Power Factor Controller

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Abstract

The surge in the utilization of inductive loads and electronic devices has raised concerns regarding the power quality of the AC system. A significant amount of electrical energy is being wasted daily due to the lagging power factor inherent in these loads. This inefficiency not only leads to increased energy costs but also compromises reliability and safety. Moreover, the fluctuating power factor of the system, influenced by variations in equipment size and usage, poses a continual challenge in balancing inductive and capacitive loads. Various control methods for Power Factor Correction (PFC) have been proposed to address this issue. This paper introduces a precise computational technique for designing and implementing single-phase power factor correction using the Arduino Uno microcontroller. The hardware setup utilizes the ATmega328 microcontroller on the Arduino Uno board. The proposed design effectively senses power factor variations and strategically switches capacitors to compensate for reactive power, thereby improving power factor close to unity, resulting in enhanced efficiency and superior quality of the AC output.

I. Keywords—Power electronics, Arduino Uno, Capacitor bank, power factor

The increase usage of inductive loads in industry will give impact to the power factor value of the system and thus efficiency of the power system decreases. Many industrial applications commonly use the single-phase switching power supplies due to some advantages which are higher in efficiency and smaller in size. The power supplies which used the AC-DC converters have the single-phase power factor correction step which is connected to the input of the converter. Nonlinear loads will lead to a poor power factor which can disrupt the AC voltage and give poor performance to other equipment connected to the same source [1]. Power factor is the ratio of real power (kW) to apparent power (kVA). The load with unity power factor will give the supply system higher efficiency loading compared to the load with power factor 0.5 or less which will give losses to the supply system. In addition, the apparent power supplied to the load will be higher compared to the real power that the load consumes voltage. Losses in the supply and distribution system can be caused by currents

I. Ease of Use

LITERAURE REVIEW

A. Introduction

Industrial and commercial firms competing in today's competitive marketplaces place a premium on electrical energy efficiency. One of the primary problems that companies strive to reconcile with vitality effectiveness for both reasonable and eco-friendly reasons is the optimal utilization of plants and equipment. Reduced energy usage is becoming increasingly important as society becomes more mindful of its environmental control, and it is a goal that everyone can achieve. Power factor adjustments are optimized by measurements such as electricity usage, resulting in lower energy consumption and CO2 greenhouse gas emissions. Its use, however, is contingent on the dimension of the fixing and the range to which the factor of power adjustment is required. To keep the system reliable, automatic power factor adjustment procedures may be used in power systems, industrial units, and even households. Therefore, the system develops more steadily, and the structure's and apparatus' efficiency improve.

B. DESIGN OF POWER FACTOR CONTRoller

Spontaneous Power Factor Revealing and Correction works upon the principle of continuously checking the system power factors and initiating necessary corrections if the power factor falls below the predetermined value. Instrument transformers linked in the circuit are used to sample the voltage and current signals. These instrument transformers provide stepped-down current and voltage values that are proportionate with the diagram of voltage and current. These recorded analog indicators are transformed to appropriate digital signs by the zero-overpass detection, which changes state at every zero-crossing point of the voltage and current measurements.

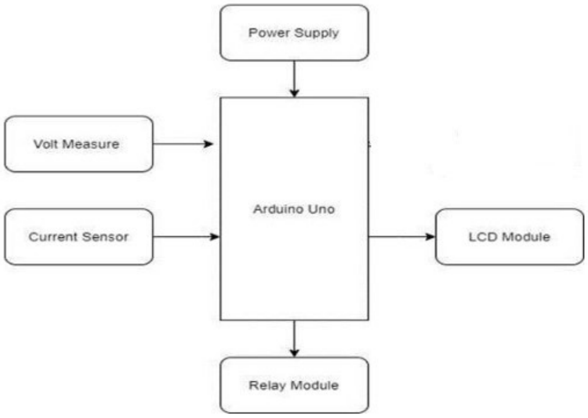
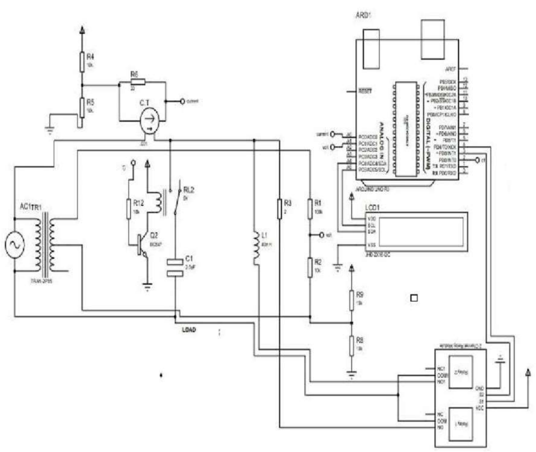


