

# Smart Adaptive Lab Assistant

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**Abstract:** *The Smart Adaptive Lab Assistant for Rectifier Circuits is an interactive educational system designed to simplify the understanding of rectifier circuits through audio-visual explanation. The system is built using the Arduino Uno as the main controller, integrated with a DFP layer Mini, I2C LCD display, rotary encoder, speaker, and amplifier module.*

*The primary objective of this project is to assist students in learning the working principles of different rectifier circuits such as Half Wave Rectifier, Full Wave Rectifier, and Bridge Rectifier in a more interactive and engaging way. Traditional laboratory teaching methods rely mainly on manual explanation and circuit observation. This system enhances learning by providing automatic audio explanations and on-screen guidance when a user selects a specific rectifier circuit using a rotary encoder.*

*When powered on, the system displays a menu on the LCD screen allowing the user to choose the type of rectifier. Upon selection, the corresponding audio explanation is played through the speaker, describing the circuit components, working principle, waveform behavior, and advantages. The LCD simultaneously displays key theoretical points for better understanding.*

*This project aims to improve conceptual clarity, reduce dependency on manual instruction, and make laboratory sessions more efficient and student-friendly. It can be implemented in diploma and engineering laboratories as a cost-effective smart teaching aid.*

*The Smart Adaptive Lab Assistant demonstrates the practical application of embedded systems in education and combines hardware and software integration to create an intelligent learning platform..*

**Keywords:** Arduino Uno, Rectifier Circuits, Smart Laboratory Assistant, DFP layer Mini, I2C LCD Display, Rotary Encoder, Audio-Visual Learning System, Embedded Systems in Education

