"Sustainability in Energy Harvesting Based on Feed Forward Back Propagation Neural Network OF Hydropower Project"

A PROJECT

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Under the supervision of

Dr. VEERESH S. GALI

(Professor)

By

RICHIKA RATHORE

(152614)

JAYPEE UNIVERSITY OF INFORMATION

TECHNOLOWAKNAGHAT SOLAN – 173234

HIMACHAL PRADESH INDIA

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CERITIFICATE

This is to certify that the work which is being presented in the project title **"Sustainability In Energy Harvesting Based on Feed Forward Back Propagation Neural Network OF Hydropower"** in partial fulfilment of the requirements for the award of the degree of Master of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Richika Rathore (152614)** during a period from August 2016 to May 2017 under the supervision of **Dr. Veeresh.S.Gali (Professor) Guide** & **Mr.Aniban Dhulia (Assistant Professor) Co-Guide**, Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of my knowledge.

Date: -

Dr. Ashok Kumar Gupta	Mr.Aniban Dhulia	External
Professor And Head of Department	Assistant Professor	
Department of Civil Engineering	Department of Civil Engineering	
JUIT, Waknaghat	JUIT, Waknaghat	

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ABSTRACT

The utilization of petroleum derivatives for vitality discharge carbon dioxide, in this manner creating an Earth-wide temperature boost that may prompt extreme climatic changes, annihilation of living species, expanding ocean level and gigantic cataclysmic events. The new non-customary sustainable power source assets, for example, sun oriented vitality, wind vitality, hydro vitality, warm vitality and so on are dynamically more important vitality sources in today's circumstances to the constrained petroleum derivative based vitality. In India, the necessity of vitality is expanding step by step and among numerous vitality expending areas, the vehicle part represents an appeal. Inexhaustible power generation can help nations to meet their manageable advancement objectives through arrangement of access to perfect, dependable, secure, and moderate vitality. Sustainable power source has gone standard, representing the larger part of limit augmentations in power era today. Various wind, hydropower and sunlight based photovoltaic limit control undertakings were introduced worldwide consistently in a sustainable power source showcase having introduced limit more than a hundred billion USD every year. Other sustainable power innovation markets are likewise best in class. Late years have seen noteworthy decreases in sustainable power source innovations' expenses thus of R&D and quickened arrangement. However approach creators are regularly not mindful of the most recent cost information. Convenientce change of mechanical gadgets has not been trailed by vitality availability of its batteries. Considering the low power utilization parameter of an assortment of convenient gadgets, the idea of vitality gathering from natural sources and human body has picked up another hugeness. In the hunt of strategies and materials that run with this need, are the vitality produced from the piezoelectricity, thermoelectricity and electromagnetism, among others. This examination surveys the ways and future pattern of vitality gathering strategies, and in addition its instruments in convenient therapeutic gadgets with low power utilization.

In this research ,we will focus on energy harvesting. Total illumination is calculated against the total time of harvesting. The experiment has been carried out in an environment which contains some consuming units with total number of rooms. The width and height of the room are considered to be identical i.e. 100×100 having

harvesting time of 10 hr. There are three environment in which experiment has been done these are

1. Sunny
2. Cloudy
3. Dark And other type

Total illumination is calculated with and without optimization. With optimization means feed forward neural network has been used and the results obtained are compared with the without optimization results

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVATION

PV	Photovoltaic
PSI	Porous Silicon
EH	Energy Harvesting
GDP	Gross Domestic Product
ANN	Artificial Neural Network
NN	Neural Network
MW	Mega Watt
KW	Kilo Watt

CHAPTER-1

INTRODUCTION

1.1 GENERAL

Energy plays very important role in human life so it is very necessary to sustained energy for national economic. It provides energy harvesting capabilities to the node to continue gaining the energy to natural or man-made phenomenon for wireless devices. This in turn brings hope for the future of wireless networks: in fact, long-lasting and self-sustaining operation, network lifetime is limited by hardware instead of stored energy. We know that the energy harvesting wireless network is expected to introduce a large amount transformative change to a wireless network: In addition to energy independence and ongoing operations, expected benefits include the reduction of conventional energy usage and associated carbon footprint, get rid of the charge by a conventional battery, and the ability to reach areas, such as remote rural areas, the concrete structure and deployment of wireless networks in the human body. Thus, the energy harvesting wireless network will make it possible to develop new medical, environmental, and safety monitoring applications, otherwise conventional battery-powered operation is not possible. There are many different collections of natural energy resources and related technologies: solar energy, indoor lighting, vibration, thermal, biological, chemical, electromagnetic, etc. [1]. Energy harvesting is a process of generating energy from an external source of solar power, thermal power, wind power, hydro power, and the energy storage period, so that a user can run a microprocessor as its limit. Energy Harvesting for low voltage and low power applications such as medical equipment, consumer equipment, transportation, industrial control and military portable or mobile market is very promising. It also requires a strong contender application spare battery, especially if the battery is in remote or difficult to reach locations. Perhaps the main commitment is to collect the energy market that can make new applications and products currently impossible to even think of. Energy can be collected from different sources of energy, waste, or otherwise not be used for any practical purpose [2].The procedure, also recognized as energy scavenging, that capture residual energy like a byproduct of a natural environmental incident or industrial procedure and is consequently, recognized as free energy. This remaining energy is being released in the environment as a waste.

Examples consist of mechanical energy is a resultant of vibration, strain, thermal energy and stress from heat escaped as of furnaces, burning engines and additional heating sources. More sources are biological, solar energy from every forms of light sources; electromagnetic energy captured via inductors; like wind and fluid energy resulting from air and liquid flow;, coils and transformers; chemical energy by naturally recurring or biological processes; and more amounts of RF energy in the environment as of ubiquitous radio transmitters and television broadcasting [3].

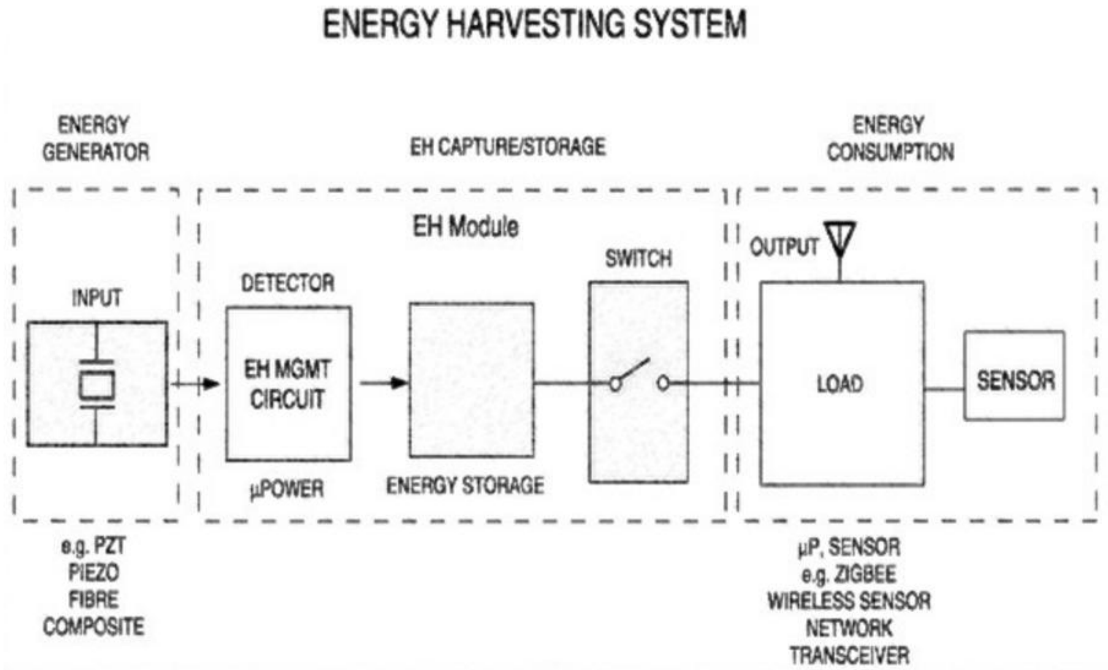

Figure1.1 Energy harvesting system

1.2 Sources of Energy Harvesting

Energy Harvesting (EH) systems is used to convert the relatively low levels of energy into high level energy so that it could give an electronic system power. Figure below shows the main components of an independent wireless sensor that are the EH transducer, Energy Processing, Microcontroller, Sensor, and the Wireless Radio [4]. Energy consumption module consists of different sub-modules namely, Energy Conversion, Energy Storage, and Power Management.

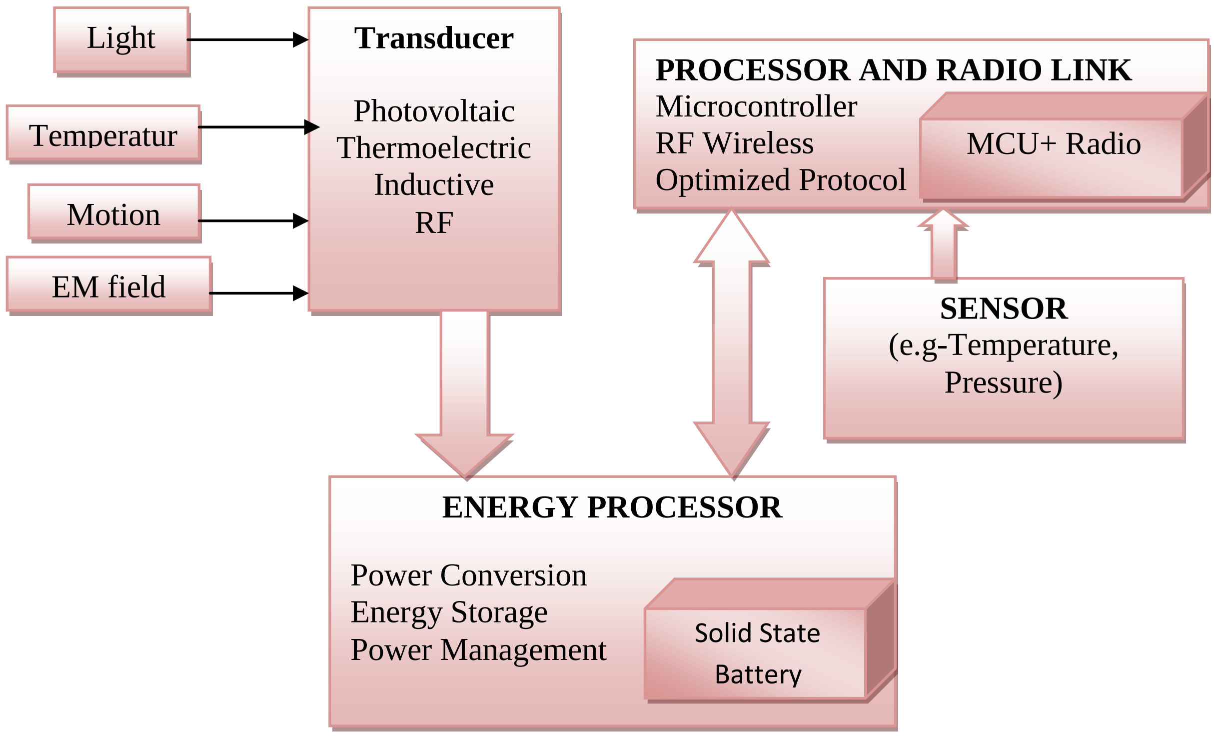

Figure 1.2 Energy harvesting hybrid for battery extension

A distinctive Energy Harvesting system initialized with an energy collector with the transducer devices that receives energy form energy sources and converts them into another form of energy. Transducer's are mainly photovoltaic or solar cells for light energy, kinetic for movement, piezoelectric for inductive for rotational or motion, pressure, thermoelectric for heat or temperature difference with electromagnetic [5]. The energy is collected from the transducers is transformed to a form that could be stored for future usage. In moveable device applications or remote sensor systems that utilizes Energy Harvesting as less rechargeable battery or storage capacitor is regularly used to store the collected energy the system requires for operation. The disadvantages for storage techniques are several in that an even rechargeable battery wears out after a few hundred charge/discharge cycles and requires to be replaced and super caps while they eventually alter their characteristics, will self discharge rapidly, as 20% per day, causing much of the converted energy to be wasted. Health as well as permanent solution is to use Enter Chip battery solid state as an energy storage element in the system to get rid of the need to be replaced, because it can support more than 5000 cycles, and having less than 3% of the minimum monthly self - discharge [6].

The final stage of the condition system the storing of the energy to fulfill the system's requirements. It can be as level converter and regulator as simple to complex power control circuitry, and power requirements in accordance with the operation of the power distribution system intelligently manage the system [2].

Below table 1 depicts few of the harvesting techniques with their power generation capability [2].

Table 1.1 Sources of Energy Harvesting [2]

Harvesting-method	Power –Density
Solar-Cells	$15mW/cm^3$
Piezoelectric	$330\mu W/cm^3$
Vibration	$116\ \mu W/cm^3$
Thermoelectric	$40\ \mu W/cm^3$

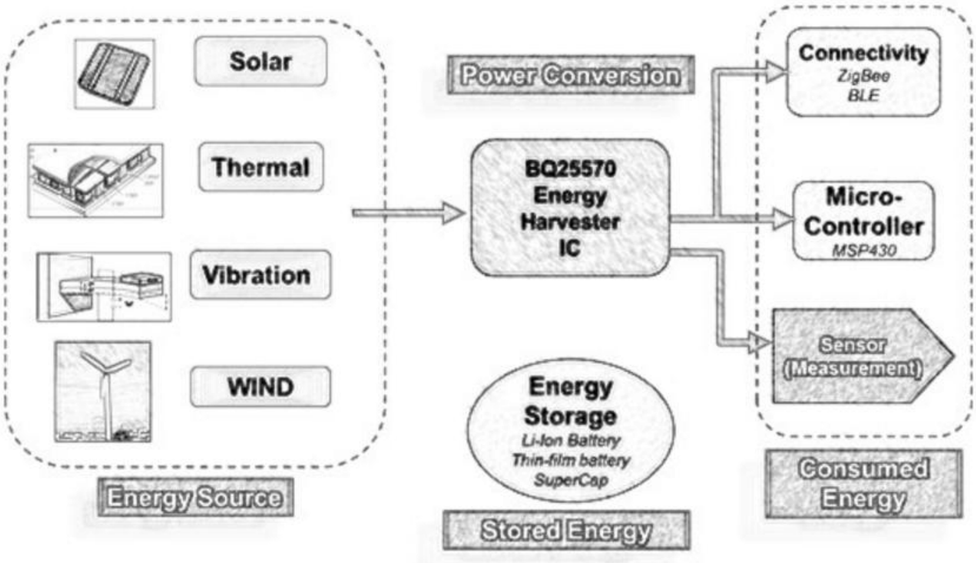

Figure 1.3 Block diagram of energy harvesting sensor

The above figure shows the different energy sources available in the environment these are mainly: Solar, thermal, Vibration and wind energy sources and are described below [7]:

i. Solar Energy

Use of conservative energy sources leads to increased greenhouse gas emissions and other environmental damage. But increase in consumption and demand on conservative energy is directly related to the economic growth [8]. Conventional energy sources are reduced and become expensive day by day. Due to this, possible energy source, particularly solar energy, continues to gain popularity as a green energy source to diminish environmental pollution. Solar energy could be harvested by several ways, like solar cells (photovoltaic), solar thermal, and photo catalysis. Unluckily, the efficiency of photo conversion is still limited. New material and methodology is must to increase the photo conversion efficiency and reduce the cost of manufacturing[9]. Porous silicon (PSI) is one of the available materials for various unique properties for photovoltaic application as well as technological manufacturing simplicity.

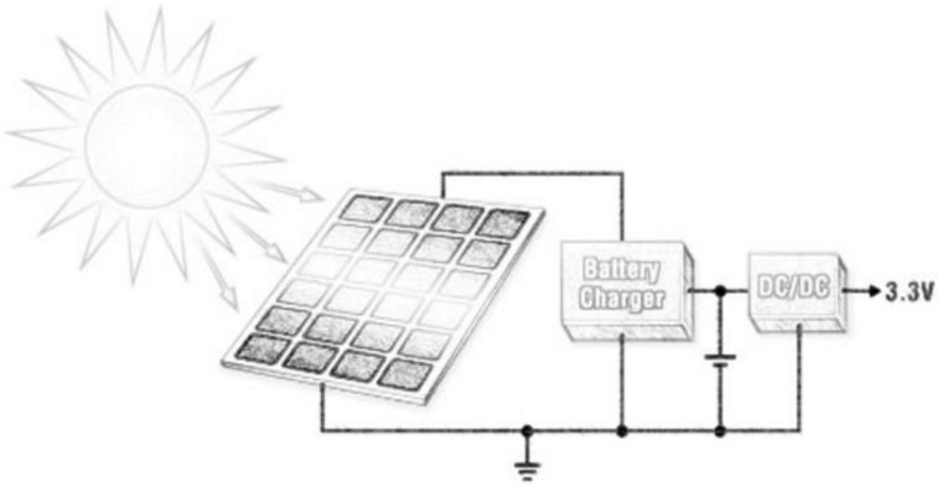

Figure 1.4 Low power solar energy harvesting systems

A shown in the figure above, when the sun rays falls on solar panel, it converts solar energy into electrical energy. This electrical energy is used to charge the battery connected to it. Again, there is a DC to DC converter that is used to change the DC level. The output obtained is 3.3 V which is used in a hotel door lock, an industrial control device, etc [10].

