

## Hackathon Project Phases - Code Crackers

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### Project Title:

Gesture-Based Human-Computer Interaction System

### Team Name:

Code Crackers

### Team Members:

- Akshay Kumar (Team Leader)
  - Aashish Jawalkar
  - Shravan Kumar
  - Surya Teja
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## Phase-1: Brainstorming & Ideation

### Objective:

Develop a vision-based system that enables users to interact with a computer using hand gestures captured by a normal webcam.

### Key Points:

1. **Problem Statement:**
    - Traditional input devices require physical contact, limiting accessibility.
    - Hands-free control enhances accessibility and convenience.
  2. **Proposed Solution:**
    - A gesture recognition system using OpenCV, Mediapipe, and AI models to process hand gestures and execute commands.
  3. **Target Users:**
    - Professionals needing hands-free control.
    - Users with mobility impairments.
    - General users looking for intuitive interaction.
  4. **Expected Outcome:**
    - A functional AI-powered gesture-controlled interface with real-time accuracy and seamless application integration.
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## Phase-2: Requirement Analysis

**Objective:**

Define the technical and functional requirements for the project.

**Key Points:****1. Technical Requirements:**

- Programming Language: Python
- Backend: OpenCV, Mediapipe, TensorFlow
- Frontend: Flask / PyQt
- OS: Windows
- Hardware: Normal webcam

**2. Functional Requirements:**

- Recognize hand gestures accurately.
- Execute system commands based on gestures.
- Provide a seamless and interactive UI.

**3. Constraints & Challenges:**

- Ensuring real-time responsiveness.
  - Handling varying lighting conditions.
  - Improving model accuracy.
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**Phase-3: Project Design****Objective:**

Develop the architecture and user flow of the system.

**Key Points:****1. System Architecture:**

- Webcam captures hand gestures.
- AI model processes the gesture.
- System executes the corresponding command.

**2. User Flow:**

- Step 1: User performs a hand gesture.
- Step 2: Model processes and matches it with predefined commands.
- Step 3: System executes the respective command.

**3. UI/UX Considerations:**

- Minimalist and user-friendly interface.
- Visual feedback for detected gestures.

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#### Phase-4: Project Planning (Agile Methodology)

##### Objective:

Break down development tasks for efficient completion.

##### Sprint Planning & Tasks:

Sprint	Task	Priority	Duration	Assigned To
Sprint 1	Research & Dataset Collection	High	6 hours	Entire Team
Sprint 1	Model Training	High	6 hours	Akshay
Sprint 2	Vision Processing Integration	High	5 hours	Aashish
Sprint 2	Gesture-Command Mapping	High	4 hours	Shravan
Sprint 3	UI Design & Testing	Medium	5 hours	Surya
Sprint 3	Debugging & Final Fixes	High	3 hours	Entire Team
Sprint 3	Final Presentation & Deployment	Low	2 hours	Entire Team

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#### Phase-5: Project Development

##### Objective:

Develop the core functionalities of the gesture-based system.

##### Key Points:

###### 1. Technology Stack Used:

- Frontend: Flask / Pyautogui
- Backend: TensorFlow, Mediapipe, OpenCV
- Programming Language: Python

###### 2. Development Process:

- Integrate real-time gesture-to-command mapping.
- Optimize system responsiveness.

###### 3. Challenges & Fixes:

- **Challenge:** Low accuracy under poor lighting conditions.
  - **Fix:** Implement adaptive lighting adjustments.

- **Challenge:** High latency in real-time processing.
  - **Fix:** Optimize model performance.

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### Phase-6: Functional & Performance Testing

**Objective:**

Ensure the system functions correctly and performs efficiently.

**Test Cases & Results:**

Test Case ID	Category	Test Scenario	Expected Outcome	Status
TC-001	Functional Testing	Recognize common hand gestures	Accurate detection	✅ Passed
TC-002	Performance Testing	Gesture response time < 500ms	Fast response time	⚠️ Needs Optimization
TC-003	Bug Fixes & Improvements	Handling different lighting conditions	Consistent accuracy	✅ Fixed
TC-004	UI Validation	Ensure responsiveness across devices	Works on Windows	✅ Passed

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**Final Submission**

1. **Project Report** (This document)
2. **Demo Video (3-5 Minutes)**
3. **GitHub Repository**
4. **Presentation**