SPECIAL FEATURE

Designing of a Solar Tree

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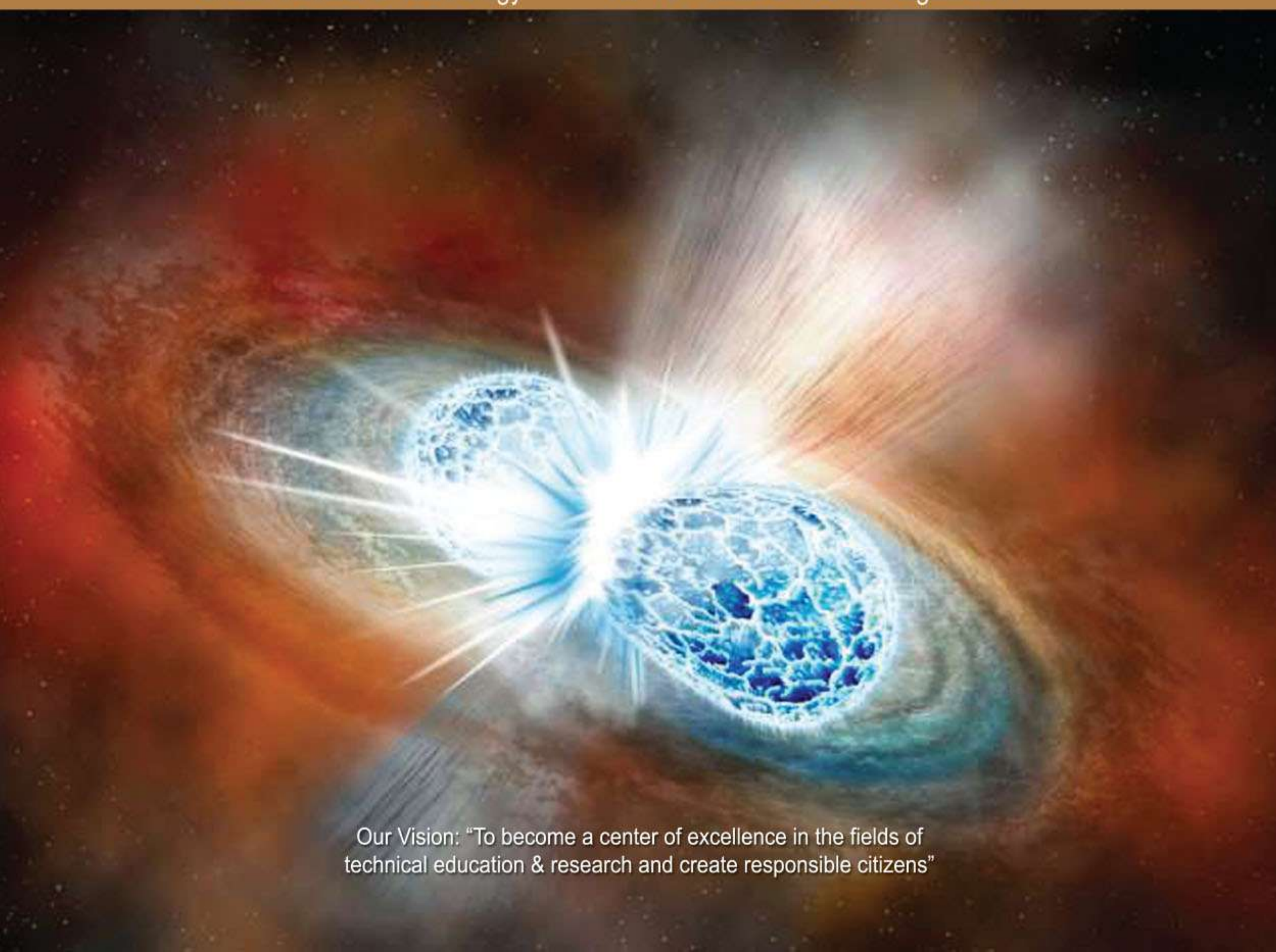

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The mystery of the cosmos...

The universe fascinates us. There is a ***cosmological principle*** which states that irrespective of who the observer is, or wherever s/he is located, the universe appears to be the same at all locations and in all directions - homogenous and isotropic on a large scale. In other words, there is no special location in the universe, neither are we special in any way. This principle is one of the pillars on which the Big Bang Theory rests; the proof is the presence of the faint and relatively uniform Cosmic Microwave Background (CMB) radiation which permeates the universe and is a tell-tale signature of the Big Bang. The CMB is left over electromagnetic radiation from the earliest of times and is well-documented by experimental evidence from the Cosmic Background Explorer (COBE). The COBE was a satellite which was operational in the early 90s, specifically designed to investigate the CMB. It determined that the universe is essentially isotropic and has a near-perfect black body spectrum with an average temperature of about 2.73 K. This evidence, along with the fact that almost all galaxies are Doppler red-shifted, gives us near conclusive evidence of the Big Bang and an expanding universe. The very faint anisotropy detected by COBE - ripples in the CMB - is believed to be consistent with structure of stars, nebulas and galaxies formed from the primordial soup in the very early universe.

The birth and death of stars, not unusual events in the cosmos, are well researched topics. The fabric of the universe is galaxies, themselves made up of billions of stars, with mind-boggling distances separating individual galaxies. Black holes are more esoteric, but a lot is known about them. Very recently in 2016, almost exactly a hundred years after the prediction by Einstein's general theory of relativity, gravitational waves were detected by the Laser Interferometer Gravitational Wave Observatory (LIGO) group. The source of the gravity wave was the inward spiral and subsequent cataclysmic merger of two black holes, of about 36 and 29 solar masses, into one black hole of about 62 solar masses. This happened at a location approximately 1.4 billion light years away from us. As predicted by relativity, this gravitational wave was a result of the mass-energy conversion of the missing 3 solar masses and generated an amount of peak energy rate equivalent to all the radiant energy of the observable stars in the universe – a staggering 3.6×10^{49} Watts! This celestial event culminated in the detection of gravity waves; the gravitational force is inherently so weak that it took something of gargantuan proportions to leave a tremor that could finally be felt.

The very existence of the universe raises fundamental questions about science, ethics, philosophy and religion. What we are able to observe, record and analyze depends on the current level of our technological prowess along with some imaginative thinking. One thing is certain - there is still profound mystery to be unearthed regarding the cosmos. As we are gradually unravelling the cosmological 'onion' layer by layer, some light is being shed about the intricate workings of nature. However, much remains to be discovered before we can come even remotely close to completing the puzzle about the universe and ourselves.

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High voltage gain DC-DC converter for photovoltaic applications using BHB cells

Abstract: *In this article the schematic and layout of multi-stage DC-DC converters are proposed for high voltage applications. A generalized converter is designed using boost half bridge cells which are connected along with voltage doublers in series for photovoltaic applications and other systems where the input voltage is low and there is a need of high output voltage. The converter is designed using PSIM software and a hardware model is implemented and results are ascertained. Different cases are studied taking different values of inputs into consideration and it is observed that along with a high boost in the output voltage, the proposed converter also served these following benefits: reduced voltage and current rating of devices thus resulting in less losses, high availability of components and flexibility in device selection due to reduced ratings, and moreover easy selection of devices according to the application under consideration as this proposed converter can be modified by increasing the number of switch legs and voltage doublers to improve the voltage and power. This converter can thus play a pivotal role in generating energy in highly remote areas which are not easily accessible by transmission lines and thus can depend upon photovoltaic renewable sources whose low voltage can be stepped to high voltage and high power values to cater to the needs of the region.*

Keywords: *Boost half bridge cell, Voltage doubler.*

I. Introduction

Modern electronic systems require high-quality, small, lightweight, reliable, and efficient power supplies. Rise in high voltage applications has indeed asked for improvements in technology, a technology which could help us harness and improve voltages for applications suited to high voltages. This is where DC-DC converters come into play.

A. DC- DC Converters

The isolated boost DC-DC converter has been increasingly needed in high power applications such as fuel cell systems, photovoltaic systems, hybrid electric vehicles, and UPS where good voltage regulation with high step-up ratio and the use of high frequency transformers for galvanic isolation and safety purpose are required. The multistage boost converter could be a choice of topology for high voltage applications, where applications require power from dc voltage sources and perform better in case they are fed from variable dc voltage sources. Considering the high frequency of MOSFET switches used in these converters there is a significant decrease in size of the transformers, filter inductors and capacitors. Further due to high operating frequency there is better dynamic response of the converter. Generally multistage

converters have several advantages over the single stage converters; easy MOSFETs selection due to reduced current rating, less power loss due to heating for presence of multiple stages, reduction in component ratings due to reduction in current.

B. Boost Half Bridge Cell

The boost half bridge (BHB) converter which is the building block for the proposed multistage boost converter has been presented as shown in fig 1. It demonstrates the following features: small input filter due to continuous input current, wide input voltage range application due to wide duty cycle range. The BHB converter with a voltage doubler rectifier at the secondary has no dc magnetizing current of the transformer, reduced voltage surge associated with diode reverse recovery, and no circulating current due to absence of output filter inductor.

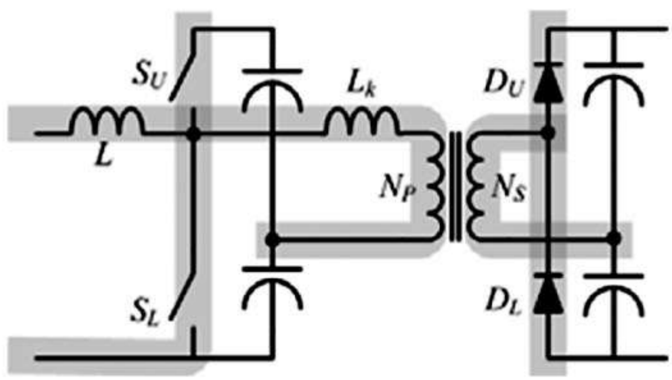

Fig. 1: BHB cell as a building block for the proposed multi-stage converter

B. PWM Switching

The use of asymmetrical PWM switching with interleaving between each leg assures several advantages. The advantages of PWM converters include low component count, high efficiency, constant frequency operation, relatively simple control and commercial availability of integrated circuit controllers, and ability to achieve high conversion ratios for step-up applications.

In this article a multi-stage DC-DC converter using BHB cells as a building block is proposed for high voltage applications especially photovoltaic applications where the input voltage is low and there is a need of high output voltage. A form of DC-DC converter is configured in such a way that the BHB cells are connected with each switch legs in parallel in the low voltage high current side and the voltage doubler rectifier are connected in series at the secondary side to increase the output voltage. Furthermore high frequency transformers are used which give an additional boost in voltage along with isolation. Therefore, the device current rating of the proposed multi-stage converter is reduced by increasing the number of parallel connection.

II. Proposed Multi-stage DC-dC Converter

A. Generalized Multi-stage DC-DC Converter

The generalized converter has *"N"* groups of converters, where each group of switch legs is connected in parallel at the low voltage high current side while each group of voltage doublers is connected in series at the high voltage low current side as shown in fig 2. That is, *"N"* is the number of voltage doublers connected in series to form the output voltage. Each of *N* groups also has *"P"* parallel connected legs, where *"P"* is the number of switch or diode legs connected in parallel to increase the output power.

For example, the "*N*th" group having *"P"* parallel-connected legs includes input inductors *LN1* to *LNP*, upper switches *SU,N1* to *SU,NP* (lower switches *SL,N1* to *SL,NP*), transformers *TN1* to *TNP*, and upper diodes *DU,N1* to *DU, NP* (lower diodes *DL,N1* to *DL, NP*) which are connected to the same output capacitors *COU, N* (*COL, N*). In summary, *"N"* should be increased to get higher output voltage, and *"P"* should be increased to get higher output power. In both cases the interleaving technique can be applied to reduce the size of input filter inductors and input and output capacitors. Therefore, *"N"* and *"P"* could properly be chosen according to given output voltage and power level. This could give flexibility in device selection resulting in optimized design even under harsh design specifications.

B. Operation of Multi-stage DC-DC Converter

This multi-stage dc-dc converter shown in fig 4 consists of a dc source, inductors, MOSFET switches, high frequency transformer, voltage doubler circuits, and load.

In this circuit number of series connected voltage doubler i.e. N=3 and number of diode legs connected to same output capacitor i.e. P=1. Initially the dc supply is given to MOSFET switches through three inductors which are connected in series with the source. These three inductors are connected only for limiting the current to switches.

After inductor there are three switch legs. The lower switches are interleaved with 90 degree phase shift and each is switched on for 120 degree. The upper and lower switches of each leg are operated with asymmetrical complementary switching to regulate the output voltage that is, D and 1-D are the duty cycles of lower and upper switches of a leg, respectively. The modes of operation are given below in fig. 4.

