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ARTICLES

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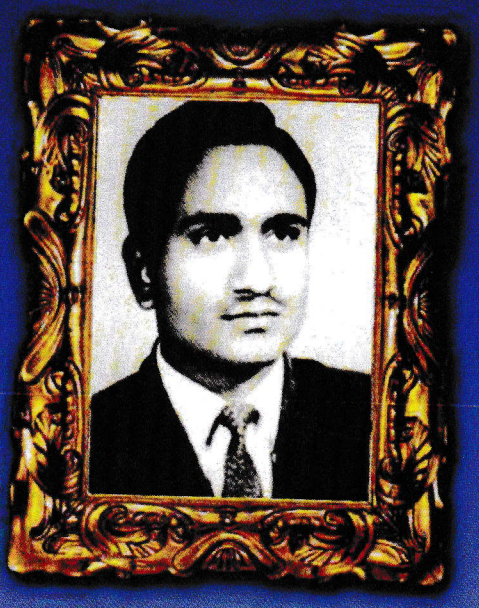
A TRUE VISIONARY

"You see things and you say **Why***? But I dream of things that never were and say* **Why** *not?"*

- George Bernard Shaw



Shri Jagannath Gupta
(1950 - 1980)

Also a true visionary...who dared to dream!
He lives no more but his dreams live on....and on!

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And more dreams to come!

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Editor's Desk

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"Wisdom is to know that we don't know."— —Socrates, 469–399 BC

It is with much joy and anticipation that we celebrate the launch of "JIMS JOURNAL OF SCIENCE &TECHNOLOGY"(JJST) with this inaugural issue. On behalf of the JJST Editorial Team, I would like to extend a very warm welcome to the readership of JJST. I take this opportunity to thank our authors, editors and anonymous reviewers, all of whom have volunteered to contribute to the success of the journal. An enormous amount of work has done into the development of this journal and I believe you will see that effort reflected in this edition and in the impact it will have on the field. It has been an interesting journey in many aspects.

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Besides frequent informal contacts, once a year we will conduct a survey of all Board members to solicit their candid feedback regarding the direction, philosophy, and operation of the journal. I am committed to personally responding to all email/phone/letter messages from them.

We encourage submission of articles in the fields of interest. Our interest in promoting these topics/themes as important features of JJST is clearly reflected in the makeup of the editorial team.

Finally, we wish to encourage more contributions from the scientific community to ensure a continued success of the journal. Authors, reviewers and guest editors are always welcome. We also welcome comments and suggestions that could improve the quality of the journal.

DR. R. K. RAGHUWANSHI

As an active practitioner and scholar in the field of science & technology, you must have experienced the need for a journal with conceptual richness, which is normally missing in various engineering magazines. In response to this need, a team of competent and dynamic professionals, at JIMS Engineering Management Technical Campus, Gr. Noida, publishes a journal titled **JIMS JOURNAL OF SCIENCE & TECHNOLOGY.**

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AN ALGORITHM FOR MEASURING EFFECTIVENESS OF INFORMATION RETRIEVAL SYSTEMS

1 Dr.Raj Gaurang Tiwari, [2] Dr.Sandeep Gupta, [3] Dr.Arun Pratap Srivastava
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Abstract

An information retrieval system has a main aim to find relevant documents. Thus relevance is a central concept of information retrieval. Measuring effectiveness of information retrieval systems is essential for monitoring search quality in dynamic environments. In this merge, top-ranked documents in the merged result are employed to evaluate and rank the systems. The results from various search engines are collected and the meta-search system merges them into a single ranked list as merging is a key component in a meta-search engine. Data fusion techniques are designed to achieve improvements in effectiveness and clarify the conditions required for data fusion to show improvement. The effectiveness of a meta-search engine is closely related to the result merging algorithm it employs. In this paper, we propose merging algorithm, based on a wide range of available information about the retrieved results, Our proposed merging algorithm shows that how to merge the matching scores of distinct query terms. Our approach is effective and outperforms the retrieved results as compared to previously proposed methods.

Keywords

Data Fusion, Precision, Meta-crawler, Information Retrieval, Profusion.

1. Introduction

A search engine is an automatic robot, which indexes Internet data mainly by itself, allowing users to search the Internet via Keyword based queries. Altavista, Lycos, Excite, Hotbot and Infoseek etc. are examples of currently popular Internet search engines. Since there are a huge number of documents on the Internet, and each search engine indexes only a subset of the Internet documents, any single search engine cannot solve the problem of Internet information retrieval completely. In order to increase the A meta search engine is an information retrieval agent which is built on the top of other search engines. Queries are submitted to the meta-search engine, which in turn sends the query to multiple single search engines in parallel and then merges multiple results offered by different search engines. Meta-search, Savvy-Search, Meta-crawler, Profusion, Inquirus and MetaGer are examples of meta search engines.

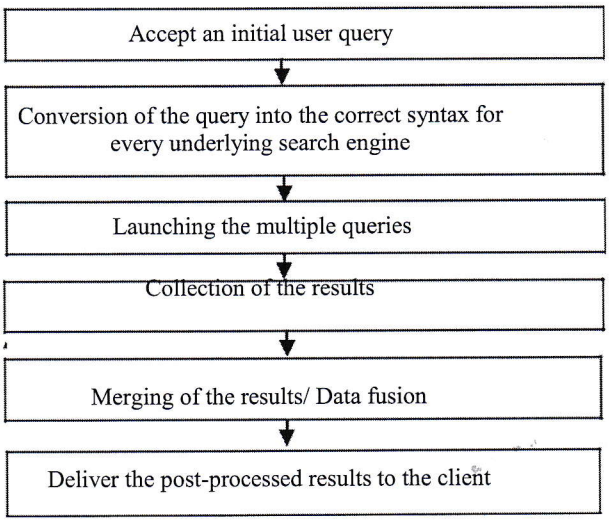

Figure 1. Steps for the principle of a meta-search

One of the main technical problems of running a meta-search engine is the fusion of results from multiple search engines. Data fusion is a technique used for combining different sources of evidence which may be contradictory, into one unified decision for whatever the application may be. Data fusion has had much success in the area of sensors for example, in which an individual sensor may4give an incorrect reading but by being combined or fused with multiple others, the result of the overall sensing operation is much more likely to be accurate and correct [1]. When used to combine more than one ranking of retrieved objects from information retrieval systems, where the rankings are based on retrieval using the same query and object representations, data fusion is a paradox. Unlike the sensor and similar applications where data fusion is used to eliminate the effects of genuinely erroneous sensor readings, or applications which fuse or combine rankings based on retrieval from different object representations (image colour, image texture, etc.), information retrieval systems fusing together the rankings from two independent retrieval algorithms operating on the same object representation can yield a fused ranking which is more effective than any of the individual input rankings [2]. Information retrieval is the discipline of retrieving relevant documents from a corpus in response to a user's information need which is expressed as a query. The matching between the query and each of the documents in the corpus is an inexact match and a ranking of documents is normally presented to a user [5]. In information retrieval, data fusion can take the form of fusing the ranked output of two or more retrieval strategies or expressing the same information need as more than one query and executing the different queries using the same retrieval strategy.

Given a query, each underlying search engine will return a result, that is usually a subset of the final post-processed result of a meta search engine. Since the number of hits of a search engine is often very large and users are subject to checking only the several top-ranked documents of the result, the order of documents in the final result is very important if users are to really get a significant benefit from the use of meta search engines. A simple method of result merge, which is used by some meta search engines, is the one after-the-other listing [6]. That is to strictly retrieve the results, ordering the top-ranked by each of search engines first, followed by all of there is no ordering among documents ranked equivalently by different sources.

From a user's point of view, the most important messages of a query result are the documents contained in the results and the order relationships between these documents. Since the document set of the final result is the join of document sets of results from all underlying Search Engines, the principal property, which makes a fusion method acceptable, is the order relationship between documents. In general, a data fusion algorithm accepts two or more ranked lists and merges these lists into a single ranked list with the aim of providing a better effectiveness than all system used for data fusion. Another aim of the data fusion is to group existing search services under one umbrella, as the number of existing search services increases.

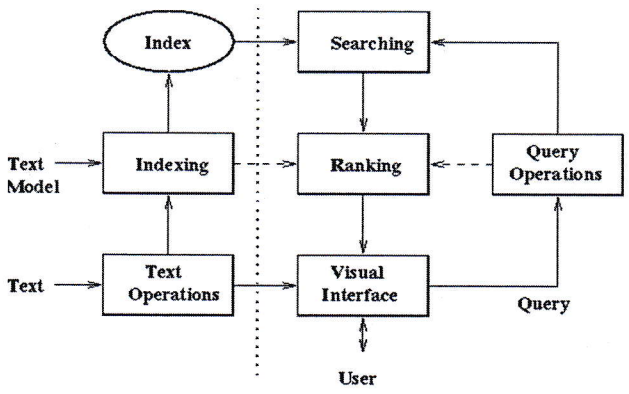

Figure 2. The components of an information retrieval process

Our goal is to examine data fusion of highly effective strategies and an attempt to create a fused result set that has better mean average precision than the most effective single system. This approach differs from the usual goal of data fusion applied to meta-search or distributed retrieval. In these cases, fusion is used to determine which result documents to select for

an integrated result set. We are trying to use fusion solely for improving retrieval effectiveness with highly effective retrieval strategies. The data fusion paradox to emerge in information retrieval research is that the fusion together of two or more independent retrieval strategies often leads to a combined level of effectiveness which is greater than the effectiveness obtained when the strategies are used in isolation. This means that if we take a query and run it on a collection of documents using retrieval method A to generate a ranking of documents and then run the same query on the same collection of documents to generate a different ranking using method B and then we combine or fuse together the two rankings by adding normalized document scores, the effectiveness of the fused ranking will generally be better than the ranking generated by either A or B, if A and B are independent. While this observation does not always hold true there is convincing evidence in information retrieval research that this phenomenon occurs with reasonable regularity.

In most IR systems a ranking of documents is normally achieved based on computing a score for each document in the collection as an estimate of its likely relevance to the query. For data fusion of such document rankings, either the absolute rank positions of a given document in two or more rankings, or the normalized scores of a document according to two or more retrieval strategies, can be combined, typically by summation. In our work described here we fuse together rankings based on normalized document scores, where the scores assigned to all documents in all system rankings for all queries are mapped into the range [0..1] with the value 1 assigned to the highest-scored document

2. Prior Approaches

Data fusion techniques can improve retrieval firstly by voting can be employed in order to boost the rank of documents that are common amongst component result sets. This point of benefit makes clear the source of Lee's statements regarding overlap. If the percentage of relevant overlap is significantly higher than the percentage of non-relevant overlap, the voting mechanisms should be more likely to boost the ranks of relevant documents, thereby improving retrieval effectiveness [3]. Secondly, CombMNZ-like fusion techniques can positively affect retrieval is if they are able to merge relevant documents that are unique to a single component system into the final fused result set. This increases recall, and may increase average precision if the new relevant documents are inserted into the fused result set at high enough ranks, thereby bringing improvements to retrieval effectiveness. The merge algorithm of MetaCrawler [6] is more sophisticated than the one-after-the-other listing. MetaCrawler uses a confidence score to determine how close a reference matches a query. A higher confidence score indicates a more relevant document. To calculate each reference's confidence score, MetaCrawler first distributes the confidence scores returned by each engine into the range 0 to 1000. Thus, the top pick from each engine will have a confidence score of 1000. Then, MetaCrawler eliminates duplicates, and adds the removed reference's score to the sum of the duplicated references confidence scores. In essence, this allows engines to vote for the best reference, as a reference returned by many engines will most likely have a higher total score than a reference returned by only one. Like MetaCrawler, Profusion [4] uses a merge algorithm that is also based on the original order of pages provided by search engines. Profusion uses a weighted score merge algorithm that is based on two factors: the value of the query-document match reported by the search engine and the estimated accuracy of that search engine. This kind of fusion has been found to be computationally simple yet as effective as a more expensive fusion [3].

Inquirus [5] uses a very different fusion method. In Inquirus, the actual pages of hits are downloaded and analyzed. Then a uniform ranking measurement is applied to documents returned by different engines. The meta-search engine displays pages in descending order of relevance. It considers the number of query terms presented in the document, the proximity between query terms, and term frequency. The

order of pages in the final result has no relationship with the original orders from underlying search engines.

The merge algorithm of MetaGer [2] , which is the representative of another popular class of fusion method, is very different from that of MetaCrawler. In MetaGer, pages are ranked based not only on their original order relationships but also on word counts within the title, the URL and the description of the hits.

One of the algorithms designed by Fox and Shaw, CombMNZ, has proven to be a simple, effective method for combining result sets. It was used by Lee in his fusion experiments, and has become the standard by which newly developed result combination algorithms are judged. More recent research in the area of meta search engines has led to the proposal of several new result combination algorithms, making use of training data and techniques such as voting algorithms and Bayesian inference. Although these algorithms have been shown to behave comparably and occasionally superior to CombMNZ, they did not exist when Lee performed his initial experiments.

3. Our Approach

This algorithm quantifies the matches based on each feature identified in Search Result Record Rank so that the matching scores based on different features can be aggregated into a numeric value. Consider a given field of a Search Result Record, say title (the same methods apply to subtitle).

Step1:

For the number of distinct query terms (NDisTerm), its matching score is the ratio of NDisTerm over the total number of distinct terms in the query (QLength), denoted SNDisTerm = NDisTerm /QLength

Step2:

For the total number of query terms (TQT), its matching score is the ratio of TQT over the length of title (i.e., the number of terms in the title), denoted STQT = TQT / TLength

Step3:

For the query terms order and adjacency information (ADJ), the matching score S_{ADJ} is set to 1 if the distinct query terms appear in the same order and adjacently in the title; otherwise the value is 0.

Step4:

The window size (WS) of the distinct query terms in the processed title is converted into score

SWS = (TLength – WS) / TLength (smaller WS leads to larger score).

Step5:

All the matching scores of these features are aggregated into a single value, which is the similarity between the processed title T and Query Q, using the following formula:

$$Sim(T, Q) = S_{NDisTerm} + \frac{1}{QLength} * (P_1 * S_{ADJ} + P_2 * S_{WS} + P_3 * S_{TQT})$$

This formula guarantees that titles containing more distinct query terms will have larger similarities.

Step6:

For each Search Result Record, the similarity between the title and the query (Sim(T, Q)) and the similarity between the subtitle S and the query (Sim(S, Q)) are computed separately first and then merged into one value as follows:

$$Sim = \frac{Tot(DisTerm)}{} * (const * Sim(T, Q) + (1 - const) * Sim(S, Q)) QLength$$

where Tot(DisTerm) is the total number of distinct query terms appeared in title and subtitle. By multiplying by Tot(DisTerm)/QLength, we guarantee that the Search Result Record containing more distinct query terms will be ranked higher. A genetic algorithm based training method is used to determine the values of the parameters involved in this method. Amongthe testing queries, the odd numbered queries are used for the training. The optimal values of P1, P2, P3 and const found by the training are 0, 0.14, 0.41 and 0.2, respectively. P1 = 0 means that the order and adjacency information is not useful for improving result merging in algorithm. One possible explanation for this is that due to the small length of each title and subtitle, the terms are already sufficiently close to each other to identify their meanings.

4. Conclusion

In this paper, we propose merging algorithm, based on a wide range of available information about the retrieved results. This algorithm quantifies the matches based on each feature identified in Search Result Record Rank so that the matching scores based on different features can be aggregated into a numeric value. Our proposed merging algorithm shows that how to merge the matching scores of distinct query terms. An effective and efficient result merging strategy is essential for developing effective meta-search systems. Our algorithm can outperform the best single search engine. Merging based on the aggregation of matching scores can be more effective than using the full documents of these results. This implies that a meta-search engine can achieve better performance than a centralized retrieval system that contains all the documents from the component search engines. Hence a simply result merging algorithm can perform as well as more sophisticated ones and our methods are robust and remarkably good in determining the poor systems. Our approach is effective and outperforms the retrieved results as compared to previously proposed methods.

