# Fabrication of Low Cost Digital Meter for Various Electrical Application

Dr.D. Prince Winston M.S.,PH.D.,[1] G.Amrutha Sri [2], M.Lavanya [3], A.KankeshRaj [4] , M.Kesavan [5]
[1]*HOD/Professor* , [2,3,4,5]*Students, Department of Electrical and Electronics Engineering,*
*Kamaraj College of Engineering and Technology*

**ABSTRACT - Developing low cost digital meter suitable for diverse electrical application considers its design and use of components. The affordability of product should be utilized and it should be user friendly .The versatility of product ensure various electrical system and measurements. It maintain precise measurement capabilities comparable to commercial meters .The display unit are placed for presenting measured values .The schematic layout and components focuses on cost – effectiveness. The fine tuning the meters performance to ensure accurate reading design.**
**It implementing instinctive controls and displays for user interaction.**

**Keywords - Affordability, versatility, measurement, accurate effectiveness.**

## I. INTRODUCTION

The increasing demand in energy saving holds prime significance because of inequality between demand and power generation. The affordable yet reliable digital meters in various electrical application has prompted the development of this project. The objective of this project is to design and fabricate low cost digital meter that aims to protect load with
Protection circuit without compromising on accuracy or versatility .It suitable for a wide range of application, from electricity monitoring too industrial power management.

The high cost of commercial digital meters often restricts their accessibility to certain segments of the market. The significance of this endeavour lies in its potential to contribute to energy efficiency, promote awareness of electricity usage, and facilitate better management of electrical system across various domains. This aim to address this limitations by developing a digital meter that is not only cost-effective and also maintain high level of precision and reliability.

Through this innovative design approaches and careful selection of components, this project seeks to optimize the balance between affordability and performance in the digital meter. As the demand for affordable yet capable digital meters continues to grow, the development of such a solution holds promise for widespread adoption and positive impact in diverse electrical applications.

By leveraging cost-effective component and innovative design strategies, this digital meter aims to fill the gap in the market it suitable for affordable electrical measurement solutions. The demand for affordable yet capable digital meters continues to grow, the development of such a solution holds promise for widespread and positive impact in diverse electrical applications. The fabrication of low cost digital meter holds the potential to democratize access to electrical measurement technology, empowering individuals and businesses alike.

## II. RELATED WORK

[1] the design and implementation of a measuring system based on a high-performance microcontroller that carries out the power quality analysis of the mains is presented, [2] One of the key factor for a capillary adoption of smart grid approach in residential or commercial environments is the availability of low cost devices able to carry on required measurement and control tasks. The development and design of commercialization of low cost smart meters will be an important field of manufacturing in the next future scope. [3] The development of society, technology and changes in consumer behaviour has led to changes in the techniques and technologies used for measuring electricity. Currently there are many studies concerning the benefit related to the use of smart meters. [4] This paper gives details of the design, fabrication and performance of the system extending our previous work reporting the basic ideas in a qualitative way. [5] This paper illustrates an arduino - based system for measuring electrical quantities and implementing overvoltage and under voltage protection, showcasing accurate functionality through an integrated monitoring GUI. [6] says the importance of smart metering systems in managing energy consumption efficiently and promoting environmental sustainability through the integration

of IoT technology, bidirectional communication, and advanced monitoring capabilities this work relates to reducing the energy costs of a manufacturing process with digital measurement techniques and current visualization options. [7] The electrical performance indexes are assessed by the dielectric constant (permittivity), dissipation factor, dielectric loss factor, electrical resistivity/ conductivity, and EMI shielding effectiveness (absorption, reflection, and multiple reflections). [8] The proposed sensing system is firstly designed by means of the computer simulation tools and then the printed circuit board of the designed metering system is implemented. Afterwards, the practical circuit is tested under different conditions. In addition, the proposed system is compared with the previously designed sensing circuit by authors in terms of cost, advantages and disadvantages. [9] The main objective of developing the smart meters was to enhance the software and simplify the hardware. Unlike traditional meters that calculate electrical parameters by means of complex circuits in hardware, this project performed the calculations directly on the microcontroller. This procedure reduced the complexity of the hardware by simplifying the meter design.[10] The need to digitize the existing Power Holding Company of Nigeria (PHCN) analogue meter and the increasing demand for smart energy compatible meter necessitated this paper. Shifting from the analogue formalities, this device incorporates voltage and current sensors and signal conditioning, all built from discrete components, PIC and liquid crystal display unit.

