

**SPECIAL FEATURE**

**A Novel Variant of  
Parallel Shortest Path  
Searching Algorithm**

**Silicon**

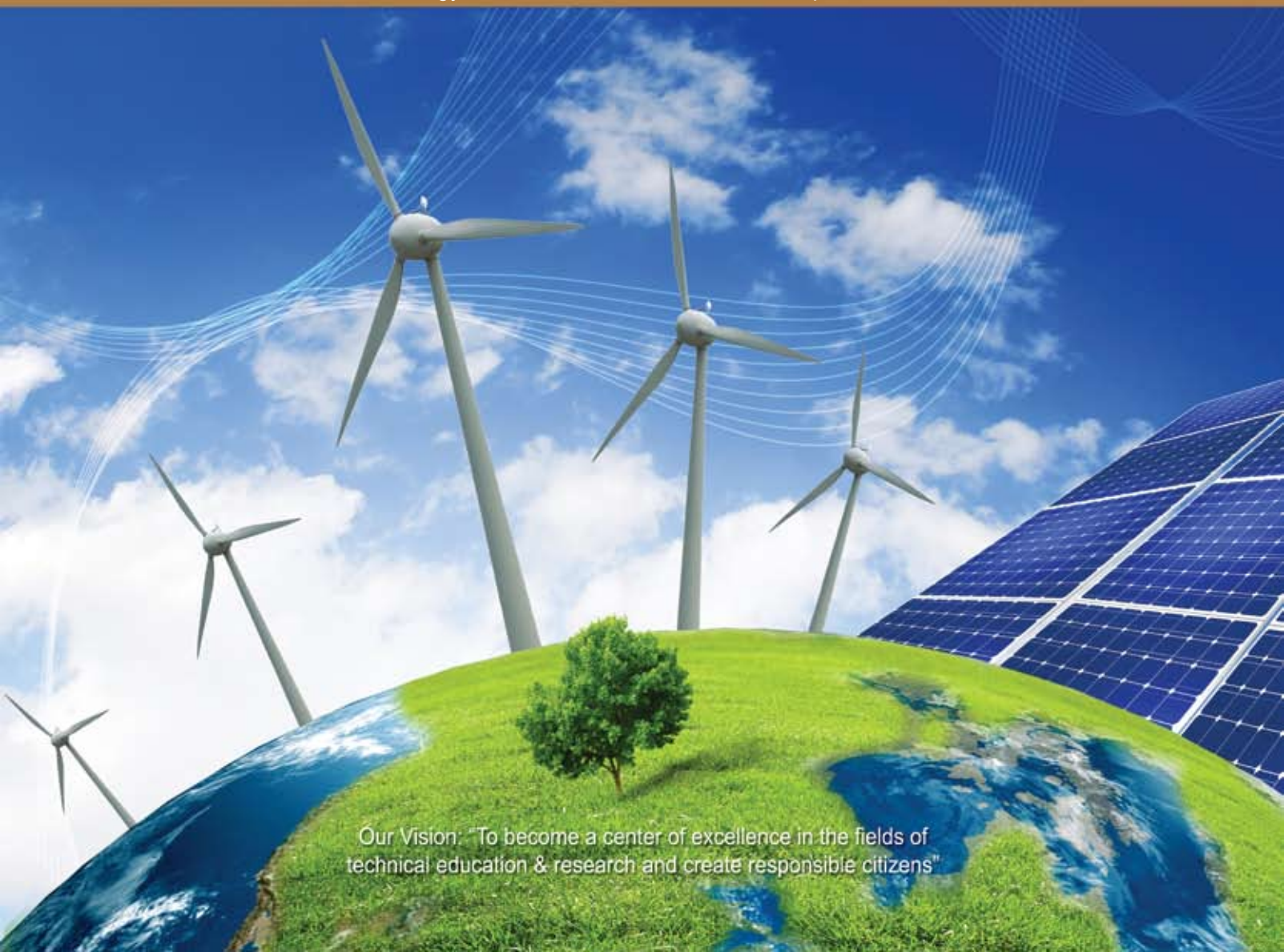
*...beyond teaching*

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## Gravity Lights- An approach towards Alternative Energy Sources

Fossil fuels are non-renewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging to retrieve. We divide our energy use among four economic sectors: residential, commercial, transportation, and industrial. Heating and cooling our homes, lighting office buildings, driving cars and moving freight, and manufacturing the products we rely on in our daily lives are all functions that require energy. There are different forms of renewable energy sources, such as Solar, Wind, Hydroelectric and Biomass to name a few. There are two types of solar energy: “Passive” and “Active”. The first simply involves making use of the position, intensity and duration of the sun's rays throughout the day to best advantage. The second type involves using mechanical and electrical technology such as photovoltaic solar panels or solar thermal panels to capture, convert and store the sun's energy either in batteries or hot water tanks for later use. Active solar hot water systems use pumps to move the heated water around. The force of the wind has been used as a renewable energy source for many hundreds of years to power sailing ships that sail the oceans and windmills that grind corn. These days however, wind power involves not one or two windmills dedicated to grinding wheat and flour, but many wind turbines arranged to capture large amount of power at once converting it into electricity and feeding it into the utility grid. Thus windmills transform wind energy into electricity. These large wind turbines are amassed together on a hill side or offshore in the sea to exploit the kinetic energy of the wind. These vast collections of wind turbines together are known as “wind farms” and are becoming an increasingly common part of the countryside. Hydroelectric energy is another renewable energy resource in which the energy is derived from the power of moving water

This water contains large amounts of kinetic energy that can be extracted and used to spin a turbine or waterwheel (mechanical energy), which drives a generator (electrical energy). Even a small stream can produce enough kinetic energy to turn a wheel. Biomass and Bio-energy are the terms used for any kind of non-fossil fuel material that is classified as being organic, biological or made of plant matter, and which can be converted into a usable energy source. Biomass energy production involves converting biological material or wastes into substances that can be used as fuel for heating, transportation or power generation. Even as we talk about different forms of renewable energy resources, over 1.2 billion people globally have no access to electricity and millions more have an unreliable supply. Often they use dangerous, polluting and expensive kerosene lamps for light. Innovators Jim Reeves and Martin Riddiford started work on the GravityLight concept as a project in 2009. Following several years of product development, testing prototypes, and user feedback they developed GravityLight which looked beyond solar light and battery powered devices. The working of GravityLight is very simple; combining kinetic and potential energy it functions by lifting an elevated weight filled with rocks or sand connected to a pulley system that slowly powers a generator as the weight falls to the ground. It takes just a few seconds to lift the weight that powers the device. As the energy generated from the device is completely self-sustained, GravityLight pays for itself within months of switching from a kerosene lamp. This can improve the lives of the people without electricity in rural areas by providing clean and affordable lighting. Such innovations and small steps can collectively address the issues of environment, human health and energy demand and lead the change for development of a sustainable energy policy in each and every country.

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## Optimization of Dc Motor Speed Control Using Nature Inspired Algorithm in R-Environment

**Abstract:** The DC motor is used as a part of various applications, for example, steel plants, electric trains, cranes and significantly more. So it is important to obtain the best performance a DC motor. In some applications of a DC motor, speed control plays an important role. DC motor speed control can be performed in various ways, but this paper proposes nature inspired algorithms programming of digital DC speed control. Nature inspired algorithms are a group of algorithms that simulate physical or biological phenomena to solve computational problems. Some examples are particle swarm optimization and cuckoo search algorithm. This paper emphasizes on implementing a nature inspired algorithm using R. R is a programming language and environment commonly used in statistically computing, data analytics and scientific research having an expressive syntax and easy to use interface.

**Key words:** Particle Swarm Optimization (PSO), Motor-generator set (M-G) set, Genetic Algorithm (GA), Proportional-integral-derivative (PID) controller.

### I. INTRODUCTION

The development of high performance motor drives is very important in industrial applications. Generally, a high performance motor drive system must have good dynamic speed command tracking and load regulating response. New technologies are emerging for control schemes. Over the past two decades, soft computation is used widely.

Nature inspired algorithm technique are quite different, and yet with unique capabilities useful in information processing by specifying mathematical relationships among numerous variables in complex system, performance mappings, control of nonlinear system to a degree not possible with conventional linear systems. Nature inspired algorithm is based on the operating principle of natural computing. This method is applied to control the motor speed [1]. For this paper Swarm Intelligence technique, in speed control is used for a shunt wound DC motor. The rotor speed of DC motor can be made to follow an arbitrary selected trajectory. The purpose is to achieve accurate trajectory control of the speed especially when the motor and load parameters are unknown.

### II. PROBLEM STATEMENT

Although the conventional P technique is widely used in DC motor speed and position control, it isn't suitable for high performance cases, because of the low robustness of P controller. Many researchers have been studying various new control techniques in order to improve the system performance

This paper proposed a new ability of Particle Swarm Optimisation (PSO) in estimating speed and controlling

the separately excited DC motor to achieve the over speed self-regulating. The estimator used to estimate the motor speed and the controller is used to generate a control signal for a converter. Simulation results demonstrate the effectiveness of this natural and advantage of the control system DC motor with PSO in comparison with the conventional scheme without PSO. P Controller is chosen to interface with the DC motor because in PSO, non-adaptive control systems have fixed parameters that are used to control a system. These types of controllers have proven to be very successful in controlling linear, or almost linear systems.

### SPEED CONTROL TECHNIQUE:

#### ● Field Control of DC Shunt Motor

By this method speed control is obtained by any one of the following means –

##### (a) Field Rheostat Control of DC Shunt Motor

In this method, speed variation is accomplished by means of a variable resistance inserted in series with the shunt field. An increase in controlling resistances reduces the field current with a reduction in flux and an increase in speed. This method of speed control is independent of load on the motor. Power wasted in controlling resistance is very little as the field current is a small value. This method of speed control is also used in DC compound motor.

##### (b) Field Voltage Control

This method requires a variable voltage supply for the field circuit which is separated from the main power supply to which the armature is connected. Such a variable supply can be obtained by an electronic rectifier.

Speed control by this method involves two ways. These are:

#### (a) Armature Resistance Control

In this method armature circuit is provided with a variable resistance. Field is directly connected across the supply so flux is not changed due to variation of series resistance. This is applied for DC shunt motor. This method is used in printing press, cranes, hoists where speeds lower than rated is used for a short period only.

#### (b) Armature Voltage Control

This method of speed control needs a variable source of voltage separated from the source supplying the field current. This method avoids disadvantages of poor speed regulation and low efficiency of armature-resistance control methods. The basic adjustable armature voltage control method of speed control is accomplished by means of an adjustable voltage generator is called Ward Leonard System [2][3]. This method involves using a motor-generator (M-G) set. This method is best suited for steel rolling mills, paper machines, elevators, mine hoists, etc.

### NATURE INSPIRED ALGORITHM

Nature provides some of the efficient ways to solve problems – Algorithms imitating processes from nature are nature inspired algorithms. These nature-inspired meta-heuristic algorithms can be based on swarm intelligence, biological systems, physical and chemical systems. Therefore, these algorithms can be called swarm-intelligence-based, bio-inspired and physics-based, depending on the sources of inspiration [4].

#### ● Optimization Methods

A process, or methodology of making something (such as a design, system, or decision) as fully perfect, functional, or effective as possible; specifically the mathematical procedures (such as finding the maximum of a function) is involved. In the above modelling, results were obtained through manual hit and trial method. The results so obtained were time consuming and not optimal. Thus evolutionary search algorithms were used to search for the most globally optimised value for the situations. Here we have taken into study a biologically inspired search techniques Particle Swarm Optimisation technique.

#### ● Particle Swarm Optimisation, a brief description

PSO is a swarm intelligence meta-heuristic inspired by the group behaviour of animals, for example bird flocks or fish schools. Similar to genetic algorithms (GAs), it is a population-based method, that is, it represents the state of the algorithm by a population, which is iteratively modified until a termination criterion is satisfied [5].

