

# APPLICATION OF INTERPRETIVE STRUCTURAL MODELING (ISM) FOR THE EVALUATION OF SUSTAINABILITY ISSUES IN THE TEA-SECTOR OF ASSAM

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## **ABSTRACT**

*Tea is one of the most popular drinks in the world since ancient times and Assam tea is a globally renowned variety of tea .For many decades, sustainability has been a major concern for the tea industry present in Assam. The research mainly focuses on the prioritization of sustainability issues present within the tea-sector of Assam. The sustainability issues concern a complex system taking into consideration the Social, Environmental and Economic factors based on literature and in consultation with workers and industrial experts of the tea sector of the state . The Interpretive Structural Modeling (ISM) qualitative analysis has been used to understand the mutual influences amongst the Sustainability issues in the tea sector of Assam by survey. The study seeks to identify which issues are the most dominant and the results draw attention of the stakeholders for the promotion of sustainability on a larger and improvised scale.*

## **I. INTRODUCTION**

Tea is an ancient beverage and the second most popular drink in the world after water and the cultivation of Tea is confined only to certain specific regions of the world due to specific requirements of climate and soil.. Since long Assam has been recognized as a dominant player in the international tea market among all the tea producing states of India. The first discovery of the tea plant growing in India was found in Upper Assam back in 1821, hence becoming the first tea growing state of India. The first tea garden was opened in 1835 at Lakhimpur district of Assam. The most notable development of the tea sector of the state is the participation of young unemployed youth as small tea growers, as a result leading to an increase in production of tea in the state. [1] In Assam tea is considered to be the most important crop. Some of the finest teas in the world are produced in the state. Assam produces 618,140 tonnes of tea(source: Tea Board Of India), almost 51 percent of the total tea produced in the country and also engages nearly 17 percent of the work force present in the state . The Tea industry of Assam is almost 180 years old. The industry has an important role to play in the state economy as well as in the national economy. In the present day scenario, Assam tea has maintained its international standard and also commands significant share in the world market. The Assam tea industry gives an average daily employment to more than six lakh persons in the state, which nearly accounts for 50 percent of the total average daily number of labours

employed by the tea industry in the country. The tea growing areas in Assam is separated into two regions, viz. Assam Valley and Cachar. The Assam Valley consists of the Brahmaputra Valley comprising the districts of Dibrugarh , Sibsagarh, Lakhimpur, Darrang, Nagaon , Kamrup , Goalpara, Karbi Anglong and North Cachar Hills districts. Among all the tea producing districts of Assam, Dibrugarh has the largest area under tea nearly about 33 percent.[2]

Like many other tropical commodity sectors all is not well in the tea industry. The areas where tea production takes place are some of the most beautiful places in the world but also some of the poorest. There happens to be a striking contrast between wide mountain panoramas with luscious green fields and the existence of miserable conditions for workers and smallholders. The production of tea is labour intensive and jobs are provided by the industry in remote rural areas. In the last few years, the tea industry in the state is under threat as the land for tea plantations have not grown much while on the other hand the work force has multiplied enormously which indicates vast surplus of labour in the tea gardens. Like many other agricultural commodities, real primary producer prices have gone down over the last few decades. The sustainability of the tea sector in the state is getting affected majorly due to the low prices. The working conditions for pickers are poor, low wages, low income and job security, discrimination along ethnic and gender lines etc. add to their miseries. The possibility for improvement of working conditions for the tea plantation workers of Assam is less as a result of absence or ineffectiveness of trade unions or they do not represent them as the workers are temporary. Apart from that, the environmental footprint of the tea sector of Assam is also considerable with reduced bio-diversity as a result of habitat conversion, high application of pesticides etc. Sustainability, defined as meeting the current needs of the present without affecting those of the future and the balance of people, planet, and profit, otherwise known as the triple bottom line, is part of the ultimate goals of sustainable development and its stakeholders. Hence, a critical analysis of the mutual relationships between the various sustainability issues viz. Social, Environmental and Economic becomes essential to promote further growth and sustainable development in the already well established and world renowned tea industry of Assam.

## II. RESEARCH OBJECTIVE

The primary objective of the present study is the utilization of Interpretive Structural Modeling (ISM) for the evaluation and identification of the various sustainability issues present within the tea sector of Assam. The following section presents the review of existing literature. The Sustainability issues in the Tea-Sector of Assam are discussed in Section 4. The model for ISM and methodology is proposed in Section 5. In the final two sections the results and discussions are present and conclusions are drawn in the final section.

## III. REVIEW OF EXISTING WORK

### 3.1. Sustainability

Lung and Levrat (2014) in their study have discussed the requirements of advance maintenance services for the promotion of sustainability.[3]

Ding et al. (2014) did a case study of the Hubei Province of Central China, for measurement of regional sustainability by the use of of a coordinated development model of economy, society and economy and

environment. Their result showed that the coordinated development index of Hubei province stayed at a poor level for the seven years of investigation. In spite of the fact that the coordinated development index was consistently increasing, the average speed of sustainable development was very slow.[4]

Bilge et al. (2014) presented a model-based approach for the assessment of value creation for enhancing sustainability in manufacturing. They concluded that the results show a positive relation between the strategic alignment value and sustainability value.[5]

Mani et al. (2014) employed AHP methodology for the determination of supplier selection using social sustainability in India. In their study many social sustainability criteria were identified through the Delphi process and the AHP model helped the supply chain managers in socially sustainable supplier selection. In their model relevant and essential social parameters were used to prioritize the suppliers.[6]

### **3.2. Interpretive Structural Modeling (ISM)**

Hansen et al. (1979) developed three broad steps for the development of an interpretive structural model. In the first step, ISM begins with an issue or problem. Secondly, the elements that comprised the issue context have been identified and listed. Finally in the last step, pairs of elements have been compared either graphically or in a relation matrix using a contextual relationship, which is mostly a verb or a verb phrase.[7]

Porter et al. (1980) have explained that ISM in the form of matrix depicts a directed (causality direction) graphic representation of a particular relationship among each pair of elements in a set, which helps in structuring a complex issue area.[8]

Anderson et al. (1994) have highlighted the utility of ISM further as the representation of a problematic situation as it captures the richness and the variety of complex phenomena.[9]

Nelson et al. (2000) have described the Interpretive Structural Modeling approach in a different way, their study shows it is relatively more efficient (in some cases) and lends itself to being replicated more effectively.[10]

Sharma et al.(2011) analysed the barriers for reverse logistics from an Indian perspective applying ISM methodology. Their work helped to identify the hierarchy of actions to be taken for handling different barriers hindering the implementation of reverse logistics.[11]

Chandramowli et al. (2011) analysed the barriers to development of land-filling communities by the use of ISM. Their paper highlights the potential of using such techniques to understand and analyze urban planning issues.[12]

Satapathy et al. (2012) used ISM approach for evaluation of the important aspects of customer's satisfaction in service quality of E-electricity utility service.[13]

Mathiyazhagan et al. (2013) employed the ISM methodology for the barrier analysis in implementing green supply chain management. The Interpretive Structural Modeling (ISM) qualitative analysis was used to understand the mutual influences amongst the twenty-six barriers by survey.[14]

## **IV. SUSTAINABILITY ISSUES**

### **4.1. Social Issues**

#### **4.1.1 Wages are low**

The large tea plantations of the state throughout the decades have benefited from low cost local or migrant labourers. The wage levels are often very low, and in smallholder gardens they get paid at much lower rates than at the estates. The wage rates of tea garden workers are fixed through a bipartite agreement between the representatives of employers and the employees of the tea gardens under the plantation labour act (for estates).

#### **4.1.2 Health & Safety Issues Along With Housing Problems**

The art of tea-plucking is a tedious and hazardous job. Workers are on their feet for hours bearing the load of the tea baskets on their shoulders as a result, back problems are common. Additionally they are exposed to pesticides, mosquitoes, other insects and poisonous snakes which pose a great threat to their health and safety. The low literacy rate and deprived health status among workers are major constraints in providing them access to major health, educational and development initiatives and programmes of the state government. Workers in the large tea estates are generally permanent but in some cases they may be of temporary nature as a result of which they are provided housing facilities in the plantation as long as they work there. Living conditions in many plantations have been found to be poor and unsanitary. Workers in tea gardens of Assam are often isolated from mainstream society and interaction with mainstream society is very low

#### **4.1.3 Discrimination on Various Grounds**

The majority of the workers in the tea plantations of Assam are from migrant, marginal and tribal communities. The total population of the tea tribes community is nearly 6 million which is 20 percent of the total population of the state[15]. Discrimination on grounds of ethnicity and gender can be commonly seen in the plantations. Women are preferred on tea estates, as they are considered better pickers and are more docile and bonded to the tea tea plantations (child/family care). They have often had very little education, but they have the skills for picking tea leaves, handed down by the previous generations so they agree to working in the field accepting the very low wages.

#### **4.1.4 Labour Casualisation and Child Labour Issues**

Tea gardens of Smallholder type depend mostly on casual( and family) labour .Casualisation of labour is a major concern as workers are not guaranteed job security and other benefits which benefit the permanent workers such as access to medical care for children. Use of child labour in Tea-sector is a common practice worldwide. As a result of financial needs and lack of education facilities, women plantation workers are often required to take their children to the tea plantations. Although efforts are made to eradicate child labour nationally (through various government initiatives) it is highly unlikely that child labour has completely vanished from the tea plantations altogether.

#### **4.1.5 Worker Representation**

In spite of the well organized workers of the tea plantations of Assam, there exists strong rivalry between the various unions on the tea plantations, which is highly disadvantageous for the workers. Unrest of labour is not always sustained and turns out to be beneficial for the management. Since plantation workers often originate from specific ethnic, tribal and/or lower caste groups, their position becomes very vulnerable.

## **4.2. Environmental Issues**

### **4.2.1 Energy Utilization**

Tea processing is an energy intensive industry. Withering, drying, grading and packing tea requires considerable amount of energy nearly 4-18 kWh per kg of tea produced. Various types of feedstock and energy sources such as firewood, oil, natural gas, electricity, are put into use. The environmental impact of tea processing depends on factor such as the use of renewable/renewed feedstock and the energy efficiency of the machinery. Drying, the most energy-intensive phase of tea processing, is mainly carried out using firewood from natural forests as a result of which extensive deforestation occurs.

### **4.2.2 Conversion of Habitat**

One of the major environmental issues relating to the tea production in the state is habitat conversion. The main reason behind such occurrence is that the habitat for cultivation is mostly located in more rugged and remote areas which possess biodiversity of the highest order. Conversion of habitats leads to the reduction of species and due to presence of sloping land considerable soil loss occurs before the plantations are fully established. Even after well establishment of the tea plantations rate of soil erosion can be high.

### **4.2.3 Use of Agrochemicals**

Use of a variety of agrochemicals throughout the growing cycle of tea in the plantations is a common practice in order to protect tea bushes and to enhance productivity. The application of agrochemicals that are listed as hazardous and toxic has negatively affected the local and wider environment: (severely) reduced soil biodiversity. Some tea gardens also use pesticides which are banned in developed countries.

## **4.3. Economic Issues**

### **4.3.1 Diminishing Prices**

The cost of production of made tea has increased due among other things to increasing fuel prices and increased labour costs, however real retail prices over the last two decades have remained constant. In other words, while the real cost of tea has remained the same for consumers, sourcing costs for retailers and packers have gone down, as has the income for producers.

### **4.3.2 Non-uniform Value distribution and buying power concentration**

The value chain in tea comprises all the stages from green leaf production through conversion into a bulk packaged product available for blending and sale to consumers. Value addition takes place for the tea leaves at each stage of the supply chain, each with associated costs which includes the cost of plucking and sorting, factory packing, internal transport, warehousing, sales charges (auction and direct), freight, insurance, interest, blending and packaging and retailers' sales costs. The downstream stages which include blending, packaging and marketing are the most profitable and this part of the value chain is under the control of a handful of multinational tea packers and brokers, who considerably influence world retail and producer prices. There is a great deal of concentration on the

buying front. A handful of companies share domination of trade and retail sales. As auction prices are reference prices for private sales, lower auction prices result in lower prices in private/direct sales.

## V. DESIGN OF RESEARCH AND MEASURES

Data collection was primarily conducted by physical interviews with around 350 workers belonging to various Tea estates of Assam. Additionally, Industry experts were consulted by telephonic conversations and via e-mails. The Sustainability Issues which deeply affected them were finally identified after categorization of the points they mentioned under broad headings. Surveys with questionnaires related to Sustainability issues in the Tea sector of Assam were also conducted in many cases linguistic barriers existing among various tea tribes in the tea gardens of Assam did not pose a problem. Hence, measures were taken to obtain valid, reliable and relevant information useful for the research.

## VI. RESULTS AND DISCUSSION

### Interpretive Structural Modeling

Interpretive Structural Modeling first proposed by J. Warfield (1973) is a computer- assisted interactive learning technique which finds its application in the identification and summarizing a relationship among specific variables which enables individuals or groups to develop a map of the complex relationships among various elements .[16] The fundamental idea behind ISM is the use of experts' knowledge and experience for the fragmentation of a complicated system into several sub-systems (elements) and construction of a multi-level structural model. It is a very useful tool for the provision of fundamental understanding of complex situations, and to formulation a course of action for solving a problem.

The Notable Characteristics of ISM are:

- (a) It is an interpretive process because the judgement of the group decides whether and how various elements are related.
- (b) Mutual relationship is the basis of the structure as the overall structure is extracted from the complex set of elements.
- (c) ISM is a modeling methodology, as the specific relationships and overall structure is presented in a digraph model.
- (d) The complexity of relationships among various elements of the system gets proper order and direction.

The steps involved in ISM are as follows:

1. Identification of the elements related to the problem by literature review, survey and expert opinion.
2. Establishment of a contextual relationship between the identified elements on the grounds of which pairs of elements would undergo examination.

In this study ISM was applied to thirteen items which are as follows:

- Low Wages
- Health & safety issues along with housing problems
- Discrimination on various grounds
- Labour casualization and child labour issues
- Worker Representation
- Energy Utilization
- Conversion of habitat
- Use of Agrochemicals
- Diminishing prices.
- Non-uniform value distribution and buying power concentration

3. Development of a Structural Self-Interaction Matrix (SSIM) of the elements which will indicate the pair-wise relationship between elements of the system. For the Structural Self Interaction Matrix(SSIM), four symbols have been put into use for denoting the directional relationship between the criterion (i and j) which are:

V: relation from element i to element j and not in both directions.

A: relation from element j to element i and not in both directions.

X: for both directional relations from element i to j and element j to i.

O: relation between elements are not valid.

**TABLE 1: Structural Self Interaction Matrix (SSIM) For Sustainability Issues.**

SUSTAINABILITY ISSUES	I10	I9	I8	I7	I6	I5	I4	I3	I2
I1	O	V	O	O	O	O	O	A	A
I2	V	O	V	O	V	A	V	A	
I3	V	O	V	O	V	A			
I4	O	O	A	A	A				
I5	X	A	V	O					
I6	V	A	V	O					
I7	V	O	O						
I8	V	O							
I9	O								

## 4. Development of a reachability matrix from the SSIM and checking the matrix for transitivity.

The Structural Self Interaction Matrix gets transformed into a binary matrix, called Initial Reachability Matrix by substitution of V, A, X, and O by 1 and 0 as per the case. The rules for the substitution of 1s and 0s are as follows:

- If the (i, j) entry in the SSIM is V, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0.
- If the (i, j) entry in the SSIM is A, then the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1.
- If the (i, j) entry in the SSIM is X, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1.
- If the (i, j) entry in the SSIM is O, then the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.
- Final Reachability Matrix is obtained with the basic assumption in ISM of transitivity of the contextual relation which states if element P is related to Q and at the same time Q is related to R, then P is also related to R.

**TABLE 2. Initial Reachability Matrix.**

Sustainability Issues	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1	0	0	0	1	1	0	0	1	0
I2	1	1	0	1	1	1	0	1	1	1
I3	1	1	1	1	1	1	0	1	1	1
I4	0	1	1	1	1	0	0	1	0	1
I5	1	1	1	1	1	1	0	1	0	1
I6	0	0	0	1	1	1	0	1	0	1
I7	0	0	0	1	1	0	1	0	0	1
I8	0	0	0	1	1	0	0	1	0	1
I9	0	1	1	1	1	1	0	1	1	1
I10	0	1	1	0	1	0	0	1	0	1

**TABLE 3.Final Reachability Matrix**

Sustainability Issues	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	DRIVING POWER
<b>I1</b>	1	0	0	0	1	1	0	0	1	0	<b>4</b>
<b>I2</b>	1	1	0	1	1	1	0	1	1	1	<b>8</b>
<b>I3</b>	1	1	1	1	1	1	0	1	1	1	<b>9</b>
<b>I4</b>	0	1	1	1	1	0	0	1	0	1	<b>6</b>
<b>I5</b>	1	1	1	1	1	1	0	1	0	1	<b>8</b>
<b>I6</b>	0	0	0	1	1	1	0	1	0	1	<b>5</b>
<b>I7</b>	0	0	0	1	1	0	1	0	0	1	<b>4</b>
<b>I8</b>	0	0	0	1	1	0	0	1	0	1	<b>4</b>
<b>I9</b>	0	1	1	1	1	1	0	1	1	1	<b>8</b>
<b>I10</b>	0	1	1	0	1	0	0	1	0	1	<b>5</b>
<b>DEPENDENCY</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>8</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>8</b>	<b>4</b>	<b>9</b>	

5. The reachability matrix is then partitioned into different levels. From the final reachability matrix, the reachability and antecedent set for each issue is found out. The reachability set comprises of criteria for itself as well as others which it may help to achieve on the other hand, antecedent set consists of itself and other criterion which helps in achieving it. The intersection set is subsequently derived and the variables having reachability and intersection sets same are provided the top level in ISM hierarchy.

