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ENERGY MANAGEMENT SYSTEM FOR PLUGIN HYBRID ELECTRIC VEHICLE

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Abstract : PHEVs are a significant module of an electric power network in the upcoming years. Energy management for PHEVs is essential for vehicle performance. Energy management in PHEVs related to the power demand throughout the travel. The power demand depends on the road condition, weather conditions and velocity. The main objective of this paper is to find the optimum power flow and to reduce the overall daily charging cost of PHEVs when subject to various constraints such as power balance constraints, Battery charging/discharging constraints and PHEVs arrival/departure State of Charge (SOC) constraints.PHEVs involve battery with different battery ratings, fuel cells as well as photo voltaic (PV) systems. Here the solar power is considered as a valuable energy source for charging of PHEVs. The process of Charging and discharging is to optimize the bidirectional energy flows between the grid and PHEVs Battery. The PHEVs charged during the periods with low electricity prices therefore owners pay minimum cost for charging their vehicles.

INTRODUCTION : Energy management is one of the major issues in transportation sector, energy sectors and also various fields. Energy management is referred as how to utilize the energy in an efficient manner it is called energy management. Air pollution and increase of fuel cost is important factor in transportation sector. PHEVs give the solutions to this problem. It provides low emission and better fuel economy compared to conventional internal combustion engine vehicles. The battery in PHEVs is designed to be fully charged using home electric plug or charging station. By using PHEVs can travel in full electric mode, which improve the fuel economy of PHEVs. Plug in hybrid electric vehicles (PHEVs) and plug-in electric vehicles (EVs) are gaining much popularity due to the global call for clean energy. Several pioneer automation companies are in the process of making PHEVs, a better option for vehicle buyers. Therefore, it is almost certain that the penetration level of these PHEVs into our national grid will keep growing. However, the grid, in its current status, is not fully prepared yet for a high PHEV penetration level. There are some problems related to their charging process; the process of charging a random number of batteries with random energy demand represents a demand side management dilemma. For instance, it is expected that, since PHEV owners within the same society are very likely to share the general outlines of their life styles, the grid will be subjected to a big demand from PHEVs batteries at the same time when people are back from work. Therefore, researchers have developed some ideas and algorithms to manage this process. The output charging rate setting of each PHEV according to these algorithms is constant during the charging period. In this paper, an RTEMA that is based on a set of priority levels of the PHEVs is developed. PHEVs will be moved from one priority level to another, and hence treated differently, based on their state of charge (SoC) and time remaining for their departure time. Moreover, previously developed algorithms did not consider the inclusion of renewable energy sources in the system, which holds the implementation of these algorithms back since we know that the concept of PHEVs is attached with obtaining the power to charge them from renewable energy. Otherwise, we end up burning more fossil fuels and hence polluting the environment even more. Saber et al. discerned this drawback and directed their work toward systems that involve renewable energy sources considering the added complexity. They aimed at minimizing the cost and emission attached with the charging process of PHEVs distributed in the network. Our Project is depends to charge the load by using the hybrid concept based on Solar PV as well Fuel Cell of the system. To find the optimum power flow and to reduce the overall daily charging cost of PHEVs when subject to various constraints. Such as power balance constraints, Battery charging/discharging constraints and PHEVs arrival/departure State of Charge (SOC) constraints.

