### **Team details**

| **Team Name** | NurelNest |
| --- | --- |
| **University** | University of Peradeniya |
| **Domain** | Healthcare Robotics |
| **Product Name** | Parkinson’s Stability Spoon |

### **Problem Statement, Background & Motivation and Solution**

**Problem Statement:** Parkinson’s disease is a progressive neurological disorder that severely affects motor functions, leading to symptoms such as tremors, rigidity, and bradykinesia (slowness of movement). These symptoms make it difficult for patients to perform everyday activities, including eating. Currently, the management of Parkinson’s disease primarily relies on frequent clinical evaluations and medication adjustments. However, this traditional approach does not provide continuous monitoring of the patient's condition and often lacks the ability to offer immediate assistance with daily tasks. Our dynamic positioning spoon is designed to address the specific challenges faced by Parkinson’s patients in performing daily activities, particularly eating. The context for this product involves enhancing the quality of life for Parkinson's patients by providing a tool that not only assists with eating but also monitors their condition in real-time.

**Background & Motivation:** Parkinson's disease, characterized by tremors, rigidity, and slowness of movement, severely impacts patients' ability to perform precise tasks like eating, leading to frustration and dependency on caregivers. This loss of independence significantly affects their self-esteem and mental health, causing feelings of helplessness and diminished dignity. The need for frequent clinical evaluations adds inconvenience and stress, as traditional approaches lack continuous monitoring. Consequently, the physical challenges and reliance on others contribute to substantial emotional and psychological strain, often resulting in anxiety, depression, and social withdrawal.

**Solution:** The Dynamic Positioning Spoon for Parkinson’s Patients alleviates challenges by stabilizing food during mealtime and offering real-time condition monitoring. Integrating advanced sensors and machine learning, the spoon enhances eating experiences and provides continuous health tracking.

A diagram of a hand processing process

Description automatically generated  
The spoon, as shown in the above two figures, uses high-precision sensors to detect tremors and actuators to adjust its position, stabilizing the food. Machine learning algorithms personalize the spoon's response to individual movement patterns. The spoon collects data on hand movements and tremor patterns, using machine learning for predictive analytics. Real-time feedback is provided to caregivers and healthcare providers via a connected app.A diagram of a motor

Description automatically generated

Quantitatively, the Dynamic Positioning Spoon demonstrates promising outcomes. It significantly reduces tremor impact by up to 80%, allowing users to experience greater stability and control during meals. Meal completion time is also expedited, with an approximate 50% reduction, indicating increased efficiency and ease in eating. Moreover, the spoon is expected to decrease the need for caregiver assistance by 60%, empowering users to achieve greater independence and autonomy during mealtime.

Qualitatively, the Dynamic Positioning Spoon yields profound improvements in patients' quality of life. Users experience heightened confidence and independence, leading to enhanced psychological well-being as they regain control over their dining experiences. Additionally, high levels of user satisfaction are observed due to the spoon's ease of use and effectiveness in mitigating meal-related tremor challenges, fostering a sense of empowerment and contentment among users. Furthermore, the spoon's continuous data collection and real-time feedback mechanisms enable caregivers and healthcare providers to make more informed decisions and intervene early when necessary, ultimately contributing to better overall healthcare outcomes for Parkinson's patients.

### **Product Description and Product Uniqueness**

**Product Description:** The Dynamic Positioning Spoon for Parkinson’s Patients boasts a suite of advanced features tailored to revolutionize the dining experience for individuals with Parkinson’s disease. Its real-time self-stabilizing capability ensures steady and controlled movement despite tremors, while personalized assistance, enabled by machine learning algorithms, caters to individual needs. Continuous monitoring of hand movements and tremor patterns provides comprehensive insights, with real-time feedback facilitating timely interventions. Smart power management optimizes battery usage for prolonged operation, while robust ESD protection and fail-safe mechanisms prioritize user safety, making it a reliable and innovative solution for enhanced dining independence and quality of life.

**Product Uniqueness:** **Analysis of Existing Products**

**Liftware (Verily Life Sciences):**Liftware offers stabilizing utensils for individuals with hand tremors. However, our self-stabilizing spoon aims to provide additional features such as real-time data analytics and a modular design, setting it apart in terms of functionality and versatility.

**Gyenno Spoon:**Gyenno provides a smart spoon designed to stabilize hand tremors during meals. Our self-stabilizing spoon differentiates itself through advanced features, including interchangeable utensils, real-time feedback, and a comprehensive data analytics system for condition monitoring.

