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Aims and Scope

Global Journal of Networks and Applications welcomes research contributions, surveys and notes in all areas relating to computer networks and applications thereof. The following list of sample-topics is by no means to be understood as restricting contributions to the topics mentioned:

- New design techniques, interesting or novel applications, components or standards.
- Interface issues including special consideration for handicapped persons.
- Computer graphics, 3-D modeling and virtual reality multi-and hypermedia including electronic publishing and digital libraries.
- Computer networks with tools such as WWW or Hyper wave.
- Emerging standards for internet presentation levels (such as XML) and Internet protocol level, new compression standards for still pictures, movies, audio and vector data, 3-D data and cartographic data.
- Work on metadata and its applications.
- Applications of networked and stand-alone multimedia systems to computer assisted presentations.
- Applications of an educational, transactional and co-operational nature.
- Gateways between databases and security, privacy and societal aspects of network and computer technology.

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Contents

Service Support in Network Management

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ABSTRACT

This paper discusses about the Operational Support Systems (OSS) and the service management component in it .OSS and its functionalities are viewed with the insight on services. Services are changes in the network elements' state in order to support efficient and reliable flow of data. As the technologies in networking is increasing and improving day by day, service management gains interest. This calls for service management to exist as an independent entity. The pillars behind any service management are elaborated here. Need, importance and integration among services is depicted by providing a comprehensive and complete service support framework as a solution.

Keywords: Operational Support Systems, Service provisioning, Service assurance, Network Management

1. INTRODUCTION

Operational support systems (OSS) refer to a comprehensive solution for Telecom providers which involve inventory management, service provisioning, billing and repair functions. It can be termed as a software which performs network management and service support. “Services” can be termed as an action which causes creation, deletion or modification of the configuration in the network elements in order to enable the flow of data to the specified network in the specified manner. Considering those network management systems which need only partial OSS operations have no choice apart from using OSS completely. Service Management is one such area. Even tough there are many applications which provide service support they are essentially a part of OSS. Also, there is still high complexity in ensuring that the services can be scalable to meet the technological demands and yet be cost- efficient [1]. Further, only service support can be provided by existing management systems as an add-on tool .Complete solution for services is discussed below.

In the 1960s the majority of the administration processes were manual. After the computer revolution, the concept of automation and managing all information within an enterprise started growing. It took many years for telecommunications companies to create a variety of applications which automated operations to a large extent.

These applications merged into larger systems which were then designated as OSS systems. OSS is a system which supports processes such as network inventory maintenance, services management, configuring network components, and deals with faults. OSS architecture forms the main coreof t h e forth layer (Service Management Layer) of the TMN (Telecommunication Network Model).OSS is the architecture which helps the service provider monitor, control and operate a network. The main functionalities of OSS can be grouped as [2]

1.1 NETWORK PLANNING AND ENGINEERING

This deals with forecasting the need and dimensioning the network based on the forecasts. It takes into consideration various access technologies and chooses the best which takes into consideration all economic and geographic factors.

1.2 BILLING SYSTEMS

This deals with providing a flexible billing system so that the customer can choose his plan. It also pays attention in pricing and giving post-paid and pre-paid billing services to its customers. Depending on the motive and profit goal, infrastructure providers, network managers and service provisioning entities can structure their prices.

1.3 AUTOMATION ASSISTANCE

Larger telecom networks are being automated and this is essentially possible through OSS. As the technology is growing, the customer requirements push the service providers to put in more value and diversity in their services [3]. Automation would aid in making the product time-efficient and cost-efficient. Thus human intervention is necessary only in case of exceptional scenarios.

1.4 SERVICES

Connecting customers from one end to another by the flow of data traffic across the network is a service. OSS extends the Network management system features by the configuration, provisioning, activating and deployment of service to the respective managed networks.

2. RESEARCH GAP

Many network management systems are leading due to their high performance. In such era, for a product to be competitive -performance, efficiency, scalability and diversity are needed. But integrating all features and components of OSS may be unnecessary when the service provider is looking at the partial integration with OSS. Business investment is also a consideration [4].

Existing scenario	Gap	Proposed scenario
Operations of OSS are all implemented as a part of OSS architecture.	No partial implementation of OSS process or operation	Service support and management as a complete solution for Telecom service providers.
No service support which does not have dependency on OSS	Service support solutions which can be used by existing and upcoming products without being a part of OSS	An intermediary and independent service support solution between network management systems and OSS.
Service management as a part of OSS	Service support as an individual component	Service Integration Framework(SIF)

Table 1: Need for independent and complete service support

3. SERVICE SUPPORT

Service Management deals with end to end connectivity of customers by the flow of data through various networks. Identifying the heterogeneous networks, configuring network elements, invoking the operations are all part of service management. Service management also deals with the ability of the product for being scalable, interoperable and reliable.

3.1 SERVICE PROVISIONING

This is intermediary between service and configuration management .Provisioning a service deals with sending requests or commands to the network to deploy the required functionality. This is performed by the process of activation. Activation targets the network elements involved in the request to provide a service it is basically is responsible for order processing and activation or de-activation of customer services.

Service Provisioning involves input from these sources – documents, repositories and the customers. Service Provisioning and activation becomes very important as this module also provides automated support [5] for reporting of all service transactions.

This area is responsible for vendor specific and multi-vendor support. It enables the service providers to customize their product to the new technologies. Service provisioning hence provides a platform to add new customers, automation of specified tasks, enhances the network management functionality. It establishes a foundation to integrate the business decisions and service support.

Today supporting new services while preserving its integrity is of at most priority. Thus, in completing the service management, service provisioning plays a very crucial role.

3.2 SERVICE ASSURANCE

It is the application of procedures and software to ensure the services are of predefined quality. The quality of service mentioned in SLA should be met [6]. The two major key components addressed here are performance and quality. It is the quality of service which generates revenue to the product and any disruption in the communication service may impact the entire company. It is intended to make certain that a service under development meets specified requirements at all stages in the process.

Performances deals with optimizing the process of providing service and also extract details about the end user experiences. This attribute maps the performance data with business decisions. This module deals with detection, isolation and correction of any faults or errors encountered during service provisioning.

The service assurance software is thus expected to be in place before any new service is introduced to the customer. Also, this software should work perfectly before the fault hits the customer domain. Assurances can also be given by a third party system [7].

The increasing demands of customers are creating a heavy push on the service providers to provide service solutions which are scalable, reliable and efficient. Thus, assuring that the service is guaranteed and ensuring its reliability and standards meet the prescribed set of demands makes it a vital component in service management.

4. SERVICE FULFILMENT

This deals with delivering the service to the end customer. It consists of chain of activities which are involved in delivering the service at the user end and customer satisfaction. The key components involved are multi-enterprise support, service design and automation, end to end support.

The pressures upon the service providers to generate new revenues and increase profits rapidly while keeping the overall cost low are increasing. A commercial platform that can be easily customized

provides the best possible alternative. Such a platform that automates the service delivery process should be built on a multi-tier, component and web-based architecture that supports n- deployment scenarios. Service fulfilment software mainly concentrates on reducing the delivery time and increasing the profit margin for upcoming services with minimal hardware [8].

This software platform must also support a complete catalog of communications products and services, to assist service providers to immediately create and provision new services and unique offerings to the customers.

Service fulfilment thus changes the focus from network operations to customer experience and feedback.

5. SERVICE INTEGRATION FRAMEWORK (SIF)

Providing services for widely distributed networks is complex and requires different service providers to interact with each other. The process of providing interoperability among different providers is necessary and combining the three pillars of service support is called integration. In order to support end to end service management, the three pillars - service provisioning, service assurance and service fulfillment must be satisfied. Also it should provide interface to connect to the OSS and other NMS.

SIF provides an independent platform which can be used by those service providers who want to support only service management. It also targets those service providers who as external vendors provide complete service solutions to the network management vendors. The three pillars coexist and the provider implements the main features in all the three modules in parallel thus assisting in efficient, reliable and timely delivery of service to the customers.

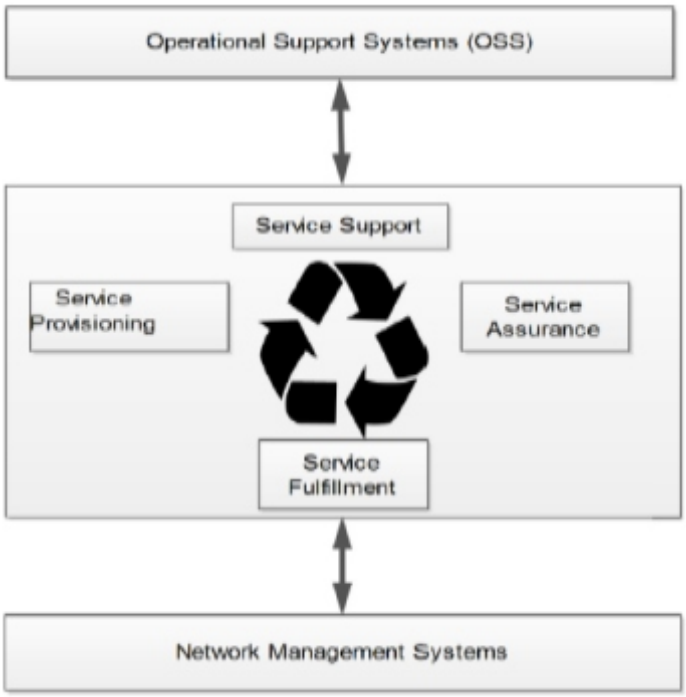

Fig1: Conceptual view of Service Integration Framework (SIF) for comprehensive service support.

5.1 OVERVIEW OF STEPS FOR IMPLEMENTING SIF

Step 1: The service provider would make SLA with the customer.

Step 2: The provider identifies the technologies, networks and services needed.

Step 3: The provider enables the configuration, activation and provisioning of services.

Step 4: Quality of service and fault management and repair handling modules are developed.

Step 5: Delivery of end-to-end service and customer satisfaction is kept in mind and feedback modules are developed.

5.2 ADVANTAGES OF SIF

- Any product can enhance its efficiency and vi sibility by using the service support solution.
- SIF is feasible as it can be integrated into existing product as an add on tool morerged into an upcoming product.
- This SIF provi des the interfaces to interact with BSS (Business Support Systems).
- Thus it associates a management system with service solution and also gives a revenue domain
- extension.

6. CONCLUSION

The OSS and service support component of it is considered here and the three pillars for service support have been mentioned. Integrating these pillars formulate a complete comprehensive service solution for any management product.

This is specifically important when only service management functionalities of the OSS have to be extracted and introduced to another product. Also considering the cost efficiency, unnecessary implementation of entire OSS would turn heavy on service support. Customized, feedback oriented, scalable service support can be provided using an integrated service support solution. This framework thus associates the revenue and technology support.

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Computing the Significance of an Independent Variable using Rough Set Theory and Neural Network

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ABSTRACT

Artificial Neural Network (ANN) and Rough Set Theory (RST) has evolved as a new decision making tool and has been widely applied to a variety of application problem involving classification. ANN and RST are both data mining tool. Neural network can be used to extract knowledge from trained neural networks so that the users can gain a better understanding of the solution, whereas rough set theory can be used to extract knowledge from the information system. The knowledge from the neural network and rough set theory can be represented in the form of rules. The RST and ANN can be used as a tool for reducing and choosing the most relevant sets of attributes from the data set.. In this paper we find the most significant attributes using the rough set theory and neural network and our finding leads to the conclusion that both these methodologies has the same result for a particular dataset.

Keywords: Artificial Neural Network; Rough set ; Decision Table ; Significant attribute; Reduct ; Core ; Decision making tool; independent Variable.

1. INTRODUCTION

Z. Pawlak[11] proposed that rough set theory is a comparatively new mathematical instrument to deal with vague and uncertain information. With the development of artificial intelligence and cognitive sciences rough set theory can be used to discover dependency among the attributes, attribute reduction, finding the most significant attribute of information system, generating rules etc[11-12]. On the other hand neural network is a kind of network system that simulates the human brain information processing system. However the processing that takes place in human brain is far more complex. As the artificial neural network now a days becomes a powerful tool to solve problem, because of its strong fault tolerance, self-organization, massively parallel processing, self-adapted and so on, which plays an important in breaking bottleneck of science and technology and exploring the complex phenomenon of nonlinear statistical modeling[4,6].

