PROJECT FOUR: MILESTONE 4 – COVER PAGE

Team Number: TUES-22

Please list full names and MacID's of all *present* Team Members

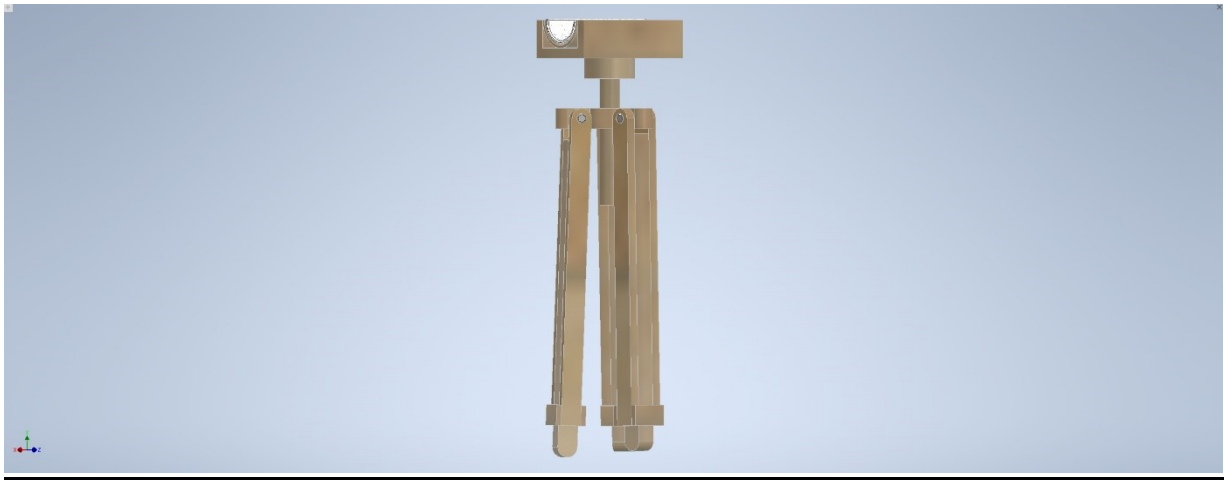
Full Name:	MacID:
Sana Khan	khans288
Yasmine Elkhouly	Elkhouy
Alexander Hucik	hucika
Sameer Shakeel	shakes4

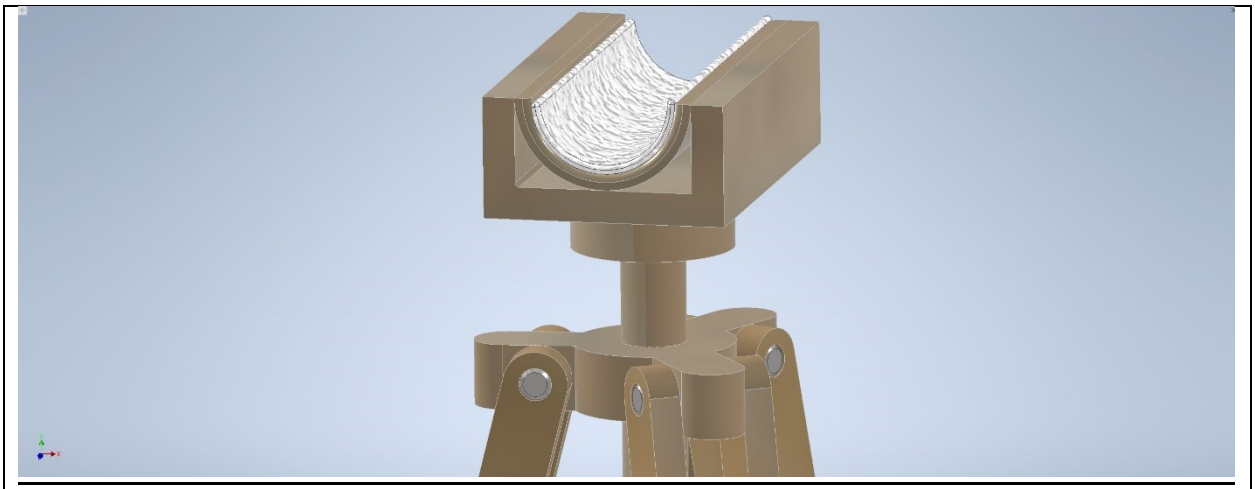
MILESTONE 4.1 – REFINED PROTOTYPE + PROTOTYPING TEST PLAN