Suppose the following scenario: a group of birds are randomly searching food in an area. There is only one piece of food in the area being searched. All the birds do not know where the food is. But they know how far the food is in each iteration. So what's the best strategy to find the food? The effective one is to follow the bird which is nearest to the food.

PSO learned from the scenario and used it to solve optimization problems. In PSO, each single solution is a “bird” in the search space. We call it “particle”. All of particles have fitness values which are evaluated by the fitness function to be optimized, and have velocities which direct the flying of the particles. The particles fly through the problem space by following the current optimum particles [6]

PSO is initialized with a group of random particles (solutions) and then searches for optimum solution by updating generations. In every iteration, each particle is updated by following two “best” values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called p best. Another “best” value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called g best. When a particle takes part of the population as its topological neighbours, the best value is a local best and is called l best.

After finding the two best values, the particle updates its velocity and positions with following equation (a) and (b).

$$v[i] = v[i] + c1 * rand(i) * (pbest[i] - present[i]) + c2 * rand(i) * (gbest[i] - present[i]) \text{ ----- (a)}$$

$$present[i] = present[i] + v[i] \text{ ----- (b)}$$

$v[i]$  is the particle velocity,  $present[i]$  is the current particle (solution).  $Pbest[i]$  and  $gbest[i]$  are defined as stated before,  $rand()$  is a random number between (0,1). Figure 1 shows the flow chart of PSO.

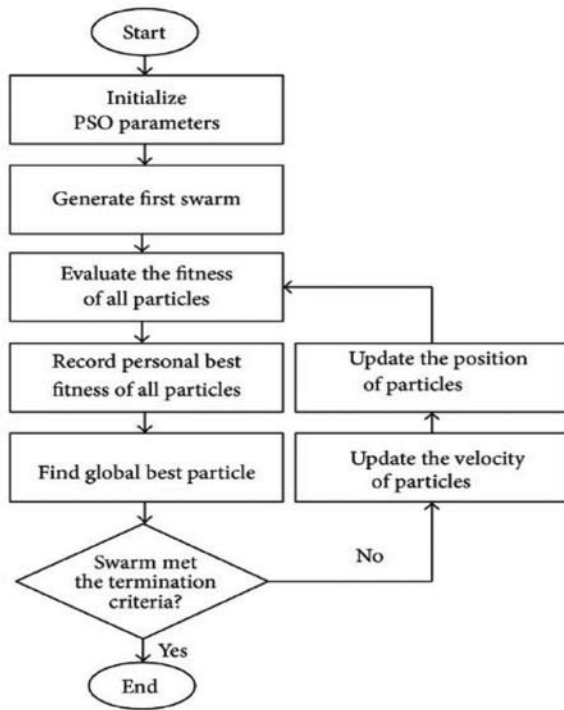


Fig1. Flow chart of PSO

Particle swarm creates initial particle velocities  $v$  at random uniformly within the range  $[-r, r]$ , where  $r$  is the vector of initial ranges. The range of component  $i$  is  $\min(\text{ub}(i) - \text{lb}(i), \text{Initial Swarm Span}(i))$ .

Particle swarm evaluates the objective function at all particles. It records the current position  $p(i)$  of each particle  $i$ . In subsequent iterations,  $p(i)$  will be the location of the best objective function that particle  $i$  has found. And  $b$  is the best over all particles:  $b = \min(\text{fun}(p(i)))$ .  $d$  is the location such that  $b = \text{fun}(d)$ .

## Iteration Steps

The algorithm updates the swarm as follows. For particle  $i$ , which is at position  $x(i)$ :

1. Choose a random subset  $S$  of  $N$  particles other than  $i$ .
2. Find  $\text{fbest}(S)$ , the best objective function among the neighbors, and  $\text{g}(S)$ , the position of the neighbor with the best objective function.
3. For  $u_1$  and  $u_2$  uniformly  $(0,1)$  distributed random vectors of length  $n_{\text{vars}}$ , update the velocity as in equation (c)

$$v = W * v + y_1 * u_1 * (p - x) + y_2 * u_2 * (g - x) - (c)$$

4. Update the position  $x = x + v$ .
5. Enforce the bounds. If any component of  $x$  is outside a bound, set it equal to that bound.

6. Evaluate the objective function  $f = \text{fun}(x)$ .
7. If  $f < \text{fun}(p)$ , then set  $p = x$ . This step ensures  $p$  has the best position the particle has seen.
8. If  $f < b$ , then set  $b = f$  and  $d = x$ . This step ensures  $b$  has the best objective function in the swarm, and  $d$  has the best location.
9. If, in the previous step, the best function value was lowered, then set  $\text{flag} = \text{true}$ . Otherwise,  $\text{flag} = \text{false}$ . The value of  $\text{flag}$  is used in the next step.
10. Update the neighbourhood. If  $\text{flag} = \text{true}$ :

- Set  $c = \max(0, c-1)$ .
- Set  $N$  to  $\text{minNeighborhoodSize}$ .
- If  $c < 2$ , then set  $W = 2 * W$ .
- If  $c > 5$ , then set  $W = W/2$ .
- Ensure that  $W$  is in the bounds of the Inertial Range option.
- If  $\text{flag} = \text{false}$ : Set  $c = c+1$ .
- Set  $N =$

$\min(N + \min(\text{NeighborhoodSize}, \text{SwarmSize}))$ .

The DC motor is the obvious proving ground for advanced control algorithms in electric drives due to the stable and straight forward characteristics associated with it.

From a control system point of view, the DC motor can be considered as Single Input Single Output(SISO) plant, thereby eliminating the complications associated with a multi-input drive system [7]. The proposed general block diagram for variable speed DC shunt motor is shown in Figure 2.

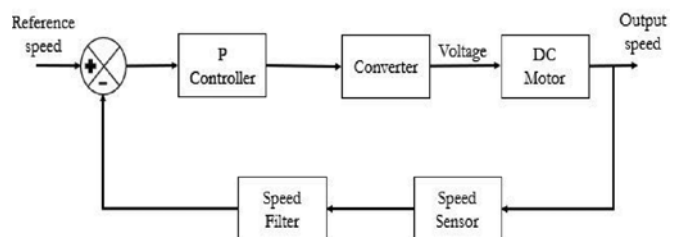


Fig. 2 Proposed block diagram for variable speed DC shunt motor

## III. PSO IN R

$\text{Psoptim}(\text{par}, \text{fn}, \text{gr} = \text{NULL}, \text{lower} = -1, \text{upper} = 1, \text{control} = \text{list}())$

**par:** Vector with length defining the dimensionality of the optimization problem. Providing actual values of  $\text{par}$  are not necessary (NA is just fine). Included primarily for compatibility with  $\text{optim}$  but if values are provided

within the lower and upper bounds then the first particle will be initialized to the position provided by par [8].

fn: A function to be minimized (or maximized), with first argument the vector of parameters over which minimization is to take place. It should return a scalar result.

Gr: A function to return the gradient if local search is BFGS. If it is NULL, a finite-difference approximation will be used.

Lower : Lower bounds on the variables.

Upper : Upper bounds on the variables.

Control : A list of control parameters.

#### Calculation of error function for R:

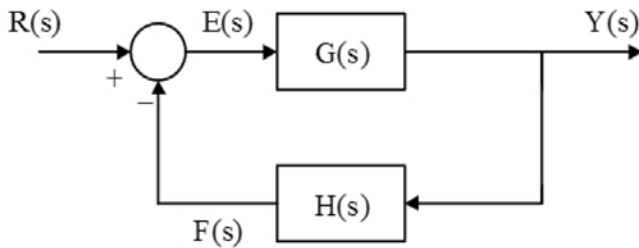


Fig. 3 Calculation of error function for R:

From Figure 3,

$$E(s) = R(s) - F(s)$$

$$= R(s) - Y(s) * H(s) \text{ ----- (d)}$$

$$\text{But, } Y(s) = E(s) * G(s) \text{ ----- (e)}$$

$$\text{Hence, } E(s) = R(s) - E(s) * G(s) * H(s)$$

$$\text{Or } E(s) * [1 + G(s) * H(s)] = R(s)$$

$$\text{Or } E(s) = R(s) / [1 + G(s) * H(s)] \text{ ----- (f)}$$

The Performance index is shown in Figure 4.

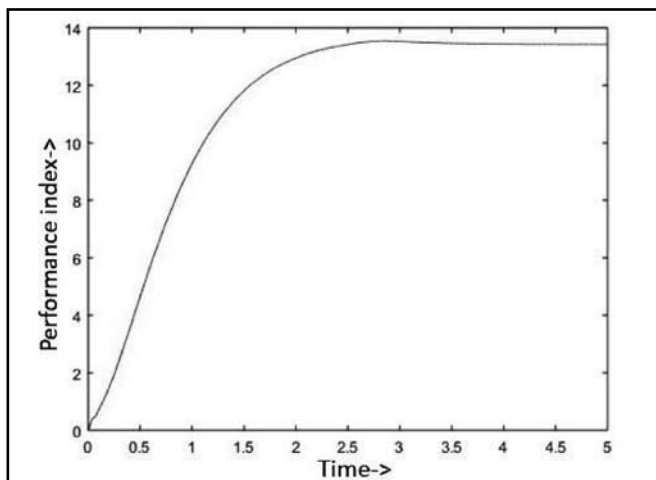


Fig. 4 Simulation plot for performance index vs time

## IV. CONCLUSIONS

Performance of P controller using Particle Swarm Optimization in R environment has been found to give good results. The conventional controllers however are not recommended for higher order and complex systems as they can cause the system to become unstable. Hence, a heuristic approach is required for choice of the controller parameters which can be provided with the help of Bio inspired methods such as Particle Swarm Optimization, where we can define variables in a subjective way.

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# Recommendation System Using Machine Learning

**Abstract :** Recommender systems use algorithms to provide users with product or service recommendations. Recently, these systems have been using machine learning algorithms from the field of artificial intelligence. Recommender systems have become increasingly popular in recent years and are utilized in a variety of areas including movies, music, news, books, research articles, search queries, social tags, and products in general. It has been identified in the literature that, many machine learning techniques has been applied on recommender systems. Here, we have presented various machine learning algorithm applied on recommender systems.

**Keywords -** Term frequency, Inverse document frequency, Similarity matrix

## 1. INTRODUCTION

Personalization of product information has become one of the most important factors that impact a customer's product selection and satisfaction in today's competitive and challenging market. Personalized service requires firms to understand customers and offer goods or services that meet their needs. Successful firms are those which provide the right products to the right customers at the right time and for the right price. Recommendation systems are widely used by e-commerce practitioners and have become an important research topic in information sciences and decision support systems. Recommendation systems are decision aids that analyze customer's prior online behaviour and present information on products to match customer's preferences. Through analyzing the customer's purchase history or communicating with them, recommendation systems employ quantitative and qualitative methods to discover the products that best suit the customer. Most of the current recommendation systems recommend products that have a high probability of being purchased. They employ content-based filtering (CBF), collaborative filtering (CF), and other data mining techniques, for example, decision tree, association rule, and semantic approach. Some of them have been used by large companies, like Amazon and Dell. In this paper, we build our recommendation system based collaborative filtering (CF) and we use two models: item-based and user-based.

## 2. MODEL FOR RECOMMENDATION SYSTEM

### A. Utility Matrix

In a recommendation-system application there are two classes of entities, which we shall refer to as users and items. Users have preferences for certain items, and these preferences must be teased out of the data. The data itself is represented as a utility matrix, giving for each user-item pair, a value that represents what is known about the degree of preference of that user for that item. Values come from an ordered set, e.g., integers 1–5 representing the number of stars that the user gave as a rating for that item. We assume that the matrix is sparse, meaning that most entries are "unknown." An unknown rating implies that we have no explicit information about the user's preference for the item. For example, we can take an utility matrix, representing users' ratings of movies on a 1–5 scale, with 5 being the highest rating. Blanks represent the situation

where the user has not rated the movie. The movie names are HP1, HP2, and HP3 for Harry Potter I, II, and III, TW for Twilight, and SW1, SW2, and SW3 for Star Wars episodes 1, 2, and 3. The users are represented by capital letters A through Z[1].