The neural network and rough sets methodologies have their place among intelligent classification and decision support systems. Both these techniques can be used for finding the significance of the attributes of a dataset but they have their own advantages and disadvantages. The rough set is a powerful tool to process uncertain or high-dimensional data, but it to sensitive to noise and it generates too many rules. This technique also help us to find the relationship among the independent and dependent variable and degree of dependency among the two variables. Whereas neural network has good robustness and self-learning, ability to detect complex nonlinear relationships between dependent and independent variables but for massive data it cannot get good effect, it require massive time frequency. Neural networks often predict with higher accuracy than other techniques because of the networks' capability to fit any continuous functions [2,7,8]. One major drawback often associated with neural networks is their lack of explanation power. It is difficult to explain how the networks arrive at

their solutions due to the complex nonlinear mapping of the input data by the networks. The outstanding feature of RST is its simplicity that makes this approach more superior.

2. ARTIFICIAL NEURAL NETWORK

Artificial neural networks are massively parallel adaptive network of simple nonlinear computing elements called neurons which are intended to abstract and model some of the functionality of the human nervous system in an attempt to partially capture some of its computational strengths[1]. A neural network is a massively parallel distributed processor that has a natural propensity for storing exponential knowledge and making it available for use. It resembles the brain in two respects:

a) Knowledge is acquired by the network through a learning process.

b) Interneuron connection strengths known as synaptic weights are used to store the knowledge[3].

2.1 Architecture of Neural Network

In neural network artificial neurons connects in fundamentally two different architectures, Feed forward and Feedback. In Feed forward network the output depends only on the presently applied input. These networks are static in nature. The basic architecture consists of three types of neuron layers: input, hidden, and output. In feed-forward networks, the signal flows from input to output units, strictly in a feed-forward direction. The data processing can extend over multiple layers of units, but no feedback connections are present[5]. For feed- forward networks, the dynamical properties of the network are important. In the feed back network , the signal flows from output units back to the input units.

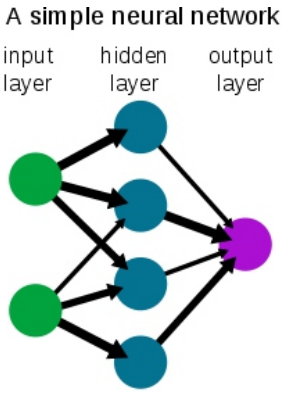

Fig 1 Feed Forward Artificial Neural Network

2.2 Applying Neural Network to Monk's Dataset

The Monk's problem rely on the artificial robot domain, in which robots are described by six different attributes. The data sets were provided by UCI Repository of machine learning databases (http://archive.ics.uci.edu/ml/). This dataset is suitable for finding the significance of attribute using Neural Network and Rough Set theory.

For Monk's dataset we have following attributes

Definition of attributes

Variable	Definition
A1	Head_ Shape
A2	Body_Shape
A3	Is_Smiling
A4	Holding
A5	Jacket_Colour
A6	Has_Tie

The learning task is a binary classification task. Each problem is given by a logical description of class. Robot either belong to the class or not. Total of 432 robots are given for classification task. The Artificial Neural Network analysis is done using SPSS 17 in the Window 2000 environment.

Table 1 Case Processing Summary

		N	Percent
Sample	Training	312	72.20%
	Testing	120	27.80%
Valid		432	100.00%
Excluded		0	
Total		432	

The case processing summary shows that 312 cases were assigned to the training sample and 120 to the testing sample. Total number of robots are 432.

Table 2 Network Information

Table 2 Network Information			
Input Layer	**Factors**	**1**	**Head Shape**
		2	Body Shape
		3	Is Smiling
		4	Holding
		5	Jacket Colour
		6	Has Tie
		Number of Units[a]	17
Hidden Layer(s)		Number of Hidden Layers	1
		Number of Units in Hidden Layer 1[a]	5
		Activation Function	Hyperbolic tangent
Output Layer	Dependent Variables	1	D
	Number of Units		2
	Activation Function		Softmax
	Error Function		Cross-entropy

Table 2 Network Information

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		Activation Function	Hyperbolic tangent
Output Layer	Dependent Variables	1	D
	Number of Units		2
	Activation Function		Softmax
	Error Function		Cross-entropy

The network information table displays information about the neural network and is useful for ensuring that the specifications are correct. In this table The input layer contains the predictors.

The hidden layer contains unobservable nodes, or units. The value of each hidden unit is some function of the predictors, the exact form of the function depends in part upon the network type and in part upon user-controllable specifications.

The output layer contains the responses. Each output unit is some function of the hidden units.

Table3 Classification Table with dependent variable D

		Predicted		
Sample	**Observed**	**0**	**1**	**Percent Correct**
Training	0	141	0	100.00%
	1	0	171	100.00%
	Overall Percent	45.20%	54.80%	100.00%
Testing	0	63	0	100.00%
	1	0	57	100.00%
	Overall Percent	52.50%	47.50%	100.00%

The classification table i.e table3 shows the practical results of using the network. For each case, the predicted response is Yes if that cases predicted pseudo-probability is greater than 0.5. For each sample:

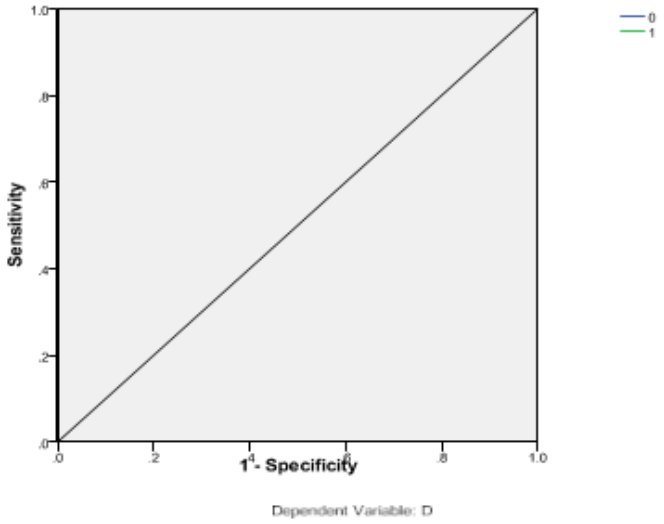
1 Cells on the diagonal of the cross-classification of cases are correct predictions.

2 Cells off the diagonal of the cross-classification of cases are incorrect predictions.

Overall, 100% of the training cases are classified correctly. Here 100% of the cases were correctly classified by the model. This suggests that, overall, our model is in fact a perfect model.

2.3 ROC curve

Graph1 displays an ROC (Receiver Operating Characteristic) curve for each categorical dependent variable. It also displays table4 giving the area under each curve. For a given dependent variable, the ROC chart displays one curve for each category. Since our dependent variable has two categories, then each curve treats the category at issue as the positive state versus the other category. The ROC curve gives you a visual display of the sensitivity and specificity for all possible cutoffs in a single plot, which is much cleaner and more powerful than a series of tables. The chart shown here displays two curves, one for the category No and one for the category Yes. This chart is based on the combined training and testing samples. The area under the curve is a numerical summary of the ROC curve, and the values in the table4 represent, for each category, the probability that the predicted pseudo-probability of being in that category is higher for a randomly chosen case in that category than for a randomly chosen case not in that category. For example, for a randomly selected robot that belong to the class and randomly selected robots that does not belong to the class, there is a 100% probability that the model-predicted pseudo-probability of robot belonging to the class and robots that does not belong to the class will be the same. While the area under the curve is a useful one-statistic summary of the accuracy of the network, you need to be able to choose a specific criterion by which robots are classified.



Graph 1

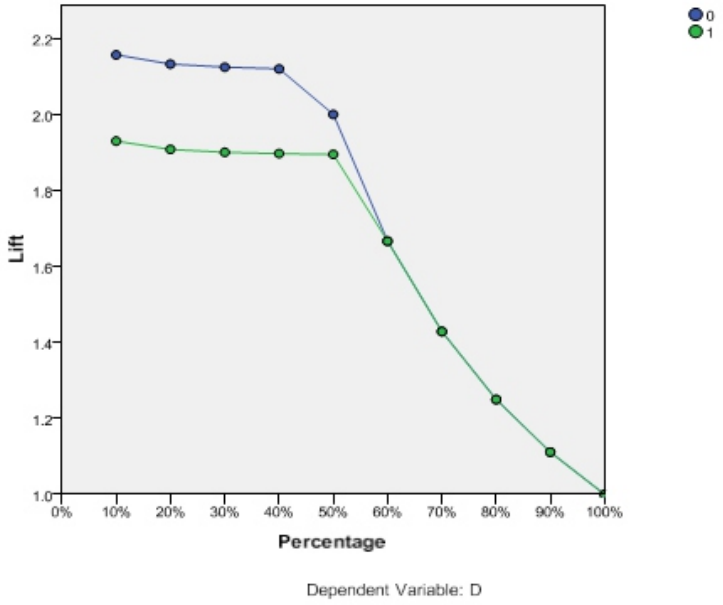
Area Under the Curve

Table 4

		Area
D	0	1
	1	1

2.4 Lift chart

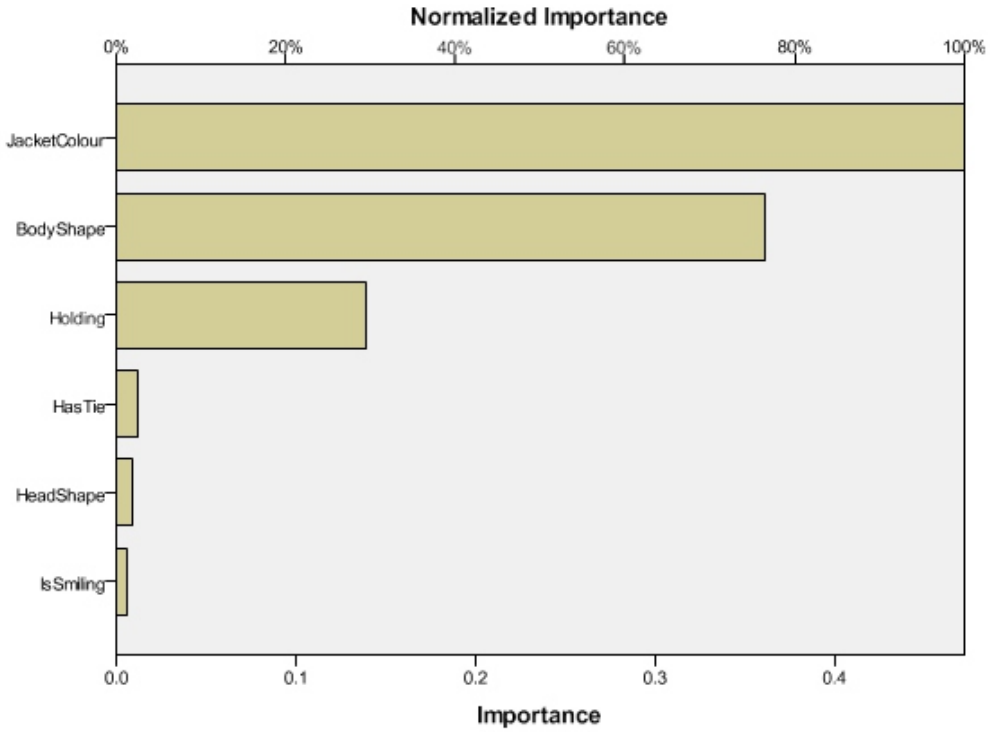
Graph 2 displays a lift chart for each categorical dependent variable. The display of one curve for each dependent variable category is the same as for ROC curves. The lift chart is derived from the cumulative gains chart; the values on the y axis correspond to the ratio of the cumulative gain for each curve to the baseline. Thus, the lift at 10% for the category Yes is 1.90%/10% = 1.9.



Graph 2

2.5 Independent Variable Importance Analysis

This analysis performs a sensitivity analysis, which computes the importance of each predictor in determining the neural network. The analysis is based on the combined training and testing samples or only on the training sample if there is no testing sample. This creates table5 and a graph3 displaying importance and normalized importance for each predictor. Note that sensitivity analysis is computationally expensive and time-consuming if there are large numbers of predictors or cases. The importance of an independent variable is a measure of how much the network's model-predicted value changes for different values of the independent variable. Normalized importance is simply the importance values divided by the largest importance values and expressed as percentages.



Graph 3

Table5 Independent Variable Importance

	Importance	Normalized Importance
Head Shape	0.009	1.90%
Body Shape	0.362	76.60%
Is Smiling	0.006	1.30%
Holding	0.139	29.40%
Jacket Colour	0.473	100.00%
Has Tie	0.012	2.40%

Table 5 shows that we have only three significant attribute that is Jacket Colour, Body shape and holding.

3. ROUGH SET THEORY

Rough set theory proposed by Z. Pawlak[10] is a new technique of decision making in the presence of vagueness and uncertainty. Rough set concept can be defined quite generally by means of topological operations, interior and closure, called approximations. Rough set data analysis is used in many applications such as process control, economics, medical diagnosis, biochemistry, environmental science, biology, chemistry psychology, conflict analysis and other fields can be found in [13-15].