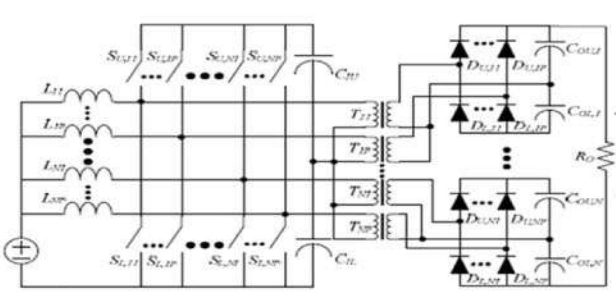

Fig. 2: Generalized multi-stage DC-DC converter (N is the number of series-connected voltage doublers, and P is the number of diode legs connected to the same output capacitors)

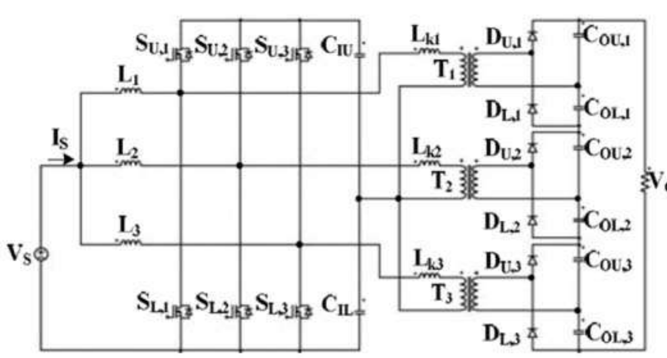

Fig. 3: Proposed converter with N=3 and P=1

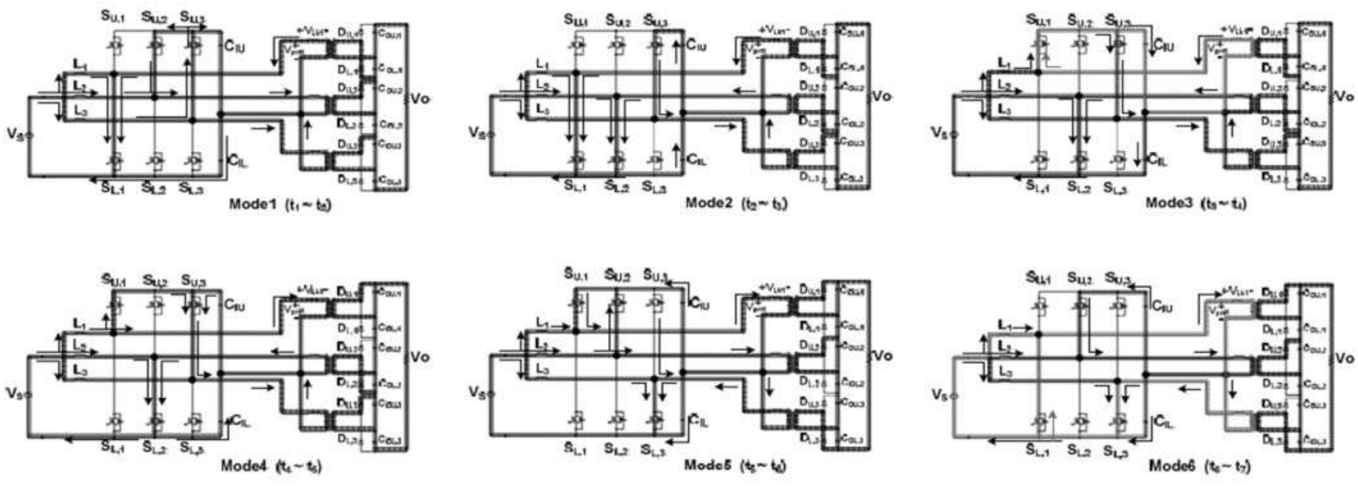

Fig. 4: Modes of Operation of proposed converter

Two capacitors are present in the input side of transformer only to reduce the harmonics or ripples which are produced due to switching operation. Then the output of capacitors are given to three high frequency transformers which are having turns ratio Np/Ns=1/3. As high frequency MOSFET switches are used so high frequency transformers are used for boosting purpose. Then the output of the transformer is given to voltage doubler circuit whose output voltage doubles (approximately) the peak output voltage of transformer for a cycle. The voltage doubler circuit consists of capacitor and diodes. There are three voltage doubler circuits in this converter which are connected in series. So the net output voltage is the summation of all the three voltage doubler output. Net output voltage appears across load which is approximately ten times of the supplied voltage.

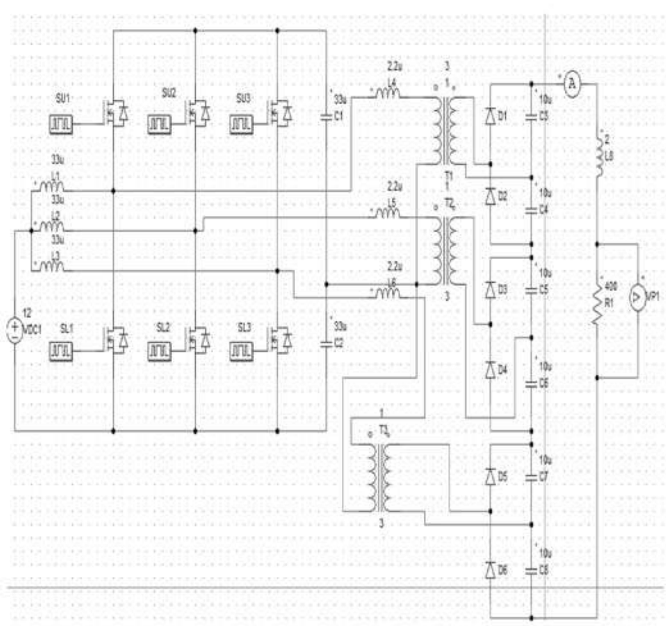

Fig. 5: Schematic of Proposed multi-stage Boost Converter

III. Simulation Results

The proposed multi-stage DC-DC converter was simulated using PSIM software. The specification of components used are-

VS=12V, L=33μH, LK=2.2 μH, CIN =33 μF, COUT= 10 μF,

NS/NP= 3:1, LO=2H, D=0.66,P=44W(load R=400 Ohm).The simulation diagram of the proposed converter is shown in fig 5.Table I shows the switching sequence given to the gate of lower and upper switch of the three legs respectively and it is displayed in fig 6. Fig 7 shows the out voltage waveform for 12V input voltage.Without load the output voltage is 470V.

Table I: Switching Sequence

Sl. No.	*Lower Switch In degrees*	*Upper Switch In degrees*
1	SL1: 1. 120	SU1: 121. 360
2	SL2: 90. 210.	SU2: 0. 89. 211. 360.
3	SL3:180. 300.	SU3: 0. 179. 301. 360.

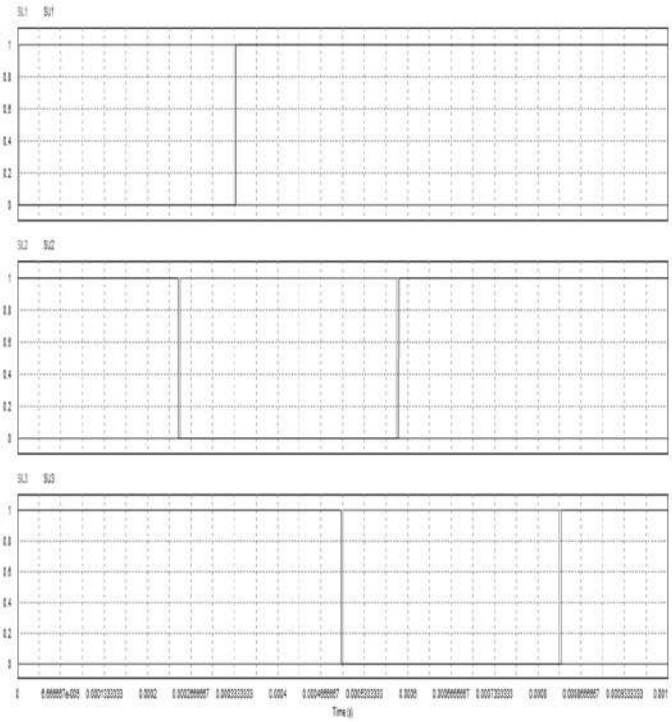

Fig. 6: Switching Sequence (Red color line for lower switch and blue for upper switch.)

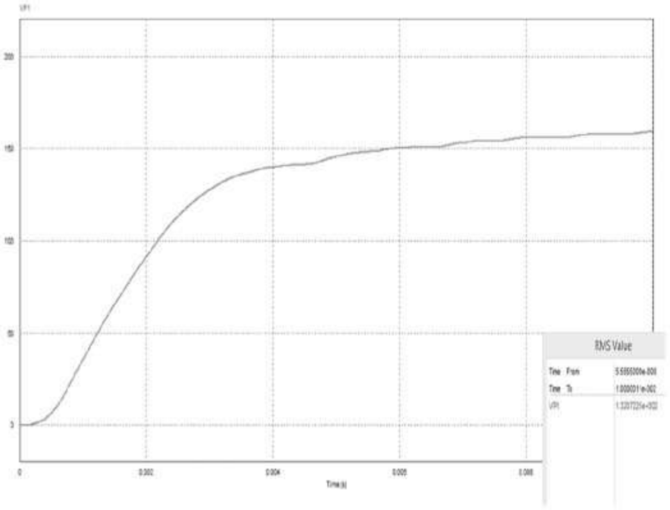

Fig. 7: Output Voltage Waveform

Table II shows the simulation result i.e. the output voltage obtained for different input voltage given to the proposed multistage dc- dc converter.

Table II: Voltage Gain Obtained for Different Voltages

Sl. No.	*Input Voltage*	*Output Voltage*	*Voltage Gain*
1	12V	132V	11
2	24V	264V	11
3	36V	396V	11
4	48V	534V	11

IV. Hardware Implimentation of Proposed Multi-stage Boost Converter

In Hardware ,the specification of components used are 12V battery as source, three inductors in input side L=33uH, six MOSFETs IRF540N of 1kHz frequency, two input capacitors CIN=33uF, three inductors L_K=2.2uH, three transformers of 1kHz frequency and N_S/N_P= 3:1, six fast recovery diodes, six output capacitors C_{OUT}= 10 µF. ATmega 16 microcontroller is used to control the switching sequence of MOSFETs as shown in fig 8.The hardware model is shown in fig 9. For 12 volt DC input , 240 volt dc output is obtained without any load at output. The 12V input voltage is given to six MOSFETS present in three legs (each leg is having 2 MOSFETS) through three input inductors. The gating pulse is given to MOSFET through ATmega-16 microcontroller according to the switching sequence in table I. Then the DC is converted to AC at output of MOSFET. Then this output voltage is given input to 1:3 transformer which is operated at 1kHz frequency. Then transformer output is given to the voltage doubler circuit in which the voltage get doubled. This process occur in all the three BHB cell. The observations are taken at transformer primary side, transformer secondary side and final output using multimeter and DSO.