Fig. 1. Functional block diagram of the prototype.

II. CIRUIT DIAGRAM

In figure 2, a circuit has been designed with Arduino Uno. To measure the line voltage here, the voltage was reduced and worked with some basic equipment like register, current sensor to measure current, a capacitor to improve the power factor system. An LCD was attached for monitoring the output data. By using relays, the loads will be controlled, and Arduino Uno had used as programming device. All details of equipment in project work are given. Arduino Is an open microcontroller board is equipped with Sets ATmega328P microprocessor and created by Arduino.

C. *Simulaiton Resluts*



The zmp1012 voltage converter is a set of uniform integrated circuits that perform all active operations for a step-down switching controller accomplished of motivating a 3-A load by good line and load control. Stable output voltages of 5 V, 3.2V and 12 V, as well as a modifiable output version, are offered. A relay was also used, a device powered by electricity.

B. *Simulation*

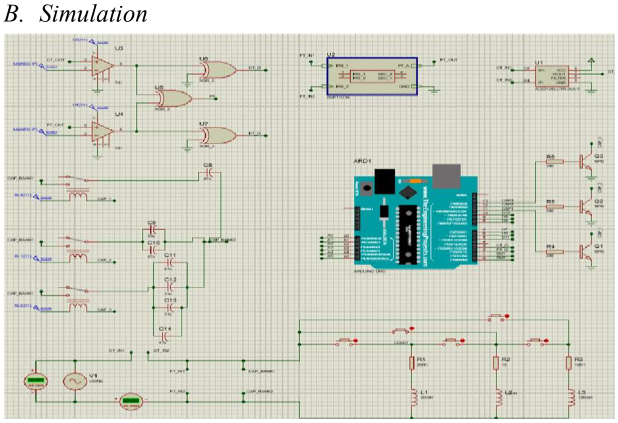
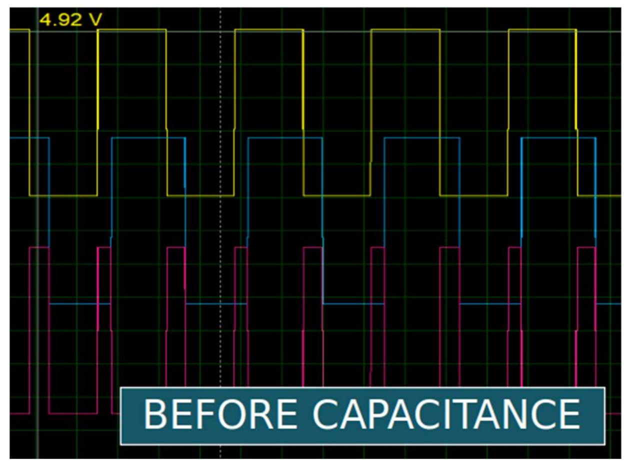


