Neurofeedback-Driven Digital Interventions for Substance Use Disorders

1. **Introduction**
Substance use disorders (SUDs) represent a significant public health challenge, affecting millions of individuals and their families. Current treatment modalities often face challenges related to adherence and relapse, necessitating innovative approaches to enhance recovery outcomes. This proposal outlines a project aimed at developing a neurofeedback-driven digital platform that leverages eye-tracking and facial expression recognition technologies to provide personalized interventions for individuals with SUDs. By offering real-time insights into emotional and cognitive states, this intervention seeks to improve treatment adherence and reduce relapse rates, aligning with the National Institute of Mental Health's (NIMH) goals to optimize digital health interventions for serious mental illnesses.

2. **Problem Statement**
Despite the availability of various treatment options for SUDs, many individuals struggle with adherence to treatment protocols and experience high rates of relapse. Traditional therapeutic approaches often lack the personalization and immediacy required to effectively engage patients in their recovery journey. The integration of neurofeedback mechanisms into digital health platforms presents an opportunity to address these challenges. However, existing digital interventions frequently fail to utilize real-time physiological data to inform treatment, limiting their effectiveness. This project aims to fill this gap by developing a platform that utilizes eye-tracking and facial expression recognition to provide adaptive, personalized feedback to users, thereby enhancing engagement and adherence.

3. **Objectives**
The primary objective of this research is to develop and test a digital intervention that utilizes neurofeedback mechanisms to support individuals with SUDs. Specific objectives include:
   1. To design a user-friendly digital platform that integrates eye-tracking and facial expression recognition technologies for real-time feedback.
   2. To evaluate the effectiveness of the neurofeedback-driven intervention in improving treatment adherence and reducing relapse rates among individuals with SUDs.
   3. To assess user engagement and satisfaction with the digital intervention, identifying factors that contribute to successful outcomes.
   4. To explore the potential for scalability and dissemination of the intervention within existing treatment frameworks.

4. **Preliminary Literature Review**
Research indicates that neurofeedback can enhance self-regulation and emotional awareness, which are critical components in the treatment of SUDs (Arrow White Paper DExTra, 2021). Previous studies have demonstrated the efficacy of digital health interventions in improving mental health outcomes, yet many lack the integration of real-time physiological data to inform treatment (NIMH, 2024). The proposed intervention builds on existing literature by incorporating advanced technologies that provide immediate feedback based on users' emotional and cognitive states, thereby enhancing the therapeutic experience. This approach aligns with the NIMH's emphasis on innovative digital health strategies that address mental health disparities and improve treatment engagement.

5. **Methodology**
The proposed research will be conducted in three phases over a 12-month period:

- ○ **Phase 1: Platform Development**
  The digital platform will be developed to integrate eye-tracking and facial expression recognition technologies. User interface design will prioritize accessibility and engagement, with iterative testing to refine functionality.
- ○ **Phase 2: Pilot Testing**
  A pilot study will be conducted with a sample of individuals diagnosed with SUDs. Participants will engage with the platform over a 12-week period, during which data on treatment adherence, relapse rates, and user engagement will be collected.
- ○ **Phase 3: Evaluation and Analysis**
  Data analysis will focus on the effectiveness of the intervention in improving adherence and reducing relapse rates. Qualitative feedback will be gathered to assess user satisfaction and identify areas for improvement. Statistical methods will be employed to evaluate the significance of outcomes.

6. **Expected Outcomes**
   The anticipated outcomes of this research include:
   - ○ A validated digital intervention that effectively utilizes neurofeedback to enhance treatment adherence among individuals with SUDs.
   - ○ Empirical evidence demonstrating the impact of real-time feedback on user engagement and relapse prevention.
   - ○ A comprehensive understanding of user experiences and satisfaction, informing future iterations of the platform.
   - ○ Recommendations for integrating the intervention into existing treatment frameworks, promoting scalability and accessibility.

7. **Key Personnel**
   - ○ **Dr. Ian McCulloh (Principal Investigator)**: Founder of Arrow Analytics, with extensive experience in neuroscience and data science research. Dr. McCulloh has led numerous federal research programs and has a strong background in developing innovative digital health solutions.
   - ○ **Dr. Christophe Morin (Co-Principal Investigator)**: An expert in consumer behavior and neuromarketing, Dr. Morin brings over 30 years of experience in applying scientific principles to enhance user engagement in digital platforms.
   - ○ **Additional Team Members**: Junior data scientists and software developers will be recruited to support platform development and data analysis.

8. **Budget & Duration**
   Total Request: $1,000,000 for a period of 12 months. Allocation:
   − Software development: $1,000,000 for a period of 12 months. Allocation:
   − Software development: $500,000
   - ○ Testing and evaluation: $300,000 − Human subjects recruiting/compensation: $300,000 − Human subjects recruiting/compensation: $150,000
   - ○ Research publication and dissemination: $50,000

9. **Conclusion**
   This proposal outlines a comprehensive approach to developing a neurofeedback-driven digital intervention for individuals with substance use disorders. By leveraging advanced technologies to provide real-time feedback, this project aims to enhance treatment adherence and reduce relapse rates, ultimately contributing to improved mental health outcomes. The proposed

research aligns with the NIMH's goals to optimize digital health interventions and addresses critical gaps in current treatment modalities.