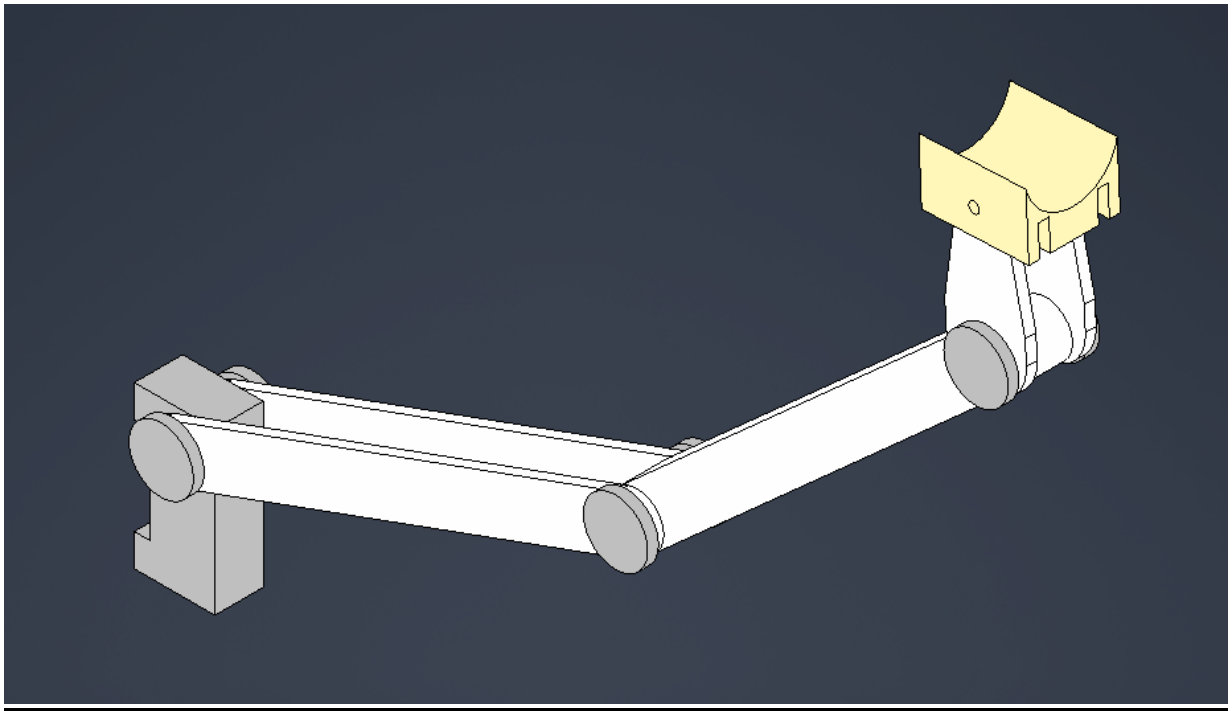
Team Number: TUES-22

1. Take picture(s) of your refined prototype.
   → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   → **Do not include more than *two* pictures per page**

Insert picture(s) of your previous prototype(s) below.