1.3 Solar energy utilization

An interesting feature of solar energy is that it can be utilized by different methods. Mainly energy utilization consists of two different methods namely, Direct method and indirect methods [11]. These methods are illustrated in figure below

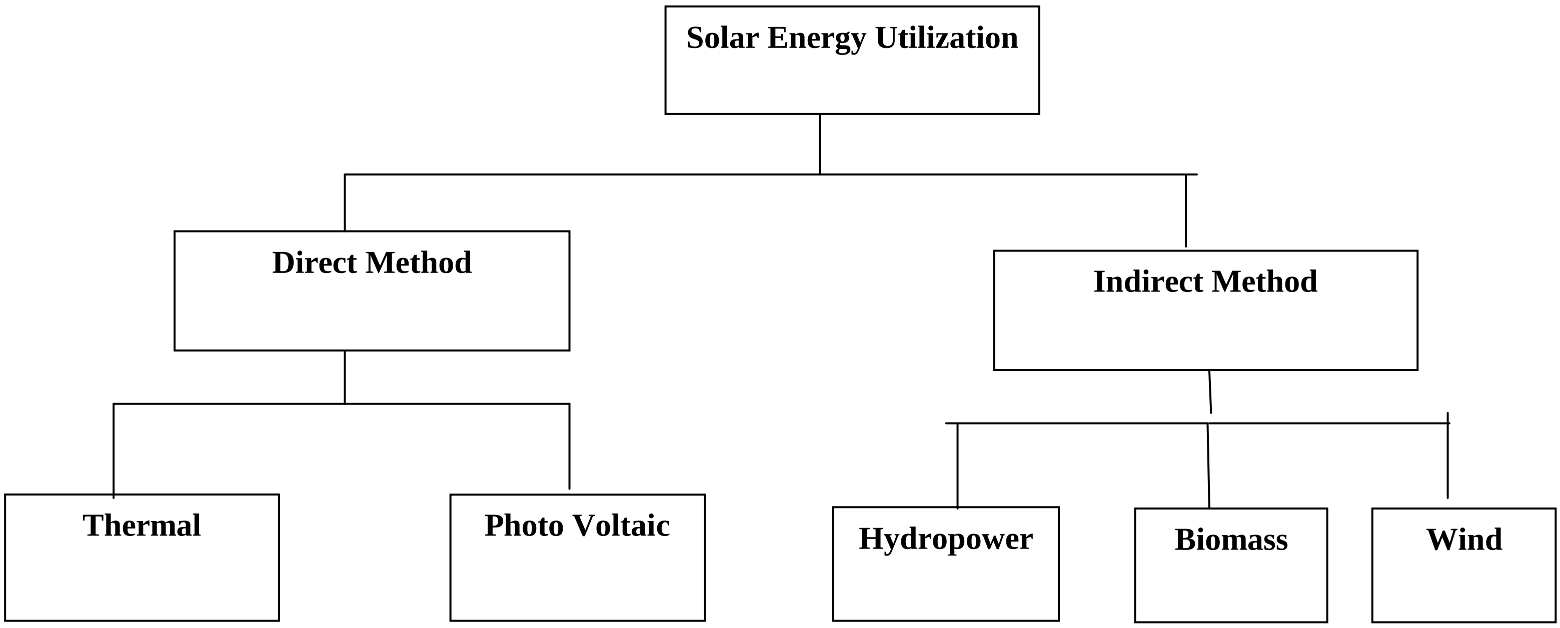

Figure 1.5 Classification of solar energy utilization

(1) Direct methods

It is the most important type of solar energy conversion system. Mainly, it is divided into two types: Photovoltaic and Thermal and are explained below:

a) Photovoltaic (PV)

The sun is the major source of energy. It is renewable as well as environmental friendly. India has abundance of sunshine per year; the average solar power is 490W / m2 / day. Solar battery system provides power for 24 hours a day. PV solar cells convert solar energy directly into Direct current (DC).In PV semiconductor, material is used in the manufacturing of solar cell module. Electricity generated from PV cells can be used to supply the load, or could be stored in battery. P Photovoltaic systems could often be cheaper, mainly in remote areas [12-17].

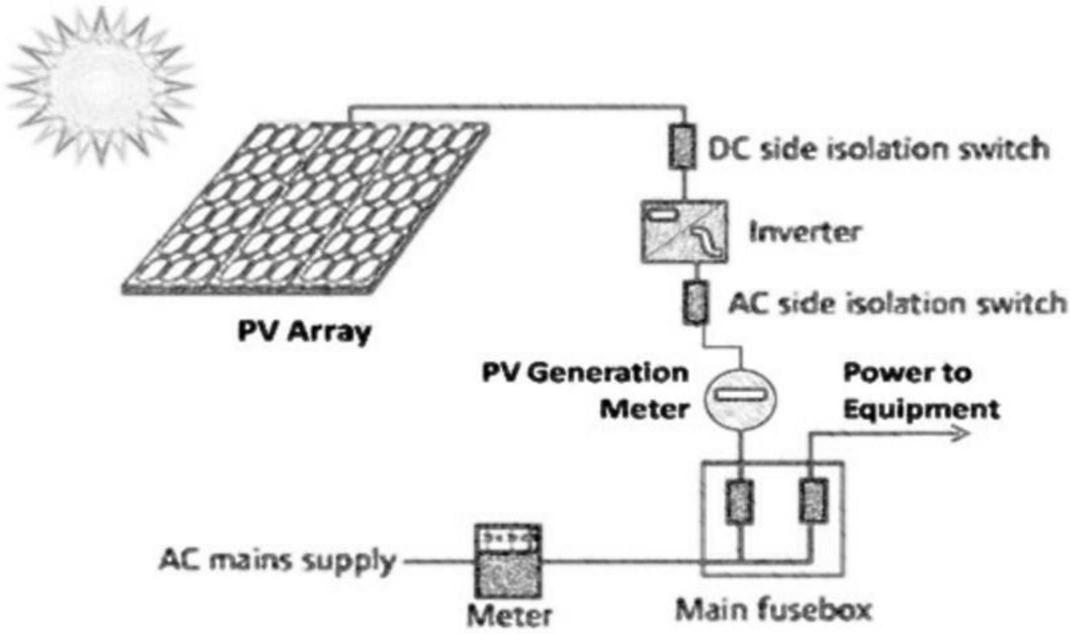

Figure 1.6: Schematic diagram of Solar PV

The main components are clearly PV panels and inverters. Inverter is needed because the photovoltaic panels produce direct current, but in house alternating current (AC) is used. Note that this system does not have any batteries, since it is a grid system. It is cheaper and more effective than using battery settings.

b) Thermal energy

Solar thermal collectors are used to take up the heat from the Sun's rays and transmit it to a heat transfer fluid, such as air, water, which in turn transports it to the areas to be heated.

(2) Indirect methods

It is a type of solar power that goes through more than one change to become usable energy. There are number of indirect energy sources available in the earth's which are described below:

a) Biomass

Biomass is defined as the waste material obtained from the plants, agriculture or food industry waste, forest waste, biological or organic residue. In India, Biomass resources are available in different forms, so, they can be categorized on the basis of nature as: grasses, woody plants, fruits, vegetables and waste of agriculture crops. So, using agriculture waste is a best option instead of wood. Other interesting techniques for refugee camps are to set up plants of small-scale DIY biogas, dependent on food residuals and wastage of human. The biogas produced could be utilized as a cooking purpose and generation of power/heat.

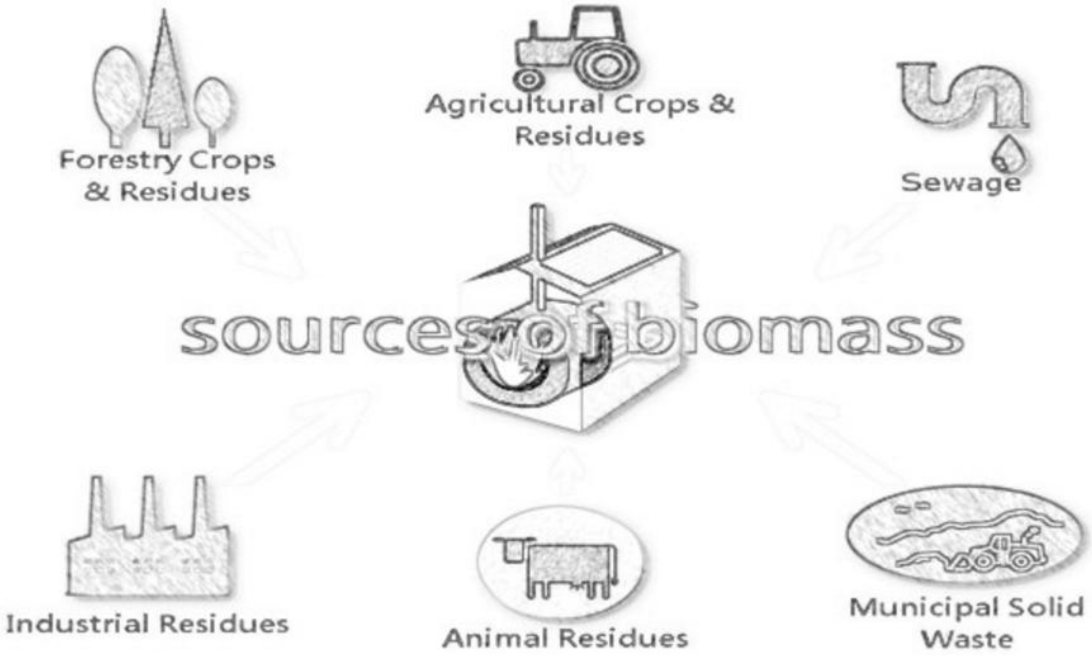

Figure 1.7 Biomass Resources

b) Wind power

It is a form of indirect sources of solar energy which uses wind to convert it into electrical energy. Wind turbines are used to convert the Kinetic energy in the wind into mechanical energy.

Figure 1.8 Wind Energy System

c) Hydro power

The most ordinary type of hydroelectric power plant utilizes a dam on a river for storing water into a reservoir. Water being sends from the reservoir flows via turbine, therefore, turbine rotates and the mechanical energy being transformed into electrical energy. It is not required to have large dam. Few hydroelectric power plants just utilize small canal for channeling the river water via turbine [18]. Other type of hydroelectric power plant – known as a pumped storage plant -that could even stores the power. The power is being sent as of a power grid in the electric generators. The generators later spins the turbines backwards, that causes the turbines to pump water via river/lower reservoir towards an upper reservoir, where the power is being stored. For using the power, the water is being released from the upper reservoir back down in the river/lower reservoir. These spin the turbines onward and activate the generators for producing electricity.

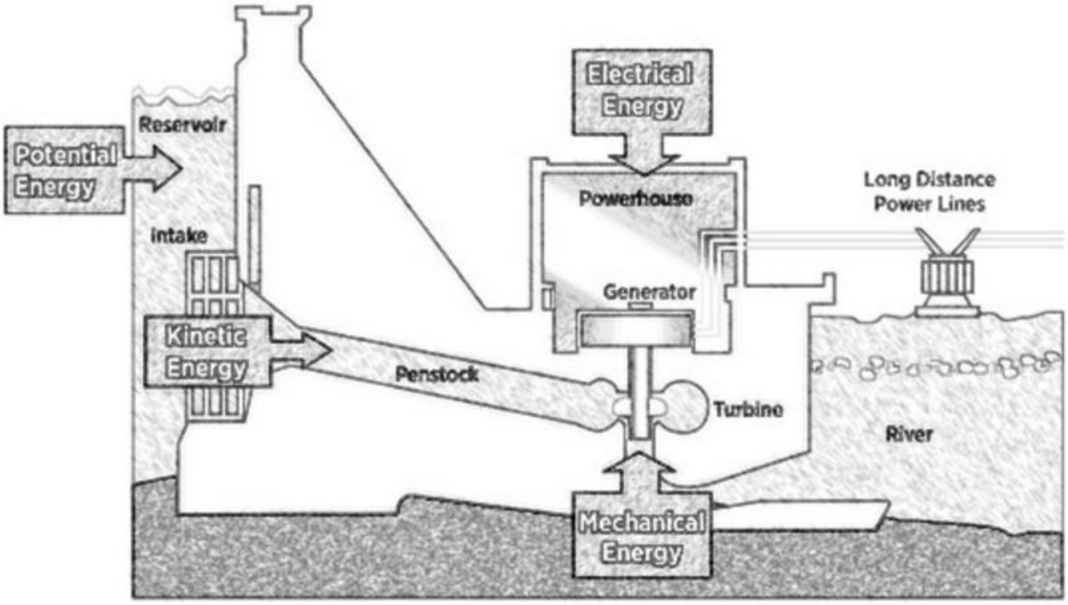

Figure 1.7 Components of a Hydropower plant [18]

Fundamental components of hydro plants can be turbine, generator, a penstock or wicket gates. Mostly, two types of turbines are utilized like impulse turbine for example Pelton Wheel turbine with the reaction turbine like Francis and Kaplan turbine. The generator and turbine are generally connected directly by a vertical shaft. Water falls on turbine from a particular height. The wicket gates are used to control the flow of water. Wicket gates could be adjusted jointly via opening of pivot in the periphery of the turbine for the quantity of water being controlled that flows in the turbine. Servo-actuators are controlled by the governor, and helps for adjusting these gates. The water rotates the turbine-generator set and thus produces electricity. Initially, the water being stored with clear hydraulic head has potential energy. Since it flows via penstock and slowly loses potential energy and increases the kinetic energy by attainment of the turbine. This kinetic energy is changed into electrical energy [30].

The major components of the hydro power plant are defined below:

i. Dam: The majority of the hydropower plants work on dam, creating huge water that could be utilized as storage and hold back water.

ii. Intake, Surge chamber and Penstock: Dam gates get opened and gravity performs the water during the penstock like a pipeline or cavity to the turbine. Before the penstock, a head race is also there. For reducing the surges in water pressure that can potentially damages and increases the stresses on the turbine, a surge chamber or tank is used.

iii. Turbine: The water falls onto the turbine blades for rotating the turbine that is attached to a generator via shaft. The Francis Turbine is known as most commonly used turbine for hydropower plants, that allows a side-by-side configuration by generator.

iv. Generators: With the rotation of the turbine blades, the rotor within the generator too rotates and electric current being produced as magnets turn in the fixed-coil generator for producing AC (alternating current).

v. Transformer: It converts the low AC voltage into higher-AC voltage so that the energy can be transmitted to long distance. Thus, step- up transformer is used.

vi. Transmission lines: These are used to transmit the electricity produced to a grid-connection point in a huge dustrial consumer directly. In remote areas, new transmission lines can represent a considerable planning problem and expenditure.

vii. Outflow: Finally, tailraces are used to carry out water through pipelines. The outflow scheme might have "spillways" that allows the water for bypassing the generation system and can be "spilled" in period of flood or very elevated inflows and reservoir level.

1.4 History of Hydropower plant

The world's first hydropower project was utilized for influencing a single lamp into the Cragside country back in 1878. After four years, the primary plant to supply power into a system for private and commercial customers was being opened in Wisconsin, in USA.

In 1880, HPP (hydropower plants) were executed in North America, at "Grand Rapids, Michigan, Ottawa, Ontario (1881), Dolgeville, New York (1881), and Niagara Falls, New York (1881)" and were utilized for giving energy to mills as well as light some local buildings [31-33].

In 20th century, as the technology was spreading on all sides of the world, by Germany generating the first "three-phase hydro-electric system" in late 1891, and in 1895, Australia has executed the very first publicly owned plant into the Southern Hemisphere.

While in 1905, a hydroelectric plant was developed on the 'Xindian creek near Taipei', with the capacity of 500 kW. It was rapidly executed by the first station in Mainland of China, the ‘Shilongba plan’ in the ‘Yunnan province’ that was developed in 1910 and executed in 1912. Being completed in ‘Shilongba’ has an installed with the capacity of 480 kW – still it is in operation with an installed having capacity of 6 MW.

As from the 20th century, the ‘USA’ and ‘Canada’ lead to the way of hydropower engineering. On 1,345 MW, the ‘Hoover Dam’ on the ‘Colorado River’ has become the largest hydro-electric plant in 1936 in India, given by the Grand Coulee Dam that is 1,974 MW at the time and 6,809 MW these days in ‘Washington’ in 1942.

As of the 1960s via 1980s, the developments of hydropower were being carried out in “Canada, the USSR, and Latin America”.

From the last few years, Brazil and China has become the leaders of world in hydropower. The “Itapúa Dam, straddling Brazil with Paraguay”, was came into existence in 1984 with12,600 MW and is now just eclipsed in size of 22,500 MW.

1.4.1 Hydropower Today

The 21st century leads to the growth of hydropower plants and it continues roughly the world. It has a significant role in Brazil GDP growth and it becomes the 7th largest country. Thus, a very rapid growth between 2000 and 2010 will increase the GDP value of USA and China [33].

1.5 Hydro Power in Himachal Pradesh

In this study, the hydro power projects of Himachal Pradesh are considered. In the national potential, the Himachal Pradesh contributes about 25%. In Himachal Pradesh the hydro power projects are categorized into three parts as:

i. Mini & micro - up to 5 MW
ii. Renewable - 5-25 MW
iii. Major - >25 MW

Table 1.2: Status of hydro power potential in Himachal Pradesh (IN MW)

Total identified Hydro Power Potential	27436
Harness able Potential	±24000

Harnessed so far	10042
Foregone Potential	755
Construction Stage	2893
Clearances/Investigation Stage	7673
Allotment Stage	2500

Table 1.3: Hydro power projects in Himachal Pradesh

Sr. No	Category	Commissioned		Under Construction		At Various Stage of Clearance & Investigation		Grand Total	
		No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW
1	0 to 5 MW	90	283.72	41	148.65	548	1184.91	679	1617.28
2	5 to 25 MW	18	213.85	20	286.60	32	458.20	70	958.65
3	Above 25 MW	22	9577.73	12	2215.40	40	6623.50	74	18416.63
4	Yamuna Projects (Himachal Share)		131.57					0	131.57
	Ranjeet Sagar Dam		27.6					0	27.60

	(Himachal Share)								
	Total	130	10234.47	73	2650.65	620	8266.61	823	21151.73

The state of Himachal Pradesh is committed for the expeditious development of entire harness able potential available in the State by way of environmentally and socially sustainable Hydro Power Development in the State. During the development of the Hydro Power, it is essential that the impacts on Environment in large be studied and accessed and mitigated accordingly because development and mitigation of the impacts are two processes which should go together simultaneously for having a proper balance between development and destruction. Prime Minster Narendra Modi inaugurated three hydropower projects in Himachal Pradesh having capacity of 1,752 MW .These are, Parbati hydro power project of capacity 520 MW, Rampur project of capacity 412 MW and Kol dam power project to the nation having capacity of 800 MW.