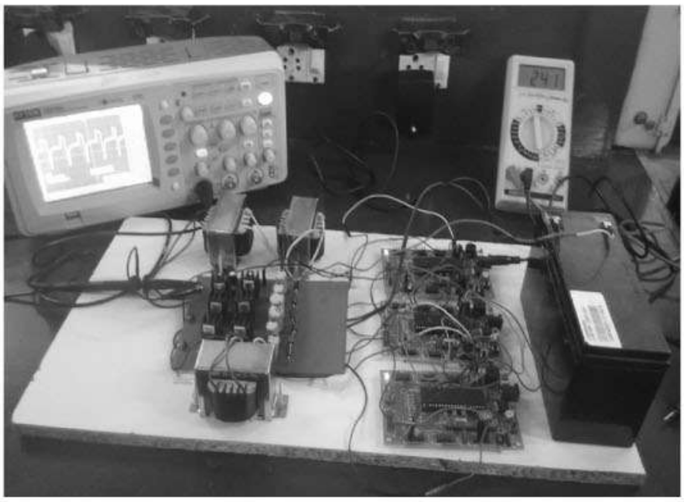

Fig. 8: Hardware model

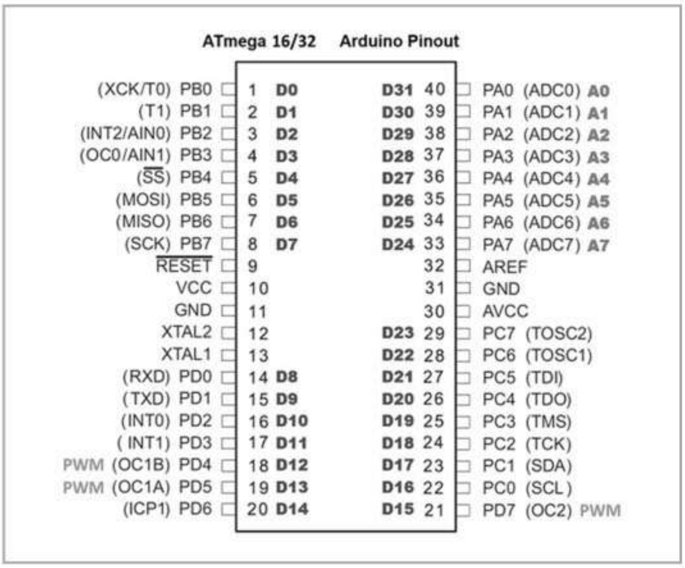

Fig. 9: ATmega 16 microcontroller

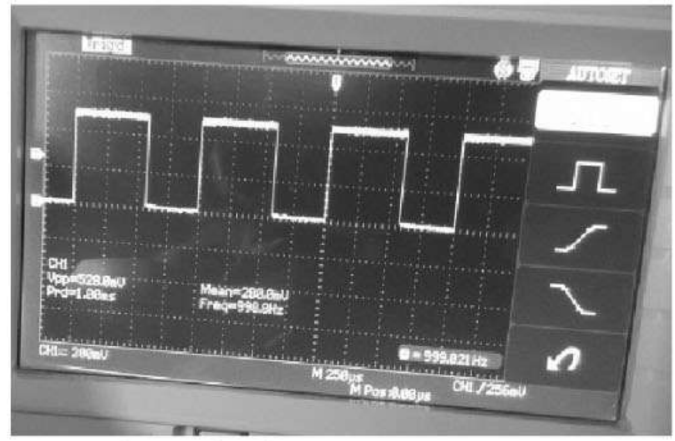

Fig. 10: Switching Waveform of Upper MOSFET

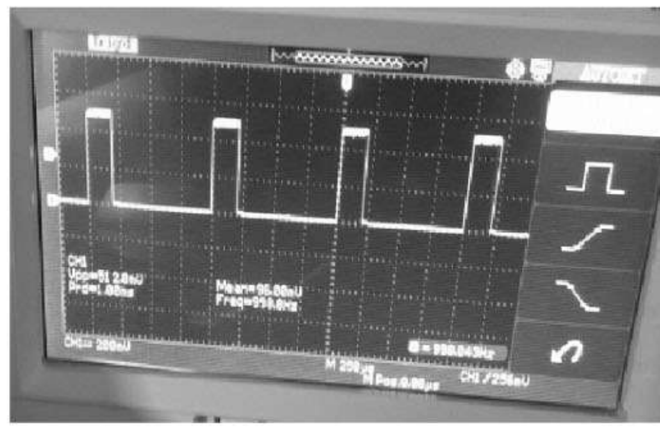

Fig. 11: Switching Waveform of Lower MOSFET

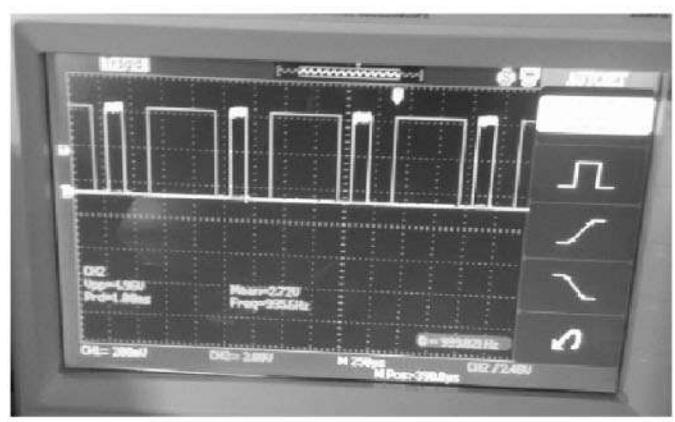

Fig. 12: Switching Waveform of one Leg

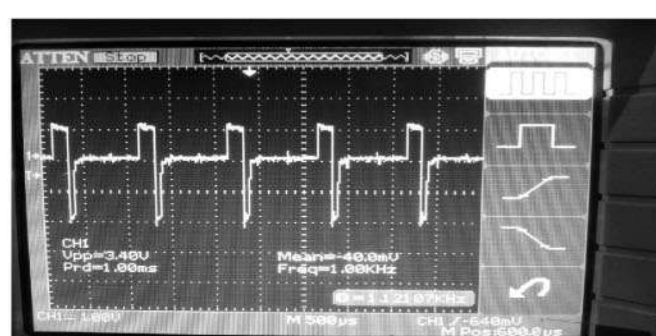

Fig. 13: Transformer Input Waveform

The switching sequence of MOSFETs are controlled microcontroller programming as given in algorithm below.

1. START
2. INITIAL DELAY TO MICROCONTROLLER
3. INPUT GIVEN TO PB0
4. INTERRUPT CALL AND TIMER CLOCK IS STARTED BY INTERRUPT SUBROUTINE AND OUTPUT OBTAINED THROUGH PD5 PIN
5. DELAY GIVEN FOR OPERATION UPTO REQUIRED TIME OF PWM
6. INPUT GIVEN TO PB1
7. TIMER STOPPED FOR PB0.
8. INTERRUPT CALL GIVEN TO MICROCONTROLLER AND TIMER CLOCK IS STARTED FOR PB1 AND OUTPUT OBTAINED THROUGH PD6 PIN
9. DELAY GIVEN FOR OPERATION UPTO REQUIRED TIME OF PWM
10. TIMER STOPPED FOR PB1
11. STOP

A. Experimental results

The switching waveforms of upper and lower MOSFET are shown in fig 10 and fig 11 respectively and together in fig 12.Transformer input waveform is shown in fig 13.The output waveform of proposed converter without load is given in fig 14.

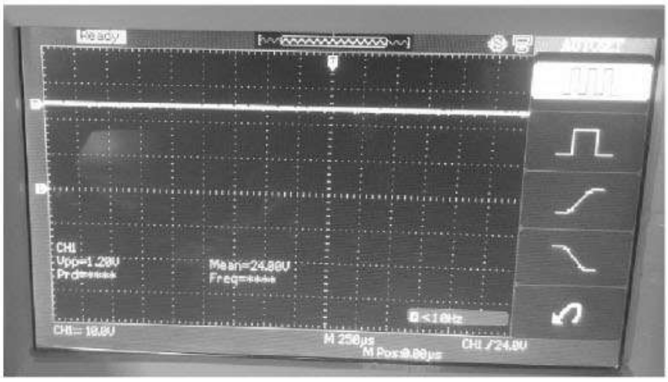

Fig. 14: Final output Waveform

B. Calculation for first BHB cell

Transformer primary peak to peak voltage = 34.8 V

Transformer primary rms voltage = $34.8/2\sqrt{2} = 12.3$ V

Transformer secondary rms voltage = 36.9 V

Voltage doubler input voltage = 52.18 V

Voltage doubler output voltage = 104.36 V

Similarly voltages were calculated for the other two BHB Cells.

The calculated results are given in Table III.

Total Calculated Output = 104.36 + 100.126 + 97.58 = 302.06 V

Experimental Output = 240 V

Table III: Calculated Results

	Transformer Primary rms Voltage (in V)	*Transformer Secondary rms Voltage (in V)*	*Voltage Doubler Input Voltage (in V)*	*Voltage Doubler Output Voltage (in V)*
BHB Cell 1	12.3	36.9	52.18	104.36
BHB Cell 2	11.8	35.4	50.06	100.126
BHB Cell 3	11.5	34.5	48.79	97.58

The results obtained experimentally differ from the calculated output due to losses in transformer, voltage doublers and connecting wires and are within acceptable experimental limits.

Hence a huge boost in voltage is observed in the output in hardware circuit.

V. Conclusions

In this article a DC-DC Converter with BHB cell and voltage doubler is proposed to increase the output voltage. Simulation of the topology of the proposed converter considering N=3 and P=1 is done using PSIM software by taking various inputs into consideration. This software design is implemented to construct a hardware circuit and input is given from a DC battery source initially. Experimental results have also been provided to validate the proposed concept. The features of proposed converter are-

- Reduced turn ratio of the transformer and voltage rating of the diodes and capacitors, and therefore especially suitable to high voltage applications
- No startup circuits, reduced current rating and reduced volume of input and output filters resulting from the interleaved asymmetrical PWM switching
- High Component availability and flexibility in device selection for optimized performance according to our needs.
- High voltage step-up ratio due to presence of BHB cell, high frequency transformer and voltage doublers.

This hardware circuit can be implemented and synchronized with a photovoltaic cell in the future which provides low DC voltage as input to the converter. In remote areas where power transmission and distribution is difficult and is not available there PV cell can be used. But high voltage and power is required, so our proposed multistage boost converter is helpful in this condition to get high voltage and in Standalone system also the proposed multistage converter can be used to get high voltage. A control circuit can also be used to regulate the output voltage.

Acknowledgement

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Some Scientists Said So….

It is strange that only extraordinary men make the discoveries, which later appear so easy and simple.

~ Georg C. Lichtenberg

The black holes of nature are the most perfect macroscopic objects there are in the universe: the only elements in their construction are our concepts of space and time.

~ Subrahmanyan Chandrasekhar

Science without religion is lame, religion without science is blind.

~ Albert Einstein

The good thing about science is that it's true whether or not you believe in it.

~ Neil deGrasse Tysonv

Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.

~ Marie Curie

Design of Adaptive Controller for a Second Order Process Using Direct Modelling and Inverse Modelling Technique

Abstract: *In this article we aim to make an unknown plant follow an input signal by applying the input signal to an adaptive controller whose transfer function approaches the inverse of the plant's transfer function. For this purpose we plan on using different modelling techniques- Direct modelling and Inverse modelling based on different adaptive algorithms- LMS, NLMS and RLS algorithms and compare the performance parameters.*

Keywords: *Least mean square (LMS), Normalized Least mean square (NLMS), Recursive least square(RLS)*

I. Introduction

An adaptive controller is a controller that self-adjusts its transfer function according to an optimizing algorithm [1, 2]. It adapts the performance based on the input signal. This article emphasizes on the use of different adaptive modelling techniques based on different adaptive algorithms as in Fig 1.

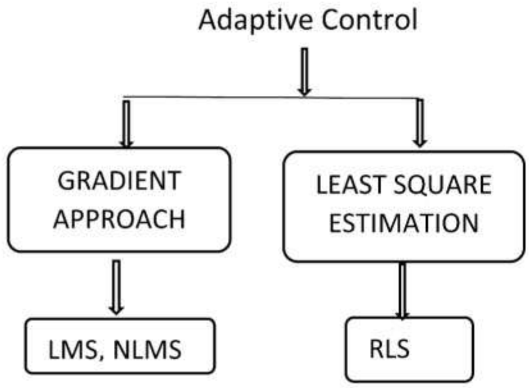

Fig. 1: Types of adaptive control algorithm

These algorithms permit the adaptive controller to adjust its parameters to produce an output that follows the output of the unknown plant output.

2. Direct Modeling

In many cases, the plant to be controlled may be unknown and possibly time varying. In order to apply adaptive modelling we have considered a stable plant [3, 4]. Both the plant and adaptive filter receive the same input signal. The output of the plant is the desired response for the adaptive filter. The discrete time impulse response of the plant is formed through the filter by varying the weights of the linear combiner as in Fig 2. After convergence the weights contain the identification information about the plant dynamics in the form of an impulse response shape.

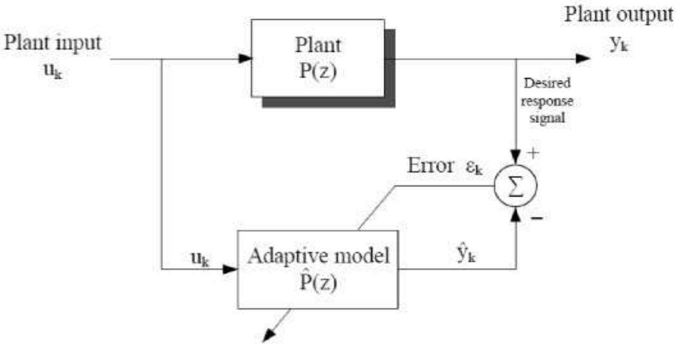

Fig. 2: Block diagram of adaptive direct modelling

Here we considered a plant having transfer function:

$$P = \frac{-3.18}{s^2 + 1.09s + 0.52}$$

By using discrete domain we got:

$$P(z) = \frac{-0.01533z - 0.01478}{z^2 - 1.892z + 0.8967}$$

3. Adaptive Inverse Modelling

Plant inverses are used as controllers in adaptive inverse control. Adaptive inverse modelling is only applicable for stable plants. If a plant has all of its zeros inside the unit circle in the z-plane, then it is called a minimum phase plant. The plant we have considered for simulation is a minimum phase plant since a minimum phase plant gives a perfect inverse. The adaptive filter as in fig 3, is connected in cascade with the plant to be inverse modelled [5].

