HUMAN CENTERED DESIGN COMPETITION

Stage 1: Inspiration

Submission deadline: 30th January, 2023

Project Title: **Multi DOF Collaborative Robots**

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Mechatronics Engineering Department UET Lahore and MADE Foundation USA bring you the Human Centered Design Competition. The aim for this competition is to foster innovation among the students of UET Lahore and create sustainable solutions that create real impact and generate viable business.

The human centered design consists of three main stages:

Figure 1: The three stages of Human Centered Design

The three stages of our competition represent these three stages of the Human Centered Design. For stage 1 of the competition, the participants must submit a concept note regarding the problem they intend to solve.

Please remember that your solutions should be desirable, feasible and viable for them to have a true impact. In one sense, the three stages of the Human Centered Design tackle the conversion of your idea into a desirable, feasible and a viable solution.

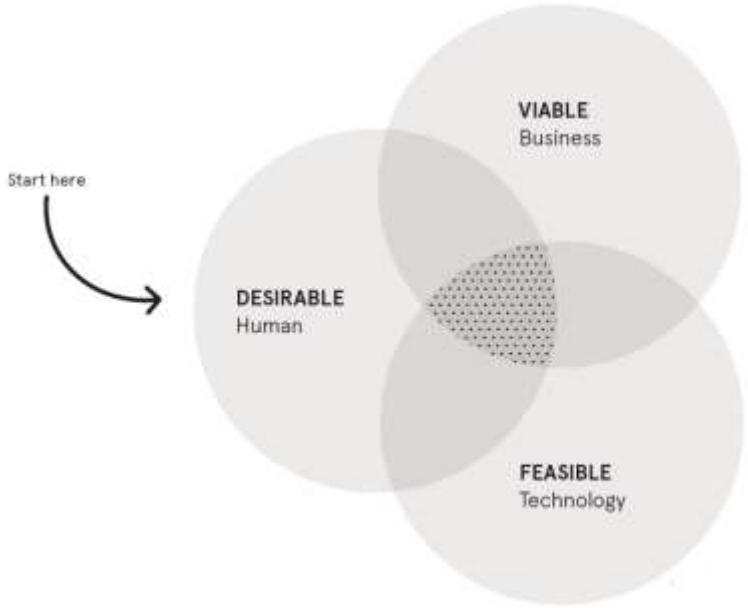

Figure 2:Ingredients of an impactful solution

INSPIRATION

The Inspiration phase is about learning on the fly, opening yourself up to creative possibilities, and trusting that if you remain grounded in desires of the communities you're engaging, your ideas will evolve into the right solutions. You'll build your team, get smart on your challenge, and talk to a staggering variety of people.

STEP 1: Frame your Design Challenge

Organize your thoughts and really think about the challenge and problem you are trying to solve. ask yourself: Does my challenge drive toward ultimate impact, allow for a variety of solutions, and consider context? Dial those in, and then refine it until it's the challenge you're excited to tackle. Don't keep it too narrow or too broad. Go through these thoughts again and again until you have reached a viable conclusion. A quick test we often run on a design challenge is to see if we can come up with five possible solutions in just a few minutes.

Answer the following questions after giving it careful thought iteratively.

- **What is the problem you are trying to solve?**

Apart from the problem description, try answering who faces it? what is the frequency of occurrence? why the currently available (if any) solutions lacking? etc.

Firstly, Pakistani Industries are mainly indulged with human workers, hence they have less precision and refinement in their products. Quality insurance and control management system is not up to the standards of international market. Therefore, for the fulfillment of their desired standards and quality production they have to rely on imported "ROBOTS" which are much expensive and abruptly disturb their budgets. In this case, import bill is increased and import-export gap is expanded. Moreover, 'products after sale services' are not available in Pakistan, so, they have to spend more money on the maintenance of the robots. Secondly. Industrialists are not much concerned about the safety measures and health issues of the workers. Mostly this case is observed in textile and automotive industries. Chemicals and poisonous smokes are making them zombies.