**TABLE 4. Partition Of Reachability Matrix: Iteration 1**

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
<b>I1</b>	1,5,6,9	1,2,3,5	1,5	<b>I</b>
<b>I2</b>	1,2,4,5,6,8,9,10	2,3,4,5,9,10	2,4,5,9,10	
<b>I3</b>	1,2,3,4,5,6,8,9,10	3,4,5,9,10	3,4,5,9,10	
<b>I4</b>	2,3,4,5,8,10	2,3,4,5,6,7,8,9	2,3,4,5,8	
<b>I5</b>	1,2,3,4,5,6,8,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,5,6,8,10	
<b>I6</b>	4,5,6,8,10	1,2,3,5,6,9	5,6	
<b>I7</b>	4,5,7,10	7	7	
<b>I8</b>	4,5,8,10	2,3,4,5,6,8,9,10	4,5,8,10	<b>I</b>
<b>I9</b>	2,3,4,5,6,8,9,10	1,2,3,9	2,3,9	
<b>I10</b>	2,3,5,8,10	2,3,4,5,6,7,8,9,10	2,3,5,8,10	<b>I</b>

TABLE 5. Partition Of Reachability Matrix: Iteration 2

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
I1	1,6,9	1,2,3	1	II
I2	1,2,4,6,9	2,3,4,9	2,4,9	
I3	1,2,3,4,6,9	3,4,9	3,4,9	
I4	2,3,4	2,3,4,6,7,9	2,3,4	
I6	4,6	1,2,3,6,9	6	
I7	4,7	7	7	
I9	2,3,4,6,9	1,2,3,9	2,3,9	

TABLE 6. Partition Of Reachability Matrix: Iteration 3

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
I1	1,6,9	1,2,3	1	III III
I2	1,2,6,9	2,3,9	2,9	
I3	1,2,3,6,9	3,9	3,9	
I6	6	1,2,3,6,9	6	
I7	7	7	7	
I9	2,3,6,9	1,2,3,9	2,3,9	

TABLE 7. Partition Of Reachability Matrix: Iteration 4

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
I1	1,9	1,2,3	1	IV
I2	1,2,9	2,3,9	2,9	
I3	1,2,3,9	3,9	3,9	
I9	2,3,9	1,2,3,9	2,3,9	

**TABLE 8. Partition Of Reachability Matrix: Iteration 5**

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
<b>I1</b>	1	1,2,3	1	<b>V</b>
<b>I2</b>	1,2	2,3	2	
<b>I3</b>	1,2,3	3	3	

**TABLE 9. Partition Of Reachability Matrix: Iteration 6**

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
<b>I2</b>	2	2,3	2	<b>VI</b>
<b>I3</b>	2,3	3	3	

**TABLE 10. Partition Of Reachability Matrix: Iteration 7**

Issues	Reachability Set	Antecedent Set	Intersection Set	Level
<b>I3</b>	3	3	3	<b>VII</b>

6. Development of ISM Model: A digraph is drawn shown in **Fig. 1** and removal of the transitive links based on the relationships given in the reachability matrix takes place. Conversion of the resultant digraph into an ISM-based model occurs by replacement of the elements nodes with statements. The digraphs drawn are complex in nature. The level I barriers are assigned the top level in the hierarchy as they won't help any other issues to achieve. The barriers having same level are kept on the same level of hierarchy. The model is finally reviewed for conceptual-inconsistency check and final modifications are applied.

7. MICMAC Analysis: In an ISM model the relationships found are tested by MICMAC Analysis in which the enablers get classified into four categories shown in **Fig. 2**. The main motive behind the analysis is to analyze the driver power and dependence of variables that influence the Tea Sector of Assam with respect to Sustainability.

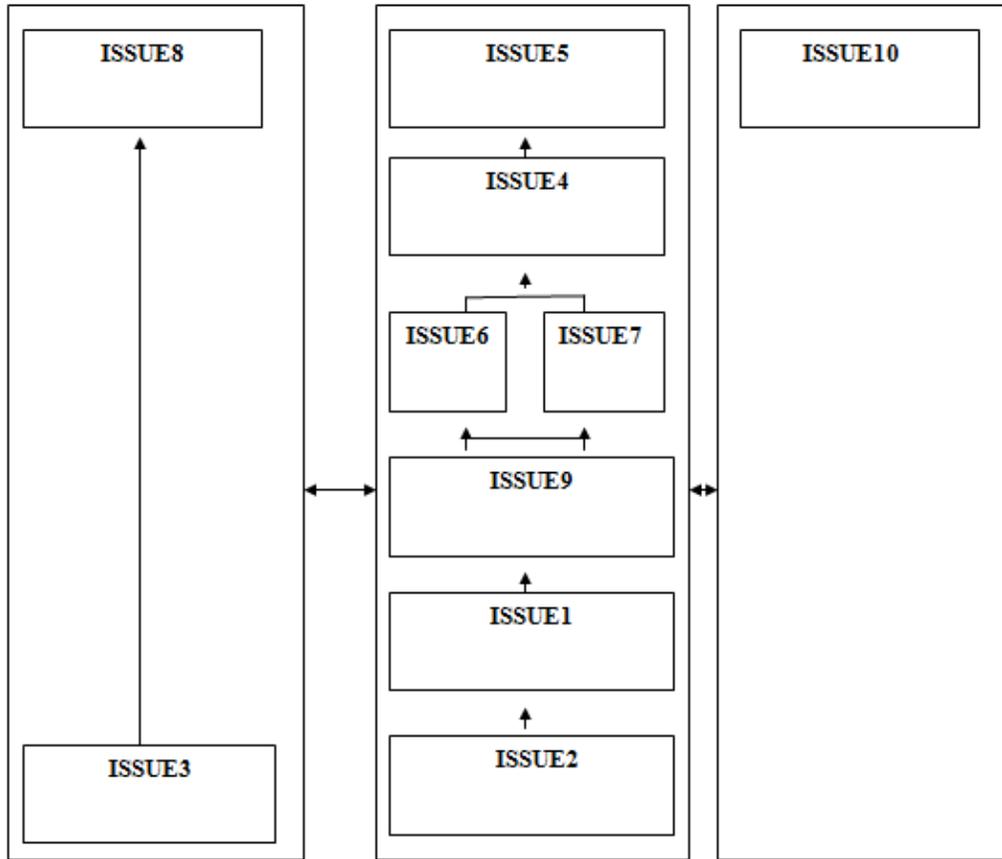


FIG. 1 Ism Based Model For Sustainability Issues In The Tea Sector Of Assam

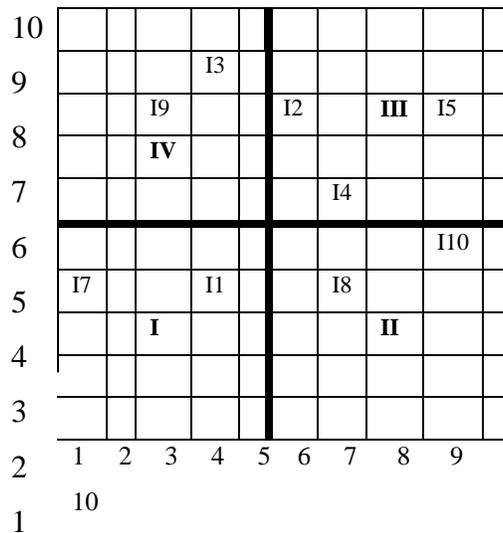


Fig. 2 Driver Power and Dependence Diagram

The four clusters into which enablers are classified in this method are-

- a) Cluster I: Weak driving power and weak dependence-This group is also known as Autonomous or Excluded Enablers.
- b) Cluster II: Weak driving power and strong dependence- This group of enablers are called as Depending Enablers
- c) Cluster III: Strong driving power and strong dependence- These enablers are simultaneously very influent and very dependent.
- d) Cluster IV: Strong driving power and weak dependence- Enablers in this group are altogether very influent and little dependent.

## **VII. CONCLUSION**

The proposed methodology in this particular research helps in the identification of the hierarchy of actions to be implemented for dealing with the sustainability issues faced by the workers in the tea sector of Assam. Some of the sustainability issues have been identified and put into the ISM model for the analysis of interaction between them. The driver dependence diagram provides with much valuable insight regarding the relative importance and interdependencies among the sustainability issues. From Fig.2. it can be clearly visualised that discrimination on various grounds and diminishing prices are the driver variables which are Issues 3 and 9 while on the other hand low wages and conversion of habitat are autonomous barriers namely Issues 1 and 7. These issues are termed as autonomous because they have very few links with the system and are to some extent out of line with the system. Sustainability issues such use of agrochemicals and non-uniform value distribution and buying power concentration have a weak driving power, but show strong dependency on other issues. This is the indication that all other issues are required to come together for overcoming the threats related to sustainability issues in the tea sector of Assam. Issues such as health & safety issues along with housing problems, worker representation and labour casualization act as linkage variables. They possess strong driver power as well as strong dependency power. These enablers should be studied with greater attention than the others. From the analysis it can be concluded that three issues discrimination on various grounds and diminishing prices act as Independent enablers possessing the maximum driving power. It can be further concluded that these variables are the key issues of sustainability in the tea sector of Assam.

The Tea sector of Assam is facing many more new challenges in the field of Sustainability due to market changes and other environmental reasons hence there is a greater requirement of development of new models to keep a check on the issues affecting the sustainability of the precious industry of the nation. The ISM model proposed in this research for the identification of sustainability issues in the tea sector of Assam can also be translated to other sectors belonging to diverse fields for further promotion of sustainable development in the country. The model suggested will provide authorities with a realistic representation of the problem in the course of successful implementation of Sustainable development.

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# PROPERTIES OF SOME SUBCLASSES OF MULTIVALENT FUNCTIONS ASSOCIATED WITH CLOSE-TO-CONVEX FUNCTION

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## ABSTRACT

For analytic function  $f(z)$  normalized with  $f(0)=0$  and  $f'(0)=1$  in the open unit disk  $U$ . A new class  $L_1^*(\beta_1, \beta_2, \lambda)$  of  $f(z)$  satisfying some conditions with some complex number  $\beta_1, \beta_2$  and some real number  $\lambda$ . The aim of present paper is to discuss some properties for  $L_1^*(\beta_1, \beta_2, \lambda)$  of  $f(z)$  associated with close-to-convex in  $U$ .

**Mathematics Subject Classification:** 30C45

**Keywords:** Analytic And Univalent Functions; Multivalent Functions;  $A$ -Convex Functions; Coefficients Bounds.

## I INTRODUCTION AND DEFINITIONS

Let  $A$  denote the class of functions of the form:

$$f(z) = z^p + \sum_{n=1}^{\infty} a_{n+p} z^{n+p} \quad (a_n \in \mathbb{C}) \quad (1.1)$$

Which are analytic and  $p$ -valent in the open disc  $U = \{z \in \mathbb{C} / |z| < 1\}$ .

Let  $R(\alpha)$  denote the subclass of  $A$  consisting of functions  $f(z)$  which satisfy

$$\operatorname{Re} f'(z) > \alpha \quad (z \in U) \quad \text{for some real } \alpha \quad (0 \leq \alpha < 1).$$

A function  $f(z) \in R(\alpha)$  is said to be close-to-convex of order  $\alpha$  in  $U$  (cf. Goodman[2])

We know that  $R(\alpha_2) \subset R(\alpha_1)$  for  $(0 \leq \alpha_1 \leq \alpha_2 < 1)$  and  $R(\alpha) \subset A$  by

Noshiro-Warshawski theorem (cf. Duren [3]).

Let  $L_1^*(\beta_1, \beta_2, \lambda)$  denote the subclass of  $A$  defined as follow:

$$L_1^*(\beta_1, \beta_2, \lambda) = \left\{ f \in A : \left| \frac{f'(z) - p z^{p-1}}{\beta_1 f'(z) + \beta_2 p z^{p-1}} \right| \leq \lambda \right\}$$

For some complex  $\beta_1, \beta_2$  and for some real  $\lambda$ .

Let  $T$  denote the subclass of  $A$  consisting of functions of the form:

$$f(z) = z^p - \sum_{n=1}^{\infty} \alpha_{n+p} z^{n+p} \quad (\alpha_n \geq 0) \quad (1.2)$$

Further, let  $L^*(\beta_1, \beta_2, \lambda)$  denote the subclass of  $L_1^*(\beta_1, \beta_2, \lambda)$  by

$$L^*(\beta_1, \beta_2, \lambda) = L_1^*(\beta_1, \beta_2, \lambda) \cap T$$

for some real number  $\beta_1 (0 \leq \beta_1 \leq 1)$  and  $\beta_2 (0 < \beta_2 \leq 1)$  and

for some real number  $\lambda (0 < \lambda \leq 1)$ .

The class  $L^*(\beta_1, \beta_2, \lambda)$  was studied by Kim and Lee [4] for univalent function.

We note that :

1)  $L^*(\beta_1, 1, \frac{1-\beta_1}{1+\beta_1}) = P^*(\beta_1)$ , where  $P^*(\beta_1)$  is the class of functions  $f(z) \in T$  which

satisfy  $\operatorname{Re}$

$f'(z) > \beta_1$ . The class  $P^*(\beta_1)$  was studied by Kim and Lee, Sarangi and Uralegaddi and Al. Amiri for univalent functions.

2)  $L^*(0, 1, \lambda) = G^*(\lambda)$ , where  $G^*(\lambda)$  is the class of functions  $f(z) \in T$  which satisfy  $|f'(z) - 1| \leq \lambda$ . The class  $G^*(\lambda)$  was introduced by Kim and Lee for univalent function.

3)  $L^*(1, 1, \lambda) = D^*(\lambda)$ , where  $D^*(\lambda)$  is the class of functions  $f(z) \in T$  which satisfy

$\left| \frac{f'(z)-1}{f'(z)+1} \right| \leq \lambda$ . The class  $D^*(\lambda)$  was introduced by Kim and Lee [4] for univalent function.

## II PROPERTIES OF THE CLASS $L_1^*(\beta_1, \beta_2, \lambda)$

### 1. Coefficient Estimate

First result for the class is contained in

#### Theorem 2.1

A function  $f(z)$  defined by equation 1.2 is in the class  $L_1^*(\alpha, \beta, \lambda)$  if and only if

$$\sum_{n=1}^{\infty} (1 + \lambda |\beta_1|) |p + n| |\alpha_{n+p}| \leq \lambda p |(\beta_1 + \beta_2)| \quad (1.3)$$

**Proof:** It follows that

$$\begin{aligned} \left| \frac{f'(z) - p z^{p-1}}{\beta_1 f'(z) + \beta_2 p z^{p-1}} \right| &= \left| \frac{-\sum_{n=1}^{\infty} (n+p) \alpha_{n+p} z^n}{(\beta_1 + \beta_2)p - \beta_1 \sum_{n=1}^{\infty} (n+p) z^n} \right| \\ &\leq \frac{\sum_{n=1}^{\infty} |n+p| |\alpha_{n+p}| |z^n|}{|(\beta_1 + \beta_2)p| - |\beta_1| \sum_{n=1}^{\infty} |n+p| |z^n|} \\ &\leq \frac{\sum_{n=1}^{\infty} |n+p| |\alpha_{n+p}|}{|(\beta_1 + \beta_2)p| - |\beta_1| \sum_{n=1}^{\infty} |n+p|} \end{aligned}$$

Therefore if  $f(z)$  satisfies the inequality (2.1), then  $f(z) \in L_1^s(\beta_1, \beta_2, \lambda)$ .

Conversely, it is simple to verify that if  $f(z) \in L_1^s(\beta_1, \beta_2, \lambda)$ , then

$$\sum_{n=1}^{\infty} (1 + \lambda|\beta_1|) |p+n| |a_{n+p}| \leq \lambda p |\beta_1 + \beta_2|$$

**Corollary 2.1** If  $f(z) \in L_1^s(\beta_1, \beta_2, \lambda)$  then we have

$$|a_{n+p}| \leq \frac{\lambda p |\beta_1 + \beta_2|}{(1 + \lambda|\beta_1|)(n+p)} \quad (n = 1, 2, 3, \dots)$$

**Corollary 2.2** A function  $f(z)$  defined by (1.2) is in the class  $L(\alpha, \beta, \gamma)$  if and only if

$$\sum_{n=1}^{\infty} (1 + \lambda\beta_1) (n+p) a_{n+p} \leq \lambda p (\beta_1 + \beta_2)$$

## 2. Distortion and covering theorem

**Theorem 3.1** : If the function  $f(z) \in L_1^s(\beta_1, \beta_2, \lambda)$  then

$$z^p - \sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)(n+p)} z^{n+p} \leq |f(z)| \leq z^p + \sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)(n+p)} z^{n+p} \quad (3.1)$$

**Proof:** Now  $f(z) \in L_1^s(\beta_1, \beta_2, \lambda)$  then

$$\begin{aligned} |f(z)| &= \left| z^p - \sum_{n=1}^{\infty} a_{n+p} z^{n+p} \right|, \quad (a_n \in \mathbb{C}) \\ &\leq |z^p| + \sum_{n=1}^{\infty} |a_{n+p}| |z^{n+p}| \end{aligned}$$

$$\text{But } |a_{n+p}| \leq \frac{\lambda p |\beta_1 + \beta_2|}{(1 + \lambda|\beta_1|)(n+p)} \quad (n = 1, 2, 3, \dots)$$

$$\begin{aligned} |f(z)| &\leq |z^p| + \sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)} |z^{n+p}| \quad \text{and} \quad \text{also} \quad |f(z)| \geq |z^p| - \\ &\sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)} |z^{n+p}| \end{aligned}$$

$$\text{And hence } z^p - \sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)(n+p)} z^{n+p} \leq |f(z)| \leq z^p + \sum_{n=1}^{\infty} \frac{\lambda p (\beta_1 + \beta_2)}{(1 + \lambda\beta_1)(n+p)} z^{n+p}$$

## 3. Modified Hadamard Product

**Theorem 4.1** : If the functions  $f(z)$  and  $g(z) \in L^s(\beta_1, \beta_2, \lambda)$  then  $f * g \in L^s(\beta_1, \beta_2, \lambda)$

For  $f(z) = z^p - \sum_{n=1}^{\infty} a_{n+p} z^{n+p}$  ( $a_n \geq 0$ ) and  $g(z) = z^p - \sum_{n=1}^{\infty} b_{n+p} z^{n+p}$  ( $b_n \geq 0$ )

Then  $f(z) * g(z) = z^p - \sum_{n=1}^{\infty} a_{n+p} b_{n+p} z^{n+p}$

$$\text{Where } \gamma > \frac{\lambda^2 p (\beta_1 + \beta_2)}{(n+p)(1+\lambda\beta_1)^2 - \lambda^2 p \beta_1 (\beta_1 + \beta_2)}$$

**Proof:** As  $f(z)$  and  $g(z) \in L^*(\beta_1, \beta_2, \lambda)$

$$\frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1 + \beta_2)} a_{n+p} \leq 1 \quad \text{and} \quad \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1 + \beta_2)} b_{n+p} \leq 1$$

We have to find smallest number  $\gamma$  such that

$$\frac{(1+\gamma\beta_1)(n+p)}{\gamma p (\beta_1 + \beta_2)} a_{n+p} b_{n+p} \leq 1$$

By Cauchy's –Schwarz inequality,

$$\frac{(1+\lambda\beta_1)(p+n)}{\lambda p (\beta_1 + \beta_2)} \sqrt{a_{n+p} b_{n+p}} \leq 1 \quad (4.1)$$

Therefore it is enough to show that

$$\frac{(1+\gamma\beta_1)(p+n)}{\gamma p (\beta_1 + \beta_2)} a_{n+p} b_{n+p} \leq \frac{(1+\lambda\beta_1)(p+n)}{\lambda p (\beta_1 + \beta_2)} \sqrt{a_{n+p} b_{n+p}}$$

That is  $\sqrt{a_{n+p} b_{n+p}} \leq \frac{\gamma(1+\lambda\beta_1)}{\lambda(1+\gamma\beta_1)}$

From Equation (4.1)

$$\sqrt{a_{n+p} b_{n+p}} \leq \frac{\lambda p (\beta_1 + \beta_2)}{(1+\lambda\beta_1)(n+p)}$$

Thus it is enough to show that

$$\frac{\lambda p (\beta_1 + \beta_2)}{(1+\lambda\beta_1)(n+p)} \leq \frac{\gamma(1+\lambda\beta_1)}{\lambda(1+\gamma\beta_1)}$$

Which is simplifies to

$$\gamma > \frac{\lambda^2 p (\beta_1 + \beta_2)}{(n+p)(1+\lambda\beta_1)^2 - \lambda^2 p \beta_1 (\beta_1 + \beta_2)}$$

