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Design and Implementation of an Energy Load Management using Artificial Neural Network

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Abstract: The design and implementation of the energy load management is proposed in this paper. The proposed system executes the load prioritization and encourages the real time monitoring of the associated loads in view of the predefined maximum load. This paper proposes the arrangement of a self-decision control framework using Artificial Neural Network (ANN).The ANN is used to generate effective energy load designs. The condition of load is controlled by microcontroller which depends on upon real time monitoring data through PC with the utilization of RF transreceiver module for communication .The server can control each one of the load depend on upon the continuous data from the sensors which are associated with the controller .The real time data of the process is sent to the customer through IOT. To avoid shortage of power on the required load the ANN Algorithm is executed in this system.

Keywords: Electricity, Energy management, Real time monitoring, ANN, IOT.

I. INTRODUCTION

Energy In everyday life the hunger after power is winding up noticeably more in the meantime the availability of power is less. Because of the advancement of new advances in the field of electronics has tremendous growth. Various Load management procedures are utilized for energy management .Load management is the way toward adjusting the supply of power on the system with the electrical load by modifying or controlling the load as opposed to the power station output .New load management technologies are continually being worked on both by private industry and public entities. Hence one of the technologies being developed is priority load management. A priority load management framework has been created keeping in mind that the end goal to pick up an ideal energy management over system load and battery storage, and in this manner gives a better management efficiency and assurance the energy supply for basic load. In industries there is significance of energy management. Because of poor energy management in system there is tremendous energy loss occurred. The system is proposed to decrease the power request in public and private sectors and to provide supply on need. Through this system the power supply is controlled and supplied. The electric supply is turned off when it crosses over the limit control level when it crosses above the threshold power level this switching is done with the help of relays. The power estimation is finished with the help of power measuring circuit which is associated over the supply and to the controller in which the projects are embedded. The RF transceiver is utilized to control and communicate with the electrical plugs. This system is comprised of Artificial Neural Network (ANN) is utilized to prioritize the load according to power demand .The ARM reads the wattage of the circuit continuously. The ANN can control every one of the loads rely on upon the continuous information from the applicable sensors which are associated with controller. To keep away from the lack of energy the ANN Algorithm is implemented in this system.

II. RELATED WORK

Presently, there is a development in the interest for power. The unit duty and online dispatch are the fiscally arranging issues .The proposed work illuminated the perfect estimation for load shedding. The technique gives a quick calculation to load shedding. In load shedding process detach the base possible weights from framework and it diminish the manual effort [1].Each load sort has particular qualities between atmosphere conditions and electric burdens. Each load sort similarly has particular characteristics among weekdays and alternate days. This paper proposes an electric load deciding technique by an ANN considering diverse load sorts. The proposed technique utilizes diverse load sorts data set away in branch work environments. An evaluating model for each load sort identifying with the each trademark is created in the proposed strategy [2].In ANN the most extreme load to each area and the additional load required to any region are the sources of data and influence created and control adversities are the outputs . Back propagation Neural (BPN) Network figuring is proposed for the scheduling different thermal power plants. ANN based Hydrothermal Scheduling was proposed by M.Suman, et.al. In our proposed work ANN is set up with different load request. When it has been prepared it secures the ability to give stack arranging outline for any regard for load request. In this planning the total load is shared to hydro and warm power stations as showed by the cost of time [3].The electrical vitality ask