Here we considered the reference model to be:

$$M(z) = \frac{0.25z}{z^2 - z + 0.25}$$

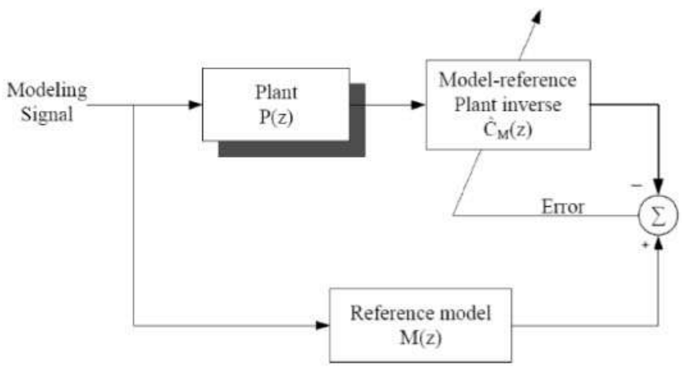

Fig. 3: Block diagram of adaptive inverse modelling

ADAPTIVE ALGORITHMS

1. LMS ALGORITHM:

The LMS algorithm is an implementation of steepest descent method. Instead of using the actual gradient, a simple estimate of the gradient is used. There is no squaring, averaging or differentiation in the algorithm so it is relatively simple and efficient[2, 4].

$$W_{K+1}=W_K+\mu(-\nabla_K)$$

$$W_{K+1}=W_K+2\mu\epsilon_K X_K$$

Where, W_K is the present weight

$W_{K+1}$is the next weight

$\mu$is the convergence factor

$\epsilon_K$is the error signal and $X_K$is the input.

$\nabla_K$is the gradient

Stability of the LMS algorithm is guaranteed if the convergence constant μ is selected within the range $(1/trR)>\mu>0$.

2. NLMS (Normalized LMS) ALGORITHM:

Normalized LMS algorithm is a variant of the LMS algorithm with much faster convergence in many cases. Convergence factor is normalized by the energy of the input signal vector. It has minimum steady state error. It exhibits better balance between simplicity and performance than the LMS algorithm [4, 7].

$$W_{K+1}=W_K+\frac{\mu}{\sigma+X^T X} \in_K X_K$$

Where, W_K is the present weight

$W_{K+1}$is the next weight

$\mu$is the convergence factor

$\epsilon_K$is the error signal and $X_K$is the input.

$\sigma$is a very small value added to prevent zero division.

RLS (Recursive least square) ALGORITHM:

RLS finds an exact least square solution per iteration based on all past data. It recursively finds the coefficients that minimize a weighted linear least squares cost function relating to the input signals. RLS exhibits extremely fast convergence [7].

$$W_{n+1}=W^T(n) + K(n)*e(n)$$

$$K(n)=\frac{U(n)}{(\lambda+x^T(n)U(n))}$$

$$U_{(n+1)}=W^{-1}(n)X(n)$$

Here λ is a constant called forgetting factor which is set by the user.

ADAPTIVE INVERSE MODELLING WITH AND WITHOUT DISTURBANCE

The system of figure 4 works well as long as there is no plant disturbance. If plant disturbance is present, its effect is to bias the Wiener solution so that M(z) will no be a proper controller [6]. The disturbance that appears at the plant output adds a component to the covariance of the input signal of the adaptive inverse model, directly affecting the Wiener solution for M^ (z) .

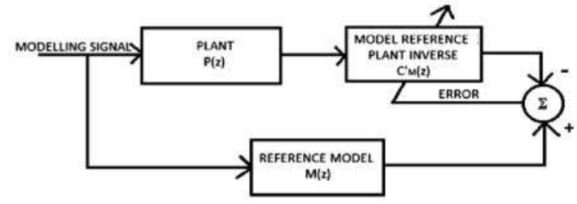

Fig. 4: Block Diagram for Adaptive Inverse Control without disturbance

To overcome this problem, the scheme of figure can be utilized. Schemes introduced above cannot provide precise control in existence of plant disturbances [16]. Their objective is to cancel the plant dynamics by obtaining a proper inverse but does not cancel the disturbance. Closed-loop adaptive inverse controllers are used to cancel the disturbances. An adaptive inverse control scheme with a disturbance cancelling feedback is used to handle plant disturbances in figure 5. Direct model is generated in an online process. As this model will be free of disturbances, output from a direct model copy is subtracted from the plant output to obtain an estimate of the disturbance. An inverse model is obtained from the direct model copy in an offline process. This inverse is used as the controller in feed forward and as the disturbance canceller block in the feedback. Disturbance estimate is passed through the disturbance cancelling block and subtracted from the plant input. Disturbance cancelling block is not activated before direct model and inverse model are formed [6].

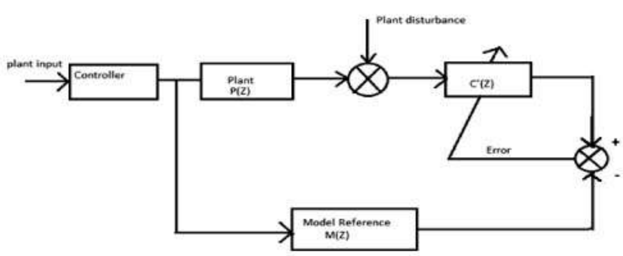

Fig. 5: Block Diagram for Adaptive Inverse Control with disturbance

We considered a 3rd order plant with the following transfer function:

$$P = \frac{5.499}{s^3 + 0.8s^2 + 0.184\ s}$$

The discrete domain of the above function:

$$P(z) = \frac{0.008971z^2 + 0.003512z + 0.008593}{z^3 - 2.916z^2 + 2.833z - 0.9176}$$

The sampling time is 0.01 sec and μ ranges from 0.1 to 0.5.

RESULT ANALYSIS

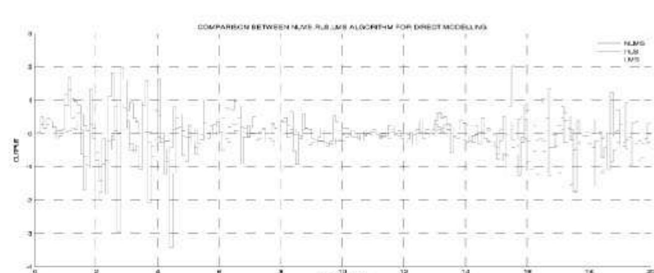

Fig. 6: Output plot of direct modelling using NLMS, LMS and RLS

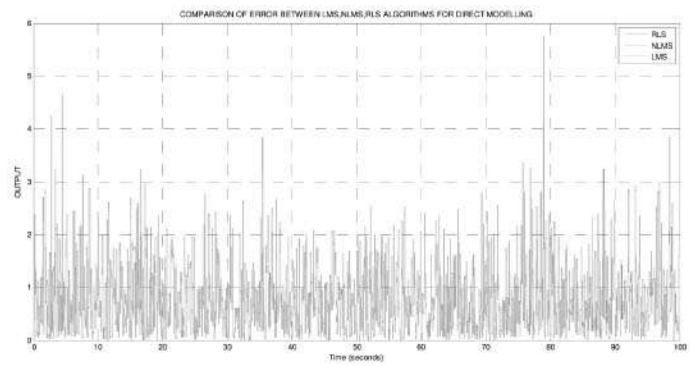

Fig. 7: Error plot of direct modelling using NLMS, LMS and RLS

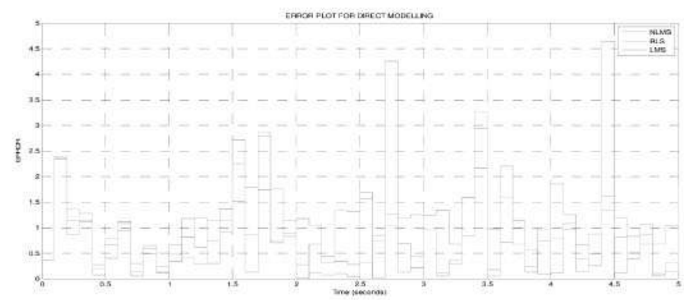

Fig. 8: Comparison of error plot of direct modelling using NLMS, LMS and RLS

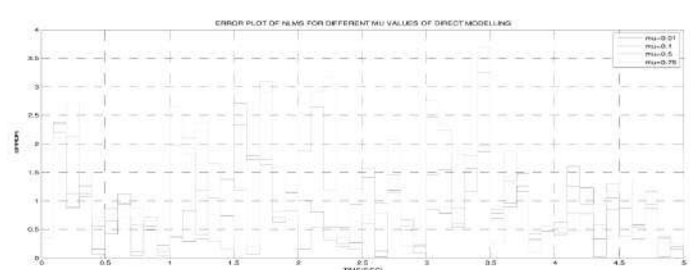

Fig. 9: Error plot of direct modelling using NLMS for different values of mu

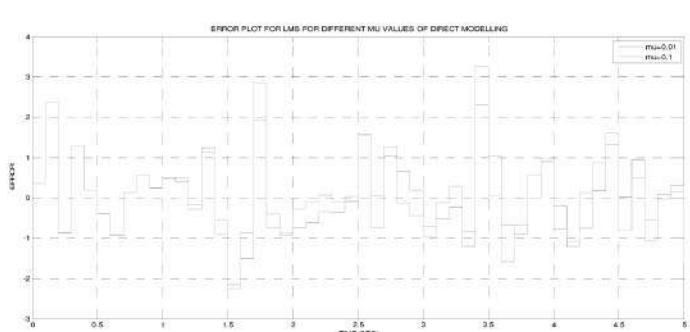

Fig. 10: Error plot of direct modelling using LMS for different values of m

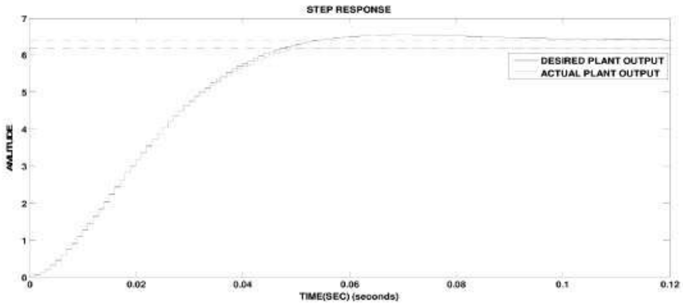

Fig. 11: Step response of direct modelling)