- **Take a stab at framing it as a design question, in one line.**

How might we propose some affordable automation solutions to the Pakistani Industries to increase their productivity?

- **Now state the ultimate impact you're trying to have.**

Mainly, our effort is to decrease the Import Bill of Pakistan, which has an ultimate impact on its economy. Figure 3 shows registered data that in 2021, Pakistan has imported Industrial Robots having net worth of 2.233 million USD. Out of this, around 92% import was from China. Moreover, this import bill has a 5-year growth potential of 15%, which will take the total amount to 4.49 million USD by 2026. A conservative approximation of the growth is shown in Figure 4.

HS 847950 - Industrial robots, nes

Exporters	Value (1000 USD)	Value growth (5 y.)
World	2,233	15
China	2,062	58
Sri Lanka	68	
Italy	63	
Denmark	29	111
Sweden	5	
United Kingdom	4	

Figure 3: Snapshot of TradeMap.org showing total import of Industrial Robots worth 2.233 million USD. The data is of Year 2021, with 5-year growth of 15%.

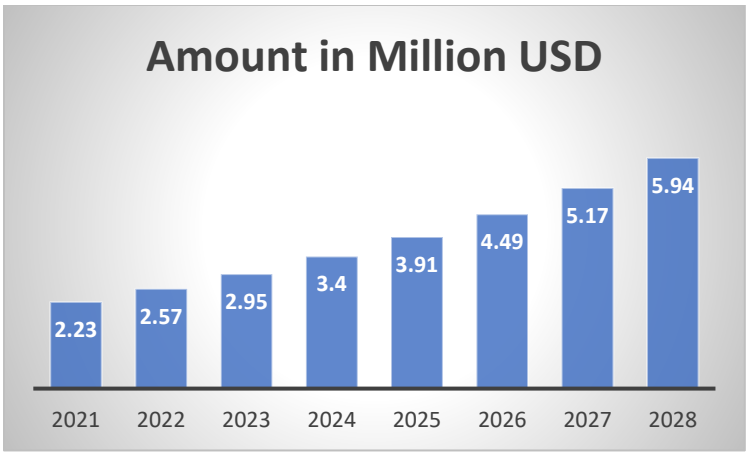

Figure 4: Projection of worth of Industrial Robots import by Pakistan till 2028 as per TradeMap.org

- **What are some possible solutions to your problem?**
  Think broadly. It's fine to start a project with a hunch or two, but make sure you allow for surprising outcomes

  - ❖ Quality products
  - ❖ Trained Labour
  - ❖ Automation
  - ❖ Robotic systems

  By bringing Automation in Pakistani Industries, we can cater multiple problems, i.e. production, economy rate and hazardous environments. Then, employers will have a skilled labour to operate and work in collaboration with the robots to perform multiple tasks in less time with precision and refinement.

- **Finally, write down some of the context and constraints that you're facing.**

  They could be geographic, technological, time-based, or have to do with the population you're trying to reach.

  We need man and material both. In Pakistan, we do not have that much Mechatronics Engineers. Pakistani industrialists need to change their mindset to accept that COBOTS are not going to replace the human workers instead they will help them out and increase the productivity of their company/organization. Our challenge is the ongoing R&D, design iterations and missing angel investors or may be venture capitalists that can help us build and grow.

- **Does your original question need a tweak? Try it again.**

  How might we develop customized ROBOTIC manipulators for Pakistani Industries indigenously along with local fabrication, machining, assembly and maintenance facilities?

STEP 2: Create a Project Plan

- **Decide on your budget and staff. Do you have everything you need to complete the challenge?**

  We have ample staff to cope up with this challenge but we are in shortage of funds.

- **Identify who will to visit to understand the problem better. How will the visits be arranged?**

  To understand the problem better, concerned persons should visit the following centers to ensure the right track towards the problem and ultimately to its solution.

