Motivation: I have increasingly become aware of the disparity between technological advancements and their practical application in enhancing people's lives. Witnessing my father's battle with lung cancer, I made a heartfelt promise to him that I would dedicate my life to helping others. This commitment, combined with my seven years of volunteering with Bridge Disability Ministries, where I witnessed firsthand the challenges faced by individuals with disabilities, deepened my motivation to drive change and develop technologies that address their needs. I recognized that my research skills could be used to empower those in need of healthcare, prompting my transition to a lab focused on accessibility research.

Starting Winter 2023, I have been working with Dr. Kim Ingraham in the Electrical and Computer Engineering Department. Since she just started her lab, I have been receiving direct hands-on mentorship from Dr. Ingraham while actively engaging in fostering a collaborative community. This close collaboration has allowed me to explore my interest in using predictive models to address real-world challenges. Dr. Ingraham's guidance has been invaluable, solidifying my focus on developing innovative solutions that improve the lives of individuals with disabilities.

Background: An estimated 4.3% of children in the United States have disabilities, a prevalence that has been steadily rising in recent years [1]. Children with motor disabilities face significant delays in their ability to walk independently; many do not achieve this milestone until they are between 3 to 5 years old, which can be 2 to 4 years later than their nondisabled peers [2, 3]. Moreover, many do not receive access to wheeled mobility devices until well into their preschool years, significantly hindering their opportunities for independent movement and social interaction [4, 5]. Early access to powered mobility devices is essential, as it enables children to explore their environment and engage in activities that foster social cognitive development [6].

Effective assessment and intervention strategies are critical for children with motor disabilities, as early diagnosis and personalized therapeutic plans can significantly improve developmental outcomes. The Assessment for Learning Powered Mobility (ALP), used in pediatric hospitals, provides valuable insights into motor, cognitive, and social-emotional growth by evaluating how children interact with assistive devices [7]. However, there is a growing need to refine diagnostic tools by leveraging data-driven approaches. In this study, we utilize the Permobil Explorer Mini (see **Figure 1**), a powered wheelchair designed specifically for young children. We gather data from nine participants with motor disabilities, as detailed in **Figure 2**. Preliminary results (see **Figure 3**) indicate both positive and negative correlations between the preprocessed parameters and developmental progress. These findings highlight the potential for predictive models to enhance diagnostic accuracy and improve therapeutic interventions for children with disabilities. Ultimately, this data-driven approach will enable clinicians to anticipate and address the therapeutic needs of children with disabilities more accurately, ensuring timely and effective interventions that promote mobility and independence.

Methods: Using the preprocessed data, I will develop a classification model to predict ALP scores through Python by 1) conducting feature engineering to identify the most relevant parameters and 2) determining the classification model that best fits the limited data. By applying linear correlation and regression against ALP scores, I can identify the parameter combinations that best predict these scores, as no single parameter shows a high correlation with ALP. To predict ALP scores, I will start with **Support Vector Machines** (SVM) because it can effectively manage complex relationships in the data. Given that each session has an assigned ALP score with a substantial amount of data, I will also experiment with models like **Multiple Linear Regression** which can handle multiple parameters. Random Forest is another strong candidate, as it can handle multiple input variables and capture nonlinear relationships. By splitting the data into an 80/20 training-validation set, I will evaluate models using accuracy and precision with a goal of 80% to determine the best approach for predicting ALP scores and guiding interventions.

Afterwards, I plan to develop an interface that incorporates the classification model using Streamlit, optimized for use by pediatric clinicians on both tablets and desktop systems commonly found in hospital environments. Streamlit is used to make interactive web applications for data science and machine learning projects. The goal is to provide an intuitive platform where clinicians can easily monitor and assess children's developmental progress in real time or after therapeutic sessions using the Permobil Explorer Mini, leveraging data-driven insights from the predictive models.

I anticipate that the development of the classification model will take approximately one quarter, followed by an additional one quarter to create the interface. To ensure I stay on track, I plan to meet with Dr. Ingraham every week to discuss my progress and receive feedback. This timeline will allow for thorough testing and optimization to ensure the platform meets the needs of pediatric clinicians.

My commitment to helping others and driving innovation was recognized when I received the Mary Gates Research Scholarship in Autumn 2022 where I utilized machine learning algorithms to analyze cell morphology in Dr. Elizabeth Nance's lab. The Mary Gates community has been incredibly valuable, providing a supportive network of scholars and mentors that enriched my research experience. This scholarship opened doors for me to present at multiple symposiums, where I not only shared my work but also connected with like-minded individuals, fueling my passion for computing and machine learning.

Professional Development: I have been inspired by labs led by female faculty, particularly by Dr. Elizabeth Nance and Dr. Kim Ingraham. While the prospect of pursuing a graduate degree is overwhelming and intimidating, the supportive environment created by my female peers and mentors has instilled in me a sense of belonging and empowerment. Their encouragement and the invaluable mentorship I have received have motivated me to take the leap and pursue a PhD.

