Problem Statement and Goals
Software Engineering

Team 11, technically functional
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Table 1: Revision History

Date	Developer(s)	Change
September 16th, 2025	Maham	Added preliminary stakeholder information
September 17th, 2025	Matthew	Added 1.1, 1.2 and References
September 17th, 2025	Vaisnavi	Added onto 1.2 and Reflection
September 18th, 2025	All members	TA meeting and feedback
September 19th, 2025	Maham	Edits
September 20th, 2025	Maham	Completing assigned parts and edits.
September 22nd, 2025	All	Finished First Draft

1 Problem Statement

1.1 Problem

According to the Global Burden of Diseases, Injuries and Risk Factors study performed in 2019, individuals that would benefit from physical rehabilitation at least once in their lifetime is upwards of 2.41 billion globally [?]. Those with access to a physiotherapist experienced a disconnect with performing a required movement with proper time-under-tension (TUT) and correct form [?]. While a physiotherapist can advise these individuals during their assessments and proceeding follow-up appointments, the efficacy of rehabilitation depends heavily on the individual's correct performance of the exercise. In turn, this creates a need for a tool that can ensure users correctly perform the exercise without

supervision. This project aims to develop a tool that can provide feedback and corrections for the prescribed physical rehabilitation exercise.

1.2 Inputs and Outputs

Inputs: Inputs: A recording of the user performing their physical rehabilitation exercise, captured through an Android smartphone with a video recording ability.
Outputs: Feedback or corrections of the demonstrated movement, along with highlighting targeted adjustments to the form as needed.

1.3 Stakeholders

1.3.1 Primary Stakeholders

End users/Patients:
The main audience for this application will be users who have been undergoing physiotherapy treatment for one leg, and have been given a home exercise plan which outlines the exercise selected by the team. These users will be obtaining accurate feedback and corrections to assist their performance of the exercise from the comfort of their home and without constant input from a physiotherapist.

1.3.2 Secondary Stakeholders

Physiotherapists:
The application can be used as an adjunct tool for physiotherapists, allowing them to evaluate patient performance, recovery changes and whether any modification to the exercise is required.

1.3.3 Tertiary Stakeholders

Regulatory authorities: They will be ensuring and assessing that the application is working in an ethical manner, safeguarding any patient information that is used and ensuring that accurate results and expertise is being provided.
Other healthcare providers: Specialists such as physiatrists and registered massage therapists may benefit from the information provided by the application about their patients.

1.4 Environment

1.4.1 Software

The application will be built using an object oriented programming language with supplementary libraries to enable the use of computer vision technology.

1.4.2 Hardware

The application will be designed for a single operating system and will run on an Android device with a camera recording ability. Any further development for different operating systems is out of scope for this project.

2 Goals

1. **Support Physiotherapy Patients in Recovery**: Assist individuals who are currently undergoing or have previously completed physiotherapy by providing a tool that reinforces the guidance given by their physiotherapist and helps them carry out prescribed exercises more effectively at home.

2. **Promote Safe and Correct Exercise Practice**: Help patients maintain proper form and technique during their rehabilitation exercises to improve recovery outcomes, reduce the likelihood of setbacks or injuries, and encourage consistency in completing their routines.

3. **Enhance Patient Confidence and Adherence**: Empower patients to take an active role in their rehabilitation by offering immediate, accessible feedback that builds confidence, encourages adherence to prescribed plans, and complements professional physiotherapy care.

3 Stretch Goals

1. **Expanded Exercise Library**: Support additional exercises beyond a single lower body part, covering upper-body and full-body rehab movements.

2. **Gamification and Engagement**: Add motivational elements like progress tracking, achievement badges, or reminders to improve adherence.

3. **Integration with Wearables**: Sync with smartwatches or fitness bands for additional data (example: heart rate, balance, or time-under-tension tracking).

The stretch goals listed above are out of scope for this project due to time and financial constraints.

4 Extras

The extras chosen for the project are a **Design Thinking Document** and **User Instructional Video**.

The Design Thinking Document will explain how we approached our project from a higher level perspective.

The User Instructional Video will be a demonstration on the use of our application, to serve as a guide to new users and a demonstration to instructors.

Appendix — Reflection

Vaisnavi - Reflection

1. What went well while writing this deliverable?

   The problem was defined clearly by looking at research on unsupervised performance of physiotherapy exercises. Having two members in the team that were more knowledgeable about the topic helped guide discussions and becoming intrigued by the proposed project. Once the team was in agreement of which direction the project was heading, additional research on the topic was done, which aided in understanding the problem and align on a realistic scope and goals. To allocate the required tasks fairly, the deliverable was sub-divided into manageable sections amongst the members. This strategy provided an additional benefit, and allowed seamless integration of various perspectives as a result.

2. What pain points did you experience during this deliverable, and how did you resolve them?

   One of the major pain points was that the entire body was too broad of a scope. To make the project more manageable, the scope was narrowed to a specific body part, where measurements such as time-under-tension (TUT) and form. TUT will be measured in seconds, and form will be measured using angles and range of movement.

3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?

   As mentioned above, the focus was shifted to a singular body part as opposed the full body. This project involves the integration of multiple technologies related to computer vision into a functional application, which is a complex endeavour. The goals listed above will become more specific and concrete as the project development progresses.

