PRINCIPAL COMPONENT ANALYSIS BASED COMPRESSED DATA SENSING FOR WSN

[1] Mrs.P.A.Mathina
Assistant Professor
Department of ECE,
PSR Engineering College, Sivakasi, India

Abstract : Sensor nodes need to collect data periodically and transmit them to the data sink through multi-hops. The clustering method generally has better traffic load balancing than the tree data gathering method. Data compression, based on compressive sensing (CS) theory, is the best form of data aggregation, which has recently been receiving focal attention owing to its ability to reduce global communication cost without incurring intensive computation or transmission overhead. In the Proposed method, the nodes close to the leaf nodes transmit the original data using CS method. Principal Component Analysis (PCA) technique is used for dimensionality reduction and data classification. PCA is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly correlated variables.

Keyword: **PCA (**Principal Component Analysis) ,CS (compressive sensing) ,Sensor, Multi-hop

I. INTRODUCTION

Wireless sensor network are typically made up of small, inexpensive and unreliable nodes, each equipped with a set of sensors and a wireless communication interface. In many sensor network application, such as environmental monitoring, health monitoring, critical infrastructure, traffic, structural, among others. Sensor nodes need to collect the data periodically and transmit them to the data sink through multi-hops. Two major challenges in WSN are global communication, cost reduction and energy consumption. The gathering of data using energy limited sensor is more efficient. For that, it many receive little data further, there is no maintenance is needed. Data aggregation is the process of summarize the data collected by the sensor avoiding expensive transmission of all sensed data by computing statistical metrics (e.g., average and sum etc).

As newly developed signal processing technique is compressed sensing (CS). It helps to deliver a full recovery of signals with high probability from their original dimension. Data compression based on compressive sensing theory is another form of data aggregation. Existing work used decentralized approach for constructing the forwarding trees and each node makes a decision in routing process locally projections are gathered by forwarding trees one tree for each projection. Projection based compressed data gathering method collects one weighted sum from interested nodes only. So, the number of links can be minimized. In compressive data gathering, the routing trees are constructed its used for distributes the energy load throughout the overall network and also reduce the overall energy consumption. This simulation result provides the increase the lifetime of sensor networks. In this method the destination on sink has to receive the weighted sum of all sensor readings. Each sensor multiplies its reading with random coefficient and sends to next sensor node.

In this paper we use PCA algorithm to reduce the number of data. PCA is statistical procedure that uses an orthogonal transformation convert a set of observation of possibly correlated variable into a set of values of linearly uncorrelated variables called Principal Components. The number of Principal Components are less than the number of original value.

II. PROBLEM DESCRIPTION

WSN consists of many numbers of nodes, that are spatially or densely deployed. Each node has many number of datas. These datas are send periodically to the destination. During this transmission the datas which are the same as well as little variance from previous data also be transmitted. This reduces the energy of the network. The Principal Component Analysis (PCA) technique only send few weighted sum of all readings rather than sending all readings. This technique will be reducing the number of transmissions.

III. COMPRESSIVE SENSING

At first, large efforts are made to acquire the full signal and then most of the information is thrown away when compressing it. One may ask whether it is possible to obtain more directly a compressed version of the signal by taking only a small amount of linear and non-adaptive measurements. Since one does not know a priori the large coefficients, this seems a daunting task at first sight-t. Quite surprisingly, compressive sensing nevertheless predicts that reconstruction from vastly under sampled non-adaptive measurements is possible even by using efficient recovery algorithms. Taking m linear measurements of a signal $x \in CN$ corresponds to applying a matrix $A \in C\ m\times N$ the measurement matrix $y = Ax$. The vector $y \in Cm$ is called the measurement vector. The main interest is in the vastly under sampled case $m \ll N$. Without further information, it is, of course, impossible to recover x from y since the linear system is highly underdetermined, and has therefore infinitely many solutions. However, if the additional assumption that the vector x is k-sparse is imposed, then the situation dramatically changes as will be outlined. The approach for a recovery procedure that probably comes first to mind is to search for the sparsest vector x which is consistent with the measurement vector y = Ax. This leads to solving the ℓ_0-miminization problem min kzk0 subject to Az = y. Unfortunately, this combinatorial minimization problem is NP–hard in general. In other words, an algorithm that solves for any matrix A and any right hand side y is necessarily computationally intractable. Therefore, essentially two practical and tractable alternatives to have been proposed in the literature: convex relaxation leading to ℓ_1 -minimization also called basis pursuit and greedy algorithms, such as various matching pursuits. Quite surprisingly for both types of approaches various recovery results are available, which provide conditions on the matrix A and on the sparsity kxk0 such that the recovered solution coincides with the original x, and consequently also with the solution of (3.4). This is no contradiction to the NP–hardness of since these results apply only to a subclass of matrices A and right-hand sides y. The ℓ_1-minimization approach considers the solution of min kzk1 subject to Az = y, which is a convex optimization problem and can be seen as a convex relaxation of Various efficient convex optimization techniques apply for its solution. In the real-valued case, is equivalent to a linear program and in the complex-valued case it is equivalent to a second order cone program. Therefore standard software applies for its solution.

IV. PRINCIPAL COMPONENT ANALYSIS

A Principal Component Analysis models the variation in a set of variables in terms of a small number of independent linear combinations of those variables. Using PCA reduces the dimensionality of set of data. Principal Component is a way to picture the structure of the data as few variable as possible optimally describes variance in a single data system.