I plan to focus my PhD research on developing personalized algorithms that enhance accessibility for individuals with disabilities, enabling them to achieve greater independence and an improved quality of life. Support from the Mary Gates Research Scholarship will significantly impact my growth as a researcher, as this project marks my first significant venture into accessibility technology, fostering my commitment to user-centric design and community engagement. This scholarship will allow me to dedicate more time to understanding the needs of individuals with disabilities, ensuring that my research is deeply informed by their experiences. By integrating principles of machine learning, human-computer interaction, and community engagement, I will be better positioned to develop effective solutions that significantly shape my journey as a scientific professional.

As I progress through my final year of undergraduate studies, I aim to prepare this project for publication, ultimately testing the final product in pediatric hospitals to evaluate the effectiveness of the algorithms in real-world settings. Presenting my work at the Undergraduate Research Symposium will allow me to share findings and connect with diverse researchers, refining my methodologies for developing effective personalized therapeutic interventions for individuals across a range of disabilities.

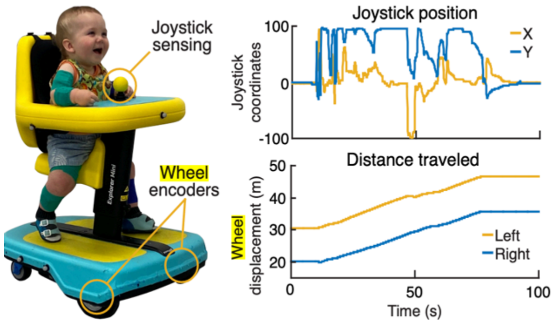

Figure 1: Diagram of Permobil Explorer Mini created by Dr. Kim Ingraham. *The wheeled mobility device is equipped with two types of sensors. One to determine the position of the joystick through time and another to understand the displacement of the device.*

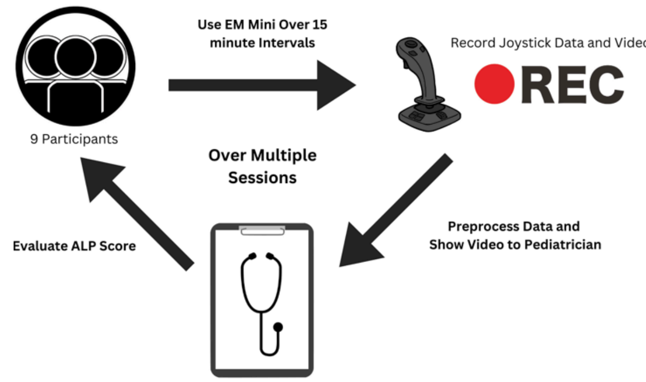

Figure 2: Schematic of Data Collection Workflow. *Participants are placed on the Permobil Explorer Mini for 15-minute intervals, during which data is collected through sensors and video recordings. This data is preprocessed into parameters and presented to the pediatrician to assign an ALP score for each session. This process is repeated across multiple sessions, with the expectation of increasing ALP scores over time.*

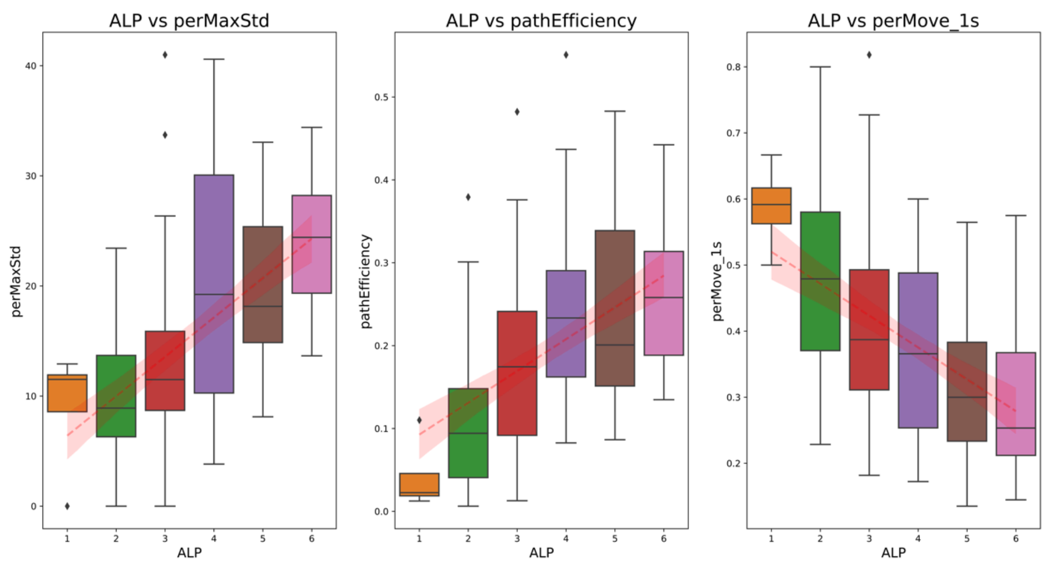

Figure 3: Correlation between ALP score and preprocessed parameters. ***perMaxStd*** *represents the variance when the joystick is at its maximum across all interactions within a session, showing a positive correlation of 0.52.* ***pathEfficiency*** *indicates the ratio of joystick path length to the distance traveled per joystick interaction, with a positive correlation of 0.50.* ***perMove_1s*** *denotes the percentage of joystick interactions lasting less than 1 second, exhibiting a negative correlation of 0.48.*

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