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AUTOMATIC POWER FACTOR CORRECTION USING AURDINO

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Abstract: -. The Automatic Power Factor Correction (APFC) using Arduino project aims to enhance electrical system efficiency by maintaining a near-unity power factor. Power factor is crucial for optimizing energy usage and reducing wastage in electrical networks. The system employs an Arduino microcontroller to continuously monitor the power factor and, based on real-time measurements, automatically controls power factor correction capacitors. Through precise control, the Arduino adjusts the capacitors to ensure the power factor remains close to unity, thereby minimizing reactive power and enhancing overall system performance. This project contributes to energy conservation and cost reduction in industrial and commercial settings by intelligently managing reactive power, aligning it with the real power demand. The integration of Arduino technology provides a cost-effective and efficient solution for power factor correction, promoting sustainability and resource efficiency in electrical systems.

1. INTRODUCTION

In the present technological revolution, power is very precious and the power system is becoming more and more complex with each passing day. As such it becomes necessary to transmit cache unit in power generated over increasing distances with minimum loss of power. However, with increasing of inductive loads, large variation in load etc. the losses have also increased manifold. Hence it has become prudent to find out the causes of power loss and improve the power system. Due to increasing use of inductive loads, the load power factor decreases considerably which increases the losses in the system and hence power system losses its efficiency

An Automatic power factor correction device reads power factor from line voltage and fine current by determining the delay in the arrival of the current signal with respect to voltage signal from the source with high accuracy by using an internal timer It determines the phase angle lag (6) between the and current signals and then determines the corresponding power factor (cos o). Then the Microcontroller calculates the compensation requirement and accordingly switches on the required number of capacitors from the capacitor bank until the power factor is normalized to about unity

Automatic power factor correction techniques can be applied to industrial units, power systems and also households to make them stable. As a result, the system becomes stable and efficiency of the system as well as of the apparatus increases. Therefore, the use of Microcontroller based power factor corrector results in reduced overall costs for both the consumers and the suppliers of electrical energy

2. OBJECTIV OF THE PROJECT

Objective:

Automatic power factor correction (APFC) using Arduino is a system that monitors the power factor A of an electrical loud and takes corrective action to improve it. The objectives of this system can clade

Improving energy efficiency. A low power factor indicates that a load is drawing more current

than it actually needs. This results in higher energy consumption, as well as higher electricity

bills. The objective of APFC is to improve the power factor of the load, thereby reducing the

amount of current it draws and improving energy efficiency

Reducing power losses: A low power factor also results in higher power fosses in the distribution system. This can lead to voltage drops and reduced equipment lifespan. By improving the power factor of the load, APFC can reduce power losses and improve the overall reliability of the system

• Improving system performance: An electrical system with a low power factor can experience number of issues, including overheating of transformers and motors, as well as voltage fluctuations APFC can help to mitigate these issues by improving the power factor of the load, leading to improved system performance and reliability.

Providing real-time monitoring: APFC using Arduino can provide real-time monitoring of the power factor of the load. This can help to identify any issues with the system, such as unbalanced loads or equipment failures, allowing for timely corrective action to be taken.

• Increasing equipment lifespan: By reducing the amount of current drawn by a load, APFC can help to extend the lifespan of equipment such as motor and transformers. This can result in significant cost savings over time, as well as improved system reliability

Overall, the objectives of APFC using Arduino are to improve energy efficiency.

3. LITERATURE SURVEY

Power factor is an energy concept that is related to power flow in electrical systems. To understand power factor, it is helpful to understand three different types of power in electrical systems.

Real Power is the power that is actually converted into useful work for creating heat light and motion. Real power is measured in kilowatts (kW) and is totalized by the electric billing meter in kilowatt-hours (kWh). An example of real power is the useful work that directly turns the shaft of a motor Reactive Power is the power used to sustain the electromagnetic field in inductive and capacitive equipment. It is the non-working power component. Reactive power is measured in kilo volt-amperes reactive (KVAR). Reactive power does not appear on the customer billing statement Total Power or Apparent power is the combination of real power and reactive power. Total power is measured in kilo volt-amperes (KVA) and is tantalized by the electric billing meter in kilo volt-ampere-hours (KVA) Power factor (PF) is defined as the ratio of real power to total power, and is expressed as a percentage (%).