For n original variables n principal components are forms as follows: The first Principal component is the linear combination of standardized original variables that has the greatest possible variance. Each subsequent principal component is the linear combination of the variables that has the greatest possible variance and its uncorrelated with all previously defined components.

Each principal component is calculated by taking a linear combination of an eigenvector of the correlation matrix with a variable.PCA is related to canonical correlation analysis (CCA). CCA defines coordinates systems that optimally describe the cross covariance between two dataset while PCA defines a new orthogonal coordinate system that optimally describes variance in a single dataset.

V. NETWORK MODEL

In our work, we measure environment temperature and moisture. These temperature and moisture measurements are done by LM35 sensor and electrodes respectively. After the measurement the sampling selection process to be done. Sampling means selecting a subset of whole population. In other words sampling methods selects only important datas from whole population. The main aim of this is reduce the energy consumption.

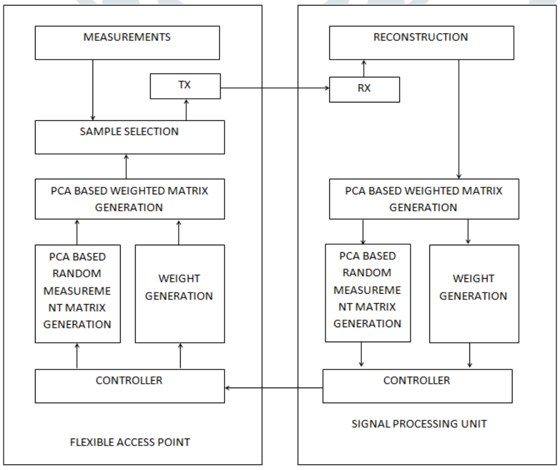

fig1: block diagram for pca based compressive sensing

In our work need to select datas which has large variation from previous or next coming datas. Then weight is generated for selecting datas. The weight is denoted by w (w0, w1…………wn). Weighted matrix is generated from the collected weights. The weighted matrix is defined as

W (u, v) =w (e) e= (u, v) ∈ E

0 otherwise

Then this datas are transmitted through wireless medium. In the receiver we recover the original datas.

VI. RESULT

The compressed datas from the original (or) actual datas are shown in the following figure.

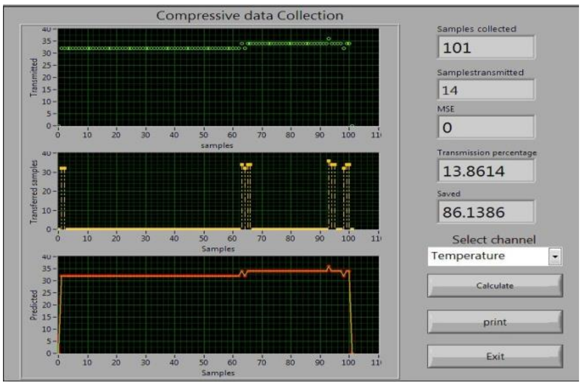

fig 2: result for temperature measurement

From this graph totally 14 number of compressed datas are got from 101 samples.

Fig 3 shows the resulting graph of solar readings. It takes 87 readings from 100 samples.

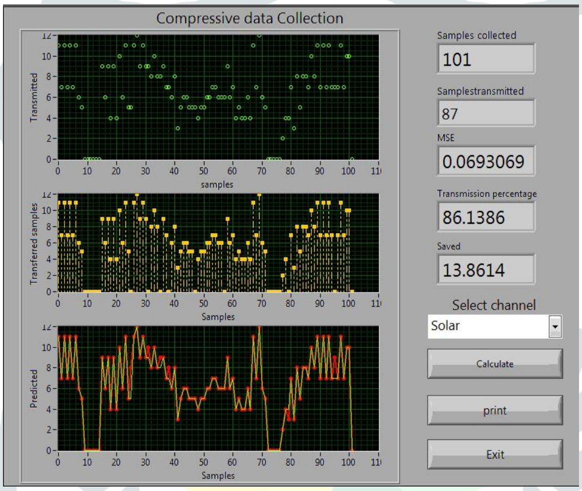

fig 3: result for readings from solar panel

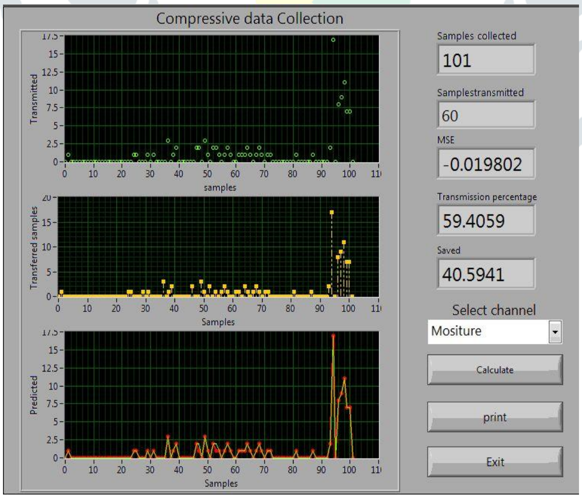

fig 4: result for moisture measurement

Moisture measurement takes 60 compressed datas from 100 samples.

VII. CONCLUSION

In the proposed work, we use compressive sensing method with Principal Component Analysis to reduce the number of transmissions. It is used to reduce energy consumption. It is also helps to deliver a full recovery of signals with high probability from their original dimension. Using principal component analysis reduce the dimensionality of set of data and reduce the original number of data without any changing the information.

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