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CHOOSING PROPER POWER DEVICE FOR BIOMEDICAL EQUIPMENT (TOTAL HARMONIC DESTORTION ANALYSIS BETWEEN TWO, THREE, FIVE, SEVEN AND NINE LEVEL INVERTERS USING FITERATION SCHEME)

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ARTICLE INFORMATION

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Author's contribution
S.H.H designed the model J.S performed experiment A.S analysied the data A.A.S completed the data.

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Biomedical engineering, Total Harmonic Distortion, Multilevel Inverter, Modified Multilevel Inverter,

ABSTRACT

Now a days, biomedical engineering, field service and other medical personnel must synchronize increasing regulatory guidelines, higher quality standards, and fast technological up grade while performing their task faster and more efficiently than ever before. To get those required outcomes we need to choose our devices and all parts of device carefully , those may cause better performance as per operation. Modified Sine Wave inverters are an option for most accurate device and are a good selection for an overall inverter. The multilevel inveters are the next level to obtain required output. They produce an AC waveform that's near to a pure sine wave. Better on the stuff you power, and reasonably good efficacy wise. More over increment in the levels of multi-level inverter we can get the standard sin wave output but at the cost of switching complexity.

1. INTRODUCTION

Inverter is fundamentally a power converter that converts dc input into AC output. The input DC is normally taken from batteries whuch are connected with the biomedical equipment in hospital like x-ray machines and ECG to continue their operation or sometimes through controlled rectifier output. The output voltage waveform of inverter may be square wave, modified sine wave or low distorted sine wave. Due to less resembled sin wave the applications in the hospitals may not perform properly which are high power applications[1]. Power quality of sine wave holds more importance than quantity. Suitable Pulse Width Modulation Control Schemes can control the inverter output easily. Properly controlled and low distorted sine wave inverters thus can be used in high applications like Standby Power Supply (UPS), Photocopy machines, Adjustable Speed Drivers (ASDs), Laser printers and high voltage direct current (HVDC) transmission systems [2].

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Such inverters in which PWM techniques are used to control output voltage of inverter are called PWM Inverters.

When the supplied dc voltage remains constant, it is called Voltage Source Inverter. The output of the inverter will remail smooth and helps to perform well in the health centers and the diagnose of the disease is 70% solution to the dsease [5]. Different power devices are used for switching purposes such as BJT, SCR, IGBT, GTO and MOSFET. All switches ease with self-commutation excluding SCR.

Multi Carrier Sinusoidal Pulse Width Modulation Techniques

a. Adjusting the acne is the method for controlling the output where the stroke differs according to the power of control [14]. They are used in essential applications such as power control power switch and off LED. Additionally, it can control the power /

earpiece of electronic devices such as transistors, silicone adjustments (SCR), insulated bipolar transistor (IGBT), relay, TRIAC and others using relevant drivers. PWM scheme is used to address the environment where you need to deal with problems such as electrical or steam control [15].

b. Power generation. They play an important role in transitions such as memory, expats, transmitters, controllers, motor cyclo converters and movements, PWM techniques offer many benefits [16].
c. . Low energy levels lost in replacement machines and reduced noise levels [17].
d. Provides some features such as switching off compatibility and power supply [18].
e. If it is properly controlled by programs such as other users who need a tutorial

1.1 In Phase Disposition (IPD)

In phase disposition technique all the signals are in phase with each other see Fig. 1.

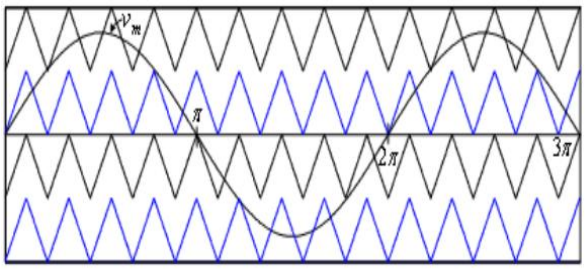

Fig. 1 In Phase Disposition PWM

1.2 Phase Opposition Disposition (POD)

In this technique two phases are 180 degrees apart from refrence line as compared to other two phases, for understanding purpose see Fig. 2.