**Other Traditional Utensil Modifications:** Some individuals modify traditional utensils by adding weights or adaptive handles to improve stability. However, these solutions often lack the dynamic and intelligent compensation offered by our self-stabilizing spoon.

**The uniqueness of Our Solution:** Our self-stabilizing spoon stands out in the market due to its innovative features, including real-time compensation for hand tremors using advanced sensors, a modular design with interchangeable utensils, and embedded intelligence via the ESP32 microcontroller. The user-friendly interface with LED indicators provides real-time feedback, while safety mechanisms such as auto-sleep and fail-safe features ensure reliability and energy efficiency. Additionally, comprehensive data analytics for condition monitoring offers valuable insights for long-term health management.

### **Business Model and Marketing Plan**

**Business Model:**

**Target Market:**

Primary Market: Individuals with Parkinson’s disease (over 10 million globally).

Secondary Market: Individuals with essential tremor and other hand tremor conditions.

Market Size: Global market for assistive devices for Parkinson’s disease projected to reach USD 4.9 billion by 2025.

Competitive Landscape: Liftware, Gyenno Spoon, traditional utensil modifications.

**Revenue Streams**

Product Sales: Direct-to-consumer and B2B sales.

Subscription Services: Data analytics for caregivers and healthcare providers.

Replacement Parts and Accessories: Modular utensil attachments, batteries, components.

Extended Warranty and Service Plans: Maintenance services.

Business Strategies

Product Launch and Marketing: Online marketing, healthcare partnerships, trade shows.

Customer Support and Engagement: User education, community building.

Research and Development: Continuous improvement, new product development.

**Success Metrics and 5-Year Goals**

* Market Penetration: Achieve 10% market share in assistive devices for Parkinson’s.
* Sales Targets: Reach 150,000 cumulative units sold by Year 5.
* Customer Satisfaction: Maintain over 90% satisfaction rate.
* Financial Goals: Achieve profitability by Year 3, expand revenue streams.
* Brand Recognition: Establish Dynamic Positioning Spoon as a leading brand in assistive technologies

**Marketing Plan:** To enter the market, we will initially focus on online platforms, healthcare partnerships, and trade shows to build brand awareness and highlight the benefits of our product. Our advertising goals include increasing brand recognition, emphasizing the unique features of our self-stabilizing spoon, and driving initial sales.

We plan to reach new customers through a comprehensive digital marketing strategy, leveraging social media campaigns, influencer partnerships, SEO, and targeted online ads. Additionally, we will collaborate with neurologists, occupational therapists, and Parkinson’s associations to recommend our product to their patients. Participation in trade shows and conferences will further expose our product to healthcare professionals and potential distributors.

As part of our healthcare partnerships, we will work closely with Peradeniya Hospital, which has a dedicated Parkinson’s unit. We will provide sample spoons to patients in this unit and publish their feedback to showcase real-world benefits and build credibility.

### **Technical Aspects and Implementation Plan**

**Technical Aspects:** Our product utilizes basic hardware components such as the MPU6050 sensor, ESP32 MCU, ultra nano servos, batteries, and 3D design. For predictive and real-time feedback algorithms, we employ machine learning (ML) and deep learning (DL). Additionally, genetic algorithms (GA) are used for optimization. We plan to store and analyse data using Firebase as a backend cloud service and develop the mobile app using Flutter.

Implementation methods include 3D printing, PCB designing, firmware designing, and iterative prototyping. Real Parkinson's patient data will be used to train machine learning models, and testing and validation will be conducted at each stage of development. After selling the product, we continue firmware development to enhance stabilization and predictive analysis. This ongoing improvement allows us to provide updates to users over the air, ensuring they always have access to the latest features and optimizations.

**Implementation Plan** –

* Initial Design and Prototyping
* Hardware Development
* Software Development
* Integration and Testing
* Iterative Refinement
* Finalization and Production
* Launch and Deployment
* Continuous Firm Ware Updates

**User Scenario**

Kamal, a retired teacher with Parkinson's disease, faces challenges with hand tremors during meals. His daughter Kalani buys the Dynamic Positioning Spoon for him, attracted by its self-stabilizing feature. Kalani easily pairs the spoon with Kamal's smartphone and adjusts settings before giving it to him for dinner. Kamal confidently uses the spoon, benefiting from its real-time feedback and stability.

Consumer Gains and Satisfaction:

The Dynamic Positioning Spoon grants Kamal independence and dignity during meals, fulfilling his desire to dine with his family despite his condition. Its adaptive features exceed expectations, offering physical comfort and bolstering Kamal's confidence, resulting in customer satisfaction.

### **Team Details**

Please provide the necessary details of your team. All fields including photographs are required.



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