The goal of a recommendation system is to predict the blanks in the utility matrix. For example, would user A like SW2? We might design our recommendation system to take into account properties of movies, such as their producer, director, stars, or even the similarity of their names. If so, we might then note the similarity between SW1 and SW2, and then conclude that since A did not like SW1, they were unlikely to enjoy SW2 either. Alternatively, with much more data, we might observe that the people who rated both SW1 and SW2 tended to give them similar ratings. Thus, we could conclude that A would also give SW2 a low rating, similar to A's rating of SW1. [2 ]

### B. Movie Recommendations

Netflix offers its customers recommendations of movies they might like. These recommendations are based on ratings provided by users, much like the ratings suggested in the example utility matrix. The importance of predicting ratings accurately is so high, that Netflix offered a prize of one million dollars for the first algorithm that could beat its own recommendation system by 10%. The prize was finally won in 2009, by a team of researchers called "Bellkor's Pragmatic Chaos," after over three years of competition.

## I. COLLABORATIVE FILTERING

We shall now take up a significantly different approach to recommendation. Instead of using features of items to determine their similarity, we focus on the similarity of the user ratings for two items. That is, in place of the item-profile vector for an item, we use its column in the utility matrix. Further, instead of contriving a profile vector for users, we represent them by their rows in the utility matrix. Users are similar if their vectors are close according to some distance measure such as Jaccard or cosine distance. Recommendation for a user U is then made by looking at the users that are most similar to U in this sense, and recommending items that these users like. The process of identifying similar users and recommending what similar users like is called collaborative filtering.

### A. Measuring Similarity

We are interested to calculate the similarity between items and users and finally to choose a group of nearest neighbours

as recommendation partners for an active user. After establishing a set of profiles by the recommender system, it is possible to reason about the similarities between users or items, and finally chooses a group of nearest neighbours as recommendation partners for an active user. Because of the importance and popularity of similarity matrices, we have examined those in detail.[3]

### B. Jaccard Index

We could ignore values in the matrix and focus only on the sets of items rated. If the utility matrix only reflected purchases, this measure would be a good one to choose. However, when utilities are more detailed ratings, the Jaccard distance loses important information.

Example : A and B have an intersection of size 1 and a union of size 5. Thus, their Jaccard similarity is 1/5, and their Jaccard distance is 4/5; i.e., they are very far apart. In comparison, A and C have a Jaccard similarity of 2/4, so their Jaccard distance is the same, 1/2. Thus, A appears closer to C than to B. Yet that conclusion seems intuitively wrong. A and C disagree on the two movies they both watched, while A and B seem both to have liked the one movie they watched in common)

### C. Cosine Similarity

We can treat blanks as a 0 value. This choice is questionable, since it has the effect of treating the lack of a rating as more similar to disliking the movie than liking it.

$$\text{sim}(i, j) = \cos(\vec{i}, \vec{j}) = \frac{\vec{i} \cdot \vec{j}}{\|\vec{i}\|_2 * \|\vec{j}\|_2}$$

### D. Pearson Correlation

$$\text{sim}(a, b) = \frac{\sum_{p \in P} (r_{a,p} - \bar{r}_a)(r_{b,p} - \bar{r}_b)}{\sqrt{\sum_{p \in P} (r_{a,p} - \bar{r}_a)^2} \sqrt{\sum_{p \in P} (r_{b,p} - \bar{r}_b)^2}}$$

## II. CONTENT BASED RECOMMENDATION

Content-Based systems focus on properties of items. Similarity of items is determined by measuring the similarity in their properties.

### A. Item Profiles

In a content-based system, we must construct for each item a profile, which is a record or collection of records representing important characteristics of that item. In simple cases, the profile consists of some characteristics of the item that are easily discovered. For example, consider the features of a movie that might be relevant to a recommendation system.

The set of actors of the movie. Some viewers prefer movies with their favorite actors. Some viewers have a preference for the work of certain directors. Some viewers prefer old movies; others watch only the latest releases. Some viewers like only comedies, others dramas or romances

### B. User Profile

We not only need to create vectors describing items; we need to create vectors with the same components that describe the user's preferences. We have the utility

matrix representing the connection between users and items. Recall the nonblank matrix entries could be just 1's representing user purchases or a similar connection, or they could be arbitrary numbers representing a rating or degree of affection that the user has for the item.

With this information, the best estimate we can make regarding which items the user likes is some aggregation of the profiles of those items. If the utility matrix has only 1's, then the natural aggregate is the average of the components[4].

Of the vectors representing the item profiles for the items in which the utility matrix has 1 for that user.

Example: Suppose items are movies, represented by boolean profiles with components corresponding to actors. Also, the utility matrix has a 1 if the user has seen the movie and is blank otherwise. If 20% of the movies that user U likes have Julia Roberts as one of the actors, then the user profile for U will have 0.2 in the component for Julia Roberts.

If the utility matrix is not boolean, e.g., ratings 1–5, then we can weight the vectors representing the profiles of items by the utility value. We normalize the utilities by subtracting the average value for a user. That way, we get negative weights for items with a below-average rating, and positive weights for items with above-average ratings.

Example: Consider the same movie information as in previous example, but now suppose the utility matrix has nonblank entries that are ratings in the 1–5 range. Suppose user U gives an average rating of 3. There are three movies with Julia Roberts as an actor, and those movies got ratings of 3, 4, and 5. Then in the user profile of U, the component for Julia Roberts will have value that is the average of 3 – 3, 4 – 3, and 5 – 3, that is, a value of 1.

On the other hand, user V gives an average rating of 4, and has also rated three movies with Julia Roberts (it doesn't matter whether or not they are the same three movies U rated). User V gives these three movies ratings of 2, 3, and 5. The user profile for V has, in the component for Julia Roberts, the average of 2 – 4, 3 – 4, and 5 – 4, that is, the value –2/3.

## III. MATRIX FACTORIZATION

It is a factorization of a matrix into a product of matrices. In recommendation system the matrix which is factorized is the user product rating matrix. For this we use Dimension Reduction Technique. Dimension reduction is the process of reducing the number of random variable under consideration via obtaining a set of principle variable P and Q.

Firstly, let us assume we have a set of users, and a set of items. Let the size  $|U| \times |D|$  be the matrix that contains all the ratings that the users have assigned to the items. Also, we assume that we would like to discover K latent features. Our task, then, is to find two matrices (a  $|U| \times K$  matrix) and (a  $|D| \times K$  matrix) such that their product approximates [5].

In this way, each row would represent the strength of the associations between a user and the features. Similarly, each row of matrix would represent the strength of the



associations between an item and the features. To get the prediction of a rating of an item  $d_j$  by, we can calculate the dot product of the two vectors corresponding to  $d_j$ .

Now, we have to find a way to obtain  $P$  and  $Q$ . One way to approach this problem is the first initialize the two matrices with some values, calculate how different their product is to, and then try to minimize this difference iteratively. Such a method is called gradient descent, aiming at finding a local minimum of the difference. The difference here, usually called the error between the estimated rating and the real rating.

To minimize the error, we have to know in which direction we have to modify the values. In other words,  $\hat{r}_{ij} = p_i^T q_j = \sum_{k=1}^K p_{ik} q_{kj}$  we need to know the gradient at the current values, and therefore we differentiate with respect to these two variables separately. Having obtained the gradient, we can now formulate the update rules for both  $P$  and  $Q$ .

Here,  $\alpha$  is a constant whose value determines the rate of approaching the minimum of  $\alpha$ . Usually we will choose a small value for, say 0.0002. This is because if we make too large a step towards the minimum we may run into the risk of missing the minimum and end up oscillating around the minimum.

A question might have come to your mind by now: if we find two matrices  $P, Q$  and such that  $P * Q \approx r$ , isn't that our predictions of all the unseen ratings will all be zeros? In fact, we are not really trying to come up with  $Q$  and such that we can reproduce exactly. Instead, we will only try to minimize the errors of the observed user-item pairs. In other words, if we let  $T$  be a set of tuples, each of which is in the form of  $(u_i, d_j, r_{ij})$  such that it contains all the observed user-item pairs together with the associated ratings, we are only trying to min for  $(u_i, d_j, r_{ij}) \in T$  (In other words, is our set of training data). As for the rest of the unknowns, we will be able to determine their values once the associations between the users, items and features have been learnt.

Using the update rules, we can then iteratively perform the operation until the error converges to its minimum. We can check the overall error as calculated using the following equation and determine when we should stop the process.

$$E = \sum_{(u_i, d_j, r_{ij}) \in T} e_{ij} = \sum_{(u_i, d_j, r_{ij}) \in T} (r_{ij} - \sum_{k=1}^K p_{ik} q_{kj})^2$$

### 3. IMPLEMENTATION

A  $|U| \times |D|$  rating matrix is taken as the input, in which each row represents the users and the column represents the items and contains the ratings of  $|D|$  items rated by  $|U|$  users. This simple matrix factorization model that uses the above Singular Value Decomposition (SVD) algorithm is used to predict the ratings of items not yet reviewed and rated by some users. The number of latent features 'K' is taken as 2 for the program. Using the final rating matrix and the criteria for recommendation the users are recommended

some items which they like or would like to use in future, according to their use pattern.

### 4. CONCLUSIONS

Recommender systems open new opportunities of retrieving personalized information on the Internet. It also helps to alleviate the problem of information overload which is a very common phenomenon with information retrieval systems and enables users to have access to products and services which are not readily available to users on the system. This paper discussed the two traditional recommendation techniques and highlighted their strengths and challenges with diverse kind of hybridization strategies used to improve their performances. Various learning algorithms used in generating recommendation models and evaluation metrics used in measuring the quality and performance of recommendation algorithms were discussed. This knowledge will empower researchers and serve as a road map to improve the state of the art recommendation techniques.

### 5. ACKNOWLEDGEMENT

We express our sincere gratitude to the faculty members and Project Guide Mr. Pradipta Kumar Pattanayak of Computer Science and Engineering Department, Silicon Institute of Technology for guidance and encouragement in carrying out this research work without whom the success could not been achieved.

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# A Novel Variant of Parallel Shortest Path Searching Algorithm\*

\*This article is selected from ICIT- 2017 student symposium

## **Abstract :**

*This paper proposes a PSPSA (parallel shortest path searching algorithm) that determines the shortest paths simultaneously from source node to all other nodes in parallel. Dijkstra's shortest path algorithm which is a popular one finds the shortest paths from the source to the all other nodes in a sequential manner. Dijkstra's algorithm is not efficient in case of large graphs when the number of nodes is more. So for calculating shortest paths in large graphs sequentially is very difficult. It takes more time for finding the shortest paths. Our proposed way finds the shortest paths in parallel from the source node to other nodes depending on the minimum cost. So due to simultaneous multipath search from source node to all other nodes it takes lesser time than Dijkstra's algorithm for finding the shortest path.*

## **1. INTRODUCTION**

In graph theory, the shortest path problem is the problem of finding a path between two vertices in a graph such that the sum of the weights of its constituent edges is minimized. There are several variants of shortest path problems such as Single source shortest paths, Single destination shortest paths, Single pair shortest path and All pair shortest paths problems. In Single-source shortest paths problem, we have to find shortest paths from a source vertex to all other vertices in the graph. In Single-destination shortest paths problem, in which we have to find shortest paths from all vertices in the directed graph to a single destination vertex. This can be reduced to the single-source shortest path problem by reversing the arcs in the directed graph. The single source shortest paths problem can be solved by Dijkstra's Algorithm which finds the shortest paths sequentially. PSPSA finds the shortest paths in parallel in a given graph. In this paper we have proposed a novel PSPSA which is more efficient than the existing PSPSA.