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SWARM INTELLIGENCE BASED ROUTING ALGORITHM FOR MANETs

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Abstract

Wireless Ad Hoc Networks are characterized by nodes which are moving continuously. Routing algorithms play a vital role in the working of ad hoc networks. Ad hoc networks are constrained by congestion, limited bandwidth, energy and security. To achieve performance optimization under these dynamic scenarios, we consider a swarm based reinforcement learning routing algorithm and compare its performance with traditional routing algorithms like dynamic source routing and ad-hoc on demand distance vector.

Keywords- *Routing Protocols, AODV, DSR, Swarm Intelligence, Reinforcement learning*

Introduction

Mobile Adhoc network (MANET) is a collection of mobile devices which form a communication network with no pre-existing wiring or infrastructure[1]. Routing in MANETs is challenging since there is no central coordinator that manage routing decisions. Multiple routing protocols have been developed for MANETs [2]. In proactive protocols, every node maintains the network topology information in the form of routing tables by periodically exchanging routing information. Routing information is generally flooded in the whole network. Whenever a node requires a path to a destination, it runs an appropriate path finding algorithm on the topology information it maintains. The destination sequenced distance vector routing protocol (DSDV), and wireless routing protocol (WRP), are some examples for the proactive protocols.[3]

Reactive protocols do not maintain the network topology information. They obtain the necessary path when it is required, by using a connection establishment process. Hence these protocols do not exchange routing information periodically.[4] The dynamic source routing protocol (DSR), Adhoc on-demand distance vector routing protocol (AODV)[5], and temporally ordered routing algorithm (TORA) are some examples for the protocols that belong to this category can work in a decentralized and self-organizing way. The routing variations in the network topology.

Swarm Intelligence and Ant Colony Optimization

Recently, a new family of algorithms emerged inspired by swarm intelligence (SI), which provides a novel approach to distributed optimisation problems [6]. The expression "swarm intelligence" defines any attempt to design algorithms inspired by the collective behaviour of social insect colonies and other animal societies. SI provides a basis with which it is possible to explore distributed optimisation problems without centralized control or the provision of a global model. Initial studies have unveiled a great deal of matching properties between the routing requirements of ad hoc networks and certain features of SI, such as the ability of ant colony to find a nearly optimal route through indirect communication between the elements.

AntNet :- AntNet [7] is an adaptive, mobile-agents-based algorithm inspired by work on the ant colony metaphor. It has been found to out-perform the best-known routing algorithms on several packet-switched communications network. In AntNet, each node keeps a routing

table, which for each destination gives the probability of choosing each neighbouring node as the next hop. In actual network operation, the next hop with the highest probability is always chosen. Periodically each node will launch network exploration agents, called forward ants to every destination. At each node, the ants will choose their next hop probabilistically using that nodes routing table. As the ants visit a node, they record their arrival time and the node identity in a stack.

An ant reaching it's destination is converted to a backward ant. The backward ant pops the entries off it's stack and visits each of the nodes that the forward ant did. At each node along the return trip, the arrival time of the backward ant is compared to the arrival time of the forward ant. [8] This gives a round-trip time to the destination over the route chosen by the forward ant. This round-trip time is compared to the average round-trip time to that destination. If the new round-trip time is smaller, the probability of choosing that route is increased. If the new time is larger, that route's probability is decreased.

Reinforcement learning and ACO based learning strategy In Reinforcement Learning (RL), the system attempts to optimize it's interaction with a dynamic environment through trial and error.

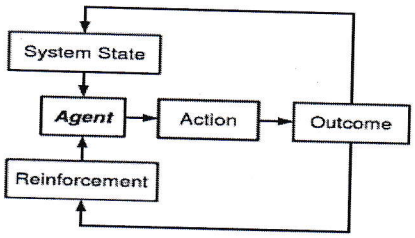

Fig1. Agent Interaction in Reinforcement learning [9]

In a standard reinforcement model, an agent interacts with the system by:

- Perceiving the current system state
- Choosing and performing one action from those available in that state
- Observing the outcome of the action: the new state of the system
- Receiving some reinforcement: a scalar value indicating the value of the action's outcome

Prioritised Sweeping [10] is a model-based learning strategy based on Q-learning. In Prioritised Sweeping, computation effort is concentrated on updating those states whose values are expected to change the most. Similarly to prioritized sweeping, ant-colony optimisation algorithms only attempt to update some subset of the states of the system with each iteration. These states are those which are reached by following some decision policy from a start state. We can interpret ant-colony optimisation algorithms as prioritising updates that are expected to be most relevant to the value of the start states. For problems where we are interested in optimising some subset of the system states rather than the entire system, we propose that a learning strategy similar to that employed by ACO could be useful. This is the strategy that we will employ for our ad-hoc routing protocol.

Swarm Based Routing Protocol

(1) Calculation of Optimal Value Function

First we can develop a reinforcement model for routing in MANETS as in [11] . We are using a model-based reinforcement-learning method, We therefore need to estimate the state transition probabilities and reinforcement functions T (s,a,s□) and R(s,a). Where (R(s,a) = rST (s,a,S) + rF T (s,a,F) In an ad-hoc network, the state transition probabilities T (s,a,s□) are simply the delivery success and failure ratios for each link in the network. For nodes which are out of transmission range of each other, this value is 0.

For nodes within range of each other, this may be affected by interference and congestion in the network. After the estimated model T (s,a,s□) and R(s,a) we can now calculate the values of by solving a set of Bellman Equations in [12]

asV(s)= $\sum_{s'} T(s,a,s').(R(s,a,s') + V(s'))]$ = $\max_a Q(s,a)$

Since each action has only 2 possible outcomes the calculation of the Q-values are quite simple. For given next-hop P, the Q-value is:

Q(N,P) = ps [rs +V(P)]+ pf [rf +V(N)]

where pS is the probability of transmission to P succeeding, and pF of it failing. Since V(N) = $\max_a$ Q(N,a), we are seeking the solution of:

V(N) = maxa [ps (rs +V(P))+ pf rf + pf V(N)]

Once the optimal value function has been calculated, the optimal policy is simply to choose the action with the largest Q-value in each state. This optimal policy will be called the exploitative policy .The exploitative policy calculated from the estimated model is that which we should follow if the model is correct. since the ad-hoc network is not static, the model (and our estimate of it) will vary with time. Therefore, in order to find an accurate exploitative policy, we will need to perform sufficient exploration of the system

Now ACO strategy alongwith can be used to formulate the routing protocol . The main points of the strategy are as follows

- Packets are created at start states, i.e. traffic sources.
- A model of the system is continually estimated. Each node records statistical information about the transition probabilities with its neighbouring states.
- Each node N maintains a current estimate of its optimal V -value, and that of its neighbouring nodes. N's estimated V -value of a neighbouring node P will decay from the time it was last advertised. A node's value will be advertised when that node forwards a packet. In this way, nodes which do not forward packets are assumed to be less valuable. The decision of other routing agents not to use a path through P can be used to infer a lower value for P.

(2) Use of Greedy Heuristic

We intend to explore the system and transfer routing information through the network by using the actual data packets that are being routed. In order that we deliver as many packets as possible, we want to weight the routing policy heavily towards exploitation. For this reason, we operate a greedy heuristic, at each node we only consider as next hops those nodes with *V*-values which are greater than that of the current node by some minimum amount . So, a node will be considered as a target for exploration only if it contributes to the delivery of the packet in question. The greedy heuristic attempts to deliver each individual packet reasonably quickly by avoiding backtracking in the network.

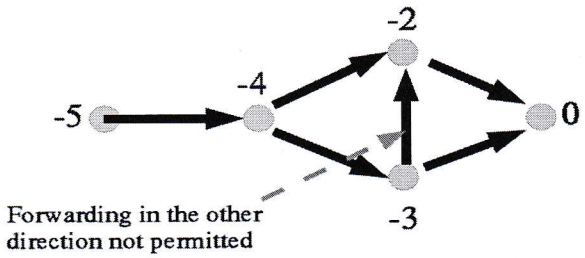

Fig 3 Greedy Heuristics : Permitted values

As shown in fig.2 the *V*-values for each node are displayed, along with the unicast actions which are permitted by the greedy heuristic in each state. The state with *V*-value -3 can be explored, but only from the state with value -4. (The state with value -3 can also be explored by an exploration action from the state with value -2).

(3) Promiscuous Receive and Silent feedback

We propose to transfer routing information through the network opportunistically. We attempt to make maximum use of each transmission made on the network. We also propose to transfer the routing information in an

on-demand manner. Each time a node transmits a data packet it also transmits the estimated optimal value function V for both the source and destination of the data being sent. Whenever a node unicasts or broadcasts a packet, it may attach it's expected optimal value, V associated with both S and D. Any of it's neighbouring nodes receiving that packet can then use these values to update it's own Q values and V value for S and D. This approach ensures that we make maximum use of every transmission.

Since the network is not static, the system is changing all the time. We need to provide a mechanism whereby stale information is discarded. For this purpose, we use an exponential decay. Each node judges the V values of it's neighbours to decay at this rate, starting at the last time they transmitted a packet. Nodes need not make a transmission to inform their neighbours of the decayed values, as their neighbours will assume this decay unless they hear otherwise.

The optimal value, V (s) of node s will be interpreted as:

V (s) = Vadv(s). λ ΔT (s)

where □ T (s) is the elapsed time since node s advertised it's V value, and Vadv(s) is the value that it last advertised. □ is the decay rate of information in the system.

Simulation and Performance Comparision: We Simulate the protocol on Ns-2 on a network scenario containing 50 nodes of which 33 are stationary and 17 are mobile. We measure performance according to a number of metrics:

- **Packet Delivery Ratio.** This is the fraction of packets created by the traffic sources which are successfully received at the traffic destination.
- **Packet Delivery Cost.** This is the ratio of the number of packet transmissions made to the number of packets delivered. This includes data packets and routing packets (if present).
- **Packet Attempted Delivery Cost**. This is the ratio of the number of packet transmissions made to the number of packets created by the traffic sources. This is equivalent to the Packet Delivery Cost multiplied by the Packet Delivery Ratio.

Results

We analyse the performance of the SWARM protocol by comparison with AODV and DSR. These experiments are carried out using NS version 2.26 . The versions of AODV and DSR used were those supplied with NS.

Using the results of the simulation we can say that SWARM based protocol works better than AODV and DSR . The advantage of SWARM over AODV and DSR is demonstrated as network congestion increases. Whereas the performance of AODV and DSR are reduced significantly as load in the network increases, the SWARM protocol manages to maintain a good level of performance. This decrease in performance of AODV and DSR with increasing load

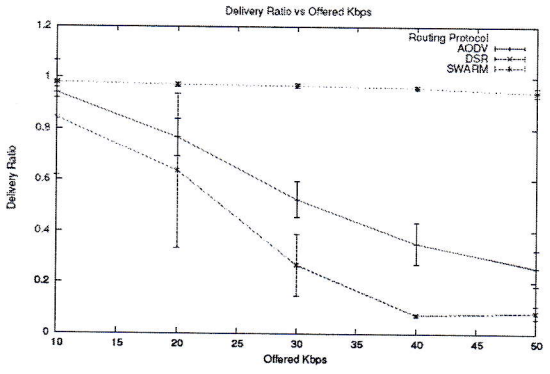

Fig3: Delay ratio vs offered Kbps

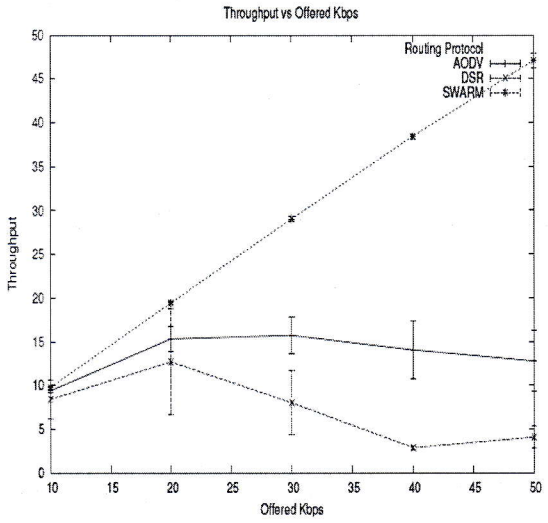

Fig 4. Throughput vs Offered kbps

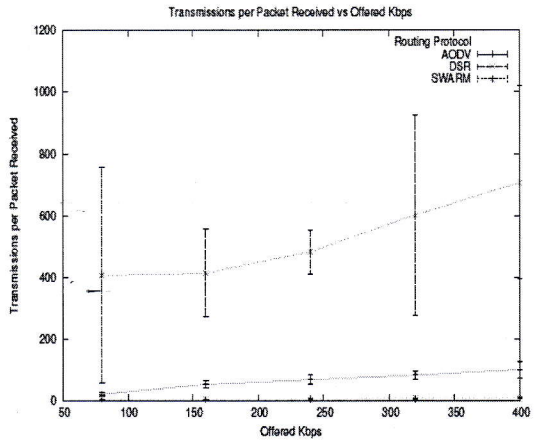

Fig 5: Transmission per packet vs Offered speed

is explained by the fact that these protocols interpret a unicast failure as a broken link, triggering route update mechanisms which require a large number of packets to be sent throughout the network. These routing packets in turn contribute to congestion in the network, worsening the situation further.

Conclusion

We have attempted to modify a swarm based protocol which operates with a continuous, rather than discrete model for the quality of links in the network. Using our continuous model of link quality, we have used reinforcement learning to define a model of optimal routing behaviour in an ad-hoc network. In this model, optimal behaviour is not merely shortest-hop paths, but also considers the quality of the links which make up those paths. The learning strategy we have designed is based on work in swarm intelligence. We adapt some of the unique features of ant-colony optimisation algorithms which are applicable to the ad-hoc routing problem. In particular, each packet routed by the protocol is equivalent to an ant in ant-colony optimisation techniques, the progress of the packet through the network incrementally changes the routing policy and the paths which are used by future packets.The simulation results show that the swarm based protocol works better than AODV and DSR protocols.

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Re-Enforcement Learning Approach by Using Transfer Learning

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Abstract: - **Transfer learning is the process that uses the information to agent. The main role of transfer learning is previous task knowledge in the current task to improve the that the learning in one task can help to improve performance of the new task .In reinforcement learning, the performance in another task. In multi agent framework the agent requires training from the task .Transfer learning use advice given by agent in one stage can be used in another with the reinforcement learning to improve the stage of the system. Our experiment is conduct on real time performance of agent. Transfer learning method is mainly strategy game setup. The result shows that Bias Transfer applied on single agent reinforcement learning algorithms reduces the training time in the target task and improves We use the better algorithm for transfer learning with asymptotic performance reinforcement learning on multi agent domain.**

Keywords: - **Multi agent systems, Reinforcement learning,** cooperative agent and another is competitive agent. In Transfer learning, Soccer game. **reinforcement learning the agent give limited feedback.**

I INTRODUCTION

In the reinforcement learning many problems require a huge amount of training time to solve the problem. When transfer learning use with the reinforcement learning in the same problem training time is reduce. Till now several methods have been proposed to solve these types of problems to reduce complexity. Most of the proposed methods are applied on single agent problems. In multi agent system the agents communicate to each other to achieve the same goal. In multi agent system the agents choose the best action among several actions to accomplish the same goal. In this paper we present the method that uses the transfer learning with reinforcement learning in multi agent system.

We represent this method in multi agent reinforcement learning (MARL). The proposed method is based on Bias Transfer, which is applied on MARL with transfer learning.the domain to achieve the goal and also improve the asymptomatic performance.

II TRANSFER LEARNING

Transfer learning is that learning in which the agents learn in the one task as the learning purpose and use in another tasks which is related to same domain. Many issues occur in the transfer learning method like how the tasks are related to each other and how these tasks are different and which part of the knowledge should be transfer or not. The tasks of the same domain may have different state space with fixed variables [7] or even different state variables [5]. Many methods have been discussed in which tasks in the different state and action space and also in the transition function and reward [12]. These proposed methods use inter tasks mapping means they use relation in the source task to other tasks. Mapping between source and target tasks can be shown as the (□ a, □ b) where the basic idea about bias transfer method is to use joint policies; means the agents learn in the source task can be apply in the target tasks that accomplish the same goal. In the bias transfer method we use Joint Action Policy as the basic learning algorithm.

