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Arduino Based Pure Sine Wave Inverter

Abhishek Kumar[1], Aayush Singh[2], Aasif Ali[3], Abhishek Pandey[4] and Sunil Saharan[5]
[1]*Student, Department of EE, CDL Govt. Polytechnic, Nathusari Chopta, India*
[2]*Student, Department of EE, CDL Govt. Polytechnic, Nathusari Chopta, India*
[3]*Student, Department of EE, CDL Govt. Polytechnic, Nathusari Chopta, India*
[4]*Student, Department of EE, CDL Govt. Polytechnic, Nathusari Chopta, India*
[5]*Lecturer, Department of EE, CDL Govt. Polytechnic, Nathusari Chopta, India*

[1]*Corresponding Author: abhishek9729145821@gmail.com*

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ABSTRACT
This project is proposed to generate the high frequency Pure Sine Wave (AC) power signal from direct current (DC) by using Arduino-Uno. Arduino generate the pulse width modulation (PWM) signal to controls the components, such as MOSFETs or ICs, to convert the DC input into a high-frequency AC signal. This project have Arduino-Uno used to control the wave shape of output AC power frequency. IC's gate input is connected to Arduino-Uno controller and chopper circuit. The gate output of IC is connected with MOSFET gate.

Keywords**:** *pure sine wave, pulse width modulated (pwm), ardunio-uno*

I. INTRODUCTION

The Objective of this paper is produce Pure Sine Wave from direct current by using Arduino-Uno. Arduino-Based Pure Sine Wave Inverters are used to convert direct current (DC) power from a battery or solar panel into alternating current (AC) power for various equipments. Pure sine wave inverter is capable of producing a smooth and clean AC waveform similar to our grid supply. The Arduino generate the pulse width modulation (PWM) signal to controls the components, such as MOSFETs or ICs, to convert the DC input into a high-frequency AC signal. The high-frequency AC signal is then fed through a low-pass filter to remove the harmonic components and achieve a pure sine wave output. To achieve accurate and stable waveform, the programming code calculates the PWM duty cycle required to approximate a sine wave and adjusts it dynamically based on feedback from the output waveform. The performance of the Arduino-based pure sine wave inverter can be evaluated by measuring the output voltage waveform using an oscilloscope and comparing it with a standard pure sine wave reference. The components required for this inverter are

- Arduino board
- ICs (555, 7408)
- MOSFETs
- Capacitors
- Resistors

II. OVERVIEW

As we know AC loads everywhere around us. In addition, most of the equipments are supplied with the pure sine wave AC Power supply. A driver circuit amplifies and shapes the PWM signals from the microcontroller to effectively control power switches (MOSFETs or ICs) in the inverter circuit. The power stage, consisting of these power switches, transforms the DC input into an AC output by controlling the current flow through a transformer and an output filter. The wave shape outcome like as picture shows under :-

However, The microcontroller generates high-frequency PWM signals with variable duty cycles to regulate the amplitude and frequency of the output waveform. An LC filter is circuit build for the smooth output waveform, removing unwanted frequencies and resulting in a pure sine wave. An Arduino-based pure sine wave inverter is a DIY project that enables the conversion of DC power into AC power using an Arduino microcontroller, power switches, PWM signals, filtering, and protection circuitry.

III. PROPOSED SYSTEM

Inverters are classified into three types:

- square wave
- modified sine wave
- pure sine wave inverters.

- A square wave inverter has poor quality output and contains lot of harmonic noise which may not suitable for many electronic gadgets. Its wave form goes up and down peak.
- A modified sine wave or modified square wave to be precise can run most of the electronic gadgets without much issue. The wave form goes positive to negative or peak up and come down and cycle repeats. It has harmonic noise but not as bad as square wave and can be filtered easily.
- A pure sine wave inverter has most complicated design and expensive one. It can run all electronic devices including inductive loads such as motors which have problems in operating with other mentioned designs. It has no harmonics and wave form is smooth sinusoidal.

Now we know the basic difference between sine, modified sine and square wave inverters. In this project we are build an inverter which can deliver a pure sine wave with the help of Arduino-Uno .
The proposed design consists of an Arduino which generates 50Hz constant square wave. An IC 555 chopper circuit generates high frequency pulse. The actual chopping of these two signals is done by IC 7408, which is AND gate. The mixed signal is fed to gate of MOSFET. The frequency of IC 555 can be varied for adjusting the output voltage by tuning the variable resistor. The constant 50Hz square wave is generated across pin #7 and pin #8 of Arduino. This flip-flop signal is fed to pin #1 and pin #4 of IC 7408. These two pins are of two different AND gates. The high frequency chopping signal is fed to pin #2 and #5. The AND gate allows only when two inputs are high, since the Arduino frequency output is lower and IC555 higher, we get chopped signal at the corresponding gate output. The chopped output is fed to MOSFET with a current limiting resistor for limiting the gate capacitor charging rate. A 9V regulator is used for arduino as constant voltage source. A 1000uF or higher capacitance can be used at battery input for smooth starting and to protect the inverter from sudden voltage fluctuations.

Chopper Circuit

The chopper circuit is simple variable frequency generator, and the circuit is self-explanatory. Now let's see how well the frequency from Arduino is chopped by high frequency generator circuit to achieve pure sine wave.

IV. CONCLUSION

A arduino based pure sine wave inverter is an essential device for converting direct current (DC) power into alternating current (AC) power with a smooth and consistent sine wave output. Arduino based pure sine wave inverters provide pure sine wave compatible with a wide range of sensitive electronic devices, including appliances, computers, audio/video equipment, and medical devices. It helps prevent potential issues like overheating, humming, interference, or damage that can occur when using lower-quality waveforms. Furthermore, pure sine wave inverters offer higher energy efficiency, enabling the optimal utilization of power and minimizing wastage. In summary, pure sine wave inverters offer clean, stable, and reliable power conversion, making them a preferred choice for various applications that require high-quality AC power output. Their benefits include compatibility with sensitive electronic devices, higher energy efficiency, and enhanced safety features, making them a reliable and valuable component of modern power systems.

FUTURE SCOPE

Our project "Arduino Based Pure Sine Wave Inverter" is promising and wide-ranging. It encompasses energy efficiency, renewable energy integration, smart grid technologies, miniaturization, IoT integration, DIY applications, advanced protection, and customization. They can seamlessly integrate with renewable energy sources like solar and wind power, facilitating the widespread adoption of clean energy. With smart grid integration, Arduino-based inverters can communicate with the grid, offering features like load management and power factor correction. Arduino's open-source nature allows for customization and scalability, making these inverters adaptable to various user needs and requirements. As technology advances, the future of Arduino-based pure sine wave inverters is bound to bring forth more efficient, intelligent, and accessible power solutions.

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