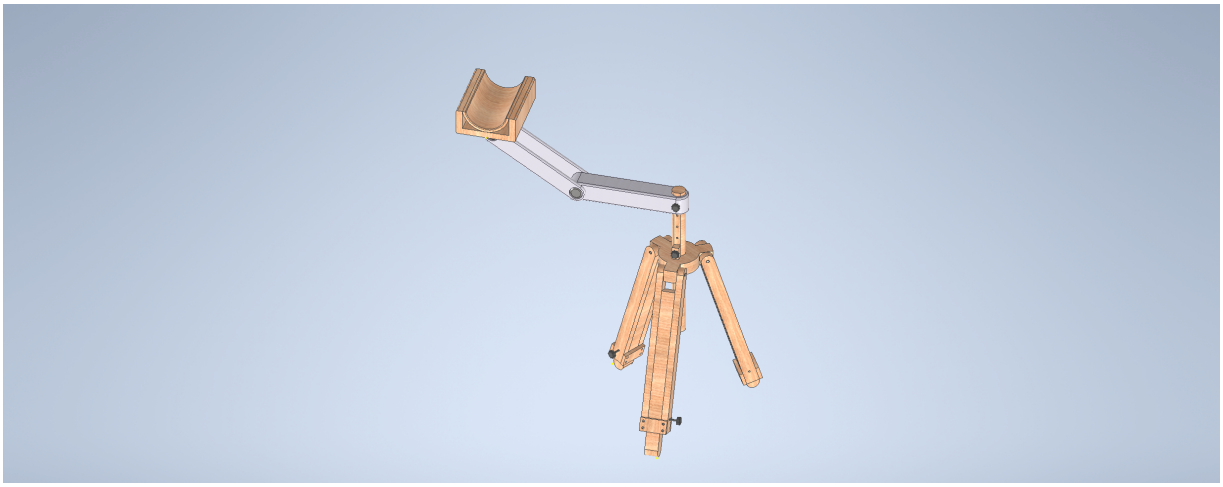






*Limit screenshots to no more than 2 per page. For additional screenshots, please copy and paste the above on a new page.

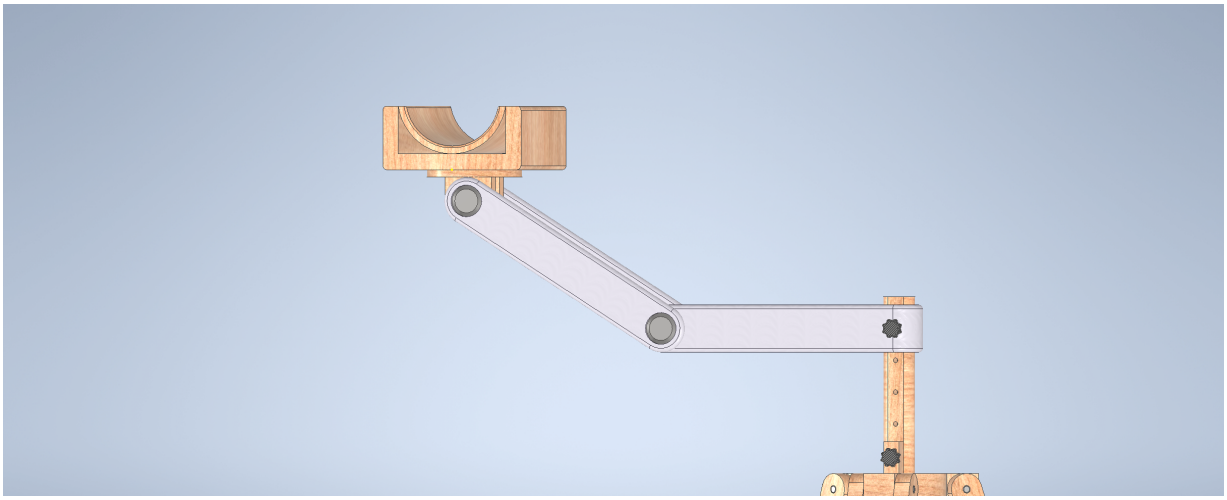
Insert picture(s) of your refined prototype below.