#### 4. Closure Theorem

**Theorem 5.1** If  $f_j(z) \in L^*(\beta_1, \beta_2, \lambda)$   $j = 1, 2, \dots, s$  then  
 $g(z) = \sum_{j=1}^s C_j f_j(z) \in L^*(\beta_1, \beta_2, \lambda)$

Where  $f_j(z) = z^p - \sum_{n=1}^{\infty} a_{n+p} z^{n+p}$  and  $\sum_{j=1}^s C_j = 1$

**Proof:**  $g(z) = \sum_{j=1}^s C_j f_j(z)$

$$\begin{aligned} &= z^p - \sum_{n=1}^{\infty} \sum_{j=1}^s C_j a_{n+p,j} z^{n+p} \\ &= z^p - \sum_{n=1}^{\infty} e_k z^{n+p} \quad \text{where } e_k = \sum_{j=1}^s C_j a_{n+p,j} \end{aligned}$$

Thus  $g(z) \in L^*(\beta_1, \beta_2, \lambda)$  if  $\sum_{n=1}^{\infty} \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} e_k \leq 1$

That is if  $\sum_{n=1}^{\infty} \sum_{j=1}^s C_j a_{n+p,j} \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} \leq 1$

$$\sum_{j=1}^s C_j \sum_{n=1}^{\infty} \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} a_{n+p,j} \leq 1$$

$$\Rightarrow f_j(z) \in L^*(\beta_1, \beta_2, \lambda)$$

**Theorem 5.2 :** If  $f(z), g(z) \in L^*(\beta_1, \beta_2, \lambda)$  then

$$h(z) = z^p - \sum_{n=1}^{\infty} [a_{n+p}^2 + b_{n+p}^2] z^{n+p} \in L^*(\beta_1, \beta_2, \lambda)$$

$$\text{Where } \gamma \geq \frac{2\lambda^2 p (\beta_1 + \beta_2)}{(1+\lambda\beta_1)^2 (n+p) - 2\lambda^2 \beta_1 p (\beta_1 + \beta_2)}$$

**Proof:**  $f(z), g(z) \in L^*(\beta_1, \beta_2, \lambda)$  and so

$$\sum_{n=1}^{\infty} \left[ \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} \right]^2 a_{n+p}^2 \leq \sum_{n=1}^{\infty} \left[ \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} \right]^2 \leq 1 \quad (5.1)$$

$$\text{Similarly } \sum_{n=1}^{\infty} \left[ \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} \right]^2 b_{n+p}^2 \leq 1 \quad (5.2)$$

$$\text{We show that } \sum_{n=1}^{\infty} \left[ \frac{(1+\gamma\beta_1)(n+p)}{\gamma p (\beta_1+\beta_2)} \right]^2 [a_{n+p}^2 + b_{n+p}^2] \leq 1$$

$$\Rightarrow h(z) \in L^*(\beta_1, \beta_2, \lambda)$$

Adding equation (5.1) and (5.2), we get

$$\frac{1}{2} \sum_{n=1}^{\infty} \left[ \frac{(1+\gamma\beta_1)(n+p)}{\gamma p (\beta_1+\beta_2)} \right]^2 [a_{n+p}^2 + b_{n+p}^2] \leq 1$$

That is enough to show

$$\left[ \frac{(1+\gamma\beta_1)(n+p)}{\gamma p (\beta_1+\beta_2)} \right]^2 \leq \frac{1}{2} \left[ \frac{(1+\lambda\beta_1)(n+p)}{\lambda p (\beta_1+\beta_2)} \right]^2$$

By simplifying we get,

$$\gamma \geq \frac{2 \lambda^2 p (\beta_1 + \beta_2)}{(1 + \lambda \beta_1)^2 (n+p) - 2 \lambda^2 \beta_1 p (\beta_1 + \beta_2)}$$

### 5. Radius problem for the class $R(\alpha)$

In this section, we discuss some radius problems for the class  $R(\alpha)$ . To discuss our problems, we need the following lemma for the class  $R(\alpha)$ .

**Lemma 6.1** If  $f(z) \in R(\alpha)$  then,  $\sum_{n=1}^{\infty} (n+p) |a_{n+p}| \leq 1 - \alpha$ .

**Corollary 6.1** If  $f(z) \in R(\alpha)$  then  $|a_{n+p}| \leq \frac{1-\alpha}{(n+p)} \leq 1$

**Remark 6.1** By lemma 6.1 we see that if  $f(z) \in R(\alpha)$  then

$$\sum_{n=1}^{\infty} (n+p) |a_{n+p}|^2 \leq \sum_{n=1}^{\infty} (n+p) |a_{n+p}| \leq 1 - \alpha$$

**Theorem 3.1** If  $f(z) \in R(\alpha)$  and  $\delta \in \mathbb{C}$  ( $0 < |\delta| < 1$ ), then the function

$\frac{1}{\delta} f(\delta z)$  belongs to the class  $L_1^s(\beta_1, \beta_2, \lambda)$  for  $(0 < |\delta| \leq |\delta_0(\lambda)|)$

Where  $|\delta_0(\lambda)|$  is the smallest positive root of the equation

$$h(|\delta|) = (1 + \lambda |\beta_1|) |\delta| \sqrt{(1-\alpha)(2-|\delta|^2)} - \lambda p |(\beta_1 + \beta_2)| (1 - |\delta|^2)$$

in  $0 < |\delta| < 1$

**Proof:** For  $f(z) \in R(\alpha)$ , we see that

$$\frac{1}{\delta} f(\delta z) = z^p + \sum_{n=1}^{\infty} \delta^{n+p-1} z^{n+p} \quad \text{And} \quad \sum_{n=1}^{\infty} (n+p) |a_{n+p}|^2 \leq 1 - \alpha$$

To show that  $f(z) \in L_1^s(\alpha, \beta, \lambda)$ , we need to prove that

$$\sum_{n=1}^{\infty} (1 + \lambda |\beta_1|) |n+p| |a_{n+p}| \delta^{n+p-1} \leq \lambda p |(\beta_1 + \beta_2)|$$

from theorem 2.1 Applying Cauchy-Schwarz inequality, we note that

$$\begin{aligned} & \sum_{n=1}^{\infty} (1 + \lambda |\beta_1|) (1 + \lambda |\beta_1|) |n+p| |a_{n+p}| \delta^{n+p-1} \\ & \leq \frac{[1+\lambda \beta_1]}{|\delta|} \left\{ \left( \sum_{n=1}^{\infty} (n+p) |a_{n+p}|^2 \right)^{1/2} \left( \sum_{n=1}^{\infty} (n+p) |\delta|^{2(n+p)} \right)^{1/2} \right\} \\ & \leq \frac{[1+\lambda \beta_1]}{|\delta|} \left( \sum_{n=1}^{\infty} (n+p) |\delta|^{2(n+p)} \right)^{1/2} \sqrt{1-\alpha} \end{aligned}$$

We note that

$$\sum_{n=1}^{\infty} (n+p) |\delta|^{2(n+p)} = \frac{|\delta|^{4(2-|\delta|^2)}}{(1-|\delta|^2)^2}$$

Therefore we show that

$$\sum_{n=1}^{\infty} (1 + \lambda |\beta_1|) |n+p| |\alpha_{n+p}| \delta^{n+p-1} \leq \frac{(1 + \lambda |\beta_1|) |\delta|}{(1 - |\delta|^2)} \sqrt{(1 - \alpha) (2 - |\delta|^2)}$$

Now, let us consider the complex  $\delta \in \mathbb{C}$  ( $0 < |\delta| < 1$ ), such that

$$\frac{(1 + \lambda |\beta_1|) |\delta|}{(1 - |\delta|^2)} \sqrt{(1 - \alpha) (2 - |\delta|^2)} = \lambda p |(\beta_1 + \beta_2)|$$

If we define the function  $h(|\delta|)$  by

$$h(|\delta|) = (1 + \lambda |\beta_1|) |\delta| \sqrt{(1 - \alpha) (2 - |\delta|^2)} - \lambda p |(\beta_1 + \beta_2)| (1 - |\delta|^2)$$

then we have that

$$h(0) = -\lambda p |(\beta_1 + \beta_2)| < 0 \quad \text{and} \quad h(1) = (1 + \lambda |\beta_1|) \sqrt{1 - \alpha} > 0$$

This means that there exists some  $\delta_0$  such that  $h(|\delta_0|) = 0$  ( $0 < |\delta_0| < 1$ ).

This completes the proof of the theorem.

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# A HYBRID APPROACH FOR DATA SECURITY USING MODIFIED RECURSIVE MODULO AND KEY ROTATION OPERATIONS

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## ABSTRACT

*When it happens data security, communicating something specific needs to be secured keeping in mind the end goal to shield the message from being utilized by an un-approved client. As I contemplated different paper there are having different calculations that protected the information like RSA, DES, TDES moreover. This paper helps in giving more security to the message as it scramble the message first to a muddled organization as it rearranges the letter of the data message keeping in mind the end goal to ensure the message and afterward recursive modulo-2 is connected lastly taken after with key Rotation operation. In Recursive Modulo-2 and key Rotation operation a square of  $n$  bits is taken as an information stream where  $n$  differs from 4 to 256, from a nonstop stream of bits and the strategies works on it to produce the middle encoded stream. This method specifically includes all the bits of pieces in a Boolean operation and a session key. Utilizing of scramble gives more security to the message send by the sender.*

**Keywords:** *scramble, securing message using Recursive MODULO-2 and Key Rotation operation, Cipher text, Block cipher, Session key*

## I INTRODUCTION

In the creating district of the cryptography strong traditions are used feasibly as a piece of the technique for guaranteeing mystery information in the midst of its transmission more than a framework. Information is encoded at the senders end using an encryption tradition and a key. On landing at the goal point, the endeavor of translating is executed utilizing an unscrambling tradition close by a key to recoup the source information. Encryption and disentangling are in nutshell termed as cryptography. On the reason of the keys used as a piece of the entire methodology, there exists two grouping of cryptography. The current field of cryptography can be partitioned into a few ranges of study: Symmetric key cryptography, open key cryptography, cryptanalysis, cryptography primitives, cryptosystems. Symmetric key cryptography alludes to encryption system in which both sender and collector have the same key .symmetric key figure are executed as either piece figure or stream cipher. A square figure and enciphers enter in pieces of plain content instead of individual character. The info structure utilized by a stream figure. key cryptography alludes to encryption technique in which both sender and collector utilizes diverse key public key cryptography can likewise be utilized for

actualizing computerized marks key. The goal of cryptanalysis is to find a couple of deficiency or feebleness in a cryptographic arrangement, thusly permitting its subversion or avoidance. it is a commonplace distortion that every encryption system can be broken.

Region 2 of the paper deals with the proposed technique, Expected.Results are given in area 3, conclusion are given on area 4, References are given in area 5 .

## II METHODOLOGY

Figure shown the overall flow of our proposed technique.

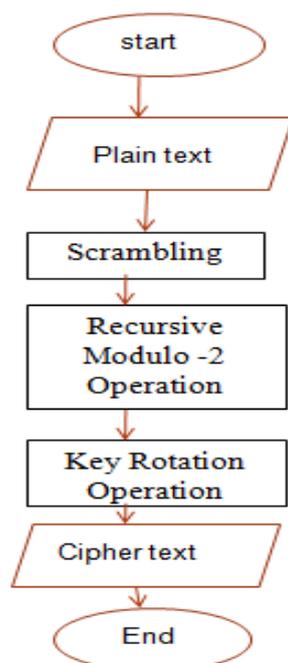


Fig: Encryption process

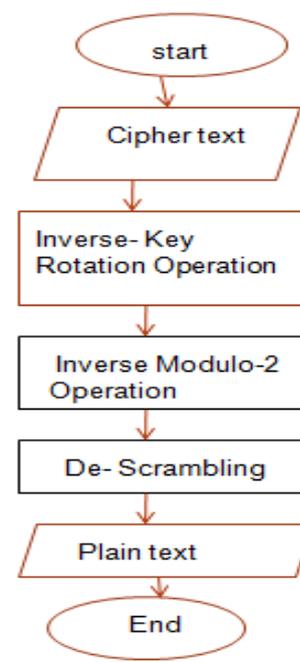


Fig: Decryption process

This techniques operates in three phases:

### a. First phase scramble the message using scrambler.

It takes the plaintext then calculate the length of the string then generate pseudo random sequence of length string and permute the input the input string index to the pseudo random sequence pattern. here snapshot shown the process of scrambling. Here the first snapshot shows the output of scrambling process other snapshot shows the ASCII form then converted into binary form which is then used by Modulo operation.

```

Command Window
Enter the text to encrypt :sonali sahu

Length of the string : 11

Sequence Genrated by PRNG : 11
Sequence Genrated by PRNG : 5
Sequence Genrated by PRNG : 6
Sequence Genrated by PRNG : 3
Sequence Genrated by PRNG : 10
Sequence Genrated by PRNG : 8
Sequence Genrated by PRNG : 4
Sequence Genrated by PRNG : 7
Sequence Genrated by PRNG : 2
Sequence Genrated by PRNG : 9
Sequence Genrated by PRNG : 1

ulinhsa cas
    
```

asinp <11x1 uint8>				
	1	2	3	4
1	105			
2	110			
3	117			
4	32			
5	115			
6	108			
7	115			
8	111			
9	97			
10	97			
11	104			
12				
13				
14				
15				
16				
17				
18				

```

abc bintext <11x8 char>

val =

01101001
01101110
01110101
00100000
01110011
01101100
01110011
01101111
01100001
01100001
01101000
    
```

**b. Second phase encrypt the message using Recursive Modulo-2 Operation .**

The technique consider the plaintext from the first phase as a stream of finite number of bits N , and is divided into a finite number of blocks, each also containing a finite number of bits n ,where , 1<=n<=N.

The principle of Recursive Modulo-2 Operation is discussed in following manner:

Let P = \_\_\_\_\_ is a block of size n in the plaintext. Then the first intermediate block can be generated from P in the following way:

$$s_2^1 s_3^1 = s_0^0 s_1^0 \oplus s_4^0 s_5^0$$

,  $0 \leq i < (n-1)$ ,  $0 \leq j < (n-1)$ ;  $\oplus$  stands for the exclusive-OR operation.

In the same way, the second intermediate block of the same size (n) can be generated by:

$$s_0^2 s_1^2 = s_0^1 s_1^1 \oplus s_2^1 s_3^1$$

$$s_2^2 s_3^2 = s_0^1 s_1^1 \oplus s_4^1 s_5^1$$

,  $0 \leq i < (n-1)$ ,  $1 \leq j < (n-1)$ ;  $\oplus$  stands for the exclusive-OR operation.

### c. Third Phase encrypt the output of above phase by Recursive Key Rotation.

The rules to be followed for generating a cycle are as follows:

1. Consider any source stream of a limited number (where  $N=2n$ ,  $n=3$  to 8) and gap it into two a balance of.
2. Consider any key worth (key=  $2n$ , where  $n=1$  to 7) relies on the source stream that is, key quality is the a large portion of the source stream).
3. Make the modulo-2 expansion (X-OR) with the key worth to the first a large portion of the source stream, to get the first middle of the road piece.
4. Make the modulo-2 expansion with the key quality (however now the key worth is switched) to the last a large portion of the source stream to get the second transitional square.

The same operation is performed for whole stream number of time with a varying block sizes.

### III EXPECTED RESULT

When we using this proposed approach definitely we will protect out data by attackers. it provides level of security ,it may be difficult to decrypt the message if the message is encrypted using the proposed key system or like manner.

- Increase the security of data transmission.
- Minimize the encryption and decryption time.
- Reduce effect of crypt analysis.
- Reduced time complexity

### VI CONCLUSION

Technique presented here is implemented for different categories of files like .cpp, .exe,.doc,.dll, .sys.When this technique is implemented with X-NOR or other operations using the same logic it will not generate a cycle so

this logic cannot be implemented with the other operations. This technique is implemented on 1.3 GHZ processor. the file size increases the encryption time as well as decryption time increases. For this technique only eight bits blocks are taken, and the third intermediate block is considered here as encrypted stream, so the time required to get the encrypted stream is always be larger than that of decryption because only one iteration is required to get the source stream in the decryption part.,since this technique generates a cycle.It can be easily implemented in any high level language in different form for practical application purpose to provide security in message transmission.

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# PROJECTILE MOTION USING MATLAB

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**A. Clara Dhanemozhi**

## ABSTRACT

A body in free fall experiences only to the forces of gravity and air resistance. A body when projected into air with some velocity at an angle with the horizontal is called a projectile. When the body takes the projectile motion, there may be air friction acting on the body. When there is no air friction, the projectile is moving in a typical parabolic path. The horizontal velocity remains constant and the vertical motion is influenced only by gravity. With air friction, the path is no longer parabolic. The projectile does not travel with a constant velocity, but it decelerates. The vertical motion will be under the combined influence of gravity and air friction. Gravity works only downward while air friction works against the direction of motion of the object. This paper describes the usage of **MATLAB** to trace the path of the projectile motion of any body when its velocity and angle are changing. MATLAB is a commercial software tool for the purpose of performing numerical calculations and data visualization. This can be mainly used to trace the path of the missile to hit the target by simulation process.

**Key Words:** Angle, Friction, Gravity Projectile, Velocity

## I INTRODUCTION

A body projected into air with some velocity at an angle with the horizontal is called a projectile and, which is then allowed to move under the action of gravity alone, without being propelled by any engine or fuel, is called the projectile motion. The path followed by a projectile is called its trajectory. A projectile moves at a constant speed in the horizontal direction while experiencing a constant acceleration of  $9.8 \text{ m/s}^2$  downwards in the vertical direction. When the body takes the projection, the friction due to air plays a major role on the body to reach the surface. The path of the trajectory varies due to air friction. Our aim is to trace the path of the projectile motion with and without air resistance using MATLAB tools for two dimensional motions by varying the velocity and angle of projection.

## II THEORY

When the flying object moves through the air, there is a relative motion between it and the air. In our study of projectile motion, we assumed that air-resistance effects are negligibly small. But in fact air resistance often called air drag, has a major effect on the motion of many objects, including tennis balls, bicycle riders, and airplanes. When air drag is neglected, the only force acting on a projectile with mass  $m$  is its weight  $mg$ . The components of the projectile's acceleration are the  $+x$ -axis is horizontal, and the  $+y$ -axis is vertically upward. The air drag force is included when it acts on the projectile. The magnitude  $f$  of the air drag force is approximately proportional to the square of the projectile's speed relative to the air:

$$f = Dv^2 \quad \text{----- (1)}$$

where  $v^2 = v_x^2 + v_y^2$

The constant  $D$  depends on the density of air, area  $A$  of the body and a dimensionless constant  $C$  called the **drag coefficient** that depends on the shape of the body.

### Time of Flight

The time interval between the time of projection and the time when the projectile passes the same horizontal plane through the point of projection is called the time of flight.

$$t_R \sim (2v_{iz}/g) \text{ -----(2)}$$

### Range of projectile

The minimum horizontal distance travelled by the projectile from the point of projection during the time flight is called its flight.

Its unit is m and dimension is L.

