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# 7 level multilevel inverter to be used in food preservation system

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***Abstract*— Multilevel inverters are widely used presently with non conventional energy sources like solar, fuel cell. The source has lower individual voltage level. Conventional inverter technique uses bulky transformer and high rating devices while in multilevel inverter there is no transformer and level is boosted by cascading switching devices in particular order. Naturally the waveform is not pure sine and harmonics are present. The paper describes. The proposed methodology was based on the non conventional sources produce low level voltage levels. It make multilevel inverter technique is useful. The application part consists of real requirement in rural area where there is load shading problem to preserve vegetable where supply source is only solar energy. Our system is suitable in area where uninterrupted supply is required like food preservation & kidney dialysis system.**

**Here 7level MLI is considered for analysis.**

***Index Terms*—Multilevel inverter, harmonic.**

## I. INTRODUCTION

Present literatures surveys are on the current trends in Electric power production in the 21st Century will see dramatic changes in both the physical infrastructure and the control and information infrastructure. A shift will take place from a relatively few large, concentrated generation centers and the transmission of electricity over mostly a high voltage ac grid to a more diverse and dispersed generation infrastructure that also has a higher percentage dc transmission lines.

Some of the distributed generation power sources that are expected to increase greatly their market share of the total power produced in the United States and abroad include renewable energy sources such as photo voltaic, wind, low-head hydro, and geothermal. [1]

The advent of high power electronic modules has also encouraged the use of more dc transmission and made the prospects of interfacing dc power sources such as fuel cells and photo voltaic more easily attainable.

A modular, scalable power electronics technology that is ideal for these types of utility applications is the transformer less multilevel converter. Multilevel inverter structures have been developed to overcome shortcomings in solid-state switching device R ratings so that they can be applied to high-voltage electrical systems.

The use of a multilevel converter to control the frequency, voltage output (including phase angle), and real and reactive power flow at a dc/ac interface provides significant opportunities in the control of distributed power systems. The general function of the multilevel inverter is to synthesize a desired ac voltage from several levels of dc voltages.

For this reason, multilevel inverters are ideal for connecting either in series or in parallel an ac grid with renewable energy sources such as photovoltaic or fuel cells or with energy storage devices such as capacitors or batteries.

Additional applications of multilevel converters include such uses as medium voltage adjustable speed motor drives, static VAR compensation, dynamic voltage restoration, harmonic filtering, or for a high voltage dc back-to-back inertia.

## II. CONCEPT OF H-BRIDGE MLI

A modular, scalable power electronics technology that is ideal for these types of utility applications is the transformer less multilevel converter. The multilevel voltage source inverters unique structure allows them to reach high voltages with low harmonics without the use of transformers. The use of a multilevel converter to control the frequency, voltage output (including phase angle), and real and reactive power flow at a dc/ac interface provides significant opportunities in the control of distributed power systems. Multilevel inverter structures have been developed to overcome shortcomings in solid-state switching device R ratings so that they can be applied to high-voltage electrical systems. [2]

Referred to as cascaded-inverters with Separate DC Sources (SDCs) or series connected H-bridge inverters Structure and basic operating principle Consists of (nl–1)/2 or h number of single-phase H-bridge inverters (MSMI modules). MSMI output phase voltage.

$$V_o = V_{m1} + V_{m2} + \dots\dots\dots V_{mh}$$

Where, $V_{m1}$: output voltage of module 1
$V_{m2}$: output voltage of module 2
$V_{mh}$: output voltage of module h

The major advantages of H-bridge MLI are summarized as follows:

1) The number of possible output voltage levels is more than twice the number of dc sources ($m = 2s + 1$).

2) The series of H-bridges makes for modularized layout and packaging. This will enable the manufacturing process to be done more quickly and cheaply.

Disadvantages:

1) Separate dc sources are required for each of the H-bridges. This will limit its application to products that already have multiple SDCSs readily available.

