


Student proposed?	Y/N	If Y, student name
ID: eg YAG-01	AK-04	
SUPERVISOR:	A. KHAN	
TITLE:	Motorized Rehabilitation System For Knee Injuries	
	<p>Knee injuries represent a significant challenge in medical rehabilitation, affecting millions of people worldwide and substantially impacting their quality of life. The rehabilitation process following knee injury or surgery traditionally relies on physiotherapy, which includes range of motion exercises to restore joint function and strengthen surrounding muscles. However, current rehabilitation methods face several limitations, including the risk of secondary injury when using the unaffected leg for assistance, inconsistent exercise application between sessions, and the resource-intensive nature of regular physiotherapy appointments. The field of knee rehabilitation has evolved significantly over time, progressing from simple braces designed to provide stability and limit motion, to motorized devices that enable controlled range of motion exercises. This technological evolution has culminated in the development of exoskeletons, which have shown promise in various applications from military use to workplace assistance. Modern exoskeleton technology incorporates features such as actuated joints, integrated sensors for movement monitoring, and real-time feedback systems, offering new possibilities for rehabilitation. There remains, however, a critical need for specialised motorised knee braces that can provide controlled assistance during rehabilitation exercises while allowing for gradual adjustment of assistance levels as patients progress. Such devices must be capable of ensuring consistent and measurable exercise performance while reducing the risk of secondary injury.</p> <p>This project aims to address these needs by developing a motorised knee brace that combines the stability of traditional braces with the controlled assistance of modern exoskeleton technology, potentially revolutionising the approach to knee rehabilitation and recovery. The project was attempted in 2024, but several limitations were experienced with the components of the prototype.</p>	

	
DELIVERABLES:	<ol style="list-style-type: none"> 1. Conduct a literature review to assess the state-of-the-art in exoskeletal structure for improving knee biomechanics. 2. Assess structures/configurations of knee exoskeletal systems. 3. Select topology to be investigated and determine design requirements. 4. Design a motorized exoskeleton for improved knee biomechanics. This will involve the support structure for the exoskeleton, motor system for actuated knee joint, sensing system for knee angle, control system for the exoskeleton. 5. Develop a prototype of the motorized exoskeleton system. 6. Testing of the exoskeleton system and analysis of its efficacy for improving knee biomechanics.
SKILLS/REQUIREMENTS:	<p>Interest in motorised systems and application thereof to biomechanics</p>
GA 1: Problem solving: <i>Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively</i>	<p>Detailed design of an exoskeletal system, including sensors and motorised actuator.</p>
GA 4**: Investigations, experiments and analysis: <i>Demonstrate competence to design and conduct investigations and experiments.</i>	<p>Prototyping and testing of exoskeletal system will be conducted. Detailed analysis of experimental results will be used to thoroughly investigate the performance of the system.</p>
GA 5: Use of engineering tools: <i>Demonstrate competence to create, select and apply and</i>	<p>Appropriate experimental techniques will be used to thoroughly investigate the performance of developed system.</p>

recognise limitations of appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering problems	
EXTRA INFORMATION:	See final year project report by: Zinzile Mabizela, October 2024.
BROAD Research Area:	Motorised systems, biomechanics
Project suitable for ME/ ECE/EE/ALL?	ME, EE

***NOTE: Complex engineering problems** require in-depth fundamental and specialized engineering knowledge and have one or more of the characteristics:

- are ill-posed, under- or overspecified, or require identification and refinement;
- are high-level problems including component parts or sub-problems;
- are unfamiliar or involve infrequently encountered issues;

and their solutions have one or more of the characteristics:

- are not obvious, require originality or analysis based on fundamentals;
- are outside the scope of standards and codes;
- require information from variety of sources that is complex, abstract or incomplete;
- involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

****NOTE: GA 4:** The balance of **investigation and experiment** should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. An **investigation differs from a design** in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Ethics clearance questionnaire

		Yes	No
Q1	Does this project involve data collection		N
Q2	Does this project involve utilizing a third-party data set		N
Q3	Does this project utilize machine learning (ML) or artificial intelligence (AI)?		N
Q4	Does it exceed the minimum risk defined here: Link [Answer is No here if your project does not utilize ML and AI]		N
Q5	Does this project involve external parties, funders, etc		N

Answer the following questions if you answer "**Yes**" to any of the above questions.

If the answer is "**Yes**" to **Q1**, please answer the following questions:

		Yes	No
Q6	Are there humans or animals directly involved in the data collection process or contains any identification information		

If the answer is "**Yes**" to **Q2**, please answer the following questions:

		Yes	No
Q7	Are the third-party data used anonymous (data does not contain human or animal-related information?)		
Q8	Are the third-party data used from an open source?		

Q9	Are the third-party data used from a different research group?		
Q10	If the answer to Q9 is “ Yes ”, do you have the approval to use third-party data sets? Attach the proof to PSQ application.		

If the answer is “**Yes**” to Q5, please answer the following questions:

		Yes	No
Q11	Have you signed an MOU between the parties [If Yes, attach the proof to PSQ application.]		
Q12	Will there be a chance for any conflict of interest between the parties? [If Yes, provide details of the issue and your plan to solve it]		