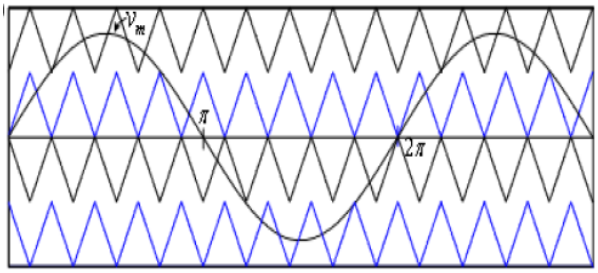

Fig. 2 Phase Opposition Disposition PWM

1.3 Alternate Phase Opposition Disposition (APOD)

In this technique all the phases are at the shift of 180 degree from one another see Fig. 3.

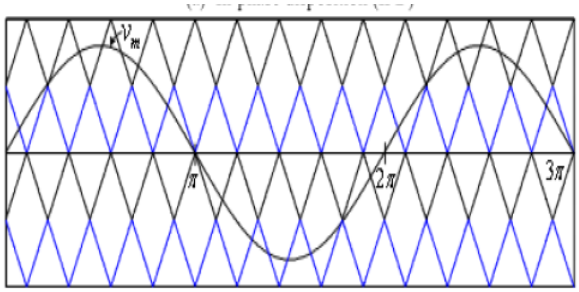

Fig. 3 Alternate Phase Opposition Disposition PWM

1. **Simulation Results of different levels of inverters .**

1.1 two level inverter

It should be noted that the total harmonic distortion in two level inveter are 99.86%.
Which are extremely dangerous to operate sensitive equipment.

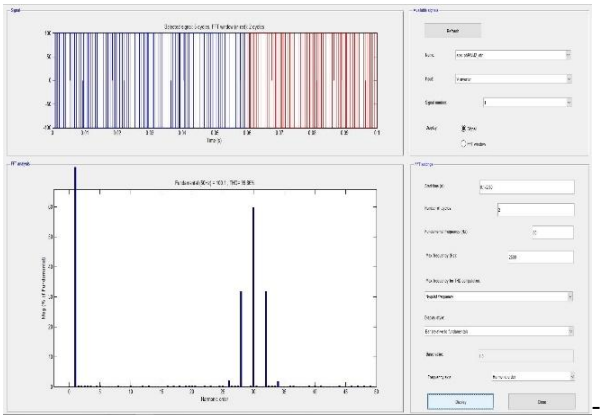

Fig. 4 MATLAB/SIMULATION TWO LEVEL INVETER

2.1 Three level inverter

It should be noted that fundamental frequency of 50 Hz, Switching Frequency of 1 KHz and Modulation Index of 1 is taken. Fig. 5 showing the out put of the voltage distortion bit better which is 51% still it needs bit improvement so lets increase one more level.

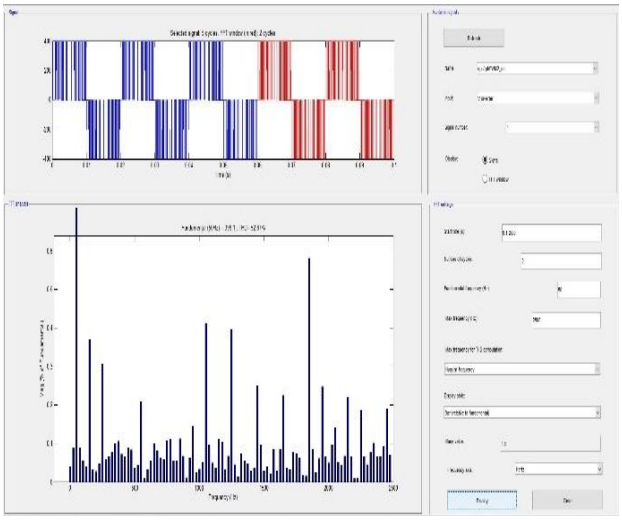

Fig. 5 Output voltage FFT analysis of three level inverter

2.2 Five level inverter

By keeping all parameters same we are now getting better sin wave just by increasing the level which is obtained by 34% of total harmonic distortion shown in Fig.6 but still it is not sufficient for the high power application.