### **A. Motivation and Applications**

Our work is motivated by the problem of determining time dependent shortest paths in highway systems where the traffic density is more. With the population growth the numbers of vehicles are sharply increasing. The traffic congestion becomes a worldwide problem. Floating car Data (FCD)-based traffic navigation system, which is an important part of Intelligent Transportation system (ITS), can improve the overall traffic efficiency by reducing the fuel consumption and exhausted emissions.

It is getting more and more attention from countries all over the world. So these problems lead to improvement of the PSPSAs[1].

The parallel shortest path searching is used to automatically find directions between physical locations, such as driving directions on web mapping websites like MapQuest or Google Maps. Shortest path algorithms can be used to find an optimal sequence of choices to reach a certain goal state. For example, if vertices represent the states of a puzzle like a Rubik's Cube and each directed edge corresponds to a single move or turn, shortest path algorithms can be used to find a solution that uses the minimum possible number of moves. Some important applications of PSPSA are in Operations research, plant and facility layout, robotics, transportation, and VLSI design. Many state and federal agencies have expressed their intent to incorporate this technology into future recovery efforts following such natural disasters as earthquakes, floods, and hurricanes[2]

### **B. PSPSA**

This algorithm finds the shortest paths using a simultaneous multi-path search method where several nodes can be determined at one time. So for finding the shortest path in the large networks, we are partitioning the network into different groups (network groups) and find the all-node pair's shortest path in each group using a pipeline operation. Networks can be abstracted, and the shortest paths in very large networks can be found easily. The proposed algorithm can decrease calculation time from  $O(n^2)$  to  $O(n)$  using a parallel search method.

## C. Related Work

The PSPSA was developed by the pioneering work of Hiroyuki ISHIKAWA in 2007 [3]. He initiated the solution of the problem of finding the shortest paths in parallel with lesser time than Dijkstra's algorithm. It is a simple algorithm that efficiently calculates the shortest paths to all destinations. The single-source shortest path (SSSP) problem is the problem of finding a path between two nodes that minimizes the sum of the weights of its constituent links. The algorithm incrementally organizes a tree structure rooted at the source. All the edges linked to the source node are added to an edge list, with costs equal to the cost of the links from the source node to the neighbours. The router on the candidate list with the smallest cost is then added to the shortest path tree, and that router's neighbours are then examined to determine whether they can be included in the candidate list. The algorithm then iterates until the candidate list is empty.

## D. Our Contribution

In this paper we have proposed an improved algorithm in compared to the existing PSPSA [3]. We found some limitations of the existing algorithm and proposed a new way to remove limitations.

## II. BACKGROUND AND PRELIMINARIES

In graph theory so many shortest path algorithms have been developed for finding shortest paths of a network from a particular node. But among all the shortest path algorithms two of them are efficient for finding shortest paths for positive weighted graphs which are mostly used for different applications.

Let  $G = (V, E)$  be an undirected graph where  $V$  is the set of nodes, and  $E$  is the set of edges. Let  $s$  be the source node, and  $w$  be a function assigning a non-negative valued weight to each edge of  $G$ . The cost of a link can be thought of as the distance between the two nodes. For each  $v \in V$ ,  $d(v)$  represents the cost of the shortest path from the source node  $s$  to  $v$ . The theoretically most efficient sequential shortest path algorithm is Dijkstra's algorithm. It calculates the shortest path between the source node and all other nodes.

### A. Dijkstra's Algorithm

For a given source vertex in the graph, the algorithm finds the path with lowest cost between that vertex and every other vertex. It can also be used for finding costs of shortest paths from a single vertex to a single destination vertex by stopping the algorithm once the shortest path to

the destination vertex has been determined. The pseudo code of the algorithm is presented below.

### Pseudo code

- 1) Set  $S$  to empty, where  $S$  is a set of nodes whose shortest paths from the source have already been determined.
- 2) Add the source node  $s$  to  $S$  and  $d(s) = 0$ . If there is a link from  $s$  to  $v$ ,  $d(v) = w(s, v)$ , for all other nodes,  $d(v) = \infty$ .
- 3) Add a node  $u$  to  $S$ , where  $d(u)$  is the smallest in  $V - S$ . If  $S = V$ , complete the task.
- 4) If there is a link from  $u$  to  $v \in V - S$ ,  $d(v) = \min \{d(v), d(u) + w(u, v)\}$ . Then go back to step 3.

**Time Complexity :** An upper bound of the running time of Dijkstra's algorithm on a graph with edges  $E$  and vertices  $V$  can be expressed as a function of  $|E|$  and  $|V|$  using the Big-O notation [4]. The simplest implementation of the Dijkstra's algorithm stores vertices of set  $Q$  in an ordinary linked list or array, and operation Extract-Min ( $Q$ ) is simply a linear search through all vertices in  $Q$ . In this case, the running time is  $O(|V|^2 + |E|) = O(|V|^2)$ . For sparse graphs, that is, graphs with fewer than  $|V|^2$  edges, Dijkstra's algorithm can be implemented more efficiently by storing the graph in the form of adjacency lists and using a binary heap, pairing heap, or Fibonacci heap as a priority queue to implement the Extract-Min function efficiently. With a binary heap, the algorithm requires  $O((|E| + |V|) \log |V|)$  time (which is dominated by  $O(|E| \log |V|)$  assuming every vertex is connected, that is,  $|E| \geq |V| - 1$ ), and the Fibonacci heap improves this to  $O(|E| + |V| \log |V|)$ .

### B. PSPSA

The basic idea of this PSPSA [5] is simultaneous multipath search from the source node depending on the cost which determines the shortest path to all other nodes. Same pace will proceed in every edges connected to a particular node.

Let  $r(u, v)$  be the distance of  $v$  from  $u$  currently in a link  $(u, v)$ . Let three sets  $S, L, V$  where  $S$  is set of all visited nodes,  $L$  is the set of links in which the current position proceeds.  $V$  is set of all the nodes of the given graph.

### Pseudo code

Function `_parallel_search(graph, source)`

1. For each vertex ' $v$ ' in graph



2. Set  $S=\emptyset$ ,
3.  $s \in S, d(s)=0, d(v)=\infty$  //  $s$ = source node
4. Set  $L$  to empty, where  $L$  is a set of links in which current position proceeds. If there is a link from  $s$  to  $v$ , add it to  $L$ .
5. for all links  $l \in L$ , Take  $r(p,q)$  steps for all  $l \in L$ , where  $r(p,q)$  is the minimum value for  $(p,q) \in L$ , Add  $q$  to  $S$  and  $d(q)=d(p)+w(p,q)$
6. Set  $r(u,v)=r(u,v)-r(p,q)$  for all  $(u,v) \in L$
7. If  $S=V$ , complete the task
8. Delete  $(v,q)$  from  $L$ , if there is a link from  $q$  to  $V-S$ , then go back to step-5.

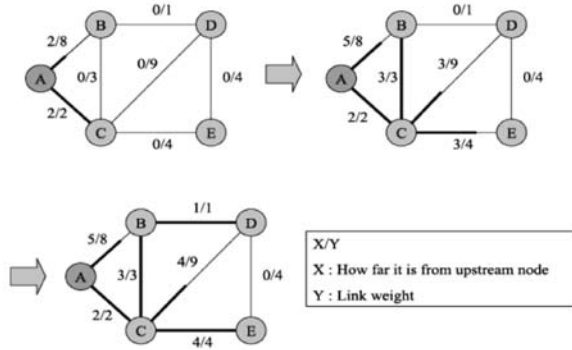


Fig.1. PSPSA based on multipath search

### C. Limitations of PSPSA

**Limitation-1:** We found this algorithm failed for finding shortest path in the following type of graph in parallel. It doesn't work in the line 7 of the pseudo code.

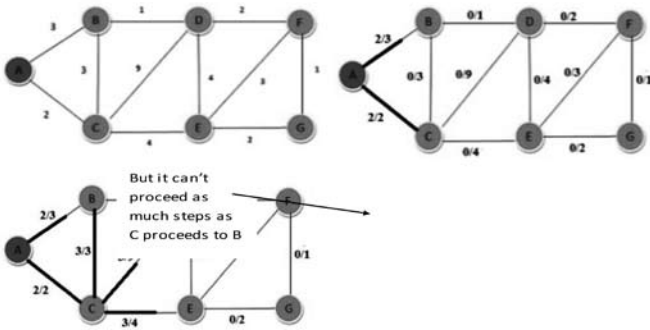


Fig. 2. Limitation of PSPSA-1

We have taken a simple graph for showing the limitation of the existing PSPSA. In the above 2nd figure we applied the PSPSA starting from the source node.

**Limitation-2:** In PSPSA algorithm there is no specific way given how to traverse the edges which are same weights from the source node. In this figure we have chosen a path randomly, but we are not getting the right shortest path.

### III. OUR PROPOSED ALGORITHM

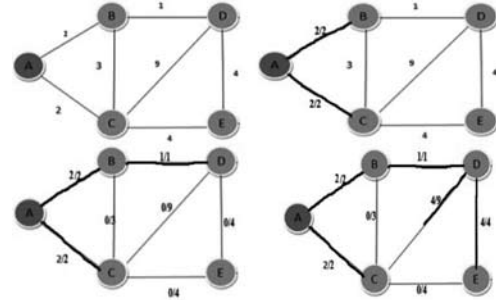


Fig. 3. Limitation of PSPSA-2

The basic idea of our proposed algorithm is that a simultaneous multipath search from the source depending on cost determines the shortest paths to each node. The pace of the proceedings changes every time and is equal to the cost of reaching the closest neighbour. The notations used and pseudo code of our proposed algorithm is presented below.

#### Notations

$V_f$  = The set of nodes whose shortest paths from the source node have been already determined.

$V_r$  = The set of nodes which is just reached.

$E_t$  = The set of edges which are presently traversed.

$E_f$  = The set of edges which are determined that they are on the shortest path way.  $r(a, b)$  the remaining cost to reach Node when  $(a, b)$  is traversed where  $(a, b) \in E$ . The following is an accurate procedure of our proposed algorithm.

#### A. Pseudo Code

1. Set  $V_f$ ,  $E_t$ , and  $E_f$  to empty. Set  $V_r = \{A\}$ , and  $r(a, b) = c(a, b)$  for  $(a, b) \in E$ ,  $r(a, b) = 0$  for  $(a, b) \notin E$ .
2. Add node  $a \in V_r$  to  $V_f$ . If  $V_f$  is equal to  $V$ , complete the algorithm.
3. Remove the edge  $(a, b)$  from  $E_t$ , and set  $r(a, b)$  to zero for all  $a$  where  $b \in V_r$ .
4. Add the edge  $(a, b)$  to  $E_t$ , where  $(a, b) \in E$ ,  $a \in V_r$ , and  $r(a, b) \neq 0$ . Set  $V_r$  to empty.
5. Compare all  $r(a, b)$  values of the edges in  $E_t$  and move the minimum value to all the edges in  $E_t$ .