  - ❖ NCRA
  - ❖ Automotive and Textile Industries
  - ❖ HCRL, UET.

- **Look at the core members of your team and determine what they're good at and what they're not so good at. List their core capabilities here:**

  - ❖ EtherCAT Programming
  - ❖ CAD Designing
  - ❖ Vision Interface
  - ❖ Mathematical Modelling

STEP 3: Secondary Research

Along with the interviews and surveys, there will be moments where you'll need more context, history, or data than a man-on-the-street style Interview can afford. It's time to start learning about the broader context.

- **List recent innovations in your particular area. They could be technological, behavioral, or cultural.**

  - ❖ Teaching the COBOT with hand handles
  - ❖ Observe the working of the ROBOT/COBOT using IOT.
  - ❖ Development of Humanoid Robots.

  Collaborative Robots are being made and used for every task all over the world. Pakistani Industrialists should adapt new technology and make the COBOTS part of their organization. Machines are everywhere in this modern era, hence, there is always space and acceptance for COBOTS in our scenario.

- **What alternate solutions are available in your area? Are there any that feel similar to what you might design?**

  Imported manipulators, but they are expensive and they are not being manufactured here. There are no after sales services easily available to them which leads to downtime of the industry.

- **What is your value addition in the existing solution, your unique selling point?**
  - ❖ Indigenously developed Multi-DOF Collaborative robots
  - ❖ Inhouse technical capabilities
  - ❖ Affordable and cost-effective solution
  - ❖ Communication Protocol EtherCAT

  Because of the above enlisted reasons, Pakistani industries are going to have minimal downtime in future.

STEP 4: Interviews

There's no better way to understand the hopes, desires, and aspirations of those you're designing for than by talking with them directly. Interviews really are the crux of the Inspiration phase. Whenever possible, conduct your Interviews in the person's space. You must categorize your extreme audience, and your main target audience and get samples from both in your interviews. It is also necessary to interview field experts who can guide you about the deeper context of the problem.

For a detailed guide on interviews, please refer to the "Field guide to the Human Centered Design" by IDEO. https://www.designkit.org/Fill in the following interview guide:

Open General	**Then Go Deep**
What are some broad questions you can ask to open the conversation and warm people up?	What are some questions that can help you start to understand this person's hopes, fears, and ambitions?
❖ What is something that is challenging for you? ❖ Take us to the area where some of your time taking jobs are being performed. ❖ What are the critical tasks you are trying to work on? ❖ Show us some of your process where you feel automation is important. ❖ What is the absenteeism rate here? ❖ What is the biggest problem you are tackling right now and how?	❖ What is your level of satisfaction considering the production rate of your company? ❖ Is there any machinery or automation solution currently being used that you have imported? ❖ How do you deal with the downtime? ❖ What will be the effect on your organization if your Labour/employee are diverted to other skilled tasks? ❖ What impact do you feel if you have 50-100 robots here working in your organization?

STEP 5: A pictorial collage

To showcase your efforts towards the human centered design, add a pictorial collage here that may showcase the problem, the people facing them, the interview process, design sketches, the work environment, etc.

Human painting the cars in hazardous environment

ROBOT for painting purposes

Human & Cobot working together

Interview Process

Design Sketches

ITERATION 1

ITERATION 2

ITERATION 3

STEP 6: Summarize

Summarize your initial findings here. Discuss about the following after reflecting on your efforts:

1. Problem
2. Target audience
3. Indented Solution with initial design sketches
4. Impact of the solution
5. Your intended roadmap for the implementation of the solution.

SUMMARY:

We are providing affordable locally manufactured automation solutions to the **Pakistani Industries** through indigenously developed **robotic arms** with after sales services. It will not only save the **import bills** to the industries but also the hazardous effects on workers and it will eventually help in reviving the economy.

ROADMAP FOR SOLUTION IMPLEMENTATION