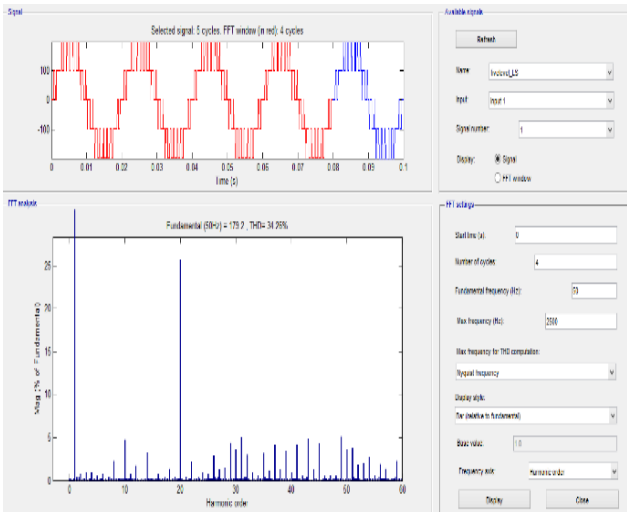

Fig. 6 Output voltage FFT analysis of five level inverter

2.3 Seven level inverter

No we have taken that iverter up to seven level which is showing bit further variation in the total harmonic distortion. The variation is positive i.e. 16% .

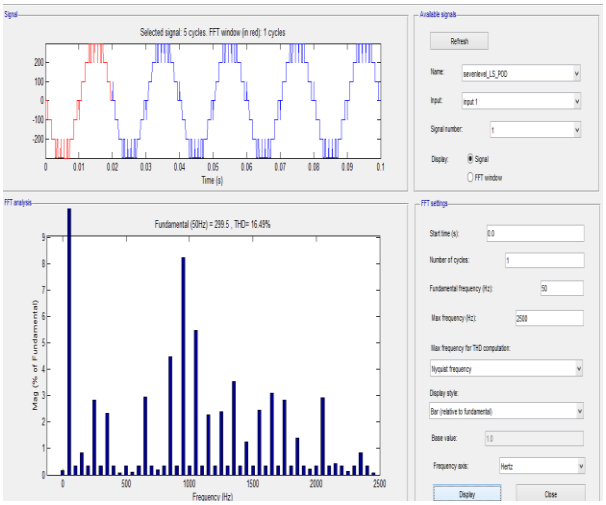

Fig. 7 Output voltage FFT analysis of seven level inverter

2.4 Nine level inverter

As the biomedical and health equipment needs much smoother out put of voltage we have discussed before. We are getting much closer to the sin wave, lets take one more level up and see the output wave form by using nine levels in the inveter shown in fig.7 we have got total harmonic distortion of 13.01%.

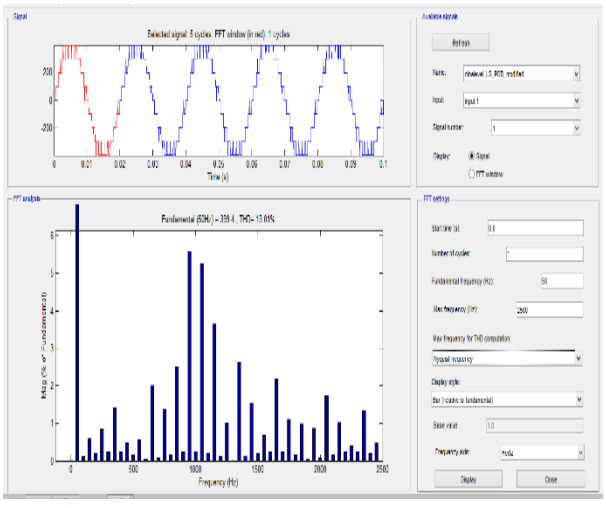

Fig. 7 Output voltage FFT analysis of nine level inverter

Table 1: Comparative Analysis of 2,3,5,7 and 9 Level PWM Inverter (without Filter)