## SYSTEM DESIGN

The system begins by the signals from the arduino, the sensor which is connected to the arduino will reads the voltage from the load and it display it in the lcd display. The potentiometer used here to vary the certain range of voltage. same as voltage the variable potentiometer values are also shown in lcd display. The solid state relay which act as the protection circuit. The design act that when the potentiometer value exceeds or decrease the relay act as switch, which on/off the circuit design.

## III. IMPLEMENTATION METHODOLOGY

Digital Voltmeter

In the proposed block diagram fig 1, The system's operation commences with Arduino receiving input signals, initiating the measurement process. A sensor, interfaced with the Arduino, detects voltage levels from the connected load, providing real-time data acquisition. This information is then promptly displayed on the LCD screen, offering immediate feedback to users. Utilizing a potentiometer, users can finely adjust voltage ranges within predetermined parameters, enhancing control and precision in electrical measurements.

Additionally, the potentiometer's variable values are mirrored on the LCD display, ensuring transparency and facilitating accurate adjustments. Ensuring safety and stability, a solid-state relay acts as a protective circuit, intervening when the potentiometer values exceed predefined thresholds. This protective mechanism safeguards against potential circuit damage, providing reassurance to users.

The integration of Arduino, sensors, potentiometers, LCD display, and solid-state relay enables a comprehensive and versatile electrical measurement system. Real-time monitoring capabilities empower users to make informed decisions regarding voltage adjustments and system operations. The intuitive interface of the LCD display enhances usability, enabling users to interpret measurement data effortlessly.

Moreover, the system's adaptability makes it suitable for diverse applications, spanning from household electricity monitoring to industrial power management. By offering cost-effective yet reliable measurement solutions, this digital meter promotes accessibility to advanced electrical monitoring technology. The system's versatility and reliability contribute to energy efficiency, promoting sustainable practices in electrical usage.

In summary, the fabrication of this low-cost digital meter signifies a significant advancement in electrical measurement technology, bridging the gap between affordability and functionality.

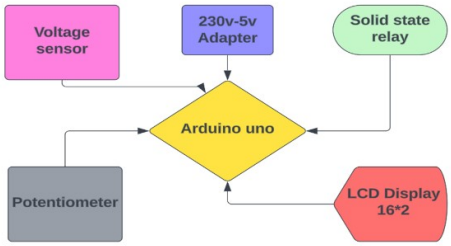


Fig 1 – digital Voltmeter

*Digital Ammeter*

In the proposed block diagram fig 2, The system function its operations as the Arduino begins processing input signals, initiating the measurement phase. Linked with a current sensor, the Arduino swiftly picks up on electrical currents flowing through the load, enabling real-time data collection. This data is promptly relayed to the LCD screen, offering users immediate insight into current levels.

Fine-tuning current ranges within predefined parameters becomes a breeze with the potentiometer, allowing for enhanced control and precision in electrical measurements. Additionally, the LCD display mirrors the variable potentiometer values, ensuring transparency and facilitating accurate adjustments.

A solid-state relay acts as a protective circuit, stepping in whenever current values surpass preset thresholds. This proactive measure serves to shield the circuit from potential damage, instilling confidence in users regarding system safety and reliability. the seamless integration of the Arduino, current sensors, potentiometers, LCD display, and solid-state relay, a versatile electrical measurement system emerges. Users can leverage real-time monitoring capabilities to make informed decisions regarding current adjustments and system operations. The intuitive interface of the LCD display further enhances usability, enabling effortless interpretation of measurement data. The adaptability of this system renders it suitable for a myriad of applications, ranging from household electricity monitoring to industrial power management. By providing cost-effective yet dependable measurement solutions, this digital meter expands access to advanced electrical monitoring technology. Its versatility and reliability contribute to fostering energy efficiency and promoting sustainable practices in electrical usage.