The proposed method can be used in multi agent domain applications. The proposed method checked on multi agent soccer domain. The result shows that the proposed method can reduce the learning task in

Xa(s) : Starget □ Ssource

Xa(a) : Atarget □ Asource

A survey found on transfer learning in the single agent reinforcement learning [9]. The transfer knowledge between the agents in the tasks may be low in which tuples as the form a, r, s□ i [6] and value function [12]. The knowledge in which higher may include these tuples like action subsets or shaping rewards. Madden and Howley has been proposed a method for single agent learning, it is very closer to our approach. This method use the extract rules from the action rules that was learned in the previous task. The proposed method use initial values to the goal task learners before the learning process starts.

III TRANSFERS IN MARL

Although in multi agent system the difficulties to solve the complex problem create a new problem, it is not like a single agent problem solving method. In multi agent the agents learns from other agents in the learning point of view. A method used in the transfer learning in single agent learning is not equal to the multi agent learning. Multi agent in any domain has been applied is a major task. In this section we will provide several issues that are arise in the multi agent reinforcement learning domain. In the context of learning in the multi agent domain is the specifically aff ect transfer learning, which has some restriction. First of all we consider the homogenous agents that mean agents have higher degree of similarities among the actions to achieve the target. We also assume that the agents may be competitive, means agents does not learn the behavior of the opponent agent in the domain. Agent homogeneity may be high restrictive; tasks with heterogeneous agents can be viewed as having many different classes of mutually same agents; then transfer would generally still take place between these same agent classes across tasks, the transfer task in this case could be seem as a series of parallel homogeneous transfers.

3.1 Inter task Mappings across Multi agent Tasks

Inter task mappings in single agent tasks use the very similar states and actions between the source and goal tasks. A diff erence in the multi-agent domain is that the learned knowledge for each task is distributed among other agents, which means that the mapping factor for the goal task have to be defined each agent. We propose a function defined for agent i that map the joint actions of an n-agent task to those of an m-agent task below:

Xi,Jn □ Jm (□ ~) : A1 × ... × An □ A□ 1 × ... × A□ m Where Jk =A1 × ... × Ak

Correspondingly a map function that maps links between tasks can be defined per agent. Although states have the same meaning in multi agent tasks as in a single agent one, they can include parameters that are associated with a specific agent. Since it is useful in a multi-agent setting to make this distinction, we denote these parameters as s and as $\bar{s}$ the rest of the state variables in the multi agent j tasks. The proposed form of such a map function for agent i is:

Xi,Sn □ Sm (s) : Sn □ Sm

Where each state s ∈ Sn and s□ ∈ Sm of the target and source tasks correspondingly has the form

s: <s,agent1,.....agent n> s': <s',agent1,.....agent m>

t: The source and target tasks may have various action and state variables combination and these can be mapped using with the same techniques which one would use in a single agent task. There are a various techniques to define these mappings, especially when goal specific tasks are taken into account. A factor to representation of an agent in a one task is considered equivalent to an agent

representation in the goal task. In many situations this mapping corresponds to that in which where each agent is thought to retain its identity over the two different domains. But it may be possible for a single agent to be mapped to the states and actions of various agents. Accordingly, we propose an approach. Static agent mapping implements a one-to-one mapping between agents that is constant. This approach electively ignores the presence or absence of actions the extra agents. This indicates that the chosen set of extra agents remains the same for all states and joint actions1. For example, shown below are functions defined for one Agent that map a three agent task to a two agent one, ignoring other Agent :

□ 1,Sn □ Sm (<s¯target , agent1, agent2, agent3>) = <s¯source, agent1, agent2> □ 1,Jn □ Jm (<□ 1,1 , ..., □ 1,i , □ 2,1, ..., □ 2,j , □ 3,1, ...,

□ 3,k >) = <□ 1,1, ..., □ 1,i , □ 2,1, ..., □ 2,j >

Where □ ij is the jth action of the ith agent in the domain. It is important to show that these functions are simplified for demonstrative purposes; they make assumption that s¯target can be mapped directly to s¯source and that each agent has the same associated state variables and actions across tasks in the same domain. It is also important to keep in mind that these functions are defined for each agent. When we transfer knowledge from a single agent domain to a multi-agent domain, there is a way to pick this extra agent.In Figure 1 we represent a case where transfer learning from a task with two other cooperative agents leads to a three agent one can have two another outcomes.

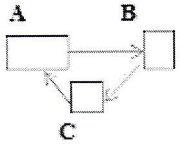

Fig.1. Agent's perception variations in static mapping when transferring from a two to a three agent task

Dynamic agent mapping is the mapping in which agent's action combination should remain the same as the requirement for all states and joint actions. This means that the agents do not retain an identity across the two other tasks. There are two ways to implement such a mapping function. For example, from the viewpoint of agent 1, such mapping functions for a three agent representation mapped to a two agent one using distance as a criterion would be:

<agent1,agent2>, d(x1,x2) < d(x1,x3)
□ 1,s3□ s2 (agent1,agent2,agent3)
=<agent1,agent3>, d(x1,x2) < d(x1,x3)

Where d(x1, x2) is distance between agent x1 and x2 in current state. The main divergence in this case is that the action map function is a function of the current state s being mapped, as in this case it depends on its properties (i.e. the agents' current coordinates).

3.2 Level of Transferred Knowledge

A Multi agent system is that in which the acquired knowledge is distributed among agents instead of residing in a single agent. This can be a major task for transfer methods, since there is no simple way to deal with multiple sources in the normal case. We select to transfer the learned joint policy in order to avoid this issue, since we can use this unified source of knowledge to transfer to each other agent. The trade-off to be made here is that some knowledge that could benefit the goal task is ignored, such as the values of suboptimal actions.

3.3 Method of Transfer

In the level of knowledge transferred, we must also decide how to incorporate this useful knowledge in the target task's learning algorithm. Transfer learning methods in single agent 'domain was modifying the learning algorithm in the goal task [12]. The usual criterion for convergence in single agent system algorithms is to give right proportion of the state and action based function in order to estimate the optimal policy.

We propose a method for transfer that incorporates the transfer knowledge as bias transfer function values in the initial action state value function. Since proof of convergence does not rely on the specific initial values of this function, we are essentially use MARL algorithm as the base. We proposed algorithm as a Bias transfer method that does not affect the convergence of the underlying reinforcement learning algorithm. Previous research in biasing the initial Q values [7] generally avoids defining the specific intervals that the bias parameter should lie within that interval. This is justified, since an optimal bias parameter value relies on the specific properties of the Q function that is being estimated in the first place of the agents. Intuitively, we seek a value enough such that it will not be overcome by smaller rewards before the goal state is reached within a few times, and low enough to not interfere with learning in the later stages. Our experiments have shown that for most problem a relatively small bias (e.g. b = 1 when Rmax = 1000) usually has better results and performance will start to drop as this value is increased. Using a bias value b, Algorithm shows the pseudo code for the generic multi-agent transfer.

Algorithm BIAS TRANSFER for agent i

1. for all states s in Starget do
2. for all joint action vectors □ ~n in A1 × ... × An do
3. Qi,target(s, □ ~n) □ 0
4. if □ i,A,n→m(□ ~n) = □ source(□ i,S,n→m (s)) then
5. Qi,target(s, □ ~n) □ b
6. end if
7. end for
8. end for

Q-value reuse adds the Q-values of the source task directly to the Q-values of the goal task. In this algorithm, the new Q-values are defined as:

$Q_{i,target}(s, \square) \square Q_{i,target}(s, \square) + Q_{source}(\square i,S,n\square m(s), \square i,A,n\square m(\square \tilde{n}))$

However, unlike the previous method that is only invoked before learning, transfer here takes place during the execution of the target task and becomes a part of the learning algorithm. A significant diff erence in this case is that one would have to choose which Qsource to use. This could be the Q function of an individual agent in the source task such as an average from all agents.

4 Experiments in the Robotic Soccer Domain

Predator prey domain is used for the evaluation of proposed techniques. The learning environment in all cases was a 5 × 5 grid, where the current state is defined by the locations of the prey and the other predators. The agents can choose their next move from the action set A= {NORTH, SOUTH, EAST, WEST, NONE} in which NONE means that they remain in their current position. States in thiscondition include the x and y coordinates of the prey and the other predators, relative to the current predator, so a state from the viewpoint of predator A in a two agent world with another predator B would be of the form

$$s = < prey_x, prey_y, B_x, B_y >$$

In all cases for both source and goal tasks the MARL algorithm used is joint action learning (JAL). The exploration method used is Boltzmann exploration, where in each state the next action is chosen with a probability of

$$Pr(a_i) = \frac{e^{Q(s,\square i)/T}}{\sum_{j=1}^{n} e^{Q(s,a_i)/T}}$$

Where the function is calculate of the maximum value of all possible joint Q actions given an agent's individual action. T is the temperature parameter, where Ns is the number of times the state was visited before and Ct is the diff erence between the two highest Q-Values for the current state of the agent. Boltzmann exploration was fully used in the single and multi-agent version of the task, but in the three agent version it was more practical to use in 10% of the steps, making it the exploration part of an e-greedy method where Q = 0.1 [3]. For all experiments we used a constant learning rate a = 0.1 and a discount factor □ = 0.9. When BITER is use, the bias parameter is b =1. The rewards given to each individual agent were r = 1, 000 for capturing the prey, r = □ 100 when collision with another agent occurs, and r = □ 10 in all other states. For each experiment, 10 independent trials were conducted. The results that we present are averaged over these repetitions.

5 Results

For each experiment, we record the performance times in terms of capture better and non-transfer better the results do not include the learning time of the source task as it is typically an order of magnitude less than the target task's. The first of all the soccer experiments involve two tasks of the team capture game, with one, two and three predators respectively. Additionally, we use the dynamic mapping method for all transfer procedures.

The first transfer case focuses on the out of circle team capture task, where we applied our proposed transfer method using a single-predator capture task as source. In this simple case, the learned policy of the source task is used to bias the initial Q function of the target task. The learning time for the source task is approximately 200 episodes, or about 1200 cycles in total. Since the size of the state and action space is relatively small, it can be assumed that the source task's learned policy is optimal. In this case each agent in the target task begins with a policy that is biased towards the learned policy from the single-agent task.

Figure 2 represents the results of BITER compared to the non-transfer case. The column and rows represent the episodes and capture times (in cycles) respectively. Table 1 presents the recorded metrics for algorithm.

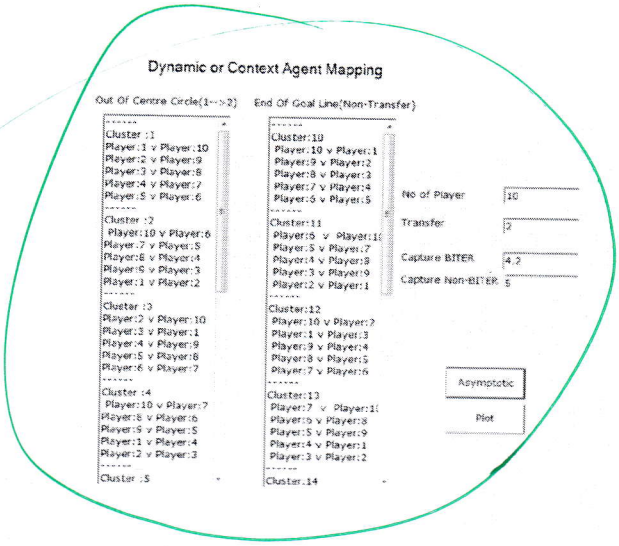

Figure2: Comparison between Biter algorithm and non-biter algorithm capture time

Agents / Algorithms	Players 8	Players 10	Players 12
Non Transfer	4	5	6
Transfer (Bias)	2.75	4.2	5.67

Table1: Performance of agents with BIAS transfer in Robo Cup soccer game.

4 Conclusions

In this paper, we present method to reduce the amount of training time for RL with the help of transfer learning. The main idea was to build extensive knowledge from few experiences. This is crucial for the application

of RL methods to real-world scenarios. We use imitation to replace the random exploration of the large state and action space with a guided exploration. In our approach, the agent has full access to experiences of a teacher, which has the same state and action space and gets identical rewards. Perceptions, actions, and rewards of the experienced agent are stored and can be accessed and reused later for the same type tasks. Similarly, own experiences are stored and re-evaluated later. This basically reduces the training expenses. We let the agent repeatedly reprocess past experiences to avoid this problem. In addition, the quick generalization of similar situations while preserving the possibility to distinguish between various situations, essentially contributes to the acceleration of the learning process. As the experimental results show, fundamental soccer skills can be learned using RL in simulation. The approach also works with a real humanoid robot on the soccer field. The given task is accomplished quickly and reliably. Although the training with the real robot requires more time than the training in simulation, it stays within limited period. .

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FACILITATOR MODEL BASED ON WEB USAGE MINING FOR RECOMMENDISED E-TRADE

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Abstract

The evolvement of today's retail environment is increasingly complex and exceptionally competitive. Contributing to this complexity, traders have multiple paths in the present scenario to do his trading. While this might sound exciting, the reality is that many retailers are struggling to understand how to effectively and consistently engage their customers across channels from digital to brick-and-mortar -- in a manner that builds long-term customer loyalty and delivers a sustained return on marketing spend. Today's consumer has higher expectations and shops differently. Thus E-trade is growing in popularity faster than any other channel. As e-trade is widely applied, web data mining technology is used for e-trade to provide recommendised e- trade and better meet the requirements of users. Beginning from the concept of recommendised information services, this paper focuses on detailing six recommendised services available in an e-trade environment and propose the Facilitator model based on web usage mining for recommendised e-trade by applying web data mining .Beside this a Relevancy search engine was developed for finding whether a webpage is relevant, very relevant, week relevant or irrelevant corresponding to a keyword (query) recommended by the customer for e-trade Paper also focuses on the analytical study on data resources, key technology and basic flow in relation to this model.

Keywords: Web Data Mining, E-trade, Recommendised Service, Facilitator Model, Relevancy Search Engine

I.INTRODUCTION

The objective of personalized information services is to provide users with individually tailored news and information. It is to optimally support them retrieving information within their scope of interest in the desired coverage, access time, and media. Personalization is also about making online information easier to access, more efficient in use, and providing an individual, personal online experience for the users. Thereby personalization can be considered twofold: as a feature that supports the information supply of a particular information provider, or as an autonomous concept which is to grab and filter information and contents from several information sources and individually present it to the users.

In either case the superordinated goal is to help the users getting the information they want in an efficient and pleasing way. Yet the hurdle with achieving this goal is that the information system must first know the users' interests, needs, and preferences [19]. Many of the existing recommendised services put the strain of gathering this information on the users. Users are confronted with incomprehensive registration forms, prompting the users to explain their life story in data. Next they have to bother with seemingly endless personalized and customization features, having to choose from dozens of check boxes or enter cryptic search and keyword strings.

The result is that many users either give up before having finished the personalization

process or they end up being frustrated because the effective results often they stay behind the expectations of the users. Such systems seem to ignore that personalization is not the actual goal task of the users but rather just getting the information they are interested in. [17].

II.RECOMMENDISED E-TRADE

Recommendised information services are now a hot research topic in global information services. Traditional universal information services are giving gradually an approach to personalized information services that, according to the interest, status and specific requirements of a user, serve the user on a targeted basis. [2] As an extension of personalized information services in e-trade, recommendised services in an e-trade environment is also a field that is prepared for key applications, development and research in personalized information services. Recommendised services in e-trade means that a business organization obtains user's data and information depending on users' visit to business organization websites, analyzes and processes such information by using web data mining technology and assist the organization in decisions making as per the requirements of users .The business organization could embark on e-trade activities, offer recommendised information services, improve the awareness , satisfaction and loyalty of the users and gain win-win for the business organization and his users (as shown in figure1)

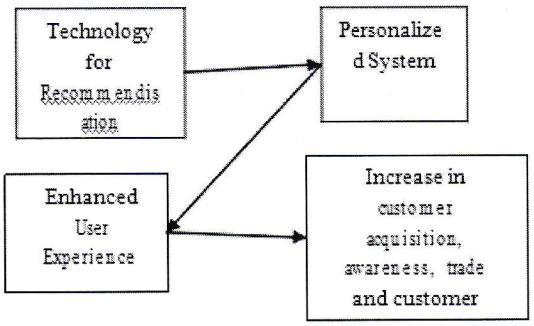


Figure1. Methodology for Recommendisation

Recommendised services in e- trade are web services centered on user requirements. The "User Analysis Module" as shown in figure 2 explains the functions to learn the user's features create user access model and offer recommendised services to the user by using technology processing and web resources [18].