PWM Scheme	$F_{fundamental}$	m_f	M	%THD without filter
				Voltage
Two Level	50	10	1	99.93%
Three Level	50	10	1	51.43%
Five Level	50	10	1	34.26%
Seven Level	50	10	1	16.49%
Nine Level	50	10	1	13.01%

this table is showing the comparative analysis of total harmonic distortion of voltage between two, three, five, seven and nine level inverters.

It is observed that the by increasing the levels of inverter we are getting near by sin wave and the total harmonic distortion is decreasing but at the cost of increment in switches due to which we have to use power full devices like FPGA to control those switches simultganeously which will increase the total cost of the device.

RC Filter:

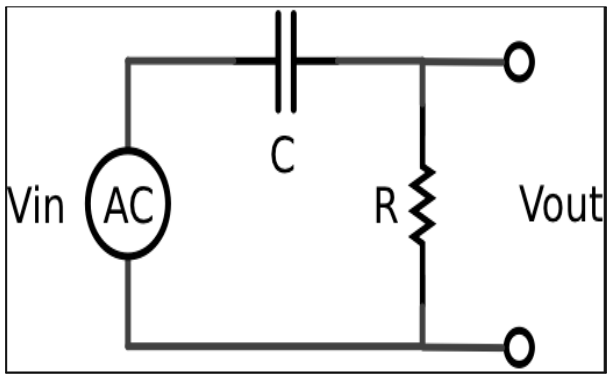

Fig. 8 RC filter circuit

Fig. 8 is showing the low pass Rc filter circuit which nis used to cut of the high frequencies from the output of the inverter it is cheap and good effective filter to use at low cost.

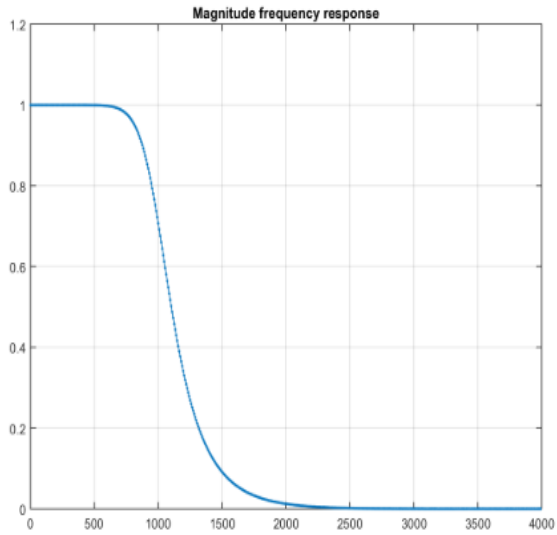

Fig. 9 RC filter Response

Fig.9 is showing the response of frequency cut off in the RC filter (Matlab simulation)

2. CONFLICT INTEREST

Most of the authors have declared that there is no conflict of interest regarding publication of this article. But few authors are suggesting the decrement in the levels of inveters and usage of filters are recommended

3. CONCLUSIONS

It is observed that by increasing the levels of inverter the total harmonic distortion is decreasing, whch was 99.93% for two level inverter and decreased up to 13% but increasing the levels of inverter can cause more switching complexity and overall cost, so to overcome that problem we must use RC filter after certain level which is reducing THD by zero and providing with same sinusoidal output wave form that is perfect for the high power applications like bio medical equipment.

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