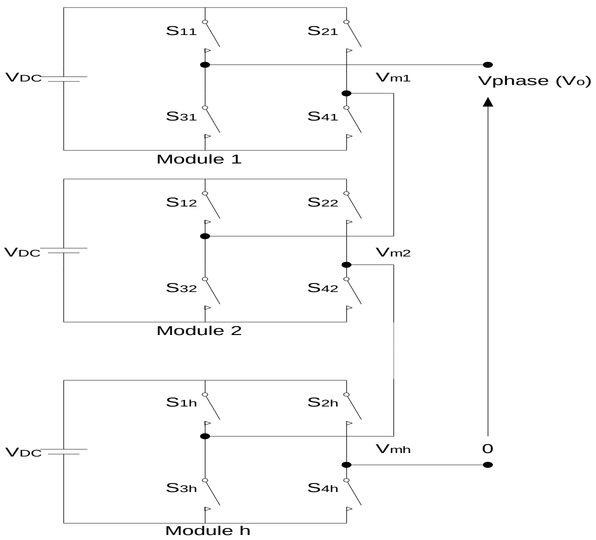


Fig 1.Structure of a single-phase nl-level MSMI

So, it is preferred to go for modular bridge structure. There are many methods to analyses performance of multilevel inverter & are well discussed by Dr. Keith Corzine University of Missouri – Rolla in his book Operation & design of MLI.

Table I. Switching Table

| Power devices index | | | | | | | | Output voltages | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $S_{11}$ | $S_{21}$ | $S_{31}$ | $S_{41}$ | $S_{12}$ | $S_{22}$ | $S_{32}$ | $S_{42}$ | $V_{m1}$ | $V_{m2}$ | $V_0$ |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | $+V_{DC}$ | $+V_{DC}$ | $+2V_{DC}$ |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | $+V_{DC}$ | 0 | $+V_{DC}$ |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | $+V_{DC}$ | 0 | $+V_{DC}$ |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | $+V_{DC}$ | $-V_{DC}$ | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | $+V_{DC}$ | $+V_{DC}$ |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | $-V_{DC}$ | $-V_{DC}$ |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | $+V_{DC}$ | $+V_{DC}$ |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | $-V_{DC}$ | $-V_{DC}$ |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | $-V_{DC}$ | $+V_{DC}$ | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | $-V_{DC}$ | 0 | $-V_{DC}$ |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | $-V_{DC}$ | 0 | $-V_{DC}$ |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | $-V_{DC}$ | $-V_{DC}$ | $-2V_{DC}$ |

## III.FOOD PRESERVATION UNIT

Industry specific requirements necessitate varied requirements and application. The vegetable/food has relatively short product availability period. When we buy the vegetable, we want to check the freshness criteria. However, there is no such a system that can check the freshness of vegetables, so people just inspect visually. If the vegetable goes beyond the expiration date, people will throw it away, so it causes huge waste of money and may threat customers 'health [9].

There will be needed certain freshness monitoring system for both customers and seller to save money and health. Oxide and carbon dioxide are needed for organisms to survive. Microorganisms absorb oxygen and emit carbon dioxide as food spoil. The respiration of food in package also affects food freshness. [10]

There are different types of controlled atmosphere storage depending mainly on the method or degree of control of the gases. Some researchers prefer to use the terms ―static controlled atmosphere storage‖ and ―flushed controlled atmosphere storage‖ to define the two most commonly used systems. ―Static‖ is where the product generates the atmosphere and ―flushed‖ is where the atmosphere is supplied from a flowing gas stream, which purges the store continuously.

Systems may be designed which utilize flushing initially to reduce the O2 content then either injecting CO2 or allowing it to build up through respiration, and then maintenance of this atmosphere by ventilation. [10,11]Controlled atmosphere storage is a system for holding produce is in atmosphere that differs substantially from normal air in respect to CO2 and O2 level. Some examples of CA atmospheres can be seen in Table II. Different varieties behave differently in CA storage; some varieties are susceptible to internal breakdown.[11]

Table II. Controlled atmosphere conditions for some vegetable species

| Species | Temper. °C | $O_2$ (%) | $CO_2$ (%) | Time |
|---|---|---|---|---|
| Cabbage | 0 | 2-3 | 4-5 | 3-4 months |
| Cauliflower | 0 | 3-4 | 5-7 | 40-50 days |
| Cucumber | 12 | 1-4 | 0 | 20 days |
| Garlic | -1 | 3 | 5 | 7 months |
| Green beans | 7 | 3-4 | 4-5 | 10 days |
| Leeks | 0 | 2-4 | 5-10 | 5 months |
| Onions | 0 | 1-2 | 0-1 | 9 months |
| Tomatoes | 2 | 3-4 | 2-3 | 30-40 days |

## IV.IMPLEMENTATION OF 7 LEVEL MLI

Power source is normally non conventional source like solar cell, fuel cell etc. H-bridge circuit contents power devices to be switched on/off as per sequence to get multilevel. These devices are normally MOSFET.
The Power devices are controlled using microcontroller which produces PWM o/p depending on harmonic level.