3.1 Reasons of Low Power Factor

- Mercury vapour lamps or lamps operated with chokes
- Power and distribution Transformers. A complete unloaded transformer is very
- inductive and has a very low power factor
- Induction motors (Load and unload condition)

The inductive load equipment causing low power factor in the mines includes Hoists Shovel. Drill Pump, Shearer, Conveyors etc.

3.2 Power Factor Correction

subject to additional charges Electrical engineers involved with the generation, transmission, dis Power factor correction is the process of compensating for the lagging current by creating a leading current by connecting capacitors to the supply. A sufficient capacitance can be connected so that the power factor is adjusted to be as close to unity as possible

Power factor correction (PFC) is a system of counteracting the undesirable effects of electric loads that create a power factor that is less than one (1) Power factor correction may be applied either by an electrical power transmission utility to improve the stability and efficiency of the transmission network or, correction may be installed by individual electrical customers to reduce the com charged them by their electricity service provider

An electrical load that operates on alternating current requires apparent power, which consists of real power and power. Real power in the power actually consumed by the load. Reactive power is repatedly demanded by the load and returned to the power source, and it is the cyclical effect that occurs when alternating current passes through a load that contains a reactive component. The presence of reactive power causes the real power to be less than the apparent power, so the electric load has a power factor of less than one

The reactive power increases the current flowing between the power source and the load which creases the power losses through transmission and distribution lines. This results in operational and financial losses for power companies. Therefore, power companies require their customers, especially dese with large loads, to maintain their power factors above a specified especially around ally or higher, or be t and consumption of electrical power have an interest in the power factor of leads because power factors affect efficiencies and costs for both the electrical power and the consumers. In addition to the increased operating costs, reactive power can require the use of wiring, so switch, circuit breakers, transformers and transmission lines with higher current capacities

Power factor correction attempts to adjust the power factor of an AC load or an AC power mission systems unity (1) through various methods. Simple methods include switching in or out barks of capacitors or inductors which act to cancel the inductive or capacitive effects of the load respective. example the inductive effect of motor leads Automatic power factor corrector may be.

4. PROBLEM STATEMENTS

The power factor of an electrical system is a crucial factor in determining its energy efficiency. Many industrial and commercial electrical loads exhibit a low power factor, leading to increased energy consumption and higher electricity bills. To address this issue, we propose the development of an Automatic Power Factor Correction (APFC) system using Arduino.

Key Objectives:

1. Power Factor Improvement: The primary objective is to design a system that can automatically monitor the power factor of an electrical system and correct it to a desired level, ideally close to 1 (unity power factor).

2. Real-time Monitoring: Implement a real-time power factor monitoring mechanism that continuously assesses the power factor of the connected load(s).

3. Capacitor Bank Control: Integrate a capacitor bank control mechanism that can switch capacitors in and out of the circuit as needed to correct the power factor.

4. User Interface: Develop a user-friendly interface, which could be a display or a web application, to allow users to set desired power factor targets and monitor system performance.