Fig. 2. Idea Implementation

A. *Circuit description*



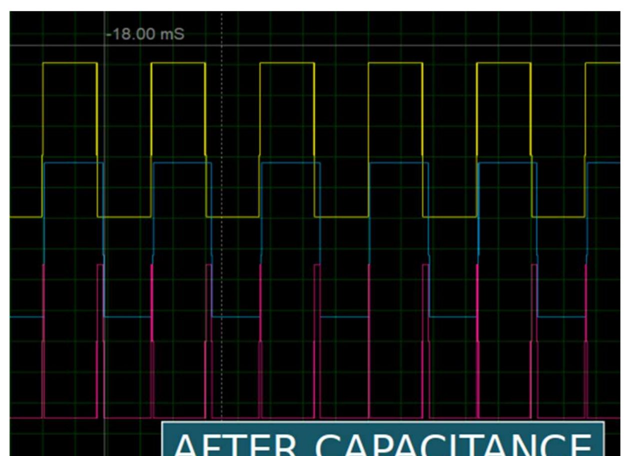
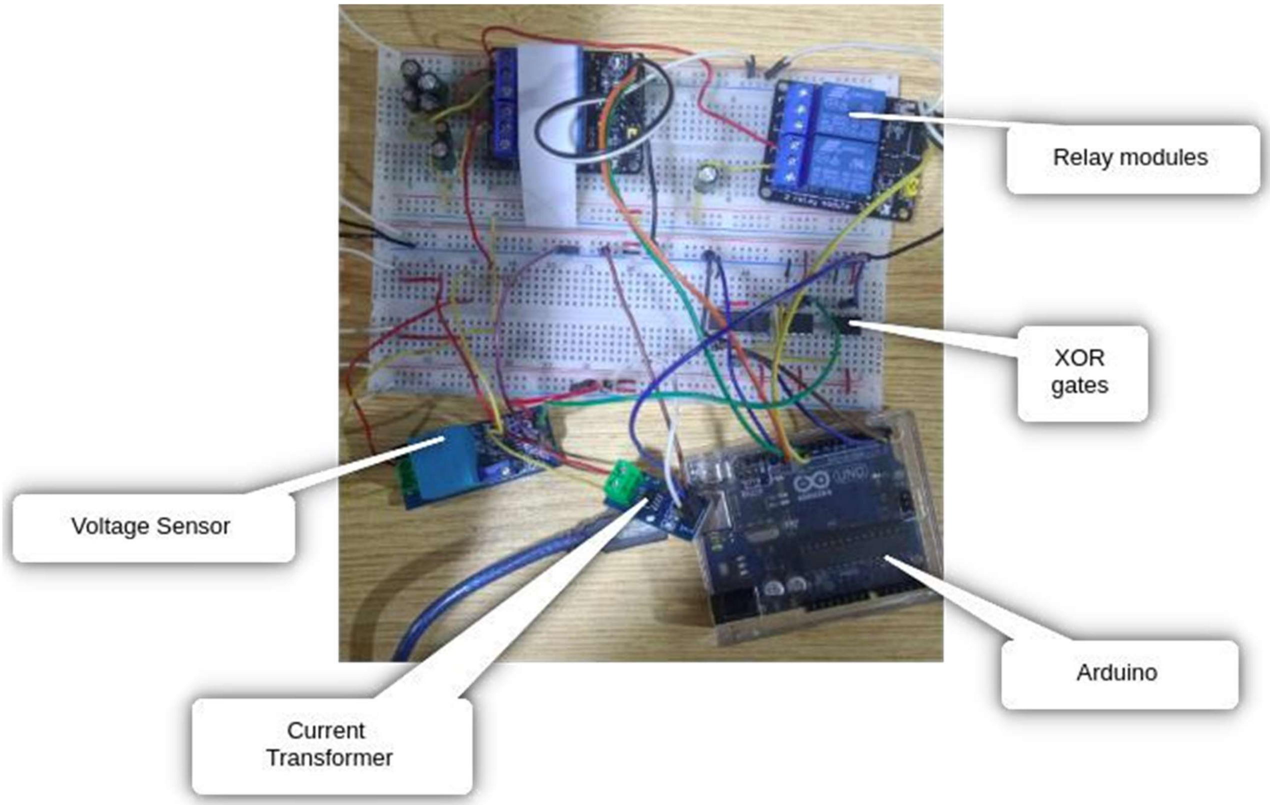


Fig4: Simulation results before and after the Addition of capacitance

D. *Observations*

As you can see form the simulation results the after addition of the capacitance the voltages and the current becomes in - phase and the power factor becomes close to zeros .

E. Hardware Implementation



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