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for in any country depends on upon the amount of parameters, for instance, temperature, time, stack, masses. To set up a framework using this number of parameters would be troublesome. So we select a ideal number commonly free of information sources. There is no convincing reason to reveal any change in the yield created by the power plants. If any area requires additional energy to meet the load requirement, system checks the areas with their most extraordinary load. This correlation helps us to find the base load required units and schedule this load to the required area. The system never encroaches upon the power source. Essential purpose of the proposed work is to diminish the power time cost and make the availability of energy on demand with no distortion. The proposed neural framework will contains three input neurons, four middle layer neurons and one output neurons. The contributions for the neural frameworks are the power interest for each region, additional power required to each region in light of additional load and power loss. The yield indicates control required for entire zone [4].The ANN is used to make the energy beneficial load designs. The proposed framework characterizes the home energy administration framework will screen, manage and control the use of home machines. This venture displays the framework of a self-ruling household control framework using Artificial Neural Network (ANN). The family control structure interfaces sensors and control loads with PIC controller. The server can control each load depend on upon the consistent data from the huge sensors which are related with controller. To stay away from the absence of drive the ANN Algorithm is completed in this structure [5].

Nagendra Kumar Suryadevara,Subhash Chandra Mukhopadhyay specified about the real time observing and controlling structure for family unit machines. The zigbee based structure lessens the standby power. The sensors screens the electrical parameters, for instance, voltage, current the joined sensor yield is then sent to the zigbee module. The data is remotely sent to the host PC and set away in the database. The continuous information is given to the customer by technique of the central hub server and the customer can screen and control the machines [6].

The execution of model hardware and software design for Automated Electric Meter Reading and Monitoring System using ZigBee Integrated Raspberry Pi.The objective of this wander was primarily to create a load at yield. Keeping in mind the end goal to meet this objective, the data is secured in the Raspbian OS of the equipment pack Raspberry which is executed with the essential data set away. The data set away in this venture is to keep up the synchronization between the co-plan of equipment and programming. This is executed in the venture which can be used as a piece of wide variety of continuous applications [7]. In this architecture, we proposed a clear management system, which is having a priority based control system. This is nothing but, when the server sends the command signal then the unit will go to the particular priority mode. So that power requirement can be fulfilled on demand and wastage of power will be prevented . In implementation we are sending the signal from the hardware section using RF transceiver module as a Transmitter, In the Receiver part another RF transceiver module connected to the server section. After receiving the signal ARM checks the priority and sends an interrupt to the connected relays. According to the priority interrupt the Load will change. This continuously monitored data is send continuously to the client through IOT technology.

III.METHODOLOGY

An artificial neural system is a data handling framework in which the components called neurons calculate the data required and generate signals. The signs are then communicated by methods for associating links. The links highlight related weight, which is then multiplied by the incoming signal in a typical neural net .The generated signal is then acquired by applying activations to the net info. An artificial neuron network portrayed by the accompanying features:

- Architecture (Connection between Neurons)
- Training or Learning (Determining Weights on the Connections)
- Activation Function (to minimize errors in modelling)

After establishing the basis of neural nets, one move to the practical networks, their applications and how they are trained. There are several algorithms accessible now to build a artificial neural system presently we used the back-propagation (BP) training algorithm .In the Back-propagation network, at first the weights are calculated discretionarily. In like manner, the outputs are likewise item arbitrarily. However, the outputs so calculated are contrasted and the actual /desired outputs by the network and the error is passed on to the initial layer, this "back propagation" process brings about correction of the weights. The transfer function utilized inside the nodes in this back-propagation network is the 'sigmoid function'.

The network starts figuring its output values bypassing the weighted inputs to the nodes in the main layer. The resulting yields of that layer are passed on, through an out and out various arrangement of weights, to the second layer, and so on until the point that the nodes of the yield layer compute the last outputs. For this situation, each data parameter (s) and output parameter (t) is standardized. After training is over the network simulates the value to be tested. The simulated or assumed outputs and actual outputs that are in normalized state are then altered back to original values by post processing. Back propagation algorithm is explained below

1. Start
2. Read all the input values, target values, learning rate coefficient. input node, output nodes, total number of input layers , maximum value of input, maximum value of target and constant,

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3. Each hidden unit receives the input signal and transmits the signal to all units in the layers.
4. Each hidden unit adds all weighted input signals.
5. Process output of hidden layer through a non-linear function to produce output of hidden layers.
6. Each unit update with its bias and weights.
7. Calculate the final output.
8. Test stopping condition.

