# OrthoAssist

***Modular Orthopedic Agent – A Multi-Agent Workflow for Precision Diagnosis***

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# Problem Statement

- Musculoskeletal injuries, especially fractures, are among the most common global emergencies. In rural and semi-urban areas, limited access to orthopedic specialists delays timely care.

- Manual imaging interpretation is slow, error-prone, and increases complications, costs, and recovery time. Existing AI systems are siloed, single-model based, and lack transparency or scalability across multiple body parts.

- With over 1.7 billion people worldwide living with musculoskeletal conditions (WHO), there is an urgent need for scalable and accessible diagnostic solutions.

- A unified, multi-agent system that validates imaging, detects fractures, generates structured reports, and provides patient-friendly explanations can deliver faster, more accurate, and empathetic orthopedic care.

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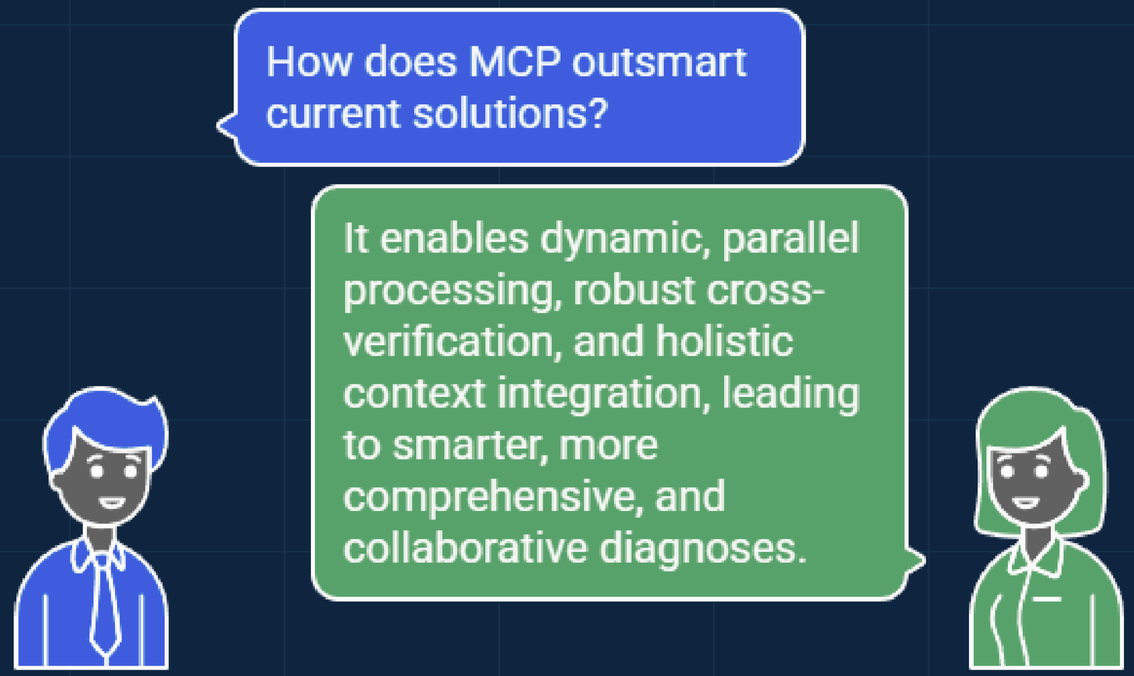
# Proposed Solution

Our Vision: To build a multi-agent workflow system that significantly enhances radiographic fracture diagnosis and provides efficient, intelligent diagnostic support.

## The Architecture – Our MCP Advantage:




### 1. Body Part Agents

- Hands Agent – Detects hand anomalies from scans.
- Legs Agent – Analyzes leg scans.
- Validation Agent – Allows only valid X-ray/MRI/CT of hand, leg, spine, ribs; blocks poor/unsupported inputs.
- Hairline Fracture Agent – Finds subtle fractures for early diagnosis.