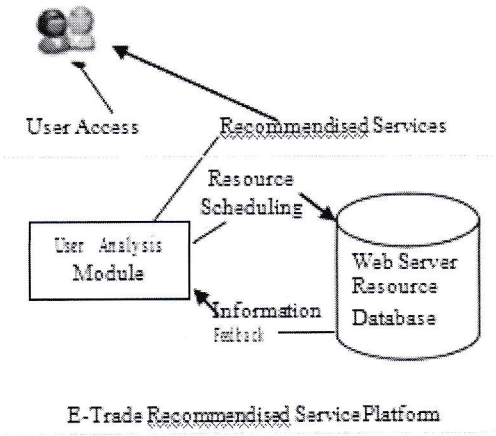


Figure 2. User Analysis Module - Meaning of Recommendised Services in E-trade

III. WEB DATA MINING

As a key technology to provide recommendised e-trade and help to collect user information, web data mining can be used to analyze user data, create access model, requirement model and interest model that accord with user features, making recommendised e-trade possible.

According to data mining behaviors, web data mining is classified as web content mining, web structure mining and web usage mining. For more information, see Table 1. Web usage mining means that by mining the log files and data at the corresponding site, you discover the behaviors of visitors and users having access to this site. Data mining methods include path analysis, association rules, classification rule, sequential patterns, statistical analysis, dependent relationships modeling and cluster analysis [4].

Classification	Secondary Classification
Web Content Mining	Text Mining
	Multimedia Planning

Web Structure Mining	Organizational Structure Mining
	Page Structure Mining
Web Usage Mining	User Record Data Mining
	Customization Mode Mining

Table I. Classification of Web Data Mining

Data on web is unstructured, semi-structured and dynamic, so web data mining has to go through the corresponding processing flow that is composed of data positioning, data preprocessing, pattern recognition and pattern analysis. In this process, we should first determine the source of data, including web document, e- mail, website log data and transaction data. Next, you should preprocess data, i.e., delete some redundant information and unify information recognition, session recognition and transaction recognition, and then carry out pattern recognition of the preprocessed data, i.e., use the data mining method to mine useful, potential and understandable information. Finally, through pattern analysis, you can convert the filtered data into useful rules and patterns to guide the practical e-trade activities.

IV. PROPOSED FACILITATOR MODEL

4.1 Use of Facilitator Technology

Agent is a computer system in a certain environment that imposes flexible autonomous actions on its environment to reach its expected target. Agent has the following essential features [5] as: autonomy, communication capacity, interaction capacity, proactive capacity, viability, perception capacity, initiative and sustainability.

In this model, Agent technology is used to help support decisions and collect information, i.e., screen out the qualified information from data in quantity according to relevant user information, update information resource database dynamically, reduce the working stress of a server and improve the efficiency.

This model has the function module of Agent technology as user Agent. The module, consisting of input interface, history database, reasoning machine and output interface, interacts with users. User Agent records user usage data via the input interface, and saves it in a history database. The reasoning machine, based on the user data in the history database, analyzes the current user intent by using knowledge base in collaboration with user model, and assists the user in using both actively or semi- actively. Meanwhile, the reasoning machine always updates or optimizes user models on the basis of users' new usage conditions, and eliminates some outdated applicable records. Additionally, this machine makes query more detailed. The output interface is used to show results. As user Agent technology is used, accurate user interest model and certain applicable experience are a great help to recommendised e-trade.

4.2 Data Source of Web Usage Mining

Server Data

The access log file of web server records access and interaction information of visitors. This web log file, containing many records, is used to record users' access to this website, including Server log (user IP, server name, URL, time to browse this site, Cookie identification number), Error log (lost connection, authorization failure, timeout, etc.), Cookie (user state and access path).

A user logs on to an e-trade website platform. Then, user Agent enables this function module on the basis of user usage information

User Registration Information

Having access to an e-trade website, a user inputs and delivers some information to the server via web page, including registration information and exchange information. Analysis of user registration information helps you to analyze user behavior pattern and formulate the corresponding e-trade policies aiming at specific users.

Transaction Data

The background database of an e-trade website saves user information, goods information table and order information table. Each time a user completes a commodity transaction, the order information table will have a new record to record the user purchase information. This information mining is of great significance to analyze users' interest.

4.3 Recommendised Model Architecture

Use of web data mining technology in combination with Agent technology allows you to model a web-based mining recommendised e-trade system, whose work flow process is discussed below:

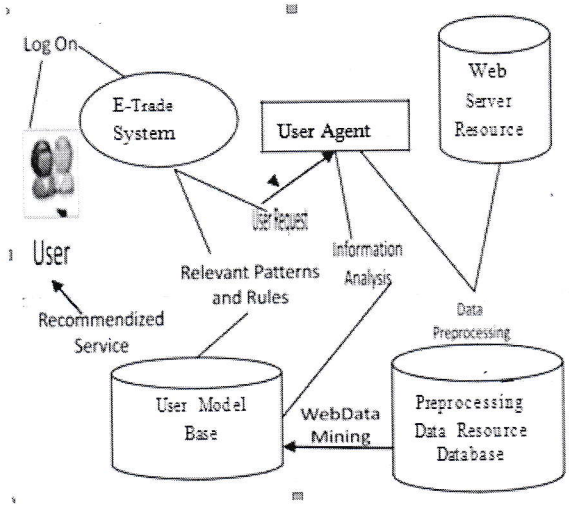


Figure 3. The structure of Web Data Mining for Recommendised E-trade

- According to the recommendised requirements of users, organize data resource and find the original use data of this user.
- Preprocess the user data, including data cleansing, conversion, integration and formatting, and load the results to the preprocessing data resource bank.
- Select a suitable data mining method in collaboration with user Agent to build user model and model base

Based on data mining results, integrate with expertise and area rules, and offer users query is retrieved using this search engine. Using Jspider (An open source spider software) [20] and Web Tracer (A software tool to visualize the structure of the web) [21] is used to generate the required web map of any web site related to E-trade activities. We can embed this search engine in the web sites for finding whether a webpage is relevant, very relevant, week relevant or irrelevant corresponding to a keyword (query) recommended by the customer for e-trade. The search result in Fig 5(b) is taken from my previous work [17] to demonstrate the usability of this search engine in the current e-trade environment. recommendised e-trade services via an e-trade system.

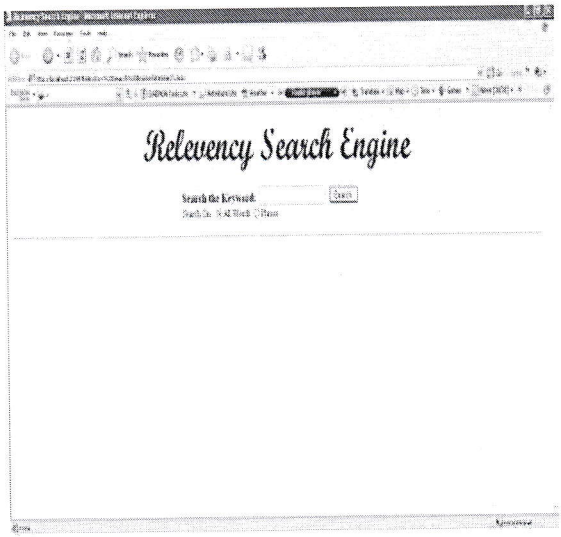
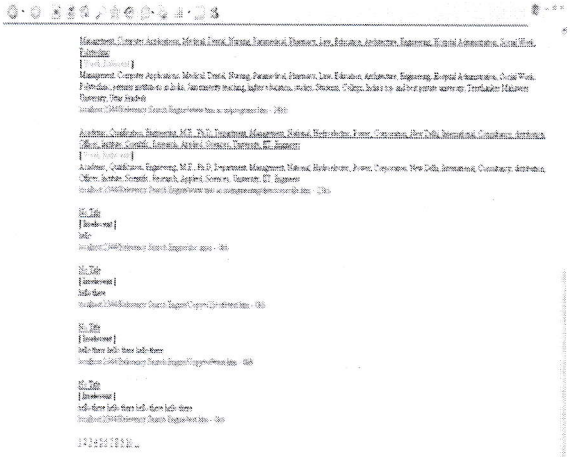


Figure 4(a). Main page of Relevancy Search Engine

V. RELEVANCY SEARCH ENGINE

A search engine was developed for finding whether a webpage is relevant, very relevant, week relevant or irrelevant corresponding to a keyword (query) recommended by the customer for e-trade. This search engine was developed in .Net Environment using C#. We named it as Relevancy Search Engine [17]. The screenshot of output is shown in figure 5.



Firgure 4(b) Search Result

VI. FUTURE WORK & CONCLUSION

As Internet-based e-trade grows rapidly, recommendised e-trade should be worth paying more attention and developing from the theoretical and practical standpoints. Obviously the recommendised_e- business have some room for further improvement and research, for instance, collection of user registration information cannot violate users' privacy during web data mining while optimization of web Figure 4(a). Main page of Relevancy Search Engine data mining algorithm and user modelling, etc, and that will be a research trend in the future recommendised e-trade. Web mining is used to extract information from users' past behaviour.

Web Usage mining plays an important role in this approach. This paper introduce the Facilitator Model Based On Web Usage Mining For Recommendised E-Trade In this model, Agent technology is used to help support decisions and collect information , i.e., screen out the qualified information from data in quantity according to relevant user information, update information resource database dynamically, reduce the working stress of a server and improve the efficiency . A Relevancy search engine is also used to process the query which provides the relevant information for the e-traders.

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Compressed Air Fueled Automotives: Study and Development

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Abstract- Cost and pollution problem associated with the fossil fuels to run the vehicles, promoting the manufacturer to think about the other alternative options of the fuels. Light duty vehicle always have been the important means of the individual transportation. Engineers are making their efforts to use of air as an energy option to run the light duty automotives. Storing of the energy in the form of compressed air is not only clean, but also it is economical and efficient. The problem which was associated with compressed air automotive was the limitation of torque generated by the engines and the compression cost of the air. In current scenario, several companies are started working on the development of compressed air vehicles to overcome theses problem issues. However, there are still many important bottlenecks of problem are to be tackled. The paper presents the technology description, latest developments, pros and cons of use of air as fuel to drive automotive.

Keywords – Compressed air, Air fueled Car, Environmental problem, fossil fuel

I. NTRODUCTION

In general, believing on the automotive fueled by compressed air is difficult. However, the idea is true and the compressed air car has become the center of discussion among the researchers in all over world. It is pollution free and is suitable for urban conditions. An air powered automotive is the vehicle which completely work on compressed air. There is no requirement of the other source of energy. It works on the first law of thermodynamics. When air is compressed it stores pressure energy which is converted into mechanical work when air expands in the cylinder.

We used to live in a very mobile society so light duty automobiles like small bikes, scooters and cars very frequent means of independent transportation for short journey. Fossil fuels which have been the main sources of fuel in the transportation history. Now, fossil fuels are depleting and more expensive. The fossil fuels are main source of air pollution. Such factors are motivating vehicle manufacturers to design the automotives fuelled by compressed air. When at present level of scientific development fuel-less flying that is flying based on the use of bio-energy and air power in the atmosphere. it seems to be almost impossible for human beings however, engineers are interested in the

development of the compressed air driven automobile as possible alternative. Engineers are paying their sincere efforts for the development of the use of air as a fuel source drive the automotives will pave the for making future bikes and small automotives running with fuel air for routine movements and this means will be free from pollution and economical. Compressed air for vehicle propulsion is not new it has been explored in past years and now air powered vehicles are in more developed phase to be prove as a fuel-efficient means of transportation. Few automobile companies are now exploring compressed air hybrids and compressed fluids for storage of the energy for automotives. Although it is a eco-friendly solution and one must consider its relevance by knowing its well to wheel efficiency. The electricity requirement for compression of the air should be considered while calculating the overall efficiency. Nevertheless, the type of concept automotives will contribute a lot to reduce urban air pollution in the long term consideration.

II. TECHNOLOGY OF THE ENGINE

The air-powered car runs on a pneumatic actuator that is powered by compressed air stored onboard the vehicle. Once high compressed air is transferred into the cylinder from onboard storage tank, slowly it releases the power to the car's cylinder. In that way, the air power is converted into mechanical power and in such a way that power is then transferred to the wheels of the car. Upto the speed of 35 mph, the air-powered car runs completely on compressed air through the previously stated process. Thus, it only emits cold air and making it emission free at speeds less than 35 mph. But when the air-fueled car accelerates beyond speeds of 35 mph, a very small conventional engine kicks in to heat the air. This heating results in the speeding of the emitted air to accelerate the car's pistons, which increasing the Cars speeds [1]. Since for this process it requires combustion engine and electricity to power the onboard air compressor, the air-powered cars emissions increases. This will be evaluated later in the paper. The air-powered automobile is able to collect compressed air from its onboard storage tank in two ways. One way is that the compressed air directly injected with the help of electricity into its thermoplastic carbon fiber tank. Although, to use this method air stations are required for filling air like CNG/LPG gas station are used. The refueling process takes approximately three minutes [1].Although; there is unavailability of air stations in market for air fueled automobile for refueling. But few researchers are not seeing it as a downside.theyconcluded that the economics' Invisible Hand will support to solve this problem at right time and air stations will be available when they are needed [2].The second method for refueling the air fueled automobile is done by plugging the automotives into a wall outlet. This allows the automotives onboard air compressor to pressurize air from the surroundings. This process takes approximately four hours.

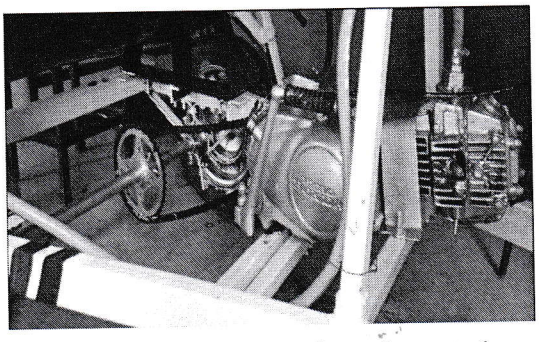

Figure 1(Hero Honda engine, four stroke 97.22cc petrol engine)

Compressed air is only means of energy storing, not an energy source like gasoline. Compressed air is stored in carbon tank similarly as in case of an electric battery. Compressed air delivers its energy in the from of thermodynamic work done by the expansion of gas [3].

III.POSSIBLE IMPROVEMENTS

Compressed-air automotives operation involve a expanding process and heats up in compression process. Since, it is very difficult to attain the ideal state as there are various losses occur in actual practice. So there is only mean to approach to ideal state by minimizing the losses. In order to reduce the losses more efficient heat exchanger is used to heat from the ambient air passenger cabin. At the time, heat generated during compression process could be stored in physical or chemical system for further use. Now compressed air can be stored at low pressure keeping the absorbing materials such activated carbon inside the tank. in this way, gas can be stored at around 500 psi accounts for Reciprocating piston or rotary expanders are generally used in the typical compressed air represent the development of air powered vehicle if a this purpose, we required there was a requirement expander system. With some changes, any four stroke petrol engine can be transformed into a air fueled engine. In this paper a four stroke 97.22 cc(HeroHonda make) petrol engine was taken and some modification have to convert it This engine has four stokes during its operation namely suction, compression, power and suction stroke have no meaning. In air fueled engine.

By squeezing air at high pressure, energy is stored in the form of pressure energyand this energy is utilized to throttle the pi

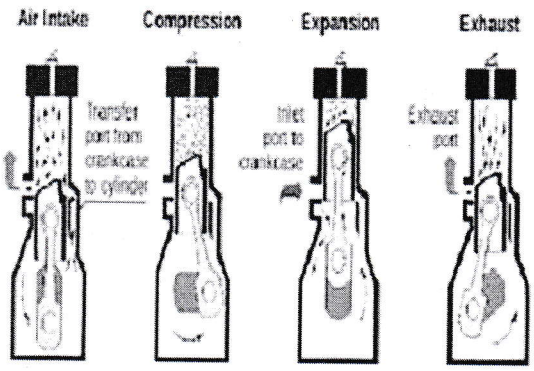

Figure 2 Four stroke SI engine[5]

ston from TDC to BDC. The engine completes its operation in only two stroke cycle. In the expansion stroke ,when inlet valve is open, high pressure air pushes the piston towards the downward direction and in that way power is transferred to crank shaft which results in the movement of the wheels. A fly wheel (for energy storing) is mounted on the crankshaft which stores the fluctuation of energy from BDC and outlet valves open at this moment to the air in second stoke as shown in figure no.3.