IV. PROPOSED MODEL

The proposed Energy load management system uses ARM as a heart of the system and WSN communication as a transmission and receiving medium for the data transfer and receive.The power management priority settings will be programmed by ANN. Current transformer is step up transformer provided to sense the exact current flowing of the particular load. Power transformer is step down transformer used to measure the voltage of particular load. The current and voltage reading is given to processor. Processor continuously reads the power of each load in the circuit. Relay circuit is used to control the loads. For consumer purpose this information will be display on the LCD.RF Transceiver module is provided for continuously transmitting and receiving the data from the hardware to provide data to MATLAB and vice versa.ANN is used to monitor, manage and control the load management using MATLAB. The algorithm used is back propagation neural network which is used to prioritize the load. This can be implemented for both linear and non linear loads.

In the Energy load management system there are two important sections. One is hardware section and the next one is MATLAB .The two sections communicate with each other through RF transceivers .The LCD is connected to the PORT 0 and relay circuit is connected to PORT 1 of ARM. The CT is connected to ARM through ADC0.The power circuit supplies 230V to power transformer, current transformer and auxiliary loads .Transformer converts 230V into12V which is supplied to whole circuit. Simultaneously this power supply is given to the relay driver circuit (ULN 2803) is used to convert the voltage of 5V to 12V to further drive the relay. A 3.3V supply is provided to the ARM processor. The connections of the project are as displayed as shown in fig 1.

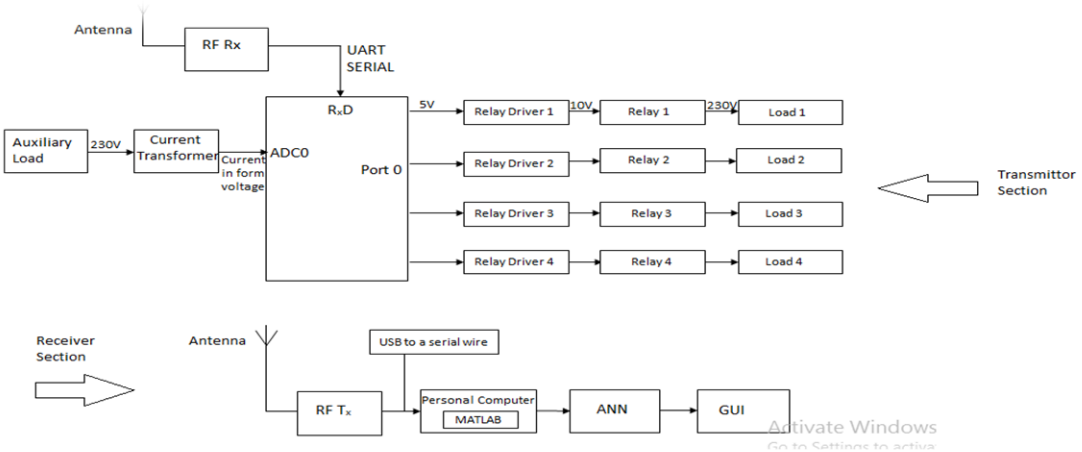

Fig 1. Architecture of System

In implementation we are sending the signal from the hardware using RF transceiver as a Transmitter, In the Receiver part another RF transceiver module connected to the PC. The ARM reads the equivalent load current and load voltage in the circuit. The information will be processed by the processor and it will calculate the amount for that consumed power. For consumer purpose this information will be display on the LCD.This wattage information is calculated continuously by ARM processor.This calculated value is send to the PC from the hardware section using RF transceiver module at 2.4 GHz frequency 9600 baud rate. This received value of wattage is given to ANN in MATLAB. Back propagation network neural network is used for prioritizing load. This prioritize load in 4 modes according to their power wattage. Modes are characterized according to the table shown below as