The rough set philosophy is founded on the assumption that with every object of the universe of discourse we associate some information (data, knowledge). The starting point of rough set theory is the indiscernibility relation, generated by information about objects of interest. Objects characterized by the same information are indiscernible (similar) in view of the available information about them. The indiscernibility relation generated in this way is the mathematical basis of rough set theory [9]. Any set of all indiscernible (similar) objects is called an elementary set and forms a basic granule of knowledge about the universe. The basic assumption of rough set theory as put forth by Pawlak is that human knowledge about a universe depends upon their capability to classify its objects. Equivalence relation is used to define the rough set[11]. Every vague concepts, in contrast to precise concepts, cannot be characterized in terms of information about their elements. Therefore any vague concept is characterized by pair of precise concepts, called the lower and upper approximations of the set, represents a rough set. The lower approximation of a rough set comprises of those elements of the universe, which surely belong to the set with the available knowledge. The upper approximation on the other hand comprises of those elements, which are possibly in the set. The difference between the upper and the lower approximation constitute the boundary region of the vague concept. Boundary region will consist of those objects which we cannot decisively classify into the set [12]. The concept of rough sets was primarily concerned with the study of intelligent systems characterized by insufficient and incomplete information [22].

The basic concept of rough set theory is to deal with the information table or decision table. Every decision table has two set of attributes. One is called the condition attributes and other is called the decision attributes. Basic problems which can be solved using the rough set approach are the following[16-17]:

1) description of objects in terms of attribute values.
2) dependencies (full or partial) between attributes.
3) reduction of attributes.
4) significance of attributes.
5) decision rules generation

Now, we define rough set mathematically.

Let a finite set of objects U and a binary relation $R \subseteq U \times U$ be given. The sets U, R are called the universe and an indiscernibility relation, respectively. The discernibility relation represents our lack of knowledge about elements of U. For simplicity, we assume that R is an equivalence relation. A pair (U, R) is called an approximation space, where U is the universe and R is an equivalence relation on U. Let X be a subset of U, i.e. $X \subseteq U$. Our goal is to characterize the set X with respect to R [19].

• The set of all objects which can be with certainty classified as members of X with respect to R is called the R-lower approximation of a set X with respect to R, and denoted by $R(X) = \{x \in U : R(x) \subseteq X\}$

• The set of all objects which can be only classified as possible members of X with respect to R is called the R-upper approximation of a set X with respect to R, and denoted by $R(X) = \{x \in U : R(x) \cap X \neq \phi\}$

• The set of all objects which can be decisively classified neither as members of X nor as members of - X with respect to R is called the boundary region of a set X with respect to R, and denoted by RN (X) R , i.e. $RN(X)R = R(X) - R(X)$

• A set X is called crisp (exact) with respect to R if and only if the boundary region of X is empty.

• A set X is called rough (inexact) with respect to R if and only if the boundary region of X is nonempty.

3.1 Information System or Decision Table

The dataset in case of rough set theory is always define in the form of table that is known as information system. An information system or Decision Table can be viewed as a table, consisting of objects(rows) and attributes (column).The attribute set consist of condition and decision attribute. Condition attributes are independent variable and decision attribute is a dependent variable [10]. In our decision table we have six condition attributes i.e Head shape, Body shape, Jacket colour, Holding, Has tie, is Smiling and one decision attribute(Class attribute).

Now we apply rough set theory to Monk's dataset using ROSE 2 Software which was created at the Laboratory of Intelligent Decision Support systems of the Institute of Computing Science in Poznan [14].

We find the Lower and Upper Approximation of Monk's dataset as follows:

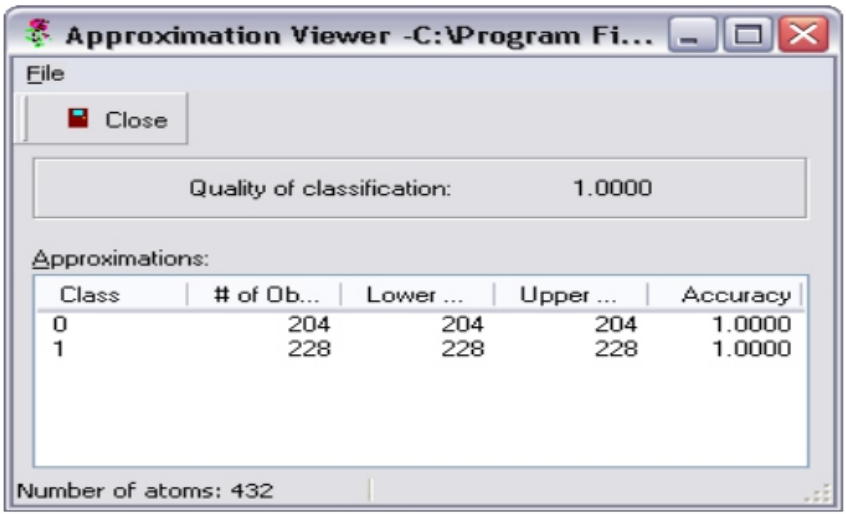


Fig 1

Class	# of objects	Lower Approximation	Upper Approximation	Accuracy
0	204	204	204	1
1	228	228	228	1

3.2 Dependency of Attributes

Important issue in rough set data analysis is discovering dependencies between condition and decision attributes. Intuitively, a set of attributes D depends totally on a set of attributes C, denoted $C \Rightarrow D$, if all values of attributes from D are uniquely determined by values of attributes from C. In other words, D depends totally on C, if there exists a functional dependency between values of D and C. Formally dependency can be defined in the following way. Let D and C be subsets of A. We will say that D depends on C in a degree k ($0 \leq k \leq 1$), denoted $C \Rightarrow kD$, if $k = \gamma(C, D)$.

If $k = 1$ we say that D depends totally on C, and if $k < 1$, we say that D depends partially (in a degree k) on C.The coefficient k expresses the ratio of all elements of the universe, which can be properly classified to blocks of the partition U/D, employing attributes C [18].Thus the concept of dependency of attributes is strictly connected with that of consistency of the decision table.

If D depends in degree k, $0 \leq k \leq 1$, on C, then $\gamma(C,D) = |POSc(D)| / |U|$

Where POSc(D), is the positive region of of the partition U/D with respect to C, it is also called as the lower approximation of the set, it is the set of all elements of U that can be uniquely classified to blocks of the partition U/D, by means of C.

In monk's dataset we have 204 elements in lower approximation for class0 and 228 elements in lower approximation of class 1 and the total element in lower approximation is 432 then the dependency coefficient is calculated as

$$\gamma(C,D) = 432/432 = 1$$

Here in this cases if k = 1, we say that D depends totally (in a degree k) on C.

3.3 Reduction of Attributes Reduct and Core

A fundamental problem that arise in rough set theory is weather the whole set of knowledge base is necessary to define some categories available in the knowledge base. Knowledge dependency play an important role in reduction of knowledge. There are two fundamental concepts, a reduct and the core. A reduct of knowledge essentially reduces the knowledge without compromising the knowledge base. From Reduct we can also generate original knowledge base. In short, reduct is essential part of knowledge, if we loose data from reduct we cannot reproduce the original knowledge, whereas the core is the indispensable part of the knowledge [21-22]. .

Now we define a notion of a core of attributes. Let B be a subset of A. The core of B is a set of all indispensable attributes of B. The following is an important property, connecting the notion of the core and reducts

$$\text{Core}(B) = \bigcap \text{Red}(B),$$

where Red(B) is the set off all reducts of B.

Because the core is the intersection of all reducts, it is included in every reduct, i.e., each element of the core belongs to some reduct. Thus, in a sense, the core is the most important subset of attributes, we cannot remove any for of its elements without affecting the classification power of attributes. Finding all the reduct of a dataset is NP hard problem [10]. However, in many applications we do not need to compute all reducts, but only some of them, satisfying specific requirements.

In Monk's dataset we have three attributes in core fig2 and only one reduct fig3. Core1 = Body Shape
Core 2 = Holding
Core 3 = Jacket Colour
Reduct = {Body shape, Holding, Jacket Colour}

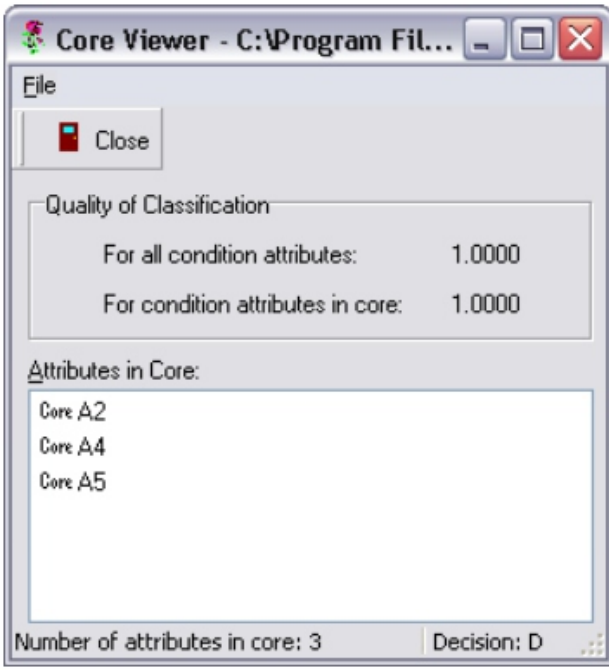


Fig 2

The attributes which are in core are also the most significant attributes and are indispensable. We cannot remove any of the core attribute without affecting the classification task. The attribute which are in core is same as the attribute that we find using the artificial neural network. Both these methodologies find that the attribute A2 i.e Body Shape, A4 that is Holding and A5 that is Jacket Colour are most significant attributes.

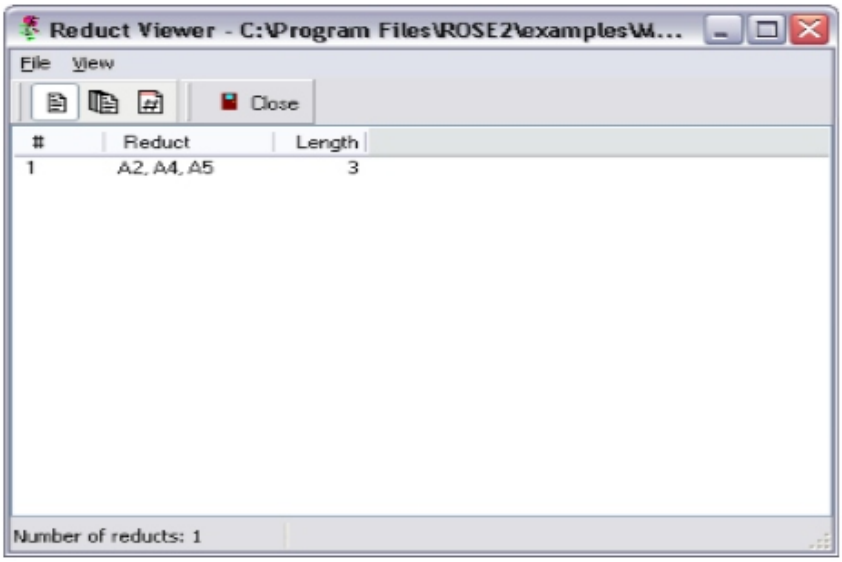


Fig 3

4 CONCLUSION

ANN and RST are relatively new decision making tools used for classification. These techniques have wide range of application in finance, bioinformatics, medicine, economics etc. The central concept in these technique is to find the significance of independent attributes or variables. In this paper we have used both these methodologies for finding the significance of attribute of a dataset. We concluded that the significant attribute found by both these techniques are same.

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Comparision Between Cluster based Energy Efficient Protocol for Wireless Sensor Network

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ABSTRACT

This paper deals with criterion used to measure communication protocol efficiency in Wireless Sensor Networks. As energy is a crucial characteristic of those networks, it is necessary to pay attention both to the energy consumption and to the distribution of energy consumption, when using communication protocols, so as to increase the lifetime of the whole network. Our aim is to present and discuss criterion designed to analyze communication protocol effectiveness. Clustering routing protocol provides an effective method for prolonging the lifetime of a wireless sensor network. But most of the researches care less about the communication between Cluster Head (CH) nodes and Base Station (BS). This paper proposed a Multi-hop Cluster based Routing Protocol comparison for wireless sensor network. In this Paper we compare the cluster based routing protocol LEACH and HEED. Simulation results show that the HEED protocol offers a better performance than LEACH clustering routing protocols in terms of network lifetime and energy consumption.

Keywords: Wireless Sensor Network, LEACH and HEED Protocol Energy Efficient, Multi-hop Clustering. Sensor nodes.

