Omni-directional sensors.
- Narrow-beam sensors.
- Active sensors.

Passive sensors are self powered. In passive sensors energy is used only to amplify their analog signal. These sensors do not manipulate the environment while sensing it. Active sensors need un interrupt energy from a power source. These sensors actively probe the environment. For example, a radar or sonar. Narrow beam sensors follow a well defined concept of course of measurement. For example, camera. Omni directional sensor have no concept of course involved in their measurement. In general the theoretical work on wireless sensor networks works with Omni directional and passive sensors.

### 1.2 Wireless Sensors Network

A sensor node is predominantly used when it is complicated or impossible to run a main supply to the sensor node. The majority cases the wireless sensor node is placed in a hard to reach location, the battery will have to be inconvenient and expensive. It is essential to ensure that there is always ample energy available to power to the power system. This is considered to be one of the important aspects in the development of a wireless sensor node. Power is consumed by the sensor for sensing, communicating and data processing. Data communication consumes more energy than any other processes. Power is stored in capacitors or batteries. Both rechargeable and non-rechargeable batteries can act as the power supply for the sensor nodes.

### 1.3 A few characteristics of a WSN:

- Power utilization, limitations for nodes using energy harvesting or batteries.
- Capability to handle node failures.
- Nodes Mobility
- Heterogeneity of nodes
- Can be scaled to large scale operation.
- Sturdy enough to endure harsh environmental conditions
- Ease of use

### 1.4 Challenges of sensors:

The main few challenges of sensor are

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- The Life time of sensors.
- The size of a sensors
- Power management.
- Network coverage area.

## 2. OBJECTIVE OF SENSOR NETWORK DESIGN

The main purpose is of net work design are Low power consumption, Adaptability, the ability to configure itself scalability, secure, fault tolerance and support.

## 3. VARIOUS COMPRESSION TECHNIQUE FOR WIRELESS SENSOR NETWORKS

Compression techniques are predominately used to increase the energy efficiency and the life time of sensors. It also helps to cut communication cost and computation cost. A few of the compression techniques for wireless sensor networks are,

- Delta Encoding.
- Run length Encoding.
- Huffman Coding.
- Arithmetic Data compression.

## 4. DELTA ENCODING:

Delta Encoding involves in storing and transmitting data as the difference between sequential data rather than complete files. Delta Encoding is also known as Delta Differencing. A Delta can be defined as directed delta and symmetric delta. A directed delta is also call as a change. It is a series of change operations. When directed delta is applied to on version v1, yields another version v2. The symmetric delta is defined as $\Delta(v1, v2) = \left(\frac{v1}{v2}\right) \cup \left(\frac{v2}{v1}\right)$.

**Drawback:**

For delta compression, delta encoding can be used when there is only a small change between adjacent values; that is, when the values in the original data are smooth.

## 5. RUNLENGTH ENCODING:

In run length encoding the count of repetition of character is sent along with the data character.

**Drawback:**

- The original data sequence influences the compression ratio.
- The procedure involves the large amount of data is difficult.

## 6. HUFFMAN CODING:

Huffman coding is a lossless data compression technique. With Huffman coding, the input data assign variable length bit code. The most frequent data assign small bit code. Compression takes place by two passes. The first pass involves creation of the tree model based on the contents by analyzing a block of. The second pass compresses the data using the model Huffman coding is predominately used in MPEG and JPEG file compression.

**Drawback:**

- Huffman algorithm considered to be slower than other compression techniques.
- It is difficult to decode data as it is difficult to find missing data and corrupt data because Huffman algorithm based on variable length code.

## 7. ARITHMETIC DATA COMPRESSION:

Arithmetic coding is generated based on their intervals. The intervals range is [0,1]. The range should be greater than 0 and should be lesser than 1.

Steps involved in arithmetic coding are:

The input data is arranged in alphabetical order and the each character frequency is detected. Based on the frequency of characters the probability is derived. Once the probability is derived the range is set.

- **To calculate the High value**

High value=Low value + (code range * high range of the symbol being coded).

- **To calculate the Low value:**

Low value = Low value+ (code range * low range of the symbol being coded).

**Drawback:**

- Complex calculation.
- Data transmission can begin only after compress the entire data is compressed.