INPUT WATT RANGE	MODE	OUTPUT
0≤W≤50	M1	L1 L2
50≤W≤100	M2	L2 L4
100≤W≤150	M3	L1 L3
150≤W≤200	M4	L2 L3

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This basically operates in two modes. They are explained as

- Manual Mode: The user can switch ON or OFF the loads without setting the maximum demand limit. The electrical parameters are being monitored on real time basis and displayed on the screen.
- Automatic Mode of operation: The load priority is set as per the user requirement and the maximum demand limit is specified. Once the time window is preset the system will enter into automatic mode of operation if the connected loads are exceeding the threshold limit then the low and moderate priority load will be switched off keeping the highest priority load ON. The loads are reset once the time window has elapsed. As shown in fig. 5, in case of manual mode of operation the system operates without any preset demand value and the loads can be manually turned ON and OFF.

ANN reads this value and prioritize the load according to power requirement. In the Receiver part RF Transceiver is connected to the PC. After receiving the signal from the server it sends to the signal to the ARM7 processor, after receiving the signal ARM7 sends an interrupt to the connected relays. Relays are driven by relay driver IC 2803. According to the priority decided by ANN,ARM interrupts the Loads will operates .Then the loads get ON/OFF through the load management system.This continuously monitored data is provided to the client through IOT .This forwarded information is used by client to know the amount of power used by the connected load at each time.

ANN

The neural network proposed will have feed forward network having one input neurons, three middle layer neurons, one output neurons and one bias neuron. The inputs for the neural network are load demand. The outputs are priority assignments. The network is trained with Back Propagation Algorithm using Gradient Descent method. In the proposed method 'tansig' for hidden layers, and 'purlin' for output layer activation function used. Error will be calculated between expected output and actual output. Error is back propagated and weights are adjusted in such a way that actual value move towards the expected value, means error is back propagated until the actual output is equal to desired output. In the process if actual output is equal to the desired output then the neural network is said to be trained.

Flowchart:

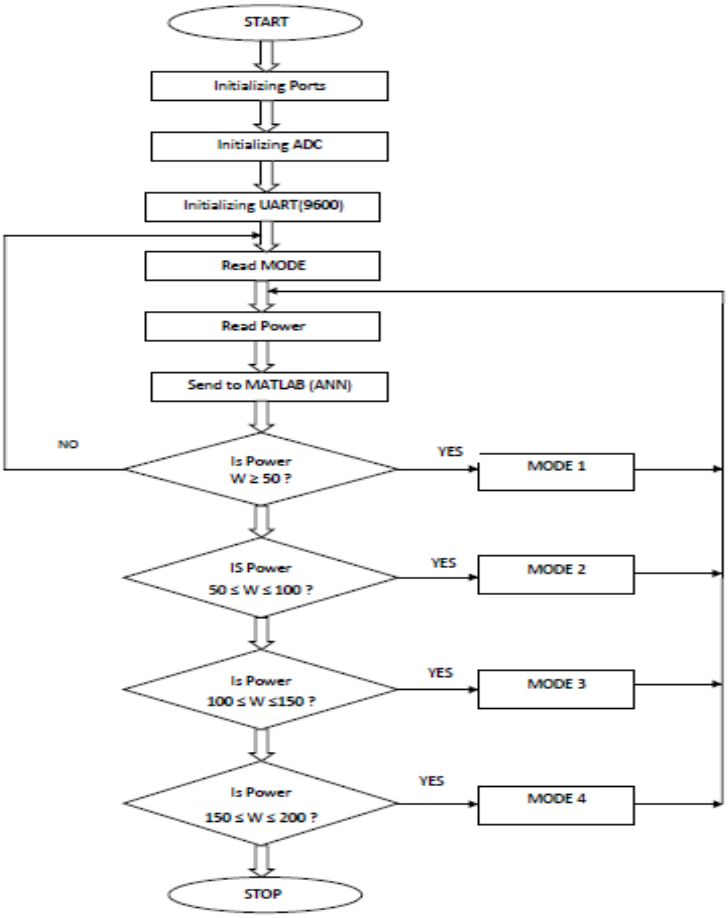

Fig 2: System flow

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V. RESULTS AND DISCUSSION

The hardware model of load management system is shown in figure 3.The loads are interconnected .The LCD, RF transciever and current sensors are initialized the current sensors will continuously monitors the connected load and provides the load current and load voltage in the circuit to the ARM. The information will be processed by the processor and it will calculate the amount for that consumed power. For consumer purpose this information will be display on the LCD. This wattage information is calculated continuously by ARM processor and is provided to ANN and it takes priority set by the user.