### 2. Functional Agents

- Diagnosis Agent – Explains conditions simply for patients.
- Report Agent – Generates structured doctor-friendly reports.
- Hospital Finder Agent – Suggests nearby hospitals/clinics.

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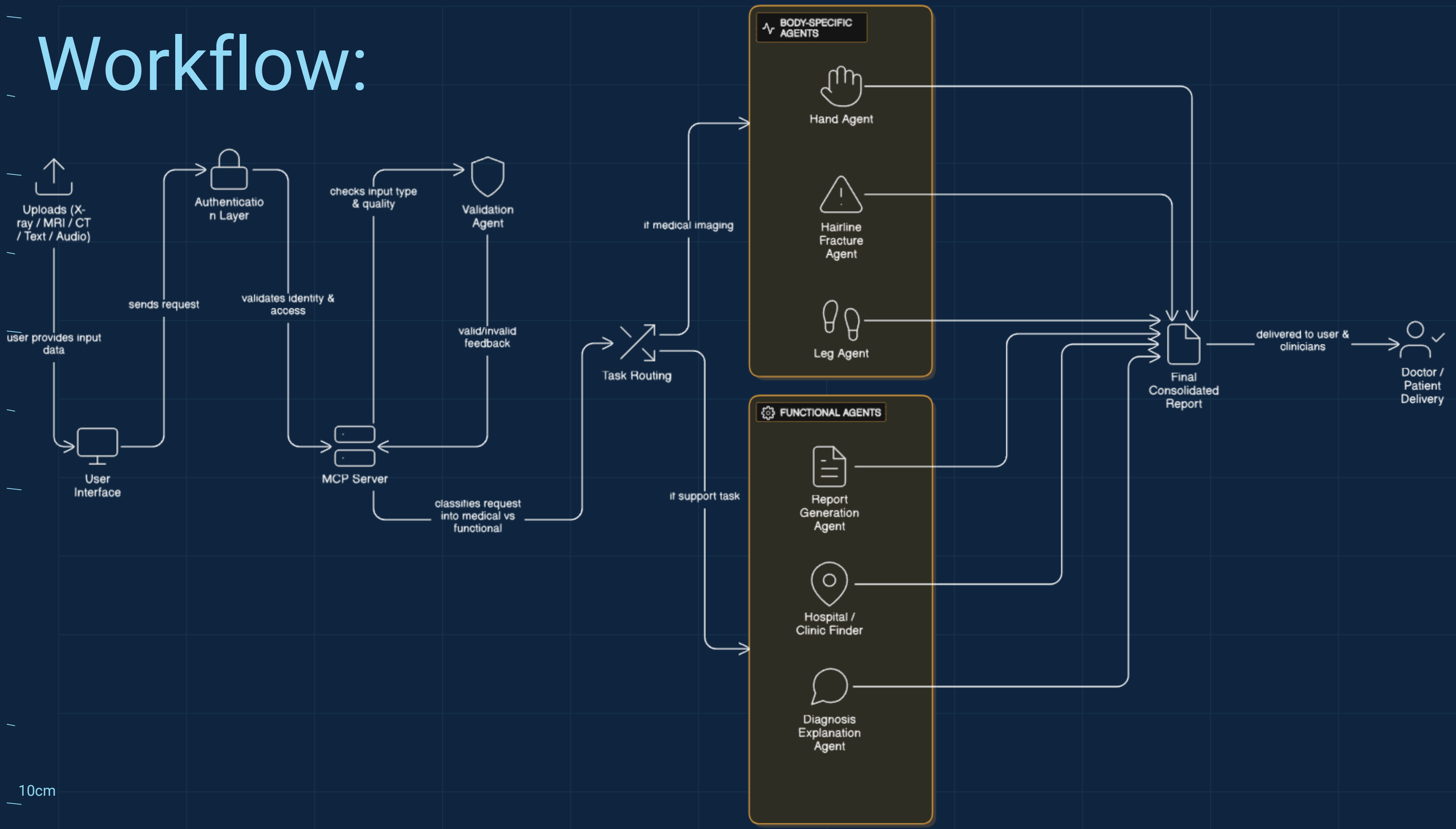
# Workflow:

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# Key Features

- Multi-Modal Inputs: Integrates X-rays, CT/MRI scans, patient text, and audio queries for a complete diagnostic view.
- **Real-Time Triage:** Classifies severity into Red / Amber / Green, helping clinicians prioritize urgent cases.
- **Intelligent Agent Collaboration (MCP-driven):** MCP core runs agents in parallel, boosting confidence and speeding diagnosis, including sentiment-based clinical suggestions.
- **Scalable Architecture:** Modular design allows easy extension to other medical domains and new agents.
- **Clinician & Patient Output:**
  - Clinician: Interactive dashboard with diagnostic suggestions and unified reports.
  - Patient: Clear, empathetic explanations and actionable follow-up recommendations

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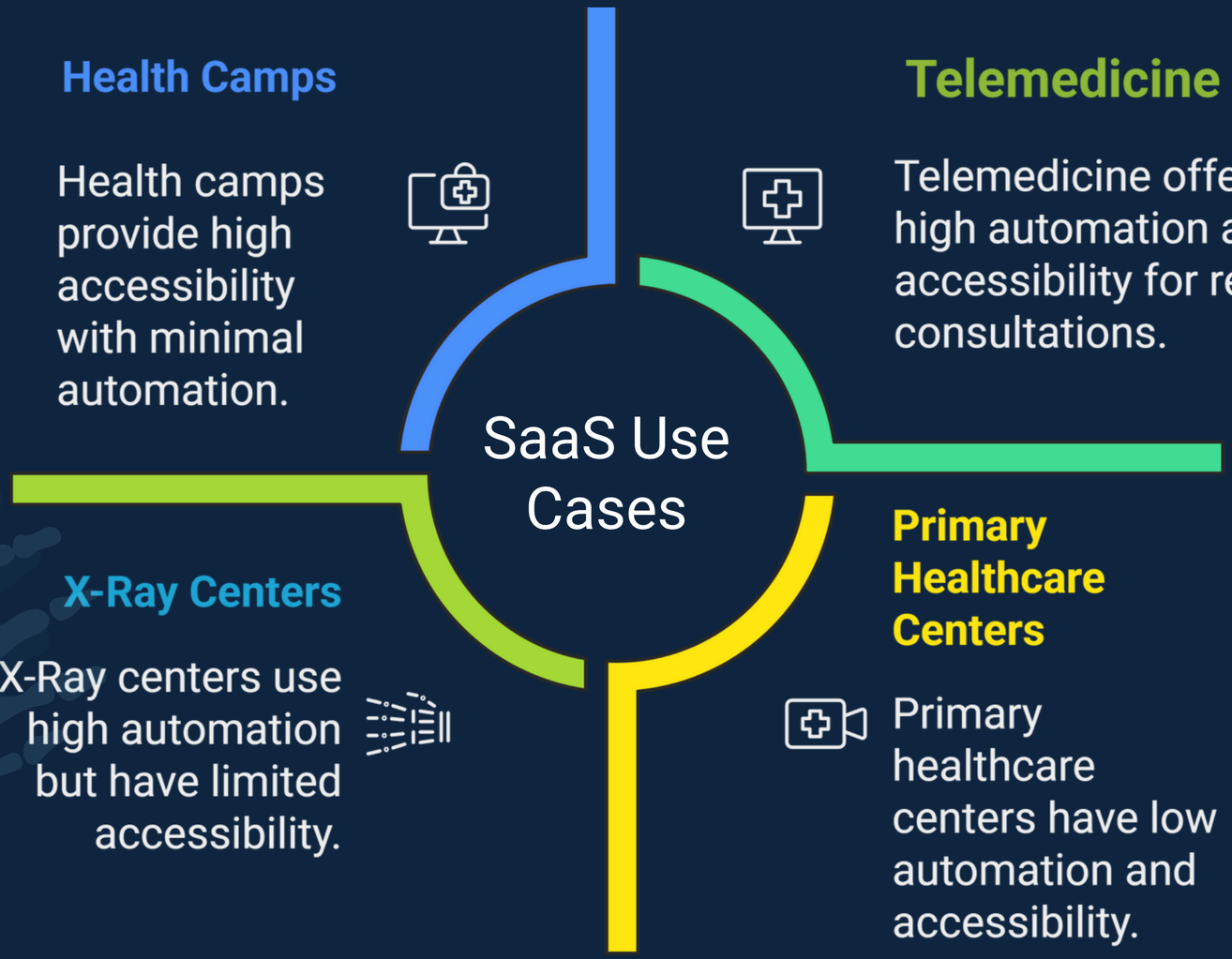
Preview