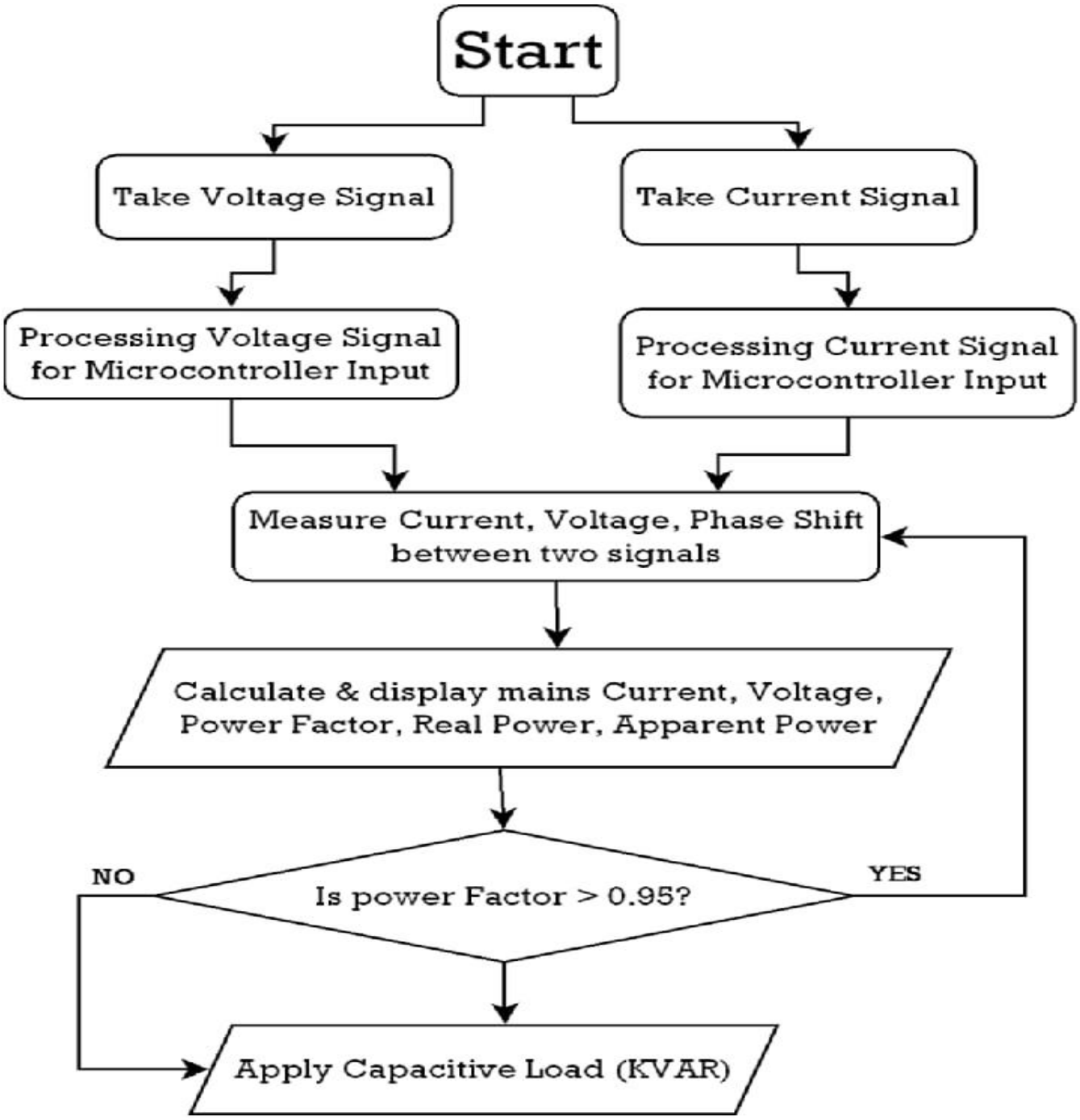
5. Safety Measures: Implement safety features to ensure that the system operates within safe voltage and current limits.

6. Energy Efficiency: The system should contribute to reducing energy consumption and, subsequently. electricity costs for the user.