Ø For Projectile motion without air resistance,

$$R = v_i^2 \sin 2\theta / g \text{ -----(3)}$$

Ø For Projectile motion with air resistance,

$$R = (m/c) v_{ix} (1 - e^{-(c/m)t_{\max}}) \text{ -----(4)}$$

### Maximum height:

The maximum height attained by the projectile motion is

$$z_{\max} = v_{iz}^2 / 2g \text{ -----(5)}$$

### Projectile motion

A particle moves in vertical plane with some initial velocity  $\mathbf{v}_0$  but its acceleration is always the free fall acceleration  $\mathbf{g}$ , which is downward.

Our aim here is to analyze projectile motion using the tools for two dimensional motions and making the assumption that air has no effect on the projectile. From figure the path followed by a projectile when the air has no effect. The projectile is launched with an initial velocity  $\mathbf{v}_0$  that can be written as

$$\mathbf{v}_0 = v_{0x} \hat{\mathbf{i}} + v_{0y} \hat{\mathbf{j}} \text{ -----(6)}$$

the components  $v_{0x}$  and  $v_{0y}$  can then be found if we know the angle  $\theta_0$  between  $\mathbf{v}_0$  and the positive x direction

$$v_{0x} = v_0 \cos \theta_0 \text{ and } v_{0y} = v_0 \sin \theta_0 \text{ -----(7)}$$

during its two dimensional motion, the projectile's position vector  $\mathbf{r}$  and velocity vector  $\mathbf{v}$  change continuously, but its acceleration vector  $\mathbf{a}$  is constant and always directed vertically downward. The projectile has no horizontal acceleration. In Projectile motion, the horizontal motion and the vertical motion are independent of each other; that is, neither motion affects the other.

The path of a projectile that is launched at  $x_0 = 0$  and  $y_0 = 0$ , with an initial velocity  $\mathbf{v}_0$ . The initial velocity and the velocities at various points along its path, along with their components. Note that the horizontal velocity components remain constant but the vertical velocity component changes continuously. The range  $R$  is the horizontal distance the projectile has travelled when it returns to its launch height.

### The vertical motion

The vertical motion is the motion for a particle in free fall, where the acceleration is constant.

$$y - y_0 = v_{0y}t - 1/2gt^2 \text{ -----(8)}$$

$$= (v_0 \sin \theta_0)t - 1/2gt^2 \text{ -----(9)}$$

Where the initial vertical velocity component  $v_{0y}$  is replaced with the equivalent  $v_0 \sin \theta_0$ .

$$V_y = v_0 \sin \theta_0 - gt \text{ -----(10)}$$

$$V_y^2 = (v_0 \sin \theta_0)^2 - 2g(y-y_0). \text{ -----(11)}$$

The vertical velocity component behaves just as for a ball thrown vertically upward. It is directed upward initially, and its magnitude steadily decreases to zero, which marks the maximum height of the path. The vertical velocity component then reverses direction, and its magnitude becomes larger with time.

### The horizontal motion

Since there is no acceleration in the horizontal direction, the horizontal component  $v_x$  of the projectile's velocity remains unchanged from its initial value  $v_{0x}$  throughout the motion. At any time  $t$ , the projectile's horizontal displacement  $x-x_0$  from an initial position  $x_0$ , is given by the equation

$$x-x_0 = (v_0 \cos \theta_0)t \text{ -----(12)}$$

### The equation of the path

We can find the equation of the projectile's path (its trajectory) is

$$Y = (\tan \theta_0)x - gx^2/2(v_0 \cos \theta_0)^2 \text{ -----(13)}$$

As  $g$ ,  $\theta_0$ , and  $v_0$  are constants, equation (13) is of the form  $y = ax + bx^2$ , in which  $a$  &  $b$  are constants. This is the equation of a parabola, so the path is parabolic.

The horizontal range  $R$  of the projectile is the horizontal distance the projectile has travelled when it returns to its initial (launch) height. To find range  $R$ , let us put  $x - x_0 = R$  in equation (12) and  $y - y_0 = 0$  in equation (8), the equation becomes

$$R = (v_0 \cos \theta_0)t \text{ -----(14)}$$

$$0 = (v_0 \sin \theta_0)t - 1/2gt^2 \text{ -----(15)}$$

Eliminating  $t$  between these two equations yields,

$$R = 2v_0^2/g \sin \theta_0 \cos \theta_0 \text{ -----(16)}$$

Using identity  $\sin 2\theta_0 = 2 \sin \theta_0 \cos \theta_0$ . We obtain

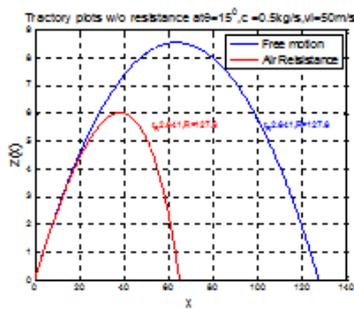
$$R = v_0^2/g \sin 2\theta_0. \text{ -----(17)}$$

This equation does not give the horizontal distance travelled by a projectile when the final height not the launch height. Note that  $R$  in eqn(17) has its maximum value when  $\sin 2\theta_0 = 1$ , which corresponds to  $2\theta_0 = 90^\circ$  or  $\theta_0 = 45^\circ$ . The horizontal range  $R$  is maximum for a launch angle of  $45^\circ$ . However, when the launch and landing heights differ, as in shot put, hammer throw, and basketball, a launch angle of  $45^\circ$  does not yield the maximum horizontal distance. We have assumed that the air through which the projectile moves has no effect on its motion. However, in many situations, the disagreement between our calculations and the actual motion of the projectile can be large because the air resists (oppose) the motion.

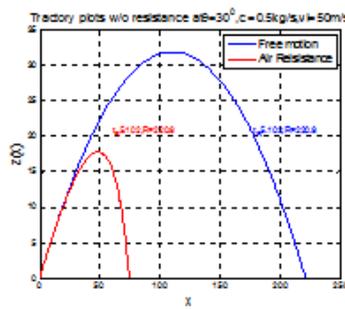
### MATLAB

MATRIX LABORATORY is a numerical computing environment and fourth generation programming language developed by math works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces and interfacing with programs written in other

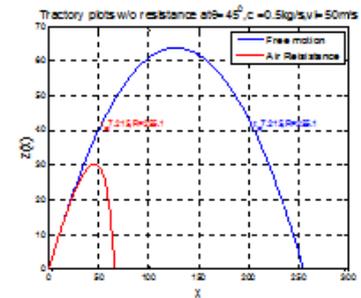
languages, including C++. Various applications of MATLAB are algorithm development, computation, Data acquisition, Modelling, simulation, Data analysis, exploration, and visualization. We have used the MATLAB version 7.9.0.529(R2009b). With the developed algorithm, a program is written to trace the path of the projectile by varying angle, velocity and drag coefficient. Fig. 1(a) – Fig.1(e) depicts the path of the trajectory when angle is varied and keeping velocity and drag coefficient constant. Fig2. shows the trajectory path for various angles. The program can be used effectively to trace the path of a missile.



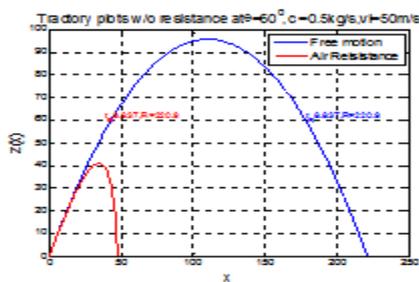
1(a)



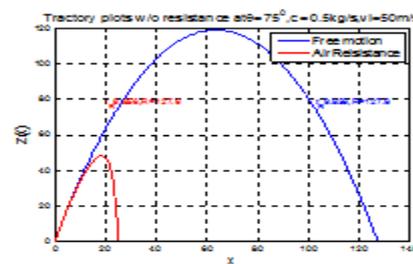
1(b)



1(c)



1(d)



1(e)

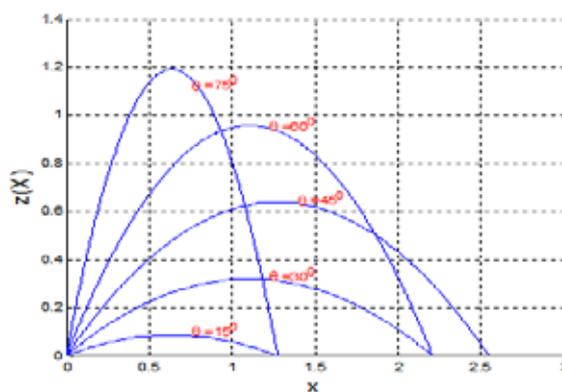


Fig.2 Trajectory path for various angles

#### IV CONCLUSION

While projectile motion functions well under the circumstances for which it was designed, many measurements of time an object remains in the air and the distance travelled will deviate from the predictions of projectile

motion. This deviation is largely due to air resistance. Air Resistance is the force that exerts on any object moving through it due to collisions with the object and surrounding air pressure. The movement of air varies at a steady rate governed by the forces acting on it. When the projectile is launched at a steep angle, it spends more time in the air than it does when launched at a shallow angle. When the projectile is launched at a shallow angle, it goes faster in the horizontal direction than if it is launched at a steep angle. Projectiles are widely used by sportsmen, especially the javelin throw; shot put, discus and hammer throw archery and shooting. The main application of it is used in missile launching.

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# A SURVEY ON SALES PERFORMANCE IMPROVEMENT USING EMOTION MINING & SENTIMENTS ANALYSIS

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## ABSTRACT

The main motive of any organization is to know about end user satisfaction and the sentiments related to their product for improvement in their sales performance. If any organization knows exactly the main reason behind deteriorating sale of their product, then it will certainly help them to improve the quality of product, according to consumer demands. What is the method?? Is there any trick or any shortcut method to know the emotions of thousands of end users? Yes, the answer is - social media, using which we can easily trace the sentiments of thousands of users, without direct interaction which is a time consuming process. "The process to track the emotions or sentiments of people and to analyze them is known as emotion mining." In this research paper we are going find emotion regarding some product which we use in our daily life by collecting data from various social media sites we like twitter, face book mouthshut.com .Then, we will form clusters of similar data which occur frequently expressing various basic emotion like Happy, joy, sad, angry etc. Next, we score them and find a score metric. The score matrix will indicate the actual performance of our product in market. The lower score indicates the lower demand of product means dissatisfaction among the end users resulting in- decrement of sale . So using emotion mining we can find out the dis-satisfaction factor of a product. After working on this factor (the main cause) we can improve our sale to a great extent.

## I. INTRODUCTION

Emotions are the key influencers of human behaviors. When we are required to take a decision, it is quite natural to look for others opinion .Similarly organizations too need the valuable opinion of consumers or public about their products and services. In the same manner customers also want to know the opinion of, existing users of a product before purchasing it.

In the past, they used to conduct -surveys, opinion polls, and focus groups to acquire public opinion. With a number of social media and micro blogging websites number of users are posting or sharing their feedback which is being used by users and organizations to analyze the content for making decisions. Irrespective of the usage these tweets often convey information about author's emotions. If we extract the keywords we can analyze the emotions behind it, which can be useful in various applications such as- Sales analysis and prediction, customer care etc.. In this research paper we are trying to develop a model to retrieve or extract emotions of the people by clustering the feedbacks of various users of different products and applying it to a rule based engine to identify similar words. We have collected data from various websites like mouthshut.com, twitter, facebook.com, etc.

To extract the resultant summary from collection of emotions from various social networking sites on the internet is called emotion mining<sup>[1]</sup>. Here in this paper we are going to apply this concept in to promotion of sale of any organization

## II. USER OPINION

A novel method may need to be adapted to deal with this type of text. The Natural Language Processing and its relevance's represent some useful tools for opinion mining and it also faces some difficulties in some aspects of documents, because each user takes up different style of opinion, thinking and way of writing. This paper will try to identify some of these aspects.

### 2.1 Customer Opinions

Each customer expresses their opinion on their own perspective, skill of writing, and thinking. Some objective entities can be divided into the following categories.

**2.1.1 Direct Opinion:** This type of opining is explicit if a feature or any of its synonyms appears in a sentence. This feature could be identified as explicit or direct opinion and they appear directly in a review. E.g.:

“The accuracy of the iPod is slow”.

**2.1.2 Indirect Opinion:** This type of opining is implicit if a feature or any of its synonyms does not appear in a sentence. This feature could be identified as explicit or indirect opinion and they do not appear directly in review. E.g.: “My compSanion said that you lost your money by purchasing this iPod”.

**2.1.3 Comparative Opinion:** This type of opinion is done by comparing more than one entity. This kind of opinion is useful for the customers or reviewers to make a comparison of similar products.

E.g.: “Apple iPod is better than Samsung.”

## III. CLASSIFICATION OF OPINION

When we read any sentence or any document or any phrase about anything then this describe some positive or negative opinion about that particular thing. Like

“*I purchase a Micromax mobile, its model is very good looking. The mobile has many feature but my friend says it has little bit slower speed but mobile is very good*”<sup>[3]</sup>.

In this paragraph there is positive opening about Micromax mobile but a single sentence is give it a negative shade – the slower speed. On the basis of all these analysis we can classify sentiments and emotion analysis broadly like:

- a. On the basis of overall paragraph or full document.
- b. On the basis of a sentence.
- c. On the basis any particular phrase.

Let's take it one by one:

**3.1 Document level:** The task of this level is to classify the resultant sentiment of full document whether it is giving positive or negative sentiments<sup>[2]</sup>.

**3.2 Sentence level:** The task of this level is to determine whether the given sentence expressed positive, negative or neutral expression. Neutral means no any opinion.

**3.3 Phrase level:** The task of this level is to determine whether the given phrases expressed positive, negative or neutral expression. Neutral means no any opinion.

## IV. PROCESS OF EMOTION MINING

Emotion mining unlock the sentiments of customers in business endeavor through:

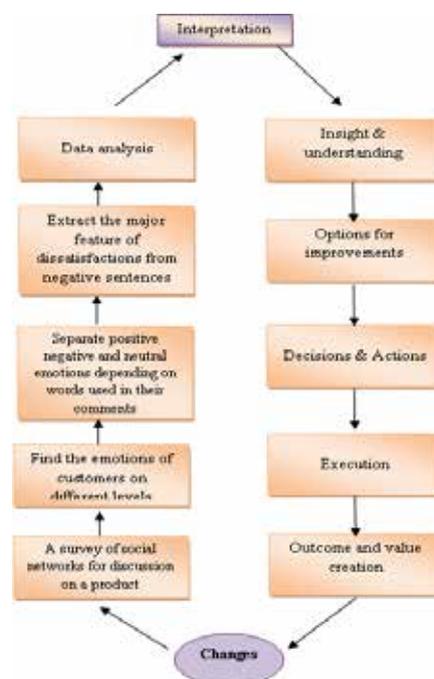
**4.1 Clarification:** The actor process of making clear and transparent emotion means feelings and emotions matter. But feelings and emotions are exquisitely sensitive to biasing factors: environmental clutter, interpersonal noise, and personality traits and states. Emotion Mining clarifies emotional responses by eliminating the biases that limit research, communication, and decision making.

**4.2 Inspiration:** The key challenge and opportunity in motivating (and inspiring) new interest and new behavior is to have knowledge of the audience, particularly the capacity to be motivated (and inspired). 'Moving the (sales) needle' through motivating (and inspiring) people to act depends on targeting communications to capture the imagination of audiences in a highly relevant, credible, persuasive, appealing, and entertaining way<sup>[5]</sup>

**4.3 Prediction:** Emotion Mining produces emotion profiles that identify why and how to communicate to motivate new interest and new behavior. Emotion Mining's subconscious 'triggers' and 'hot buttons' describe a possible, perhaps probable, and easily testable future.

## V. THE MODEL

In Fig 1 A Model Describe Step By Step Process of How Any Organization Can Improve Their Performance After Analyzing The Customer Feedback or Comments From Social Networking Sites.



**Figure 1: Process Model to Find Improvement Factor In Sales**

The process is like a cycle where organization read the emotions of end user, apply the data mining process to retrieve the significance information from the pool of data. Then interpret this information in industrial terms by which we can find out the main reason behind the degradation of sales. In any organization there are many

options available to do the changes in their own product they can find the best using decision making process. Apply the changes on product. Then again repeat the cycle. We can say that this is a endless cycle with infinite looping because according to time there could be a new reason every time like change in interest, seasons, fashion change etc behind effects on sales so there is a every time need to be updated.

Let's take these steps one by one;

### **5.1 Survey of Social Network**

By recognizing Text, speech, body gestures and some visual information from any social networking site like tweeter face book etc, we can find the opinion or emotion regarding any product or thing available in the market. This process is called micro blogging.

### **5.2 Find Emotions on Different Levels**

This is a major step of emotion mining cycle. Because everyone has his owns emotions regarding any thing by comparing these emotions and the words used to describe that emotion we can generate a generalize conclusion on what he think about anything; like happy, sad, anger etc.

### **5.3 Separate Positive and Negative Emotions**

By analyzing the type of emotion and the words used to express it we can separate positive and negative emotions. For improvement on sales we should know about what are the negative things which user doesn't like. This will give a clear direction of field of improvement.

### **5.4 Extract The Major Dissatisfaction Factor**

There may be more than one factors of negative opinion. Categorize the dissatisfaction factors and find out the major factor of dissatisfaction.

### **5.5 Data Analysis and Interpretation**

Apply algorithms and find out interpretation. The main purpose of this phase is to transform the data collected in to credible evidence about the development of the intervention and its performance.

This process usually includes the following steps:

1. Organizing the data for analysis (data preparation)
2. Describing the data
3. Interpreting the data (assessing the findings against the adopted evaluation criteria).

### **5.6 Understanding and Options For Improvements**

After analyzing deeply finally we have a priority wise list of different factors which affect our sales performance, we can apply here a decision making process to find out different possible solutions of a problem for improvement.

### **5.7 Decision, Action and Execution**

Find out the final decision regarding changes of any point or stage of product development life cycle. Changes could be major changes or minor any kind. Action can affect any one phase or may be more than one phase of development cycle <sup>[4]</sup>.

For Execution of these changes we can create a change management execution plan

A common problem within change management is the generation of a sequential list of tasks to implement a specific change type.

Now analyze the final outcome and again apply the research process on market outcome. This is a endless process through which we change our product according to market needs. Market needs are not stable there are many things which affect the consumer interest like weather, cost, comparing product etc. which affect the sale of product, so there is always a scope of changes.

## VI. CONCLUSION

Customer's opinion plays a key role in deciding the success rate of any product. It is no longer necessary to conduct surveys, opinion polls, and focus groups in order to gather public opinions as there is an abundance of such information on various social networking sites like twitter, Facebook etc. However, finding and monitoring emotions on the Web and distilling the information contained in them is a difficult task. Each site typically contains a huge volume of opinion text and average human reader will have difficulty identifying relevant sites and extracting and summarizing the opinions in them. In this paper we have provided a model for automated sentiment analysis which takes a survey of social networking sites, Extracts emotions, classifies them into positive or negative emotions and analyzes the factor causing dissatisfaction which paves way for any organization to enhance their product for better sale.

## VII. FUTURE SCOPE

In our model we have presented a basic process model to gather the general customer emotion regarding a particular product which is further analyzed to understand the dissatisfaction factor or the root cause behind poor sales. As part of our future work we are working on graph-based hashtag approach for classifying posts on social networking sites and blogs.