1. INTRODUCTION

Wireless Sensor Networks (WSNs) are formed by hundreds or thousands of nodes that gather information and forward it to base station node. Distinguished from traditional wireless networks, sensor networks are characterized of severe power computation, and memory constraints [1]. As the wireless nodes in a WSN are usually driven by power sources (e.g. batteries) which are irreplaceable, energy resource of sensor networks should be managed wisely to extend the lifetime of sensors. Routing protocol is one of the core technologies in the WSN. Due to its inherent characteristics, routing is full of challenge in WSN [2]. Clustering is a well-know and widely used exploratory data analysis technique, and it is particularly useful for applications that require scalability to hundreds or thousands of nodes [3]. For large-scale networks, node clustering has been proposed for efficient organization of the sensor network topology, and improves the network lifetime. We consider a network of energy-constrained sensors that are deployed over a geographic area for monitoring the environment. Among the sources of energy consumption in a sensor node, wireless data transmission is the most critical. Within a clustering organization, intra-cluster communication can be single hop or multi-hop, as well as inter-cluster communication. Low Energy Adaptive Clustering Hierarchy (LEACH) [4] is the first clustering protocol that was proposed for reducing power consumption. It forms clusters by using a distributed algorithm, each node has a certain probability of becoming a cluster head per round, and the task of being a cluster head is rotated between nodes. A non-CH node determines its cluster by choosing the CH that can be reached with the least communication energy consumption. In the data transmission stage, each cluster head sends an aggregated packet to the base station by single hop. Hybrid Energy-Efficient Distributed (HEED) [5] clustering approach, is one of the most recognized energy-efficient clustering protocols. It extends the basic scheme of LEACH by using residual energy and node degree or density. In HEED, the initial probability for each node to become a tentative cluster head depends on

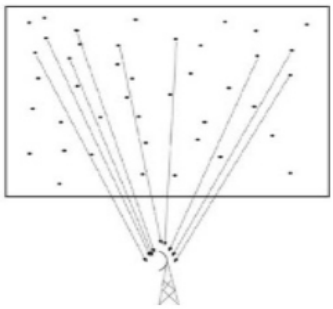
its residual energy, and final heads are selected according to the intra-cluster communication cost. The clustering process is divided into a number of iterations, and terminates within a constant number of iterations. HEED achieves fairly uniform distribution of cluster heads across the network. Although the protocols above reduce energy consumption on forwarding paths to increase energy efficiency.In LEACH and HEED protocols the basic difference is that while find out the cluster node in a network we use the maximum energy at the node. While in HEED protocol we use maximum energy of the node and as well as the minimum distance between the node and the base station. In this way we balance the energy consumption over the network. Many researches dedicate to energy efficient routing of WSNs [7-10], but most of them care less about the communication between Cluster Head (CH) nodes and Base Station (BS). In this paper, we compare the LEACH and HEED Clustering Routing Protocols.

The remainder of this paper is organized as follows. Section 2 introduces a single-hop clustering and multihop routing protocol, Section 3 describes the LEACH and HEEDS protocol. Section 4 contains performance evaluation of our scheme throughout simulations results and section 5 shows the conclusion.

2. CLUSTERING ROUTING PROTOCOLS

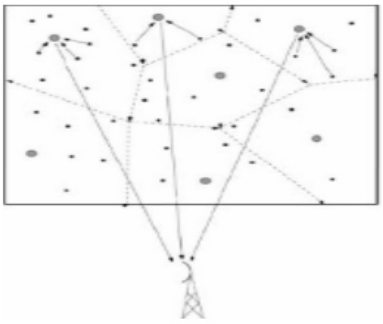
2.1 Single Hop Protocol:

Employ clustering techniques in routing protocols can hierarchically organizing network topology and to increase the lifetime of a wireless sensor network. A single- hop clustering routing protocol can reduce the communication overhead by selecting a CH to forward data to base station via one hop. As shown in Fig. 1 [4], the transmission range will be decreased obviously with clustering. Many single-hops clustering routing protocol have been proposed like LEACH, HEED as discussed.



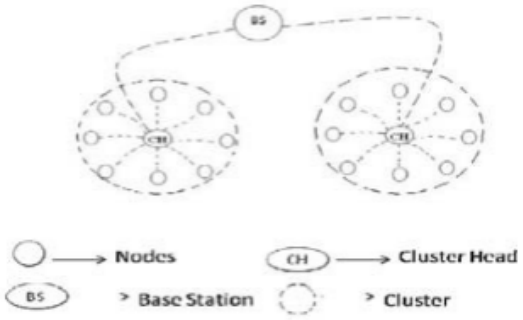
(a) Single hop without clustering

HEED protocol is a distributed single-hop clustering routing protocol for Wireless Sensor Networks, which selecting CHs based on both residual energy of each node and communication cost. It has the advantages in increasing the network lifetime and having a constant algorithm complexity.



(b) Single hop with clustering

Figure 1. Clustering Routing Protocols



In steady state phase, the clusters are formed and the corresponding cluster head is selected. After the cluster head receives the data it can be aggregated and the data can be transmitted to the base station. Research on application-specific protocol architecture for wireless micro Sensor networks by W.B.Heinzelman, proposed a solution that, In LEACH-C [4], during the set-up phase each node sends information about its current location to the sink. In order to determining good clusters, the sink needs to ensure that the energy load is evenly distributed among all the nodes. The sink computes average node energy, and determines which nodes have energy below this average. This solution minimize the amount of energy for transmit their data to cluster head. After the cluster head and associated cluster (the node which have energy below the average energy) are found, the sink broadcasts a message that obtains the cluster head ID for each node. If a cluster head ID matches its own ID, that node seems to be an cluster head, otherwise the node determines its TDMA slot for data transmission and goes sleep until it's time to transmit data. Once the cluster heads and associated clusters are found, the sink broadcasts a message that obtains the cluster head ID for each node. If a cluster head ID matches its own ID, the node is a cluster head. Otherwise the node determines its TDMA slot for data transmission and goes sleep until it's time to transmit data.

2.2 Multi-hop Routing Protocol:

To increases the network lifetime and well balances the energy consumption, we adopt an energy-driven method to rotate cluster-head, and propose a Multi-hop Clustering Routing Protocol for long range transmission in the wireless sensor networks.

3. LEACH PROTOCOL:

LEACH-distributed or LEACH [2] is a self-organizing, adaptive clustering protocol that uses randomization to distribute the energy load evenly among the sensors in the network. LEACH makes some assumptions about both the sender nodes and the underlying network, being some of them very strong. LEACH assumes that all sensor nodes can adapt their transmission range. Furthermore, energy consumption during transmission scales exactly with the distance and every sensor node is able to reach a base station (BS). Moreover, nodes support several MAC layers and perform signal-processing functions. LEACH uses a distributed algorithm to determine the cluster heads in the set-up phase whereas in the steady phase nodes send their data according to the time schedule provided by their cluster heads. This operation of LEACH is divided into rounds as shown in figure 2.

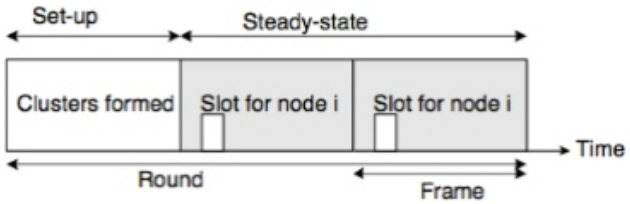


Figure 2

When clusters are created, each node n autonomously decides if it will be a cluster head for the next round. The selection is stochastic and each node determines a random number between 0 and 1. If this number is lower than a threshold T (n), the node becomes a cluster head. T (n) is determined according to the equation:

$$T_1(n) = \frac{P}{1 - P * (r \bmod \frac{1}{P})},$$

For nodes that have not been cluster head in the last 1/P rounds, otherwise T1 (n) is zero. Here P is the desired percentage of cluster heads and r is the current round. Using this algorithm, each node will be a cluster head exactly once within 1/P rounds. After 1/P – 1 rounds, T1 (n) = 1 for all nodes that have not been a cluster head. When a node has elected itself as a cluster head, it broadcasts an advertisement message telling all nodes that it is a cluster head. Non-cluster heads use these messages from the cluster heads to choose the cluster they want to belong for this round based on the received signal strength of the advertisement message.

3.1 HEED Protocol:

The clustering process is triggered repeatedly after every clustering process time and network operational interval. At each node, the clustering process requires a number of iterations called Niter. Every step should be long enough to receive messages from any neighbour within the cluster range. Also it is set an initial percentage of cluster heads among all nodes in the network called Cprob. It is only used to limit the initial cluster head announcements. Before executing HEED, a node sets its probability of becoming a cluster head, CHprob, as follows:

$$CH_{prob} = C_{prob} * \frac{E_{residual}}{E_{max}},$$

Where Eresidual is the estimated current residual energy in the node and Emax is a reference maximum energy (corresponding to a fully charged battery), which is typically identical for all nodes. During any iteration i, i < Niter, every uncovered node elects to become a cluster head with probability CHprob. After step i, the set of tentative cluster heads, SCH, is updated and a node vi selects its cluster head to be the node with the lowest cost in SCH. Every node then doubles its CHprob and goes to the next step. If a node elects to become a cluster head, it sends an announcement message where the selection status is set to tentative_CH, if its CHprob is less than 1, or final_CH, if it's CHprob has reached 1. A node considers itself covered if it has heard from either a tentative_CH or a final_CH. If a node completes HEED execution without selecting a cluster head that is final_CH, it considers itself uncovered, and announces itself to be a cluster head with state final_CH. A tentative_CH node can become a regular node at a later iteration if it finds a lower cost cluster head. The inter-cluster communication to allow all the cluster heads to send the data they have aggregated from their cluster members is not explained, but there are some statements and requirements over it. The communication among the cluster heads to allow all the data to reach the base station should be based on a multi-hop approach.

HEED uses two clustering parameter to select CH: one is residual energy, and the other is communication cost. The communication cost is defined as an average minimum reach ability power, which means the minimum power levels required by all nodes within the cluster range to reach the CH. The communication cost held by CHs is used to let a node which belong to several CHs choose the best one. In HEED, each node must be mapped to exactly one cluster, and each node belongs to its only CH within one hop. After a clustering process, each node can either elect to become a CH due to a

probability or join a cluster according to CH messages. A HEED process can be divided into three steps [4]:

(1) initialize: firstly, set an initial percentage of CHs among all nodes. A node which is selected to be an initial CH will broadcast its cost to nodes within its cluster range other nodes will then choose their own CHs. A node may belong to two or more CHs at the beginning, but it can select an optimal one in iteration processing by comparing the costs of these CHs. Furthermore, each node also computers a probability of becoming a CH when finds not any CHs due to its residual energy.

(2) Iteration processing: After initializing, nodes will go to the iteration process. In each iteration step, every node which detects no CH elects to become a CH with probability mention above. After one iteration, a set of tentative CHs is known for nodes, and then they select the tentative CHs with the lowest cost as their CHs. When a node elects to become a CH, it'll send an announcement message to notice its neighbours. After that, all nodes double the probability and go the next iteration until the probability to be value 1 or the iteration time exceeds. If a node hears from no CH, it elects itself to be a CH and inform to its neighbours.

(3) Finalize: Once a node complete iteration, it implies that the node has chosen its suitable CHs with high residual energy and low cost, and then joins to the cluster. Meanwhile, every node elect to be final CH will pronounce its cost to nodes within cluster. HEED uses the clustering approach by considering the residual energy and has a constant iteration number, so it can Increase the network life time and suit for large network. However, one-hop clustering routing protocols only perform well in a case when the CH close to base station. When a CH locates far from the base station, it may consume more energy to forward data to the base station via one hop. Actually, there are hundreds or thousands of nodes in large WSN, so some of CHs may distribute far away from base stations. Therefore, it may save more energy when letting a farther CH forward data to a base station through other closer CHs via multiple hops.

4. SIMULATION ASSUMPTIONS:

We have used MATLAB software in our simulation evaluation. Considered an area of x-axis and y-axis of 100*100 meter.Etx and Erx are (Electrical=Etx=Erx) EDA (Data Aggregation Energy).Further Parameter assumption given below in the table:

Assumption Table:

Parameter	Values
Field Area	100*100 m
No. of Nodes (n)	100
Initial energy	0.5 j
Eelec	50 *nJ=bit*
Efs	10 *pJ=bit=m* 2
Emp	0. 0013 *pJ=bit=m* 4
Dcrossover	87m
EDA	5 *nJ=bit=signal*
Packet size	4000 *bits*

4.1 Leach Simulation Results:

The first Figure 1 shows the All dead nodes, figure 2 shows the All Alive nodes, Figure 3 shows the number of data packets transfer from cluster head to base station and finally figure 4 shows the total number of cluster formed. All these figures are shown below.