1.6 Impact of hydropower projects

Most of Himachal Pradesh hydropower projects are run on river projects. The river water is diverted by the head of an underground tunnel. The water fall is used to take out energy with the help of turbines being developed in underground powerhouses deep in the hills. The hills breaking are important for laying the steeply falling head race tunnel with the construction of underground power houses having the reservoir lying in the head, really bother the delicate ecological balance in the HP (Himachal Pradesh) regions of mountainous. As the water of the river gets diverted, the river dries up and a landslide occurs as the hill is blasted. Thus, it causes the damage of roads, forests, water sources house, and farmland in the village.

1.7 Hydro Power in India

The status of hydro power potential in India is very good. India's first hydro power station is established in Darjeeling in 1998 having capacity of 130 kW. But, now in India, numbers of hydro power projects are present [36].

Table 1.4: Hydropower potential break up in the country on the basis of regions

Region/State	Identified Capacity (MW)	Capacity Developed(MW)	Capacity under construction(MW)	Capacity yet to be developed(MW)
Northern	53395	13771.9	6734	32889.1
Western	8928	5803.8	400	2724.2
Southern	16458	9394.8	786	6277.3
Eastern	10949	3049.4	2211	5688.7
North eastern	58971	1202.7	2724	55044.3
All India	148701	33222.5	12855	102623.5

The above table does not include schemes below 3 MW up to March 2003 and thereafter up to 5MW under construction

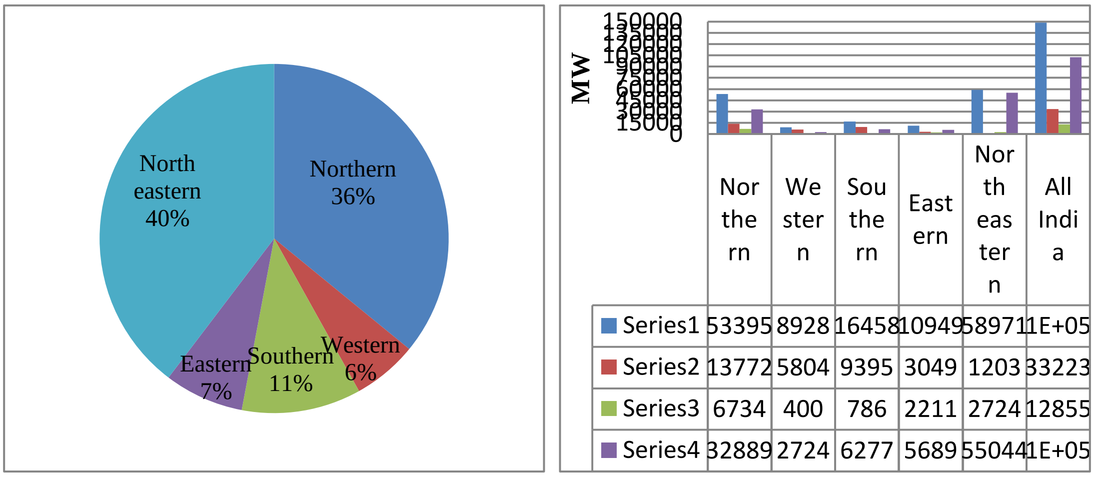

Fig. 1.8: Hydro power potential in India

Maximum hydro power potential in India is in north eastern and northern region. Ministry of New and Renewable Energy categorize the hydro project into mini, micro, small and large. So, in India:

i. Micro - 0.01- 0.1 MW
ii. Mini - 0.1-5 MW
iii. Small - 5-25 MW
iv. Large - >25 MW

1.8 Classification of hydroelectric power plant

According to the size, hydroelectric plant are mainly of four types: Micro, Mini, Small, and Large.

1.8.1 Micro hydro plant

The hydro plants having capacity up to 100 KW are known as Micro Hydro Plant. These power plants can produce enough energy for a home, farm and village

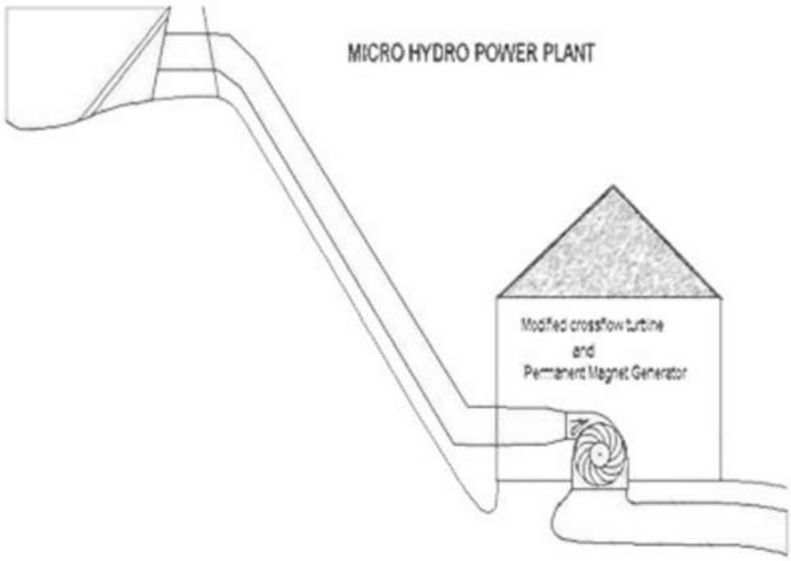

Fig. 1.9: Micro hydro power plant

1.8.2 Mini Hydro power plant

The power plant that generates power up to 1 MW are known as mini hydro power plant.

1.8.3 Small Hydro power plant

These hydro power plant generated energy up to 30 MW.

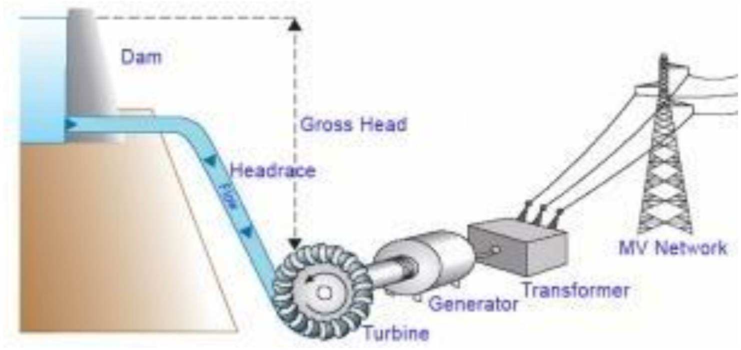

Fig. 1.10: Small hydro power plant

1.8.4 Large hydro power plant

A large hydro plant generated power more than 30 MW.

Hydro class	Power Range (KW)	No. of Homes Powered
Pico	0-5	0-5
Micro	5-100	5-100
Mini	100-1	100-1,000
Small	1-10	1,000-10,000
Medium	10-100	10,000-100,000
Large	>100	>100,000

Table 1.6: Classification of hydro power plant

1.9 Cost analysis

Hydropower is the simply large-scale and cost-effective storage technology being available these days. In spite of another energy storage technology, hydropower is the simply technology contributing economically large-scale storage. It is also a comparatively resourceful energy storage alternative. Small hydropower is usually a very cost-effective electric energy generation method. It usually needs to be situated near to the related transmission lines for make its exploitation economic. The techniques of small hydropower generally take less time for constructing large-scale ones though planning and authorization processes are same.

The total investment costs for hydropower mainly depends on the site, choice of design and the cost of labor and materials. The work in hydropower needs large number of civil workers as compared to the renewable technologies. It signifies that the cost of material and labor plays an important role in the overall costs of hydropower. There is extensively less difference into the cost of electro-mechanical. The whole installed costs for large-scale hydropower projects usually from a range of low of USD 1 000/kW to around USD 3 500/kW. So, it is not strange to get projects with costs exterior this range. Like, installing hydropower capacity that was developed for water provision, food control etc. and might have costs as small as ‘USD 500/kW’. Other example for the project by remote sites, with no enough local infrastructure and situated distant from related transmission networks, could cost considerably extra than ‘USD 3500/kW’. Below fig. 1.12 summarizes a number of studies that have analyzed the costs of hydropower plants.

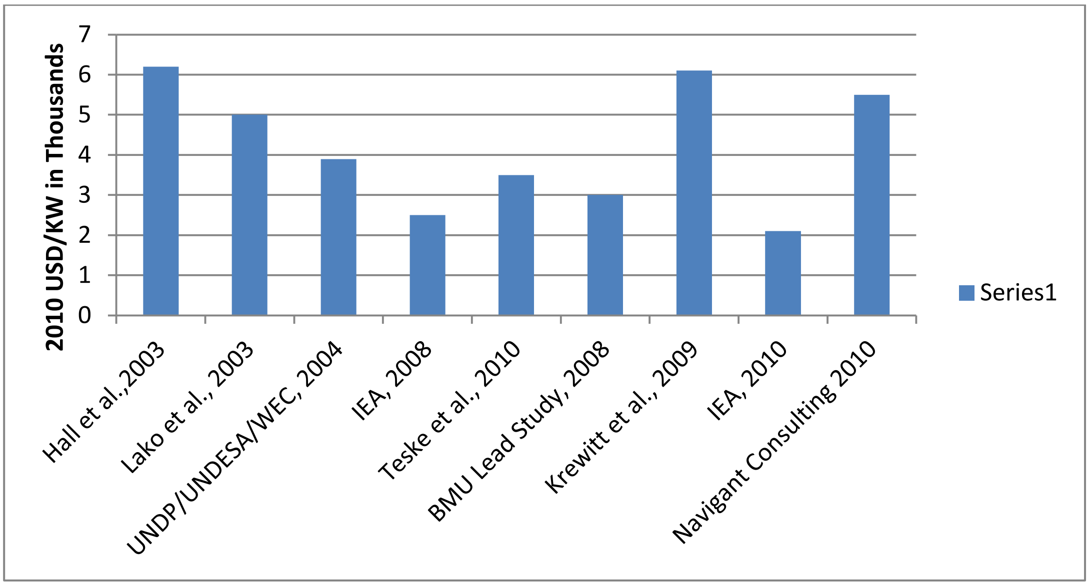

Fig.1.12: Summary of the installed costs hydropower projects from a range of studies

A wide ranging analysis of cost of over 2 155 possible hydropower projects in the ‘United States’ totaling 43 GW documented with an average capital amount of ‘USD 1 650/kW’, having ‘90 %’ of projects with costs below ‘USD 3 350/kW’ (Hall, et al., 2003). In other study (Lako et al., 2003), the 250 projects worldwide having total capacity of ‘202 GW’ with an average investment cost of ‘USD 1 000/kW’ and ‘90 % had costs’ of ‘USD 1 700/kW’ or less (Lako et al., 2003).

Table 1.7: State-wise and sector wise installed capacity and number of Hydroprojects

State	State sector		Central sector		Private sector		Total	
	No. of projects	Installed capacity (MW)	No. of projects	Installed capacity (MW)	No. of projects	Installed capacity (MW)	No. of projects	Installed capacity (MW)
J&K	1	450	1	330	1	850	3	1630
HP	6	956	4	2532	5	460	15	3948
Uttrakhand	-	-	4	2135	3	505	7	2640
Sikkim	-	-	-	-	10	2622	10	2622
Arunachal	-	-	3	2710	-		1	2710
Mizoram	-	-	1	60	-	-	1	60
Meghalaya	1	40	-	-	-	-	1	40
W Bengal	-	-	1	160	-	-	1	160
Punjab	1	206	-	-	-	-	1	206
M.P	-	-	-	-	1	400	1	400
Maharashtra	1	80	-	-	-	-	1	80
A.P	3	410	-	-	-	-	3	410
Kerala	2	100	-	-	-	-	2	100
Total	15	2242	14	7927	20	4837	49	15006

Table 1.7 represents the investment costs of hydropower projects by different states in India. The price of hydropower vary within states and among states based on the resource being available, cost structure of the local economy, site-specific considerations etc., explaining the wide cost bands used for hydropower. The less installation costs are usually connected with addition of the capacity at obtainable hydropower schemes or energy gathering from obtainable dams which do not have any hydropower services. The growth of green field sites are extra expensive and

normally varies as of ‘USD 1 000 to USD 3 500/kW’. Installment costs of little projects are slightly higher. This is due to the higher cost of electromechanical and installed cost. The installation ranges per kW of ‘small’ hydropower plant projects could be lower if the plants have more head and install ability. The installed ability and exact investment costs are comparatively based on the tough irrespective of the size of head. The scale economies for head size over 25 to 30 meters are reserved. The cost of investment as a installed capacity and turbine head function is illustrated in Figure 1.13.

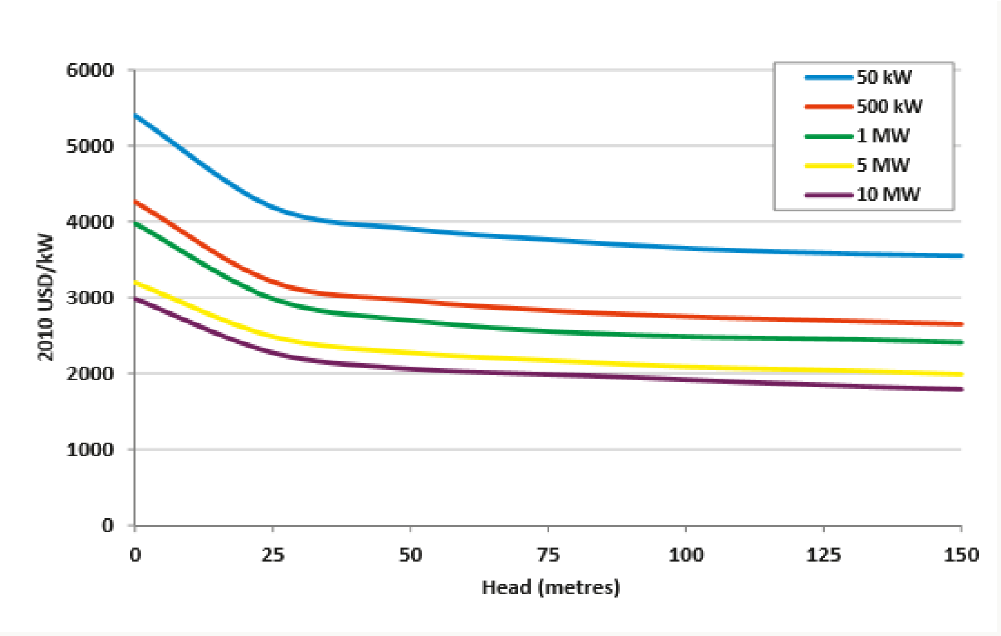

Fig. 1.13: Investment costs as a function of installed capacity and turbine head

1.10 Ways of energy harvesting

There are different ways to harvest or to store energy. So that, one can use energy when required.

1.10.1 Piezoelectricity

The piezoelectric effect in Quartz crystal was executed by brothers “Pierre and Jacques Curie” in 1880. This method was based on the phenomenon known as piezoelectricity. In this, the mechanical energy is converted in electrical energy and vice versa. When an outside force is taken, that is mechanical work done is being preserved as elastic strain energy, and a number is in the electric field and connected with the material induced polarization. If an exterior conduction path via a load is given, a current that neutralize the net charge produces.

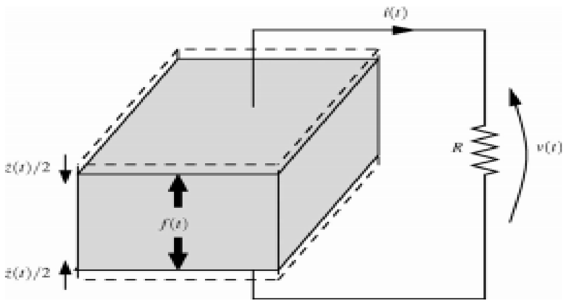

Fig. 1.14: Working operation of Piezoelectric Transducer

Generally, ceramics material is used in Piezoelectric with more electromechanical coefficients of coupling, by 'lead zirconate titanate' behaves as the most common. Theis material does not accept more strain levels; therefore, several form of lever is necessary for combining them by devices of important relative displacement. The majority of common geometry is applying the piezoelectric like a thin layer on a cantilever beam as of proof mass is being balanced.

1.10.2 Thermal energy

'Thermal energy' is considered as the type of energy presented in environment. The harvesting devices can use thermal energy of number of sources as human being, machines animals, or another natural source. Different researchers have worked to convert thermal into useful electrical energy for decades. The temperature of body varies when it has energy. In these circumstances, the molecules are presented in steady motion, and the disturbance is calculated by temperature. They are simply calculated as they the source of individual discomfort. In winter, for reducing the body heat loss, we wear warmly clothes, the heating as well as air conditioning enhances comfort levels by the settlement of indoor air temperatures for the comfort of personal preferences. The undesirable temperature gradient could be put for the useful work being known as the thermoelectric effect. It is based on the principle of seeback effect, which is used to convert the temperature difference between two bodies or plates into electric potential.

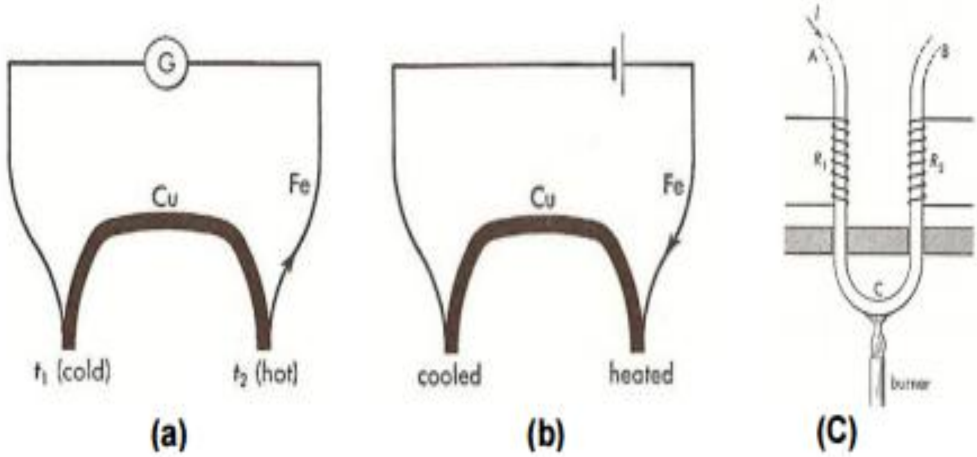

Fig. 1.15: (a) Seeback effect (b) Peltier effect and (C) Thomson effect

The Peltier effect is the occurrence of heat at an electrified junction of two different metals, 'Peltier' has discovered the junctions of different metals being heated or cooled and based on the direction having an electrical current being passed via them, as shown in Fig. 1.15 (b). The Peltier effect can be used to make a refrigerator which is compact and has no circulating fluid. The Thomson effect describes that an emf (electromotive force) would exist within a single conductor whenever a temperature gradient was present (Fig. 1.15 (C)).