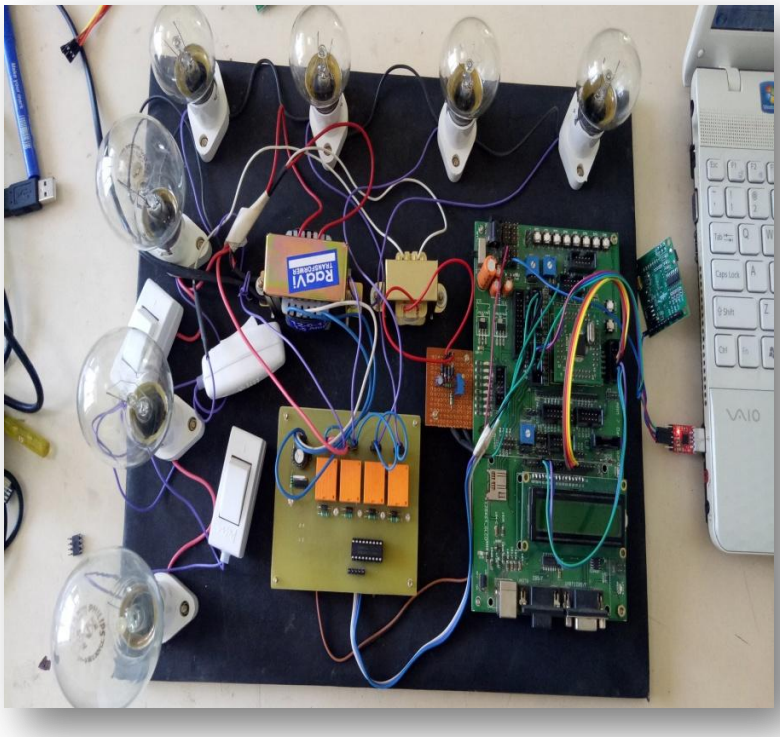

Fig 3: Overview of the system

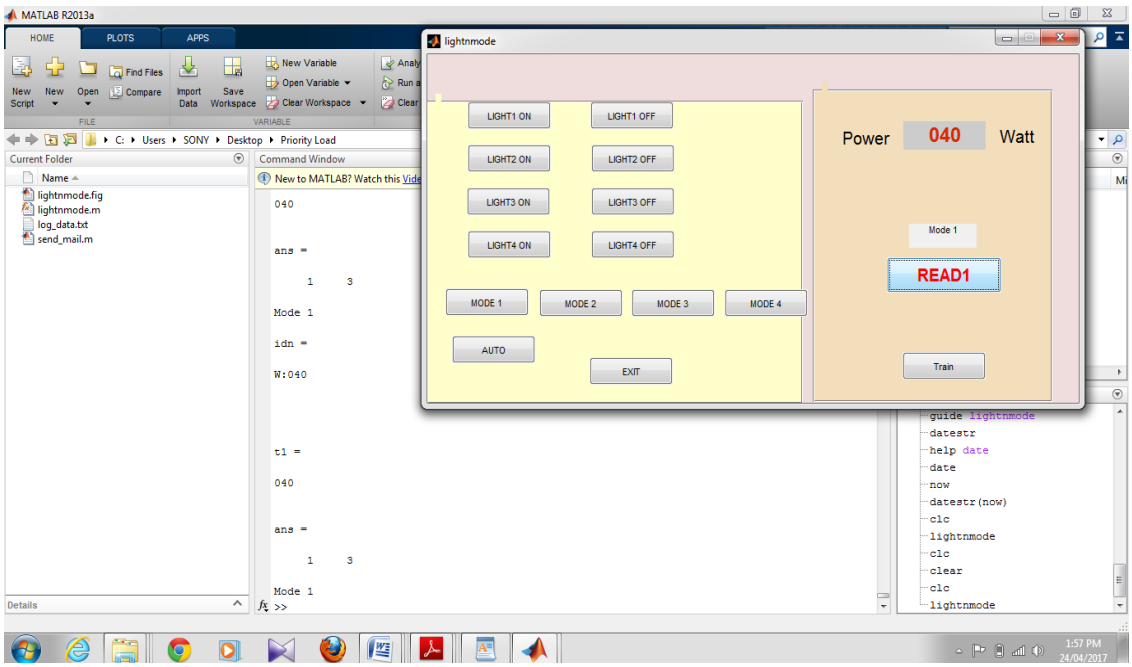

Fig 4.Graphical user interface of priority load management system.

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Fig 4 shows graphical user interface through which we can turn ON/OFF the loads .The calculated power is also shown on the screen. The continuously monitored data is forwarded to the client through IOT .This forwarded information is used by client to know the amount of power used by the connected load at each time provided to the client through email. Fig 5 shows the data transmitted to the client thorugh mail which conatins the mode in which load operates ,date and time.