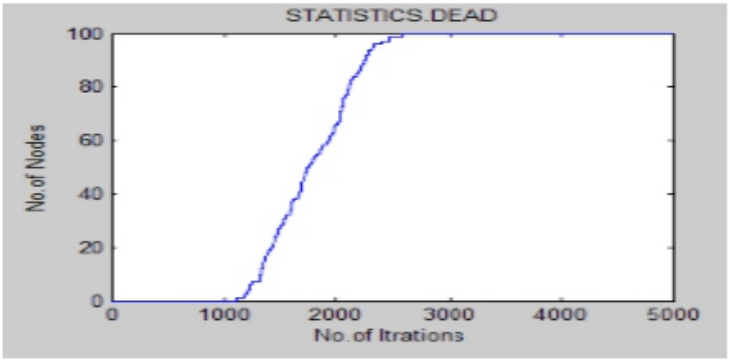


Figure 1

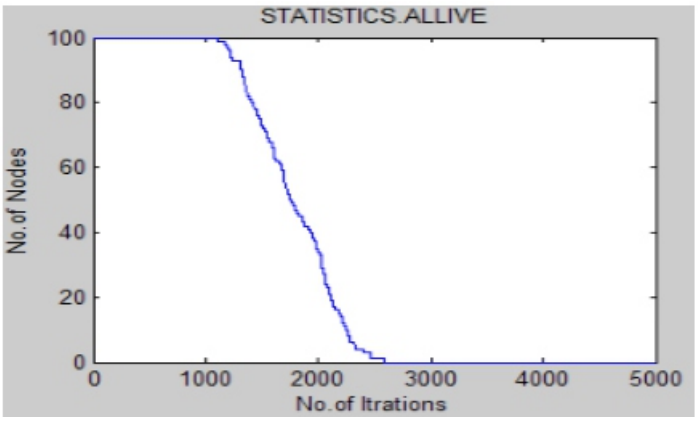


Figure 2

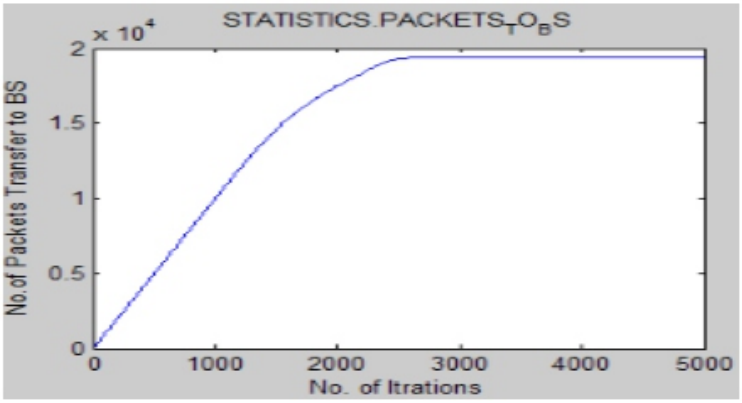


Figure 3

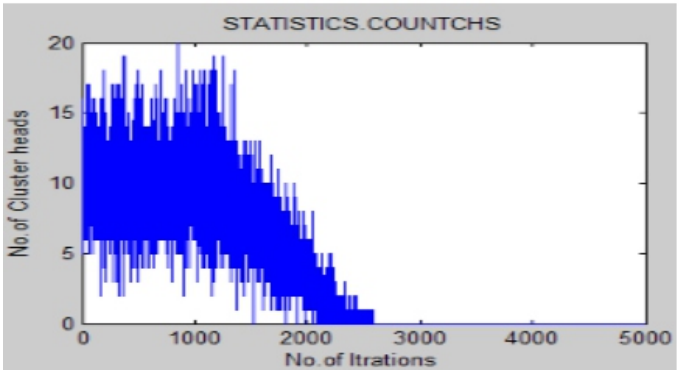


Figure 4

4.2 HEED PROTOCOL RESULTS:

The first Figure 5 shows the All dead nodes, figure 6 shows the All Alive nodes, Figure 7 shows the number of data packets transfer from cluster head to base station and finally figure 8 shows the total number of cluster formed. All these figures are shown below.

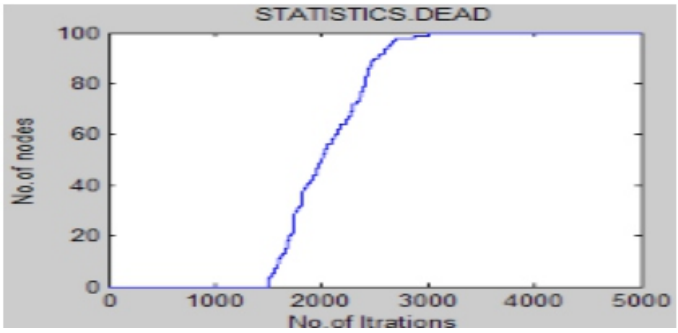


Figure 5

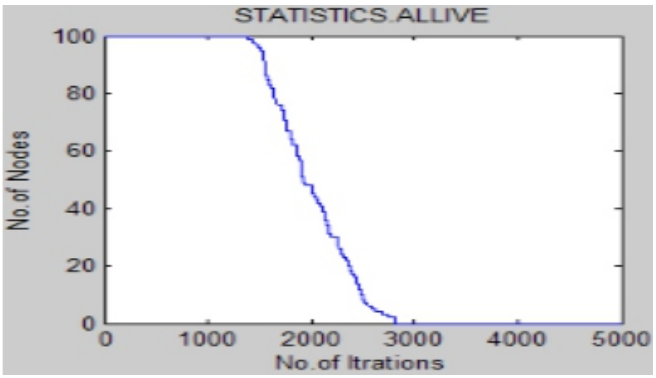


Figure 6

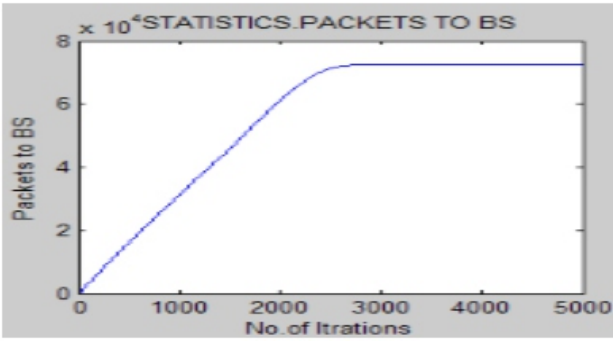


Figure 7

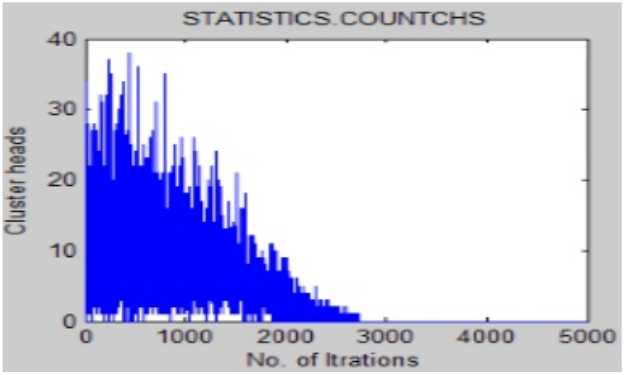


Figure 8

4.3 Statistics Comparison Results of LEACH and HEED Protocols:

Cluster Based Protocols	First Dead	Tenth Dead	All Dead	Packet to CH	Packet to BS
HEED	1495	1593	3008	130784	73741
LEACH	1075	1337	2496	158891	19361

5. CONCLUSION AND FUTURE SCOPE

After the comparing analysis we observed that the HEED routing protocol is more energy efficient routing protocol for wireless sensor network as comparisons to LEACH protocol in the form of energy consumption and cost of sensor nodes. Further in future we use the movable nodes to compare and analyzed these protocols.

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Boosting of Wireless Sensor Nodes Battery using Single Energy Multi Data Semd & Memd Transmission Mode By Radio Frequency Energy

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ABSTRACT

The main problem in wireless communication networks is the field nodes (mobile or station- ary) are battery resource constrained. Consider a situation of multi-hop wireless communication in a sensor network in which the information from a node is transferred to the base station using ad hoc multi hop network. That is, the sensed information from a field sensor node is forwarded by multiple intermediate nodes until information reaches the base station. If one of the nodes which participate in multi-hop forwarding is switched off due to low battery power, the network is disconnected and the field information could be lost on the way. While energy efficiency of communication protocols tries to ensure extended network lifetime, battery drainage problem still remains. In many applications, due to the deployment terrain condition or because of the sheer number of field nodes, it is very difficult or infeasible to replace the exhausted batteries .The means to recharge the nodes without shutting down the network is very important for uninterrupted operation of the network and also to keep the network maintenance cost at a minimum.

One technology which serves this purpose is energy harvesting - a process by which energy is derived from an external ambient source (e.g., kinetic energy, RF, solar power, thermal energy, or vibration and wind energy). While there have been proposals on tapping the non- network ambient energy sources, such as solar, thermal, wind, etc., they are not universally available. Recharging from RF sources is being investigated by other researchers, which proposes to use very high power external source, such as microwave source, and it involves a significant waste of RF energy. We propose to use the RF energy that is already available in the network due to regular communication among the nodes. Our approach does not depend any specific external energy sources, and thus, if found feasible, it would over a universal solution. In this work, we explore the means of imparting energy to the field nodes by exploiting network topology and communication protocols. The first aim is to achieve acondition that allows equal distribution of energy among all nodes. We test the one- dimensional as well as two-dimensional topologies, antenna radiation patterns, and coordination among nodes in receiving and radiating energy, to achieve the best possible equitable energy distribution. To achieve the equienergy distribution we propose a method in which the field nodes which are power rich not only receive energy from the power they also contribute energy to the weaker nodes. We call it as multi hop charging. In this study, we compared the multi hop charging with the single hop charging method.

Keywords: Wireless communication network, energy efficiency RF energy, sensor nodes, multi-hope communication and recharging, Energy harvesting, energy scavenging, wireless sensor networks (WSNs), energy management

1. INTRODUCTION

The wireless sensor nodes rely on batteries for the energy needed for their operation. With the energy harvesting technology, the batteries can be recharged. The challenge is developing the technology in which the sensor nodes can be operated battery free saving the maintenance and replacement costs. In this study we describe a novel approach of harvesting RF energy which is already available in the network

The following are the major issues we are addressing

- Sensor nodes are power constrained. So need to be recharged automatically.
- There is need for battery free operation. It also saves opex costs and replacement efforts.
- How the cluster head in a sensor network can act as energy source and data sink.
- How efficiently the RF energy can be used for multi hop communication.

Various energy harvesting approaches were studied. This work is based on the idea of transferring energy to the field nodes not only from the energy source but also from the higher power nodes that is which has more power compared to other nodes in the network. We call it as multi hop energy transfer or multi hop charging.

Figure 1: source delivering power to the sensor node

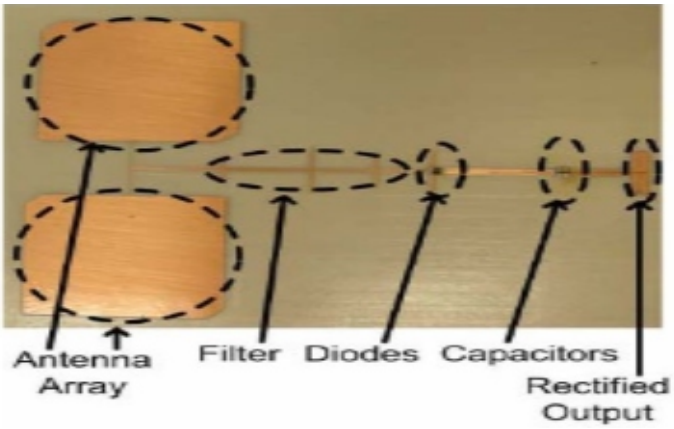


Figure: Prototype of Antenna Array and Rectification circuit

In the WSN, there is a need for sensor nodes to be recharged automatically. One of the ways is RF energy harvesting - a method of receiving electromagnetic energy and converting it to DC power, Which is the input to the battery charging circuit whose output is used fortransmitting and receiving the signal. This can be accomplished using antenna, rectifier, charging circuit as shown in fig 1

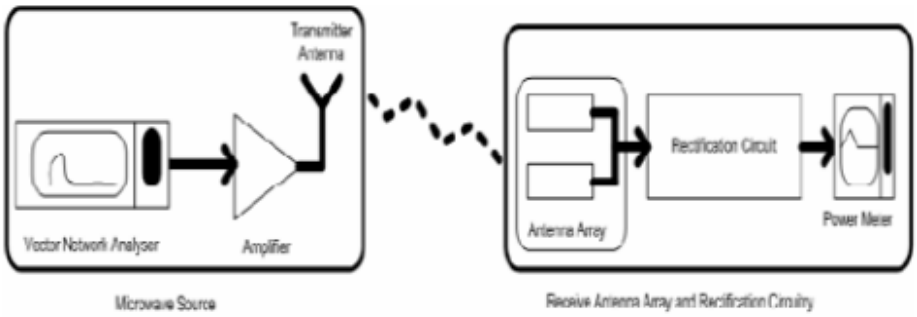


Figure 2: RF energy harvesting Process.