1.10.3 Electromagnetic energy

An electric field always produces a magnetic field and, on the other hand, a time varied magnetic field obtained an electric field. The 'Faraday induction law' defines the alteration having a magnetic field that can induce in an electric current. Also, of 'Ampere-Maxwell equation' that states that an alteration produced by an electric field in a magnetic field. There are basically variety of electrical generators that utilizes mechanical vibrations, example are being used in watch as well as radio frequency circuits and are able to utilize the energy recovered as of the natural environment.

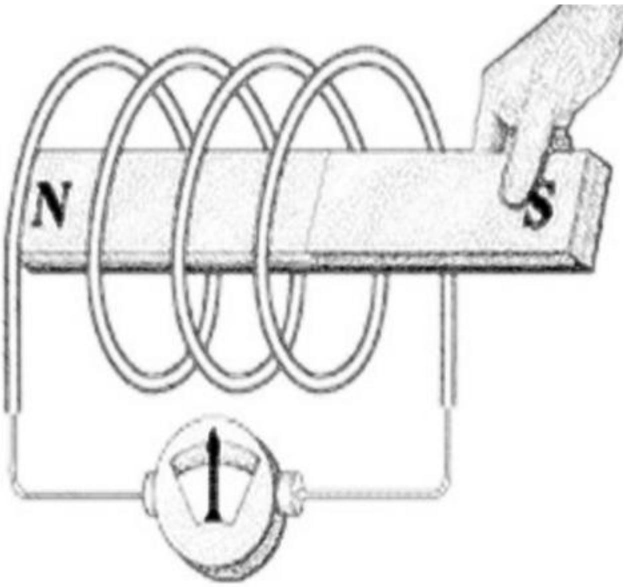

Fig. 1.16 working principle of electromagnetic induction

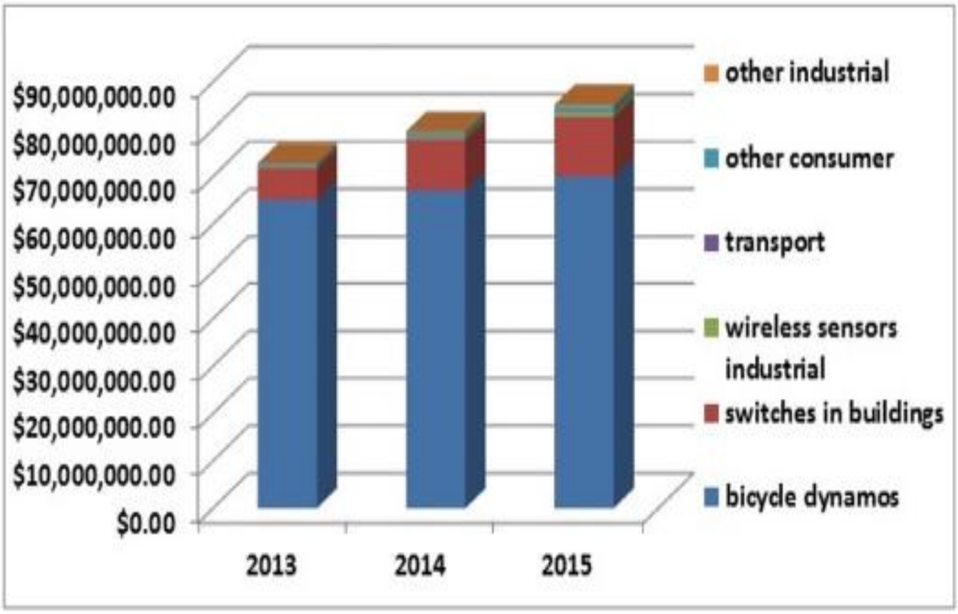

Fig.1.17 Market value for electrodynamics energy harvesters, 2013-2015

1.11 Proposed technique

1.11.1 Neural network (NN)

Neural network is known as a computational system inspired from the processing method, structure and learning ability of the brain. NN has large number of neuron likes processing elements and between those elements weights are there which connect the processing elements. Knowledge is acquired by the network through a learning process. It is a non-linear structure and powerful tool to model, mainly when a data relationship that is unknown. Neural network could find and learn correlated patterns among input datasets with the targets values. Through different learning algorithms, ANN is given training on the basis of which it can easily finds the result of novel independent input data. They reproduce the learning process of the brain with the solution for non-linear ad composite data yet it has the data being noisy or distorted, to best suited for modeling of agriculture data. Artificial neural network consist of easy computational units known as neurons that are connected to each other. They are highly used because of its highly complex problem solving nature. A main feature of this network is the adaptive nature; the "learning by example" replaces "programming" during the processing of problems. The feature make it more appealing in the application domains as person can have little or no knowledge about the problem towards solving it but training data is accessible. In the classification and prediction area, ANN is highly used now. Mostly used algorithm in ANN is Back propagation algorithm.

1.11.2 Development of ANN model

ANN is multilayer as it has layers of units. It consists of layer of units which works on similar tasks. The primary layers have input units and is known as independent variables. The final layer has output units. Other layers into the model are hidden .There are mainly two functions that governs the behaviour of the units in every layer and are same for all units in Artificial Neural Network.

i. Input function,
ii. Output/activation function

1.11.3 Neural Network Architecture

i. Amount of hidden layers: The hidden layer has the network with the ability for generalizing .NN has one hidden layer and adequate neurons is able for processing a constant function. Mainly NN has two hidden layers.
ii. Amount of hidden neurons: An irregular approximation could be achieved by the rule known as pyramid rule. For three layer network, having y x input and y as O/P neurons, the hidden layers contain 'Sqrt(x*y)' neurons.
iii. Number of output nodes is equal to number of input nodes. If less output node is there, it will produce inferior results.
iv. Activation function: It helps in determining the output of processing node. Each node takes it input and put activation function on it.

The basic objective of NN is to work as human brain works. NN consists of various numbers of neurons and their working is similar to the brain neuron structure. There are various types of neural networks but usually utilizes NN as Back Propagation Neural network. Two types of structure are considered in NN model:

i. Cyclic;
ii. Acyclic

The normal BPNN is the basically used for training 'Multilayer FNN'. The linear as well as nonlinear outputs are provided by below equations:

The net input is specified by:

$$n1^{k1+1}(i) = \sum_{j=1}^{s1k1} w1^{k1+1}(i,j)a1^{k1}(j) + b1^{k1+1}(i) \quad (5)$$

The unit is specified by

$$a1^{k1+1}(i) = f1^{k1+1}(n1^{k1+1}(i)) \quad (6)$$

This recurrence relation is execute at the last layer

$$-F1^{M1}(n1^{M1})(t1_{q1} - a1_{q1}) \quad (7)$$

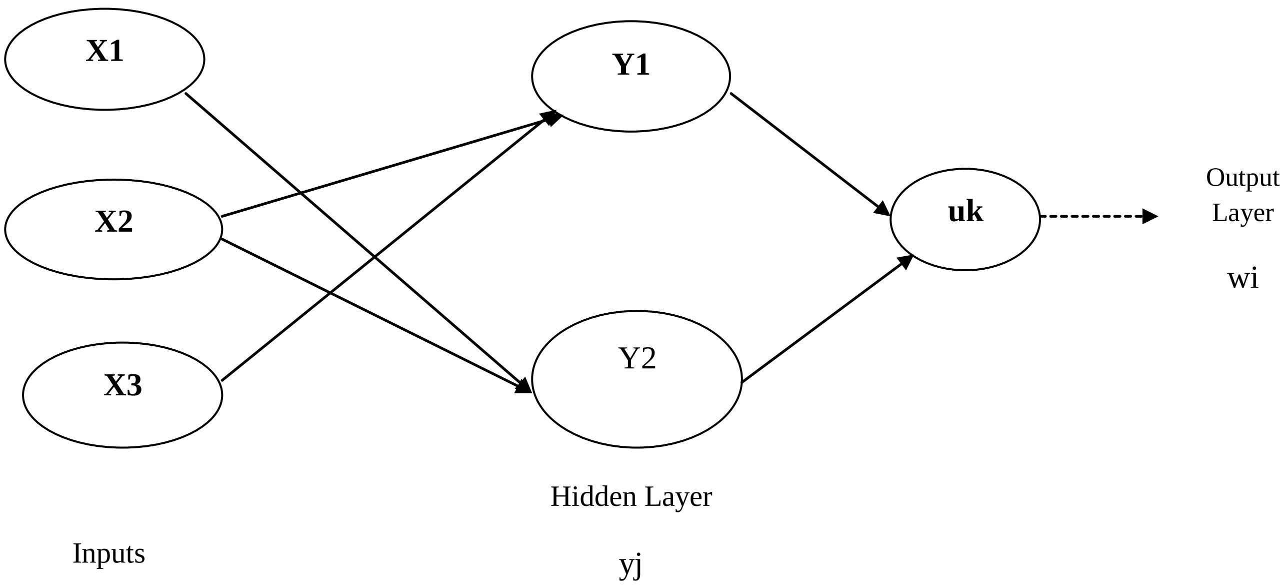

Fig1.7 Layers of neural network

In supervised training, the system learns with the prediction of outcomes for known examples. The system compares the prediction with the recognized results and learns from the mistake.

In unsupervised training, the system with no output/result is depicted as part of the process of training. Taking delta rule as an example, learning is taken as a supervised process which occurs with every ‘cycle’ or ‘epoch’ means every time the network is shown with a novel input pattern via forward activation flow of O/P, and the adjustments of backward error propagation of weight [31].

1.11.4 LEVENBERG ARCHITECTURE

Ad hoc Network is that the network has always struggled in managing the events. With the passage of time, the probability of occurrence of malicious events has increased to a great extent. An intelligent sense of think is required in such situation which can take dynamic decision. Artificial Intelligence can be a very well suited solution for this problem and hence, the problem statement of this research work includes the introduction of Feed Forward Back Propagation Neural Network under “Levenberg Architecture” with varying number of neurons.

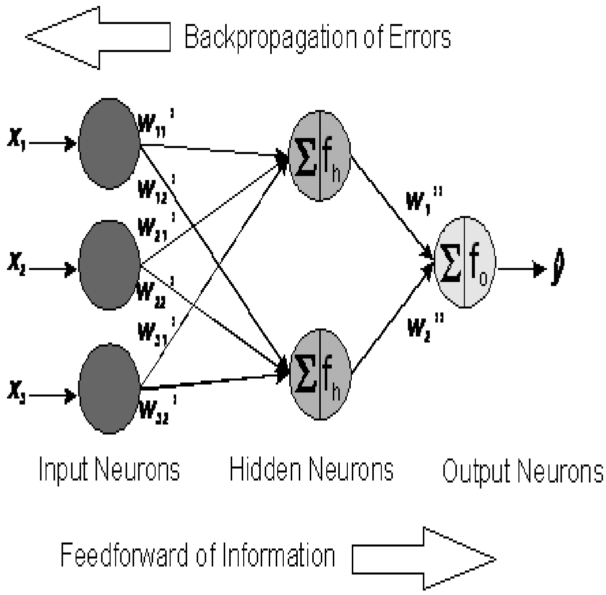

Figure 1.9 feed forward multilayer back propagation network

The above figure consist [48] of three input variables, namely, "X_1, X_2, X_3" with one response variable "Y". The inputs are connected to the Neural Network at the units of inpu. Then the input variables are multiplied by the weighted function$w_{ij}^{'}$.Then the hidden neuron sum up the weighted signals from the input neurons and forward the result to the activation function f_h.The result obtained from the activation layer again multiplied with the weighted function $w_j^{''}$.Then send the results obtained to the O/P neurons. The O/P neuron performs an outline and projection upon the activation function f_0.The output of this response being represented by y^*.For single output neuron, the output can be obtained using the below formula.

$$y^*=f_0[H^{''}+\sum_{j-1}^{n_h} w_j^{''} f_h(\sum_{i-1}^{n_v} w_{ij}^{'} x_i + H^{'})] \quad (1)$$

$H^{'}$ *and* $H^{''}$ *are th*e biases of the hidden as well as O/P neurons.

n_h and n_v are the no of I/P neurons as well as hidden neurons.

During the process of training, calibration samples have known y being passed via network. Then, by comparing predicting response and known experimental response the error is calculated. The comparison is repeated until low error is achieved.

CHAPTER-2

LITERATURE REVIEW

2.1 Energy harvesting

S. Ulukus *et al,. (2015*) summarized recent benefaction in the wide area of communication of energy harvesting wireless. Author has provided the current circumstances of the wireless networks self-possessed of energy harvesting nodes. The authors has taken into account the aspects of energy cooperation and energy at the same time with the transfer of energy harvesting wireless network of independent emerging related fields. And various models of different network size with the potential of energy saving nodes and collecting the model node. The authors also provided a model of total energy consumption. Energy harvesting wireless network at the same time has new theory challenges due to physical phenomena and practical issues being important. The authors has considered a mathematical formula and practical considerations. These include physical properties, such as memory defects, consumption model, processing costs and reality modeling, such as cause energy collection overview. Further, the energy field of data transmission offers exciting possibilities for further use and operation of the network to improve its performance and usually depends on the efficiency of energy transfer, and therefore, depends on the device and circuit technology, will again link up with the theory of the real world.

Sravanthi Chalasani and James M. Conrad, 2008 discussed about sources of energy harvesting which may be obtained from the wind mill and water wheel. The author has proposed a variety of technology-based investigation to identify the source of energy. Access to energy is an alternative to being considered as a viable option at present for energy control systems embedded power from the environment. The author has used self-powered devices drive with the tremendous growth in the field of energy harvesting. Because of the fewer restrictions on the use of power harvester, lack of electricity generated; the researchers has worked on creating new methods. These methods will help one of the best sources of energy harvesting as a wireless mobile equipment Technical Field.

Jaspreet Singh et al., 2016 proposed solar energy harvesting system based on the floating thermo-electric generator (TEG). On the hot side of the TEG, the solar radiations are made to fall whereas the other side was cooled by continuously flowing running water of waterfall so that a suitable temperature gradient between two faces of the TEG have maintained. The TEG generates the electrical energy depending on the temperature difference between the faces of thermoelectric generator. The proposed energy harvesting scheme is capable enough to produce an average output power of 1230.25 milliwatts and 432.39 milliwatts when author uses an array of 12 TEG in series and parallel combination, respectively. Combination of twelve TEGs gives 96.37% and 93.52 % more efficient in comparison to array of four TEG's when connected in series and parallel combination, respectively in standstill water conditions. The electrical output generated by floating TEG based energy harvesting system is enough to charge the Nickel-Metal Hydride rechargeable cells of 1.2 volt each arranged in the form of grid having two cells in series.

2.2 Energy utilization

Ming-Tse kuo and Wen- Yi Lo., (2013) has studied the issues occurred throughout the long operation of Genetic Algorithm as concentrator photovoltaic below sunlight. This outcome in an enhancement in the temperature of surface. Increase in temperature decreases efficiency of PV power generation which can damage the solar cells and another aspects of the power generation system. Therefore, to cool the heated surface of the solar cells, a water circulation system was used, and heated water was stored in a storage tank. This technique is used to maintain the cooling efficiency of the photovoltaic solar cell, the power generation efficiency of the solar cell is due to the rapid temperature rise due to decline. Due to temperature rise, the cooling system also reduces the amount of damage to the solar cell and the power generation system. Further, using a neural network algorithm to generate a photovoltaic power output of the comparison with the active water circulation system and a water circulation system photovoltaic various activities at various temperature intervals so as to obtain the best real-time predictive start and stop times on cooling systems for each temperature interval. The experimental results were subsequently analyzed and compared to the power generation efficiency of the examined photovoltaic. The power capacity of photovoltaic increased using the cooling system by '2% to 15%' with the enhancement of the power generation efficitively of photovoltaic by '2.29% to 3.37%'. Author also discussed about the combined application of photovoltaic and thermal technologies, the total energy of the whole is enhanced by '37% to 59%', even after accounting for the energy usage of the cooling system. As a result, the protection of environment, energy savings, with the utilization of sun energy have been improved. Author has used neural network for optimization and hence its efficiency get increased

Partha Das, (2014)has explained the effect of terrain, sun and temporal information being gainful for a robotic explorer, and have exposed different ways for using such information. The conditions of real-time sensing are used for the information that enables intelligent navigation are used. Author also worked for long term solar navigation plans and the generated information was used by robotics or by human users. By using power consumption, the solar power generation becomes novel constraint for evaluation. The complexity for integrating temporally varying aspects like terrain shadowing because of multiple paths such as coverage patterns given by step-by-step plans of simulation. Moreover, with the Hyperspectral Image Analysis, the author has found soil mineral nature with the geographical nature of that place.

Alabi Soneye and Adebola Daramola., (2011) has studied solar energy utilization in Ibadan. The current supply of natural energy is a distant outcry from demand. Therefore the necessities for practical solution have low cost renewable sources like as solar energy systems. This source has less negative effect on the environment. However, the solar market for the developing countries is neither reasonable nor sustainable. It resolves the still increasing petroleum cost products protecting the ecosystem with the support of climate change. Author has used decentralization as well as localization of generation, transmission and distribution.

2.3 Hydro power

Zang, J., *et al.*, (2015) has presented comparison between the impact of large hydro project and small hydro project is done by relating them to GHG activity. In this, the inventory is established for hydropower development. According to this inventory, the impacts due to hydropower projects are classified in three categories – Civil Work Reservoir Impoundment, Cumulative impacts. In this, the author has found all the activities or impacts under these three classes and relates them with greenhouse gas activities and finally transformed into the CO_2 equivalent directly or indirectly. Total externality for hydropower project and carbon emission amount by various impact or externalities are calculated using calculations. In this, both direct and indirect emission, reduction and carbon neutral are found. The data required for calculation of externality are composed from statistical materials of the ‘Tibetan Environmental Protection Bureau’ and the ‘Water conservation bureau’ via personal communication. The outcome has shown the civil works amount as per unit installed capacity is remarkable large for Small Hydro Project than the Large Hydro Projects. So, the externalities of civil work for Small Hydro Project are higher than Large Hydro Project. Except the externalities due to reservoir impoundment with cumulative impacts for Small Hydro Project is considerably less. With these three types, the externalities for Small Hydro Project are significantly less than those for Large Hydro Projects. Therefore, small Hydro Projects better suitable for environment and having low carbon energy than Large Hydro Projects in ‘Tibet’. To meet huge hydroelectricity demand, Large Hydro Project is essential. So, to make balance between negative externality and positive ones due to Large Hydro Project it is suggested to increase the power density of project.