The above figure shows an example of our proposed algorithm. The denominator represents  $c(a, b)$  and the numerator represents  $c(a, b) - r(a, b)$  in edge  $(a, b)$ . First subfigure is the initial state of the proposed algorithm. First, the algorithm adds edge  $(A, B)$  and  $(A, C)$  to  $E_t$  and  $V_r = \{A\}$ . For these links  $r(A, B) = 3$  and  $r(A, C)$

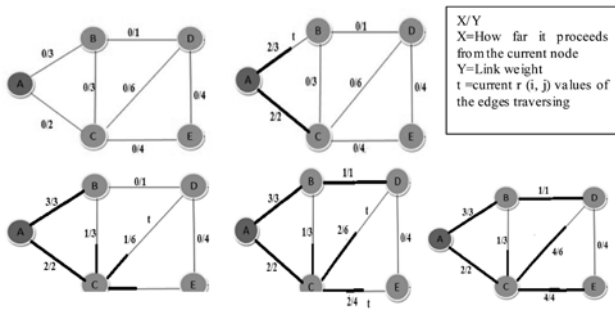


Fig.4. Illustration of Proposed Algorithm

= 2. The minimum value is 2 in this example, so link AC reaches node C and AB proceeds two steps. Now  $r(A, C) = 0$  and  $r(A, B) = 1$ . Then it adds C to Vf and  $d(C) = 2$ . Link AB proceeds two steps. It deletes AC from Et and adds CB, CD, and CE to Et. Now Vr is empty. It updates  $r(A, B) = 1$ ,  $r(C, B) = 3$ ,  $r(C, D) = 6$ , and  $r(C, E) = 4$ . The minimum value is 1, so link AB reaches node B. Now  $r(A, B) = 0$ . It then adds B to Vf and  $d(B) = 3$ . Link CB, CD, and CE proceed one step. It deletes AB and CB from Et and adds BD to Et. It updates  $r(B, D) = 1$ ,  $r(C, D) = 5$ , and  $r(C, E) = 3$ . The minimum value is one, so link BD reaches node D. It adds D to Vf and  $d(D) = 4$ . It adds DE to Et. Delete BD from Et. Now  $r(C, D) = 4$ ,  $r(C, E) = 2$ ,  $r(D, E) = 4$ . So Link CD and CE and DE proceeds two steps. Then it adds E to Vf. The task is completed because  $V_f = V$ .

## C. Case Study

We have illustrated various cases of our proposed algorithm with examples. We have taken the assumption that graph is connected, weighted and undirected.

**Case-1:** All weights of edges are same and graph is not complete

Here the time taken for finding shortest path is very less because after two iterations we will get the shortest path to all other nodes. First from A to C and B, then C to D

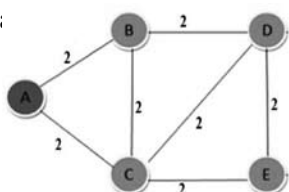


Fig.5. Input graph for case-1

**Case-2:** All weights of the edges are distinct and graph is not complete.

Here the time complexity is more compared to the case-1 because in the case-2 we are proceeding as per our proposed algorithm.

**Case-3:** All weights of the edges are same and graph is complete

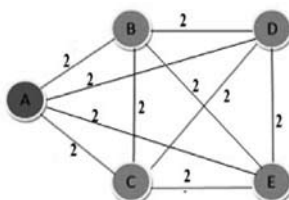


Fig.6. Input graph for case-2

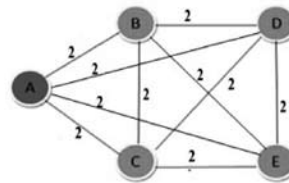


Fig.7. Input graph for case-3

Here we found the shortest path very easily by applying PSPS algorithm because directly we get shortest path from source node to all other nodes.

**Case-4:** All weights of the edges are different and graph is complete.

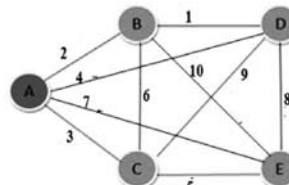


Fig.8. Input graph for case-4

Here in the complete graph if we apply the proposed algorithm, we can easily find the shortest path than the case-2 graph of different weights.

## IV. CONCLUSIONS & FUTURE WORK

In this paper, we have observed that our new proposed variant of PSPSA solves the limitations of existing PSPSA proposed in (Hiroyuki Ishikawa et al., 2007). As a future work, this algorithm can be applied to simple directed negative weighted graphs. It can also be applied to special type of graphs like bipartite graphs.

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# Progress in Biotechnology

## 1. MACHINE LEARNING CLASSIFIES CANCER

Nowadays, many brain tumours are identified by analysis of both histological and molecular features. A key development for histological analysis is the expansion of computational tools that allow machine-learning processes to analyse histological data of molecular pattern. In this approach, a computer is 'trained' using a data set of sample images of tumours that have been classified by a physician. The computer uses the classification information to develop its own pattern-recognition criteria with which to identify tumour types. However, a challenge arises if clearly defined diagnostic criteria for certain tumours are lacking, or if different types of tumour are histologically indistinguishable. The computer uses supervised machine learning to recognize methylation patterns present in the pathologist-classified samples. Unsupervised machine learning involves the computer searching the data sets for patterns that it could use to assign samples into its own computer-generated classification categories. After training, the computer could classify tumours into 82 distinct classes on the basis of specific methylation profiles.



## 2. ARTIFICIAL AND BIOLOGICAL CELLS WORK TOGETHER AS MINI CHEMICAL FACTORIES

Researchers have fused living and non-living cells for the first time in a way that allows them to work together, paving the way for new applications. It encapsulates biological cells within an artificial cell. It can be used to harness the natural ability of biological cells to process chemicals while protecting them from the environment. This system lead to applications such as cellular 'batteries' powered by photosynthesis, synthesis of drugs inside the body, and biological sensors that can withstand harsh conditions. Biological cells can perform extremely complex functions, but can be difficult to control when trying to harness one aspect. Artificial cells can be programmed more easily but cannot be built easily. The new system bridges the gap between these two approaches by fusing whole biological cells with artificial ones, so that the machinery of both works in concert to produce what needed. This is a paradigm shift in thinking about the way artificial cells are designed, which will help accelerate research on applications in healthcare and beyond.





## Design and Development of 4G Telemetry Node and Webservices

**Abstract :** In this paper we have used SIM900 Telemetry which is the automatic measurement and wireless transmission of data from remote sources. Today, telemetry applications include measuring and transmitting data from sensors located in automobiles, smart meters, power sources, robots and even wildlife in what is commonly called the Internet of Things (IoT). A generic 4G Telemetry node can be utilized to acquire real-time physical parameters from the field side for remote telemetry operation. GSM Module along with Arduino UNO Board were used.

**Keywords – IOT(Internet of Things), GSM.**

### 1. INTRODUCTION

A telemeter is a device used to remotely measure any quantity. It consists of a sensor, a transmission path, and a display, recording, or control device. In general, telemetry works in the following way: Sensors at the source measure either electrical data (such as voltage or current) or physical data (such as temperature or pressure). These measurements are converted to specific electrical voltages. A multiplexer combines the voltages, along with timing data, into a single data stream for transmission to a remote receiver. Upon reception, the data stream is separated into its original components and the data is displayed and processed according to user specifications [1]. Applications of telemetry:

#### i) Meteorology

Telemetry has been used by weather balloons for transmitting meteorological data since 1920.

#### ii) Motor racing

Telemetry is a key factor in modern motor racing, allowing race engineers to interpret data collected during a test or race and use it to properly tune the car for optimum performance. Systems used in series such as Formula One have become advanced to the point where the potential lap time of the car can be calculated, and this time is what the driver is expected to meet.

#### iii) Transportation

In the transportation industry, telemetry provides meaningful information about a vehicle or driver's performance by collecting data from sensors within the vehicle. This is undertaken for various reasons ranging from staff compliance monitoring, insurance rating to predictive maintenance.

#### iv) Agriculture

Most activities related to healthy crops and good yields depend on timely availability of weather and soil data.

Therefore, wireless weather stations play a major role in disease prevention and precision irrigation. These stations transmit parameters necessary for decision-making to a base station: air, temperature, precipitation and leaf wetness, solar radiation and wind speed, water deficit stress (WDS) leaf sensors and soil moisture (crucial to irrigation decisions). Because local micro-climates can vary significantly, such data needs to come from within the crop. Monitoring stations usually transmit data back by terrestrial radio, although occasionally satellite systems are used. Solar power is often employed to make the station independent of the power grid.

#### v) Communications

Telemetry is used in many battery operated wireless systems to inform monitoring personnel when the battery power is reaching a low point and the end item needs fresh batteries.

### 2. HARDWARE IMPLEMENTATION

#### SIM900 GSM MODULE

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design [1,2].

- SIM900 is designed with a very powerful single-chip processor integrating AMR926EJ-S core.
- Quad - band GSM/GPRS module with a size of 24mm x 24mm x 3mm .
- SMT type suit for customer application.
- An embedded Powerful TCP/IP protocol stack.

## 2.1 Interfacing of GSM Module to Arduino

A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These type of provisions vary with different modules [3].

**SIM900 GSM Module** –The module supports communication in 900MHz band. In India most of the mobile network providers operate in the 900 Mhz band. If you are from another country, you have to check the mobile network band in your area. A majority of United States mobile networks operate in 850 Mhz band (the band is either 850Mhz or 1900Mhz). Canada operates primarily on 1900 Mhz band [4].

**TTL Output Pins in the module** – We can feed the data from gsm module directly to Arduino only if the module is enabled with TTL output pins.

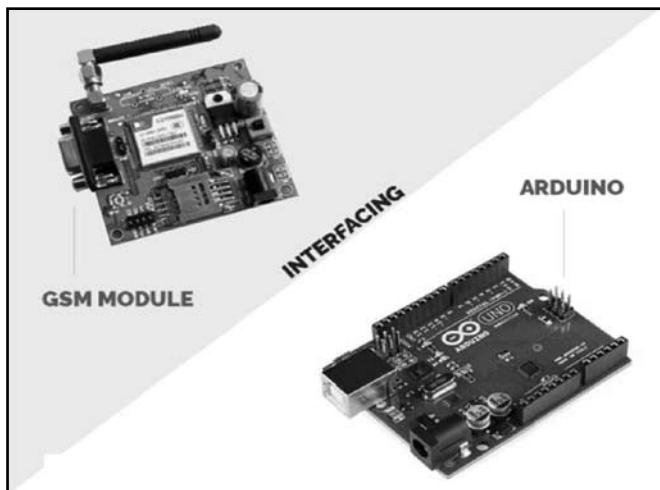


Fig 1 Arduino with GSM module

## 2.2 Booting the GSM Module

1. Insert the SIM card to GSM module and lock it.
2. Connect the adapter to GSM module and turn it ON.
3. Now wait for some time (say 1 minute) and see the blinking rate of 'status LED' or 'network LED' (GSM module will take some time to establish connection with mobile network)
4. Once the connection is established successfully, the status/network LED will blink continuously every 3 seconds. We may try making a call to the mobile

number of the SIM card inside GSM module. If you hear a ring back, the GSM module has successfully established network connection.

## 2.3 Connecting GSM Module to Arduino

There are two ways of connecting GSM module to arduino. In any case, the communication between Arduino and GSM module is serial. So we are supposed to use serial pins of Arduino (Rx and Tx). In this method, the Tx pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to Tx pin of Arduino. connect the ground pin of arduino to ground pin of GSM module [3,4].

The problem with this connection is that, while programming Arduino uses serial ports to load program from the Arduino IDE. If these pins are used in wiring, the program will not be loaded successfully to Arduino. So you have to disconnect wiring in Rx and Tx each time you burn the program to Arduino. Once the program is loaded successfully, we can reconnect these pins and have the system working.

There is an alternate method in which two digital pins of arduino are used for serial communication. We need to select two **PWM enabled pins of arduino** for this method i.e pins 9 and 10 (which are PWM enabled pins). This method is made possible with the **Software Serial Library of Arduino**. **SoftwareSerial** is a library of Arduino which enables serial data communication through other digital pins of Arduino. The library replicates hardware functions and handles the task of serial communication.

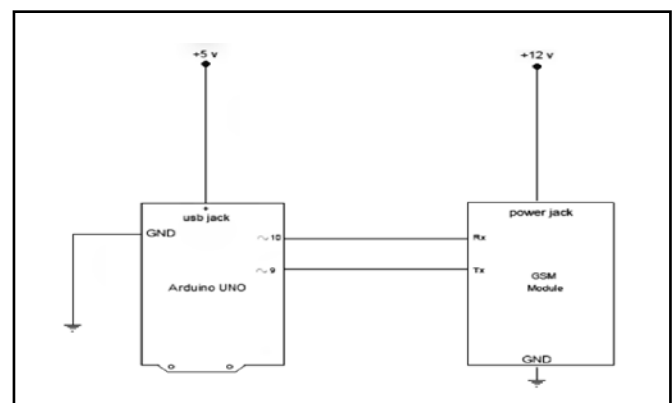


Fig 2 Interfacing Arduino with GSM module

The Program has two objectives as described below:-

- 1) **Send SMS using Arduino and GSM Module** – to a specified mobile number inside the program
- 2) **Receive SMS using Arduino and GSM Module** – to the SIM card loaded in the GSM Module.