We propose a system where battery powered wireless sensor nodes can be recharged by harvesting energy from a microwave Radio Frequency (RF) signal source. The remote power charging module of the wireless sensor node architecture consisted of an antenna array and a rectification circuit. A prototype of the antenna array and rectification circuit of the remote power charging module for the wireless sensor node was constructed and is presented in this paper. Wireless RF power transmission has been investigated as a viable method of power delivery in a wide array of applications, from high-power space solar power satellites to low- power wireless sensors. However, until recently, efficient application at the low sub-milli watt power levels has not been realized due to limitations in available control circuitry. This paper presents RF energy is currently broadcasted from billions of radio transmitters around the world, including mobile telephones, handheld radios, mobile base stations, and television/ radio broadcast stations. The ability to harvest RF energy, from ambient or dedicated sources, enables wireless charging of low-power devices and has resulting benefits to product design, usability, and reliability. Battery-based systems can be trickled charged to eliminate battery replacement or extend the operating life of systems using disposable batteries. Battery-free devices can be designed to operate upon demand or when sufficient charge is accumulated. In both cases, these devices can be free of connectors, cables, and battery access panels, and have freedom of placement and mobility during charging and usage.

The obvious appeal of harvesting ambient RF energy is that it is essentially “free” energy. The number of radio transmitters, especially for mobile base stations and handsets, continues to increase. ABI Research and supply estimate the number of mobile phone subscriptions has recently surpassed 5 billion, and the ITU estimates there are over 1 billion subscriptions for mobile broadband. Mobile phones represent a large source of transmitters from which to harvest RF energy, and will potentially enable users to provide power-on-demand for a variety of close range sensing applications. Also, consider the number of Wi-Fi routers and wireless end devices such as laptops. In some urban environments, it is possible to literally detect hundreds of Wi-Fi access points from a single location. At short range, such as within the same room, it is possible to harvest a tiny amount of energy from a typical Wi-Fi router transmitting at a power level of 50 to 100 mW. For longer-range operation, larger antennas with higher gain are needed for practical harvesting of RF energy from mobile base stations and broadcast radio towers. In 2005, Power cast demonstrated ambient RF energy harvesting at 1.5 miles (~2.4 km) from a small, 5-kW AM radio station. RF energy can be broadcasted in unlicensed bands such as 868MHz, 915MHz, 2.4GHz, and 5.8GHz when more power or more predictable energy is needed than what is available from ambient sources. At 915MHz, government regulations limit the output power of radios using unlicensed frequency bands to 4W effective isotropic radiated power (EIRP), as in the case of radio-frequency- identification (RFID) interrogators. As a comparison, earlier generations of mobile phones based on analog technology had maximum transmission power of 3.6W, and Power cast’s TX91501 transmitter that sends power and data is 3W.

2. MODELASSUMPTION:

ATLAS universal patch antenna of 3db is considered for source antenna at node A and nodes 'B','C'. Radiated power delivered by the source node A is 40dbm. e1=0.35 % rectification efficiency according to received power at node 'a' in receiving mode (from the paper umedo) e2=0.12 % rectification efficiency according to received power at node 'b' when it is receiving only from source (from the paper umedo) e3=0.32 %rectification efficiency at node 'b' when it is receiving both from source and the node 'a' CC 1000[9] is a low power transceiver that can be used in the sensor node for low power applications. It can be operated at 315/433/915 MHz frequency bands. The current consumption while transmitting is 5.3 mA at -20 dbm and 7.4 mA while receiving the signal at a data rate of 76.8 kbps. It has different power transmission levels- -20dbm, -5 dbm, 0dbm, 5dbm, 10 dbm. Different types of antenna datasheets [10], [11], [12], [13] are used for simulation purpose. And last K is the compression factor. Mat lab simulation tool is used for implementing our approach. If an antenna transmits certain amount of power to a farther node, the power received at the receiver will be found as follows:

$$p_r(dbm) = p_t(dbm) - PL(db) \tag{2.1}$$

where

p_r=received power

p_t=transmitted power

PL=path loss

path loss is calculated using logarithmic path loss model

$$PL(d) = PL(d_0) + 10 * n * log(\frac{d}{d_0}) + Fadingloss \tag{2.2}$$

where

d_0=reference distance

$PL(d_0)$=path loss at d_0

which is calculated as

$$PL(d_0) = -10 * log(\frac{g_t * g_r * \lambda^2}{(4 * pi * d_0)^2}) \tag{2.3}$$

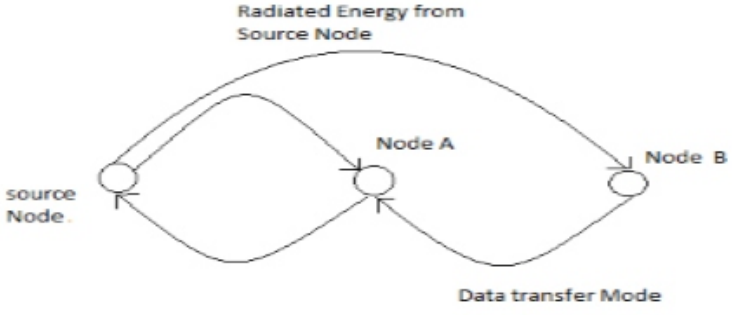
where λ =wavelength of the signal= $\frac{speedoflight}{frequencyofoperation}$

g_t=gain of transmitter antenna

g_r=gain of receiver antenna

Fading losses are taken as 6dB [15]

SEMD (Single energy multi data transmission mode)



3. RELATED WORK

WSNs have received a lot of attention in recent years and this is reflected in the significant interest shown by researchers in its different aspects. Power and energy efficiency have received particular attention because of limiting value they place on the many potentials of WSNs. A brief discussion of some background information from related research is discussed in the sections that follow. Many research efforts geared towards increasing the lifespan of WSN batteries have adopted the approach of lulling the WSNs to sleep at periods when they are neither receiving nor transmitting data. In their work, Li et al [11] identified with the mostly-off approach of Intel's Fab project. As a modification, they presented a low-power listening with flooding, as well as local update with suppression as a means of reducing latency and cost of flooding respectively, while enjoying the benefits of sleeping nodes. Low power listening involves the periodic sampling of a channel by taking one or a few signal strength samples [11]. Some techniques utilize duty cycling to conserve power. In duty cycling, sensor nodes periodically alternate between active and sleeping states. An added synchronization requirement is implicitly imposed since nodes need to be on for data transmission to occur. Sensor MAC (S-MAC), a technique proposed by Ye et al [19] employs message pass into reduces contention latency and uses synchronization between local nodes to account for clock drift.

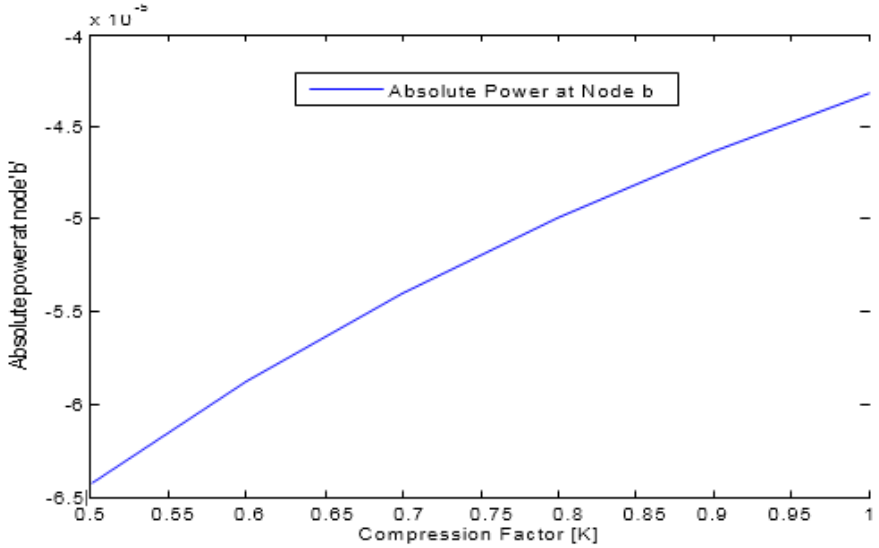
4. FINAL RESULT:

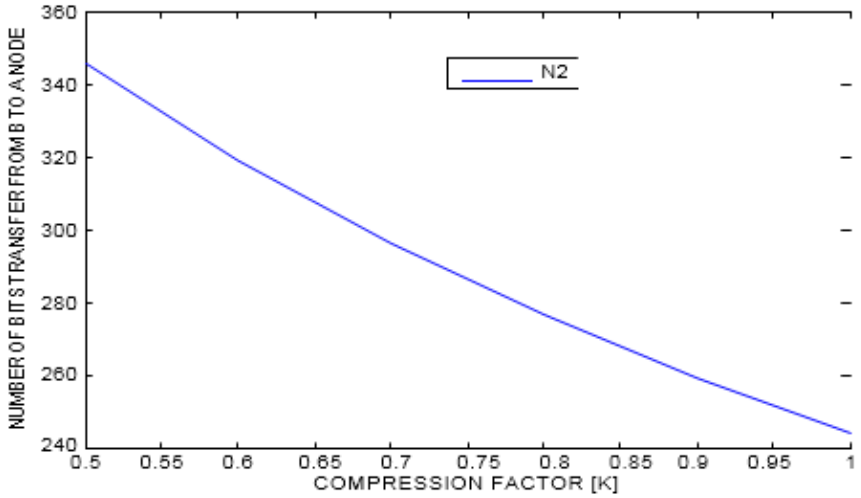
Case 1: Ea= zero (i.e. remaining Energy after transmission and reception become Zero at Node A). Than there is only one equation implies one unknown variable. 'X2' which is fraction of time node 'b' in transmission of data to node 'a' is considered as unknown.

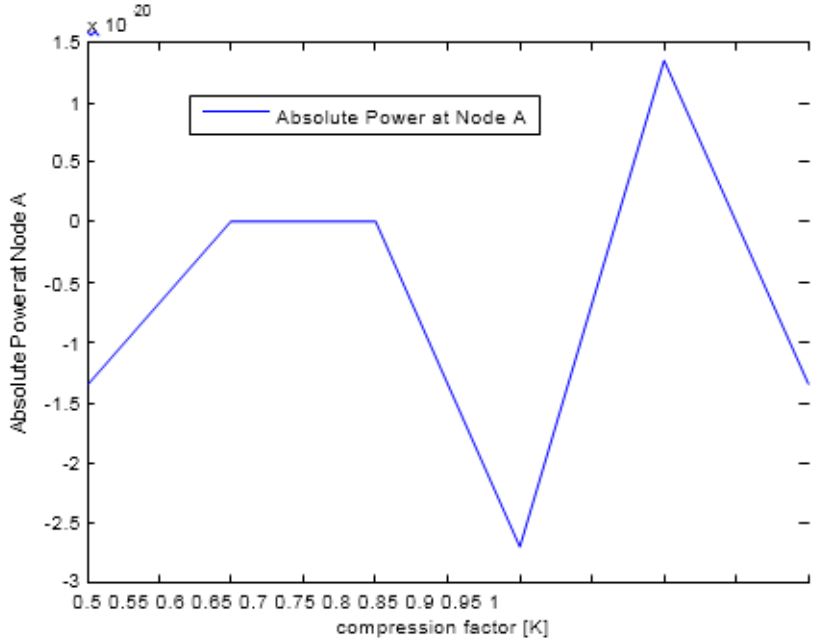
$$E_a = e_1 * p_1 * (T - x_1 - x_2 - x_3) - x_3 * p_d - p_{t_x} * x_1 - p_{r_x} x_2$$