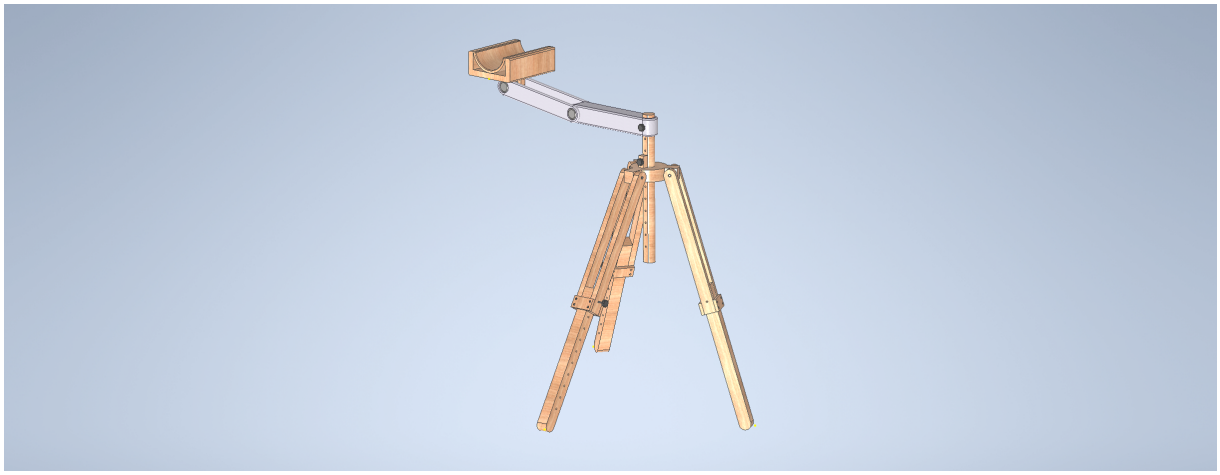


*Limit screenshots to no more than 2 per page. For additional screenshots, please copy and paste the above on a new page.

Team Number: TUES-22

Insert picture(s) of your refined prototype below.





*Limit screenshots to no more than 2 per page. For additional screenshots, please copy and paste the above on a new page.

2. Include details on how design concept was refined (what feedback was incorporated, what features are different than previous refined concept (initial prototype), etc.).

Include details on your thought process and how the concept was refined below, with notes on relevant feedback that was incorporated ***(max. 200 words).***

We decided to combine the linkage arm design and the tripod arm rest design as the two fit well together. The flaw with the linkage design was that it really had no support as it was planned to be attached to an easel, and when weight would be put on the arm rest it might possibly move the easel which is something our client would preferably not want. It also included a poorly designed arm rest with no padding. The feedback received with the tripod design was that it was limited on its range of motion and only allowed for a fixed position unless it would be adjusted by the client. Therefore, we decided to combine the two designs to create one design which has the height adjustable linkage arm, giving the design a higher range of motion and including a much-improved arm rest that includes padding. It also includes proper support for this linkage arm as it is attached to the tripod which now does not interfere with the easel of the client. Overall, the new design is much more improved and will continue to implement more changes based on feedback and observations.

Team Number: TUES-22

3. Create a detailed prototype testing plan. (Max 500 words)
   - → Consider what is feasible with the resources you have
   - → "Testing" can include analytic solutions such as hand calculations, motion simulations in Inventor
   - → Explore what you might do if you had more time, money, tools, etc.
   - → Use IEEE referencing if any research is done

*Insert your **Present Testing Plan** (how you would test your prototype with the resources that you have available).*

For our testing plan, we are going to run three test plans for our three main objectives, in which our solution; should be reliable, ergonomic, and have multiple functions.