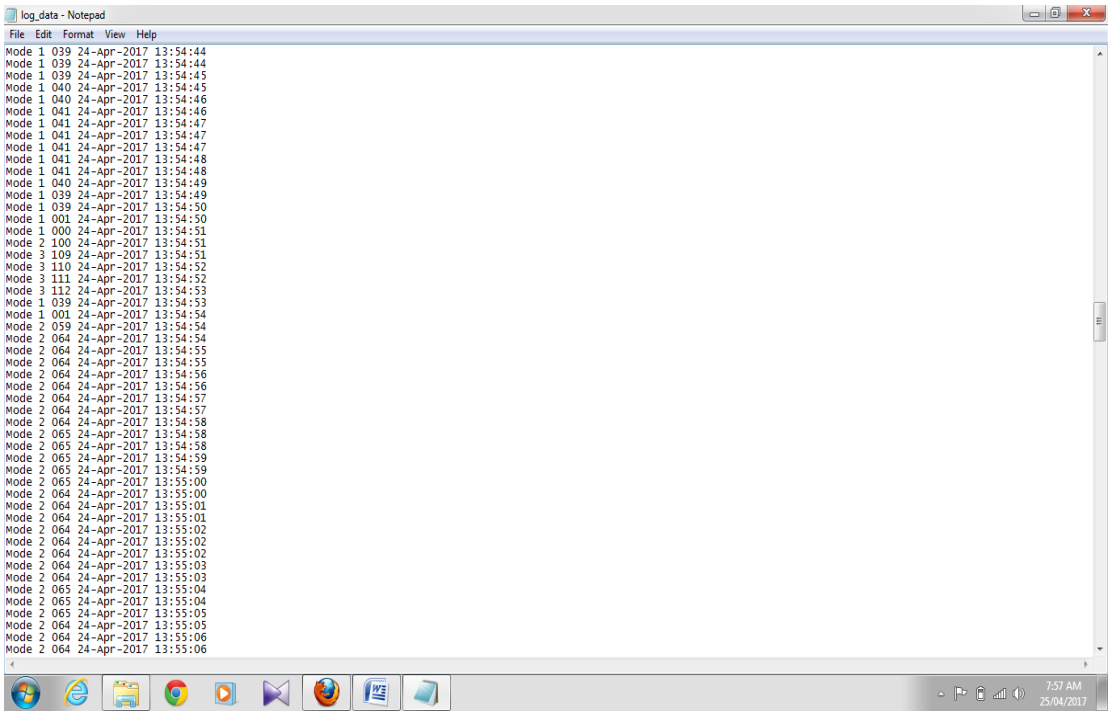

Fig 4 .Capture of real time data of process

Figure 6 shows the graphical representation of mode of operation. According to the demand of auxiliary load, all the connected loads are set in the desired priority the various power values within the desired mode are plotted and the total power consumption for a particular period is as shown in the figure below.

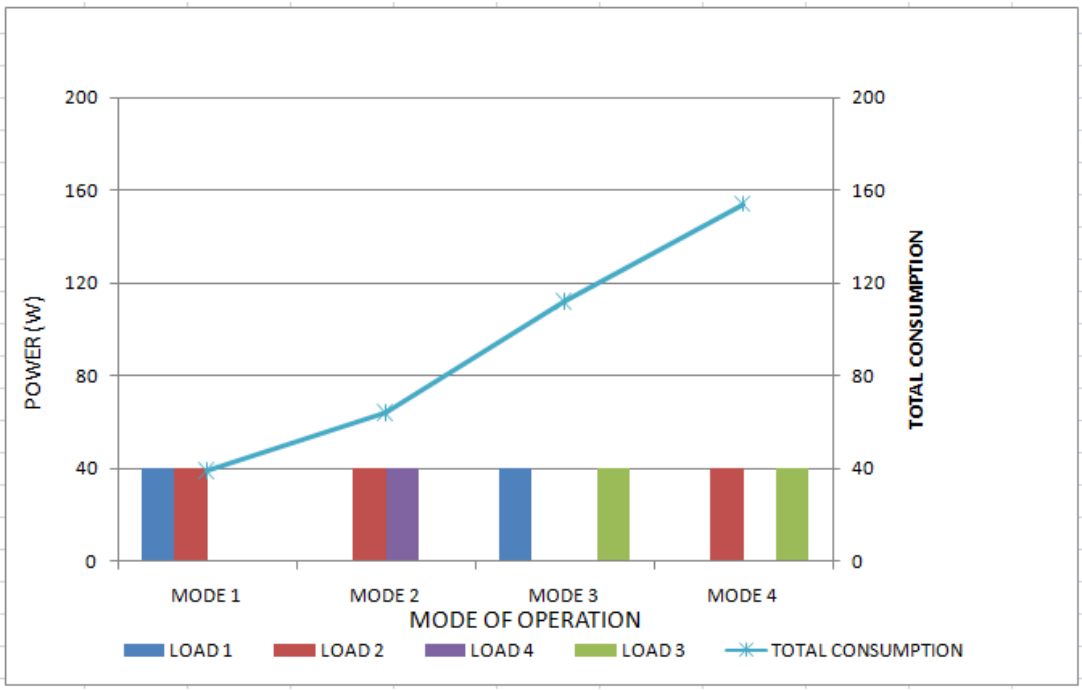

Fig 4.Graphical representation of priority load management system.

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VI. CONCLUSION

Power consumption is an essential need in the day to day life. The aim of this project was mainly to encourage the real time monitoring of the associated loads in view of the predefined maximum load and to build a load at output . In this system, Arm will continuously monitor power supply in the circuit and display section is kept in the device in which shows power reading. At the same time ANN controls the load according to power requirement which will turn on or off the load with respect to the priority.Thus the power can be managed in an efficient way. .The real time data of the process is sent to the customer through IOT technology. This is implemented in the project which can be used in wide variety of real time applications.

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BIOGRAPHIES

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