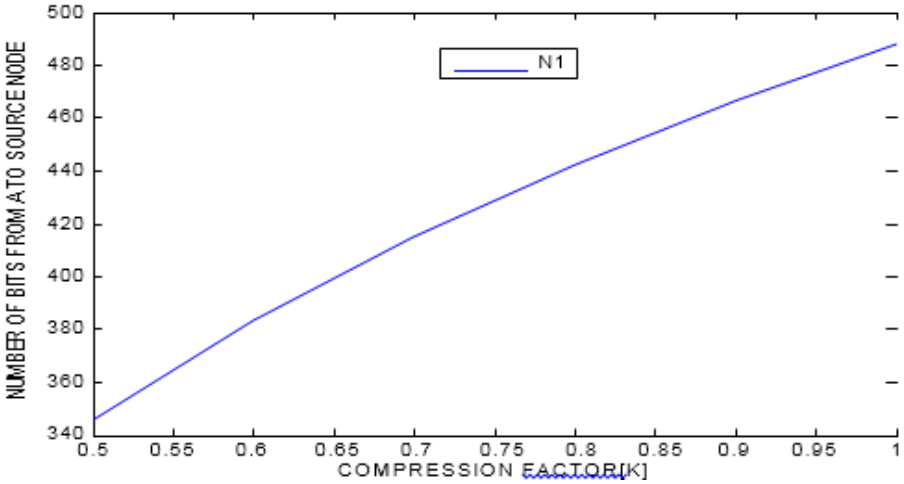
$$E_b = e_2 * p_2 * (T - x_1 - x_2 - x_3) + e_3 * (p_{d1} + p_2) * x_3 - p_{t_x} * x_2$$

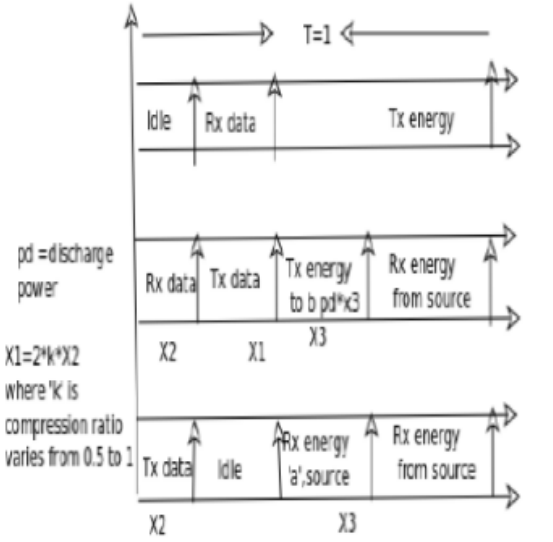
It is clearly show that when Ea put zero than Maximum number of bits transfer from B to A is 346 and minimum is 245. And Maximum number of bits transfer from A to Source node is 490 and minimum is 346. It is clearly find that remaining energy at node B will be negative and no recharge process going on. So finally discard this case and put Eb will be zero.




N2
NUMBER OF BITS TRANSFER FROM B TO A NODE
COMPRESSION FACTOR [K]


x 10^20
Absolute Power at Node A
Absolute Power at Node A
compression factor [K]


N1
NUMBER OF BITS FROM A TO SOURCE NODE
COMPRESSION FACTOR[K]

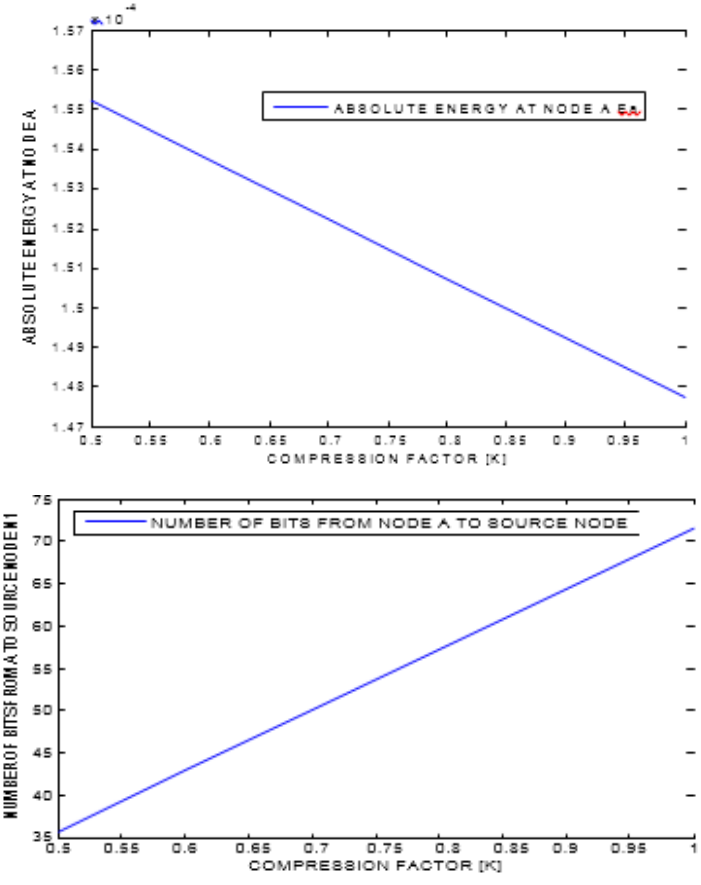


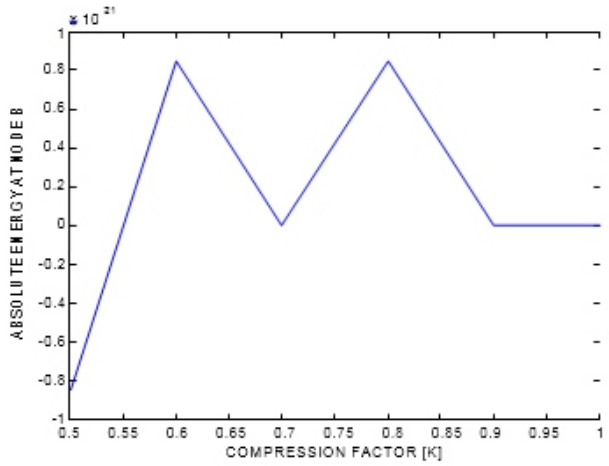
Timing Diagram of Multi hop charging and communication

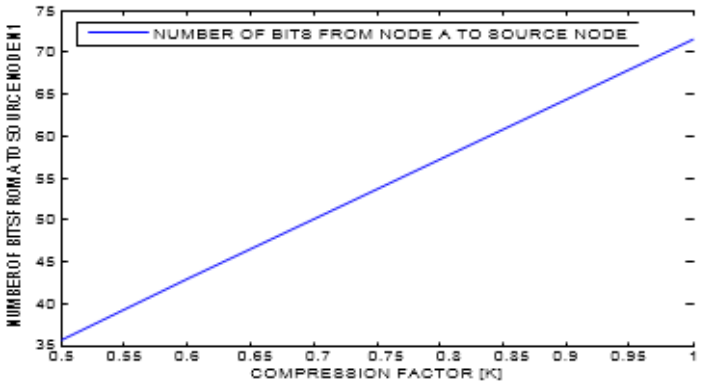
Case 2: when Eb=0

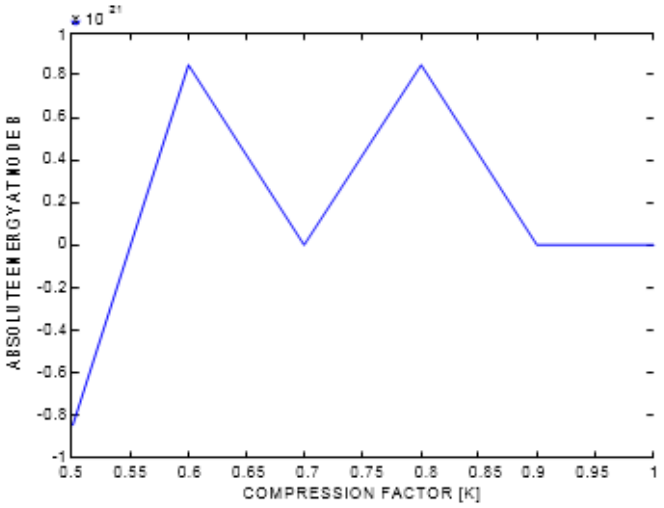
Eb= zero. here there is only one equation implies one unknown variable.'x2' which is fraction of time node 'b' in transmission of data to node 'a' is considered as unknown.

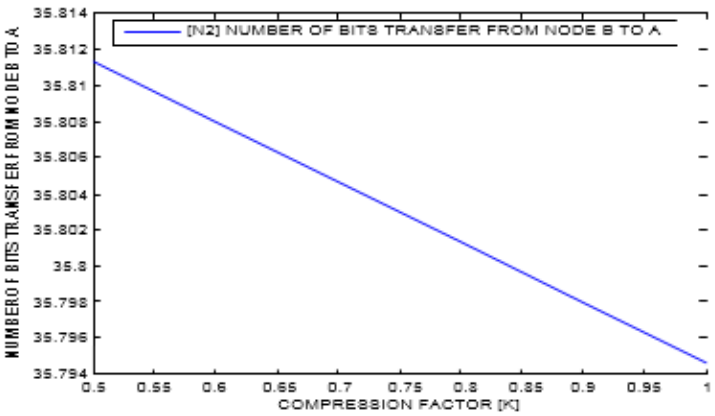
In this case Eb put zero than we find that both Ea and Eb find positive and very effectively and number of bits transfer from Node B to A is approx. 36 and A to source is minimum 36 and maximum 72. In this case we observe that our battery effectively charge and appropriate communication going on from each and every node.




x 10^21
ABSOLUTE ENERGY AT NODE B
COMPRESSION FACTOR [K]


NUMBER OF BITS FROM NODE A TO SOURCE NODE
NUMBER OF BITS FROM A TO SOURCE NODE N1
COMPRESSION FACTOR [K]


x 10^21
ABSOLUTE ENERGY AT NODE B
COMPRESSION FACTOR [K]


[N2] NUMBER OF BITS TRANSFER FROM NODE B TO A
NUMBER OF BITS TRANSFER FROM NODE B TO A
COMPRESSION FACTOR [K]

5. DISADVANTAGE OF EXISTING TECHNOLOGY

Two kinds of far-field coupling electromagnetic energy sources are usually considered currently: ambient radiation derived from radio and TV broadcasting, and energy deliberately broadcast by RF devices. The former is not reliable while the latter needs a deliberate energy supply.

In addition, people have to face the problem of electromagnetic pollution, and it is considered that overall electromagnetic radiation should be reduced [20][21][22][23]. So it makes sense to make use of existing electromagnetic radiation distributed around rather than adopting additional electromagnetic power supply device.

6. FUTURE WORK:

The goals achieved are, the power patterns of different one dimensional and two dimensional topologies are simulated and analyzed. Achieved equienergy distribution for a three node case (without data transfer), the multi hop energy transfer and direct energy transfer approaches are compared. The optimum configuration of parameters for multi hop charging is required which is analyzed for a certain configuration of a network.

There can be some improvements in the project. Equienergy distribution case can be analyzed increasing the number of nodes with and without data transfer. This can be extended to the random deployment of nodes.

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Operations Research - Meaning Features Limitations

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INTRODUCTION

Application of mathematical (quantitative) techniques to decision making In OR, a problem is first clearly defined and represented (modeled) as a set of mathematical equations. It is then subjected to rigorous computer analysis to yield a solution (or a better solution) which is tested and re-tested against real-life situations until an optimum solution is found. OR applies different approaches to different types of problems: dynamic programming, linear programming, and critical path method are used in handling complex information in allocation of resources, inventory control, and in determining economic reorder quantity; forecasting and simulation techniques such as Monte Carlo method are used in situations of high uncertainty such as market trends, next period's sales revenue, and traffic patterns. Also called decision science, management science, or operational research.

Operational Research (OR) is the use of advanced analytical techniques to improve decision making. It is sometimes known as Operations Research, Management Science or Industrial Engineering. People with skills in OR hold jobs in decision support, business analytics, marketing analysis and logistics planning – as well as jobs with OR in the title.

IMPORTANCE OF OPERATIONS RESEARCH

Operations research (OR) is a management function that draws extensively from the divisions of mathematics and science. It makes use of algorithms, statistics and numerous modeling techniques from mathematics to find the best possible solutions for complex problems. In OR, the maxima has to be optimized and the minima has to be reduced for all the objects involved. Maxima are usually the yield, performance and profit and minima are the losses and risks.

THERE ARE MANY REASONS TO USE OR.

Business Operations

- OR could be very effective in handling issues of inventory planning and scheduling, production planning, financial and revenue management and risk management. Basically, OR could be used in any situation where improvements in the productivity of the business are of paramount importance.

Control

- With OR, organizations are greatly relieved from the burden of supervision of all the routine and mundane tasks. The problem areas are identified analytically and quantitatively. Tasks such as scheduling and replenishment of inventories benefit immensely from OR.

Decision Making

- OR is used for analyzing problems of decision making in a superior fashion. The organization can decide on factors such as sequencing of jobs, production scheduling and replacements. Also the organization can take a call on whether or not to introduce new products or open new factories on the basis of a good OR plan.