In order to be reliable, we need to ensure that our device can bear a weight of an average arm, which is approximately a maximum of 12 pounds, without stress failure of the linkage supporting the arm rest. To test this objective, we will use the stress analysis simulation in Inventor. Initially we will assign our desired material to the linkage and arm rest component of our model (which are stainless steel and wood respectively). Then, we would apply a pressure load to the arm rest and linkage components in several fixed positions, with a magnitude of 5.338E7 MPa for 12 pounds per square millimeter and determine if displacement occurs.

To test how ergonomic our device is we will build the physical arm rest and have several people (within our household) test out how comfortable it is. The arm rest will be made of wood and padded with memory foam and lined with silk since that is a material that is gentle on the client's skin. We can get them to rate the comfort on a scale of 1-10 with 1 being the least comfortable and 10 being the most comfortable. In addition, we can ask the people testing if they feel any sharp edges or hard components within the arm rest since these are aspects that bring discomfort to our client that need to be removed.

To test for multiple functionalities, we will build the physical tripod and see how easy and how long it takes several people (within our household) to adjust the height of the tripod using the wide knob. We could also get their feedback on how much upper body strength and pressure on the arms is required to set up the device as well. We can ask them to rate the difficulty on a scale of 1 to 10 with 1 being the most difficult and 10 being the least difficult to set it up and adjust the height. In addition, we will do a motion simulation showing the height of the tripod being adjusted as well as the movement of the linkage to demonstrate its range of motion.

*Insert your **Future Testing Plan** (how you would test your prototype with the resources that you do not currently have available but may have in the future).*

For our future testing plan, we plan to run three test plans with resources that are not currently available for our three main objectives, in which our solution; should be reliable, ergonomic, and have multiple functions.

In order to be reliable, we need to ensure that our device can bear a weight of an average arm, which is approximately a maximum of 12 pounds, without stress failure of the linkage supporting the arm rest. To test this objective, we would build the linkage and arm rest component of our model with material resources and expertise we may potentially have available in the future. Then, we would conduct tests with several people to ensure our device can handle the pressure load of an arm to the arm rest and linkage components in several fixed positions.

To test how ergonomic our device is we will build multiple refined physical arm rests and have several people test out how comfortable it is. The arm rest will be made of wood and padded with memory foam and lined with various materials (silk/organic cotton/wool), which would be gentle on the client's skin. We will have people with an arm, wrist, or hand condition similar to Allana's, test out the comfort of the different arm rests and the material that it is padded with. We can build several arm rests with different widths and materials and have them rank each arm rest to see what they find the most and least comfortable. This will allow us to narrow down our decision to choose an optimal material and size of the arm rest.

To test for multiple functionalities, we will build a refined physical tripod which functions through the use of linear actuators. We could conduct a test with several people to adjust the height of the tripod through the linear actuators. We can ask them to rate the difficulty on a scale of 1 to 10 with 1 being the most difficult and 10 being the least difficult. In addition, with the linkage component of the device being built, we could physically demonstrate the range of motion of the arm rest and conduct a test out with several people to determine how easy it is to adjust the position of their arm with the linkage on a scale of 1 to 10 with 1 being the most difficult and 10 being the least difficult.

Team Number: TUES-22

4. Fill out the table below, detailing each team member's contribution to this stage

Team Member's Full Name:	Contribution:
Sana Khan	Testing plan
Yasmine Elkhouly	Testing Plan
Alexander Hucik	Refined Prototype
Sameer Shakeel	Refined Prototype

MILESTONE 4.2 – DESIGN REVIEW

Team Number: TUES-22

Include feedback from peers in this row.
Include feedback from science students in this row. • Make sure the tightening knobs are at arm level. • Make sure it is not too heavy but durable/stable. • Make sure the memory foam can be removed to ensure it can be cleaned. • Do not use glue since she is allergic. • Consider adding a weight to counter the weight of her arm so the tripod doesn't tip over.
If applicable, include feedback from the client in this row.