## Advantages of GSM:

- GSM is used all over the world by millions of users.
- International roaming facility permits the use of one phone throughout the world unlike CDMA which will work in Asia, but not European nations.
- GSM is established, started in early-90s due to which a more stable network with healthy features are available.
- The accessibility of Subscriber Identity Modules (SIM cards), which are smart cards; provide secure data encryption to give GSM m-commerce advantages.
- GSM service is in more than 200 different countries, so it is quite easy to simply use your GSM phone when you are in one of these countries.

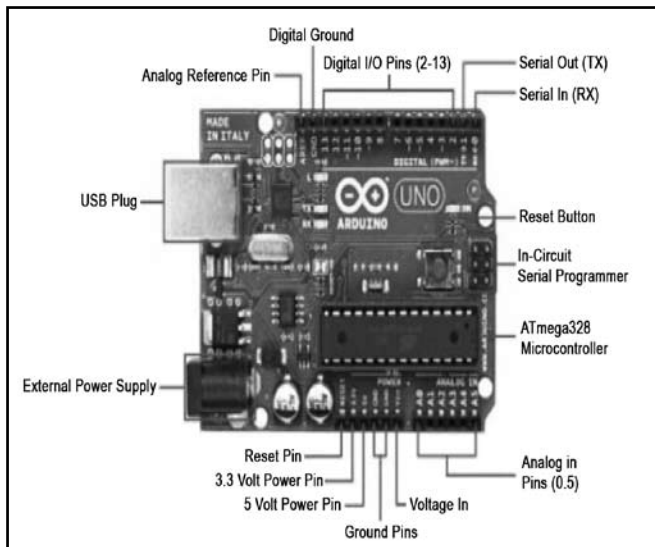


Fig 3: Arduino board

The Arduino Uno as shown in fig 3 is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

## The power pins are as follows:

- VIN- The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). We can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V- This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V).
- 3V3- A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND- Ground pins.

**Memory :** The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM.

**Input and Output :** Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.



- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication.
- AREF. Reference voltage for the analog inputs.
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

### 3. SENSORS

#### DHT11-Digital Temperature And Humidity Sensor

DHT11 digital temperature and humidity sensor is a composite Sensor containing a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology is done, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement devices, and connected with a high-performance 8-bit microcontroller.

Temperature -> 0-50 degree

Humidity-> 20-95

**LDR (Light Dependent Resistor) Sensor :** An LDR is component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. It has no polarity that is, it can be connected in any direction.

**YL-69 SENSOR :** The soil moisture sensor or the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of the plants.

The sensor is set up by two pieces: the electronic board and the probe with two pads, that detects the water content.

The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED.

### 4. BLYNK APP

**4.1 BLYNK SERVER :** Blynk Server is an open-Source Netty based Java server, responsible for forwarding messages between Blynk mobile application and various microcontroller boards such as node MCU as shown in fig 4. Blynk cloud is a software written on java using plain TCP/IP sockets and running on our server. Blynk Ios and Android apps connect to Blynk cloud by default. Access is free for every Blynkuser. To run BlynkServer, all we need is Java Runtime Environment.

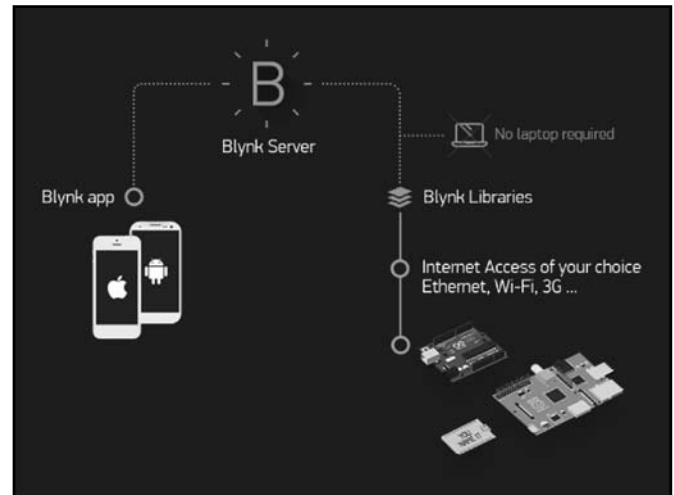


Fig 4: Connection to Blynk Server

Today, telemetry applications include measuring and transmitting data from sensors located in automobiles, smart meters, power sources, robots and even wildlife in what is commonly called the Internet of Things (IoT). A generic 4G Telemetry node can be utilized to acquire real-time physical parameters from the field side for remote telemetry operation. In this project we have used SIM900 GSM Module along with Arduino UNO Board.

### 5. CONCLUSIONS

In this paper data were sent through mobile to GSM Module by using Arduino as an interface. Through which the other components in the electronic circuit is operated by using it. Power supply is also given to the circuit through Battery and also other components like relay, yl-69, DHT11, LDR are operated. This enables wireless transmission of data from remote sources.

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**Ankit Kumar, Gaurav Sachan, Mamta Kumari,  
Megha Singh, Siddhant Patel**

8th Sem. AEI

Although surface plasmon resonance (SPR) sensors exhibit the higher sensitivity among the sensors based on the evanescent waves sensing principle for optical sensing of biochemical entities in gasses and liquids, many research groups are trying to enhance the sensitivity and detection accuracy over the last decade to detect the smaller samples with high accuracy. In this work, we have made an attempt to study the interaction of transverse magnetic (TM) polarized electromagnetic wave with different SPR active metals coated with mono or few layers of graphene and its effect on the sensor performance such as sensitivity and detection accuracy using different SPR configurations and various sensing scheme in visible and near IR. The work also includes the study on the ratio of electric field intensity at metal-sensing layer interface to that at prism-metal interface to understand the effect of field enhancement on the performance of the sensor based on numerical simulations using Transfer Matrix Method (TMM) and Finite Element Method (FEM). We observed that high adsorption efficiency of graphene helps in increasing sensitivity whereas high index coupling prism helps in enhancing detection accuracy. However, with the increase

in number of graphene layers to attain higher sensitivity, we found a trade-off between sensitivity and detection accuracy, this put a constraint on the usage of number of graphene layer for high performance SPR sensor. In order to address this trade-off, we used low refractive index dielectric. Following this work, by adopting SPR sensing in imaging mode, we studied the performance in terms of imaging sensitivity and detection accuracy. Further, to understand the effect of field enhancement on the performance, we optimized different types of SPR configuration based on graphene for maximum electric field at sensing layer interface and compared the related performance with the widely reported high performance SPR configuration such as bimetallic and high index Si over layer on metal. Based on evaluation of electric field intensity enhancement factor (FIEF), we carried out the performance study of graphene based SPR sensor with respect to different structural configurations for aqueous and gaseous sensing. We found enhanced performance for graphene based SPR sensor in visible and near IR.

**Dr. Pradeep Kumar Maharana**

Dept. of BSH

## Astronomers witness a spectacular and awe-inspiring celestial event for the first time - a super- massive black hole eating a star!



Scientists Miguel Perez-Torres, of the Astrophysical Institute of Andalusia in Granada, Spain, and Seppo Mattila, of the University of Turku in Finland, along with a host of colleagues watched, as a star about twice the mass of our sun, was shredded and swallowed by a super-massive black hole. The event took place in between colliding galaxies about 150 million light years away. The observation - the first of its kind – was through radio and infrared telescopes.

*Excerpted from a recent article  
published by USA today*

# Frequency Based Tariff Calculation

**Abstract:-** Every system needs to be automatic, portable and remote controlled. This work presents a novel smart energy meter for an automatic and superior metering and billing system. The integration of the Arduino and Short Message Service (SMS) using LAN to provide the meter reading system with some automatic functions that are predefined. Arduino is an open source single board micro controller descendant of the open source wiring platform designed to make the process of using electronics and multi-disciplinary projects. By using the instrument transformer the current and voltage are reduced to safer values. The proposed energy measurement using arduino aims to determine the utilisation of energy. The arduino based power measurement aims to measure power consumption with higher resolution and consumes lesser power. Through this project we are easily going to identify the safer frequency zone for the customers with a variable load and inform the customer.

## I. INTRODUCTION

It has become a trend to integrate automatic systems via wireless applications over network. Along with the advancement of technology development, research on wireless applications and remote control has become widespread, our proposed smart energy meter is highly deserved for national implementation as it will minimize load shedding, provide two way communication hence maintain the system stability. An electricity meter, electric meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, business, or an electrically powered device. A smart energy meter (SEM) is electric device having an energy meter chip for electric energy consumed measurement, wireless protocol for data communication and peripheral devices for security purpose, data showing, meter controlling etc. The Energy Monitoring System is appropriate for Industries, manufacturing plants, commercial buildings or any situation where an electrical system is used. The system provides centralized energy monitoring and control. The Energy Management System leads to savings in the overall cost. These savings may be come from better utilization of manpower, servicing cost, savings in the energy consumption, and non-breakdowns in the system. The smart energy meter contains an energy meter, a microcontroller (Arduino) which is connected between the energy meter and the load. The proposed smart energy meter is able to provide all the metering and billing services like frequency variations, counting the consumed energy, sending the generated bill by the SMS (short message service). Factually at present, the metering and billing system of our country is totally conventional and it is slow, with faulty and detection and management, switch mode power supplies, and overcurrent fault protection. [1]

## II. COMPONENTS

We used some specific components in our project which helped our project to complete its objective. Here, a brief description of each specific components that we used will be shown as follows.

### 1. Step Down Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the alternating voltages in electric power applications.[2]

### 2. Arduino

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The source code for the IDE is released under the GNU General Public License, version 2. Nevertheless, an official Bill of Materials of Arduino boards has never been released by Arduino staff. Although the hardware and software designs are freely available under copyleft licenses, the developers have requested that the name Arduino be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product. Several Arduino-compatible products commercially released have avoided the project name by using various names ending in -duino.



### 3. Current Sensor

ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer.

### 4. Potentiometer

Potentiometer, informally a pot, is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

### 5. Potential Transformer

Voltage transformers (VT), also called potential transformers (PT), are a parallel connected type of instrument transformer. They are designed to present negligible load to the supply being measured and have an accurate voltage ratio and phase relationship to enable accurate secondary connected metering.

### 6. ZCD

Generates a pulse at every zero crossing point of the signal (either current or voltage) then the output is fed to the pulse circuit. LM358 IC is the ZCD that we are using in our project as shown in fig1.

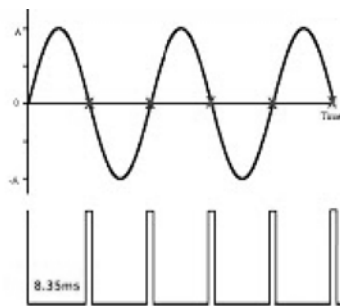


Fig 1. Zero Current Detector

The flowchart of the operation is shown in fig2.