Sharma, A.K., *et al., (* 2015)has discussed the issues of hydro policies, environmental issues, social issues, economical issues and another challenges connected to small hydropower projects in ‘Jammu and Kashmir’. Many researchers has reported small hydropower plant being more environment friendly source of energy than large hydropower plant because for large hydropower plant big reservoir constructed that affects huge area and eco balance also. The river flow is less affected in case of small hydropower plants contain fewer effects on surrounding plus aquatic life. Small hydropower plants are more feasible in Himalayan regions and are more acceptable to the local as of some construction period, displacement less land requirement, list deforestation, less investment, job opportunities, power supply. Analysis is done on the basis of examination articles, reports, and another pertinent material on web. Only 16% of the identified potential is still exploited in Jammu and Kashmir. The micro as well as mini hydro projects up to 2MW are being handled by the state Jammu and Kashmir Energy Development Agency with 2-25MW by ‘Jammu and Kashmir State Power Development Corporation Ltd’. The growth of small hydropower plant in ‘Jammu and Kashmir’ is challenging because of social, economic as well as environmental factors. The environmental factor can be resolved by providing mitigation measure by concurrency the issues with environmental experts. Steps taken are maintaining minimum amount of water flow, disposal of excavated earth from construction of hydro project, use of excavated mode for construction purpose, E-flow arguments, and guidelines for small hydropower project. EIA, EMP, SIA needed to be addressed for projects and mandatory EIA clearance rate before development of project. The more critical by factors are objection certificate, other clearances, lack of facility, etc. These can be resolved by adopting simplified and time bound mechanism. Also Indus Valley Water Treaty Argument must be reviewed by both the country to minimize the adverse effects. To minimize the financial factors interested private parties can be attracted. Small hydropower plant development in Jammu and Kashmir helps to improve the socio-economic conduction of people of the state.

Wagner, B., *et al*., (2015) has summarized historical development of hydropower projects in 'Austria' and its upcoming economic and environmental challenge is given. Hydropower has provided electricity from many decades. In the middle of the 19^{th} Century, the first hydropower plant is documented and is still in operation. After that numbers of new large and small hydropower plants were constructed. In 1995, first time 'Austria' fulfills the whole electricity demand. In 1960, whole 31 new large hydropower plants were developed. The raped development had affected the environment and society to it that leads to a prevention of a further development. Stricter strategy and criteria for the process were developed which makes the new development more difficult. Then, in 1980 and 1990 small hydropower plants are constructed on small as well as medium rivers. Run of rivers plants are high in number than storage space and pump storage plants. The small numbers of hydropower plants are more than the large one but '86.2%' of yearly generation is given by big hydropower plants and 13.8% share is of small hydropower plants. Currently 5200 plant exist, it includes the projects which cover the national electricity needs and generates electricity for own consumption.

Henning, T., *et al.,* (2013) has analyzed the current status of 'hydropower projects' with environmental as well as socio-economic consequences. China is the world's fastest growing hydropower country having engineering and technical expertise. China is economically strong enough to develop large and expensive hydro projects. Yunnan is predicted as the hydro battery of china having the hydropower capacity more than Canada or United States in future. The main control on large hydropower development is of central and local government; only minor role is of private sector.

China is currently constructing most large hydro projects. For the purpose of rural electrification, china is successfully pushing the development of small hydropower. The main drivers of small hydropower projects are local and private entrepreneurs. Small hydropower project helps socio-economic development of rural area. But, now small hydropower projects flow development cause serious direct and indirect results. The effected people argue that they cannot oppose small hydropower project development which is not allowed for decision making. Small hydropower project are basically considered as environmentally sound renewable energy sources but the huge number of diversion type projects could cause dewatered section for long stretches and cause cumulative environmental impact. It shows that small hydropower project developments have weak environmental and institutional control. The cumulative biophysical impacts of small hydropower project are more than that of large hydropower project.

Bakken, T.H., *et al.*, (2012) has reviewed the comparison of small and large hydropower plant. The comparison of environmental impacts due to large hydropower plant and small hydropower plant is done by keeping the volume of energy produced. For comparison, 3 large hydropower plants and 27 small hydropower plants are considered. From 3 large hydropower plants, the average environmental impacts and 27 small hydropower plants the accumulated impacts of all are compared. To eliminate the effect, difference in topography, climate or type of ecosystem the plants are chosen from similar region with alike bio-geographical characteristics. The environmental impacts of plants are identified from EIAs reports. The environmental factors are selected and then impacts hydropower projects on these factors unreliable from very large negative impact for very large positive impact. From the graph, it is clear that large hydropower plants have less adverse impact than small scale hydropower plants with quantity of energy production. The negative impact of large hydro development than small hydro projects are mostly on water temperature, humidity and positive impacts are on natural resources fish recreation soil erosion sediment transportation ice conditions local-climate. In other environment factors, both large small hydro projects and small hydro projects have similar impacts.

Kucukali, S., *et al.*, (2011) has studied fuzzy set concepts used for the risk assessment of hydropower projects and specialist judgments used in the place of probabilistic reasoning. First, by using data from expert interviews, field studies and literature review the eleven classes of risk factors of project are determined. These factors were place Environmental issues, geology land use, Social acceptance, Financial, Grid connection, Natural hazards, Laws and regulatory amendments, Access to infrastructure, Terrorism and Revenue. A survey was conducted for determining the relative importance of the risk factors. For this, 14 experience experts were participated and were grade the significance of risk factors between 1 to 4, where 1 represents low and 4 represents very high. The result shows that most concerned risk is site geology and environmental issues. Then risk index (R) value is calculated. The value of R lies in range 1.2 to 2.8 where R value between 1.2 to 1.6 indicate low risk, 1.6 - 2 indicates medium risk, 2 – 2.4 high risk and 2.4 – 2.8 on a real case hydropower project. This shows that the planned methodology can be easily used to quantify risk rating.

Sinclair, A.J., (2000) has discussed the change in the Environmental Protection Act in 1997. At that time, the procedure for public hearing is established as a component of EIA. The three cases of Kullu District are considered where the public hearing is done. The primary data collection methods were qualitative interviews, document reviews and participant observation. Result has shown the environmental impact assessment is in its nascent stages in Himalaya region in India. There is a failed record of EIA and public participation because the information available was found to be difficult to access and not user friendly. Hearing occurs at the operational level. No decision is made according to the conclusion comes from public hearing and had occurred prior to public hearing. There is hindrance in serious public involvement due to lack of education and environment awareness, lack of basic services such as school, hospitals, and etc. people concerns mainly related to the safety issues, socio-economic issues, and job opportunities and very little with the environmental impacts. Sometimes, local people are aware and concerned about their environment but then due to lack of resources they do not participate in decision making process. In developing countries people have the time, willingness, organization and resources to participate. This is also possible in some parts of India but in high mountain rural areas extra steps must be taken to facilitate public participation.

2.4 Ways of energy

J. Paulo and P.D. Gaspar,(2010) has discussed the disadvantages, advantages, and future trend of methods of energy harvesting, as well as its properties in portable medical devices with less power consumption. In medical field, there are different parameters that must be monitored. Authors have discussed different harvesting methods like Piezoelectricity, electromagnetic, Thermal energy and also have discussed their industrial applications.

Paul D. Mitcheson *et al.*,(2008) has discussed the principles with the state-of-art in motion-driven little energy harvesters and discussed, appropriate applications, trends and probable prospect developments. Author has discussed about Wireless sensor nodes, principle of operation of electromagnetic transducer, and their performance limits.

Xinping Cao *et al.,* 2007 has proposed the system of incorporated vibration power generator. This system has a generator of mini electromagnetic vibration power with an efficient energy harvesting circuit embedded on a small printed circuit board (PCB) with a CMOS integrated chip. A reply of PWM (Pulse width modulation) boost converter on the voltage of the element of energy storage was used and the maximum power of 35mW has been harvested.

CHAPTER-3

PROBLEM FORMULATION

During the last decades, renewable energy sources have been recognized as one of the main solutions in coping with the future energy needs, because the use of fossile fuels have no negative effect on environment. The mistreatment of renewable energy sources however, faces serious difficulties regarding the penetration limits in the electrical grid due to its stochastic and variable availability. [5]. A greater part of world’s energy is extracted from fossil fuels that lead to creation of CO2 – a greenhouse gas and critical factor for global warming. 1 kW of energy production from fossil fuels generates 1000g of CO2 [6]. So, men are focusing from fossil fuel to renewable based energy harnessing. Mostly used renewable energy source today is solar energy. sun radiates light at the rate of 3.8×1023 kW out of which 1.8×104 kW is captured by earth . 1h of capturing energy at this rate can satisfy yearly worldwide energy demand [7]. Solar energy harvesting system based on the floating thermo-electric generator (TEG) has been proposed by the author ‘Jaspreet Singh ‘On the hot side of the TEG the solar radiations are made to fall whereas the other side was cooled by continuously flowing running water of waterfall so that a suitable temperature gradient between two faces of the TEG have maintained. The TEG generates the electrical energy depending on the temperature difference between the faces of thermoelectric generator. The proposed energy harvesting scheme is capable enough to produce an average output power of 1230.25 mill watts and 432.39 mill watts[8].The above mentioned problems are shorted using ‘Neural network ‘and observe energy harvesting in different weathers like in sunny weather, in cloudy weather and in dark or other type of weather.

CHAPTER-4

OBJECTIVES

4.1 OBJECTIVES

1. To study the various energy harvesting techniques with optimization.

2. To propose a novel algorithm for energy Harvesting technique using the artificial neural network for energy optimization.

3. To create an environment which contains some energy consuming elements in a room to simulate the proposed work.

4. To present a model on different type of weather like

a. sunny

b. Cloudy

c. Dark and other weather

5. To compare the proposed work with previous existing work we calculate the performance metrics likes illumination in flux with respect to time.

CHAPTER-5

METHODOLOGY

5.1 METHODOLOGY

Following are the steps that have been carried out for the proposed work:

Step 1: the type of weather will be selected from the environment like

i. Sunny
ii. Cloudy
iii. Dark and other type of weather

Step 2: Initialize the flux

Step 3: Time of harvesting is defined which is 10 hr in the proposed work.

Step 4: Defined energy consuming element

Step 5: Are of the room is initialized in which the simulation takes place. Are of the room is length ×width is 100×100.

Step 6: Status of the consuming energy is defined

Step 6: Total energy consuming is calculated..

Step 6: 1 is selected for ON and 2 is selected for OFF.

Step 6: NN is initialized for energy optimization and training and testing is performed on it.

Step 7: Calculate the performance parameters.

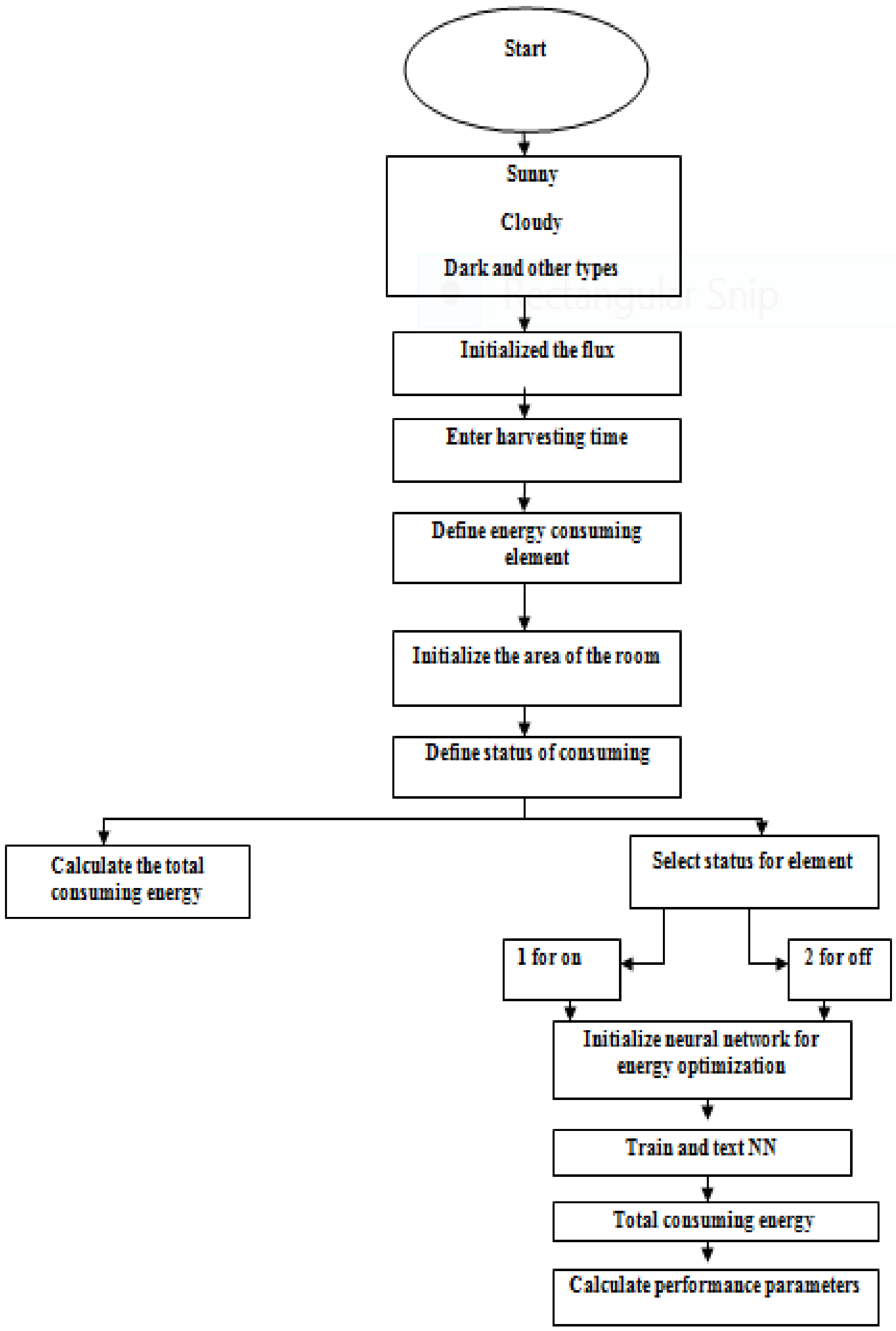

Fig 5.1 Flowchart of proposed work

5.2 Psedorandom code

```
clc; % clc is to clear the  previous screen
clear all;  % to clear the previous references
close all; % to close the oepned windows
disp('SELECT THE TYPE OF WEATHER YOU WANT TO KEEP ');
wt=input('PRESS 1 FOR SUNNY WEATHER \nPRESS 2 FOR CLOUDY WEATHER \nPRESS 3 FOR DARK OR OTHER TYPE OF WEATHER'); %wt is the weather type
disp('FLUX IS BY DEFAULT 130000 FOR SUNNY WEATHER');
global rm;
rm=0;
fs=130000; % flux for sunny weather
fs=13000:13000:130000;
idol_time_rec=1;
fc=(fs*30)/100; % fc is the flux for sunny weather and it has been set for 30 % of the original flux
fo=(fs*10)/100; % 10 % for the other type of weather
time=input('ENTER TIME OF HARVESTING IN HOURS ');% TIME OF HARVESTING
l_no=input('ENTER TOTAL NUMBER OF ENERGY CONSUMING ELEMENTS IN ONE ROOM ');
no_room=input('ENTER TOTAL NUMBER OF ROOMS GETTING USED AT THE CURRENT TIME *** MINIMUM 1');
len=input('ENTER THE LENGTH OF ROOM(*** LENGTH WOULD BE IDENTICAL FOR EACH AND EVERY ROOM *** ) ');
wid=input('ENTER THE WIDTH OF ROOM(*** LENGTH WOULD BE IDENTICAL FOR EACH AND EVERY ROOM *** ) ');
active_l=input('SELECT TOTAL NUMBER OF ON CONSUMING ELEMENTS PER ROOM ');
area_room=len*wid;
total_area=area_room*no_room;
allillumination=[];
for si=1:10
if no_room>0
mess=strcat('TOTAL AREA OF THE ENTIRE ROOMS INVOLVED IS ',num2str(area_room * no_room));
disp(mess);
if wt==1
   disp('TOTAL FLUX FOR SUNNY WEATHER ');
   disp(fs);
   illumination=fs/total_area;
   mess=strcat('ILLUMINATION IS ',num2str(illumination'));
```

```
    disp(mess);
    energy_harvested=261*time;
    energy_consumed=(3*active_l*no_room)*40*time;
    energy_remained=energy_harvested - energy_consumed;
    disp('TOTAL ENERGY CONSUMED : ');
    disp(energy_consumed);
elseif wt==2
    disp('TOTAL FLUX FOR CLOUDY WEATHER ');
    disp(fc);
    illumination=fc/total_area;
    mess=strcat('ILLUMINATION IS ',num2str(illumination'));
    disp(mess);
    energy_harvested=261*time;
    energy_consumed=(3*active_l*no_room)*40*time;
    energy_remained=energy_harvested - energy_consumed;
    disp('TOTAL ENERGY CONSUMED:');
    disp(energy_consumed);
elseif wt==3
    disp('TOTAL FLUX FOR OTHER TYPE OF  WEATHER ');
    disp(fo);
    illumination=fo/total_area;
    mess=strcat('ILLUMINATION IS ',num2str(illumination'));
    disp(mess);
    energy_harvested=261*time;
    energy_consumed=(3*active_l*no_room)*40*time;
    energy_remained=energy_harvested - energy_consumed;
    disp('TOTAL ENERGY CONSUMED : ');
    disp(energy_consumed);
else
   disp('WRONG SLECTION OF THE WEATHER TYPE ');
   disp('PROGRAM TERMINATED ');
end
disp('KINDLY CHOOSE AN OPTION \n');
if si==1
choice=input('PRESS 1 FOR ALL CONSUMING SOURCES ON \nPRESS 2 FOR ALL CONSUMING SOURCES OFF ');
end
if choice==1
    illumination=fs/total_area;
    mess=strcat('ILLUMINATION IS ',num2str(illumination'));
```

```
    disp(mess);
    energy_harvested=261*time;
    energy_consumed=(3*l_no*no_room)*40*time;
    energy_remained=energy_harvested - energy_consumed;
    disp('TOTAL ENERGY CONSUMED : ');
    disp(energy_consumed);
elseif choice==2
    illumination=fo/total_area;
    mess=strcat('ILLUMINATION IS ',num2str(illumination'));
    disp(mess);
    energy_harvested=261*time;
    energy_consumed=0;
    energy_remained=energy_harvested - energy_consumed;
    disp('TOTAL ENERGY CONSUMED : ');
    disp(energy_consumed);
else
    disp('WRONG CHOICE');
end
else
    msgbox('NEED TO ENTER AT LEAST ONE ROOM');
    disp('MINIMUM 1 ROOM REQUIRED ');
end
illumination=illumination*rand;
figure,
if wt==1
    plot(1:10,illumination,'r','linewidth',3);
    title('illumination VS time');
    xlabel('Time in hours');
    ylabel('Illumination in flux');
    grid on;
elseif wt==2
    plot(1:10,illumination,'r');
    title('illumination vs time','linewidth',3);
    xlabel('time in hours');
    ylabel('Illumination in flux');
    grid on;
elseif wt==3
plot(1:10,illumination,'r','linewidth',3);
    title('illumination vs time');
    xlabel('TIME in hours');
```

```
    ylabel('Illumination in flux');
    grid on;
end
allillumination(si,1:10)=illumination;
end

trainset=allillumination;
[r,c]=size(allillumination);
for i=1:r
   group(i)=i;
end
net=newff(allillumination',group,30);
net.trainparam.epochs=100;
net=train(net,allillumination',group);
result=sim(net,allillumination');
optimizedillumination=allillumination+(abs(mean(result)))/numel(result);
figure,
     plot(1:10,illumination,'r','linewidth',3);
    hold on;
    plot(1:10,optimizedillumination,'g','linewidth',3);
     title('illumination vs time');
    xlabel('TIME in hours');
    ylabel('Illumination in flux');
    legend('Normal','Optimized by Neural');
    grid on;
```