1.1 Need of Plug-in Hybrid Technology:

The introduction of the hybrid electric vehicle to the market opened the door for advanced technology vehicles to use electric powertrains to reduce petroleum consumption by increasing fuel economy. Plug technology offers the best of both electric and hybrid electric vehicles i.e., the emission reduction benefits of electric vehicles and fuel savings of hybrid electric vehicles. A plug-in hybrid with ability to plug-in to grid electricity. A conventional HEV depends on petroleum fuels, generating required electricity on hand, has a battery pack that can be fully charged by plugg electrical outlet. In plug-in hybrids, the battery pack is the primary source of power for relatively short distances. For longer distances, once the battery has been depleted to a certain state over to hybrid mode. It has the potential to displace a significant portion of Need of Plug-in Hybrid Technology The introduction of the hybrid electric vehicle to the market opened the door for advanced technology vehicles to use electric powertrains to um consumption by increasing fuel economy. Plug-in hybrid technology offers the best of both electric and hybrid electric vehicles i.e., the emission reduction benefits of electric vehicles and fuel savings of hybrid electric vehicles. A plug-in hybrid electric vehicle is a hybrid electric vehicle with an ability to plug-in to grid electricity. A conventional HEV depends on petroleum fuels, generating required electricity on-board. A PHEV, on other hand, has a battery pack that can be fully charged by plugging into a standard electrical outlet. In plug-in hybrids, the battery pack is the primary source of er for relatively short distances. For longer distances, once the battery has been depleted to a certain state-of-charge (SOC), the vehicle would switch r to hybrid mode. It has the potential to displace a significant portion of transportation petroleum consumption by using electricity for portions of trips. Depending on the configuration of the vehicle, people who drive less than all-electric range per day would use no fuel at all. A PHEV offers most of the environmental benefits of an electric vehicle operation without giving up on the advantages of an IC engine based vehicle. One of the unique advantages of plug-in hybrid vehicles is their capability to integrate the transportation and electric power generation sectors in order to improve the efficiency, fuel economy and reliability of both systems.

From the perspective of public health, pollutants from power plants are less threatening when compared to vehicular emissions. This is because the latter are released in much closer proximity to individuals. Operating in electric only mode, plug-ins have no tailpipe emissions thus providing a potential health benefit. Indirect emissions of plug-ins are the functions of the fuel mix, efficiency of generation, transmission and distribution of the power systems while running on electricity. These emissions represent a much smaller percentage of full fuel cycle emissions of the pollutants listed for a vehicle operating on electricity than upstream emissions from a vehicle operating on petroleum fuels. Several studies have found that when charged from the grid, plug-in hybrid electric vehicles emit less CO_2 and other pollutants over their entire fuel cycle than conventional vehicles and hybrid electric vehicles. Thus, PHEVs may reduce the emissions impact of the transportation sector in many regions where grid electricity is effectively a cleaner source of transportation fuel than petroleum fuels. When compared to non-plug-in hybrids, a plug-in hybrid offers 25–55% reduction in NO_x, 35–65% reduction in greenhouse gases and 40–80% reduction in gasoline consumption. With regard to greenhouse gas emissions, plug-ins are more advantageous than hybrids with clean power. Indeed, one of the great advantages of plug-ins is that the electricity used to power the vehicle may be derived from any combination of energy sources, including coal, nuclear, natural gas, oil or renewable sources such as hydropower, solar or wind. Plug-ins greenhouse gas benefits would grow in a future scenario in which power sector CO_2 emissions are reduced from present levels.

1.2 Benefits of Plug-in Hybrid Technology

The most clear-cut benefit of plug-in hybrids is their ability to reduce petroleum consumption by providing electric power operation for a substantial fraction of daily driving. In addition to all-electric range, ultra-low emissions during engine operations are achievable with simple engine controls and standard catalytic converters. The overall benefits of PHEVs can be listed as follows: PHEVs are two or three times more fuel efficient than conventional vehicles.

They display reduced fuel consumption and tailpipe emissions even when compared with HEVs.

They can use any decentralized renewable energy based power, thus reducing the dependency on fossil fuels.

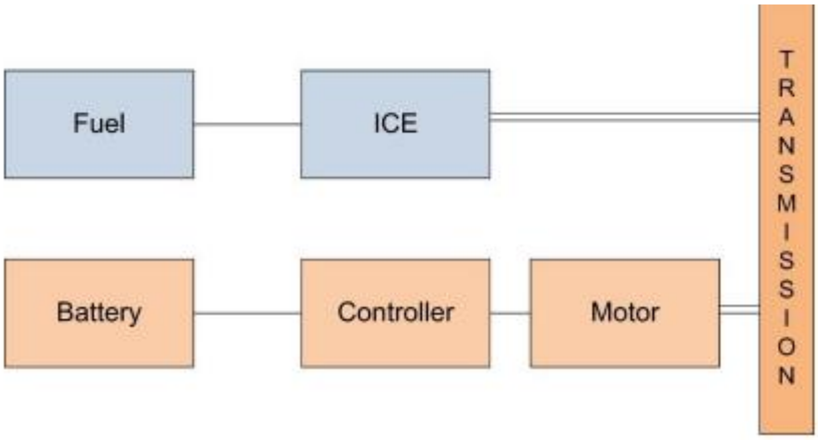
They can recover energy from regenerative braking, thus minimizing energy loss.