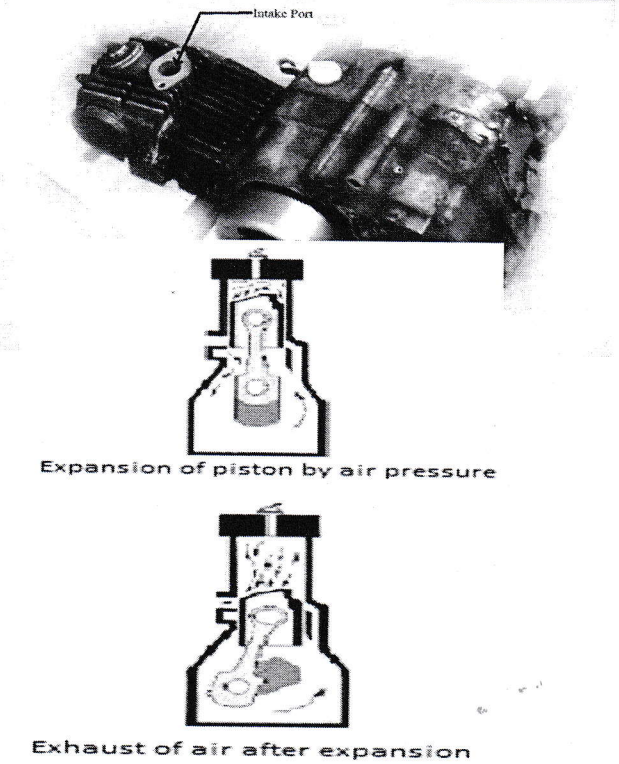

Figure 3 Working of air Fueled engine[5]

Following modifications have been made into the four stroke petrol engine to convert it into compressed air engine.

- Modification of the inlet port according to the air intake
- Changing of valve timing
- Modification with the timing chain
- Changing of the angle of cam

Intake port modification

Intake port should be in favour of air so the Intake port of the experimental engine has been changed for the use of compressed air as input to the cylinder. Air the air storage tank has to pass through a pipe of 10 mm internal diameter. Intake port of the engine has shown in the figure no.4.

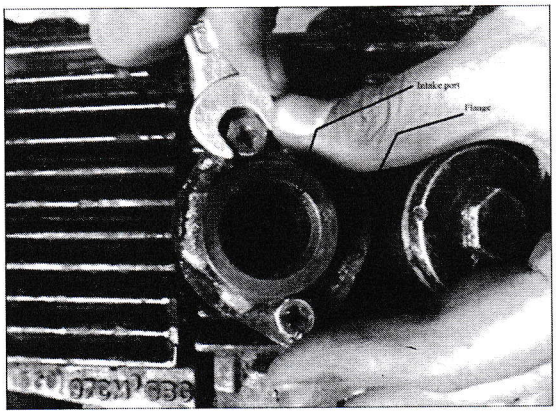

Figure 4 Intake port modification (source: onsite engine)

Valve timing diagram

IO= Intake valve open,TDC=Top dead Centre

EC= Exhaust Valve close, BDC=Bottom dead center, BDC=Bottom dead center,IC= Inlet valve close , EO= Exhaust Valve Open

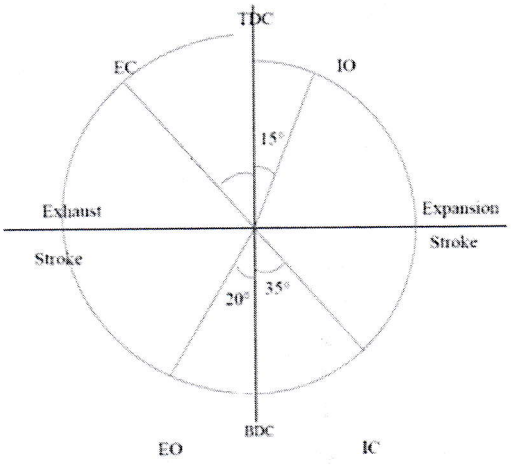

Figure 5 Valve Timing diagram

Timing chain

By reducing diameter of big sprocket equal to small sprocket diameter, gear ratio 1:1 could be maintained for vale timing. It results in the reduction of the distance between ends points of sprockets that laid the cutting of the timing chain.

Cam shaft

The main function of camshaft is to open and closing of valves. Gear ratio must be one for opening and closing the valve during the piston come down and goes up respectively. It means the angle of cam must be 180°.

To change the cam angle a different approach is followed to save money. In this approach, cam shaft is cut into two different parts by cutting it through the gap remaining between the cams After that by adjusting it at at 180°, it has joint by MIG welding shielded by argon.

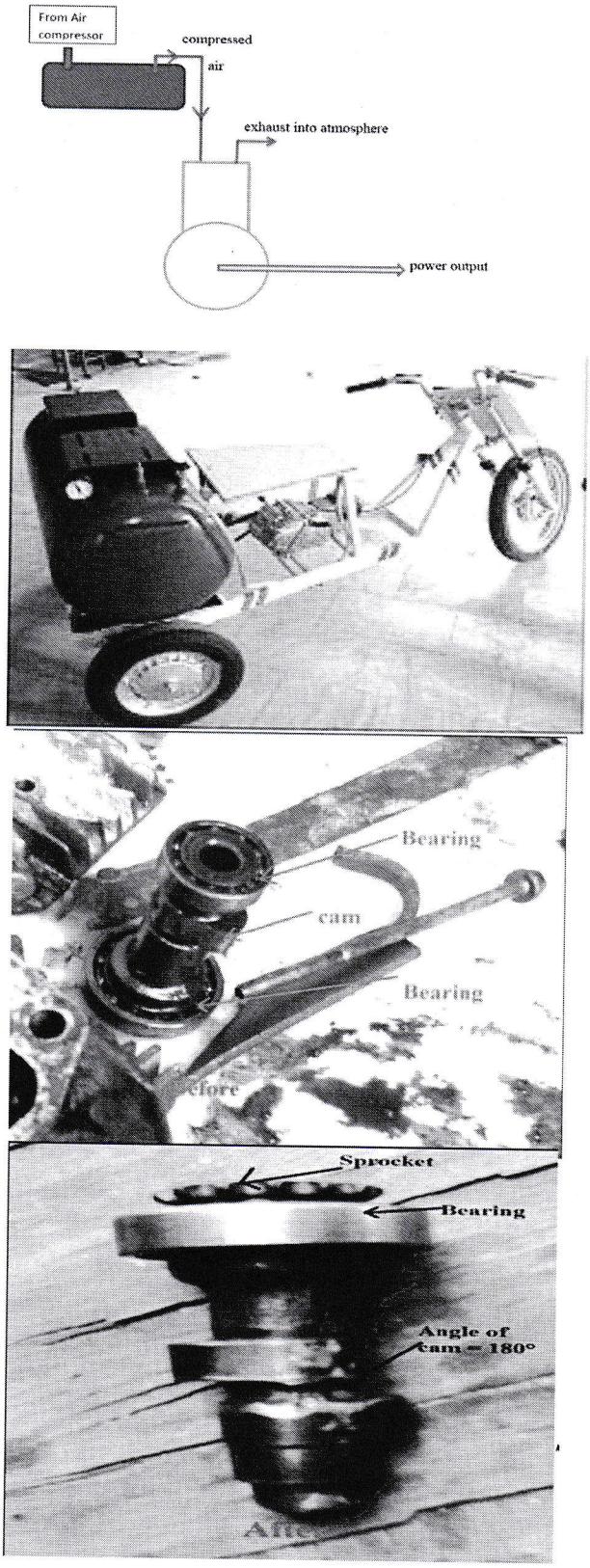

Figure 6 Changes made with the . cam(onsite engine model)

IV.WORKING PROCEDUDRE AND CALCULATIONS

Air fueled automotive run on compressed air instead of fossil fuel .Since the vehicle works on air so it produces no ill effect on the environment.A cylinder of compressed air engine provides the power to the automobile. The engine can be run either on only compressed air alone or act with an internal combustion engine. Compressed air is stored in fiber or glass fiber tank at a pressure of 4000 psi. The air is fed through an air injector into the engine cylinder in which it expands. The air pushes the piston to move the crank shaft, which give the power to automotives.

Calculations of the pressure to drive the experimental vehicle

Since the experimental vehicle has to run on compressed air so we have calculated that how much pressure is required to run it. For calculating the pressure we need initial data like weight and torque. After that pressure can be calculated with the help of formula given.

$$P = \frac{F}{A}$$

Force required running the vehicle should be greater than the resisting force on the wheel. The resisting force is the friction force between road surface and wheel. So the friction force on the wheel :

Friction force (f) = □ ×N

Where □ is coefficient of friction

N is normal reaction force equal to weight (calculated above)

f = 0.3×1862

= 558.60 N

For calculating torque, Relation between linear acceleration, **a** and angular acceleration,**α** for pure rolling is used as:

a = □ * R where R is radius of the

wheel (200 mm measured from the model)

Resisting torque on wheel ($\square_{R)}$ = f • R

The net torque causes angular acceleration on wheel

(□) = $\square_e$ – $\square_R$

Where; $\square_e$ is the torque applied by engine.

Since, □ = I • □

$\square_e - \square_R$ = I • □

$\square_e$ = $\square_R$ + I • □

= $f \cdot R + \frac{1}{2} m R^2 * (f/mR)$

{ since,□ = f/mR}

$\square_e = 3fR/2$

As we have; f = 558.6N, R = 200 mm = 0.2 m(measured data)

$\square_e$ = 3×558.6×0.2/2

= 167.6 N-m

So that to rotate the crank shaft 62 N-m torque is required. This torque will be provided by the force exerted on the piston F_p(say).

F_p = torque / radius of crank

F_p = 62/0.04 {crank radius, available data}

F_p = 1550 N

Since, Pressure = Force /Area Area of piston = (□ /4) × d^2 Area of piston = 2.29×10^{-3} m^2

{diameter of the piston=54mm, available data}

Pressure = $1550/2.29\times10^{-3}$

= 676,855.89 N/m^2 Or = 6.77 bar

This is the minimum pressure required to move the vehicle having 1862 N weight. To move the vehicle it is required t higher pressure than calculated value.

Mass of the body = 25 kg
Mass of air tank = 45 kg
Mass of engine = 25 kg
Mass of the human = 65 kg(average value)
Friction force
Since the vehicle is made for use of individual person. The vehicle is light utility vehicle. The total mass of vehicle will be =160 kg (by adding all masses)
Due to the safety factor ,the mass is considered as 190 kg.
Weight = mass × gravitational acceleration
= 190×9.8
= 1862 N
This is the weight of the vehicle including passenger

As we have calculated the torque 167.6 N-m but due to considering some other factors in case of actual practice, We are taking an increased value of torque; (considering margin)

$\square_e$ = 180 N-m(increased value)

as the gear ratio in first gear is 2.71(std.data), it means; (Torque on output shaft of engine)/(torque on crank) = 2.71

So, Torque on crank shaft = $\square_e$/2.71

= 167.6 /2.71

= 61.83□ 62 N-m

V.CONCLUSION

Paper presents a brief introduction of the air fueled automotives and developed a working model to show its suitability as light utility vehicle in the individual transportation. This kind of vehicle and technology may be the path breaking steps to reduce the hazardous emissions from the streets of big old cities in India. If in the near future compressed air storage and filling facilities increases, then acceptability and suitability with improved design of air fueled automotives will increase Also air vehicle provides an answer to the shortage of conventional and high of cost of fuel. With petrol and diesel not only associated with price issue, it is also a main source of air pollution in our cities. All we know that there will be shortage of conventional fuels in future, so this type of concept will be more obvious.

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LPG FUEL COMPATIBILITY IN 4-STROKE PETROL ENGINE

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Abstract— **In this research work, engine performance and exhaust emissions of 4stroke SI engine have been experimentally investigated. The engine is operated with petrol and liquefied petroleum gas (LPG) as a fuel. The engine testing is done over a wide range of engine speed. Engine power, fuel consumption and exhaust emissions of the engine using petrol and LPG are measured and compared. The experimental result concludes that 4stroke SI engine when operated with LPG fuel has lower torque and power as compared to conventional 4stroke petrol engine. However, using LPG on 4stroke SI engine has lower fuel consumption and emission like carbon monoxide (CO), hydrocarbon (HC), etc. compared to conventional 4stroke petrol engine.**

Keywords— LPG 4STROKE; S.I ENGINE; EMISSION.

I.Introduction

The internal combustion engine (ICE) has been used by the automotive industry to provide mobility for more than 100 years to an increasing number of people worldwide, which has greatly improved productivity and quality of life of mankind. The world vehicle population is about 800 million today, and is projected to grow to 1.1 billion by the year 2020. The developing countries including the most populous China and India are expected to experience the highest vehicle growth rate. Global oil consumption by the vehicle fleet is presently about 80 million barrels per day and is expected to reach more than 100 million per day by 2020. As the demand overruns supply, oil prices will continue to increase. While high oil price will be a mere inconvenience to wealthy people, it will put the dream of mobility out of reach for the majority of the world's population in developing nations. This will have a very significant negative effect on their economies which are globally connected to the economies of developed nations, including the United States. Out of a dark future for the oil era, hydrogen energy and also LPG provides great hope. In the long term, hydrogen will mean energy security, energy diversity, and sustainability for all.

Two-wheeler vehicles are popular means of transportation in most developing countries. Countries such as India, China, Thailand, Indonesia, Bangladesh, Malaysia and Nepal, are highly dependent on these vehicles and these are also the countries where not only is the air quality extremely poor, but are also highly dependent on oil import.

This eases the demand for on-board hydrogen fuel storage, and the overall hydrogen fuel capacity needed. Most importantly, it is

believed that hydrogen two-wheeler technologies can be more easily deployed in developing countries because the fuel need for the desired range is a small fraction of that needed for passenger cars in developed nations. This also makes it feasible for two-wheelers to be fuelled by renewable hydrogen, leading to a true sustainable transportation. The objectives of this project, partially funded by USAID/DOE were to:-

1) Address concerns over urban pollution and greenhouse emissions in developing nations;
2) Gain application knowledge of hydrogen that will be beneficial to its commercialization.

To accomplish these objectives and for sustainable economic growth, it is imperative that all nations, especially developing countries, begin making an accelerated transition from fossil fuels to clean alternatives. There are many options for alternative energy. These include natural gas, bio-diesel, ethanol, methanol, propane, electric "fuel", solar "fuel", and hydrogen.

II. Research Methodology

Item	Specification
Engine Type	4 stroke side valve
Engine Displacement	197 cc
Engine Power	5.5 HP
Cooling	Air
Cylinders	Side valve single
Bore* Stroke	67 x 56 mm
Compression	6.5: 1
Maximum Power	3.7 kW (5psi @ 3600 rpm)
Recommended Power	3.3 kW (4.5 psi (@ 3600rpm)

Maximum Torque	10.4 Nm (1.06kg-m @ 2500rpm)
Starting	Recoil
Air Cleaner	Semi dry
Shaft	3/4 keyed
Fuel Capacity	4.3 litter
Oil Capacity	0.7 liter
Fuel Consumption	390 g/kW-hr
Rating	Domestic
Dimensions (L x W x H)	327x 375 x438 mm

III.LPG Methodology

Fig.1 shows the schematic diagram of the experimental set up. In the fuel supply system, LPG pressure is regulated and controlled by pressure regulator and pressure gauge. In Fig.2 shows the experimental set up for testing of LPG and petrol fuel 4stroke SI engine.

The engine is connected to dynamometer with drive shaft for measuring torque and power. Fuel consumption is measured on volume basis. Exhaust gases are collected for analysis.