CHAPTER-6

IMPLEMENTATION AND EXPERIMENT

6.1 SIMULATION ENVIRONMENT:

Computer	Core 2 Duo or higher
RAM	3 MB
Platform	Windows 7
Other hardware	Keyboard, mouse
Software	Mat lab 7.0.4

Table 6.1 Tools Used

MATLAB represents the name Matrix Laboratory. MATLAB was originally intended to be easily accessed by the LINPACK (linear system package) and EISPACK (Eigen system package) project developed by Matrix Software, MATLAB is a high-performance technical computing language. It integrates computation, visualization and programming environment. In addition, MATLAB is a modern programming language environment: it has a fine data structure that contains built-in editing and debugging tools, and support for object-oriented programming. These factors make MATLAB become a prominent tool for education and research. Compared with traditional computer languages (eg, C, FORTRAN), MATLAB has many advantages for solving technical problems. MATLAB is an interactive system, which is basically an array of data elements not required dimensions. The package has been commercially available since 1984, it is now considered the most global universities and industry standard tools. It has a powerful built-in program, you can perform various calculations. The graphics command also has an easy to use, so that the visual results immediately available. Specification application collects in the package is referred to in the toolbox. There kit for signal processing, symbolic computation, control theory, simulation and optimization.

After login, you can enter MATLAB by double-clicking on the shortcut icon on the Windows desktop. When you start MATLAB, a special window called MATLAB desktop appears.

The major tools within or accessible from the desktop are as shown below:

- Command Window
- Command History
- Workspace
- Current directory
- Help browser
- Start button

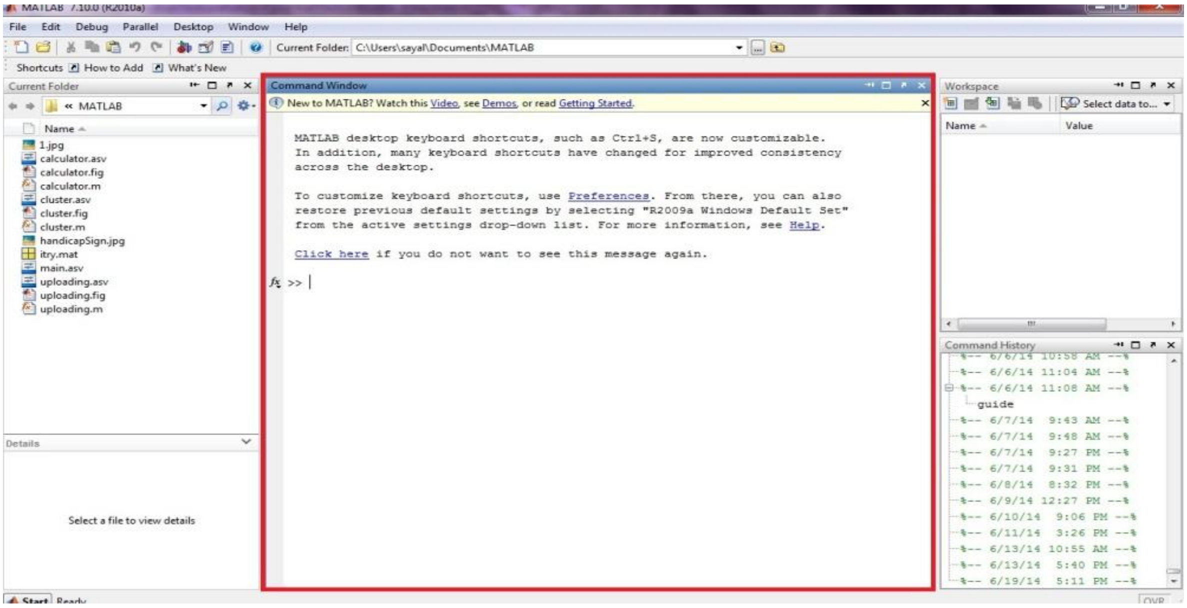

Figure 6.1Command Window

You can write a command in a command window. Non-graphical output displayed in this window. A '>>' display system available for input. When the system is calculating or waiting, 'ready' and 'busy' is displayed in the lower left corner of the window.

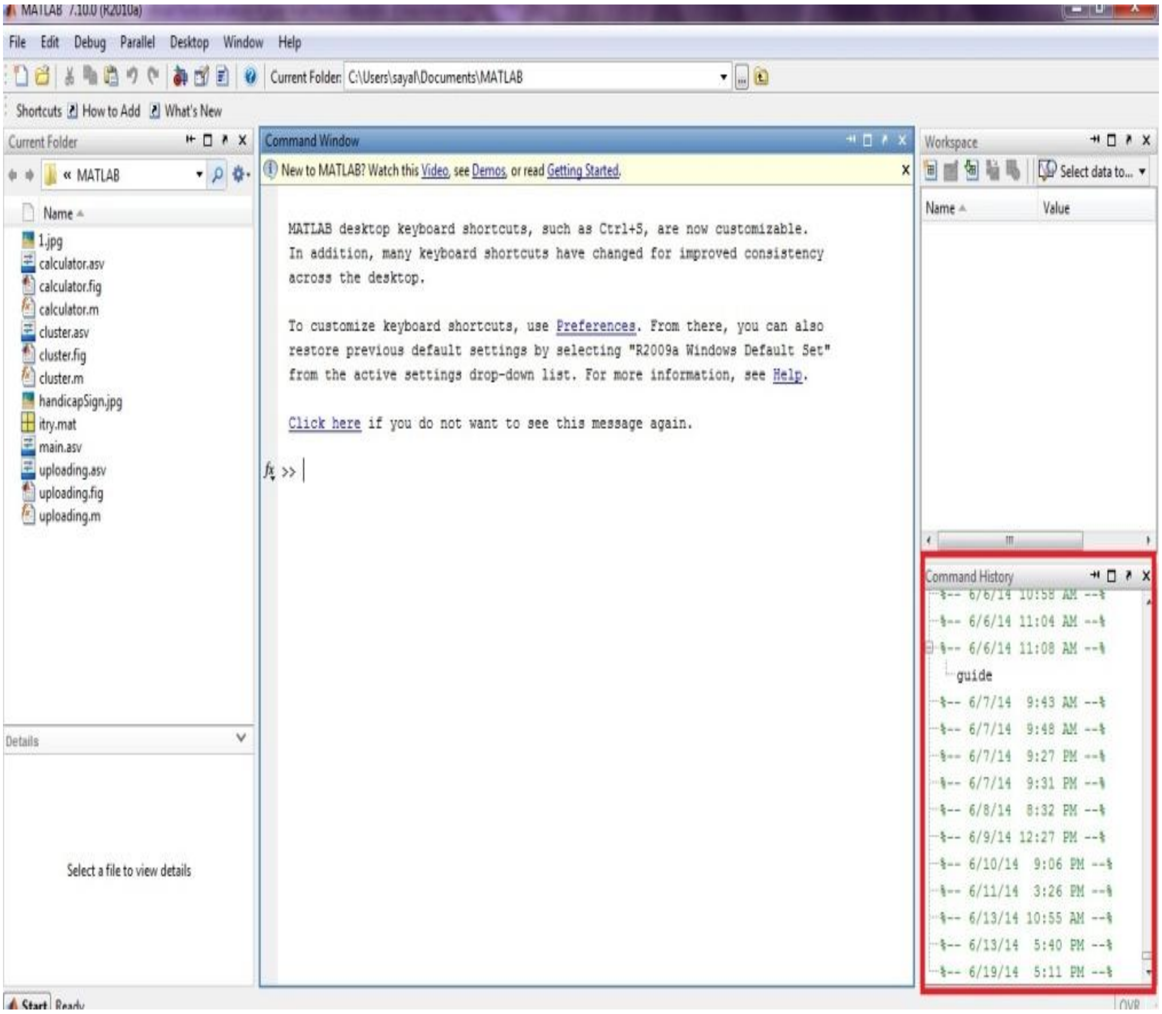

Figure 6.2Command History

The figure is a command history and shows the recent history session for display. It can also be used to copy / paste or for reference commands.

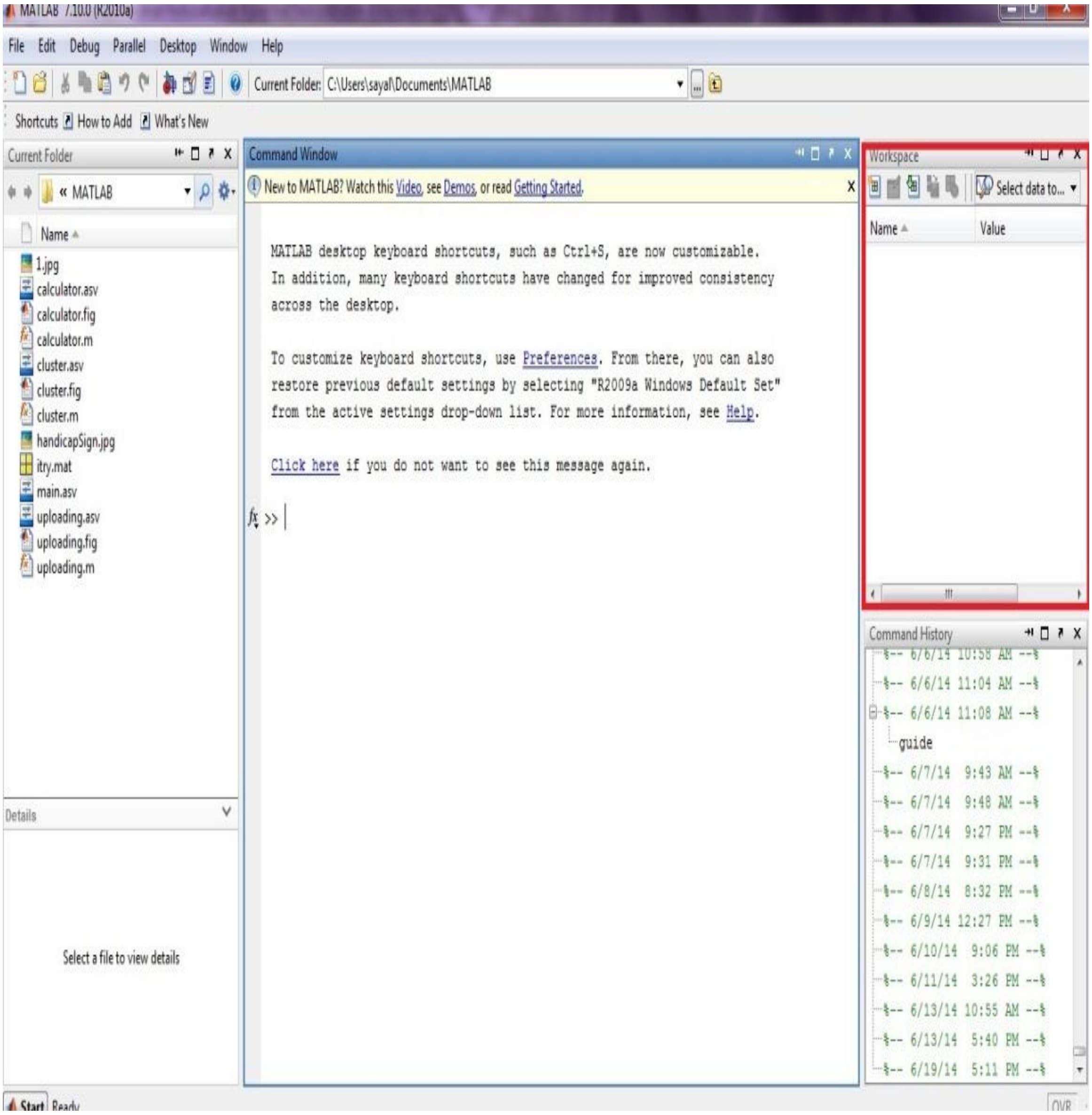

Figure 6.3Window space

The figure shows the variables that can currently be given by the user with the basic data of every variable with its minimum and maximum Values with the dimensions. The top icon creates the various functions such as saving/deleting, variables, creating with plotting etc.

"File>Save>workspace" command is utilized for saving the variables from one session to other.

'.mat' extension is utilized for the workspace.

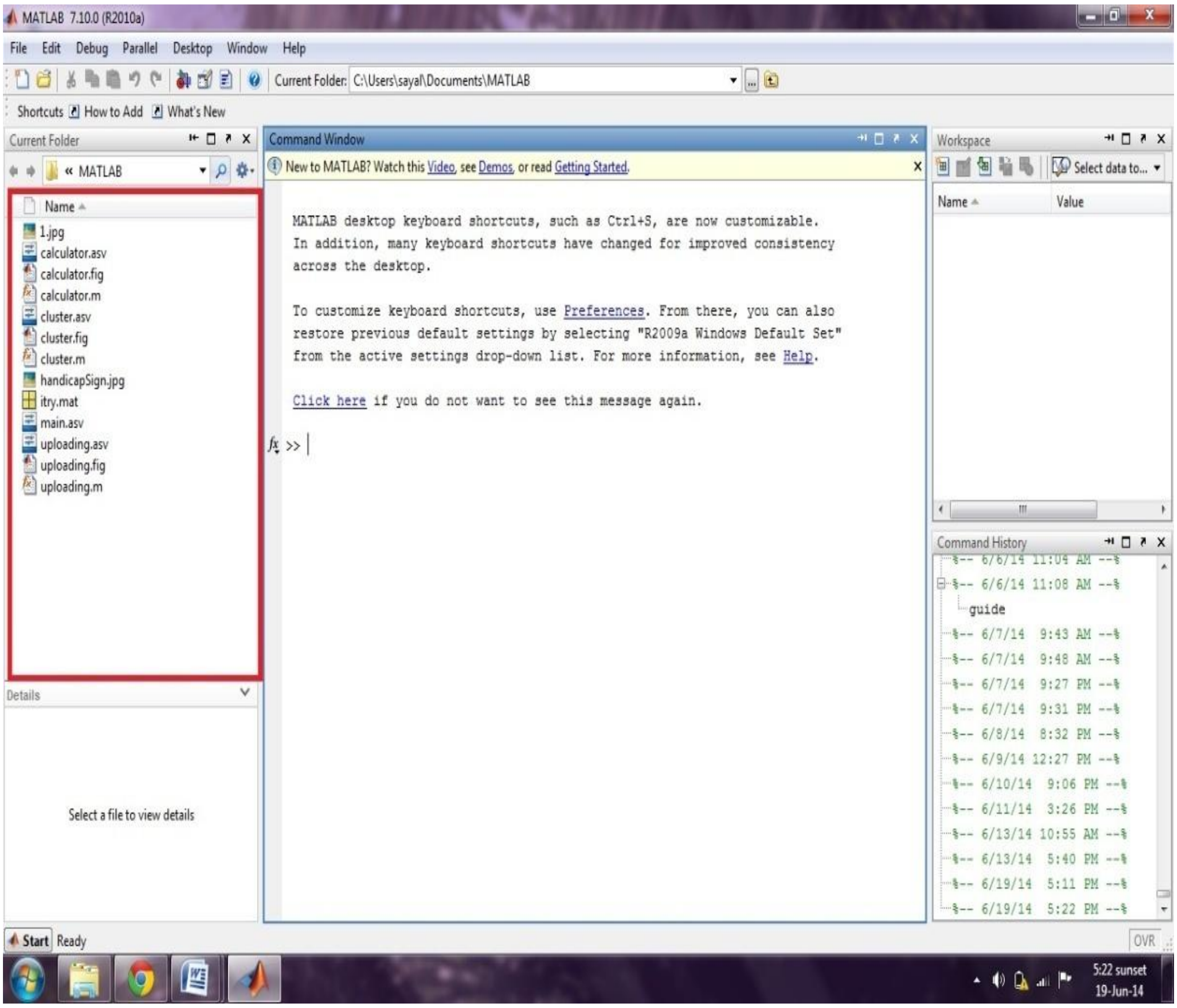

Figure 6.4 Current Folder

The current folder is the folder defining the currently working in MATLAB. Anything could be saved by default. The current folder at the centre top could change the directory. It also shows the list of the files in the current directory.