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# INTELLIGENT VEHICULAR COMMUNICATION SYSTEM FOR COLLISION AVOIDANCE AND EVALUATION METRICS

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## ABSTRACT

*Adhoc networks consider vehicals as their prime area of development and many projects are already running for investigation of number of application areas including traffic and travel information systems.*

*In this paper we present conceptual model of intelligent networks and the general concept of intelligent ad hoc vehicular network for Collision Avoidance and later we describe the logical framework auto sensing of traffic information in vehicular ad hoc networks. Collaborative Signal and Information Processing is utilized to allow this higher level information to be generated by collaboration between nodes.*

*Efficient traffic alerts and updated information about traffic incidents will reduce traffic jams, increase road safety and improve the driving in the city.*

*This scheme is application specific and requires some knowledge of the topology of the road network. At this stage we have assumed this information can be obtained from a digital map.*

**Keywords:** *Gps, Manet, Traffic & Travel Information Systems, Vanet , Vehicular Networks, Wireless Technology*

## I. INTRODUCTION

Vehicular Ad Hoc Networks (VANET) are a form of MANETs used for communication among vehicles and between vehicles and roadside equipment.

In VANET is an Intelligent Vehicular AdHoc Networking and uses WiFi IEEE 802.11 and WiMAX IEEE 802.16 for easy and effective communication between vehicles with dynamic mobility. Effective measures such as media communication between vehicles can be enabled as well methods to track automotive vehicles. In VANET is not foreseen to replace current mobile (cellular phone) communication standards.

### 1.1 Mobile Ad-Hoc Network (MANET)

A mobile ad-hoc network (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which form an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet.

Many commercial field forces deploy a ruggedized portable computer such as the Panasonic Tough book 29 with their fleet of vehicles. This requires the units to be anchored to the vehicle for driver safety, device security, and user ergonomics. The rugged laptops are rated for severe vibration associated with large service vehicles and off-road driving, and harsh environmental conditions of constant professional use such as in EMS, fire and public safety.

Within an ad hoc network, although each node (vehicle) is an independent device, by coordinating their sensing, processing and communication to acquire information about their environment, it is possible to accomplish high level tasks. This collaboration makes nodes more autonomous and as a whole, forms a novel type of distributed sensor network.

## **II. INTELLIGENT NETWORKS**

### **2.1. The Need for Intelligence**

Integration of 3G solutions isn't the only step mobile operators must take to support today's and tomorrow's subscribers and services.

They must deploy systems that utilize leading technologies to the fullest advantage. The new systems must provide two key areas of System intelligence. The interaction with subscribers, services, and transport mechanisms. The service flexibility, which is the ability to enable subscribers to choose how they access the network and their services.

#### **2.1.1. Interaction**

The level of interaction requires the advanced ability to inspect packets from individual transactions in great detail, which will provide the mobile operator with a greater understanding of its subscribers. With this vital capability, mobile operators can determine subscriber usage patterns, and then make intelligent decisions regarding deployment of customized services and service billing.

In order to capture this information, mobile operators must deploy an intelligent mobile gateway at the edge of the packet core that will perform deep packet inspection to determine the subscriber's service level and align it with applications, location, portal access, community.

Services or other criteria. It can then examine the network status and conditions. When the intelligent mobile gateway understands all the dynamics of the subscriber session, it can intelligently shape the session using quality of service (QoS), bandwidth allocation, and flow control. This allows operators to actively shape and manage traffic flows, improving the mobile subscribers' experience, and appropriately charging the subscriber.

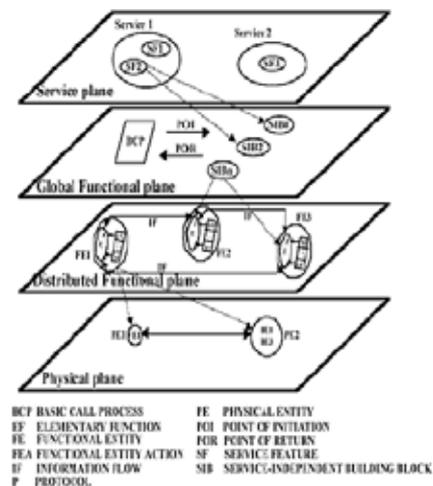
Furthermore, deep packet inspection functionality provides much more flexibility for operations, such as subscriber classification and billing. With this ability, mobile operators can account and bill for services based on criteria, such as time, location, per usage, service level, destination, application, and other parameters, while employing billing techniques like pre-paid, reverse charge, push service billing, and many others.

#### **2.1.2. Service Flexibility**

An intelligent mobile gateway positioned at the edge of the network not only efficiently handles the traffic, it has the processing power and memory required for a resource intensive transaction, such as streaming audio or video, that would ordinarily overburden a mobile device. In such transactions, the information can be cached at the edge of the network where it can be appropriately processed, managed, and streamed to the subscriber, reducing the impact on the mobile device and network, thereby enhancing the subscriber's capabilities.

## 2.2. Conceptual Model of The Intelligent Network

The IN standards present a conceptual model of the Intelligent Network that model and abstract the IN functionality in four planes shown in “Fig. 1” –



**Figure 1: IN Conceptual Model**

The **Service Plane (SP)**: This plane is of primary interest to service users and providers. It describes services and service features from a user perspective, and is not concerned with how the services are implemented within the network.

The **Global Functional Plane (GFP)**: The GFP is of primary interest to the service designer. It describes units of functionality, known as service independent building blocks (SIBs) and it is not concerned with how the functionality is distributed in the network. Services and service features can be realised in the service plane by combining SIBs in the GFP.

The **Distributed Functional Plane (DFP)**: This plane is of primary interest to network providers and designers. It defines the functional architecture of an IN-structured network in terms of network functionality, known as functional entities (FEs). SIBs in the GFP are realised in the DFP by a sequence of functional entity actions (FEAs) and their resulting information flows.

The **Physical Plane (PP)**: Real view of the physical network. The PP is of primary interest to equipment providers. It describes the physical architecture for an IN-structured network in terms of physical entities (PEs) and the interfaces between them. The functional entities from the DFP are realised by physical entities in the physical plane.

## III. CONCEPT OF INVANET

InVANET is an Intelligent Vehicular AdHoc Networking and uses WiFi IEEE 802.11 and WiMAX IEEE 802.16 for easy and effective communication between vehicles with dynamic mobility. Effective measures such as media communication between vehicles can be enabled as well methods to track automotive vehicles. InVANET is not foreseen to replace current mobile (cellular phone) communication standards.

"Older" designs within the IEEE 802.11 scope may refer just to IEEE 802.11b/g. More recent designs refer to the latest issues of IEEE 802.11p (WAVE, draft status). Due to inherent lag times, only the latter one in the IEEE 802.11 scope is capable of coping with the typical dynamics of vehicle operation.

Automotive vehicular information can be viewed on electronic maps using the Internet or specialized software. The advantage of WiFi based navigation system function is that it can effectively locate a vehicle which is inside big campuses like universities, airports, and tunnels. InVANET can be used as part of automotive electronics, which has to identify an optimally minimal path for navigation with minimal traffic intensity. The system can also be used as a city guide to locate and identify landmarks in a new city.

Communication capabilities in vehicles are the basis of an envisioned Intelligent Vehicular AdHoc Network (InVANET) or Intelligent Transportation Systems (ITS). Vehicles are enabled to communicate among themselves (vehicle-to-vehicle, V2V) and via roadside access points (vehicle-to-roadside, V2R). Vehicular communication is expected to contribute to safer and more efficient roads by providing timely information to drivers, and also to make travel more convenient. The integration of V2V and V2R communication is beneficial due to the fact that V2R provides better service sparse networks and long distance communication, whereas V2V enables direct communication for small to medium distances/areas and at locations where roadside access points are not available.

Providing vehicle-to-vehicle and vehicle-to-roadside communication can considerably improve traffic safety and comfort of driving and traveling. For communication in vehicular ad hoc networks, position-based routing has emerged as a promising candidate. For Internet access, Mobile IPv6 is a widely accepted solution to provide session continuity and reach ability to the Internet for mobile nodes. While integrated solutions for usage of Mobile IPv6 in (non-vehicular) mobile ad hoc networks exist, a solution has been proposed that, built upon on a Mobile IPv6 proxy-based architecture, selects the optimal communication mode (direct in-vehicle, vehicle-to-vehicle, and vehicle-to-roadside communication) and provides dynamic switching between vehicle-to-vehicle and vehicle-to-roadside communication mode during a communication session in case that more than one communication mode is simultaneously available.

### **3.1. Ipv6**

Mobile IPv6 is a version of Mobile IP - a network layer IP standard used by electronic devices to exchange data across a packet switched internetwork. Mobile IPv6 allows an IPv6 node to be mobile—to arbitrarily change its location on an IPv6 network—and still maintain existing connections.

## **IV. INTELLIGENT TRANSPORTATION SYSTEM NETWORK ARCHITECTURE**

The ad hoc network will comprise two node types: mobile nodes (vehicles) and fixed nodes deployed at the roadside. The number of fixed nodes in the network will be small relative to the number of mobile nodes. A subset of these fixed nodes will be connected to external networks. Each vehicle participating in the ITS will be equipped with a telemetric platform interfaced to on-board systems through a CAN bus. Through this platform data will be collected and analyzed from on-board sensors. These sensors may include,

- Anti-Lock Braking System (ABS)
- Automatic Traction Control (ATC)
- Speedometer
- Airbag and crash sensors.

It is assumed that vehicles are able to obtain positional information from on-board GPS receivers. All nodes are equipped with a processor, memory and digital communication equipment. Nodes organize themselves into a number of local ad hoc networks (or clusters). At this local level, a proactive routing scheme is adopted so that

communication between nodes in the same cluster is responsive. Nodes advertise their presence to their immediate neighbors by transmitting periodic beacons. These beacons are essentially empty packets with information contained only in the packet header. Information in the packet header is shown in Table 1;

<i>Field Name</i>	<i>Description</i>
Node ID	Unique identifier.
Time-stamp	Time packet was transmitted.
Destination	ID of destination node
Location	Geographical location of originating node.
Velocity	Velocity of originating node.
Heading	Navigational heading of node.

**Table 1: Summary of packet header**

On receipt of a beacon message, the 'node id' of the originating node is added to a list of neighbors. Nodes regularly scan this list to determine link states. If no beacon message is received from a node in the list, after a given period of time the neighbor is considered lost. This process enables link-state information to be constructed and maintained for the local ad hoc network.

#### **4.1 Collaborative Signal and Information Processing**

Collaborative signal and information processing (CSIP) [Kumar et al, 2002] provides the data representation and control mechanisms to allow nodes in the ad hoc network to collaboratively process and store sensor information, respond to external events and report results [Liu et al, 2002].

Traffic information is generated in the network by means of task requests. Task requests may be issued by individual nodes or they may be 'injected' into the network through a fixed node with a connection to an external network. Task requests are divided into types with each relating to some well-known traffic phenomenon, for instance one task request may be to detect "ice on the road". Each task request type is associated with one or more of the available onboard sensors which may be sampled to determine the existence of the phenomenon. Taking the "ice on the road" task request as an example, it may be associated with the ABS, ATC and an external thermometer. Particular readings from each of these sensors can be interpreted to indicate that there is "ice on the road".

When a sensing task is generated, it is added to the task list of the originating node. Each entry in the task list contains a number of name-value pairs. The node then transmits the task request to its immediate neighbors. On receipt of the task request, the receiving node checks if there is a corresponding entry in its own task list. If a task request of equal priority and of the same origin is not found in the task list, the new task request is added. The node then directs its subsystems to begin sampling each of the on-board sensors that has indicated by the type of the task request. Samples are then compared with the ranges specified and combined to determine if the event type given in the task request is also occurring at that location. These results are summarized in a task response message and transmitted to the node identified as the origin of the task request. When task requests are forwarded, the forwarding node adds their own 'node ID' to the task request i.e., they become the originator of that task request. This process enables task requests to propagate through the network. If an individual node's task list grows too large, task requests with the lowest priorities are removed. Any task request which has expired will also be removed. As task responses are generated, they will propagate back to the originator of the task request. This node will have a number of responses associated with a single request. These responses are

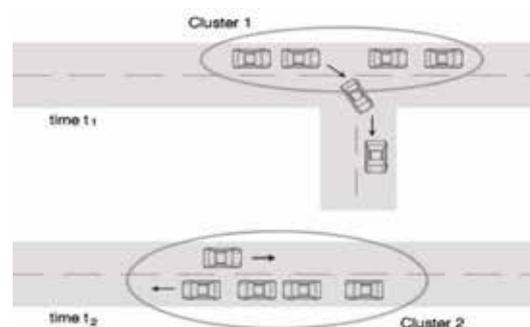
then combined to localize traffic phenomenon i.e., the locations of responses giving high confidence levels can be used to produce a boundary for the traffic phenomenon detailed in the original request. The task response message at the originating node may then be distributed.

#### 4.2 Information Distribution

Traffic information is most likely to influence drivers' decisions when it relates to the immediate area or when they are likely to enter into that area. To maximize information gain in the network whilst keeping the consumption of network resources to a minimum, traffic information (i.e., task response messages) will only be transmitted to a node if that information is relevant in terms of the nodes likely route. Consider the scenario shown in Fig. 2; at time  $t_1$ , a node belongs to cluster 1 and is involved in CSIP to detect a particular event in the traffic network and a task response message is generated. The node's heading changes and the links to nodes in cluster 1 are destroyed. Later, at time  $t_2$ , the node comes into communication range of a second cluster.

Links between the node and others in the local ad hoc network are established through the neighbor discovery protocol outlined in section 3.1. As new neighbors are discovered, the node receives beacon messages with positional information included in the packet headers (see Table 1). This positional information is combined with information about the structure of the road network (e.g., a digital map) to determine the likely route of each neighbor. Using this information, the receiving node examines the list of task response messages for any that relate to possible routes of each neighbor. Relevant traffic information is transmitted to that neighbor.

This method of information distribution is novel in that the movement patterns of a node are used to determine when it should be provided with traffic information. We anticipate that this method will reduce bandwidth consumption whilst increasing information gain, outweighing any cost associated with the additional processing necessary.



**Figure 2: A Task Response Message Is Stored In A Mobile Node and Distributed To Another Ad Hoc Cluster.**

#### V. ROUTING METHODOLOGY

In VANETs, wireless communication has been a critical technology to support the achievement of many applications and services. However, due to the characteristics of VANETs such as high dynamic topology and intermittent connectivity, the existing routing algorithms in MANETs are not available for most application scenarios in VANETs.

Depending on the number of senders and receivers involved, routing approaches can be divided into three types: geocast/broadcast, multicast, and unicast approaches. (i) Geocast/Broadcast- With the requirement of distributing messages to unknown/unspecified destinations, the geocast/broadcast protocols are necessary in VANETs. The

current message broadcast protocols on vehicular ad hoc networks, such as a spatially aware packet routing algorithm (which predicts the permanent topology holes and conducts the geographic forwarding), SADV (which finds the best path to forward the packet), an interference aware routing scheme (which equips the node with a multichannel radio interface and switches the channels based on the SIR evaluation), FROV (which selects the retransmission spans further node to rebroadcast a message), and a multihop broadcast protocol (which divides the road into segments and chooses the vehicle in the farthest nonempty segment). (ii) Multicast- Multicast is necessary to communications among a group of vehicles in some vehicular situations, such as intersections, roadblocks, high traffic density, accidents, and dangerous road surface conditions. The multicast protocols have been categorized into two main types. One is topology-based approaches, such as ODMRP (which generates a source-based multicast mesh and forwards based on the group address), MAODV (which generates a group-based multicast tree), and GHM (which generates group-based multicast meshes). The other one is location-based approaches, such as PBM (which is based on positions of all one-hop neighbors and positions of all individual destinations), SPBM (which introduces hierarchical group membership management), LBM (which uses a multicast region as destination information for multicast packets), and RBM and IVG (which define a multicast scope for safety warning messages). (iii) Unicast- The unicast communication protocols for VANETs have three approaches- greedy: nodes forward the packets to their farthest neighbors towards the destination, like improved greedy traffic-aware routing (GyTAR); opportunistic: nodes employ the carry-toward technique in order to opportunistically deliver the data to the destination, like topology-assist geo-opportunistic routing; and trajectory based: nodes calculate possible paths to the destination and deliver the data through nodes along one or more of those paths, like trajectory-based data forwarding (TBD)

## VI. EVALUATION METRICS

Metrics have been designed for evaluating the performance of VANET at application and Network Layer. The major factors of evaluation metrics are shown in the Table 2.

Factors of evaluation	Description
Delay Time	Compared to ideal time vehicle would take in absence of signals and other vehicles
Estimation Error	Accuracy of information available in the range specified
Transmission delay	Average delay of a packet when the packet is generated, until the time it gets successfully received by all neighbors
Packet delivery ratio	Ratio of the number of messages received by the destination to the number sent by the sender
Jitter	Jitter is the variation in the end-to-end delay between packets arriving at the destination
Connection duration	To monitor a meaningful interaction between different parties
Load on the network	Number of packets sent, received and dropped
Awareness percentage	Fraction of nodes passing the location that had information about the location before entering it

**Table 2: Performance factors evaluation metrics of VANET at Application and Network Layer**

## **VII. CONCLUSION**

In this research paper we have presented the general concept of intelligent ad hoc vehicular network for Collision Avoidance. Also here we have presented the logical framework auto sensing of traffic information in vehicular ad hoc networks.

It also deals with efficient traffic alerts and updated information about traffic incidents will reduce traffic jams, increase road safety and improve the driving in the city, but in spite of having all the measures it suffers with few minor issues like delay jitter, network load which we will be addressing in our next research work.

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# A NEW OPTIMIZATION METHOD FOR NONLINEAR PROGRAMMING PROBLEMS WITH DISCRETE VARIABLES

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## ABSTRACT

In this paper, a method for optimization of nonlinear programming problems with discrete variables is proposed. In the proposed method, an appropriate initial discrete feasible solution is first selected and then the given nonlinear programming problem is solved as a mixed integer linear programming problem. The process is repeated until an optimal solution is obtained.

**Keywords:** *Nonlinear Programming Problem, Discrete Variable, Optimal Solution.*

## I. INTRODUCTION

In most of the optimization problems, the design variables are assumed to be continuous, which can take any real value. When the design variables are restricted to take only discrete values, the problem is called a discrete programming problem.

In this paper, an optimization method for discrete nonlinear programming problem is proposed and illustrated by an example. As in most of the cases, the solution of the discrete problem is expected to lie in the vicinity of the continuous optimum, the given nonlinear programming problem can be solved as a continuous nonlinear programming problem using any of the standard nonlinear programming techniques.

## II. FORMULATION OF THE PROBLEM

The nonlinear programming problem with discrete variables can be stated as follows :

$$\text{Minimize } f(\mathbf{X}) \quad \dots\dots\dots(1)$$

subject to

$$g_j(\mathbf{X}) \leq 0, \quad j = 1, 2, \dots\dots\dots, m \quad \dots\dots\dots(2)$$

$$h_k(\mathbf{X}) = 0, \quad k = 1, 2, \dots\dots\dots, p \quad \dots\dots\dots(3)$$

$$x_i \in \{d_{i1}, d_{i2}, \dots\dots\dots, d_{iq}\}, \quad i = 1, 2, \dots\dots\dots, n_0 \quad \dots\dots\dots(4)$$

$$x_i^{(l)} \leq x_i \leq x_i^{(u)}, \quad i = n_0 + 1, n_0 + 2, \dots\dots\dots, n \quad \dots\dots\dots(5)$$

where the first  $n_0$  design variables are assumed to be discrete and  $\mathbf{X} = [x_1, x_2, \dots, x_{n_0}, x_{n_0+1}, \dots, x_n]^T$ .