### III. VOLTAGE MEASUREMENT

Household electricity input 240V AC supply is given to the voltage measurement circuit. As the Arduino and other electronic devices in our model are of the rating

### FLOW CHART

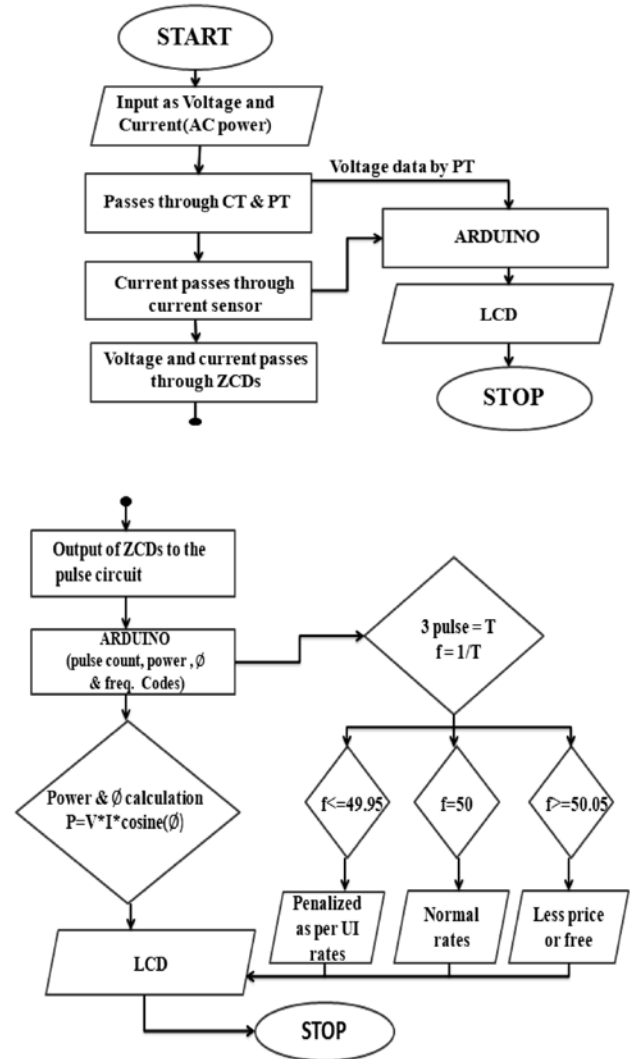


Fig 2. Flowchart of the operation.

5-12V DC, we have prepared a solution for that. First we have used a 40:1 step down transformer which gives 6V AC as output. To convert this AC output to DC, we have used a rectifier circuit. The rectifier circuit consists of 4 diodes. Then the 6V DC was given to the potentiometer for getting desired DC supply.

Then we have used a capacitor to damp the ripple content in the desired DC supply. Now the voltage is given to the Arduino. Arduino receives 1000 samples of the signal per second. Then it processes the signal to find out the RMS voltage for calculating the energy. But it provides the instantaneous voltage to the display to show the real time voltage value to the user.

The circuit diagram of the proposed scheme is given in fig 3.

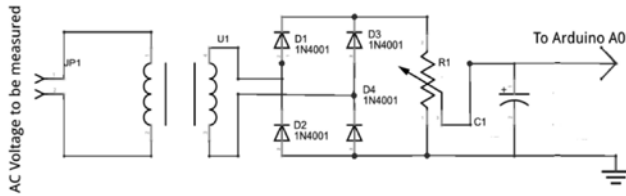


Fig 3. Circuit Diagram

## IV. CURRENT MEASUREMENT

### Hall Effect:

The Hall Effect is the production of a voltage difference (the Hall voltage) across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. It was discovered by Edwin Hall in 1879.

The Hall coefficient is defined as the ratio of the induced electric field to the product of the current density and the applied magnetic field. It is a characteristic of the material from which the conductor is made, since its value depends on the type, number, and properties of the charge carriers that constitute the current. The Hall effect is due to the nature of the current in a conductor. Current consists of the movement of many small charge carriers, typically electrons, holes, ions or all three. When a magnetic field is present, these charges experience a force, called the Lorentz force. When such a magnetic field is absent, the charges follow approximately straight, 'line of sight' paths between collisions with impurities, phonons, etc.

However, when a magnetic field with a perpendicular component is applied, their paths between collisions are curved so that moving charges accumulate on one face of the material. This leaves equal and opposite charges exposed on the other face, where there is a scarcity of mobile charges. The result

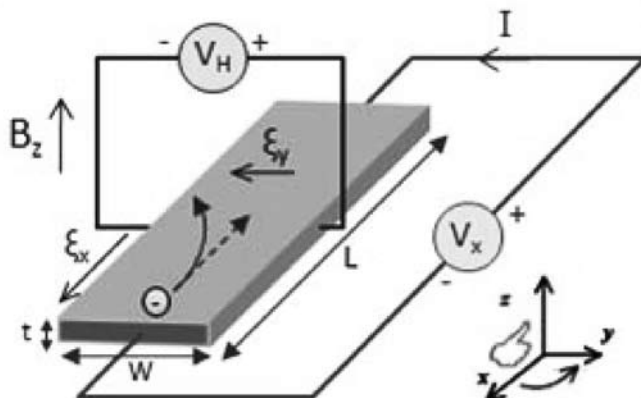


Fig 4. Hall Effect

is an asymmetric distribution of charge density across the Hall element, arising from a force that is perpendicular to both the 'line of sight' path and the applied magnetic field. The separation of charge establishes an electric field that opposes the migration of further charge, so a steady electrical potential is established for as long as the charge is flowing. In classical electromagnetism electrons move in the opposite direction of the current I (by convention "current" describes a theoretical "hole flow"). The hall effect mechanism is shown in fig4.

## V. POWER FACTOR MEASUREMENT

Two different types of powers are associated with electric power system. Active power is consumed by load while Reactive power energizes capacitive as well as magnetic circuits. Reactive flows in system but it is not utilized. The utility companies restrict the flow of reactive power to a certain value. To determine the amount of reactive power, a quantity called power factor was introduced.

Power factor is defined in two different ways. One is related to the flow of power in the system.

It is the ratio of the active power to the total power of the system.

$$p.f = \frac{\text{Active power}}{\text{Total Power}} = \frac{KW}{KVAR}$$

Whereas

$$\text{Total power} = \sqrt{(\text{active power})^2 + (\text{reactive power})^2}$$

Also power factor is defined as cosine of angle between the voltage and current.

$$p.f. = \cos(\Phi)$$

where  $\Phi$  is the angle between voltage and current of the system.

The operation of a zero crossing detector (ZCD), is to create pulses when the signal crosses the zero reference value. We have used 2 ZCD circuits for measuring the power factor. One ZCD circuit is connected to the potential

transformer(PT) for Voltage. When the voltage signal crosses the zero value, a counter will be started.

Another ZCD circuit is connected to the current transformer(CT). When the current signal crosses the zero a counter will be started for current. The difference between both the counters of voltage and current will then be converted into angle( $\Phi$ ).

The Unified Power Flow Controller (UPFC) is the most versatile one that can be used to enhance steady state stability, dynamic stability and transient stability.

The UPFC is capable of both supplying and absorbing real and reactive power and it consists of two ac/dc converters. One of the two converters is connected in series with the transmission line through a series transformer and the other in parallel with the line through a shunt transformer. The dc side of the two converters is connected through a common capacitor, which provides dc voltage for the converter operation. The power balance between the series and shunt converters is a prerequisite to maintain a constant voltage across the dc capacitor. As the series branch of the UPFC injects a voltage of variable magnitude and phase angle, it can exchange real power with the transmission line and thus improves the power flow capability of the line as well as its transient stability limit. The shunt converter exchanges a current of controllable magnitude and power factor angle with the power system. is normally controlled to balance the real power absorbed from or injected into the power system by the series converter plus the losses by regulating the dc bus voltage at a desired value.[3]

## Interline Power Flow Controller (IPFC)

- Effective power flow and compensation management of multi line transmission system.
- Consists of number of converters which are connected with a common DC link.
- Equalise both real and reactive power between the lines.

## VI. BENEFITS OF USING FACTS DEVICES

- Better utilisation of existing transmission System assets.
- Reducing generation cost.

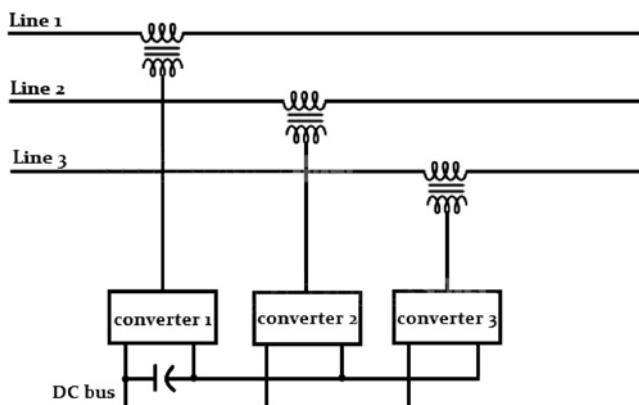


Fig 5 Interline Power Flow Controller (IPFC)

- Contribute to optimal system operation by reducing power losses and improving voltage profile.
- Increase the loading capability of the lines to their thermal capabilities.
- Environmental benefits.
  - ◆ High initial cost
  - ◆ Generally rough riding quality
  - ◆ High repair cost [5]

## VII. CONCLUSIONS

This paper has presented various FACTS controllers and analysed their control attributes and benefits. It is a new technology based on power electronics.

It provide necessary help in meeting the needs of higher requirements of the liability and quality of electricity. It has the potential to contribute towards the development of the future of Indian Transmission System. It also provides effective solutions to the several criticalities encountered. FACTS offers an opportunity to enhance controllability, stability and power transfer capability of ac transmission systems. The application of FACTS controllers throws up new challenges for power engineers, not only in hardware implementation, but also in design of robust control systems, planning and analysis.

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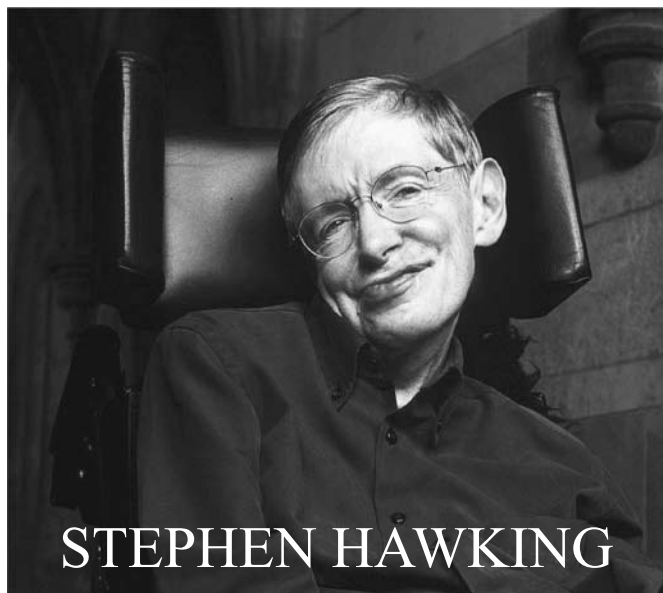
## ACKNOWLEDGEMENTS

We would like to extend our heart felt thanks to Prof Ramprasad Panda, our guide for his support and guidance.

Adnan Imteyaz, AishwaryaPatra,  
Ankita Shubhadarshini, Binay Naik, Nihar Mohanty,  
Pallavi Nanda

8th Sem. EEE





Stephen Hawking was regarded as one of the most brilliant theoretical physicists in history. His work on the origins and structure of the universe, from the Big Bang to black holes, revolutionized the field, while his best-selling books have appealed to readers who may not have Hawking's scientific background. Hawking died on March 13, 2018. Professor Stephen William Hawking was born on 8th January 1942 (exactly 300 years after the death of Galileo) in Oxford, England. His parents' house was in north London but during the second world war Oxford was considered a safer place to have babies. When he was eight his family moved to St. Albans, a town about 20 miles north of London. At the age of eleven, Stephen went to St. Albans School and then on to University College, Oxford (1952); his father's old college. Stephen wanted to study mathematics although his father would have preferred medicine. Mathematics was not available at University College, so he pursued physics instead. After three years and not very much work, he was awarded a first class honours degree in natural science.