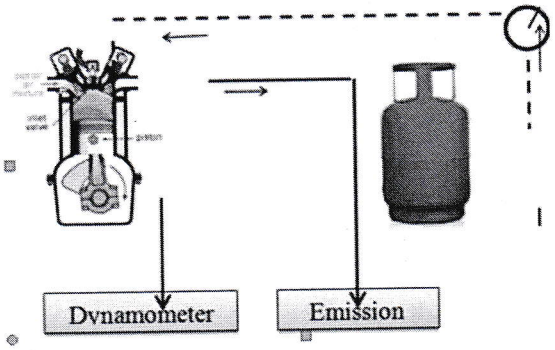

Fig.1 Schematic diagram of the experimental set up

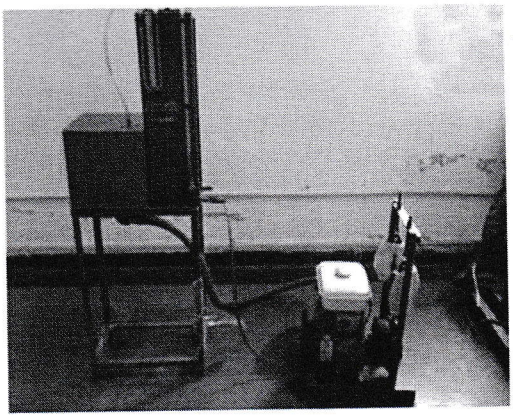

Fig.2 Experimental Setup

The effect of LPG, petrol on engine performance and emissions is investigated and compared. The tests are performed at engine speed variation from 2000 to 3000 rpm, and full open intake ports. Torque and power are measured at 2500 and 2800 rpm. Exhaust emissions are obtained by gas analyser at 2500 and 2800 rpm. Fuel consumption is observed at different engine speed. Fuel consumption of using petrol is

reported in litter per hour while that of using LPG is recorded in kilogram per hour.

IV.Performance parameter

Engine performance is an indication of the degree of success with which it is doing its assigned job, i.e. the conversion of the chemical energy contained in the fuel into the mechanical work. The degree of success is based on the following basic parameter.

1. Power and mechanical efficiency.
2. Mean effective pressure and torque.
3. Specific output.
4. Fuel-air ratio.
5. Specific fuel consumption.
6. Thermal efficiency.
7. Octane number.

b.p. = 2πNT

Where T is i torque in Nm and N is the rotational speed in revolutions per second.

T=WR (2)

Where W = 9.81×net mass (in kg) applied; R= radius in m

Mechanical efficiency = b.p. /i.p (3)

Friction power = indicated power – brake power

f.p. =i.p.-b.p (4)

Q=A * V (5)

0.3 (m^3/hr.) = (□ /4 * 0.062) * V

0. 3/3600 (m^3/sec.) =
□ /4 * $(0.06)^2$ * V V =
0.029 m/sec

IV.Results and discussion

Brake Power V/S Brake Thermal Efficiency

b.p. Vs BTE @ 2800 rpm

Break power(kw)	BTE(%)@2800rpm	
	LPG	petrol
0.345	9	17
0.69	18	24
1.035	20	30
138	28	38

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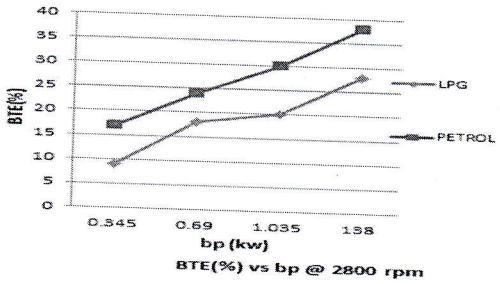

BTE(%) vs bp @ 2800 rpm

b.p. Vs BTE @ 2500 rpm

Break Power(kw)	BTE (%)@2800rpm	
	LPG	Petrol
0.308	10	12
0.616	24	23
0.924	25	27
1.232	26	34

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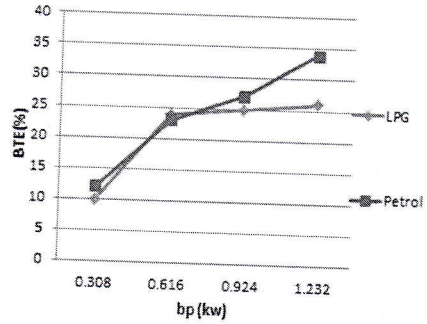

BTE(%) vs bp @ 2500 rpm

From above figures, it is found that as the brake power increases, there is considerable amount of increase in brake thermal efficiency.

IV Conclusion

LPG has a higher octane rating and compression ratios without knock. Hence, the engine can run effectively at relatively high the specific fuel consumption of the engine. LPG reduces the engine volumetric efficiency, and thus, effective power of the engine reduces. Furthermore, the decrease in volumetric efficiency also reduces the engine effective efficiency and consequently

increases specific fuel consumption. The CO and HC emissions increase as the compression ratio, speed, and load increase. In the case of using LPG in SI engines, the burning rate of fuel is increased, and thus, the combustion duration is decreased. Therefore, the cylinder pressures and temperatures are predicted for LPG, is higher compared to petrol. This may cause some damages on engine structural elements. LPG free of lead has very low sulfur content. Combustion of Gaseous fuels like LPG occurs in a nearly uniform fuel air mixture leading to a reduction in incomplete combustion deposits such as soot on the walls of combustion chamber. Thus, according to the above results, we can say that LPG has less effective power as compared to petrol but eco-friendly due to its less lead & sulfur content and low incomplete combustion.

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A Review of Geospatial Model for Power Transmission Line Routing

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***Abstract*— Now, electricity is the necessary component of our life like sun. Electricity i.e. power, speeds up and make very easy most of the human needs. To deliver power to load end, we need power transmission lines (PTL). Therefore, some route is chosen to place these transmission lines from generating station to load end. one of the most effective way for resolving highly complex spatial problems. In GIS, raster data models which is used for storage and visualization of spatial data sets provides important advantages especially Also, we have to choose the best route so that our various factors like economic factors environmental factors, and geographic factors can be satisfied. Each of these factors basically represents a spatial data set. Thus, optimum PTL routing is a spatial problem Geographical Information System (GIS) is currently in such projects which is to be constructed for long distances.**

***Index Terms*—transmission, GIS, tools, constraints, factors, cost**

I. Introduction

The development of any nation is measured in terms of its power consumption capacity. Electricity seems to be the necessary component of our life like sun. No one can imagine life without electricity as almost every component of human daily activity depends on electricity. Electricity i.e. power, speeds up and make very easy most of the human needs. With this, the use of power is increasing day by day. It is necessary to deliver power to load end and for this. We need power transmission lines. Routing a transmission line is much more difficult than routing any other public infrastructure. Current route determination methods are considerably insufficient in transmitting the power to long distances. The optimum route for Power Transmission Line (PTL) in the majority of cases is not the shortest path between the start and end points. For the determination of the optimum one, many factors which affect the route should be considered all together. Some of these factors are (i) technical factors such as slope, landslide, earthquake/fault, road/railway/pipeline crossing, lightning strike, wind, snowfall, and thunderstorm; (ii) environmental factors such as national parks, archaeological areas, water resources, river crossing, wildlife, and forests; (iii) socio-economic factors such as agricultural areas, residential areas, cultural assets, temples, shrines, recreation areas, tourism, right of way, and relocation. Therefore, power transmission line routing is an essential engineering task which optimizes the equipment installation and maintenance costs by proper select ion of the line route subject to various constraints like geographic, environmental, social and legal constraints. Each of these factors basically

corresponds to a spatial data set. Therefore, optimum PTL routing is a spatial problem Geographical Information System (GIS) seems to be a necessary tool for resolving such complicated spatial problems. GIS provides raster data models which can be used for storage and visualization of spatial data sets.

II. TOOLS USED FOR GEO SPATIAL MAPPING

Various tools and techniques had been used by different researchers and scholars for transmission line routing and are as follows:

A. Ground survey:

Ground surveying is the measurement of dimensional relationships, as of horizontal distances elevations, directions and angles on the earth surface. Surveyors use various tools to do ground survey, such as total station, GPS receivers, prisms, 3D scanner, radio communicators, digital tools and surveying software. The various types of survey done are archaeological survey, geological survey, deformation survey, hydrographic survey, soil survey etc. (Miller and Simpson 1994).

B. Photogrammetry:

In Greek, photogram means light and metros means to measure. Therefore, photogrammetry is the science of making measurements from photographs. The two types of photogrammetry are aerial photogrammetry and close range of photometry. In arial photogrammetry, as the name indicates, photographs are taken through aeroplanes and a camera is used which is pointed vertically towards the ground. In close range photogrammetry, the camera is close to the subject. Some applications of photogrammetry are architecture, engineering, quality control, police investigation and geology. (Keifer and lillesand).

C. Topographic maps:

A map showing perfect graphic and having accurate characteristics, including the representation of graphic features is called topographic map. The main characteristic of these maps is that these maps represent specific streams like forest cover; individual buildings water bodies etc. (Gill et al 2006).

D. Satellite imaging:

Satellite photography can be used to produce composite images of an entire hemisphere. There are four types of resolution when discussing satellite imagery in remote sensing: spatial, radiometric. Satellite images have many applications in meteorology, agriculture, geology, biodiversity conservation, regional planning, education, intelligence and warfare. Images can be in visible colors and in other spectra.

E. GIS:

GIS is asystem of hardware, people, organizations and institutional arrangements for collecting, storing, analyzing information about areas of the earth. GIS not only permit the automated mapping or display features, but also provide capability for recording analyzing descriptive characteristics about the features. For example, a GIS might contain not only a map of the location of roads but also a database (attribute) about each road, such pavement type, speed limit, number of traffic lanes, date of construction and so on.

III.CONSTRAINTS OF POWER TRANSMISSION LINE ROUTING

There are certain factors or features which may affect the process of power transmission line routing either directly or indirectly. Some of these factors are as follows:

A. Environmental factors:

Now days, the government is much concern of how a certain project is affecting the environment. A wave flow is there by the government to protect the environment and no comprise is done on the part of the environment. So, the impacts of certain factors given below on environment are needed to be considered and are as follows:

- Construction
- Seismology
- Water quality
- Air quality
- Vegetation
- Wildlife
- Fish Habitat

B. Socio-economic factors:

Certain socio-economic factors are as follows:

- Visual Effect
- Land Values
- Relocation
- Employment
- Linear developments
- Land clearing
- .Industrial development
- Population Density

C. Engineering factors:

Engineering which directly affect the performance and cost of PTL routing projects. Certain factors which affect are as follows:

- In design phase: route, transmission structure, pole placement
- Tower height:

D. Science factors:

Some of the science factors are as follows:

- Lightning
- Wind
- Ice loading
- Forest Fires

E. Legal factors:

Some of the legal or judicial factors which may be required are as follows:

- Certification of public convenience
- Explanation for need of transmission line
- Environmental impact assessment report
- Permission from cultural and religious bodies
- Permission from archeological and historic conservation agencies
- Authority from landowner, the one on whose property the line passes
- Permission letter from certain electric, television, radio and airport authority

F. Health hazards:

As the current flows in the power transmission lines, the air near the surface of lines gets ionized. This ionized air when comes in contact with the telephone lines, a force called electromagnetic force is created. This phenomenon may affect the health of the people living near these areas and may create an opposition towards these lines. This phenomenon may be in the form of:

- Electric fields
- Magnetic fields

- Electromagnetic interference
- Audible noise
- Fire
- Induced currents
- Hazardous materials

G. Economic factors:

Some of the economic factors are as follows:

- Establishing time
- Minimum cost

IV. SYSTEM FORMULATION

PTL seems to be a complex system. Power transmission lines relates closely to geographic location, environment, geological condition and some required factors like geographic object with continuous distributive character. It is necessary to raster datasets for GIS based route optimization. Database design seems to a important step in this process. Next step is to create optimum route with the help of intermediate process and data is produced. A fundamental model is presented as shown below.

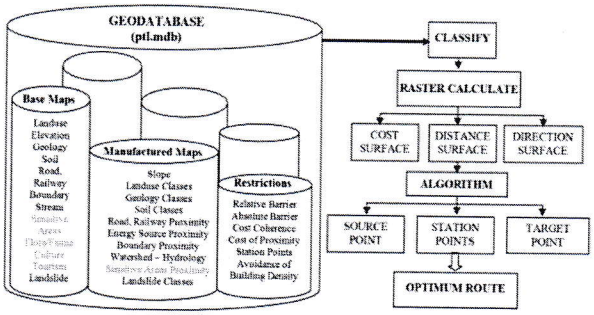

Fig1: A conceptual model for optimum PTL route (Volkan et al, 2010)

A. Data, Factor and Weighting:

Initially before obtaining data, a preliminary generalized area of interest was created based on physical barriers and the start and end location of the route is analysed.

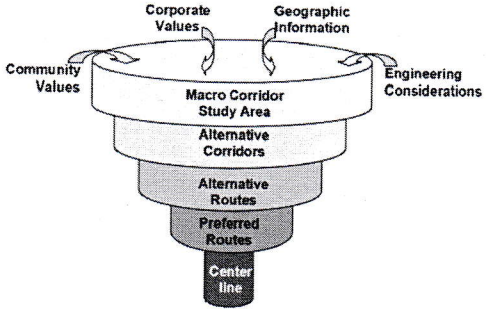

Fig2: Funnel Approach (Glasgow et al, 2004)

In this model, firstly some datasets such as, building density, soil, slope, linear infrastructures, landslide, flora/fauna, land use, protected area and lakes are composed. After then, every dataset are converted to raster data format separately and raster based routing method is applied for PTL routing.

B. Least cost path analysis:

Now we need to determine the minimum cost which follow the following procedure as defined by Collischonn in his paper. (Collischonn and Pilar, 2000; Douglas 1994).Process steps for the optimum PTL defined over the model are as follows:

a) Factor selection and raster conversion: The first step is to define the factors and factor weights that directly or indirectly affect the PTL route.
b) Pixel based calculation and weighted surface: Pixel-based mathematical calculations are made using factor weights and classified raster data layers.
c) Absolute/Relative barriers: In this step, value was used in sub-unit classification for absolute barriers (active landslide areas, flora fauna areas, etc).
d) Source/Destination/Stops: Source and target points are recorded in the database as a separate file.

e) Optimal routing: After all these procedures, a Cost Distance Algorithm is applied which gives distance and direction data which uses ArcGIS software whereby the final route is obtained.

V. DISCUSSION

Finally, current PTL and optimized PTL is compared and the factors are evaluated which are affecting the optimum PTL route.

CONCLUSION

The routing of transmission lines is a complex process which involves many steps including routing and designing of transmission lines. Also, routing process involves many constraints like environmental, social, economic and many other factors to be considered which performing these steps. Here, a GIS-based application has been developed for PTL routing. It is shown that, PTL routing process can be made simpler and less time consuming by using the geographical information system. Landscape features are incorporated into ArcGIS software, and then it can be applied to any transmission routing project. The GIS data format used in the proposed methodology is the raster format for input values (associated costs: terrain, slopes, land use, geology, obstacles, infrastructures, maintenance, etc.) as well as for computational results. The raster-based GIS model depends on collecting all factors that would affect routing on a single raster-based surface.

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Designing and Implementation of Optical Wireless Communication

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Abstract: A Free Space Optical (FSO) Laser Communication Link has presented with the development of a full-duplex FSO transceiver. Experimental results explain the performance of the complete system and offer methods of maximizing efficiency of such FSO-based communication systems. It is apparent that the system performs best at a particular frequency of 1 KHz.

KEYWORDS: FSO, LASER, Atmospheric attenuation, Link Budget.

I. INTRODUCTION

There are numerous choices for data communication in the existing technology such as through wired like through copper wire or fiber optic cable and wireless like, radio frequency (RF). One another technology, known as Free Space Optical (FSO) Communication. This technology referred to the transmission of modulated visible or infrared (IR) beams through the atmosphere to obtain broadband communications. This technique requires clear line-of-sight between the transmitter and the receiver [1, 2].

Recent breakthroughs in wireless technology and the need for high speed internet have increased the demand for faster, higher bandwidth wireless access networks [3, 4]. The two wireless options normally used are either radio or optical networks. Radio frequency has been the primary medium of communication for a long period of time. However, the RF spectrum has become congested and may no longer fulfill the demand of broadband high-speed applications [5, 6]. In addition to this radio communication requires the leasing of frequencies in order to be legally permitted to use them. On the other hand, free space optical communication has the key to supply the ever-increasing demand for higher bandwidth, without the associated hassles or interference experienced with radio communication as shown in Figure 1[7].

