ELECTIVE (SSC5b) REPORT (1200 words)

A report that addresses the above four objectives should be written below. Your Elective supervisor will assess this.

During my time at the Robotics and Rehabilitation (RoAR) Lab at Columbia University in New York, I had the extraordinary opportunity to delve into the intersection of robotics and rehabilitative medicine. This experience was not only intellectually stimulating but also profoundly impactful in shaping my understanding of how cutting-edge technology can transform patient care. Under the guidance of Professor Sunil Agrawal, I explored innovative approaches to assist and rehabilitate individuals with gait abnormalities and neurodegenerative conditions.

One of the most fascinating projects I engaged with involved a novel device integrated into a sandal, designed to measure the force exerted at the heel and toe during walking. This device allowed researchers to perform detailed gait analyses by capturing real-time data on the distribution of forces across the foot. The implications of this technology for clinical practice are profound, as it provides invaluable insights into the biomechanics of walking. For patients with gait abnormalities, such as those caused by cerebral palsy (toe-walking), this device offers a non-invasive means to assess and monitor their condition over time.

In conjunction with the force-measuring sandal, I had the chance to work with the Tethered Pelvic Assist Device (TPAD). The TPAD is an ingenious piece of equipment that aids in the rehabilitation of individuals with abnormal gait patterns. By providing dynamic support and corrective feedback, the TPAD helps patients to practice and improve their walking. For example, in individuals with cerebral palsy, the TPAD can be programmed to correct specific gait deviations, thereby facilitating more natural and efficient walking patterns. The data from real patients who had used the TPAD over a course of 6 weeks was especially interesting, as I could see first-hand how technology can make a tangible difference in their lives.

Another highlight of my time at the RoAR Lab was exploring the use of the VIVE Pro virtual reality (VR) headset. The potential applications of VR in rehabilitative medicine are vast, and the RoAR Lab is at the forefront of this exciting field. I was particularly intrigued by the use of VR games and mazes to train individuals with Parkinson's disease (PD) who experience freezing of gait, a common and debilitating symptom. By immersing patients in a virtual environment, researchers can create controlled settings that challenge and improve their motor skills in ways that are engaging and adaptable to their needs. I also gained a valuable insight into the constraints of medical research as for this study the patients were required to be fitted with a spinal stimulator which created a bottleneck for recruitment. This was also further exacerbated via the Medicaid/ insurance-based model of US healthcare and I was lucky enough to sit in a meeting between the roboticists and the clinicians where they were able to troubleshoot and target set for recruitment.

The integration of VR technology into rehabilitative practices opens new possibilities for therapeutic interventions. One project, that I hope to design and follow through, was the use of the VIVE Pro to measure eye movement speeds in patients with PD. I had the opportunity to present my ideas to the group, proposing the development of a VR-based cognitive rehabilitation (CR) game aimed at overcoming ocular muscle bradykinesia, a condition characterised by the slowing of eye movements. By training patients in a virtual environment, we could potentially enhance their ocular motor function, thereby improving their overall quality of life.

Presenting my idea to the RoAR Lab team was an exhilarating experience. The feedback I received was both encouraging and insightful, pushing me to think critically about the design and implementation of such a game and the validity of any measurements that could be taken via the VIVE pro. The collaborative atmosphere of the lab fostered a spirit of innovation and continuous learning, with a real onus on problem solving for which I am immensely grateful.

The blend of robotics, biomechanics, and virtual reality at the RoAR Lab provided a comprehensive understanding of how interdisciplinary approaches can revolutionize rehabilitative medicine. Each day brought new challenges and learning opportunities, from analysing data collected from the sandal device to understanding the mechanics of the TPAD and experimenting with VR applications. These experiences have deepened my appreciation for the potential of technology to address complex medical issues and have inspired me to pursue further research in this field.

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Reflecting on my time at the RoAR Lab, I am filled with a sense of gratitude and excitement for the future of medicine. The innovative work being done at Columbia University is paving the way for new therapeutic modalities that could significantly improve patient outcomes. The integration of advanced technologies such as robotics and virtual reality into clinical practice represents a promising frontier in healthcare.

In conclusion, I would like to extend my heartfelt thanks to Professor Sunil Agrawal for the opportunity to be a part of the RoAR Lab. His mentorship and the collaborative spirit of the lab have been instrumental in my learning journey. The insights gained and the skills developed during this time will undoubtedly influence my future career in medicine. The future of medicine is indeed bright, with robotics and technology playing a pivotal role in shaping new paradigms of patient care. My experience at the RoAR Lab has reaffirmed my belief that we are on the cusp of a new era in rehabilitative medicine, where technological advancements will continue to enhance our ability to diagnose, treat, and improve the lives of patients around the world.

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