Unchanged fuel filling station infrastructure. Home based battery recharging at a fraction of the cost of petroleum equivalent.

The IC engine will serve as a backup power source when the battery is depleted.

1.3 Modelling of Hybrid Electric Vehicle

The architecture is of HEV is broadly classified on the basis of sequence of energy flow between the components. The basic classification of HEV is series and parallel. The series architecture suffers drawback of double energy conversion process and associated losses, additional weight of generator and traction motor sizing requirements. The parallel architecture uses IC Engine and motor both to propel the drive thus provides opportunity to switch on and off the IC Engine for controlling the fuel economy. it is essential to develop the vehicle models for a precise prediction of fuel consumption for varying load conditions.



The two input of driving force makes the modelling of HEV and its components more complex than conventional vehicles. Mathematical modelling includes comprehensive, practical, updated, and easy to implement schemes.

1.4 Solar PV:

A photovoltaic (PV) system consists of one or more solar panels, an inverters, as well as other electrical and mechanical components that utilize the Sun's radiation to create power. PV systems come in a wide range of sizes, from small rooftop or portable devices to large utility-scale power plants. Although PV systems can run off-grid, this article concentrates on PV systems that are linked to the utility grid, also known as grid-tied Power system. Grid-connected or stand-alone, stationary or tracked, flat plate or concentrator operation, photovoltaic systems are utilized in a wide range of applications and can be configured in a variety of configurations. The battery must be considered while defining PV system specifications. The quantity of battery storage required is determined by the load energy consumption as well as local weather patterns. The expense of keeping costs low vs satisfying energy demand is always a trade-off. A variety of fundamental battery properties can have a substantial influence on the operation of a PV system. PV systems have the unique potential to produce electricity for local consumption in regions where there are no power lines and expensive fuel is in short supply. They can provide electricity to locations that would otherwise be without it, as well as raise the standard of living in those locations while being ecologically friendly. They can power water pumps in locations where this vital resource is scarce, medical health centers that previously lacked enough or consistent electricity, and communities that are largely shut off from one another world and where activity ceases as the sun sets. Temperature impacts, recharge efficiency, charge voltage, and the period of time a PV battery can sustain the load without using energy from the PV array are among the most essential qualities. It's critical to properly identify battery charging needs and satisfy them with suitable charge management voltage and current.

PV materials and devices change sunlight into electrical energy. A single PV device is known as a cell. A distinct PV cell is usually small, classically producing about 1 or 2 watts of power. These cells are complete of different semiconductor device materials and are often less than the breadth of four human hairs. In order to continue the outdoors for many years, cells are sandwiched between shielding materials in a blend of glass and/or plastics. To boost the power output of PV cells, they are associated together in chains to form larger units known as components or panels. Modules can be used individually, or several can be coupled to form arrays. One or more arrays is then related to the electrical grid as part of a broad PV system. Because of this modular structure, PV schemes can be built to meet virtually any electric power need, small or large. PV modules and displays are just one part of a PV system. Systems also embrace growing structures that point panels toward the sun, along with the mechanisms that take the direct-current (DC) electricity produced by modules and convert it to the alternating-current (AC) electricity used to power all of the applications in your home. The main PV systems in the country are placed in California and produce power for utilities to distribute to their customers. The Solar Star PV power station harvests 579 megawatts of electricity, while the Topaz Solar Farm and Desert Sunlight Solar Farm each yield 550 megawatts.

2. DEVELOPMENT PROCESS

2.1 REQUIREMENT ANALYSIS AND SPECIFICATIONS

The requirement engineering process consists of feasibility study, requirements elicitation and analysis, requirements specification, requirements validation and requirements management. Requirement's elicitation and analysis is an iterative process that can be represented as a spiral of activities, namely requirements discovery, requirements classification and organisation, requirement negotiation and requirements documentation.

2.1.1 INPUT REQUIREMENT AND OUTPUT REQUIREMENTS

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

What data should be given as input?
How the data should be arranged or coded?
The dialog to guide the operating personnel in providing input.
Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1.Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2.It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3.When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus, the objective of input design is to create an input layout that is easy to follow

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2.Select methods for presenting information.