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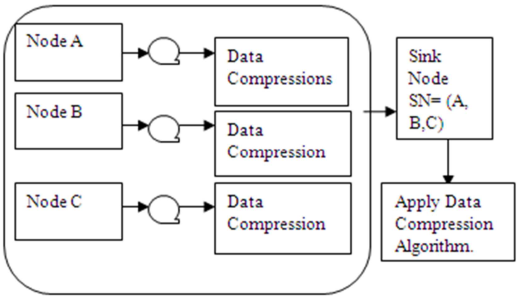
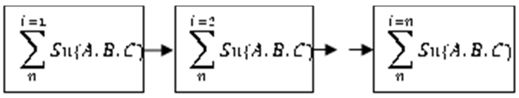
**Overview of data Compression**




**PACKET STREAM FLOW**

Packet s1 Packet s2 … … Packet sn



## 8. COMPRESSION ALGORITHM

Algorithm for sequential data compression algorithm[3]

**Compression Algorithm:**
Input:
The sequence data to be compressed.
Output:
Compressed data

Begin:
1: Initialization
1:1. Sequence Data(SD)
1.2. Double digit Code(DC)
1.3. Single digit Code(SC)
2. While (Code has Double digit)
Convert ← Single digit
Then
Evaluate and combine Single and Double Digit code.
Until
All the code changed as single digit.
3. Assign ←character code sign
4. Character code sign ← compressed data

**Decompression Algorithm:**
Input: Compressed Data
Output: Original Data.
Location Table ←LT
Current table←CT
Previous table ←PT
Begin: If (PT==CT)
Assign: Location ←CT
Compare
Location 1 AND Location 2
Then
Subtract: Second Location [Index]
First Location [Index]
Go to
Previous table and
Search missing Index (Compressed value)
Otherwise: go to next following table
Until (CT== location table).

## 9. PROPOSED ALGORITHM

Along with the previously proposed sequential data compression algorithm [3] a concept of fragmentation has been added to achieve better compression ratio.

**Algorithm for Fragmentation**

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Begin:
1: Initialize:
PS → Packet Size
DS → Data Size
EG → Remaining Energy
TT → Transmission Time
TP → Transmission way
ISN → Idle State Node

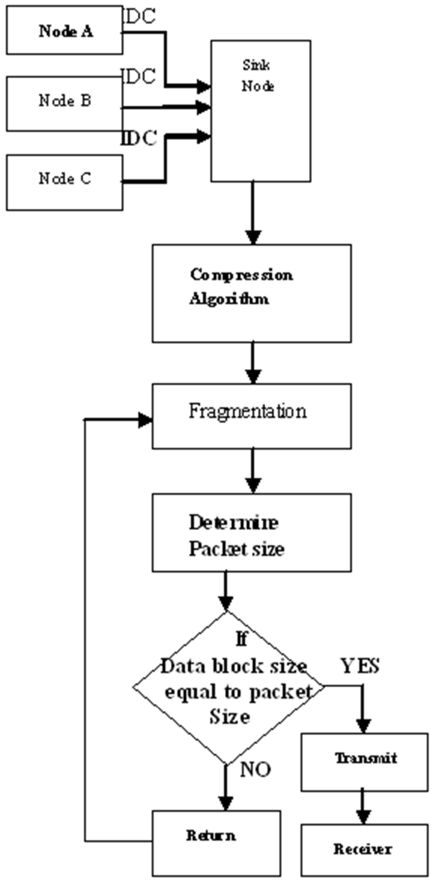
TTWIN→TransmissionTimewithIdle Node TTWOID → Transmission Time without Idle Node

Calculate:
Cycle1 :Transmission Time
Transmission way
Idle State Node.
Compare:
(TTWIN and TTWOID)
If ( TTWOID faster than TTWIN)
Transmit the data.
Else
Convey to next way.
Then
Compare PS and DS
If(PS = = DS)
Transmit the data.
Else
Apply fragmentation .

**Fragmentation Processes**:

If (packet size > Data size)
{
Determine Available Size(AS)
Get Next Packet Data(NPS)
If(AS==NPS)
{
$\sum Sn(A) U \sum Sn(B)$
} else
CV = NPS mod AS
Then:
$\sum Sn(A) U \sum Sn(B)$

**Steps for data fragmentation**




**Evaluation Processes**

Sensing Physical Layer Protocol

Inputs: Sequential uncompress Data.

Sensing data collection protocol

Data sequence, node1,node2, node3,….node n. Data sequence(node1(data),

Node2 (data),node3(data)…. Node n(data)).

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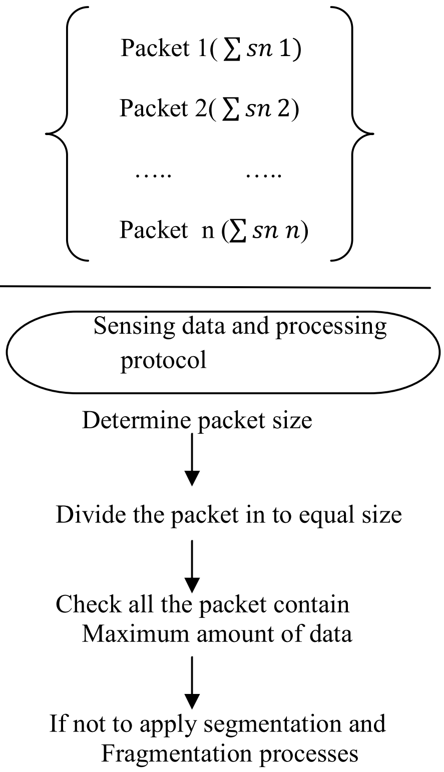


## 10. ADVANTAGES OF FRAGMENTATION AND SEGMENTATION

- Transmission is Reliable
- processing speed is Increase
- processing time is Decrease
- Energy Efficient.
- The number of sleep node is Reduced.
- Accelerated data Transmission.
- Improve error Detection and correction.
- Easy data access.