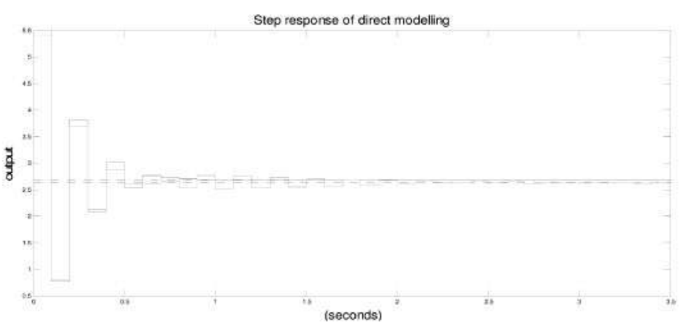

Fig. 12: Step response of direct modelling for 3rd order process

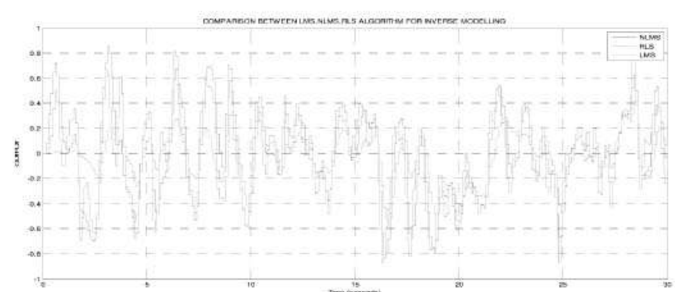

Fig. 12: Output plot of inverse modelling usingNLMS, LMS and RLS

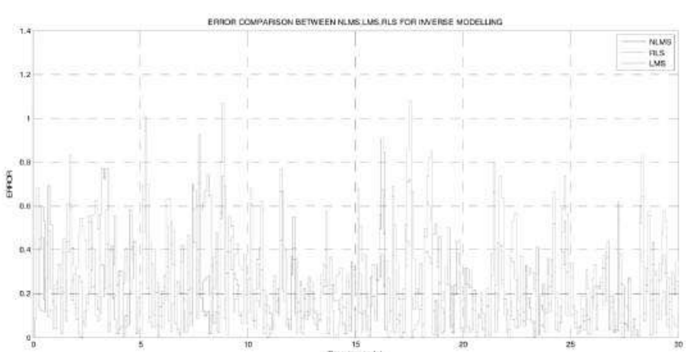

Fig. 13: Error plot of inverse modelling using NLMS, LMS and RLS

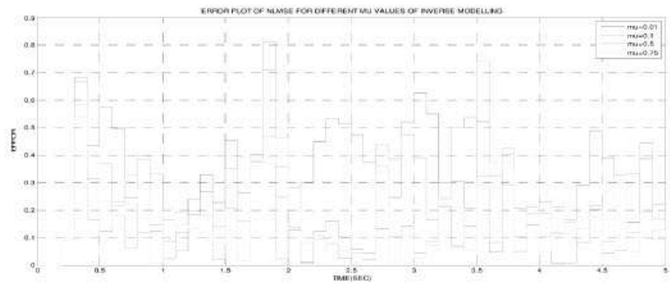

Fig. 14: Error plot of inverse modelling using NLMS for different values of mu

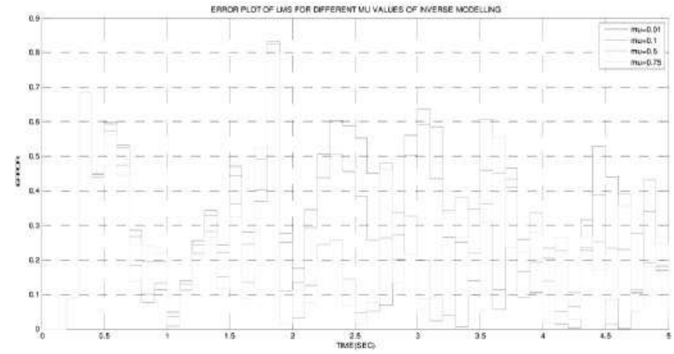

Fig. 15: Error plot of inverse modelling using LMS for different values of mu

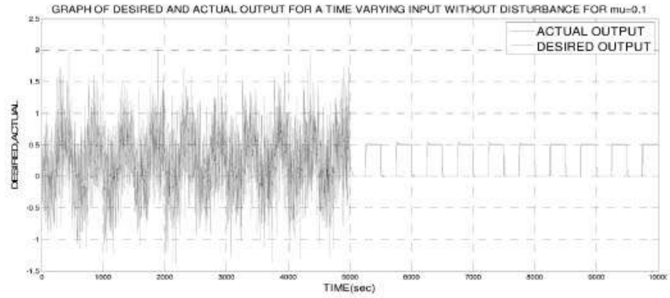

Fig. 16: Output plot using NLMS algorithm for inverse modelling for 3rd order plant

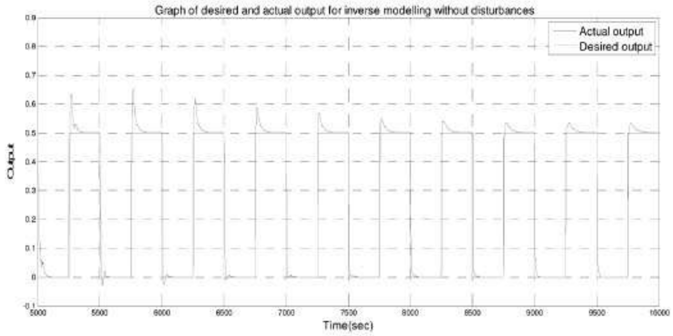

Fig. 17: Output plot using NLMS algorithm in inverse modelling for 3rd order plant

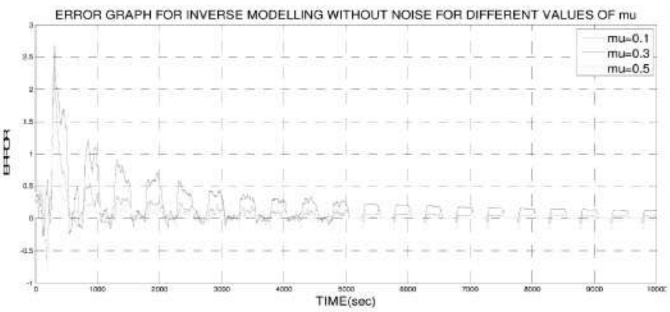

Fig. 18: Error plot for different values of mu in inverse modelling

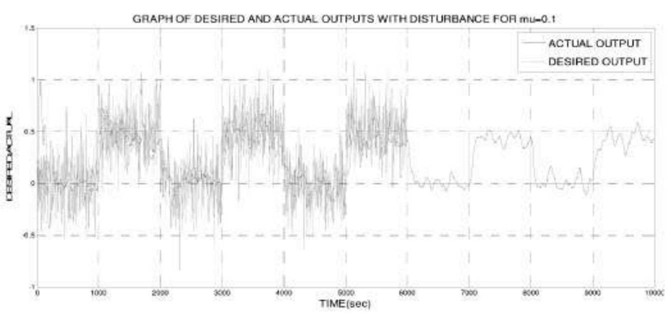

Fig. 19: Output plot using NLMS algorithm for inverse modelling with disturbances

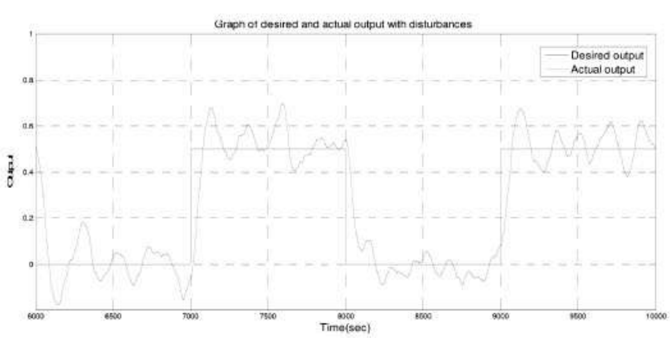

Fig. 20: Output plot using NLMS algorithm for inverse modelling

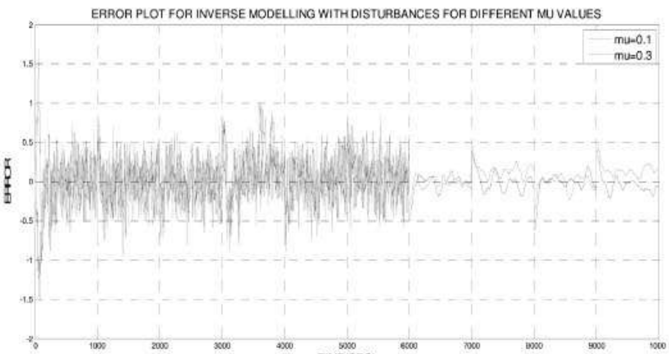

Fig. 21: Error plot using NLMS algorithm for different values of mu in inverse modelling

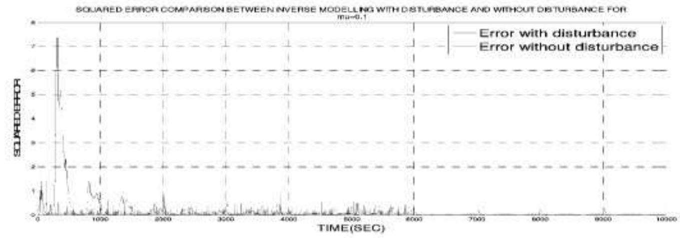

Fig. 22: Comparison of squared error using NLMS algorithm for inverse modelling with and without disturbance

Results of direct and inverse modelling are shown in figure 6 to figure 22.

CONCLUSION

We observed that the step response for both the modelling techniques using LMS, NLMS and RLS algorithms. Though RLS converges faster than others but we cannot use RLS in all the cases due to its complexity. To overcome the complexity problem LMS and NLMS algorithms were used. It was observed that NLMS algorithm outperformed others.

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Lean software development (LSD) – An Agile methodology

Modern day customers expect rapid delivery of software products with required quality. Speed of software development is essential in fulfilling customer's present needs and not what they required yesterday. Agile software development methodologies are gaining in popularity due to their adaptability to uncertain product requirements, changing demands of customers and increasing competition in software Industry.[1] Software Development Life cycle (SDLC) consists of many traditional methodologies such as Iterative, Big Bang, Spiral, V-Model, and so on, most of them are focusing on the software development process with a predictive and analytic approach. These methodologies require thorough planning and estimation of upcoming tasks be delivered in the future without taking into account changing needs of the customer. On the other hand, Agile software development approach's adaptive features help in coping with frequent modifications to the product as required by the customer. It elucidates the features of the future tasks instead of predicting them. The main principles of Agile methodologies are: flexibility, communication, collaboration, and simplicity.[2] Agile methodologies include many popular models like Crystal, Atern, Scrum, Extreme Programming (XP) & Lean Development. We will focus our discussion on Lean Software Development (LSD) model as it is suitable to many modern day projects and has wide acceptability in Agile community. Lean Software Development methodology as shown in fig. 1 is originally based on lean manufacturing principles and practices initiated in 1980's. LSD emphasizes on optimizing efficiency and minimizing waste in the development of software products.

Principles of Lean Software Development

The main principles of LSD are: Eliminate waste, Amplify learning, Decide as late as possible, Deliver as fast as possible, Empower the team, Build integrity in and See the whole.[3]

Eliminate Waste: Everything not adding value to the customer is waste. Industry research reveals that a lot of time and effort is spent on wastes that includes: Extra processes, extra features, building the wrong feature or product, partially done coding eventually abandoned, mismanaging the backlog, rework, unnecessarily complex solutions, extraneous cognitive load, waiting for other activities, ineffective communication, managerial overhead not producing real value. In order to eliminate waste, one should be able to identify it. A value stream mapping technique is used to identify waste. The second step is to point out sources of waste and to eliminate them. Waste-removal should take place iteratively until even seemingly essential processes and procedures are liquidated.

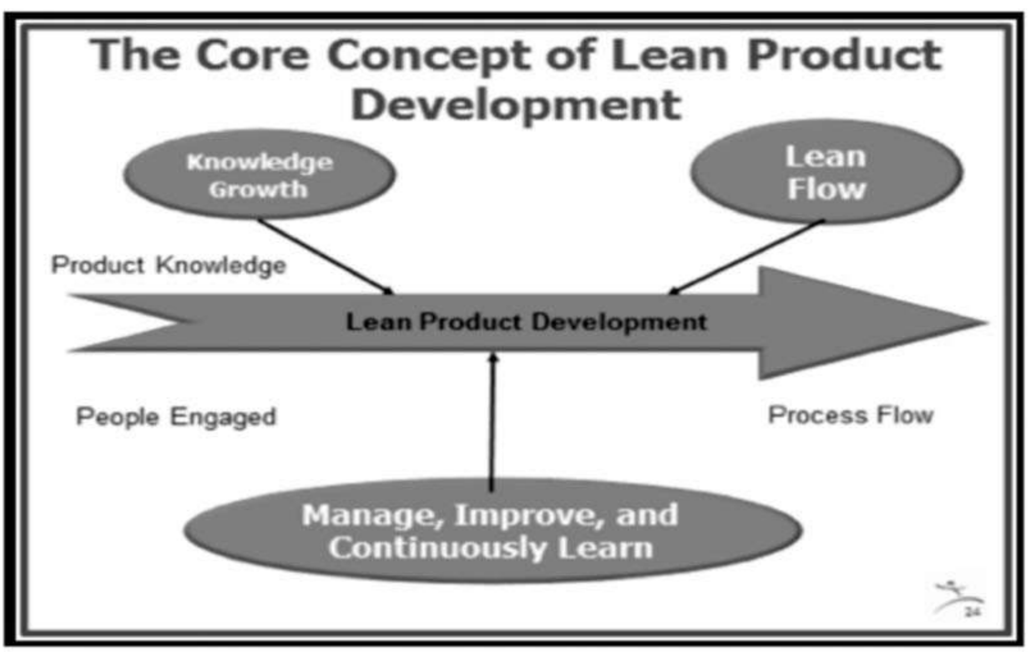

Fig. 1: Core concepts of Lean Product Development

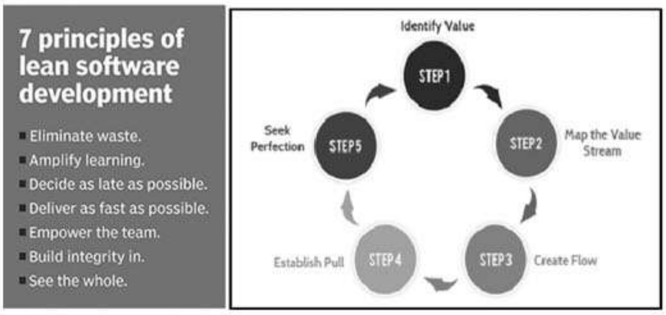

Fig. 2: Principles and Value Identification steps of Lean Software Development

Amplify learning: Software development is a continuous learning process based on iterations when writing code. Instead of doing extra documentation or detailed planning, different ideas could be tried by writing code and building. The process of user requirements gathering could be simplified by presenting screens to the end-users and getting their input. The accumulation of defects should be prevented by running tests as soon as the code is written.The learning process is sped up by usage of short iteration cycles – each one coupled with refactoring and integration testing.

Decide as late as possible: As software development is always associated with some uncertainty, better results should be achieved with an options-based approach, delaying decisions as much as possible until they can be made based on facts and not on uncertain assumptions and predictions.