Using a first order Taylor's series about a point  $\mathbf{X}_0$ , the above problem can be stated as follows :

$$\text{Minimize } f(\mathbf{X}) = f(\mathbf{X}^0) + \tilde{\mathbf{N}}f(\mathbf{X}^0)\delta(\mathbf{X}) \quad \dots\dots\dots(6)$$

subject to

$$g_j(X) \gg g_j(X^0) + \tilde{N}g_j(X^0) \delta X \leq 0, \quad j = 1, 2, \dots, m \quad \text{.....(7)}$$

$$h_k(X) \gg h_k(X^0) + \tilde{N}h_k(X^0) \delta X = 0, \quad k = 1, 2, \dots, p \quad \text{.....(8)}$$

$$x_i^0 + \delta x_i \in \{d_{i1}, d_{i2}, \dots, d_{iq}\}, \quad i = 1, 2, \dots, n_0 \quad \text{.....(9)}$$

$$x_i^{(l)} \in x_i^0 + \delta x_i \in x_i^{(u)}, \quad i = n_0 + 1, n_0 + 2, \dots, n \quad \text{.....(10)}$$

$$\delta X = X - X^0 \quad \text{.....(11)}$$

We define the discrete variables as follows :

$$x_i = y_{i1}d_{i1} + y_{i2}d_{i2} + \dots + y_{iq}d_{iq} = \sum_{j=1}^q y_{ij}d_{ij}, \quad i = 1, 2, \dots, n_0 \quad \text{.....(12)}$$

with  $y_{i1} + y_{i2} + \dots + y_{iq} = \sum_{j=1}^q y_{ij} = 1 \quad \text{.....(13)}$

and  $y_{ij} = 0$  or  $1, \quad i = 1, 2, \dots, n_0, \quad j = 1, 2, \dots, q \quad \text{.....(14)}$

Using equations (12) to (14) in equations (7) to (11), we get

$$\text{Minimize } f(X) = f(X^0) + \sum_{i=1}^m \frac{\partial f}{\partial x_i} \sum_{j=1}^q y_{ij}d_{ij} - x_i^0 \sum_{i=m+1}^n \frac{\partial f}{\partial x_i} (x_i - x_i^0) \quad \text{.....(15)}$$

subject to

$$g_j(X) \gg g_j(X^0) + \sum_{i=1}^{n_0} \frac{\partial g_j}{\partial x_i} \sum_{l=1}^q y_{il}d_{il} - x_i^0 \sum_{i=n_0+1}^n \frac{\partial g_j}{\partial x_i} (x_i - x_i^0) \leq 0, \quad \text{.....(16)}$$

(j = 1, 2, ..., m)

and

$$h_k(X) \gg h_k(X^0) + \sum_{i=1}^{n_0} \frac{\partial h_k}{\partial x_i} \sum_{l=1}^q y_{il}d_{il} - x_i^0 \sum_{i=n_0+1}^n \frac{\partial h_k}{\partial x_i} (x_i - x_i^0) = 0, \quad \text{.....(17)}$$

(k = 1, 2, ..., p)

with  $y_{i1} + y_{i2} + \dots + y_{iq} = \sum_{j=1}^q y_{ij} = 1, \quad i = 1, 2, \dots, n_0 \quad \text{.....(18)}$

$y_{ij} = 0$  or  $1, \quad i = 1, 2, \dots, n_0, \quad j = 1, 2, \dots, q \quad \text{.....(19)}$

and  $x_i^{(l)} \in x_i^0 + \delta x_i \in x_i^{(u)}, \quad i = n_0 + 1, n_0 + 2, \dots, n \quad \text{.....(20)}$

### III. SOLUTION OF THE PROBLEM

An initial point  $X^0 = [x_1^0, x_2^0, \dots, x_n^0]^T$  is selected and the problem stated in equations (15) to (20) is solved as a mixed integer linear programming problem treating both  $y_{ij}$  ( $i = 1, 2, \dots, n_0, \quad j = 1, 2, \dots, q$ ) and  $x_i$  ( $i = n_0 + 1, n_0 + 2, \dots, n$ ) as unknowns. The initial values of the discrete variables  $x_1^0, x_2^0, \dots, x_n^0$  are selected in such a way as to optimize the objective function. Once the first

linearized discrete problem is solved, the subsequent linearizations can be made using the result of the previous optimization problem.

**Example**

$$\text{Maximize } f(\mathbf{X}) = x_1 x_2 \quad \dots(1)$$

subject to

$$g(\mathbf{X}) = x_1^2 + x_2^2 \leq 4 \quad \dots(2)$$

$$x_1 \in \{0.1, 0.5, 1.1, 1.6, 2.0\}$$

$$x_2 \in \{0.4, 0.8, 1.5, 2.0\}$$

**Solution:** If we take  $\mathbf{X}^0 = [2.0, 2.0]^T$ , then condition (2) is not satisfied. Hence we cannot take  $\mathbf{X}^0 = [2.0, 2.0]^T$ . Similarly, we cannot take  $\mathbf{X}^0 = [1.6, 1.5]^T$ .

Let us start with  $\mathbf{X}^0 = [1.1, 0.8]^T$ . Then

$$f(\mathbf{X}^0) = 0.88, \quad g(\mathbf{X}^0) = -2.15,$$

$$\tilde{\nabla} f(\mathbf{X}^0) = [x_2^0, x_1^0]^T = [0.8, 1.1]^T$$

and  $\tilde{\nabla} g(\mathbf{X}^0) = [2x_1^0, 2x_2^0]^T = [2.2, 1.6]^T$

Now

$$x_1 = y_{11}(0.5) + y_{12}(1.1) + y_{13}(1.6)$$

$$x_2 = y_{21}(0.4) + y_{22}(0.8) + y_{23}(1.5)$$

$$\delta x_1 = y_{11}(1.1 - 0.5) + y_{12}(1.1 - 1.1) + y_{13}(1.6 - 1.1)$$

$$\delta x_2 = y_{21}(0.4 - 0.8) + y_{22}(0.8 - 0.8) + y_{23}(1.5 - 0.8)$$

$$f = 0.88 + [0.8, 1.1] \begin{matrix} \hat{e} & 0.6y_{11} + 0.5y_{13} \\ \hat{e} & \hat{u} \\ \hat{e} & 0.4y_{21} + 0.7y_{23} \\ \hat{e} & \hat{u} \end{matrix}$$

$$g = -2.15 + [2.2, 1.6] \begin{matrix} \hat{e} & 0.6y_{11} + 0.5y_{13} \\ \hat{e} & \hat{u} \\ \hat{e} & 0.4y_{21} + 0.7y_{23} \\ \hat{e} & \hat{u} \end{matrix}$$

Therefore the first approximate problem can be formulated as follows :

$$\text{Minimize } f = 0.88 - 0.48 y_{11} + 0.40 y_{13} - 0.44 y_{21} + 0.77 y_{23}$$

subject to

$$-2.15 - 1.32 y_{11} + 1.10 y_{13} - 0.64 y_{21} + 1.12 y_{23} \leq 0$$

$$y_{11} + y_{12} + y_{13} = 1$$

$$y_{21} + y_{22} + y_{23} = 1$$

$$y_{ij} = 0 \text{ or } 1, \quad i = 1, 2, \quad j = 1, 2, 3$$

The optimal solution of this problem can be found as

$$y_{11} = 0, y_{12} = 1, y_{13} = 0, y_{21} = 0, y_{22} = 0, y_{23} = 1$$

Therefore,

$$x_1 = 1.1, x_2 = 1.5, f(\mathbf{X}) = 1.65, g(\mathbf{X}) = -1.05$$

Using the point (1.1, 1.5) as the second approximate solution, the process is repeated until the final optimal solution is obtained.

## **VI. CONCLUSION**

The optimal solution of the given NLP found by the proposed method is very close to the exact optimum if the initial point  $X^0$  is selected very carefully. In order to find the initial point  $X^0$ , the given NLP can be solved as a continuous NLP by ignoring the discrete nature of the variables. If the resulting continuous optimal solution happens to be a feasible discrete solution, it can be used as the initial point  $X^0$ . After getting an appropriate initial point, the proposed method can be applied to find an optimal solution and the process can be repeated until the final optimal solution is obtained.

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# **RADIATION HYGIENISATION OF SLUDGE AS A POTENTIAL SOLUTION FOR SLUDGE TREATMENT IN GANGA ACTION PLAN: CASE STUDY OF VARANASI**

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## **ABSTRACT**

*Disposal of municipal sewage sludge, especially in large metropolitan cities is emerging as a serious problem for urban authorities as sludge contains a high load of potentially infectious microorganisms that can be a serious threat to public health. Radiation technology is recommended for sewage sludge disinfection, a dose of 6 KGy is for sewage sludge and a dose of 1 KGy for sewage water. The gamma irradiation reduces the pathogens and organic pollutants drastically and reduces the availability of heavy metals uptake by the plants from the irradiated sludge. Sewage wastewater, treated with gamma radiation can be an important non-conventional water resource for irrigation. Sewage sludge generated from such water is a good source of organic fertilizer. Looking at the severe paucity of land for STP plants, unhygienic conditions in and around current STP plants, leading to increased incidents of communicable diseases and also odor nuisance from the sludge disposal sites. Shri Ram Institute for Industrial Research in collaboration with BARC proposes to build gamma irradiation based sewage treatment plant in Varanasi. The author was involved in preliminary assessment of possibility of establishing a Gamma Irradiation unit in Varanasi which is still under discussion with relevant authorities.*

**Key Words:** *Sludge, Gamma Irradiation, Sewage Treatment Plant, Ganga Action Plan, Hygienisation*

## **I INTRODUCTION**

The Ganga basin accounts for a little more than one-fourth (26.3%) of the country's total geographical area and is the biggest river basin in India, covering the entire states of Uttarakhand, Uttar Pradesh (UP), Bihar, Delhi, and parts of Punjab, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, and West Bengal. The Ganga basin is bound in the north by the Himalayas and in the south by the Vindhyas. The main river stream originates in the Garhwal Himalaya (300 55' N, 7907' E) under the name of the Bhagirathi [1].

Main stem of river Ganga houses a population with high density. In absence of proper sanitation, abstraction of surface and groundwater for irrigation and drinking purposes and partially treated domestic and industrial effluent

turns Ganga into a polluted river in the stretch from Kannuj to trighat in the state of Uttar Pradesh and also makes the water of river Ganga unfit even for bathing purposes.

**Table 1: Total population (2011)**

State / UT	Persons	Density (persons per km <sup>2</sup> )	Urban Population
Uttarakhand	10,116,752	190/km <sup>2</sup>	30,91,169 (30.55%)
Uttar Pradesh	199,581,477	828/km <sup>2</sup>	4,44,70,455(22.28%)
Bihar	103,804,637	1,102/km <sup>2</sup>	1,17,29,609 (11.30%)
Jharkhand	1,150,038	720/km <sup>2</sup>	79,29,292
West Bengal	91,347,736	1,029/km <sup>2</sup>	2,91,34,060 (31.89%)
<b>Total</b>	437,816,840(43.78 Crore)		96,354,585 (9.63 Crore) (22% )

Major point sources of pollution in river Ganga are discharge of untreated/partially treated sewage from urban centers discharge from open drains carries sewage, industrial wastewater, returned storm water discharge from major tributaries discharge of untreated/partially treated/treated wastewater from industrial units.

Water Quality of Ganga in Varanasi: located in Uttar Pradesh Lower Stretch (from Dalmau to Trighat):

In this stretch the water quality can be defined as:

- DO & pH - meeting the water quality criteria for bathing at all the monitoring locations.
- Conductivity meeting the primary water quality criteria based on designated best use.
- DO varies from 5.1-11.1 mg/l.
- BOD ranges from 2.3-10.5 mg/l. The maximum value of BOD has been measured at upper stretch Vindhyachal (Mirzapur). All the monitoring locations are exceeding the water quality criteria notified for bathing.
- Faecal Coliform values range from 40-46000 MPN/100ml and not meeting the water quality criteria for bathing at all monitoring locations except upper stretch of Vindhyachal.
- While the Total Coliform value ranges 110- 70,000 not meeting the criteria for category 'C' of designated best use concept at all monitored locations.

In Varanasi the water quality parameters were observed to be: DO 7.6 & 7.1 mg/l in upper and lower stretch, respectively, BOD 3.9 & 8 mg/l in upper and lower stretch, respectively, faecal coliform 8,000 & 40,000 /100ml in upper and lower stretch, respectively, and Total Coliform 13,000 to 58,000/ 100 ml, conductivity 250 & 272µmhos/cm in upper and lower stretch, respectively. In overall analysis, the River Ganga in lower stretch of Uttar Pradesh is highly polluted.

The Government of India established the Ganga Action Plan in 1986 to lead the way in river pollution control programs. In 2009, the Government declared the Ganga a national river and established the National Ganga River Basin Authority. The National Mission Clean Ganga (NMCG)–the implementing agency under this Authority–is

now housed in the Ministry of Water Resources, River Development and Ganga Rejuvenation under the Government of India. The Mission Director is the chief executive of the NMCG.

At the state level in Uttar Pradesh, there is a state Project Management Group (PMG) chaired by the Chief Minister. It includes members from the State Ministries of Environment and Irrigation, the Uttar Pradesh Pollution Control Board and the state water commissions. The State PMG decides whom to select for work, and in most cases uses the Uttar Pradesh Jal Nigam (the state level sewage engineers) to execute wastewater project work. The State PMG can outsource consultancy work and allocate projects to NGOs as well; although in all cases, it has allocated the wastewater engineering work to the Uttar Pradesh Jal Nigam.

This sacred city requires a competent participatory authority to master plan, design, select the right scales and technology, construct, operate and effectively maintain a comprehensive wastewater collection, treatment and reuse system.

## 1.1 Sewage Water

Sewage wastewater, if properly treated, must be considered an important non-conventional water resource for irrigation. Sewage sludge generated from such water is a good source of organic fertilizer. However, treatments should be applied in order to achieve the following: pathogens disinfection, organic pollutants degradation, and less available heavy metals. In addition, sewage sludge loading to agriculture land should be monitored as excessive application may result in nitrate pollution of the ecosystem.

Raw sewage sludge and sewage water are considered to be a valuable source of plant nutrients and organic matter. However, it contains several pollutants which can adversely affect the environment (water resources, plants, soils, animal and human health). The continuation of using raw sewage water and effluent in irrigation could result in environmental pollution, which is reflected in the accumulation of the following dominant pollutants:

- 1) Heavy metals (e.g. Cd, Pb, Ni, Co, Cr, Zn, Cu, Fe, Mn) which is found in soil, plant and water table. As such metals enter the food chain it creates hazards to animals and human health. In addition, heavy metals affect plant growth, soil microbial activity and soil fertility.
- 2) Toxic organic compounds (e.g. detergents, pesticides, dyes, phenolic compounds, chlorinated hydrocarbons) which are biologically resistant to degradation, highly toxic and carcinogenic
- 3) Harmful pathogens (parasites, bacteria, and viruses) which transmit significant diseases to animal and human.
- 4) Sewage water from industrial areas are always mixed with industrial waste, in particular waste of nitrogen fertilizer factories contain high concentration of nitrate salts. The leached nitrate represents a hazard to the environment, human and animal health.

Such pollutants could reach groundwater; through direct leaching from contaminated soil, human food; through the food chain, creating environmental and health problems. This situation started to cause governmental and public concern.

## 1.2 Impacts of river pollution

### 1.2.1. Waterborne illnesses

Waterborne diseases account for 80% of all health problems and one-third of all deaths in India and the developing world.

In Varanasi alone, 66% of people who use Ganga's waters each year contract a waterborne illness such as typhoid and dysentery. As mentioned previously, fecal coliform levels are rising all throughout the main stretch of the river, contributing to the continued increase in these illnesses.

### **1.2.2. Nitrate contamination in groundwater**

The ultimate result of groundwater contamination with mismanaged sewage is **nitrate levels higher than the** prescribed levels for almost the entire nation.

### **1.2.3. Contamination of food and water lead to malnutrition and stunted growth**

According to data from the highly-regarded Demographic and Health Surveys, an international effort to collect comparable health data in poor and middle-income countries, high rates of open defecation in India statistically account for high rates of stunting in both socially advantaged and disadvantaged families living near sites of open-defecation. "International differences in open defecation can statistically account for over half of the variation across countries in child height"

### **1.2.4. Massive human rights violations**

Lack of access to clean water, right to worship and right to life are just some of the ways that the sewage waste pollution in Ganga is wreaking havoc. "If 90 school buses filled with kindergartners were to crash every day, with no survivors, the world would take notice. But this is precisely what happens every single day because of poor water, sanitation and hygiene (WASH)" (UNICEF) [2].

### **1.2.5. Subject of national disgrace**

Sullied waters do not just pose a serious public health and human rights crisis but also are an aesthetic insult that has become not only a national but an international disgrace to what Indian's regard as their most sacred Ganga River. This leads people from all over the world to regard many aspects of the rich Indian culture and tradition as confusing and contradictory.

## **1.3 Status of Municipal Sewage Generation in Ganga River:**

There are 36 Class I cities and 14 Class II towns along the mainstream of Ganga. Status of wastewater generation and treatment capacity in these urban centres along Ganga River is summarized in table 2 below:

**Table 2: Wastewater generation and- treatment capacity (Source: CPCB 2013)**

Category	Wastewater- generation (MLD)	Treatment Capacity (MLD)
Class - I (36)	2601.3	1192.4
Class - II (14)	122	16.4
Total	2723.3	1208.8

Table 2 above indicates that there are fifty cities (Class I & Class II) discharging 2723.3 MLD wastewater out of which 1208.8 MLD has the treatment capacities i.e., 44 %. The contribution of class I cities is 96 % of total wastewater generation and the treatment capacity is almost 99 % of the total treatment capacity.

Varanasi, the parliamentary constituency of PM Modi, alone generates approximately 400 MLD sewage out of which only 100 MLD is treated in three STPs, and the remaining untreated waste water finds a way to Ganga [3]. In Varanasi, there are three sewerage treatment plants in Dinapur, Bhagwanpur and Diesel Locomotive Works (DLW) with capacities of 80 MLD, 9.8 MLD and 12 MLD respectively. Varanasi has five sewage pumping stations along the ghats, and one main sewage pumping station at Konia. The Konia pumps are supposed to pump up to 80 million liters of sewage per day to the Dinapur treatment plant located in the trans-Varuna neighborhood of Dinapur village, if they work at full capacity, however they rarely do.

These STPs were constructed under the first phase of Ganga Action Plan (GAP-I). These treatment plants are based on activated sludge process (ASP). Under GAP-II, a sewage treatment plant of 140 MLD was to be built at Sathwa, while another STP of **37 MLD was to** be built in Ramnagar area [4].

In a survey conducted by the Japan International Cooperation Agency (JICA), the middle stretch of Ganga from Kanpur to Varanasi was found to be the most polluted. According to the report prepared under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), the quality of water in Varanasi is far below the IS standards.