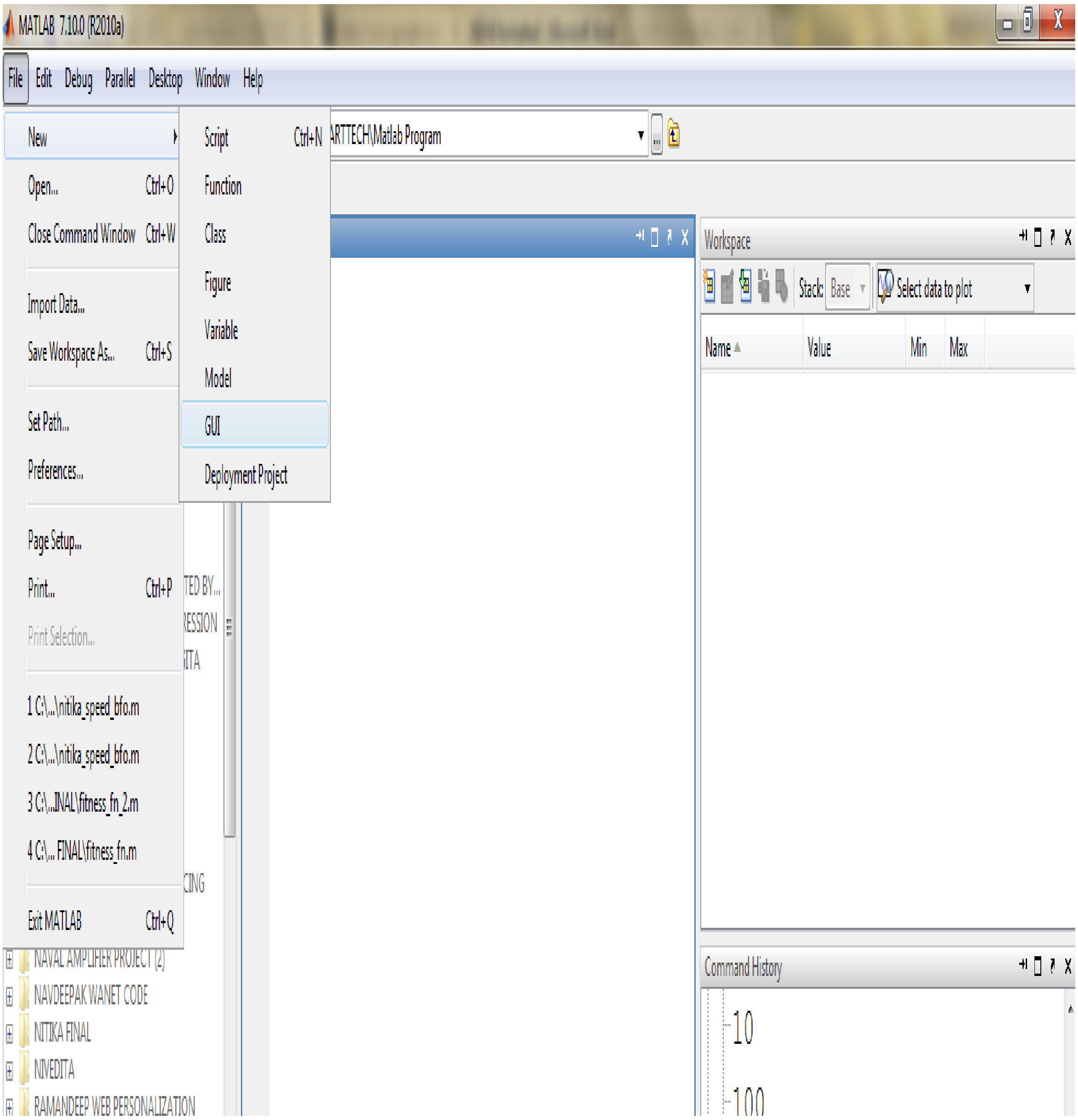

Figure 6.5 Start GUI

The above figure shows the Start Graphical User Interface. By clicking on the novel menu from the top icons, a novel GUI could be form.

- Opening a New GUI in the Layout Editor:

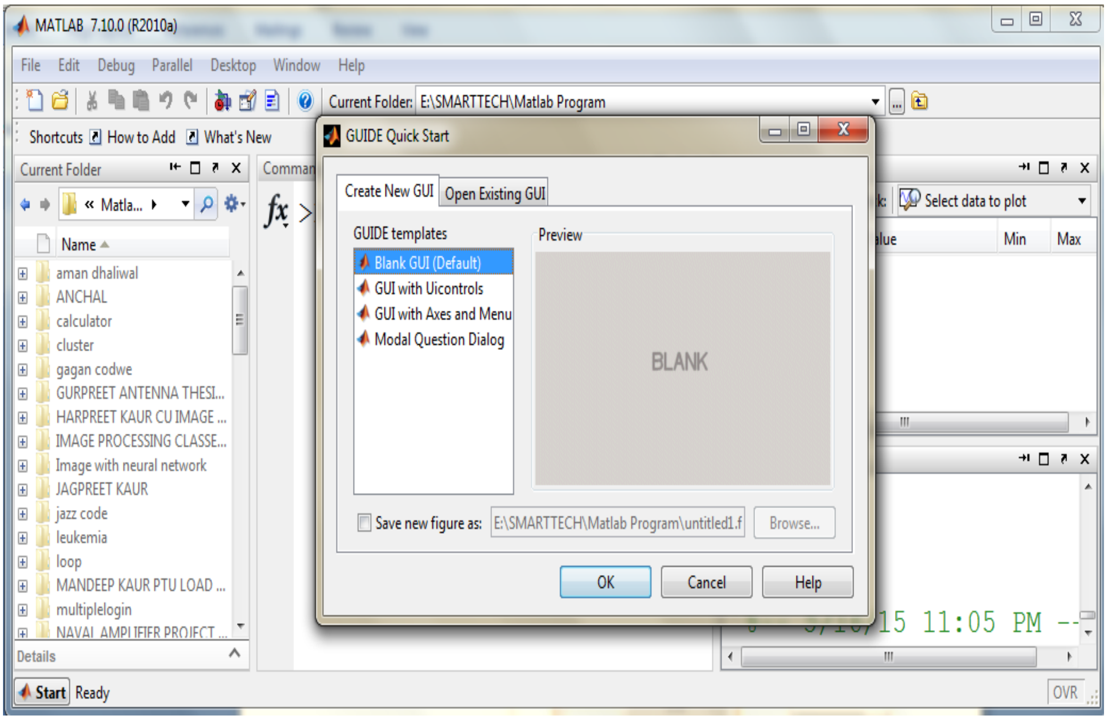

Figure6.6 NEW GUI

The Figure above describes different options for making a GUI. Blank GUI's could be made or GUI'S with some alternatives.

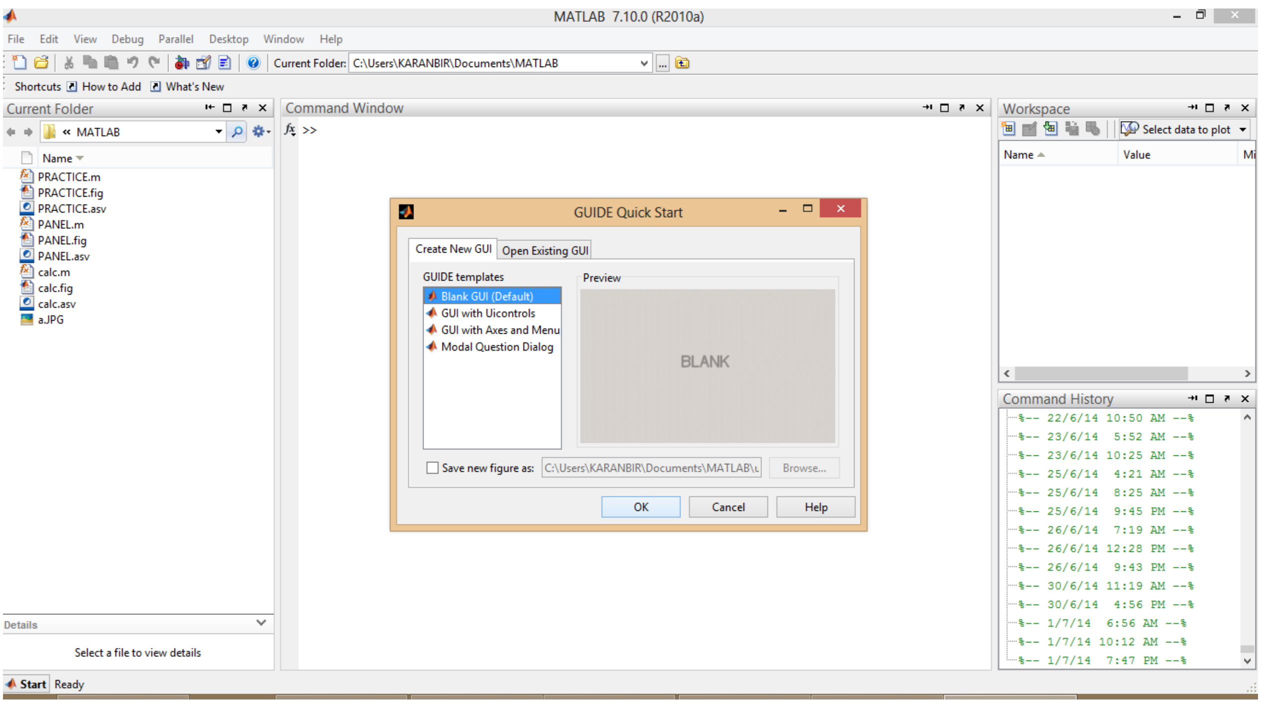

Figure 67 Other Options for GUI

Figure above describes how to create a novel GUI or to open a related one. For developing a GUI as per user's requirement, the blank GUI or default option could be used, or a number of options being available for using predefined GUI.

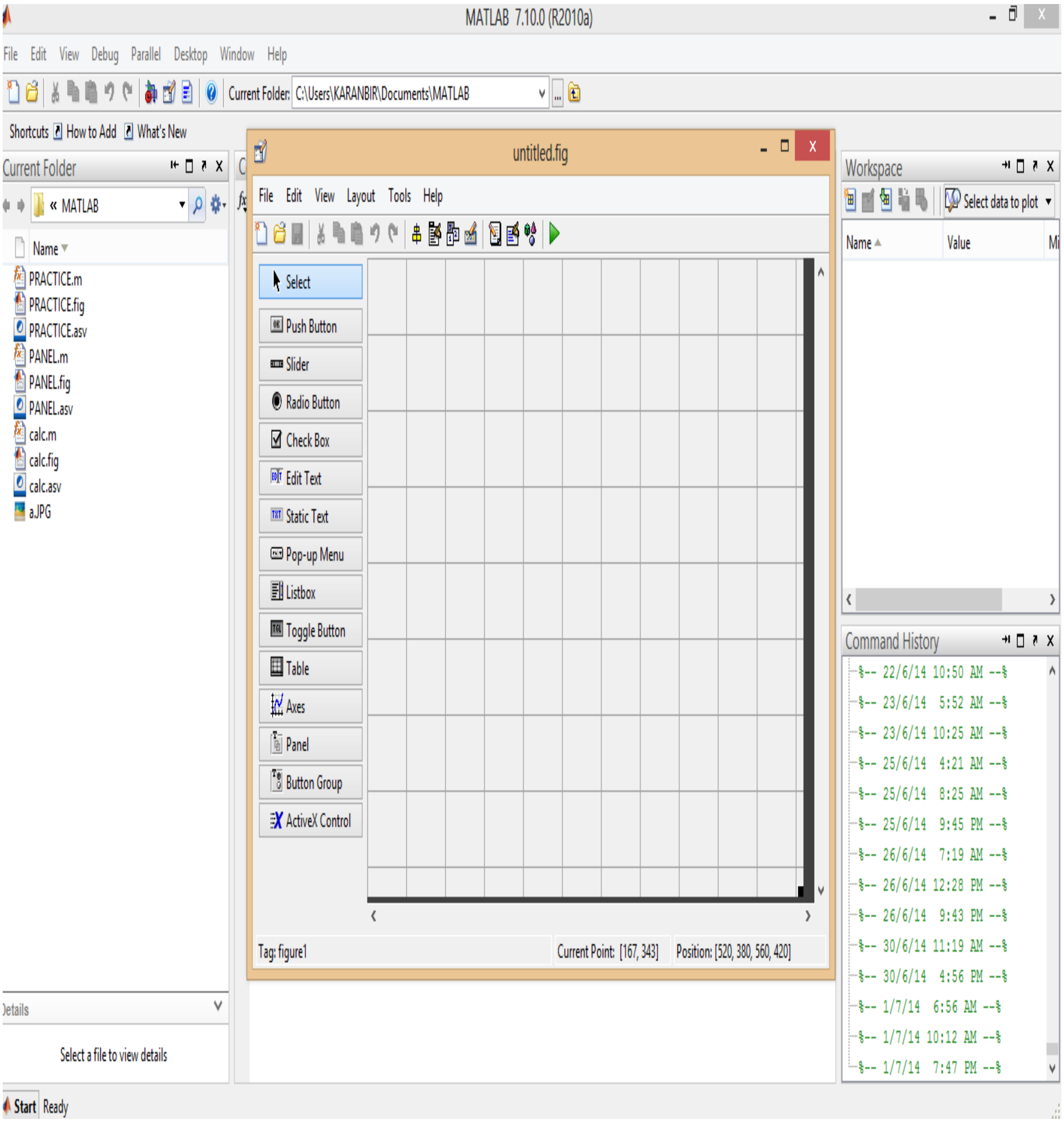

Figure 6.8 To Draw a GUI

The above diagram shows the platform for drawing GUI. It is being saved with the extension, '.fig'. Few tools are available to design and control for setting the properties of the tools.

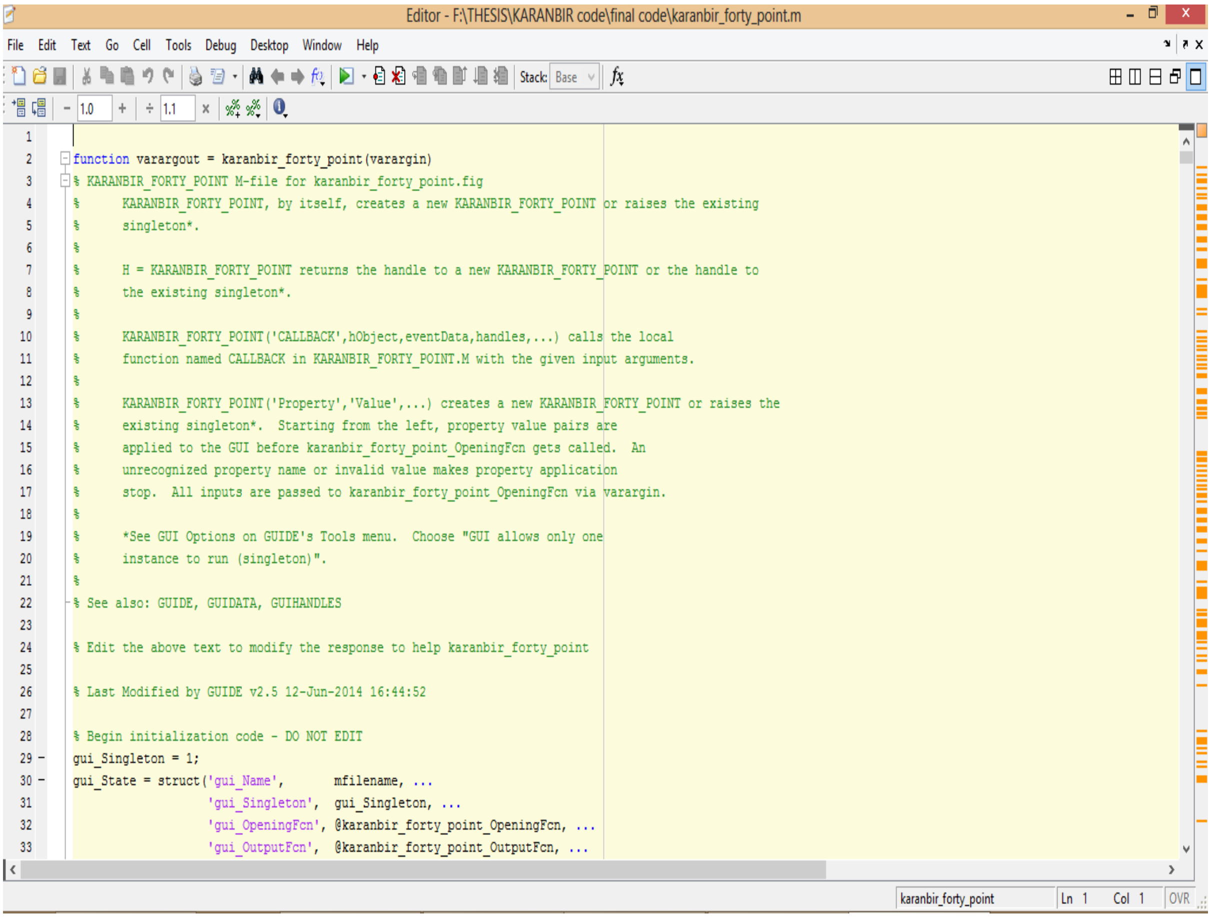

Figure 6.9 Editor Window

The code could be edit after being saved it in the editor window. The user could edit .m-files; with the scripts with the functions that were being defined earlier. By typing the ‘edit’ command in the window, the window above could be displayed. By ‘edit myfile’ command, “.m” file could be open for editing.

1. 6.2 MATLAB CHARACTERISTICS

- Given by Cleve Moler in the 1970's
- Resulted from FORTRAN as subroutines LINPACK with EISPACK, linear as well as eigen value systems.e
- Executed principally as an interactive system for accessing LINPACK as well as EISPACK.
- It was rewritten in C in late 1980's having more functionality, including plotting routines.

- The Math Works Inc. was produced (1984) to marketplace and go on with expansion Of MATLAB.