Deliver as fast as possible: In the era of rapid technology evolution, it is not the biggest that survives, but the fastest. The sooner the end product is delivered without major defects; the sooner feedback can be received, and incorporated into the next iteration. The shorter the iterations, the better the learning and communication within the team. The speed of delivery provides the opportunity to delay making up their minds about what they really require until they gain better knowledge.

Empower the team: There has been a traditional belief in most businesses about the decision-making in the organization – the managers tell the workers how to do their own job. But, the roles are turned – the managers are taught how to listen to the developers, so they can explain better what actions might be taken, as well as provide suggestions for improvements. The lean approach follows the Agile Principle "find good people and let them do their own job" by encouraging progress, catching errors, and removing impediments, but not micro-managing.

Build integrity in: The customer needs to have an overall experience of the System. This is the so-called perceived integrity: how it is being advertised, delivered, deployed, accessed, how intuitive its use is, its price and how well it solves problems.Conceptual integrity means that the system's separate components work well together as a whole with balance between flexibility, maintainability, efficiency, and responsiveness. This could be achieved by understanding the problem domain and solving it at the same time, not sequentially.

See the whole: Software systems nowadays are not simply the sum of their parts, but also the product of their interactions. Defects in software tend to accumulate during the development process – by decomposing the big tasks into smaller tasks, and by standardizing different stages of development, the root causes of defects should be found and eliminated. During a longer period of development, a stronger subcontractor network is far more beneficial than short-term profit optimizing, which does not enable win-win relationships.[4]

The last three lean principles as in fig. 2 share a lot in common with Agile thinking. The idea that the team sets the pace or, in Agile terms, the sprint and is responsible for delivering the promised product is directly in line with what Agile teams practice. And the phrase see the whole brings to mind the Agile retrospective where the team gathers at the end to discuss what successes and challenges it saw. Lean also includes a critical piece of modern application development: a focus on regular communication with customers.

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Designing of a Solar Tree

Abstract: *This article introduces a new solar technology that emulates how trees convert sunlight into energy. Trees, shrubs and plants use an inherent structural design to expose their leaves, height dense to sunlight for photosynthesis. This determines their survival. Based on this we describe the coconut tree growing u to 30m(98 feet) tall, with pinnate leaves 4-6m(1320feet) long to design a solar tree. Pinnate refers to a leaf resembling like a feather having the leaflets on each side of a common axis. It can be either even or odd. By this structured pattern that leaves follow to arrange themselves on a tree. With this arrangement we introduce a new idea to design a solar tree using nano-wire solar cell. Nanoparticles exhibit a number of special properties relative to bulk material. A single Nanowire concentrates the sunlight up to 15 times of the normal sunlight intensity. Surprising results have the potential for developing a new kind of highly efficient solar cell. Nanowires possess some distinctive physical light absorption properties. For many years it has been a high mark for solar cells efficiency among researchers, but now there is possibility that it may be raised higher. Hence it is a revolutionary urban lighting concept that not just trees but other objects can also be decorated. These technologies eventually lead to the development of high efficiency solar cells. Now a days with the growing population and energy demand we should take a renewable option of energy source and also we should keep in mind that energy should not cause pollution and other natural hazards. In this case the solar energy is the best option for us.*

I. Introduction

Solar power is the generation of electricity from sunlight. This can be direct as with photovoltaic (PV) or indirect as with concentrating solar power where the sun's energy is focused to boil water which is then used to provide energy. Solar power is a predictably intermittent energy source, meaning that while solar power is not available at all times, we can predict with a very good degree of accuracy when it will not be available. One area of application of solar energy is found in the construction of solar tree.

Solar Tree or Solar Photovoltaic Trees are a solar structure that looks like trees. They can be framed from small scale like a bonsai tree to large scale like the size of the wind turbine. It is a solar artwork which is a combination of artistic and technological effort. This is relatively new concept is conceived in an attempt to use new technology relating to harvesting and use of solar energy. In solar trees, PV panels or cells are arranged in a Fibonacci series pattern instead of leaves. It requires only 1% land as compared to the conventional flat arrangement. The panels of flat mounting for homes are inefficient, as the angle of sun's rays is not constant, particularly during the changes in seasons.

1.1. Solar Panels

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. Solar cells, which largely are made from crystalline silicon work on the principle of Photoelectric Effect that semiconductor exhibits. Silicon in its purest form- Intrinsic Silicon- is doped with a dopant impurity to yield Extrinsic Silicon of desired characteristic (p-type or n-type Silicon). When p and n type silicon combine they result in formation of potential barrier.

A photovoltaic (PV) module is a packaged; connect assembly of typically 6×10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few commercially available solar modules that exceed 22% efficiency and reportedly also exceeding 24%. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery bank for storage, interconnection wiring, and optionally a solar tracking mechanism.

Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range (specifically, ultraviolet, infrared and low or diffused light). Hence, much of the incident sunlight energy is wasted by solar modules, and they can give far higher efficiencies if illuminated with monochromatic light. Therefore, another design concept is to split the light into different wavelength ranges and direct the beams onto different cells tuned to those ranges. This has been projected to be capable of raising efficiency by 50%. Scientists from Spectrolab, a subsidiary of Boeing, have reported development of multi-junction solar cells with an efficiency of more than 40%, a new world record for solar photovoltaic cells. The Spectrolab scientists also predict that concentrator solar cells could achieve efficiencies of more than 45% or even 50% in the future, with theoretical efficiencies being about 58% in cells with more than three junctions.

Currently the best achieved sunlight conversion rate (solar module efficiency) is around 21.5% in new commercial products typically lower than the efficiencies of their cells in isolation. The most efficient mass-produced solar modules have power density values of up to 175 W/m2 (16.22 W/ft2). Research by Imperial College, London has shown that the efficiency of a solar panel can be improved by studding the light-receiving semiconductor surface with aluminium Nano cylinders similar to the ridges on Lego blocks. The scattered light then travels along a longer path in the semiconductor which means that more photons can be absorbed and converted into current. Although these nanocylinders have been used previously (aluminium was preceded by gold and silver), the light scattering occurred in the near infrared region and visible light was absorbed strongly. Aluminium was found to have absorbed the ultraviolet part of the spectrum, while the visible and near infrared parts of the spectrum was found to be scattered by the aluminium surface. This research, could bring down the cost significantly and improve the efficiency as aluminium is more abundant and less costly than gold and silver. The research also noted that the increase in current makes thinner film solar panels technically feasible without "compromising power conversion efficiencies, thus reducing material consumption".

- Efficiencies of solar panel can be calculated by MPP (Maximum power point) value of solar panels.
- Solar inverters convert the DC power to AC power by performing MPPT process: solar inverter samples the output Power (I-V curve) from the solar cell and applies the proper resistance (load) to solar cells to obtain maximum power.
- MPP (Maximum power point) of the solar panel consists of MPP voltage (Vmpp) and MPP current (Impp): it is a capacity of the solar panel and the higher value can make higher MPP.

Micro-inverted solar panels are wired in parallel which produces more output than normal panels which are wired in series with the output of the series determined by the lowest performing panel (this is known as the "Christmas light effect"). Micro-inverters work independently so each panel contributes its maximum possible output given the available sunlight.

2. Theory and Construction

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones are available, based on thin-film cells. The cells must be connected electrically in series, one to another. Externally, most of photovoltaic modules use MC4 connectors' type to facilitate easy weather-proof connections to the rest of the system.

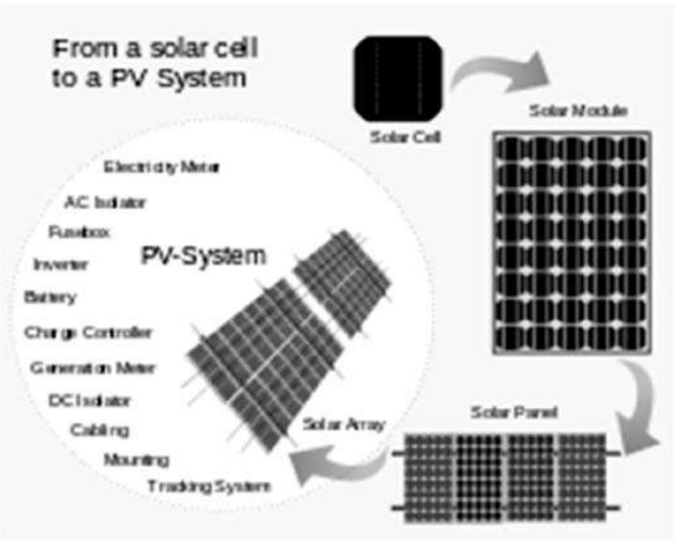

Fig. 1: Solar PV System

The different components of a PV system are shown in fig. 1.

Modules electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability. The conducting wires that take the current off the modules may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way. Component

Of Solar Tree are Solar panels, battery bank, Charge controller, wires and RGB LEDS

3. Performance and Degradation

Module performance is generally rated under standard test conditions (STC): irradiance of 1,000 W/m², solar spectrum of AM 1.5 and module temperature at 25 °C. Electrical characteristics include nominal power (P_{MAX}, measured in W), open circuit voltage (V_{OC}), short circuit current (I_{SC}, measured in amperes), maximum power voltage (V_{MPP}), maximum power current (I_{MPP}), peak power, (watt-peak, W_p), and module efficiency (%).

Nominal voltage refers to the voltage of the battery that the module is best suited to charge; this is a leftover term from the days when solar modules were only used to charge batteries. The actual voltage output of the module changes as lighting, temperature and load conditions change, so there is never one specific voltage at which the module operates. Nominal voltage allows users, at a glance, to make sure the module is compatible with a given system.

Open circuit voltage or VOC is the maximum voltage that the module can produce when not connected to an electrical circuit or system. VOC can be measured with a voltmeter directly on an illuminated module's terminals or on its disconnected cable.

The peak power rating Wp , is the maximum output under standard test conditions (not the maximum possible output). Typical modules, which could measure approximately 1x2 meters or 2x4 feet, will be rated from as low as 75 watts to as high as 350 watts, depending on their efficiency. At the time of testing, the test modules are binned according to their test results, and a typical manufacturer might rate their modules in 5 watt increments, and either rate them at +/- 3%, +/-5%, +3/-0% or +5/-0%.

Solar modules must withstand rain, hail, heavy snow load, and cycles of heat and cold for many years. Many crystalline silicon module manufacturers offer a warranty that guarantees electrical production for 10 years at 90% of rated power output and 25 years at 80%.Potential induced degradation (also called PID) is potential induced performance degradation in crystalline photovoltaic modules, caused by so-called stray currents. This effect may cause power loss of up to 30 per cent. The largest challenge of photovoltaic technology is the efficiencies of such solar systems. While utilizing such systems draws a great interest due to the long term returns of profit, the efficacy needs to come a long way before making it plausible to be introduced in all consumers of electricity.

The problem resides in the enormous activation energy that must be overcome for a photon to excite an electron for harvesting purposes. Advancements in photovoltaic technologies have brought about the process of "doping" the silicon substrate to lower the activation energy thereby making the panel more efficient in converting photons to retrievable electrons. Chemicals such as Boron (p-type) are applied into the semiconductor crystal in order to create donor and acceptor energy levels substantially closer to the valence and conductor bands. In doing so, the addition of Boron impurity allows the activation energy to decrease 20 fold from 1.12 eV to 0.05 eV. Since the potential difference (EB) is so low, the Boron is able to thermally ionize at room temperatures. This allows for free energy carriers in the conduction and valence bands thereby allowing greater conversion of photons to electrons.

Solar power allows for greater efficiency than heat, such as the generation of energy in heat engines. The drawback with heat is that most of the heat created is lost to the surroundings. Thermal efficiency is as defined:

$$\eta_{th} \equiv \frac{W_{out}}{Q_{in}} = 1 - \frac{Q_{out}}{Q_{in}}$$

Due to the inherent irreversibility of heat production for useful work, efficiency levels are decreased. On the other hand, with solar panels there isn't a requirement to retain any heat, and there are no drawbacks such as friction.

4. Maintanance

Solar panel conversion efficiency, typically in the 20 percent range, is reduced by dust, grime, pollen, and other particulates that accumulate on the solar panel. "A dirty solar panel can reduce its power capabilities by up to 30 percent in high dust/pollen or desert areas", says Seamus Curran, Associate professor of physics at the University of Houston and director of the Institute for Nano Energy, which specializes in the design, engineering, and assembly of nanostructures. Paying to have solar panels cleaned is often not a good investment; researchers found panels that hadn't been cleaned, or rained on, for 145 days during a summer drought in California, lost only 7.4 percent of their efficiency. Overall, for a typical residential solar system of 5 kilowatts, washing panels halfway through the summer would translate into a mere $20 gain in electricity production until the summer drought ends—in about 2 ½ months. For larger commercial rooftop systems, the financial losses are bigger but still rarely enough to warrant the cost of washing the panels. On average, panels lost a little less than 0.05 percent of their overall efficiency per day.