In essence, the creation of this low-cost digital meter marks a significant leap forward in electrical measurement technology, effectively bridging the gap between affordability and functionality.

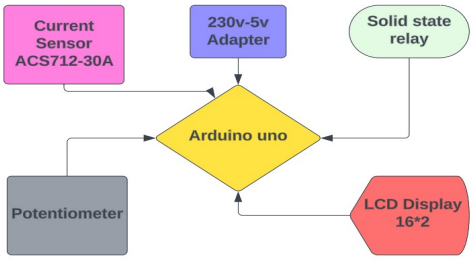


Fig 2 shows the block diagram of digital ammeter with protection circuit

*Digital Temperature meter*

The system's operation begins with Arduino processing input signals, initiating the measurement process. A temperature sensor, connected to the Arduino, detects temperature levels from the connected environment, facilitating real-time data acquisition. This acquired data is promptly showcased on the LCD screen, providing immediate feedback to users. With the use of a potentiometer, users can finely adjust temperature ranges within predetermined parameters, enhancing control and precision in temperature measurements.
Moreover, the variable values of the potentiometer are reflected on the LCD display, ensuring transparency and facilitating accurate adjustments. To ensure safety and stability, a solid-state relay functions as a protective circuit, intervening when the potentiometer values surpass predefined thresholds. This protective mechanism safeguards against potential circuit damage, offering reassurance to users.

The integration of Arduino, sensors, potentiometers, LCD display, and solid-state relay enables a comprehensive and versatile temperature measurement system. Real-time monitoring capabilities empower users to make informed decisions regarding temperature adjustments and system operations. The intuitive interface of the LCD display enhances usability, enabling users to interpret measurement data effortlessly.

Furthermore, the system's adaptability makes it suitable for diverse applications, ranging from household temperature monitoring to industrial temperature control. By providing cost-effective yet reliable measurement solutions, this digital temperature meter promotes accessibility to advanced temperature monitoring technology. Its versatility and reliability contribute to energy efficiency, fostering sustainable practices in temperature regulation.

In conclusion, the fabrication of this low-cost digital temperature meter represents a significant advancement in temperature measurement technology, bridging the gap between affordability and functionality.

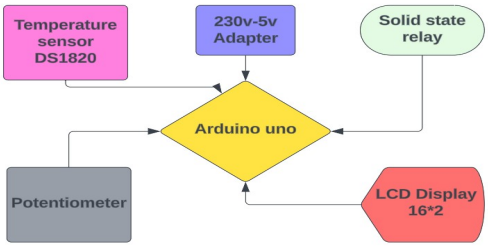


Fig 3 shows the block diagram of digital temperature meter with protection circuit

## IV. CONCLUSION

The fabrication of a low-cost digital meter was successful, achieved through meticulous component selection and manufacturing methods aimed at reducing production expenses. Despite its affordability, the digital meter maintains a high level of accuracy and precision, comparable to commercial-grade meters. This was ensured through rigorous calibration and testing processes, validating its reliability across different electrical parameters.

A notable feature of the digital meter is its versatility, capable of measuring a wide range of electrical quantities. This adaptability renders it suitable for diverse applications including household electricity monitoring, industrial power management, and educational purposes. Real-time monitoring capabilities provide users with immediate feedback, empowering them to make informed decisions regarding their electrical systems.

The user interface, comprising an LCD display and intuitive controls, enhances usability, allowing users to interpret measurement data effortlessly. Additionally, safety measures such as the inclusion of a solid-state relay ensure the system's stability and protect against potential circuit damage. This reliability and safety are essential for long-term operation and user confidence.

Looking ahead, there is potential for further improvements in reducing manufacturing costs and enhancing measurement capabilities. Future iterations could also focus on integrating additional features based on user feedback and emerging technological advancements. In summary, the fabrication of this low-cost digital meter represents a significant advancement in electrical measurement technology, offering an affordable and reliable solution for various electrical applications.

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