In October 1962, Stephen arrived at the Department of Applied Mathematics and Theoretical Physics (DAMTP) at the University of Cambridge to do research in cosmology, there being no-one working in that area in Oxford at the time. His supervisor was Dennis Sciama, although he had hoped to get Fred Hoyle who was working in Cambridge. After gaining his PhD (1965) with his thesis titled 'Properties of Expanding Universes', he became, first, a research fellow (1965) then Fellow for Distinction in Science (1969) at Gonville & Caius college. In 1966 he won the Adams Prize for his essay 'Singularities and the Geometry of Space-time'. Stephen moved to the Institute of Astronomy (1968), later

moving back to DAMTP (1973), employed as a research assistant, and published his first academic book, *The Large Scale Structure of Space-Time*, with George Ellis. During the next few years, Stephen was elected a Fellow of the Royal Society (1974) and Sherman Fairchild Distinguished Scholar at the California Institute of Technology (1974). He became a Reader in Gravitational Physics at DAMTP (1975), progressing to Professor of Gravitational Physics (1977). He then held the position of Lucasian Professor of Mathematics (1979-2009). The chair was founded in 1663 with money left in the will of the Reverend Henry Lucas who had been the Member of Parliament for the University. It was first held by Isaac Barrow and then in 1669 by Isaac Newton. Stephen is currently the Dennis Stanton Avery and Sally Tsui Wong-Avery Director of Research at DAMTP. Professor Stephen Hawking has worked on the basic laws which govern the universe. With Roger Penrose he showed that Einstein's general theory of relativity implied space and time would have a beginning in the Big Bang and an end in black holes (1970). These results indicated that it was necessary to unify general relativity with quantum theory, the other great scientific development of the first half of the 20th century. One consequence of such a unification that he discovered was that black holes should not be completely black, but rather should emit 'Hawking' radiation and eventually evaporate and disappear (1974). Another conjecture is that the universe has no edge or boundary in imaginary time. This would imply that the way the universe began was completely determined by the laws of science. Recently Stephen has been working with colleagues on a possible resolution to the black hole information paradox, where debate centres around the conservation of information. In 1963 Stephen was diagnosed with ALS, a form of Motor Neurone Disease, shortly after his 21st birthday. In spite of being wheelchair-bound and dependent on a computerized voice system for communication Stephen continues to combine family life (he has three children and three grandchildren) with his research into theoretical physics, in addition to an extensive programme of travel and public lectures.

He was a great scientist and an extraordinary man whose work and legacy will live on for many years. His courage and persistence with his brilliance and humor inspired people across the world. We must realize the fact that "In the middle of every difficulty, lies an opportunity" and get going in the path of innovation and success to create a world a better place to be.

**Nivedita Mahapatra**

## Hardware Design of a Magnetic Levitation (Maglev) System

**Abstract-** This paper presents few methods of non-contact measurement and control of the magnetic field strength. At first magnetic levitation phenomena and commercial Mag-Lev suspensions systems is explained. Then it explains the Hall effect physics and example use of Hall effect sensor in educational magnetic levitation device. Next it explains the hardware setup of the system designed and studied also its other alternative circuits which can be prepared.

**Keywords-** Hall effect sensors, magnetic levitation, magnetic field strength.

### I. INTRODUCTION

Magnetic Levitation is a method by which an object is suspended in the air with no support other than the magnetic field. Difficulty in stabilizing a levitating object by using inverse square law was studied by Samuel Earnshaw in 1842. Earnshaw's Theorem states that a point charge cannot have stable equilibrium position when a static force is applied following the inverse square law. This theorem is also applicable to the magnetic force of the permanent magnet. Werner Braunbeck extended the analysis to uncharged dielectric bodies in electrostatic fields and magnetic bodies in magnetostatic fields in 1939. It was observed that for diamagnetic material, super conducting body and conducting body with eddy current induced on them can have stable equilibrium point.

Magnetic levitation is an electromechanical coupling concept. The magnetic field is created by electromagnet coil which is electrical part attracts the magnetizable material or object [1]. The magnetic force is controlled by controlling the current in the coil. When the object moves to close the magnet the current in the coil is decreased and vice versa.

Magnetic Levitation can be classified according to magnetism as

- **Levitation by attraction:** This works on the principle that when two magnets are placed end to end with opposite pole facing each other [2].
- **Levitation by repulsion:** This works on the principle that when two magnets are placed end to end with same pole facing each other.

### II. APPLICATIONS OF MAGNETIC LEVITATION

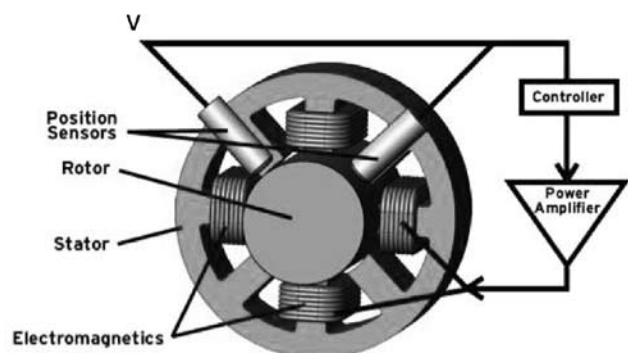
- **Magnetic Levitation train:** Magnetic Levitation (MagLev) train has been the most important usages of magnetic levitation technology. The train moves along the guide way with the help of magnetic field which helps the train to levitate and propel. In March 2004 first MagLev commercially implemented was Sanghai's

Transrapid system which uses German model and in April 2005 Japan implemented its own HSST Limino at relatively slow speed compared with the Shanghai one. The fastest train is the "Lo" series train in Japan is with a top speed of 603km/hr.

- **Magnetic Bearing:** Magnetic bearings use a rotor to levitate and rotate with magnetic flux interaction from stator mounted electromagnet as shown in fig. 1. Since no contact thus no friction, no drag and no wear and tear of parts. Magnetic bearings are used in flywheel as energy storage device, as blood pump, micro positioning system and semiconductor industries.

- **Launching Rocket:** NASA's Marshall Space Flight Center at Huntsvhill, Alabama has developed a track to magnetically levitate a space craft and give initial velocity to reach escape velocity of earth. The project is to make space transportation with less cost [3]. The space craft will be able to have 964km/hr when launched from the track without having any fuel consumption.

- **MagLev wind turbine:** Guangzhou Energy Research Institute researcher have estimated that magnetically levitated wind turbine can as much 20% more efficient than traditional wind turbine. The proposal is given for colossal wind turbine with vertical blades and supported by neodymium magnets. Since the efficiency is more thus area required to generate same power is much less here than traditional wind turbine.



**Fig.1** Magnetic bearing with controller and position sensing sensor

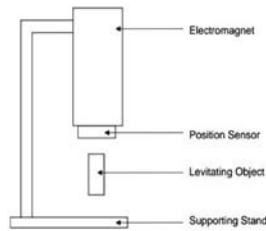


Fig. 2 Magnetic levitation setup

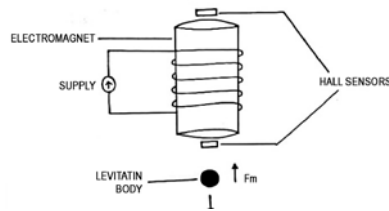


Fig. 3. The metallic ball dynamics

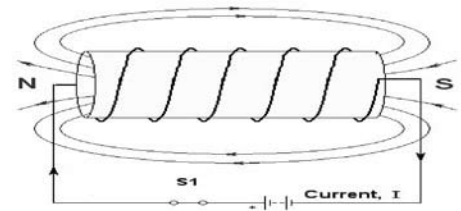


Fig. 4. Current flowing in an electromagnet

### III. MAGNETIC LEVITATION SETUP AND MODELLING

We have designed a magnetic levitation circuit which suspends an object at a set distance below the electromagnet. The physics behind it is to simply provide a magnetic force which is equal and opposite to the gravitational force, so that the two forces cancel and the object remains suspended. Fig. 2 diagram shows the basic structure of the levitation set up.

The set up consists of a position sensor (here we have used two hall sensors) [4]. The circuit works by comparing the signal from the sensors and sending a voltage proportional to the difference or “error”. The metallic ball dynamics under equilibrium position when applied with electromagnetic field is given by Newton Law as shown in fig. 3.

- **Electromagnet** : An electromagnet is a type of magnet in which magnetic field is produced by an electric current as shown in fig. 4. Electromagnet usually consists of insulated wires wound into a coil. Current through that coil produces magnetic field. Its advantage over the electromagnet is that magnetic field can be quickly controlled by controlling the current in the coil.

- **Levitating Body** : The levitating Body must be a magnet which can be levitated due to the combined effect of electric force, magnetic force and gravitational force. The reluctance acts as a resistance of magnetic circuit, which is directly proportional to length and inversely proportional to area. So the levitating body must be of small length and large area [5, 6].

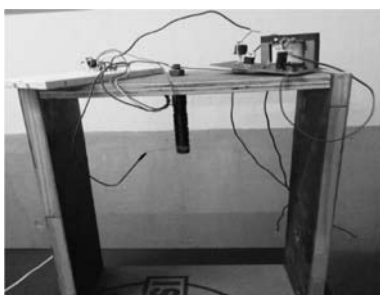
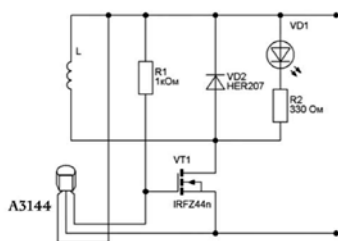


Fig. 7. Hardware setup

- **Hall Sensors** : Hall sensor is a transducer that varies its output voltage in response to a magnetic field. It operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the hall plate can be determined. Hall Effect sensors are used for proximity switching, positioning, speed detection and current sensing applications [7].

### IV. HARDWARE SETUP

The circuit diagram and the power supply circuit is shown in Fig. 5 and 6 respectively.

### V. CONCLUSIONS

The aim of this work is to design and study control techniques for magnetic levitation system, which is typically highly unstable and non linear. There are several approaches for obtaining magnetic levitation. Hence we are trying to find a suitable circuit to reduce oscillations and stabilise the object at a particular distance. Magnetic Levitation is a very advantageous technology with promising future scope to be used in various fields.

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8th Sem. EEE





## Eating lettuce is more harmful to the environment than eating bacon

For a healthy and peaceful life we need a clean and green environment. In the modern era our environment is getting affected by lot of means such as air pollution, soil pollution, water pollution, noise pollution and deforestation. Researchers have found a way of linking the environment to the diet we consume. Interestingly, eating a vegetarian diet could actually contribute to climate change. A study on vegetarian diet shows that the greenhouse gas (GHG) emission of fruits, vegetables and dairy product per calorie is higher, when compared

to that of meat. The study measured the changes in energy use, blue water footprint and GHG emissions of the concerned food. It was found that lot of common vegetables requires significant calories for production. As reported, a diet with mix of fruits, vegetables, dairy and seafood increased energy use by 38 percent, water use by 10 percent and GHG emissions by 6 percent. Hence, eating lettuce is about three times more harmful to the environment than eating bacon.



## Engineers find a way to evaluate green roofs

Green infrastructure is an attractive and demanding concept. It breaks the monotony of common dark roofs and is the need of the hour. It is an extension of the existing roof which includes high quality water proofing, drainage system, root repellent system, filter cloth, a lightweight growing medium and plants. This green roofs improve and reduce energy consumption and heat. A modelling study found that adding a green roof to 50 percent of the available surface, would cool them by 0.1-0.8°C.

Two ways of greening rooftops exists: intensive and extensive. Intensive green roofs are elevated plant with shrubs, trees, walkways. Extensive roofs are relatively light and supports healthy native ground cover that requires little maintenance. An extensive green roof system can cost \$108-248 per square meter while an intensive green roof cost \$355-2368 per square meter. The Chicago's City Hall is the most famous American green rooftop which combines extensive and intensive system hence a semi-intensive system.

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