# SaaS Use Cases & Market Research




Business Model: Cloud-based SaaS with tiered subscriptions (Basic, Pro, Enterprise).

Market Reasearch: Orthopedic AI market growing 20% CAGR, underserved niche in diagnostics.

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# Technical Feasibility, Budget & Tools

One-Time Training Cost (1-2 Months) :

Total: ₹4,000 – ₹8,000

Platform: Google Colab Pro+

Purpose: Provides on-demand A100 GPU access for efficient YOLO model training during the MVP phase.

Monthly Deployment Cost :

Total: ₹600 – ₹4,000 / month

Platform: Render

Breakdown:
• Backend API: ~₹600/month
• Inference: Range depends on using CPU vs GPU instance.

Total MVP Budget & Viability :

First 2-3 Months: ₹20,000 – ₹25,000

This covers one-time training costs plus the initial 2 months of live deployment.


**MCP Core**

Multi-agent coordination ensures seamless orchestration.

**Backend & APIs**

Python drives API endpoints and central orchestration.

**AI Models**

YOLO-based models are leveraged for high-precision image detection, and NLP transformers are used for insightful text/symptom analysis. The project begins with extending YOLO to detect additional body parts.

**Interactive Frontend**

React/Next.js dashboard for intuitive user experience.

**Data Management**

PostgreSQL/MongoDB efficiently handles health records.

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# Potential Impact & Future Scope

## Impact:

- ***Bridging Healthcare Gaps:*** Focused on Tier 2–Tier 3 towns, rural X-ray centers, and health camps
- ***Faster Diagnosis & Enhanced Triage:*** Real-time severity classification with multi-modal inputs reduces missed details and prioritizes urgent cases instantly
- ***Reduced Workload***: Automates routine radiology tasks, letting doctors focus on critical cases
- ***Empowered Clinicians***: Provides context-aware, actionable AI insights they can trust
- ***Improved Patient Experience:*** Delivers clear, empathetic explanations in simple terms
- ***Scalable Design***: Easily extendable to new body parts and imaging modalities (MRI/CT)

### Previous Iteration

- Detects bone fractures in X-ray images with YOLOv11.
- Simplifies diagnosis using a fine-tuned LLM.
- Creates structured PDF reports for doctors.
- Offers a user-friendly web interface for uploads, results, and insights.

**Project Link**

### Current Scope

- Multi-Modal Inputs: X-rays, CT/MRI, text & audio.
- Real-Time Triage: Severity classified(Red/Amber/Green)
- MCP Collaboration: Parallel agents → faster, confident, sentiment-aware diagnosis.
- Scalable Design: Easy extension to new domains/agents.

### Future Scope

- Remote/Offline Access: Mobile support for use in low-connectivity areas.
- Expanded Coverage: Add new micro-agents to extend diagnosis across more body parts.
- Rehab Support: Exercise assessment and monitoring post-fracture.
- Multi-Domain Expansion: Extend beyond orthopedics into cardiology, neurology, dermatology, etc.

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