It is estimated that out of the total pollution load reaching the river stream, the load from point sources (urban wastewater and industrial effluent) is significantly high (94%), including 79% load from municipal sewage and 15% load from industries.

Under Ganga Action Plan phase II, the UP Jal Nigam's (UPJN) had initially planned to establish two STPs (one of 120 MLD under JNNURM and other of 140 MLD funded by Japan International Cooperation Agency) at Sathwa. Initially, the land acquisition department had been given Rs 3545.35 lakh to acquire 43.537 hectare land of 408 farmers in 2010-11. However, strong protest by farmers did not allow UPJN to procure the required land.

After failing to get the land to establish the STP based on Up-flow Anaerobic Sludge Blanket (UASB) process technology at Sathwa, UPJN decided to shift the STP of 140 MLD capacity to Dinapur, where its treatment plant was established under GAP I, the Ganga Pollution Control unit of UPJN decided to switch over to 'combi-treat-improved sequential batch reactor' technology for the proposed STPs. The decision to change the technology was taken to reduce the land requirement and for better results than those achieved by conventional technology of

wastewater treatment. The general manager of Ganga Pollution Control unit Ramesh Singh, said the agency cannot afford more delay in procuring land for the proposed STPs due to the threat of JICA stopping funds if project of 140 MLD STP is not completed by 2015. However, shifting of the proposed STP of 140 MLD capacity from Sathwa is largely impossible as major works of laying sewer lines to take to the proposed STP had been completed. The remaining works of laying trunk sewer line in 30 km area in main city and construction of rising main (pumping station) would start in a few months as tenders for it have already been floated.

## II SRI GANGA PROJECT

Looking at the severe paucity of land for STP plants, unhygienic conditions in and around current STP plants, leading to increased incidents of communicable diseases and also odor nuisance from the sludge disposal sites. Shri Ram Institute for Industrial Research in collaboration with BARC proposes to build gamma irradiation based sewage treatment plants at one of the locations viz. Sathwa and/or Dinapur, where UPJN is currently trying to build a conventional STP of 120MLD capacity. Subsequently smaller projects will be initiated at other proposed locations at Ramnagar and Mughal Sarai.

### 2.1 The Gamma irradiation Technology

Worldwide, Gamma radiation has been used in sterilization of medical products and preservation of food. Gamma radiation and electron beams have been successfully used on sludge and wastewater treatment to eliminate pathogenic organisms and toxic organic chemicals. Sufficient data are available for gamma radiation treatment of sludge, permitting its application on commercial scale. [5]

Several methods are available at present, and have been in use for a long time, for sludge stabilization and disinfection. These methods are aerobic digestion, anaerobic digestion, composting, liming and heat treatment [6]. Recently gamma radiation and electron beam has been introduced for sewage sludge stabilization.

Brandon (1979) [7] evaluated the different methods of sludge stabilization and found that aerobic and anaerobic digestion are not very effective in reducing pathogens, lime treatment requires that a high pH be reached and maintained, heat treatment is effective but is expensive and is energy intensive, composting requires all of the composting sludge reached an adequate temperature for pathogens inactivation. It is obvious that irradiation of sewage sludge ensure the safe recycle of sewage sludge.

### 2.2 Current Gamma irradiators worldwide

Irradiation facilities for treatment of water have been constructed in many countries of the world. The first large scale plant was the Geiselbullach Gamma Sludge Irradiator, constructed in Germany in 1973. In India, the first sewage hygienization centre was commissioned in Baroda in 1992. It was a joint effort of Bhabha Atomic Research Centre, Mumbai, Municipal Corporation of Baroda and M.S. University of Baroda. The final objective is to treat entire sludge output of about 110 cubic meters per day. Similar sludge treatment plants have been installed in Canada, USA, Japan, Norway and South Africa.

### 2.3 Advantage of using Gamma Radiation in Sewage Sludge Treatment

The advantages of gamma irradiation are many, few are listed below:

- 1) Excellent penetration power
- 2) Environmentally clean
- 3) Uniform dosage in materials
- 4) Small energy consumption
- 5) Neither toxic chemicals nor residual radioactivity are produced in the material

### 2.4 Expected Mechanisms of Gamma Radiation Effect on Sewage Sludge

Following are the mechanism by which gamma radiation can effectively hygienises the sludge:

- 1) Degradation
- 2) Oxidation
- 3) Bond Rupture
- 4) Conditioning
- 5) Denaturation

### 2.5 Impact of Gamma Irradiation on various sludge components

**2.5.1 Pathogens.** This high quality sewage water (pathogen free) cannot be achieved by conventional method of treatment. Sewage water and sludge contains various harmful pathogenic organisms (bacteria, parasites and viruses). These pathogens are capable to induce several human diseases. Crop irrigated with sewage water and consumed uncooked represent health hazard. Pathogens that survive in the soil and/or in the crops and create such hazards.

**Table 3: Pathogenic organisms and their associated diseases**

	<b>Bacterial Pathogens</b>	<b>Related Disease</b>
1	Salmonella	Salmonellosis
2	S. typhimurium	Typhoid fever
3	Shigella	Shigellosis
4	Enterococcus (Fecal Streptococci)	Diarrhea
5	E.Coli (Fecal Coliform)	Diarrhea
6	Vibro cholerae	Cholera
7	Campylobacter jejuni	Gastroenteritis
	<b>Parasites</b>	<b>Related Disease</b>
1	Ascaris Lumbricoides	Ascariasis
2	Taenia spp	Taeniasis and Cysticercosis
3	Giardia Lamblia	Giardiasis

4	Entamoeba histolytica	Amoebic dysentery
	<b>Viral Pathogens</b>	<b>Related Disease</b>
1	Hepatitis A	Hepatitis
2	Rotavirus	Gastroenteritis and polio
3	Reovirus	Fever, respiratory infection
4	Adenovirus	Respiratory and eye infections

The conventional method of sewage water treatment includes primary treatment (precipitation), secondary treatment (biological), tertiary treatment (chlorination) and digestion. Chlorination has been used in treating the effluent from conventional treatment plant. Chlorination may eliminate bacteria and amoeba cysts; however it can't influence enteric viruses and/or parasite eggs [8]. Chlorine does not penetrate into large particles, thus it can only be applied in purified sewage water. Chlorine can react with the organic residues in the wastewater to form hazardous substances which is carcinogenic. Wastewater chlorination in Europe and the USA has been replaced by UV-irradiation. But in India it is still prevalent and rather major mode disinfecting the water.

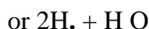
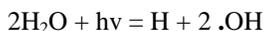
There is a worldwide interest in the use of ionizing radiation as a new method to eliminate pathogens in sewage sludge [9 & 10] and waste water. The dosage of gamma radiation required for pathogens inactivation may vary with pathogen types, initial population, previous treatment and moisture content. A dose range from 3 to 10 Kgy has been reported as an adequate for sewage sludge disinfection. In the opinion of radiation scientists, 3-5 Kgy of ionized radiation is adequate to completely inactivate pathogens in sewage sludge [11].

Suess (1977) [12] has reported a dose of 3 Kgy for sludge decontamination but Takehisa [13] (1980) and Hashimoto et al.,(1988)[14] found that 5 Kgy is the appropriate disinfection dose for dewatered sludge, whereas El-Motaium et al., (2000) [15] found that a dose of 1 Kgy and 6 Kgy are sufficient for disinfection of sewage water and sewage sludge respectively. McCaslin and Sivinski (1980) [16] found that 1 M rad of gamma irradiation effectively destroys pathogenic bacteria and parasites in dried sewage sludge.

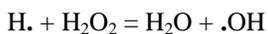
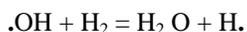
Viability of *Ascaris ova* is an important criterion for safe sludge disposal. It has been chosen as indicator organism for inactivation studies. This is because an *Ascaris ovum* is the most resistant species to most forms of treatments [17] (Gaspard, 1995). A dose of 10 Kgy is required by for *Ascaris ova* elimination from sludge [10] (USEPA (1993)). Brandon (1978)[7] indicated that 1 Mrad was a sufficient dose to ensure the inactivation of *Ascaris* eggs naturally present in digested sludge filter cake and in composted sludge.

The reduction of pathogens in sewage sludge by radiation is a function of the absorbed dose and may be described by a first order reaction equation. Chang (1997) [18] has reported the mechanism by which gamma radiation inactivate pathogens. He concluded that gamma radiation induces ionization in biological tissue resulting in the production of free radicals that cause denaturation of cell protoplasm and damage of membranes and cell walls causing lysis. Protoplasm damage causes inactivation of most pathogens, being single-cell organisms.

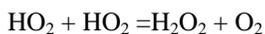
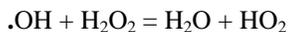
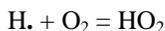
The formation of free radicals is given by the following reaction [19]:



Chain reactions



Combination reactions



Presence of oxygen is important in the process as the oxygen is a known radio-sensitizer which helps in fixing the radiation damage done to cells thereby inhibiting their self repair mechanism and resulting in inactivation of the microorganism [11]. As a result, small molecules may be broken into shorter chains and/or so activated that the potential for chemical reactions is increased.

In the connection the electron also produce ozone, peroxide, hydroxide ions, and oxygen ions in even pure water. These products of irradiation are very strong oxidants due to ionization and absorption of energy into the molecular chain structure and breaking molecular structures [20].

### 2.5.2 Toxic Organic Pollutants

A large number of persistent organic pollutants (POP) exist in sewage sludge. They can persist through treatment such as anaerobic digestion. These persistent compounds are hydrophobic and they bind to soil organic matter. There is a large range of hydrophobicity and volatility involved [21]. Examples of toxic organic compounds are (chlorinated hydrocarbons "PCBs", polycyclic aromatic hydrocarbon "PAH", phenolic compounds, dioxins, phthalates and surfactants). These compounds are very toxic, carcinogenic and highly resistant to degradation. They can enter soil and plant through sewage sludge application to agricultural land [22] and even non-polar ones, can be assimilated by intact plants or in-vitro cell culture system [23]. The amount taken up by plant depends on plant species and the physico-chemical properties of the compound [23].

Polychlorinated biphenyl (PCBs) is one of the most important xenobiotics persistent pollutant in the environment [24]. Polychlorinated biphenyls (PCBs) are industrial compounds. Although the production of PCBs was stopped in most of the industrial countries, PCBs still belong to the most important pollutants in the environment due to their persistence [25]. Plant uptake of PCBs can occur through two path ways the root system or atmospheric deposition [26 & 27]. The lipid soluble class of these compounds are the most dangerous when ingested by animals or humans [28]. In raw or digested sludge, the concentration of PCB types should be highest in the lipid phases.

PAHs are non-polar and hydrophobic compounds that are difficult to mobilize due to their low water solubility. Solubility decreases as the number of rings increases. They are lipophilic and accumulate in soils by binding to organic matter. These compounds exist in the environment due to human activities. Their main sources are 1) combustion of organic materials such as wood 2) combustion of synthetic organic materials such as gasoline. They

are components of petroleum (crude and refined) coal. They released to the soil via solid byproduct, to the aquatic environment via oil spill and to the air via combustion of organic materials as airborne particulates. The lowest molecular weight compound in this group is naphthalene and the highest is graphite [29]. Human can be exposed to PAHs via air, water and food. The main reason for the concern about PAH in the environment is the fact that some of them can cause cancer in human. Fluoranthene is one of the most abundant PAHs that have been detected in air, water, soils, sediments and even in biota including man.

Phenolic compounds such as Pentachlorophenol (PCP) have been used as wood preservatives and as herbicide in rice due to its antimicrobial, herbicide and insecticide properties. There is concern on the possible transfer of PCDD/Fs (e.g. pentachlorophenol, PCP) and PCBs from sludge into human food chains [30 & 31]. The source of PCDD/Fs in sludges is atmospheric deposition followed by runoff. In contrast, Horstmann and McLachlan (1994) [32] identified household (laundry wastewater) wastewater as a more important source of PCDD/Fs than runoff. Pentachlorophenol (PCP) is a priority organic pollutant that is mainly used as a fungicides and insecticide in commercial wood treatment [33]. The use of PCP has lead to its widespread in air, food, sediment [34], water, and municipal sewage sludge [35]. The lowest PCP concentration that causes significant decrease in rhizobial population was 120 mg PCP Kg<sup>-1</sup> soil. POP accumulate in the soil, but the persistence varies between different groups and specific compounds within each group, it increase generally in the order: PCBs>CBa>PAHs>PCDD/Fs [21].

Pandya et al., (1989)[36] in their study on Chickpea (*Cicer arietinum*) found that plant grown in gamma irradiated sludge have higher growth and yield than those grown in unirradiated sludge. They suggest that gamma radiation induced inactivation of toxic substance(s) in sludge.

The effect of ionizing radiation on water results in the formation of hydroxyl radicals (OH.) and solvated electrons (e-aq, H.). Therefore, gamma radiation can be used to study the effect of free radicals species on solutes or pollutants in water.

Research conducted by (M.I.T.) [28] demonstrate that trace amounts of polychlorinated biphenyls (PCBs) in pure water and of water-dissolved herbicide of the urea type-monuron were 96% destroyed using dosages as low as 10 Krad. Their destruction was explained by the attack of hydroxyl radicals (OH.) formed by dissociation of water molecules by the ionizing electron energy.

### 2.5.3. Radiation-Treated Sludge as Biofertilizer

It has been found that raw sludge could not support Rhizobium growth [37]. There are limitations in using acid- or alkali-treated sludge as a biofertilizer, because it could affect the fertility of the soil. Experiments were carried out to study the growth of Rhizobium leguminosarum in irradiated liquid sludge. Irradiated sludge was found to support the growth of Rhizobium very well. Rhizobium sp is well known for its nitrogen fixing abilities using atmospheric nitrogen [38& 39].



**Fig. 1. The hygienised sludge is an ideal medium for inoculating bacteria like Rhizobium. (Source: BARC).**

#### 2.5.4 Heavy Metals

Sewage wastewater and sludge, particularly when mixed with industrial waste, contain a large amount of potentially toxic metals such as Hg, Cr, Pb, Cd, Ni, Co, Cu, Zn, Fe, Mn. Heavy metals exist in different forms (water soluble, exchangeable, organically complexed, adsorbed in organic sites, occluded or held in primary minerals). These forms differ in their mobility in soils and extractability by plants.

Several metal uptake studies have shown that, the water soluble fraction of metals, such as cadmium, lead, mercury and chromium that can be accumulated by living plants and thus enter the animal and human food chain. Some of these heavy metals are essential plant nutrients (Fe, Cu, Mn, Zn) while others (Cd, Pb, Cr, Hg) are not. The heavy metals have no known beneficial physiological function and are considered toxic to plant.

Cadmium is toxic to human and animals. Cadmium toxicity affects primarily kidneys thus disturb P & Ca metabolism, other organs can also be affected (e.g. cause bone diseases). Lead is of primary health concern. The effect of lead toxicity in human health is through causing brain damage. The main source of toxicity by lead is from direct ingestion of soil by humans and grazing animals.

Very few studies have addressed the topic of the effect of irradiation on the bioavailability of heavy metals. Based on work of Massachusetts Institute of Technology, they concluded that electron disinfection dosage does significantly reduce the water-soluble fraction of several potentially toxic metals [28]. This effect would tend to render metals less available for plant uptake. They suggest that electron treatment can bind water-dissolved metals to sludge components. Some workers in the U.S. have claimed decreased solubility of metals in irradiated sludge [40]. In the same line, Ahlstrom (1985) [41] found that irradiation did not increase the extractability and plant uptake of a broad range of nutrients and heavy metals from sludge-amended soils. This finding was supported by our results in Egypt [42].

### III PROPOSED GAMMA IRRADIATION PLANT

The design and maintenance of the Gamma irradiation plant will be done by BARC. The gamma irradiation can be used either to directly irradiate sludge in slurry form, similar to the current practice at the Vadodara Gamma irradiation plant which irradiates slurry with almost 80~95% water. But alternatively we can irradiate only the semi-dry/ dry sludge in order to save energy and to have a faster process.

The rough sketch of the of the design has been given in the Fig. 2 below:

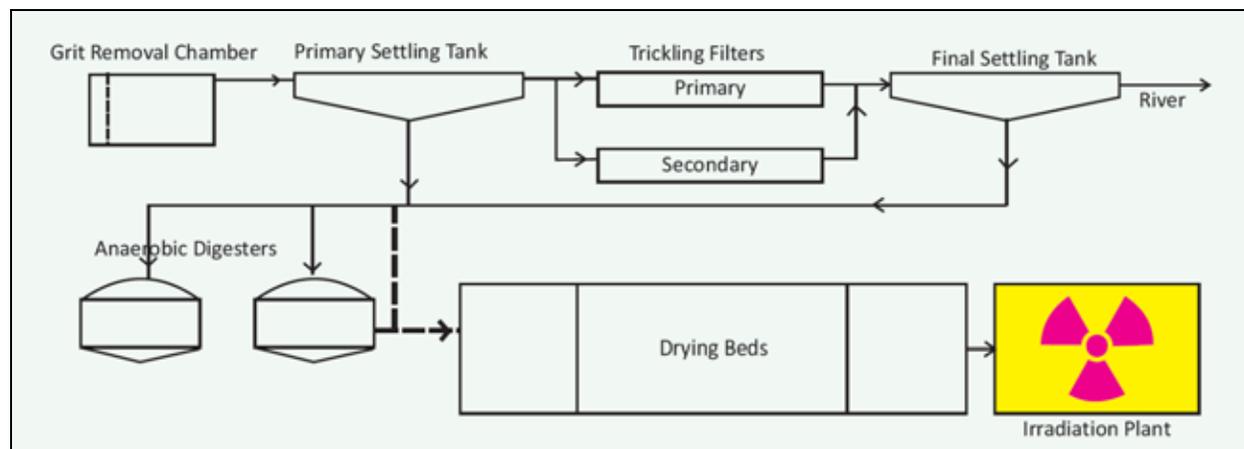


Fig. 2. Municipal Sewage Treatment Plant with sludge Irradiation Facility (Source: BARC)

### IV CONCLUSION

Radiation sterilization using gamma radiation from Cobalt - 60 source is a well established industrial process in India. One such facility is also available at Shriram Institute for Industrial Research, Delhi. Dry sludge can be hygienised using same technology and in a similar process. An irradiation plant can be integrated to STP or could be located at a different place to serve as central facility for other STPs in the region. City like Vadodara of 2.2 million population generates about 100 tons of dry sludge at STPs from 300 millions liters of sewage everyday. Looking at the severe paucity of land for STP plants in various cities, unhygienic conditions in and around current STP plants, leading to increased incidents of communicable diseases and also odor nuisance from the sludge disposal sites. Shri Ram Institute for Industrial Research in collaboration with BARC proposing to build gamma irradiation based sewage treatment plants at one of the locations viz. Sathwa and/or Dinapur, where UPJN is currently trying to build a conventional STP of 120MLD capacity. Subsequently smaller projects will be initiated at other proposed locations at Ramnagar and Mughal Sarai.

The sludge will be dried and sold as organic manure. The Vadodara Gamma Irradiation facility has 100% utilization of the compost so produced. Through these two processes partial cost of running the irradiation plant will be recovered.