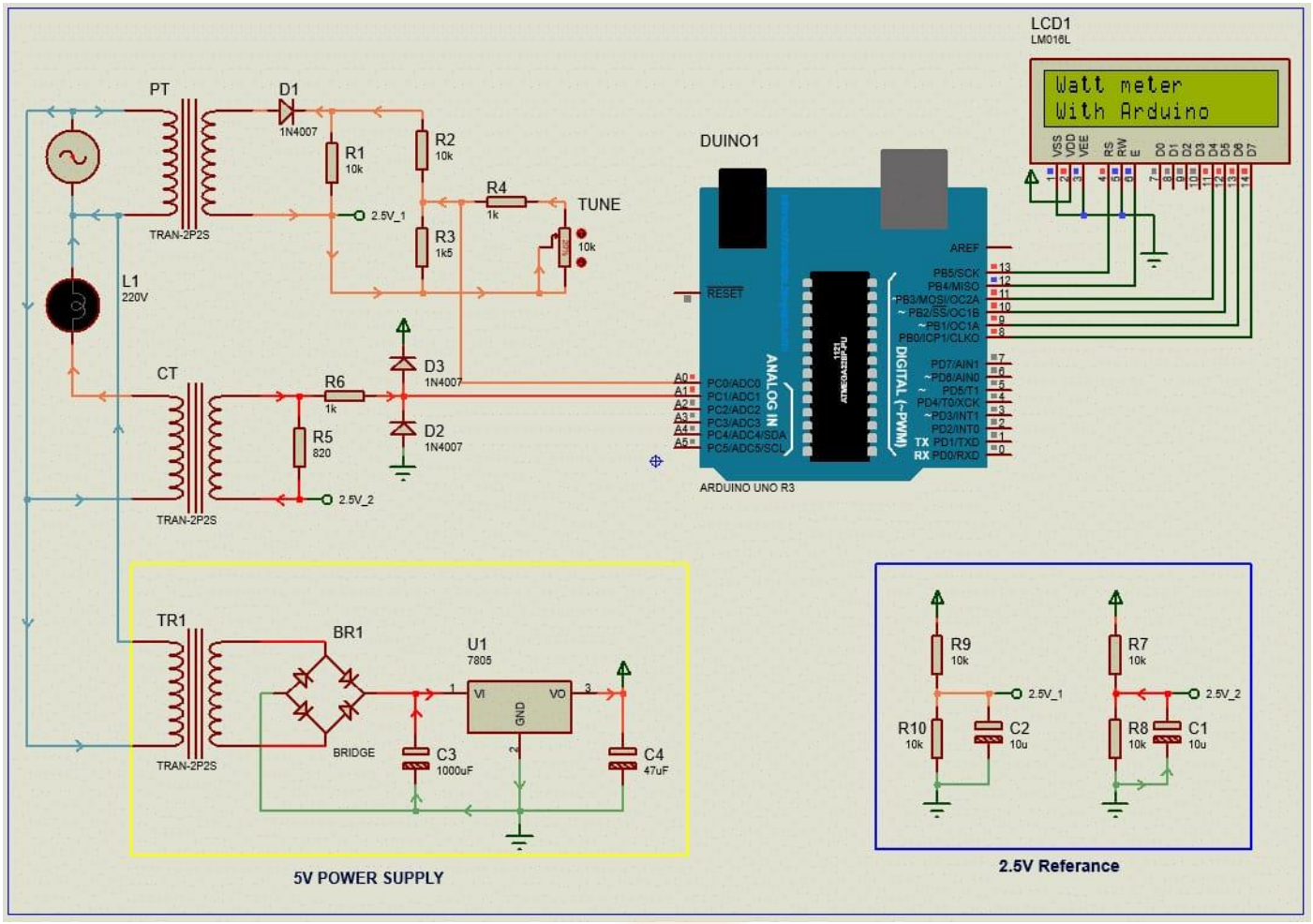
7. Arduino Integration: Utilize Arduino microcontrollers or compatible platforms to control and automate the APFC system.

8. Documentation and Testing: Thoroughly document the design, wiring, and coding aspects of the project. Conduct testing to ensure the system's accuracy and reliability.

5. PROPOSED SYSTEM MODEL



6. CIRCUIT DIAGRAM



7. ADVANTAGES

1) Improved Power Factor: APFC using Arduino can actively enter the power factor of an electrical system and automatically adjust the connected capacitors to maintain a neat-unity power facer. This leads to efficient power utilization losses, and improves overall system performance.

2) Energy Efficiency: By maintaining a power factor, APFC helps in minoizing reactive power consumption. This results in reduced electricity hills and increased energy efficiency.

3) Cost Savings APFC ensures that the electrical system operates at an optimal power factor which reduces the burden on the power distribution infrastructure. As a result, willy companies may provide incentives of discounts on electricity bills for maintaining a good power factor, leading to cost savings.

4) Automatic Operation: The Arduino-based APFC system operates automatically without the need for manual intervention. It continuously mentors the power factor and adjust the capacitors accordingly, eliminating the need for constant monitoring and adjustment.

5) Flexibility and Scalability. Arduino is a versatile platform that allows for easy customization and expansion of the APFC system. Additional features, such as data logging, remote monitoring, or integration with other automation systems, can be easily implemented.

8. CONCLUSION

- Power factor correction equipment designed based on microcontroller and capacitor banks was used for measurement and monitoring of modeled electrical bead and the following deduction wane obtained

- The power factor correction device designed was able to improve the power factor from 0.76 t 0.97 under the test load and condition
- The average savings in energy consumption was about 1.7% for the designed loud and different load patterns
- With the proper amount of reactive power compensation, the system capacity is released as there is a reduction in current drawn
- The economic analysis suggested the payback period to be around 9 months with a significant amount of savings in energy cost.
- The designed equipment was studied in the laboratory scale, it can be implemented in the mine substations with proper protection to verify the operation in a real time environment
- In case of automatic PF correction, if the load is changing frequently, the numerous switching of capacitor bank may cause harmonic problem. Suitable filter design as well as an optimum algorithm design can be done based on the frequent load change pattern to avoid regular switching of capacitor bank
- A comparative study on the location of correction equipment may be employed in the field to find out the optimum location referring to maximum utilization and savings