Matthew - Reflection

1. What went well while writing this deliverable?

   I think during this deliverable we were able select a problem statement that resonated with each of us. Furthermore, the supporting sections helped guide our conversations and team meetings involving stakeholders, environment, inputs and outputs. Something that worked well involved splitting up the sections and subsections by topic rather than the deliverable itself. This resulted in more meaningful conversation and each of us acted almost as a subject matter expert. This was showcased during the meeting with the TA where we were able to ask our own questions while also letting other team members jump in to expand the idea further.

2. What pain points did you experience during this deliverable, and how did you resolve them?

One main pain point was refining the scope of the project and also project selection which had led to the work of this deliverable. Initially starting we had a few ideas around accessibility and "- a tool to assist [blank]" which had been good during the brainstorming process as we could begin to filter out projects through a voting process. But as the project came down to two, we were divide and navigating it in terms of complexity was difficult. We resolved it by building out the scopes of each project in separate 'mini' teams and then presented it informally to each other. Through addressing each of our concerns, we were also able to refine the scope so the projects were less prone to scope creep later on. Our final decision came down to a vote and we had then resolved our pain point regarding project selection and scope.

3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?

I think that in order to adjust the scope of the project, we needed to outline the metrics that we were evaluating for success. Further, we needed to first identify the problem at hand. Once we were able to restrict the problem statement, we considered the target stakeholders on both sides [for physiotherapy]. We then considered possible solutions and then tried to evaluate the scope. We had to limit the scope quite a bit from what was initially thought but in doing so, we created a "MVP" with additional features if there is extra time to develop. For example, our app may be limited to a certain body part for physio assessment but if there is more time then we may expand on the goals and evaluate the stretch goals as well.

Cieran - Reflection

1. What went well while writing this deliverable?

The team came together very early on to divide up the work and set expectations for each other. This set a tone of professionality and efficiency that I am looking forward to seeing from the group as we move forward with the project. Additionally, everyone was settling in very nicely and this acted as a good re-introduction for a few of us to github's functionality and little quirks that we will have to work with and around this term. I think we've done well to manage our time and efforts towards this deliverable and I hope it continues.

2. What pain points did you experience during this deliverable, and how did you resolve them?

Initially we were torn between two projects of different scope and content entirely, unsure of how to proceed we stalled for a long time waiting for information from third parties before innevitably taking a vote and crossing the issue off ourselves. This wasn't a huge issue, but I would say before we managed to understand and contribute well together using github it slowed us down with our parallel work. We came together to find an alternative path to parallel contributions and feel as though our progress is well on its way.

3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?

We estimated through looking at the pre-approved projects and discussing with other groups that a project using cameras to record and measure exercises effectively would be challenging enough and complex enough for our capstone. However, once we sat and discussed the problem we determined that the number of exercises and movements we will have to detect and recognize is much too large. After that conversation, we locked our scope to a single body part for the time being to prove that this project can be done, but also to make the workload reasonable for the team.

Eman - Reflection

1. What went well while writing this deliverable?

The work assignment and distribution were two aspects of this project that went especially well. Every member actively participated in our team meeting by offering their areas of expertise and selecting the sections they felt most qualified to finish, all while providing a thorough justification for their selections. This created a sense of responsibility and made sure that assignments were tailored to each person's strengths. Furthermore, team members generously offered assistance beyond their own tasks, evaluating each other's work and offering helpful criticism, which improved the document's overall quality.

2. What pain points did you experience during this deliverable, and how did you resolve them?

Making a clear distinction between the main aims and stretch goals of our project was a major challenge we faced while producing this deliverable. Since many of the concepts felt significant and connected, it was initially challenging to distinguish between what was necessary to provide our proof of concept and what might be regarded as future improvements. To address this, we reexamined the project's actual goal and determined which results were definitely required to verify our idea. We then classified long-term objectives and other features as stretch goals. Through

this procedure, we were able to focus, reduce our scope, and design a realistic development plan while still taking into account potential future developments.

3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?

   To ensure our goals were suitable for a Capstone project, we adjusted the scope by narrowing the focus of our application to a single body part of the lower body (either leg). This allowed us to keep the project manageable while still demonstrating technical depth in computer vision, pose analysis, and real-time feedback. We also defined a clear distinction between primary goals, which validate our proof of concept, and stretch goals, which represent future enhancements beyond the scope of the course. This balance ensured the project remained feasible within the given timeline while retaining the complexity expected of a senior design project.

Maham - Reflection

1. What went well while writing this deliverable?

   We got to exercise the soft skills we have been developing all throughout our degree - teamwork, effective and timely communication, and creating a project from scratch! This project appealed to all of our team members in very different ways. Everyone's ideas and feedback were taken into consideration and any decisions made were collaborative. Our team is still in the initial stages of understanding each other and their workstyles, and this deliverable gave a glimpse into that.

2. What pain points did you experience during this deliverable, and how did you resolve them?

   As mentioned by other team members, the scope of the project turned out to be too big and complex to tackle with the amount of time and resources that we had. We decided to minimize the area that the application was being designed for and determined it to be the lower part of the body (needs more specialization but we still need to consult our experts/advisors). At the end of the day, all of us were in agreement of our plan going forward and looked forward to the next step.

3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?

   This project is a challenging endeavour and requires the use and integration of various systems that we have learned over the course of our degree. At first, our project seemed too ambitious when the whole body was being considered, but narrowing it down made it more achievable. Some body

parts, such as the hand or ankle, were too complex and had too many motions to account for. In the end, it was collaboratively decided that only one exercise would be chosen and that our project would be a 'blueprint' for future development of similar applications.