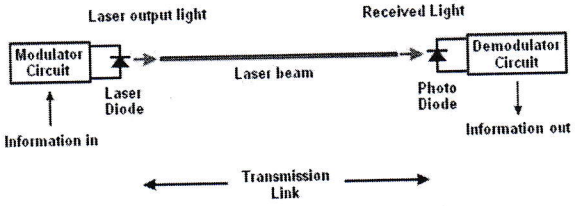

Figure 1: FSO communication overview

The signal in FSO travels in the free space between transmitter and receiver, rather than through a wire or fiber, or through a waveguide. Another important feature of FSO is that it is unaffected by electromagnetic interference and radio frequency nterference, which increasingly plague radio based communication systems [8] FSO systems are used in disaste recovery applications and

for temporary connectivity while cabled networks are being deployed [9].

II. A FREE SPACE OPTICAL LASER COMMUNICATION LINK

The free space optical laser communication link developed has included four circuits: the analogue transmitter and receiver, the digital transceiver, RS-232 and the Voice Unit (VU) meter. This required a line-of-sight (LOS) link through a laser beam in free space.

2.1 System outline

The accomplished system consists of two transceivers that simultaneously transmit and receive either analogue or digital information. The system has full-duplex analogue/digital communicator. The system has shown in Figure 2.

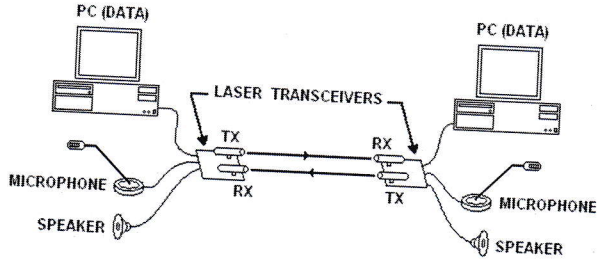

Figure 2: FSO setup

2.2 Transmitter and Receiver Section

The transmitter section performs amplitude modulation of the laser diode when analog or digital signal has applied through it. The receiver section performs the demodulation of the analogue signal through detection diode. The digital circuit section has MAX232 IC to generate the RS232-compatible signals necessary for interfacing PC and the circuit.

2.3 Hardware

The development of this study was divided into two main categories:

- The Analogue transceiver – including VU meter
- The Digital transceiver

The hardware involved in this design incorporates three distinct circuits, which perform analogue modulation, digital modulation, and signal strength display, respectively. The completed system houses all these modules as a single unit, sharing the critical input and output components.

III.EXPERIMENTAL RESULT

The experiment has been designed to implement the VU meter as a method of measuring signal strength. The data has been obtain for plotted on graphs for further analysis

Distance	Signal Strength (%)						
	150 Hz	300 Hz	500 Hz	1 KHz	2 KHz	5 KHz	12 KHz
1	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
4	90	100	100	100	100	100	90
5	90	100	100	100	90	90	80
6	90	80	80	100	80	80	60
7	70	80	80	90	70	70	60
8	50	70	70	80	70	50	50
9	50	60	60	70	60	40	40
10	30	60	60	70	50	40	20

Table 1: Signal Strength vs. Distance

In order to get a set of results to compare the overall signal strengthversus the distance, the average signal strength has calculated at each frequency as shown in table 2.

Frequency (KHz)	Average Signal Strength (%)
0.15	76
0.3	83
0.5	85
1	91
2	82
5	77
12	70

Table 2: Average Signal Strength vs. Frequency

3.2Plot of Result

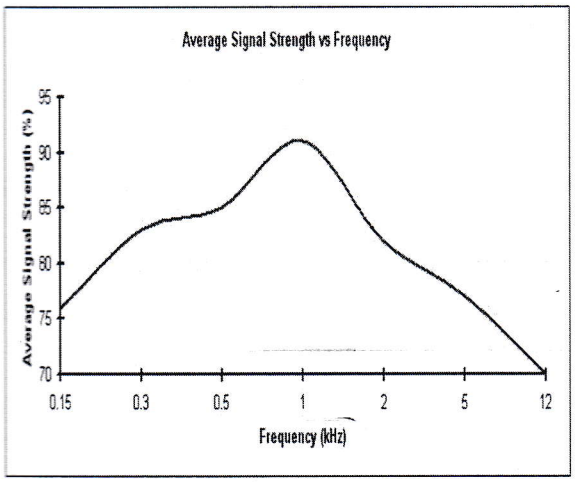

Figure 3: Average Signal Strength vs. Frequency

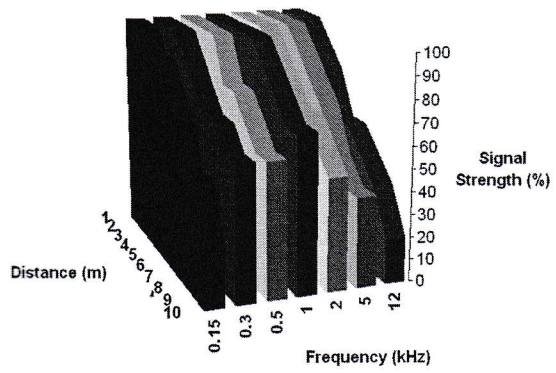

Figure 4: Area block: Distance vs. Frequency vs. Signal Strength

IV.DISCUSSION

The strength of the signal not solely dependent on the transmission distance. Rather the signal strength varies according to the frequency of the transmitted signal, as can see in graph. Though only seven values of frequency has been considered, the system gives best result, when transmitting a signal close to 1 kHz frequency. The signal attenuates more for frequencies below and above this 1 kHz frequency.

The increased attenuation may be partly due to the divergence and the natural frequency of the laser module and the addition of focusing aids at the receiver or by aperture averaging the signal strength can increase uniformly, over the given range of frequencies.

V.CONCLUSION

A free space optical full-duplex communication system having analog and digital link has been successfully designed and implemented. It has been possible to get the experimental data from system which gives very useful outcomes, which proved to be very useful information. At 1 KHz, the system gives better output and efficiency.

The system performance can be improve by proper alignment and focusing systems in addition to the use high quality laser diodes specifically designed for modulation.

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Nanotechnology - A Cost-Effective Development

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Abstract : **The financial facility for nanotech research has some differences around the world. In Europe, the private investors are sheathing behind the public funding agencies. Although the United States and Japan have a additional balanced partition of private and public funding, the European nanotech research has to suffer from lower private funding sources. This paper will discuss on the public funding of nanotechnology in European countries is more competitive on a world level and shows the premature reaction of European research policy to the fresh opportunities which is opened by nanotechnology and the involvement at the "nano race". However, the deficiency in commitment of European private investors is not nano specific – the same can be observed for the overall R&D expenditures.**

Keywords – **nanotechnology; nano race; nano devices; global race; commercialization;**

I. INTRODUCTION

Nanotechnology can be everywhere. It is in car tyres, in tooth paste, in sunscream [1], in shirts and trousers, in tennis rackets and tennis balls, in CD players and even in surfaces of bath tubes, toilets and wash basins. With fresh properties e.g. smaller, lighter, faster, cheaper, water, dirt and stain resistance which enhance consumer goods. Nowadays it is widely accepted that nanotechnology is a collection of different technologies and approaches, which all use the physical properties of dimensions on the nanometer scale, which differ from those observed in the micro and macro world. In order to draw a correct and comprehensive picture of the technology and to achieve a fair assessment of its status, potentials and drawbacks, it is necessary – where possible - to look at nano-technology sub-areas such as nano-materials and Nano-electronics, nano-biotechnology and nano-medicine, or nano-tools, nano-instruments and nano-devices.

Nanomaterials are expected to have the major influence on virtually all fields where materials play a role. They consist of ultra-thin coatings and active surfaces as well as the new generation of chemical engineering. Nano-electronics has a major impact on the information and communication technologies by continuing or overcoming (with the aid of quantum electronics) Moore's law of doubling data storage and processing capacities every 18 months. Nano-biotechnology will make the difference in medicine, for pharmaceuticals and diagnostics, in countless industrial processes, agriculture and food industry. Nano-tools are nanotech enabling technologies, such as electron microscopes (Scanning Tunnel Microscope STM, Atomic Force Microscope AFM) and ultra-precision machines.

II COMMERCIALISATION OF NANOTECHNOLOGY: PROSPECTS OF MARKET VOLUMES AND SHARES

Nanotechnology is expected to have a substantial impact on the world's economy, market volumes are appropriate indicators for

its economic significance. Most market estimated for nanotechnology originate from the early 2000s, with a time horizon up to 2016. Perhaps the best known figure for the future nanotechnology market has been published by the National Science Foundation (NSF) of the United States in 2006 [7]. The NSF estimated a world market for Nano-technological products of 1 trillion US Dollars for 2016. Depending on the definition of nanotechnology and its contribution to added value of the final goods as well as the degree of optimism, numerous other forecasts vary between moderate 150 billion in 2010 (Mitsubishi Institute, 2002) and 2.6 trillion in 2014 (Lux Research, 2008) [5]. The latter, most optimistic scenario would imply that the market for nanotechnology-based products would be larger than the vision in relation of information and communication technology market and would exceed the future biotech market by ten times.

The figures presented above show the possible direction, but are not adequate for deeper analyses of the development of the nanotechnology market. Lux Research [5] and the NSF have both spent some efforts in breaking the figures down in nanotechnology subfields, the first in an analysis of 5 years in the past (2004-2008), the ultimate result shows the expected breakdowns of the 1 trillion world market share in 2016 (Figure 2).

The figure shows that in the today's market for nanotechnology products, nano-devices and nano-biotechnology are expected to be responsible for the largest shares of around 420 and 415 million US Dollar. Materials and tools take part as a minor role with 145 and 50 million US Dollar. To evaluate the forecasts for 2016, all areas are expected to undergo significant increases, e.g. for materials from 145 million up to 340 billion US Dollar. Nano-electronics will amount to 300 billion US Dollars, followed by pharmaceuticals, chemical processing and aerospace.

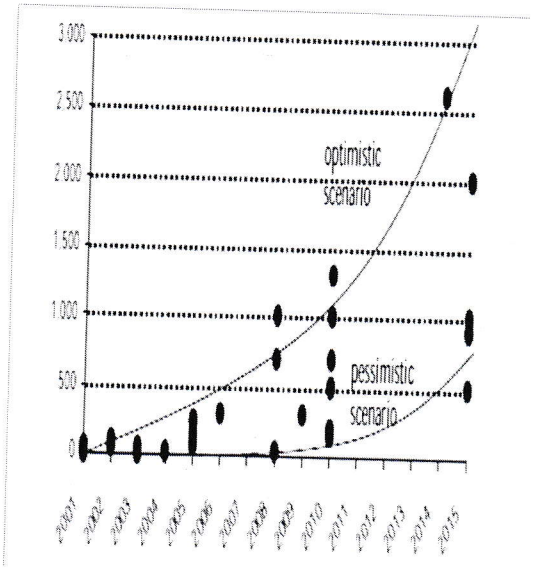

FIGURE 1: World market forecasts for nanotechnology in billion US Dollar. Diverse sources

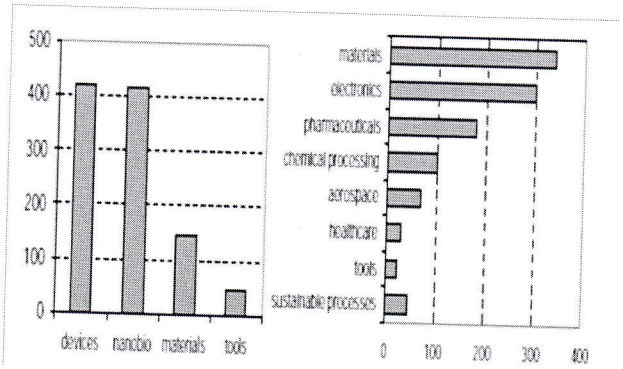

FIGURE 2: World market 1999-2003 and forecasts for 2016 in US $ billion. Sources: left: Lux Research, 2004, right: NSF, 2001

The three phases model of Lux Research (2004) illustrate the so far comprehensive and sophisticated prospect of the developments in the nanotechnology field. The model embrace a first phase up to 2004 with some nanotechnology integrated in high-tech products. The subsequently phase up to 2009 will bring break-throughs for nanotechnology innovations. Nano-electronics would dominate this market. In a third stage from 2010 onwards, nanotechnology will become common place in manufactured goods with healthcare and life science applications

entering the pharmaceutical and medical devices markets.

Nano-biotechnologies will contribute significantly to the developments in the pharmaceutical industry. Basic nano-materials as such will loose importance at this time. Lux Research (2008) estimates a market share for nanotechnology products of 4 % of general manufactured products in 2014, with 100 % nanotech in PCs, 85% in consumer electronics, 23 % in pharmaceuticals and 21 % in automobiles. This would lead for nanotechnology to an overall share of 15 % of the global manufacturing output in 2014.

In an analysis of the drug delivery market, estimates for nano-enabled drug delivery market support the above presented projections. Figure 3 shows the volume and share of the enabled drug delivery market compared to the worldwide drug delivery market.

The expected development of the market for nano-enabled drug delivery shows an average annual increase of 50 % between 2005 and 2012. The increases of the market share follow a same path, but with slightly lower rates. In 2012, about 4.8 billion US Dollar will be earned with nanotechnology on the drug delivery market, which would be a market share of 5.2 %. If the development continues, this market share will increase to 7 % in 2016 and 10 % in 2020.

The difference between the acceptance of genetically modified crops between the European and the American public illustrates this case adequately. Stricter regulations and less explicit marketing of the nanotech element in the products can be the consequence for the more critical regions. Independent of these aspects, Lux Research (2008) has broken down the figures of their forecasts (2014:2.6 bn) by region (Figure 3).

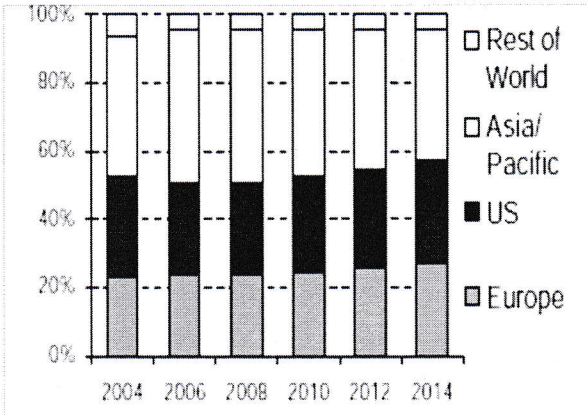

FIGURE 3: Global sales of products incorporating emerging nanotechnology by region – forecast in percent. Source: Lux Research, 2004

III THE GLOBAL NANO RACE: SOME DATA ON PUBLIC AND PRIVATE FUNDING

The National Nanotechnology Initiative (NNI) in the United States, launched by the former president Clinton and entering into force in 2001, can be seen as the starting point of a global race for the world leading economies in nanotechnology research programmes. However, funding for nano-science was already established in many regions of the world by this time, with Europe already being strong in nano-materials by the mid- 1980s. Up to now, many other countries and the European Union have dedicated considerable amounts of money to nano-technology research and development. Table 1 gives a snapshot of public funding activities in 2008.

Regarding the EU Member States, which are accounting together for a much larger share of European public expenditure [4] in nanotechnology than the European Commission, Germany is the top spender, followed by France and the UK. Japan and South Korea are on a

comparable level. In addition, taking into consideration that the figures are not reflected in purchase power parities, China's efforts must be considered as substantial and more than significant in a worldwide comparison.

