

Development of HMI Display using Active Harmonic Filter for Power Electronics

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Abstract: *This paper presents a low-cost Human Machine Interface (HMI) based system integrated with an Active Harmonic Filter (AHF) for real-time power quality monitoring in industrial applications. Due to the increasing use of non-linear loads in industries, issues such as harmonic distortion and poor power factor have become common and require effective monitoring and mitigation. Commercial power quality analyzers and AHF units are costly and difficult for small- and medium-scale industries to adopt. To address this gap, the proposed system utilizes an STM32 microcontroller for real-time measurement, FFT-based harmonic analysis, and AHF control. A Nextion touch-screen HMI is used to display key electrical parameters such as voltage, current, total harmonic distortion (THD), and power factor. The prototype was developed using STM32CubeIDE, Keil uVision, and Nextion Editor, resulting in a significantly low-cost solution compared to traditional systems. Experimental results show a reduction in THD from 25.8% to below 5% and improvement in power factor to above 0.95. The total cost of the system is approximately ₹8,000, achieving around 68% cost savings over commercial alternatives. The developed system provides a practical and economical solution for industrial power quality monitoring without compromising performance and accuracy.*

Keywords: Human Machine Interface (HMI), Active Harmonic Filter (AHF), STM32, Power Quality Monitoring, Harmonic Reduction, Real-Time System, Low-Cost Automation