## ACKNOWLEDGEMENTS

The author acknowledges the team which runs the Gamma Irradiation Facility run by BARC at Vadodara for sludge irradiation. In particular inputs from Mr. Naresh Kumar Garg who heads the facility and will be instrumental in the proposed project.

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# THE ROLE OF WEB SERVICE IN INFORMATION SHARING AND INTEGRATION OF EDUCATIONAL SERVICES

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## ABSTRACT

*This paper seeks to explore the utility and vitality of the web services in the educational domain. It will also illustrate various scenarios where web services could be a probable solution to a problem faced in the education sector. Although many web-based educational systems exist presently only a few of them are capable of sharing their components with others, hence a web service could be used to provide interoperability and reusability of various educational components.*

*The advent of web services can give a new dimension to the current education system altogether and this paper is all about proposing the ways and means to go about achieving the same.*

***Index Terms: About Four Key Words or Phrases in Alphabetical Order, Separated By Commas.***

## I. INTRODUCTION

Web Service is nothing but a method that facilitates machine to machine interaction over a network. It uses a standard XML messaging system and is not tied to any operating system or programming language. A Web Service is self-describing and easily discoverable via simple find mechanism. It is made up of mainly three components: SOAP, UDDI, and WSDL; A Web Service can be built on Solaris which can be accessed from your VB programs that runs on Windows.

Now the significance or the purpose of web services comes in the picture. Here are certain points that illustrate the said significance:

- Web Services helps in exposing the existing function on to network
- Provides a way of connecting different applications through its interoperability
- Implements standardized protocol
- A very low cost of communication is incurred

With the aid of web services the education can be a lot cheaper, more resourceful, updated and dynamic. Web Services are tools that will make the process of education, in a developing economy like ours, transcend all the barriers ranging from cost to infrastructure to methodology with utmost ease.

## II. ADVENT OF WEB SERVICES IN EDUCATION SECTOR

A lot has been already discussed regarding web services, still many a times it is often confused with web applications which is not very different from a web service, but there are two things that make a web service distinguishable from a web application they are firstly web-services are a very large scale implementation of web services and secondly they are exclusively meant for application to application (or device to device) interaction whereas a web application is meant for user to application interaction.

Here is an example that will clearly illustrate what a web service actually is: suppose without being logged into your account you type “pizza” in Google. You then are displayed a number of pizza joints near where you live. Now how did Google figure out your location? This is where a web service comes into picture; a web service has a list of IP addresses mapped with their respective locations. Google has your IP address all it has to do is use the GeoIP address to translate the IP address into the corresponding locations.

Since the concept is clear now, we must discuss the advent of web services in the field of education. The root cause of resorting to web services is that the conventional method of imparting education is becoming very expensive and also the traditional means is not scalable that is it is not adequate enough to adjust to the rapidly increasing student population, courses, technologies, etc. Hence the course of imparting education has adopted the route of E-Learning. It has already gained popularity as it is scalable and efficient.

Now there are two phases of E-Learning: first one is before the web-services came into picture and the second one is after the advent of web services. E-Learning before the web services was characterized by the following points:

- Ø E-Learning was mostly done through web applications
- Ø Applications were in the form of bundled suites.
- Ø Bundled suites refer to the compilation of variety of features and functions’
- Ø These applications were not exactly a jack of all trades
- Ø Another major letdown of these suites were that they are heavy and bulky
- Ø This bulk is useless because not everything is wholly utilized by clients.

With that the application phase ended and web services emerged. Web services have the ability to build finely grained components that can be reused if a need of similar nature arises in the future. Switching to web services induces a win-win situation because it is beneficial to both client and the vendors, for clients there is a greater choice as well as customization options. And the vendors can be benefitted by the unbundling of the applications since now they can sell it at the same price but the number of applications sold would be more because of the unbundling hence the profit would increase in geometric progression.

## III. ACHIEVING INTEROPERABILITY WITH THE WEB SERVICES

The Web Services facilitate interoperability between two different applications or machine by implementing the following **Data Exchange Architecture**.

In a typical Web services architecture, a service provider has a service that is made available to other systems to use. The provider creates a WSDL service description that defines the service interface, that is, the operations of

the service and the input and output messages for each operation. The provider publishes its WSDL service description to a discovery agency. Service requesters find services via discovery agencies and use the WSDL description to interact with the corresponding service provider. A typical exchange scenario that results from a Web service call induces the following steps: (i) execute the service at the provider and produce relevant XML documents from source data and, (ii) ship the produced documents to the requester that consumes them. We use this architecture as the basis for exchanging large data volumes and extend it with the ability to register fragmentations and with optimization capabilities.

First, the source and target systems independently specify their respective fragmentations using an extension to WSDL and register it at a discovery agency (Step (1)). Discovery agencies are repositories of WSDL specifications which may be mapped to Universal Description Discovery and Integration (UDDI) for publishing and discovery of existing services. The discovery agency generates a mapping between the two fragmentations and a data transfer program that combines and splits source fragments to generate target ones (Step (2)). The decision of where to perform an operation depends on how much it costs at each system. As in publish & map, we expect the service endpoints to be able to split fragments in order to store them. They may not however have the ability, or the intention, to combine fragments. This is captured in our cost model. Distributed processing is achieved by probing the source and target systems, which implement an interface to provide the cost of each primitive operation (Step (3)). In step (4), the discovery agency assigns operations to the source and the target, which generates and executes code on their internal data structures. The discovery agency acts as a middle-ware that does not know about the internal data structures used by the source and target systems. All it sees is the fragmentations defined by each system and a cost interface. The way each fragment is actually produced or consumed by a system is hidden by the WSDL interface. Therefore, the discovery agency needs only high level operations to transform fragments.

#### IV. PROPOSED SCENARIOS OF WEB SERVICES IMPLEMENTATION

**Document-sharing:** A web service could be designed that could facilitate exchange of notes among students or between a student and an instructor. This web service would provide secure access to documents irrespective of location or device. And as the author of the documents one can selectively share documents, with centralized user management and tight control over sharing. If the author wants he can also restrict download. Also this web service would provide a space where users could give their feedback.

**Attendance Tracking System:** This web service if implemented could be beneficial for the students who study in institutions where there is a requirement of a certain percentage of attendance for each course in order to be able to successfully complete the course. The web service needs to be designed in a way that it keeps a daily track of the bunks in every course and prompts the student by sending a warning message to his cell phone that his attendance is falling below the required standards. In this way a student could be pre-alert about his attendance.

**Keeping people connected:** A web service that could keep people connected through a unified contact. There are many Social Networking Sites that could facilitate the same so what would be so special about this web service. This web service would integrate all the social/professional networking sites which implies that

regardless of your account on any of the above mentioned sites, you need not create a separate account to be able to stay connected. With this web service each user could use his/her own personal account, this web service acting as the middle ware, could help connect to the user who has logged in using his personal account.

**Online document storage:** This web service is, in part, of similar nature to the previously mentioned web service pertaining to document sharing. But this web service would not facilitate document sharing, it would be exclusively meant for secure online document storage. Now the significance of this web service lies in the fact that there is a higher probability of risk of data loss if any physical medium for storage is used, hence this web service would act as a safe for the important and confidential data.

**Holding multi-party meetings:** A web service could be implemented that could host real-time meetings for students as well as instructors online. This would facilitate the instructors and students to interact face to face without the imposition of being in the same vicinity.

**Creation of web-survey tool:** Creating a web service that would conduct surveys based on a particular topic and record responses. Based on the responses it would generate the required data in the statistical format which can prove to be useful for the purpose of research and administration.

**Hand-in folder for instructor:** This again could be an implementation of web service which could be of utmost necessity for not only the students but the teachers as well. This web service would manage handing in course assignments online. All the instructor is required to do is to create a hand-in folder for each course with a list of assignments. Set a start and end date of submission. The web service will automatically prompt the student regarding his due submissions and also send a reminder one day before the deadline. This web service would relieve the instructor of handing the assignments to the students every time or remind them constantly of their deadlines. The student would become more responsible as there will remain no room for negotiations once the deadline is past as the folder would no longer accept any more submissions.

**Web-service enabled content repositories:** This web service as the name suggests would act as a content repository. It would go out and discover new learning resources available on a daily basis, find them, retrieve them and integrate them into a course.

## **V. CONCLUSION**

Web services are the next best alternative that will lead to the advancement of not only the education sector but economy as a whole. Thus we need to spread awareness regarding this concept, so that we can bring about a change that will benefit us in the present era.

This decade has witnessed a lot of technical advancements and there are many more to come but web services in the educational field is going to be one of the biggest breakthroughs that have come forth in the recent times.

The use of web services in the education are going to increase tremendously from a limited few to infinite, so all we need to do is be prepared to witness the dynamic age of education which will cater to the needs of anyone and everyone who wishes to gain knowledge and education.

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# STUDY OF CRYOGENIC ROCKET ENGINE

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## ABSTRACT

*This paper is all about Cryogenic Technology used in rocket's engine for all its space missions & its applications. This technology consists of use of two basic elements of universe Liq. Hydrogen(-253°C) & Liq. Oxygen(-183°C). This engine follows Newton's basic 3<sup>rd</sup> law of motion. This is the only engine that gives 100% efficiency without any green house emissions or pollution up to the date on earth. This engine gives a thrust of 15000 lb. when basic methods are used. This thrust can be increased to great extent if research in proper field is done.*

*When these fuels are mixed at their cryogenic temperatures they give out huge energy which can be utilised to:*

- *Take off of a Space vehicle its escape velocity.*
- *Launch a missile across continents.*
- *Generate electric energy.*

**Keyword : Rocket engine, Cryogenic technology, Cryogenic temperature, Liquid hydrogen and oxygen, Newton's third law of mechanics.**

## I. INTRODUCTION

Cryogenic Technology which mainly deals with temperatures below -150 C is the main working principle behind the cryogenic engines. When elements cooled at these temperatures they change their properties. Same is the case with one used in rocket engines when oxygen is cooled below -183 degree centigrade it changes its state to liquid & its properties, similarly when hydrogen is cooled below -253 degree centigrade.

During these temperatures when these liquid are clashed against in a controlled condition in a combustion chamber it gives a huge thrust which has a specific impulse of near about 450. No other engine can generate this amount of energy in negligible amount of fuel. Since its invention in USA is used in all space mission by every country due to its reliability. Cooling used for thrust chamber during combustion is also provided by liquid fuel which saves a lot of energy used for cooling[].

As compared to other fossil fuel the cryogenic fuel requirement is far less to produce same amount of energy.

## II. HISTORY OF TECHNOLOGY

This Rocket Technology has a great History involving many giant nations including USA, Russia, Japan, France etc. A close competition was led in later half of 20<sup>th</sup> Century for this technology since its invention by USA. When USA successfully launched its 1<sup>st</sup> Atlas V rocket in 1963 boosted up the cold war between Russia & USA which played a great role in rapid advancement in this technology in such a short period of time.

After USA Russia started it's tests of launch vehicles. Firstly Russia carried a dog named 'Lynus' in space in 1983. Russia was first to take human in space using sputnik.

During this period lot of European countries were trying their rockets with same technologies & succeeded later, But no human being till 1985.

Here's the detail review of the competition

<b>Engine/Rocket used</b>	<b>Nation</b>	<b>Year</b>
<b>RL-10</b>	<b>USA</b>	<b>1963</b>
<b>LE5</b>	<b>Japan</b>	<b>1977</b>
<b>HM7</b>	<b>France</b>	<b>1979</b>
<b>N1</b>	<b>Russia</b>	<b>1983</b>
<b>GSLV-D5</b>	<b>India</b>	<b>2013</b>

### **2.1. India**

Indian Space Research Organisation was also trying it's hand on this technology in 20<sup>th</sup> Century. ISRO's then Chairman U.R.Rao in 1993 announced that it's Cryogenic engine will have a launch in just 4 years. But it took more than 20 years to Ignite it's Cryogenic Engine so we joined the competition much late in 21<sup>st</sup> Century due to its frequent failure & no technological support from other developed Countries.

But now ISRO is working good with successful launch of Mangalyaan in it's first attempt, being the first country of this kind.

### **III.CONSTRUCTION**

Cryogenic Engine involves:

- I. Two Tanks for Liq. Oxygen & Liq. Hydrogen respectively.
- II. A turbo Pump.
- III. A Gas generator.
- IV. A Combustion chamber.
- V. A nozzle with a cooling jacket.

In this setup a turbo pump is used to give a high velocity to the fine droplets of fuel in combustion chamber. A gas generator is used to drive the turbo pump. Gas generator uses the energy from fuel to generate energy for turbo pump.

## **IV. WORKING**

### **4.1. Gas Generator**

The gas generator is used in order to drive the turbo by a gas flow. The gas generated produces this energy by pre burning some amount of liq. Fuel. Use of Gas generator aligned with Turbo pump increases the efficiency of this engine to a great Extent

### **4.2. Turbo Pumps**

The working of this engine is very easy to understand as it does not involve any complicated cycles or any reciprocating mechanism. The fuel from tanks is firstly passed through the turbo pumps which rotates at a speed of about 14000 rpm by which the mass flow rate of fuel increases to about 2.4 tons before reaching the combustion chamber.

### **4.3. Injector**

Injector plays the most important role in the rocket engine it is like heart of the engine that pumps out the appropriate amount of fuel from the turbo pump to the combustion chamber as per requirement. Injector ensures the stability of the combustion chamber therefore designing of injector is the most challenging part of the designs department of cryogenic engine even today. The frequency of the combustion chamber is to be maintained between 100-500 cycles per second. If this rate is affected even slightly shifted above or below leads to the failure of engine which has been seen in tragedy of 'Discovery Spacecraft'. But if injector is so designed so as to increase the specific impulse more than 700 Space crafts can travel much long distances in the universe. Injector is the only component of this engine which is still under construction yet.

### **4.4. Combustion Chamber**

Finally when this finely distributed fuel droplets enter into the thrust chamber at such high velocities & at their cryogenic temperatures they colloid to each other in the trust chamber, this reaction at such specific conditions increases the pressure of chamber to about 250 bar with a release of huge amount of thrust which is more than 15000 lb.

This high amount of trust is then manipulated by a narrow opening towards the nozzle. The opening is kept narrow so as to follow law of rate of discharge which states that 'velocity is inversely proportional to area'. By this technique we get the desirable amount of thrust which helps a space craft to achieve it's escape velocity.

Due this reaction in continues period of time the temperature of Combustion Chamber as well as nozzle raises up to 3000-4000°C. To withstand such a high temperature for long period of time without any deformation a cooling Jacket is required.

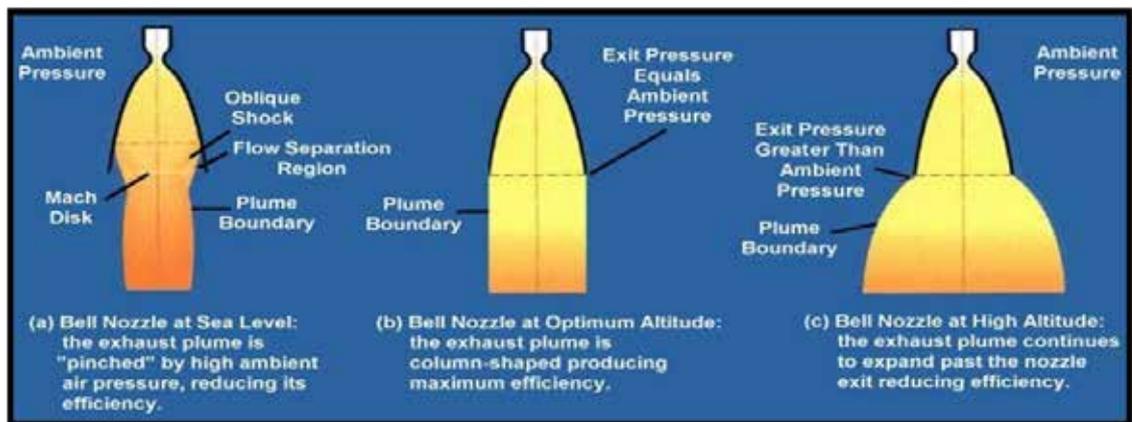
### **4.5. Cooling Jacket**

Cooling Jacket is the necessity of this engine but this facility is provided by the fuel of the engine itself so no external energy is to be used. The mechanism usually used in cooling jackets is active cooling.<sup>[6]</sup> In this Technique the cooling jacket is made such that a flow of liq. Proponents is passed through the tubes provided from between the jackets. The liq. propellant passed are already at their cryogenic temperature so provide a very effective cooling. This simple mechanism permits the Use of this technology throughout it's journey without any deformation in Combustion chamber or Nozzle.

When all these components work in their perfect algorithm, only then we can achieve our goal a successful launch of a space vehicle for it's space mission.

#### 4.6. Plume characteristics

After the reaction in trust chamber Tremendous amount of energy comes from the nozzle through the small opening in the form of plumes. These plumes have a very high temperature during their emissions. Therefore nozzle is also provided with cooling jacket. As the rocket heads from ground the shape of plumes also changes with respect to height achieved by the rocket



**Fig. 4.6.1**

When the height of rocket is near to sea altitude the ambient pressure acting on rocket & in directly on engine is more, hence more energy is required to overcome it, so the plume area is less than nozzle diameter at this altitude also efficiency is less.

When the Rocket advances to a optimum altitude the plume boundary equals the diameter of nozzle that means ambient pressure equals exhaust pressure. Therefore maximum efficiency is achieved i.e. 100% this phase gives full efficiency which is only possible in cryogenic engine. After heading this altitude the rocket advances toward vacuum environmental, this area gives optimum efficiency near about 88% which remain constant here onwards.

#### V ADVANTAGES

- 1) High Energy per unit mass Propellants like LOX and LH<sub>2</sub> give very high amounts of energy per unit mass.
- 2) Clean Fuels: Their product give out only water thrown out of the nozzle in the form of very hot vapour.
- 3) Economical: LOX & LH<sub>2</sub> costs less than gasoline.

#### VI DISADVANTAGES

- 1) Boil off rate
- 2) High reactive gases
- 3) Leakage
- 4) Hydrogen embrittlement
- 5) Zero gravity condition

## VII. FUTURE SCOPE

Being the most reliable engine & its use in all space missions a lot of advancement in this technology is made every day. This technology involves fuel which cheaper than even fossil fuel therefore this technology can give humans safe & reliable technology in near futures. Generally any rocket engine burns their respective fuels to generate the thrust<sub>[4]</sub>. If any other engine has capacity to generate thrust efficiently then it can be called rocket engine.

Currently NASA scientists are working on 'Xenon Ion Engine' which accelerates the ions or atomic particles to extremely high to create thrust more effectively and efficiently by usage of electrostatic or electromagnetic force by the principle of Lorentz force or Columbian force. In this technology ions are powered towards the anion at a speed of 30 km per second

## VIII. CONCLUSION

Cryogenic Rocket Engine is a simple engine based on laws of Cryogenic science & Newton's 3<sup>rd</sup> law of motion. Cryogenic Technology ensures the stability of fuel & by following Newton's 3<sup>rd</sup> law the thrust is generated. These two principles work hand in hand to make this engine a mega success of 20<sup>th</sup> & 21<sup>st</sup> Century. Also while comparing Rocket engine with jet engine, thrust produced in rocket engine is outwards and that in the jet engine is inwards. Hence this efficiency cannot be achieved by any other engine.

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