Coordination

- Various departments in the organization can be coordinated well with suitable OR. This facilitates smooth functioning for the entire organization.

Systems

- With OR, any organization follows a systematic approach for the conduct of its business. OR essentially emphasizes the use of computers in decision making; hence the chances of errors are minimum.

Examples of OR in action

- **Scheduling:** of aircrews and the fleet for airlines, of vehicles in supply chains, of orders in a factory and of operating theatres in a hospital.

- **Facility planning:** computer simulations of airports for the rapid and safe processing of travellers, improving appointments systems for medical practice.

- **Planning and forecasting:** identifying possible future developments in telecommunications, deciding how much capacity is needed in a holiday business.

- **Yield management:** setting the prices of airline seats and hotel rooms to reflect changing demand and the risk of no shows.

- **Credit scoring:** deciding which customers offer the best prospects for credit companies.

- **Marketing:** evaluating the value of sale promotions, developing customer profiles and computing the life-time value of a customer.

- **Defence and peace keeping:** finding ways to deploy troops rapidly.

METHODS USED WITH OR:

1. Linear Programming:

A typical mathematical program consists of a single objective function, representing either a profit to be maximized or a cost to be minimized, and a set of constraints that circumscribe the decision variables. In the case of a linear program (LP) the objective function and constraints are all linear functions of the decision variables. At first glance these restrictions would seem to limit the scope of the LP model, but this is hardly the case. Because of its simplicity, software has been developed that is capable of solving problems containing millions of variables and tens of thousands of constraints. Countless real-world applications have been successfully modeled and solved using linear programming techniques.

2. Network Flow Programming

The term network flow program describes a type of model that is a special case of the more general linear program. The class of network flow programs includes such problems as the transportation problem, the assignment problem, the shortest path problem, the maximum flow problem, the pure minimum cost flow problem, and the generalized minimum cost flow problem. It is an important class because many aspects of actual situations are readily recognized as networks and the representation of

the model is much more compact than the general linear program. When a situation can be entirely modeled as a network, very efficient algorithms exist for the solution of the optimization problem, many times more efficient than linear programming in the utilization of computer time and space resources.

3. Integer Programming

Integer programming is concerned with optimization problems in which some of the variables are required to take on discrete values. Rather than allow a variable to assume all real values in a given range, only predetermined discrete values within the range are permitted. In most cases, these values are the integers, giving rise to the name of this class of models.

Models with integer variables are very useful. Situations that cannot be modeled by linear programming are easily handled by integer programming. Primary among these involve binary decisions such as yes-no, build-no build or invest-not invest. Although one can model a binary decision in linear programming with a variable that ranges between 0 and 1, there is nothing that keeps the solution from obtaining a fractional value such as 0.5, hardly acceptable to a decision maker. Integer programming requires such a variable to be either 0 or 1, but not in-between.

Unfortunately integer programming models of practical size are often very difficult or impossible to solve. Linear programming methods can solve problems orders of magnitude larger than integer programming methods. Still, many interesting problems are solvable, and the growing power of computers makes this an active area of interest in Operations Research.

4. Nonlinear Programming

When expressions defining the objective function or constraints of an optimization model are not linear, one has a nonlinear programming model. Again, the class of situations appropriate for nonlinear programming is much larger than the class for linear programming. Indeed it can be argued that all linear expressions are really approximations for nonlinear ones.

Since nonlinear functions can assume such a wide variety of functional forms, there are many different classes of nonlinear programming models. The specific form has much to do with how easily the problem is solve, but in general a nonlinear programming model is much more difficult to solve than a similarly sized linear programming model.

5. Dynamic Programming

Dynamic programming (DP) models are represented in a different way than other mathematical programming models. Rather than an objective function and constraints, a DP model describes a process in terms of states, decisions, transitions and returns. The process begins in some initial state where a decision is made. The decision causes a transition to a new state. Based on the starting state, ending state and decision a return is realized. The process continues through a sequence of states until finally a final state is reached. The problem is to find the sequence that maximizes the total return.

The models considered here are for discrete decision problems. Although traditional integer programming problems can be solved with DP, the models and methods are most appropriate for situations that are not easily modeled using the constructs of mathematical programming. Objectives with very general functional forms may be handled and a global optimal solution is always obtained. The price of this generality is computational effort. Solutions to practical problems are often stymied by

the "curse of dimensionally" where the number of states grows exponentially with the number of dimensions of the problem.

6. Stochastic Programming

The mathematical programming models, such as linear programming, network flow programming and integer programming generally neglect the effects of uncertainty and assume that the results of decisions are predictable and deterministic. This abstraction of reality allows large and complex decision problems to be modeled and solved using powerful computational methods.

Stochastic programming explicitly recognizes uncertainty by using random variables for some aspects of the problem. With probability distributions assigned to the random variables, an expression can be written for the expected value of the objective to be optimized. Then a variety of computational methods can be used to maximize or minimize the expected value. This page provides a brief introduction to the modeling process.

7. Combinatorial Optimization

The most general type of optimization problem and one that is applicable to most spreadsheet models is the combinatorial optimization problem. Many spreadsheet models contain variables and compute measures of effectiveness. The spreadsheet user often changes the variables in an unstructured way to look for the solution that obtains the greatest or least of the measure. In the words of OR, the analyst is searching for the solution that optimizes an objective function, the measure of effectiveness. Combinatorial optimization provides tools for automating the search for good solutions and can be of great value for spreadsheet applications.

8. Stochastic Processes

In many practical situations the attributes of a system randomly change over time. Examples include the number of customers in a checkout line, congestion on a highway, the number of items in a warehouse, and the price of a financial security, to name a few. When aspects of the process are governed by probability theory, we have a stochastic process.

The model is described in part by enumerating the states in which the system can be found. The state is like a snapshot of the system at a point in time that describes the attributes of the system. The example for this section is an Automated Teller Machine (ATM) system and the state is the number of customers at or waiting for the machine. Time is the linear measure through which the system moves. Events occur that change the state of the system. For the ATM example the events are arrivals and departures.

In this section we describe the basic ideas associated with modeling a stochastic process that are useful for both Discrete and Continuous Time Markov Chains

- **Discrete Time Markov Chains**

Say a system is observed at regular intervals such as every day or every week. Then the stochastic process can be described by a matrix which gives the probabilities of moving to each state from every other state in one time interval. Assuming this matrix is unchanging with time, the process is called a Discrete Time Markov Chain (DTMC). Computational techniques are available to compute a variety of system measures that can be used to analyze and evaluate a DTMC model. This section illustrates how to construct a model of this type and the measures that are available.

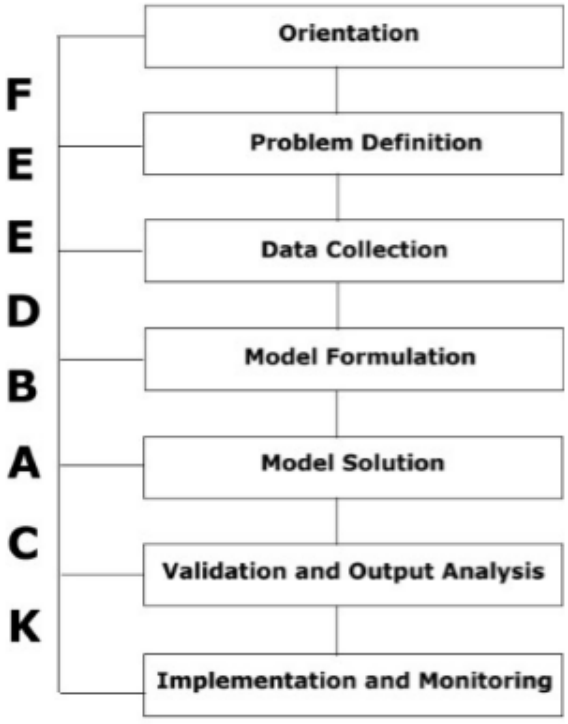
- **Continuous Time Markov Chains**

Here we consider a continuous time stochastic process in which the duration of all state changing activities are exponentially distributed. Time is a continuous parameter. The process satisfies the Markovian property and is called a Continuous Time Markov Chain (CTMC). The process is entirely described by a matrix showing the rate of transition from each state to every other state. The rates are the parameters of the associated exponential distributions. The analytical results are very similar to those of a DTMC. The ATM example is continued with illustrations of the elements of the model and the statistical measures that can be obtained from it.

9. Simulation

When a situation is affected by random variables it is often difficult to obtain closed form equations that can be used for evaluation. Simulation is a very general technique for estimating statistical measures of complex systems. A system is modeled as if the random variables were known. Then values for the variables are drawn randomly from their known probability distributions. Each replication gives one observation of the system response. By simulating a system in this fashion for many replications and recording the responses, one can compute statistics concerning the results. The statistics are used for evaluation and design.

THE OPERATIONS RESEARCH APPROACH



The prevalence of operations research in the Nation's economy reflects the growing complexity of managing large organizations that require the effective use of money, materials, equipment, and people. Operations researches analysts help determine better ways to coordinate these elements by applying analytical methods from mathematics, science, and engineering. They solve problems in different ways and propose alternative solutions to management, which then chooses the course of action that best meets the organization's goals. In general, operations research analysts may be concerned with diverse issues such as top-level strategy, planning, forecasting, resource allocation, performance measurement, scheduling, design of production facilities and systems, supply chain management, pricing, transportation and distribution, and analysis of data in large databases.

ADVANTAGES OF OPERATION RESEARCH:

1. Effective Decisions

Operations Research (OR) helps the managers to take better and quicker decisions. It increases the number of alternatives. It helps the managers to evaluate the risk and results of all the alternative decisions. So, OR makes the decisions more effective.

2. Better Coordination

Operations Research (OR) helps to coordinate all the decisions of the organisation. It coordinates all the decisions taken by the different levels of management and the various departments of the organisation. For e.g. It coordinates the decisions taken by the production department with the decisions taken by the marketing department.

3. Facilitates Control

Operations Research (OR) helps the manager to control his subordinates. It helps the manager to decide which work is most important. The manager does the most important work himself, and he delegates the less important work to his subordinates.

Operations Research (OR) helps a manager to fix standards for all the work. It helps him to measure the performance of the subordinates. It helps the manager to find out and correct the deviations (difference) in the performance. So, OR facilitates control.

4. Improves Productivity

Operations Research (OR) helps to improve the productivity of the organisation. It helps to decide about the selection, location and size of the factories, warehouses, etc. It helps in inventory control. It helps in production planning and control. It also helps in manpower planning. OR is used in expansion, modernisation, installation of technology, etc. OR uses many different mathematical and statistical techniques to improve productivity. Simulation is used by many organisations to improve their productivity. That is, they try out many production improvement techniques on a small scale. If these techniques are successful then they are used on a large scale.

DISADVANTAGES:

There are a number of limitations of operations research which may be stated as follows:

1. In the quantitative analysis of operations research, certain assumptions and estimates are made for assigning quantitative values to factors involved. If such estimates are wrong, the result would be- equally misleading.

2. Many management problems do not lend themselves to quantitative measurement and analysis. Intangible factors of any problem concerning human behaviour cannot be quantified accurately and all the patterns of relationships among the factors may not be covered. Accordingly, the outward appearance of scientific accuracy through the use of numbers and equations becomes unrealistic.
3. The quantitative methods of operations research are many cases costly, elaborate and sophisticated in nature. Although complex problems are fit for analysis by tools of operations research, relatively simple problems have no economic justification for this type of quantitative analysis.
4. A knowledge of some concepts of mathematics and statistics is prerequisite for adoption of quantitative analysis by the managers. According to the present training and experience of most managers, the actual use of these tools may be confined to a few cases.
5. Operations research is not a substitute for the entire process of decision making and it does not relieve the managers of their task of decision making. In one phase of decision making viz., selection of best solution through the evaluation of alternatives, operations research comes into the picture.

Managers have to prepare the ground-work for the introduction of operations research through several steps in decision making viz., diagnosis of problem, analysis of problem and development of alternatives; and even after the selection of best solution by operations research, managers have to put the decision into- effect and to institute a system of follow-up.

SUMMARY:

The goal of OR is to develop information to provide valuable insight and guidance. By utilizing OR methods, the objective is to apply to any given project the most appropriate scientific techniques selected from mathematics, any of the sciences including the social and management sciences, and any branch of engineering, respectively. The work normally entails collecting and analyzing data, creating and testing mathematical models, proposing approaches not previously considered, interpreting information, making recommendations, and aiding at implementing the initiatives that result from the study. Moreover, utilizing OR methods allow to develop and implement software, systems, services, and products related to a clients methods and applications. The systems may include strategic decision-support systems, which play a vital role in many organizations today.

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