System Architecture (Real Buildable Stack)

```
Wearable (ESP32 + MPU6050)
        ↓
Bluetooth / WiFi
        ↓
Edge Device (Laptop / Raspberry Pi)
        ↓
FastAPI (Data API)
        ↓
ML Engine (Python)
        ↓
PostgreSQL
        ↓
React Dashboard
```

Hardware Stack (Do NOT overbuy)

Part	Why
ESP32	BLE + WiFi
MPU6050	6-axis motion
DS18B20 / DHT11	Temperature
Li-ion + TP4056	Power
Wrist band	Mount

Cost: ₹1500–₹2500

This is enough to build a **patent-level demo**.

Firmware Stack (ESP32)

Language: **Arduino C++**

ESP32 does only 3 things:

```
Read MPU6050
Read temperature
Send via Bluetooth / WiFi as JSON
```

Example JSON:

```
{
  "worker_id": "W01",
  "ax": -0.3,
  "ay": 1.2,
  "az": 9.6,
  "gx": 21,
  "gy": -4,
  "gz": 3,
  "temp": 31.5
}
```

No AI on ESP32 — keep it clean.

Backend Stack (Your Core Intelligence)

Use:

Layer	Tech
API	**FastAPI**
Realtime	**WebSockets**
Database	**PostgreSQL**
Data Processing	**Pandas, NumPy**
AI	**Scikit-learn**
Streaming	**Redis (optional)**

This makes your system **cloud-ready and patent-grade**.

AI Stack (Where you win)

You will build **three models**:

① Activity Classifier

Input:

```
Ax, Ay, Az, Gx, Gy, Gz
```

Output:

```
Sewing | Idle | Adjusting | Error
```

Model:

- RandomForest or XGBoost

② Fatigue Model

Features:

- Motion speed
- Repetition count
- Temperature

Output:

```
Normal | Fatigued | High Risk
```

③ Ergonomic Risk Model

Rule + ML:

```
If wrist angle > X for > Y minutes → Risk
```

Frontend Stack

Since you know MERN:

Part	Tech
Dashboard	**React**
Charts	**Recharts / Chart.js**
Live data	WebSocket
Alerts	Toast / Red flags

Show:

- Worker state
- Productivity %
- Risk level
- Heatmap

How to Build It (Timeline)

Week 1

- ESP32 + MPU6050 data stream
- CSV logging

Week 2

- Label motion data
- Train activity model

Week 3

- Build FastAPI + AI pipeline
- Live predictions

Week 4

- Build dashboard
- Pilot demo

Why this stack is perfect for you

Because:

- You already know **Python**
- You are learning **AI/ML**
- You know **MERN**
- You have **ESP32**

This project unifies **everything** you want to become:

AI + IoT + Full-stack + Researcher

Final Truth

If you build this:

- You can file **your own patent**
- You can pitch to **textile startups**
- You can win **SIH-level hackathons**
- You can convert this into **a startup**