3.Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

Convey information about past activities, current status or projections of the
Future.
Signal important events, opportunities, problems, or warnings.
Trigger an action.
Confirm an action.

2.2 RESOURCE REQUIREMENT

HARDWARE REQUIREMENT

Processor Type - i3 and above

Speed -2.4 GHZ

Ram - 4 GB

Hard disk -200 GB HD

SOFTWARE REQUIREMENT

Operating System - Windows 10

Software Programming Package - MATLAB R2021a

3.MATLAB programming:functions

Matlab comes with built-in functions. However, the user can program its own functions (in regular text files with .m extension) to process data in a customized manner.

Check the MATLAB documentationonhowtowriteyourownfunctionswithdifferentnumberofinputandoutputarguments:

>> doc function

BASICS OF DIGITAL IMAGE PROCESSING

Digital Images Monochrome (grayscale) images can be modeled by two-dimensional functions $f : R^2 \to R$. The amplitude off at spatial coordinates (x, y), i.e., f(x, y), is called the intensity or gray level at that point, and it is related to a physical quantity by the nature of the image acquisition device; for example, it may represent the energy radiated by a physical source. We will deal with bounded (i.e., finite) quantities, and so $|f| < \infty$. Common practice is to perform an affine transformation (substituting $f \leftarrow af + b$ for all (x, y) by means of some suitable constants a, b) so that f takes values in a specified interval, e.g., $f \in [0, 1]$.

A digital image can be modeled as obtained from a continuous image f by a conversion process having two steps: sampling (digitizing the spatial coordinates x, y) and quantization (digitizing the amplitude f). Therefore, a digital image may be represented by an array of numbers, $M = (m_{ij})$, where i, j and m can only take a finite number of values, e.g., $i = \{0, 1, \ldots, W - 1\}$, $j = \{0, 1, \ldots, H - 1\}$ and $m = \{0, 1, \ldots, L - 1\}$ for some positive integers W, H, L (Width, Height and number of gray Levels)2 . That is, a digital image is a 2-D function whose coordinates and amplitude values are discrete (e.g., integers). Specifically, $m_{ij} = q\, f(x, y) = q\, f(x_0 + i \cdot \Delta x, y_0 + j \cdot \Delta y)$, where Δx and Δy are the sampling steps in a grid with spatial coordinates starting at some location (x_0, y_0), and $q : R \to \{0, \ldots, L - 1\}$ is the input-output function of the quantizer (stairway shape).

Common practice for grayscale images is to use 1 byte to represent the intensity at each location (i, j) (i.e., picture element or "pixel"). Since 1 byte = 8 bits, the number of possible gray levels is $L = 2^8 = 256$, and so intensities range from i = 0 (black) to i = L − 1 = 255 (white). However, to numerically operate with grayscale images, it is convenient to convert the data type of the image values from integers to real numbers, i.e., from 8 bits to single or double precision. Once operations are finished, it may be convenient to convert back to 8-bit format for storage of the resulting image, thus producing a quantization of the data values. Medical images are usually represented with a larger depth (10-12 bits) to mitigate the occurrence of visual artifacts due to the quantization process.

Color images can be represented, according to the human visual system, by the combination of three monochrome images (with the amount of red (R), green (G) and blue (B) present in the image), and so, each pixel is represented by 3 bytes, which provides a means to describe $2^{3\times8} \approx 16.8$ million different colors. Many of the techniques developed for monochrome images can be extended to color images by processing the three component images individually. The number of bits required to store a (grayscale) digital image is $b = W \cdot H \cdot \log_2(L)$, and so compression algorithms (such as JPEG) are essential to reduce the storage requirement by exploiting and removing redundancy of the image. Spatial resolution is a measure of the smallest discernable detail in an image, and it is usually given in dots (pixels) per unit distance. That is, it is the density of pixels over the image, but informally, the image size (W × H pixels) is regarded as a measure of spatial resolution (although it should be stated with respect to physical units - cm, etc.). It is common to refer to the number of bits used to quantize intensity as the intensity resolution.