## 11. PERFORMANCE AND MEASUREMENT:

The compression performance can be measured
Using the following parameters.

i. Compression ratio
ii. Compression factor
iii. Compression time.

$$\text{Compression Ratio} = \frac{CompressedFileSize}{OriginalFileSize}$$

$$\text{Compression Factor} = \frac{Original\ File\ Size}{Compressd\ File\ Size}$$

Compression Time = the time taken by the algorithm to compress file.

*Table 1. Compression Ratio And Compression Time For SDC*

| Original File | | SDC(Sequential Coded Data Compression Techniques) | | |
|---|---|---|---|---|
| S.No | File Size | Compressed File Size | Compression Ratio | Compression Time(ms) |
| 1 | 45060 | 24036 | 1.8746 | 195 |
| 2 | 587426 | 365841 | 1.60568 | 380 |
| 3 | 5,692 | 3521 | 1.6165 | 75 |
| 4 | 3,69,852 | 2,54,781 | 1.451 | 310 |

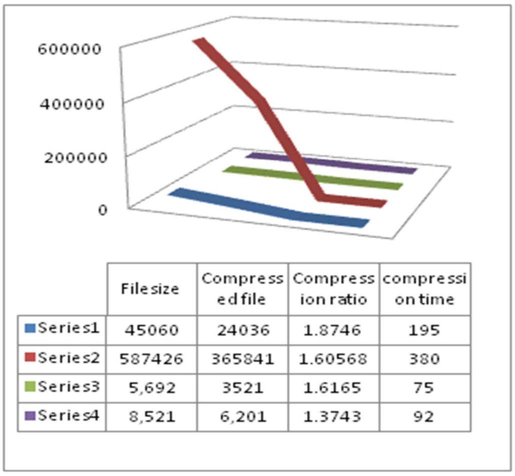


*Fig.1 Compression Ratio And Compression Time For SDC*

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*Table 2. Compression Ratio And Compression Time For PLDC*

| Original File | | PLDC(Packet Level Data Compression Techniques) | | |
|---|---|---|---|---|
| S..No | File Size | Compressed File Size | Compression Ratio | Compression Time(ms) |
| 1 | 45060 | 23,300 | 1.93390 | 194 |
| 2 | 587426 | 315921 | 1.85940 | 376 |
| 3 | 5,692 | 3060 | 1.86013 | 75 |
| 4 | 3,69,852 | 225891 | 1.63730 | 308 |

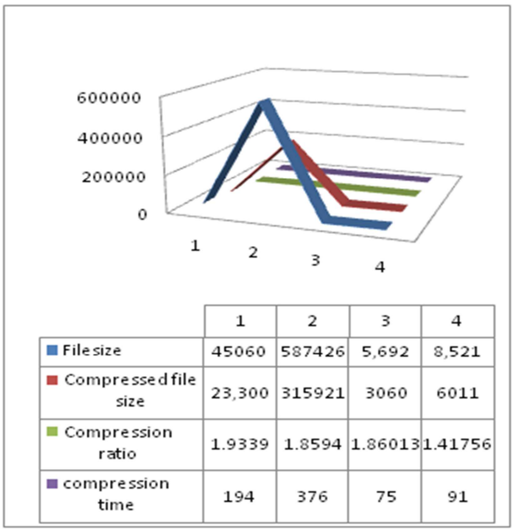


*Fig.2 Compression Ratio And Compression Time For PLDC*

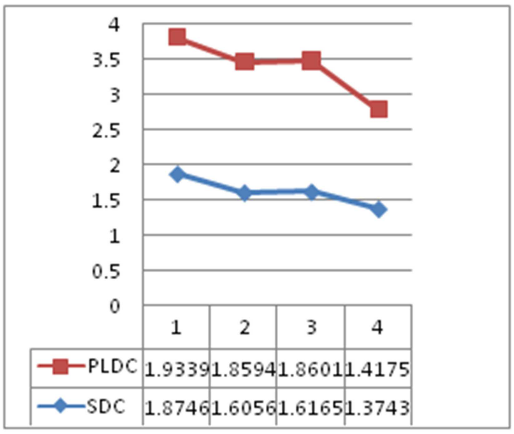


*Fig.3 Comparison Of Compression Ratio For PLDC And SDC*

## 12. CONCLUTION

This paper to propose Packet level data compression algorithm. Using this algorithm a better compression ratio has been achieved when compared to the previously proposed algorithm[3]. This paper also discusses various standard compression Algorithms. (Delta encoding, Huffman coding, Run length encoding and Arithmetic coding).

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