

## CONCEPT

An intelligent system that automatically detects, analyzes, and improves software codebases.

It acts as a virtual coding assistant (agentic) that not only identifies technical debt (poor design, code smells, inefficiencies) but also provides AI-powered refactoring strategies to make code cleaner, safer, and more sustainable.

### How the Project Works (Conceptual Workflow)

- Access Project Folder :Scans source files in supported languages: Python, Java, JavaScript, C++.
- Analyze the Code:Runs static analysis to detect,Code smells (long methods, duplication, dead code),Security vulnerabilities,Poor naming, inefficient loops, unused imports.
- Calculates metrics:Maintainability Index,Cyclomatic Complexity,Debt Ratio
- Suggest & Apply Refactoring (AI-powered)
- Uses LLMs + rule-based engines to propose fixes:
- Split large functions.
- Apply design patterns (e.g., Strategy Pattern).
- Improve naming & structure.
- Remove redundant code.
- Make Code Sustainable:Output code is readable, modular, scalable, and secure.
- Generate Reports & Explanations

### Provides:

Technical debt score

Reasoning → What's wrong, why it matters, how the fix helps.

Ensures transparency so developers learn while improving code.

### 6. Continuous Monitoring (CI/CD)

Integrates with:

GitHub Actions, GitLab CI, Jenkins.

Prevents new technical debt from entering the codebase.

## Technologies Required

### Code Parsing & Static Analysis

AST Parsers: ast, Spoon, ESLint, Babel Parser.

Static Analyzers: SonarQube, pylint, flake8, radon, PMD.

### AI/ML for Refactoring

LLMs: GPT, CodeT5, StarCoder, CodeBERT.

Rule-based Refactoring: Rope (Python).

### Backend / Orchestration

Languages: Python / Node.js.

Pipeline Manager: FastAPI / Flask / Celery.

Flow: Scan → Analyze → Refactor → Report → Commit.

### Reporting & Visualization

UI: React + Tailwind.

Charts: Chart.js / D3.js / Plotly.

Debt Scoring: SonarQube-like formulas.

CI/CD Integration

GitHub Actions, GitLab CI, Jenkins.

Similar Pre-Existing Software

Tool	Capabilities	Limitations
SonarQube	: Detects technical debt & code smells	No automatic refactoring
Code Climate:	: Code quality & maintainability analysis	No AI refactoring
Snyk Code (DeepCode):	AI-powered bug & vulnerability detection	Limited refactoring
Amazon CodeGuru:	AI reviews for Java/Python performance & bugs	Restricted language support
Facebook SapFix:	Automated bug-fixer (internal tool)	Not available publicly
JetBrains IDEs (IntelliJ, PyCharm):	Manual developer refactoring tools	No autonomous AI
Resharper (.NET):	Code analysis + refactoring	Limited to .NET ecosystem