Project Overview: Biomechanical Analysis using IMU Sensors

**Objective:**

To develop a system for real-time biomechanical analysis, aiding individuals in understanding and optimizing their movement patterns, thus promoting optimal joint health and pain-free movement.

**Methodology:**

1. Sensor Integration: Utilize nine IMU sensors, leveraging devices like the Arduino Nicla Sense ME, attached to key body joints. The optimal method for secure attachment is under consideration.
2. Baseline Data Collection: Use standard anatomical position (individual standing upright with arms by their side and palms facing forward) as the 0,0,0 coordinate reference.
3. Data Gathering: During dynamic movement, acquire inertial data from the gyroscope (measuring angular velocity) and accelerometer (measuring linear velocity).
4. Data Transmission: Send collected data in real-time via BLE (Bluetooth Low Energy).
5. Data Processing: Analyze the transmitted data, potentially utilizing a Kaman filter or a similar algorithm.
6. Kinematic Analysis: Apply inverse kinematics to calculate body joint angles during motion.
7. Visualization: Employ OpenSim, an open-source software, to graphically represent the analyzed data.
8. Feedback and Recommendations: Based on the analysis, provide users with actionable insights on the quality of their movements or posture. For instance, highlighting imbalances during a squat or excessive spinal rotation. Suggest relevant stretches and corrective exercises to mitigate these issues.
9. EMG Integration (Future Scope): To understand muscle engagement patterns further, there's a potential to incorporate EMG sensors. This can illuminate which muscles are functioning optimally, which are underperforming, and which might be compensating.

**Value Proposition:**

Many individuals often overlook minor discomforts, only addressing them when they escalate to debilitating pains requiring medical intervention. This system aims to be a proactive solution, allowing users to understand the root causes of discomfort, and guide them towards achieving a more biomechanically sound movement pattern. The broader goal is to enhance users' knowledge of their body's biomechanics, enabling them to move efficiently and painlessly.

**Personal Motivation:**

With a personal inclination to understand and address minor aches before they escalate, I envision this device as a valuable tool for those committed to maintaining optimal joint health and ensuring pain-free movement. As modern medicine and technology has increased our life spans, we need to also keep our focus on increasing our health span.