6.3 STRENGTHS

- It might behave as a calculator/ PL (programming language)
- It collaborates adequately calculation as well as graphic plotting.
- It is moderately easy to learn
- It can fix the errors easily.
- It is optimized to be relatively fast while executing the matrix operations
- It does have few object-oriented elements.

6.4 RESULT ANALYSIS

The simulation environment of the proposed work is shown in the table 5.2.

Table 6.1 Result Simulations

Time of harvesting	10 Hr
Area of room	100×100
Simulation Tool	Matlab
Authentication Parameter	Energy Consumption
Evaluation Parameter	Illumination in flux

Here, we formulated the following results in MATLAB with 50-100 nodes.

The figure 6.10 is for the training of the neural network trained with different illumination. The detailed description is as follows. The snapshot of neural network after training is shown in figure 6.11.

6.4.1 RESULTS FOR SUNNY WEATHER

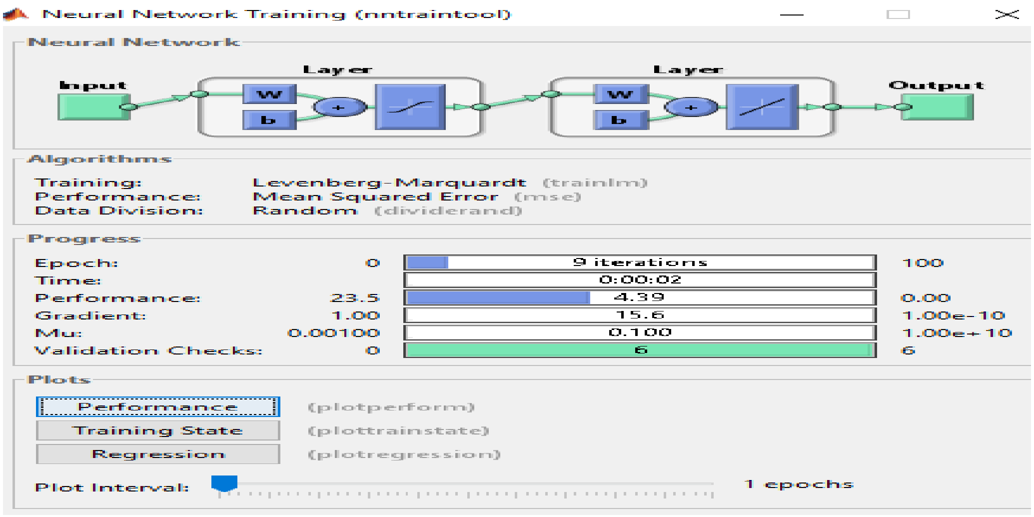

Fig. 6.10: Neural Network training

Artificial neural network training architecture is shown in figure 6.10. As shown in the figure 6.10 neural network has three layers.

i. Input layer: The trained data is provided on this layer.

ii. Hidden Layer: Processing of the trained data is done in this layer.

iii. Output Layer: Classified results are taken from this layer.

The real big challenge is controlling the consumption of the energy and making the framework aware that someone has left the room. For such purpose artificial Intelligence has been marked and the Feedforward Back Propagation network is trained with 10 hidden neurons. The key idea is to make the framework aware about the maximum amount of the illumination which is generated.

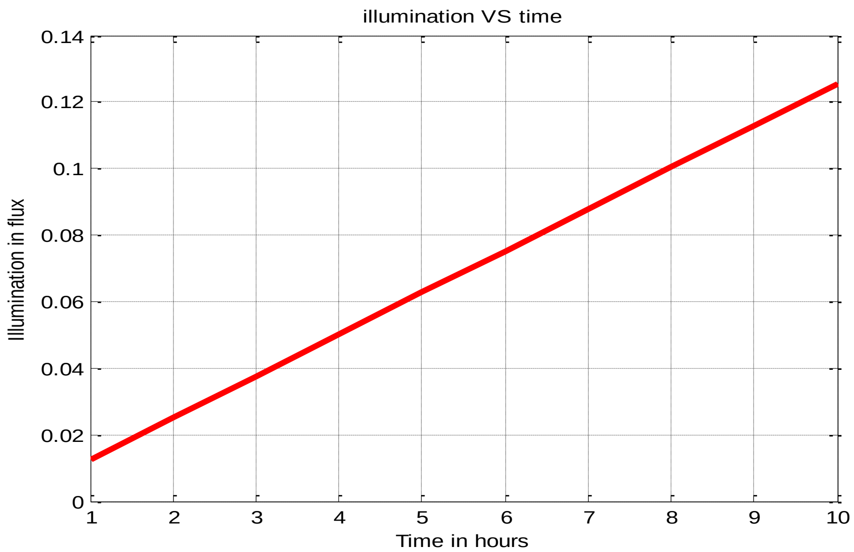

Fig.6.11 Illumination vs time graph for sunny weather

The above figure depicted that as the time goes on increasing illumination also get increased and the graph obtained for sunny day is linear. The average value obtained for illumination is .07 flux

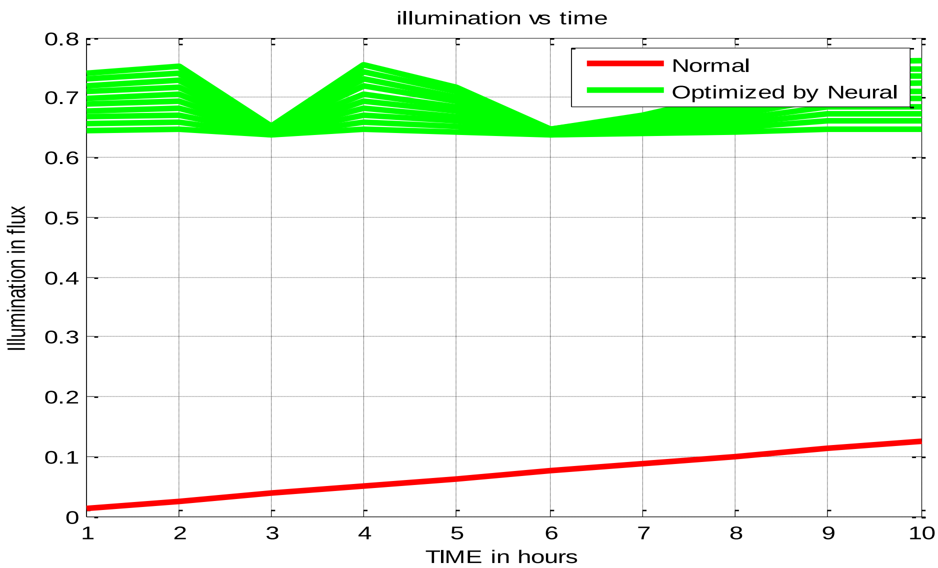

Figure 6.12 comparison graph for sunny weather

The above graph represents the comparison between illumination in flux and time in hours. In the above figure red line indicate the illumination obtained without optimization whereas, the green part of the graph obtained when optimization of the proposed work is done by using Neural network. It is clear from the graph that for sunny weather value of illumination is more than without optimization.

6.4.2 RESULTS FOR CLOUDY WEATHER

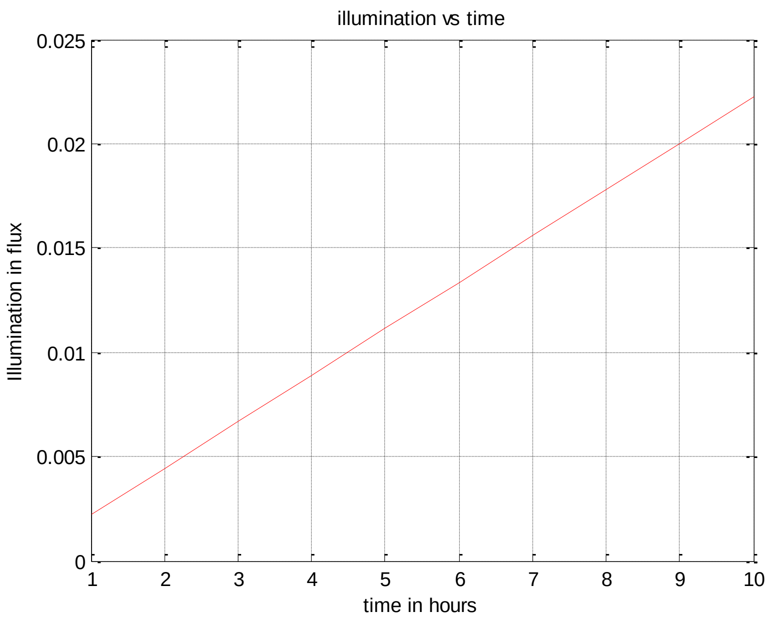

Fig.6.13 illumination vs. time graph for cloudy weather

The above graph represents that as the time goes on increasing illumination also get increased and the graph obtained for cloudy day is linear. The average value obtained for illumination is .012 which is less than the value obtained for sunny weather. This is because, in sunny day the intensity of light is more than the cloudy days.

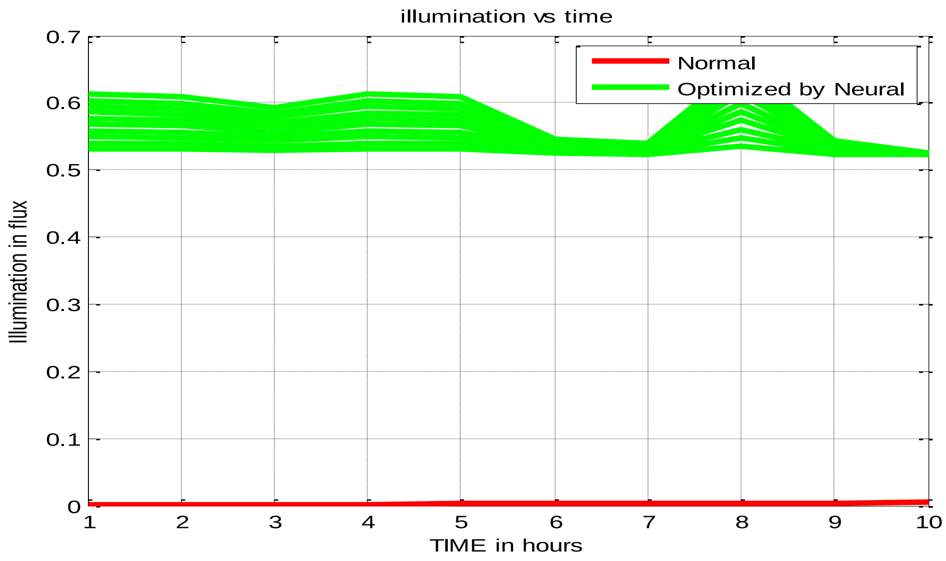

Fig.6.14 Comparison graph for cloudy weather

Above figure shows that without optimization poor results are obtained which are shown by red line? Whereas, with optimization i.e when neural is used energy harvesting is more which is shown by green lines. The approximate average value obtained from the above graph with and without optimization are .585 flux and .001flux respectively.

6.4.3 Results for dark or other type of weather

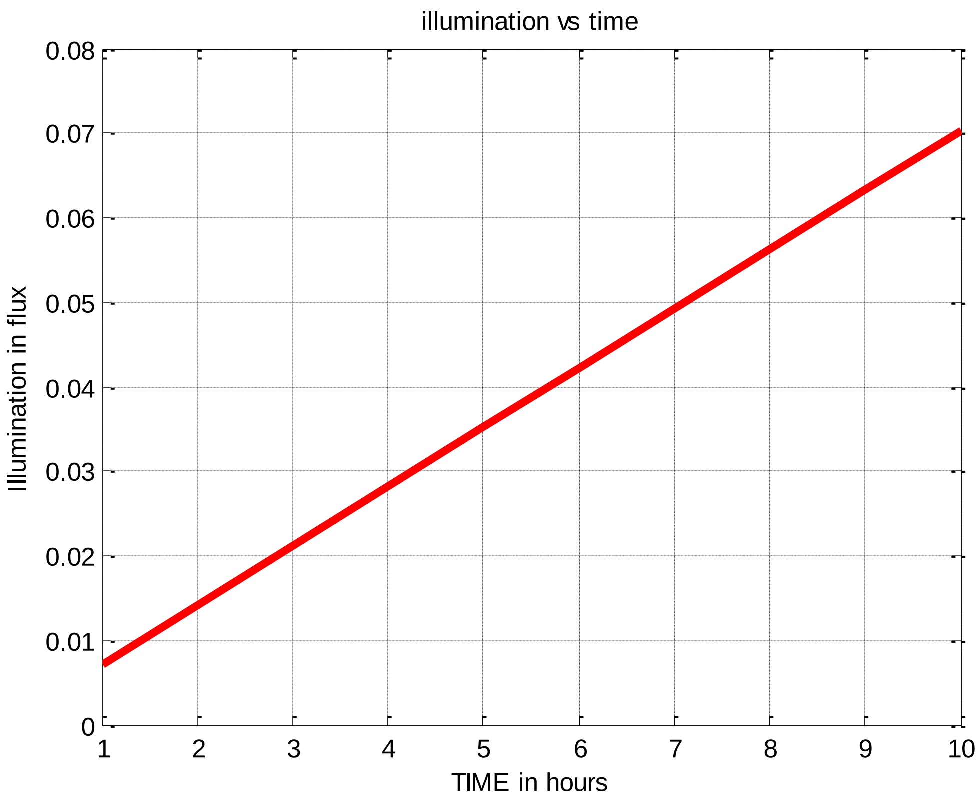

Fig. 6.15 illumination vs. time graph for dark and other type of weather

The graph obtained for dark and other type of weather is linear having average value approximately equal to .035 flux. The value obtained for these weathers lies between the value of illumination obtained for sunny and cloudy weather.

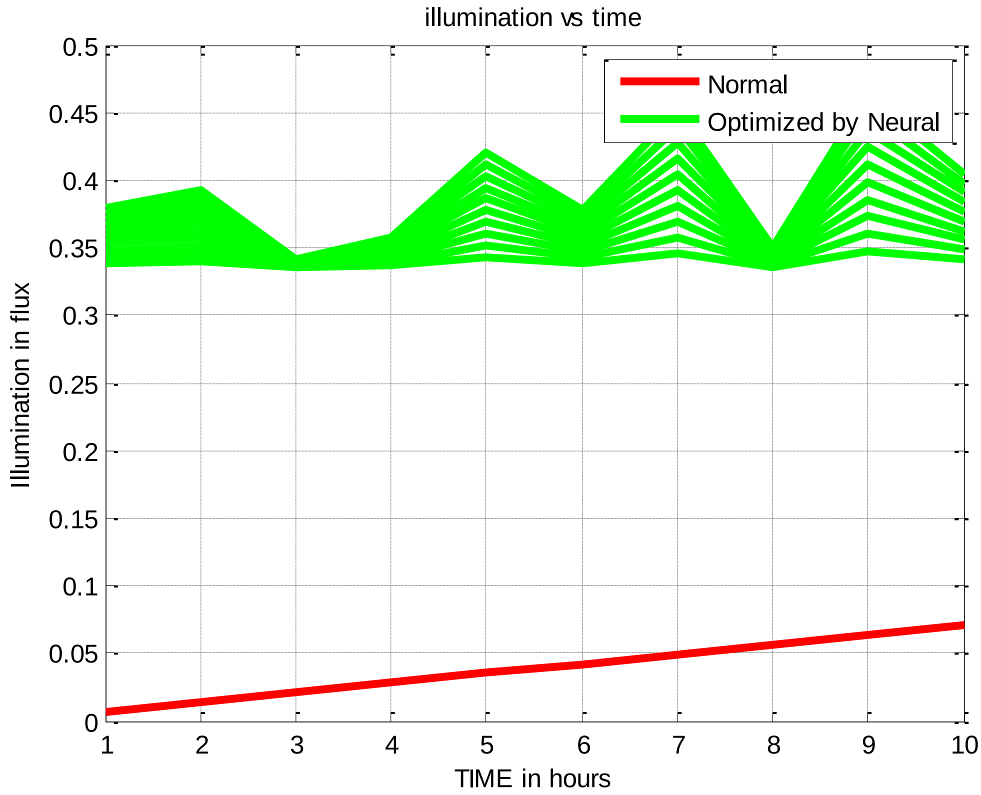

Fig.6.16 Comparison graph for dark and other type of weather

Above figure shows that without optimization poor results are obtained which are shown by red line? Whereas, with optimization i.e when neural is used energy harvesting is more which is shown by green lines. The approximate average value obtained from the above graph with and without optimization are .395 flux and .035 flux respectively. When these values are compared with the graph obtained for sunny and cloudy weather, we will come to know that the value obtained from the above graph lies between the values obtained from these two weathers.

CHAPTER-7

CONCLUSION

This study provides validation for need to modify current solar energy performance models to better estimate the influence of snow on solar panels for installation in climates where snowfall is common. As we know that Energy harvesting as a procedure by which the energy is being derived from outside sources like solar power, thermal power, wind power, hydro power etc. and storing these energies for a period of time and process them so that they could be utilized later like operating a microprocessor in the limits. Energy harvesting has great promise for low-voltage as well as low-power applications in a large range of portable/mobile markets such as consumer devices, medical equipment, industrial controls, transportation and military. The aim of the research work is to harvest energy. For this purpose, feed forward back propagation neural network has been applied. The developed ANN forecasting model is able to measure the total illumination against the total time of harvesting. The total time of harvesting taken in the proposed work is 10 hr. whereas, the size of the room is 100×100 and the initial flux generated is 13000. The total energy harvesting has been observed for three type of environment namely: Sunny, Cloudy, for dark and other type of weather. From the experiment it is concluded that The illumination obtained for sunny weather is higher than the cloudy weather .Whereas, the illumination obtained for dark and other type of weather lies between sunny and cloudy weather, Illumination value obtained for sunny weather, cloudy weather, dark and other type of weathers are .07 flux,.012 flux and .035 flux respectively. Also the total energy harvesting obtained for all these three environment has been shown in the form of graph and it is concluded that in sunny weather energy harvesting is higher than the cloudy weather whereas, for dark and other type of weather energy harvesting obtained lies in between these two weathers.72 illumination in flux has been harvested for sunny weather. Whereas, for cloudy weather .585 illumination in flux has been harvested .For dark and other type of weather .395 illumination in flux has been harvested.

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