Loading animage

To read an image from disk, use the command imread:

>> A = imread('example.tif');

To see all the supported file formats and options of this veil-in function, you may type

>> doc imread

Once variable A has been created, we may see its properties by typing:

>whos A It will return that A is a variable of type uint8 (unsigned integer represented by 8 bits = 1 byte) and it is a multi-dimensional array/matrix of size 650 × 600 × 3, i.e., an image of 650 × 600 pixels and three components or bands, thus, it is a color image (in RGB format).

To know more about the attributes of an image, you may use the command imageinfo, which is part of the Image Processing Toolbox:

>>imageinfo('example.tif')

Displaying an image and coordinate axesconvention

To visualize an image without loading it in the workspace (not creating a variable), you may type:

>>imageview('example.tif')

To visualize the image that has been previously loaded in variable A, you may type:

>> figure, imagesc(A)

This will create a new window and display a color image. By default, it will also show the tick marks in both axes, in pixel units, and in the "matrix" axes mode (>> axis ij), as opposed to the "Cartesian"axesmodeimpliedby(>>axisxy).Inthe"matrix"axesmode,thecoordinatesystem originisattheupperleftcorner,withthepositive*i*axisextendingdownwardandthepositive*j*axis extending to the right. This is a conventional representation from the way CRT displaysworked.

To properly set the aspect ratio of the figure, use

>> axis equal tight

If you have the Image Processing Toolbox.

type >> figure, imshow(A,[]) to visualize the image in variable A. You may also try (>> axis on) to visualize the axes; (>> axis off) to hide them.

If the image was an indexed image that stores colors as an array of indices into a colormap (e.g., a GIF image), you could use (>> colormap(gray)) to display a binary or grayscale image.

To find out the intensity value at pixel (j, i), type: >>A(222,320,:) It will return three numbers R=217, G=14, B=39. Hence the color is approximately red.

This is depicted in Fig. 2. You may select and visualize part of an image using indices into the array.

For example, to visualize the pixels of A in the rectangular region between rows i∈ [200, 400] and columns j ∈ [100, 500], type: >> B = A(200:400,100:500,:);

You may close a figure window from command line by typing

>> close(fig_number) where fig_number is the number in the top bar of the figure window.

To close all figure windows, type

>> close all

Writing an image to disk

To write an array into a file with an image format,

we use the function imwrite:

>>imwrite(B,'SavedImage.tif') This will create a file called SavedImage.tif in the working folder.

You may want to check the supported image format files by typing

>> doc imwrite

Resolution Spatial resolution.

Given a well-sampled digital image, the effect of reducing the spatial resolution while keeping the number of intensity levels constant is coded.

To run the script,

type >>run_spatial_resolution in the command window.

You may have to move to the folder containing the corresponding .m file or may have to add such folder to the MATLAB path. The output produced on the input image is shown in Fig. 3. The image quality degrades as it is represented with fewer number of pixels. The coarsening effect or "pixelization" is evident when an insufficient number of pixels is used; such number of samples cannot capture the fine details present in the scene.

Filtering

1-D Filtering Convolution.

The convolution of two sequences of numbers ("signals") a[n] and b[n], $n \in Z$, is symbolized by c = a ? b and calculated according to

$$c[n] = X\infty\ k=-\infty\ a[k]b[n-k].$$

The convolution is commutative (a ? b = b ? a), so a and b can be swapped in the previous formula. In practice, we use sequences of finite length, so the summation in (1) is carried over a finite number of products.

2-D Filtering.

