# Project Plan: AI-Based Real-Time Breadboard Verification System

## 1. Introduction

This project aims to simplify the debugging of breadboard-based IoT and AI/ML prototype circuits by using computer vision and object detection techniques. A camera setup will monitor the breadboard as users build circuits and give real-time feedback on wire placements. This system integrates computer vision (YOLOv8), hardware (camera), and web development (Flask/React) to provide an interactive, automated assistant for breadboard-based prototyping.

## 2. Literature Survey

A set of relevant papers will be reviewed focusing on object detection using YOLO, real-time image processing on embedded systems, and automated verification systems. Papers include:  
[paper 1](https://www.mdpi.com/2073-8994/17/2/309)

[paper 2](https://www.mdpi.com/2076-3417/9/18/3750)  
Further analysis will be added in the detailed literature review section.

## 3. Project Workflow

Step-by-step plan to be followed:  
1. Dataset Creation – Collect and annotate images of breadboard setups.  
2. Model Training – Use YOLOv8 to train on annotated data.  
3. Real-Time Detection – Build a camera pipeline using OpenCV + YOLOv8.  
4. Matching System – Create logic to compare live feed with reference layout.  
5. Web Interface – Build a simple UI using Flask or React.  
6. Integration – Merge detection, comparison, and UI.  
7. Testing – Evaluate accuracy and performance.  
8. Documentation – Write paper and prepare demos for presentation.

## 4. Tools and Technologies

- YOLOv8 (Ultralytics)  
- Python, OpenCV  
- Flask / React (Web Interface)  
- Raspberry Pi or USB Camera  
- VSCode / GitHub for version control

## 5. Timeline (Estimated)

Week 1: Literature survey and dataset collection  
Week 2: Data annotation and YOLO training  
Week 3: Real-time detection pipeline  
Week 4: Reference matching logic  
Week 5: Web interface setup  
Week 6: Integration and testing  
Week 7: Documentation and demo prep

Week 8: Paper publication and patent filing