5. Price

Average pricing information divides in three pricing categories: those buying small quantities (modules of all sizes in the kilowatt range annually), mid-range buyers (typically up to 10 MW annually), and large quantity buyers. Over the long term there is clearly a systematic reduction in the price of cells and modules. For example, in 2012 it was estimated that the quantity cost per watt was about US$0.60, which was 250 times lower than the cost in 1970 of US$150. A 2015 study shows price/kWh dropping by 10% per year since 1980, and predicts that solar could contribute 20% of total electricity consumption by 2030, whereas the International Energy Agency predicts 16% by 2050.

Real world energy production costs depend a great deal on local weather conditions. In a cloudy country such as the United Kingdom, the cost per produced kWh is higher than in sunnier countries like Spain.

For merchant solar power stations, where the electricity is being sold into the electricity transmission network, the cost of solar energy will need to match the wholesale electricity price. This point is sometimes called 'wholesale grid parity' or 'bus bar parity'.

Some photovoltaic systems, such as rooftop installations, can supply power directly to an electricity user. In these cases, the installation can be competitive when the output cost matches the price at which the user pays for his electricity consumption. This situation is sometimes called 'retail grid parity', 'socket parity' or 'dynamic grid parity'. Research carried out by UN-Energy in 2012 suggests areas of sunny countries with high electricity prices, such as Italy, Spain and Australia, and areas using diesel generators, have reached retail grid parity.

6. Standards

Standards generally used in photovoltaic modules:

- IEC 61215 (crystalline silicon performance), 61646 (thin film performance) and 61730 (all modules, safety)
- ISO 9488 Solar energy.
- UL 1703 From Underwriters Laboratories
- UL 1741 From Underwriters Laboratories
- UL 2703 From Underwriters Laboratories
- CE mark
- Electrical Safety Tester (EST) Series (EST-460, EST-22V, EST-22H, EST-110).

7. Conclusions

India is a highly populated country, so we should take the advantage of such an energy which requires a very less space to produce energy efficiently. In this case solar tree could be the best one for us. We can also use the technique called “SPIRALLING PHYLLATAXY” to improve the efficiency of the plant. It can be applied in street lightening system, industrial power supply etc. It is much better than the traditional solar PV system in area point of view and also more efficient. So this will be a very good option and should be implemented.

Acknowledgement

We would like to express our sincere gratitude to our guide Prof. Seema Behera and all the faculty members of Electrical Department for their support.

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Application of IoT in Remote Healthcare

What is IoT?

IoT stands for **Internet of Things**, the technology which helps us to interact with things around us in various ways. The things can be systems, machines or static objects. Unlike M2M which is used for machine to machine communication for mere monitoring and control applications. **IoT** is used for wide variety of applications. The applications of IoT are enormous like interacting with text books using QR code printed on it, RFID (Radio Frequency Identification Detector), smart meters, home router, TV, light control, A/C control, finding where which movie is running using NFC (**Near-field communication**) protocol [1]. IoT has covered all the industries right from energy, manufacturing, healthcare, telecom and transportation. Though there are numerous advantages of IoT for the user in various fields there are many security aspects which need to be taken care by the user of IoT enabled devices in healthcare specially. There are three main aspects such as **connectivity, remote management and security** required to implement IoT in healthcare system. The concept of clouds and mobile app has pioneered the existence of IoT.

As mentioned any device, system, person referred as things can be remotely controlled using applications running on smart device (can be smart phone, remote controller etc.) [2]. It is only required to have IP address assigned to each IoT devices. There is no common protocol stack finalized for IoT things. In general First each thing should have physical layer to connect with the medium either wired or wireless (wifi, WiPAN, LTE, GSM etc.). Second, each should have layer to interface with backhaul network as per technology the device will be developed for. The third is basic IP address interface. These three basic layers comprise of the IoT protocol stack [1,2]. The controller controls the things.

Sensors are used in electronics-based medical equipment to convert various forms of stimuli into electrical signals for analysis. Sensors can increase the intelligence of medical equipment, such as life-supporting implants, and can enable bedside and remote monitoring of vital signs and other health factors [3]. An aging and expanding population is accelerating the development of new and different types of medical equipment, including various sensors used inside both equipment and patients' bodies. Healthcare organizations want real-time, reliable, and accurate diagnostic results provided by devices that can be monitored remotely, whether the patient is in a hospital, clinic, or at home.

Key Sensors and Applications for healthcare

Pressure sensors are used in anesthesia delivery machines, oxygen concentrators, sleep apnea machines, ventilators, kidney dialysis machines, infusion and insulin pumps, blood analyzers, respiratory monitoring and blood pressure monitoring equipment, hospital beds, surgical fluid management systems, and pressure-operated dental instruments [4, 5].

Temperature sensors are used in anesthesia delivery machines, sleep apnea machines, ventilators, kidney dialysis machines, blood analyzers, medical incubators, humidified oxygen heater temperature monitoring and control equipment, neonatal intensive care units to monitor patient temperature, digital thermometers, and for organ transplant system temperature monitoring and control.

Applications for **flow sensors** include anesthesia delivery machines, oxygen concentrators, sleep apnea machines, ventilators, respiratory monitoring, gas mixing, and electro-surgery, in which high-frequency electric current is applied to tissue to cut, cause coagulation, desiccation, or destroy tissue such as tumors.

Image sensor applications include radiography, fluoroscopy, cardiology, mammography, dental imaging, endoscopy, external observation, minimally invasive surgery, laboratory equipment, ocular surgery and observation, and artificial retinas.

Accelerometers are used in heart pacemakers and defibrillators, patient monitoring equipment, blood pressure monitors, and other integrated health monitoring equipment.

Biosensors find applications in blood glucose and cholesterol testing, as well as for testing for drug abuse, infectious diseases, and pregnancy.

Magnetoencephalography (MEG) and magnetocardiography (MCG) systems use superconducting quantum interference devices or SQUIDs. These highly sensitive magnetometers measure extremely weak magnetic fields and are used to analyze neural activity inside the brain.

Encoders can be found in X-ray machines, magnetic resonance imaging (MRI) machines, computer-assisted tomography equipment, medical imaging systems, blood analyzers, surgical robotics, laboratory sample-handling equipment, sports and healthcare equipment, and other noncritical medical devices.

Wok flow of IoT in remote healthcare system

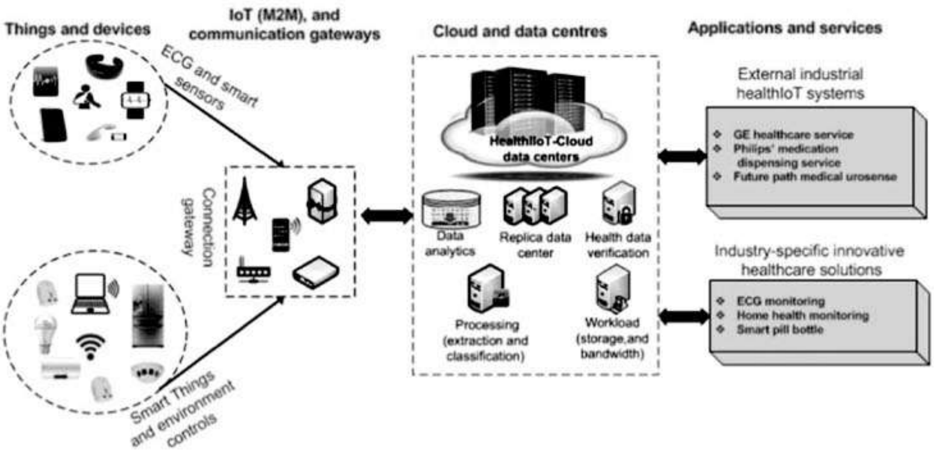

Fig. 1: Data flow architecture for Health-IoT monitoring value chain. [4]

The application using IoT is the combination of big data, IoT, Machine to Machine (M2M) communication, cloud computing, and real-time analysis of data from interconnected sensor devices. The success of Health-IoT largely depends on the advancement of the cloud-computing technology and big data analysis. It creates a platform for interconnected smart medical devices to operate with large amounts of data (big data) from anywhere at any time. The data are actually generated by number of interconnected smart devices, communication apps, and their usage in healthcare monitoring applications [3,5]. Data are gathered and analyzed from e-health records, imaging equipment, medical sensors, devices, and smartphones over the cloud. This analysis augments the decision-making power of healthcare professionals, and helps patients have an active role in managing their personal health.

Figure-1 shows how the flow of a patient's healthcare data is captured securely, how it is transferred seamlessly through a connection gateway to the cloud data centers for further analysis and processing, such as feature extraction, classification, verification, workload measurement, and big data management. After being processed and securely stored in the cloud, the chain of collected data is either accessed by healthcare professionals or delivered to external systems for further specific healthcare IoT solutions.

Conclusions

The viability of the Health-IoT platform has been proved by conducting a series of in-field tests, involving bio-sensing, data retrieval, medication reminder and alarm, and multi standard communication capability test. However, limitations still exist in the healthcare system where current interactions between a user and the devices with more user friendly functions and exploring new application scenarios for this Health-IoT platform are also open issues to work on.

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Analysis and Performance of Power Converters in Photovoltaic system by using Different Control Strategies

Renewable energy systems are likely to become widespread in the future due to adverse environmental impacts and escalation in energy costs linked with the exercise of established energy sources. Solar and wind energy resources are excellent alternative resource which will have the actual potential to satisfy the load dilemma to some degree. This work consist of photovoltaic (PV) system configuration, modelling, control strategies, and uses software tool for designing the PV based converter system for a standalone application.

The standalone operation of a PV system is the best option in remote areas, which are isolated from the utility grid. But due to the inherent transient nature of solar energy, it is not constant throughout the day, and also sometimes the PV generation is not sufficient to fulfil the power demand of the varying local load.

For controlling the standalone PV system, its mathematical modelling is absolutely necessary. Maximum power point tracking (MPPT) controller is used for extracting the optimal power available at PV module, by controlling the duty cycle of a Cuk converter. This MPPT control technique shows fast and robust behaviour even in changing environmental and load condition compared to conventional MPPT control techniques.

The stability analysis is performed by using bode plots for the converter system. The system is simulated in MATLAB/SIMULINK and simulation results gave effectiveness of proposed controller in a standalone PV system.

The present work depicts the modelling of Cuk converter operating in continuous conduction mode using the State-Space Averaging (SSA) technique. The transfer function of the Cuk converter is a higher order system. Model Order Reduction technique (MOR) is used for compensator design for the converter. First the dynamic model of a Cuk converter is designed using SSA technique which linearizes the model and provides a system with higher order transfer function. Then this higher order model is reduced to a lower order model using MOR technique. In this work comparative performance study of DC-DC converter using different controller techniques such as PI controller, fuzzy logic controller, lead compensator and optimal controller are also examined. The critical gain and critical time period for PI controller are obtained using the root locus plot. A fuzzy logic controller design is based on general knowledge and not on mathematical model of the system. Fuzzy logic controller (FLC) is cheaper to develop for a wider range of operating conditions, and they are adjustable in terms of natural language. The design of a compensator improves the transient response of the system and operates the system within a specified phase margin range. If any disturbances are added into the system then that can be eliminated by the use of linear quadratic regulator. All the controllers are described for the Cuk converter and all the results are validated by MATLAB/Simulink platform.

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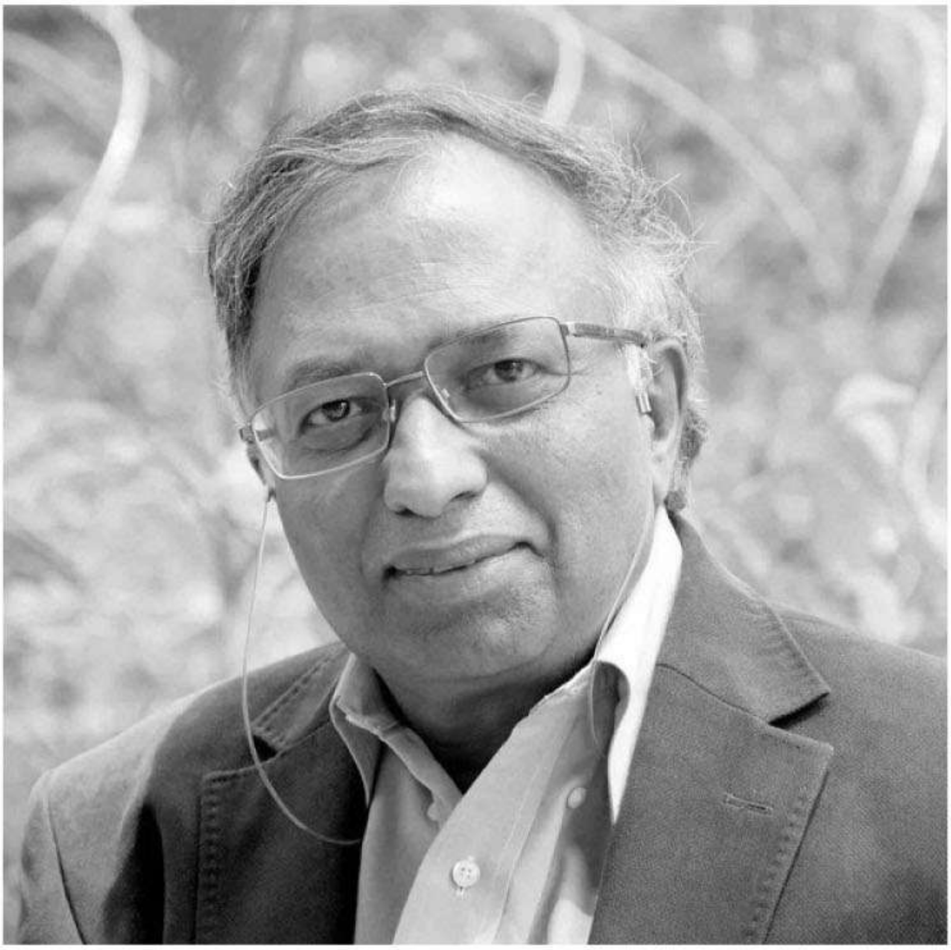

He is an Indian scientist who is popularly known for his significant contributions that gave birth to the first supercomputer's development in India. As engineers we must acknowledge this star pioneer of the IT field for making our lives so convenient and easy with his innovations in the field of IT.