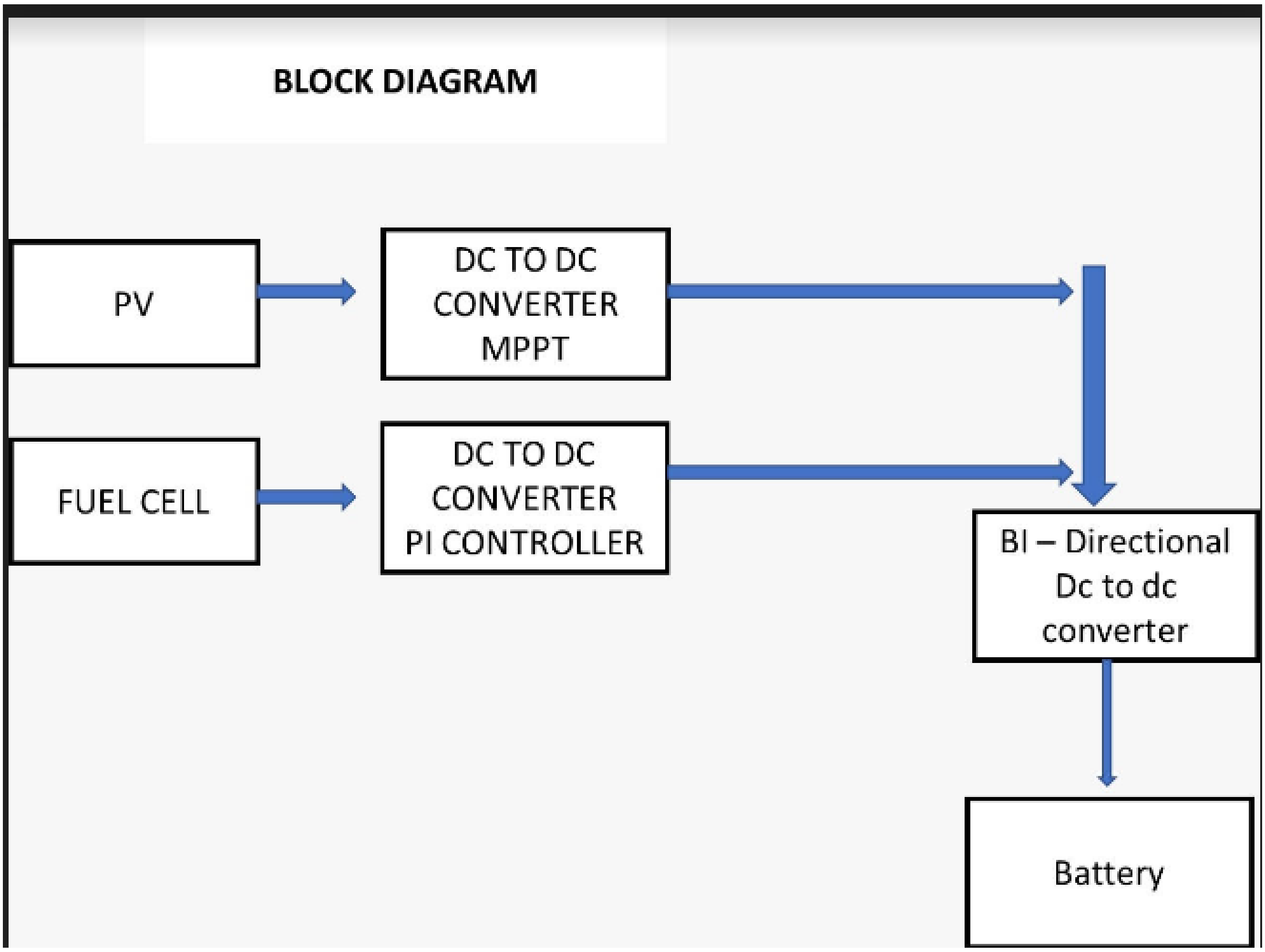
The convolution operation can be extend to two-dimensional discrete signals, i.e., monochrome images. Following the notation in the course slides, the convolution of two digital images h, f is given by g = h ? f and calculated as

$$g\ [is, j] = X\ u\ X\ v\ h\ [u, v]\ f[i-u, j-v].$$

h represents the filter (and is called "kernel" or "mask") and f the input image.

RESULT AND DISCUSSION

The proposed system Uses the MATLAP method for simulation developed in MATLAB R2018Ra and the system configuration is AMD RAYZEN 5, and processor speed is 2.9 GHz and 8 GB RAM. In proposed two work source are considered. Computational Method for Two source is analyzed.



Conclusion: The proposed method provides the optimal power flow and charging cost minimization of plug in hybrid electric vehicles. It improves the performance of V2G and G2V functionalities by using renewable sources. The photovoltaic and Fuel cell model was designed using MATLAB. The excess energy which is produced from photovoltaic and fuel cell power is transferred to the electrical network. PHEVs system is designed and charging cost is minimized by using MILP method. The proposed method satisfies the optimal power flow in the PHEVs system and also improves the system efficiency and minimizes the losses. The excess energy from renewable energy resources can also be sent to the utility grid and also satisfies the power demand.

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