USA (Federal)	9100	Israel	460	Singa pore	84
Japan	7500	Nether lands	423	Norway	70
Euro Comm.	3700	Canada	379	Brazil	58
USA (States)	3333	Ireland	330	Thai land	42
Germany	2931	Switzer land	185	India	38
France	2239	Indonesia	167	Malaysia	38
South Korea	1733	Sweden	150	Romania	31
United Kingdom	1330	Finland	145	S. Africa	19
China	833	Austria	131	Greece*	12
Taiwan	759	Spain	125	Poland*	10
Australia	620	Mexico	100	Lithuania	10
Belgium*	600	New Zeal.	92	Others	28
Italy*	600	Denmark	86	Total	3,850

TABLE 1: Estimated worldwide public funding, in 100,000€, for nanotechnology R&D in 2004 by individual countries. *Data are from 2006. Source: European Commission, 2008

All countries are outdone by the United States, which is with the total expenditures of more than 1.2 billion Euros in 2005 and 1.7 billion Euros in 2007 by the federal government agencies and the federal state the largest public spending country worldwide. However, as a whole, and only taking into account the public funding of nanotechnology, Europe would be on a similar level as the United States (Figure 4).

IV ANALYSING THE ECONOMIC IMPACT: JOBS AND COMPANIES IN NANOTECHNOLOGY

The creation of companies is an important indicator for the development and economic significance of a new technology. New companies are typically start ups with one main asset: the patent on a new technology which they can exploit themselves or license to other companies which are more capable in terms of production or distribution. Venture Capital is a major source of financing in this high tech and thus high risk sector.

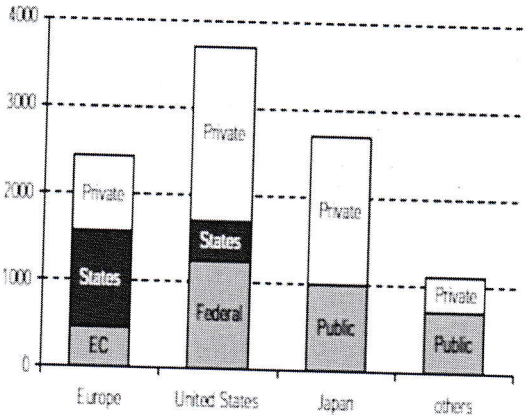

FIGURE 4: Estimated public and private funding for nano-technology R&D in 2007 by world regions in million € (1€=1$). Source: updates figures of European Commission, 2008

When it comes to the creation of new jobs, start ups and small and medium sized enterprises (SMEs) contribute most. The NSF [2] estimates that about 2 million nanotechnology workers will be needed worldwide by 2016. They would be distributed across the world regions as follows: 0.8-0.9 million in the US, 0.5-0.6 million in Japan, 0.3-0.4 million in Europe, about 0.2 million in the Asia- Pacific region excluding Japan and 0.1 million in other regions. Additionally, 5 million related supporting jobs, or at average 2.5 jobs per nanotech worker, would be created (Roco, 2003). Even more optimistic, Lux Research expects a number of 10 million manufacturing jobs related to nanotechnology by 2014.

Typical examples are big companies in chemical and pharmaceutical industry, optics and electronics (Bayer, BASF, Carl Zeiss,

Agfa-Gevaert, General Electrics, Philips, all created before 1900), though these established companies form a minority in the list of all existing nano-tech companies.

V THE TECHNOLOGICAL DEVELOPMENT OF NANOTECHNOLOGY: PATENT APPLICATIONS

Durable economic success would not be possible without a strong scientific and technological basis. On the other hand, scientific and technological excellence does not automatically facilitate economic success and breakthrough. The so called 'European paradox', which referred to Europe's strength in science and its weakness in technological application and consequently economic success, did reflect these causalities. It is advisable to have a closer look at the two main quantifiable indicators of scientific and technological excellence: patents and publications.

Patents reflect the ability of transferring scientific results into technological applications. Patents are also a prerequisite for economic exploitation of research results and are thus central for any analysis which deals with economic potentials of a technology and the identification of most promising fields and actors in terms of persons, organisations or countries. The European Patent Office (EPO) has developed a methodology in order to identify and classify nano-technology patents and patent families' at most important patent offices worldwide. The initial purpose was to facilitate the work of the patent examiners and to identify developments in this emerging field in order to respond upfront to increased need of new patent examiners and interdisciplinary cooperation. The introduced 'tagging' method also serves researchers who are interested in patent analyses in the field of nanotechnology. It has the clear advantage that nano-tech patents can be identified more adequately and that worldwide comparisons are more reliable because no world region is favoured.

Table 2 shows that the United States are the most active patenting country in each subfield, both for applicants and for inventors. But the countries on the following ranks change their position depending on the field. Germany, France and Canada rank higher for nano biotechnology, the Netherlands and Sweden come up in nano-electronics, while Belgium and Taiwan rank high in nano-materials. Switzerland is in particular strong in nano-devices, and the UK in Nano-optics [3].

The world's fastest growing economies are on track to catch up to U.S. R&D investment. From 2001 through 2007, the emerging economies of China, South Korea, and Taiwan increased their gross R&D investments by about 140 percent. During the same period the U.S. increased its investments by 34 percent.

Within the U.S., federal funding of basic research in engineering and physical sciences has experienced little to no growth over the last thirty years. In fact, as a percentage of GDP, funding for physical science research has been in a thirty year decline.

Nanotechnology				Nanobiotechnology			
Appl. Country	No.	Inv. Country	No.	Appl. Country	No.	Inv. Country	No.
USA	1136	USA	1177	USA	145	USA	188
Japan	461	Japan	600	Germany	25	Germany	27
Germany	199	Germany	200	Japan	14	Japan	17
UK	59	S.Korea	73	France	11	Canada	12
France	52	UK	68	Canada	10	UK	10
S.Korea	48	Canada	38	Italy	8	France	9
Netherlands	37	France	37	UK	6	Italy	9
Canada	32	Taiwan	29	India	6	India	6
Italy	16	Netherlands	29	Israel	3	Israel	4
Taiwan	15	Switzerland	21	S.Korea	2	S.Korea	4

Nanomaterials				Nanodevices			
Appl. Country	No.	Inv. Country	No.	Appl. Country	No.	Inv. Country	No.
USA	303	USA	345	USA	103	USA	106
Japan	114	Japan	146	Japan	30	Japan	35
Germany	65	Germany	61	Germany	21	Germany	19
UK	21	UK	21	Switzerland	8	Switzerland	9
France	17	S.Korea	21	S.Korea	7	S.Korea	8
S.Korea	15	Taiwan	15	Singapore	4	Sirgapore	4
Belgium	8	France	14	Sweden	4	Sweden	4
Taiwan	8	Canada	9	Israel	3	Israel	4
Canada	6	Belgium	7	France	3	UK	3
China	5	Singapore	7	Netherland	2	France	3

Nanoelectronics				Nanooptics			
Appl. Country	No.	Inv. Country	No.	Appl. Country	No.	Inv. Country	No.
USA	122	USA	113	USA	171	USA	162
Japan	192	Japan	258	Japan	102	Japan	120
Germany	55	Germany	60	UK	26	UK	25
Netherlands	28	S.Korea	40	Germany	16	Germany	18
S.Korea	24	Netherlands	19	France	10	S.Korea	9
Canada	11	Switzerland	12	S.Korea	6	Canada	8
France	10	UK	11	Canada	6	Denmark	7
UK	8	Sweden	10	Israel	5	Italy	6
Sweden	6	Taiwan	10	Singapore	5	Sirgapore	6

TABLE 2: Top 10 patenting countries worldwide in each nanotech field, 2003, Note: numbers of patents are rounded, ranking refers to fragmented numbers. Source: EPO, 2008.

VI THE SCIENTIFIC BASIS OF NANOTECHNOLOGY: SCIENTIFIC PUBLICATIONS AND CITATIONS

Scientific publications are the most appropriate indicator for measuring scientific excellence by quantifying the output. However, the pure output number could be misleading; other indicators such as citations do reflect the quality of a scientific paper and its impact on the scientific community. In the 1990s, the European share still slightly increased, while the number of scientific publication originating from the USA and Canada decreased and especially 'other Asia', i.e. China, gained significance. Thus, it can be concluded that Europe has a large scientific basis in nanotechnology, comparable with its main competitors. 'Other Asia' is the most dynamic world region. A closer look at the different countries will shed some light at the origins of the nano-scientific publications. Figure 5 shows more recent data on the number of publications by country and by scientific disciplines. Not surprisingly, the United States is most active with in total more than 18,000 Nano-scientific publications from 2002 to 2007, Japan and China follow but with a large difference. The largest European countries are in position of four to seven. South Korea, Canada, and Spain complete the top ten. The picture change slightly when one distinguishes between the three nano-scientific subfields chemical synthesis, superconductivity, quantum computing and Nano-materials. In the first two fields, Germany is much stronger than China, on a similar level with Japan, and the UK and France are on a similar level with China. China is very strong in nano-materials; it takes over the second position from Japan and reduces the gap to the United States.

Not all scientific publications have the same quality and being active does not necessarily create an impact. A good indicator for the quality of a paper and thus its relevance and impact is the number of citations it receives. Table 3 shows the quotes 'cites per paper' for each of the 25 top cited countries in the 1990.

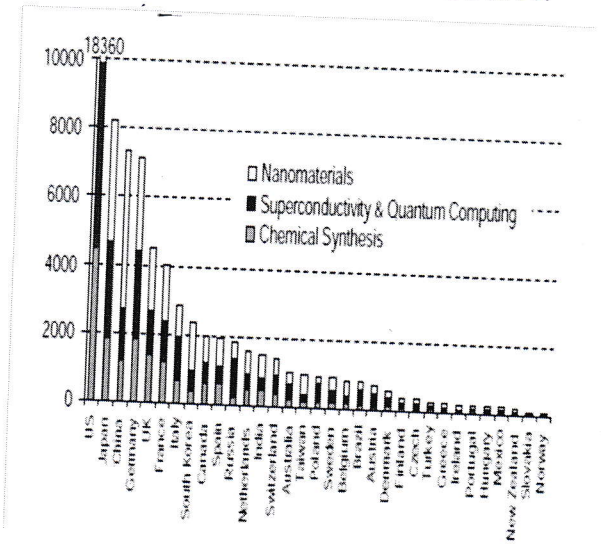

FIGURE 5 Scientific publications in nano-science per country and subfield, 2002-2007 (SCI database). Sources: Igami, 2008, Science Citation Index 2002-2007. The analysis has been conducted by NISTEP, 2008.

When it comes to the relative impact, two small countries are in the lead: Switzerland and the Netherlands. The top three are competed with the United States.

Nation	Number of papers	Total cites	Cites per paper
Switzerland	792	8233	10.4
Netherlands	514	4767	9.27
US	9993	92108	9.22
Canada	754	5707	7.57
Belgium	382	2873	7.52
Ireland	131	926	7.07
England	1545	10325	6.68
Denmark	217	1401	6.46
France	2673	17168	6.42
Japan	4251	26267	6.18
Germany	3634	22373	6.16
Spain	874	5131	5.87
Israel	371	2063	5.56
Brazil	245	1253	5.11
Austria	220	1103	5.01
Italy	958	4585	4.79
Sweden	381	1729	4.54
Australia	349	1508	4.32
India	636	2005	3.15
Poland	387	969	2.5
Russia	1708	4240	2.48
China	3168	7653	2.42
S.korea	579	1243	2.15

TABLE 3: Number of nanotechnology publications and citations in the SCI database 1991-2000 for top 25 cited countries, ranked by average cites per paper. Note that the EU-25 figures do only refer to the countries that appear in this table. Source: Thomson ISI database, 2007.

The other most active countries United Kingdom (represented here by England and Scotland), France, Japan and Germany are only in the midfield, behind Canada, Belgium, Ireland and Denmark.

The three most dynamic countries Russia, China and South Korea competed in the picture. The list of top cited countries in nanotechnology does also reflect a general phenomenon: If a country is English speaking or does not have a strong language in terms of numbers of persons speaking it, or it is multilingual, it has a far greater tendency for publications in 'world journals' in English language, which do have a higher impact than national language oriented journals with a smaller potential readership and thus a smaller impact.

These observations do support the interdisciplinary character of nano-sciences: A nano-scientific article can be relevant for many disciplines and has thus the highest impact if the target community is broad – as it is the case for 'Nature' and 'Science' and the more general chemical and physical journals. Another, more general reason is that only high quality articles are accepted in these high level journals, which also leads to a larger number of cites. It can also be concluded that the nano-scientific performance of most of the European countries is ambiguous. European countries are either very active or with a high impact, while the United States, though very active, are also strong on the impact side.

Compared with the patent data, two most important conclusions can be drawn.

- First, neither for publications nor for patents, Europe is homogenous. There is no evidence for a 'European paradox' but for a dispersed knowledge base and technological applications across Europe.
- Second, the United States is the benchmark when it comes to both scientific and technological excellence in nanotechnology. This conclusion is not new, but reinforced by evidence.

VII CONCLUSIONS

Regarding the financing of nanotech research, some differences between the world regions become obvious. In Europe, the private investors are lagging behind the public funding agencies. While the United States and Japan have a more balanced partition of private and public funding, the European nanotech research

has to suffer from lower private funding sources. On the other hand and in order to put it positively, the public funding of nanotechnology in Europe is competitive on a world level and shows the early reaction of European research policy to the new opportunities opened by nanotechnology and the participation at the "nano race". However, the lack of commitment of European private investors is not nano specific – the same can be observed for the overall R&D expenditures as well and therefore have to be put down to other, more general reasons in the European industrial research system. The problem is well known and falls within the "Barcelona 3% - and 2/3 from industry - objectives" tackled on the European level (European Council, 2012).

The high level of public funding of nanotechnology research is very likely to have a positive impact on the S&T excellence of Europe. Knowledge and intellectual property are created in research projects which are to a great extent publicly funded. However, the successful technological implementation and the translation into commercially successful products depend also on the integration of industry in these projects, which is taking place but has to be improved. In this connection it can be considered as advantageous that Europe is focusing on civil applications of nanotechnology, other than e.g. the United States which spends a great share of its public funding of nanotechnology for military research. Another positive aspect of the substantial (civil) public funding in Europe is the societal dimension: Nanotechnology will have a positive impact on economic development – if it provides new solutions and does not create new problems. Only in this case will society in form of consumers, pressure groups and regulatory agencies accept and support nanotechnology products. The current discussions on the potential dangers of nano-particles are addressed by contributing with research activities on the topic. Political action is also needed if risks turn out to be socially unacceptably high. The possibility to politically steer research, i.e. the definition of priority areas such as research on safety aspects of nanotechnology, on new environmental solutions, or on new medical devices, is one great advantage of publicly funded research. By influencing the direction of nanotechnology research, it can correspond to the societal expectations and consequently have a positive economic impact.

The political lessons learnt from the data are not new: Europe is doing well, but has to reduce a gap to the United States and Japan in many fields and for many indicators. In addition, Europe has to observe carefully the development in the emerging nanotech countries China, India and Russia. Much will depend on Europe's scientific and technological excellence in order to strengthen the nanotech knowledge base in research and industry and not to ignore the parallel need for well educated nanotech workers and researchers and worldwide competitive infrastructure for knowledge production.

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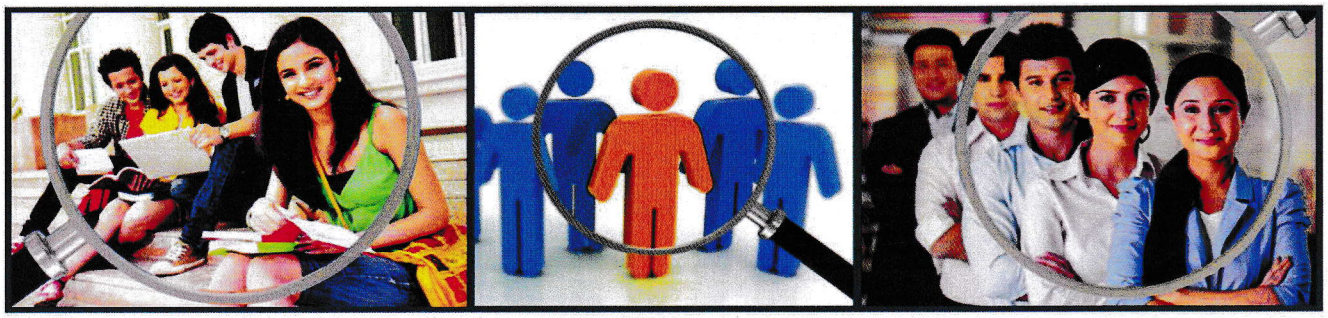

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