He was awarded with Padmashri award and the Maharashtra Bhusan award which is the highest recognition in the Government of Maharashtra in the year 2000. Presently, he is known for the most recognised positions that he holds in various recognized institutions of the country. Recently, he has been appointed as the new chancellor of Nalanda University.

The Architect of PARAM Series of computers was born on 11 October 1946 in Pune. He developed the first supercomputer, the PARAM 8000 in 1991. All these PARAM series of computers have been designed and assembled by the Pune-based Centre for Development of Advanced Computing(C-DAC). The second updated version, PARAM 10000 was developed by him in 1998. At present, Bhatkar is focusing on exacscale supercomputing via the capability, capacity and infrastructure on National Knowledge Network. He has also authored many research papers and technology books. So far he has published 12 books and presented more than 80 technical and research papers at numerous conferences and conventions.

When we contrast the conditions of life prevailing a hundred years back with amenities and comforts that we enjoy today, we realize the debt of gratitude that we owe to science and the scientists. When it comes to thinking out of the box and creating history, names of legends like Steve Jobs and Albert Einstein etc comes to our mind! One such remarkably talented scientist of our nation who led the development of the first supercomputer, PARAM in India after US refused to sell supercomputers to India was Vijay P. Bhatkar.

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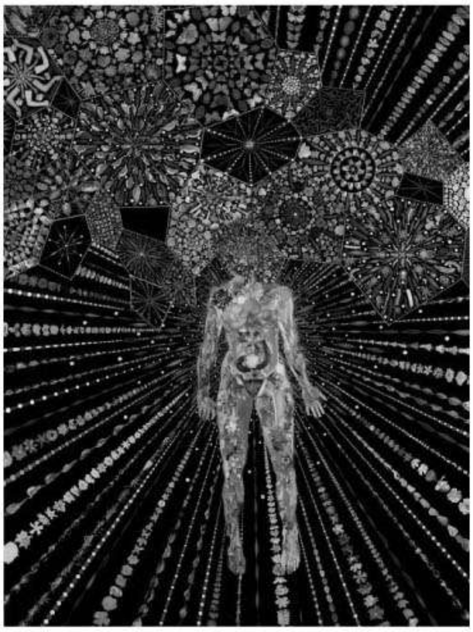
THE CELL ATLAS

The cell Atlas is Biology's next megaproject, it is a scheme to individually capture and scrutinize millions of cells using the most powerful tools of modern genomics and cell biology.



The cell Atlas is a map of human cells and a technological marvel which for the first time comprehensively reveal what human bodies are actually made of and it also provides scientists a new sophisticated model of Biology that speed up the search for drugs and make it possible to catalogue all types and even subtypes of cells in the body. It provides high resolution insights into the spatial distribution of proteins within the cells. It helps to distinguish different stages of differentiation and cell states, such as immune activation. It allows researchers to map cell lineages, such as tracing a red blood cell all the way back to its stem cell origins in the bone marrow.

It has the potential to transform our approach to biomedicine and help to identify markers and signatures for different diseases, uncover new targets for therapeutic intervention. The cell Atlas covers 12073 genes.

REVERSING PARALYSIS

In the next 10-15 years, scientists are hoping to reverse paralysis caused by spinal cord injuries which would make possible a paralyzed person to walk again. It is a technology that will connect the part of the brain that controls movement to the spinal cord.

The experiment was conducted on a paralyzed macaque monkey. As the chip interpreted the monkey's paralyzed leg began to extend and flex. From there, he was able to walk. To do it, a recording device was installed beneath its skull, touching its motor cortex, and consisted of a pad of flexible electrodes around the animal's spinal cord, below the injury. A wireless connection joined the two electronic devices.

According to a Swiss based research company, the brain spine interface bridges the spinal cord injury, in real time and wirelessly. The neuroprosthetic system decodes spiking activity from the brain's cortex and then relays this information to a system of electrodes located over the surface of the lumbar spinal cord, below the injury. Electrical simulations of a few volts was delivered at precise locations in the spinal cord, modulates distinct networks of neurons that can activate specific muscles in the legs.

This technology is promising and will have a life changing impact for people suffering from paralysis.

BOTNETS OF THINGS

An IoT botnet is a group of hacked computers, smart appliances and internet connected devices that have been co-opted for illicit purposes. Botnets is under the control of a botmaster, who can use the bot army to steal information or carry out scams on a massive scale. It made headlines as the instrument behind a distributed denial of service DDoS attack against domain name system DNS provider Dyn that took dozens of websites, including Amazon, Netflix, Spottify, Twitter, and even the Swedish government websites.

A researcher at Proofprint, a California based enterprise security company noticed that hundreds of thousands of malicious emails logged through a security gateway had originated from a botnet that included not only computers but also other devices including household appliances.

The problem is getting worse due to a flood of cheap webcams, digital video recorders, and other gadgets. Because these devices typically have little or no security, hackers can take them over with little effort. And that makes it easier than ever to build huge botnets that take down much more than one site at a time.

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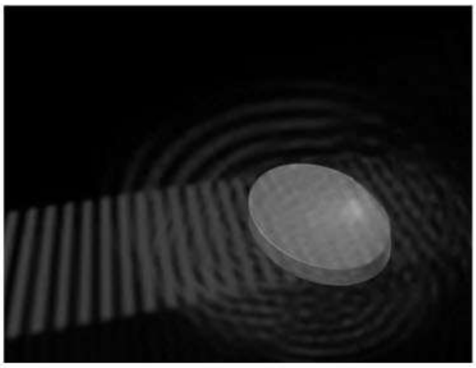
360 DEGREE SELFIE

The 360 degree selfie technology is a breakthrough technology recognized by MIT Technology Review. The spherical images made by inexpensive cameras with this technology are opening a new era in photography.

Due to this camera that creates 360°pictures, people can use their mouse cursor (on a computer) or finger (on a smartphone or tablet) to pan around the image in a circle or scroll up to view the 360 degree aspect of an image. If they look at the image through a virtual-reality headset they can rotate the photo by moving their head, intensifying the illusion that they are viewing the image in real world.

The technology has been applied in the media industry to report important events, and have a deep influence in other industries like tourism, real estate and film production.

BEAM OF INVISIBILITY



According to a new study, a specially designed material can mask itself from other forms of light when it is hit with a "beam of invisibility".

Complex materials such as sugar cubes are opaque because their disorderly structures scatter light around inside them. With new technique, the original light wave is guide through the object as if the object was not there at all. This sounds impossible but with certain materials and using wave technology, it is indeed possible.

The concept involves shining a beam, like laser onto a material from above to pump it full of energy. This can alter the material's properties, making it transparent to other wavelengths of light coming in from the side.

Such work could have applications in telecommunication network. However, considerable work is still required to get this from the stage of fundamental research to practical applications.

HOOVER DAM

Sometimes engineering marvels can be decades old and a testament to human ingenuity – one such example is the Hoover Dam in Boulder city, Nevada, USA. The Hoover Dam is situated in Hill area known as Black Canyon between Arizona and Nevada, around thirty miles from Las Vegas, at the bottom of Lake Mead. During the Great recession, as jobs were not available, thousands of men and their families came to Black Canyon to build the Hoover Dam. The Hoover Dam makes Arizona an inspiring sightseeing. The project of Hoover Dam designed to change Colorado River into a hydroelectric power source for the region's growing populace and continuous water supply to the rest of Area. Before the dam was built, the Colorado River flowed freely through Black Canyon. Today, the entire area is changed into the Lake Mead National Recreation Area.

Construction of the dam began in 1931 and completed by 1936, two years later than schedule. Initially it was given a name as Boulder Dam, but was later renamed after President Herbert Hoover, who had been one of the original proponents of the project. American Society of Civil Engineers declares this dam of America's Seven Modern Civil Engineering Wonders, and it also stands as a National Historic Landmark.

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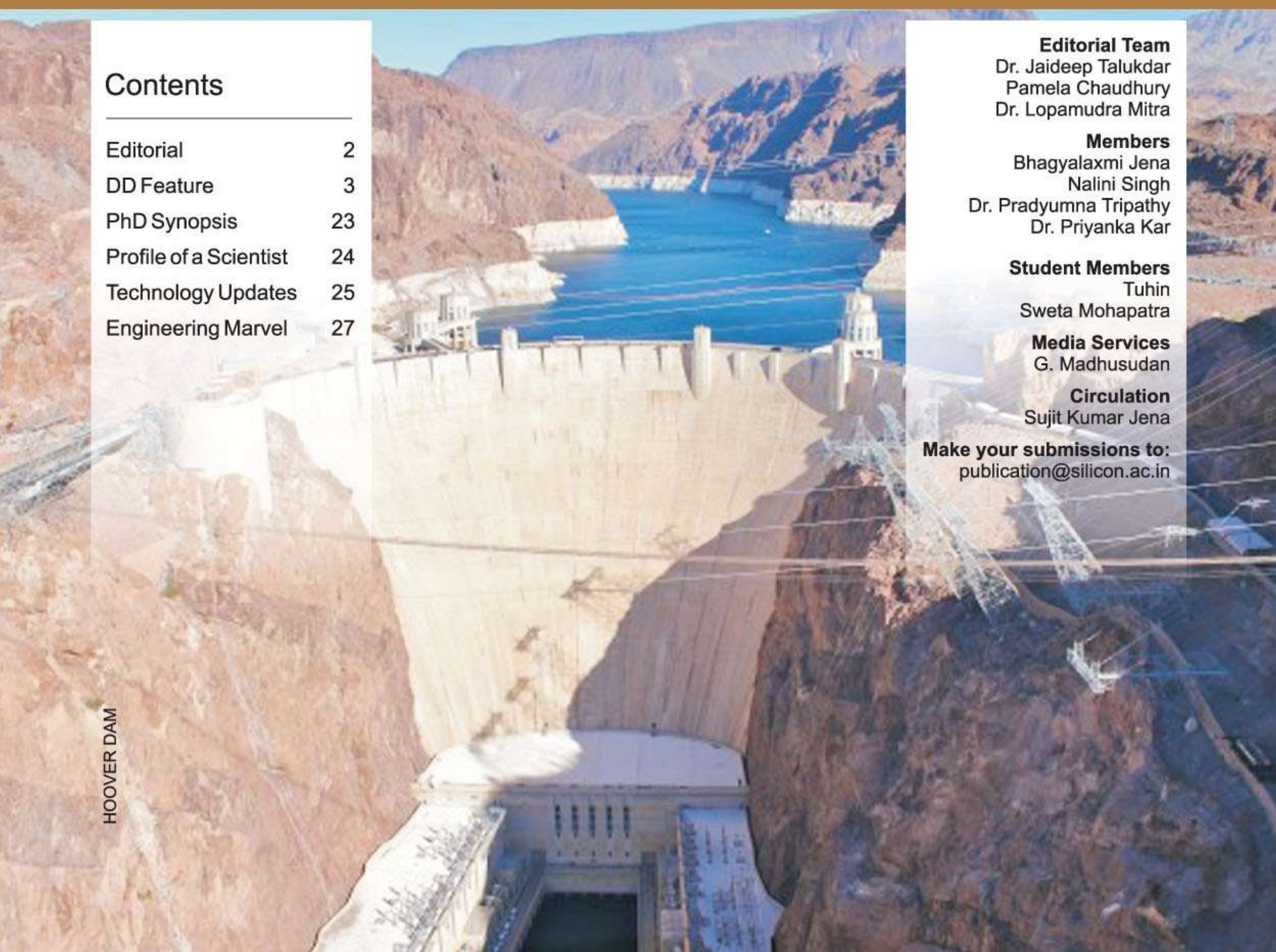

HOOVER DAM

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