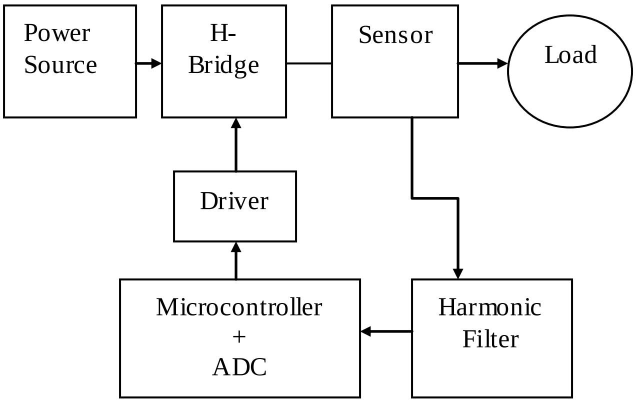


Fig 2.Block diagram of a scheme

The driver block provides necessary voltage levels to turn on/off the power devices. Load parameters are sensed using line sensors which are in the form of CT, PT The output of sensor is then filtered to check harmonic components level and given to microcontroller block. The microcontroller block also contents ADC which converts filter output to digital one. The microcontroller then generates PWM to reduce harmonic levels. [7,8]

## V.REAL PHOTOGRAPH OF PROJECT

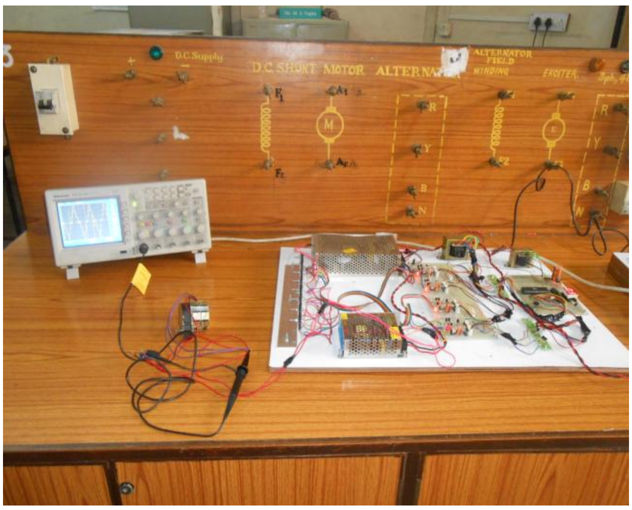

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Fig 3 hardware implementation

## VI .CONTROL LOGIC FOR FOOD PRESERVATION

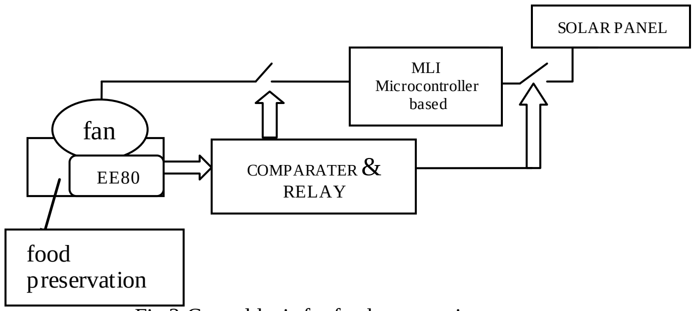


Fig 3.Control logic for food preservation

The control logic for food preservation is given here:

- EE80 is humidity, temperature, Co2 sensor.
- Output of EE80 is compared with set value using op amp comparator.
- The comparator then switches the MLI to connect fan.
- MLI circuit is microcontroller based.
- The supply voltage for microcontroller and MOSFET firing is generated using dc-dc convertor.

## VI.CONCLUSION

The proposed methodology is useful for non –conventional source based power. The uplift of voltage level can be achieved using MLI technique. The paper work also deals with practical application like food preservation for which non interrupted supply is required.

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