# X-Marks the Spot: ME 2400 Project
(Jan – May 2025)

Marks 30   Presentation Date: May 2nd || Report Due Date : May 4th

Prof X, uses a wheelchair to drive to the grocery store from the Xavier school for children with special abilities, which is going through its formative years. He finds it difficult to independently put the wheelchair in the passenger seat of the car, after he transfers into the car. His mechanic has designed a mechanism to automatically mount the wheelchair to the trunk gate of the car. However he still needs someone to move the wheelchair to the back of the car for the mechanism to grab it. This is where you come in.

Your team has been contracted by Prof X to build a mechanism for his wheelchair to be automatically taken to the back at the push of a button.
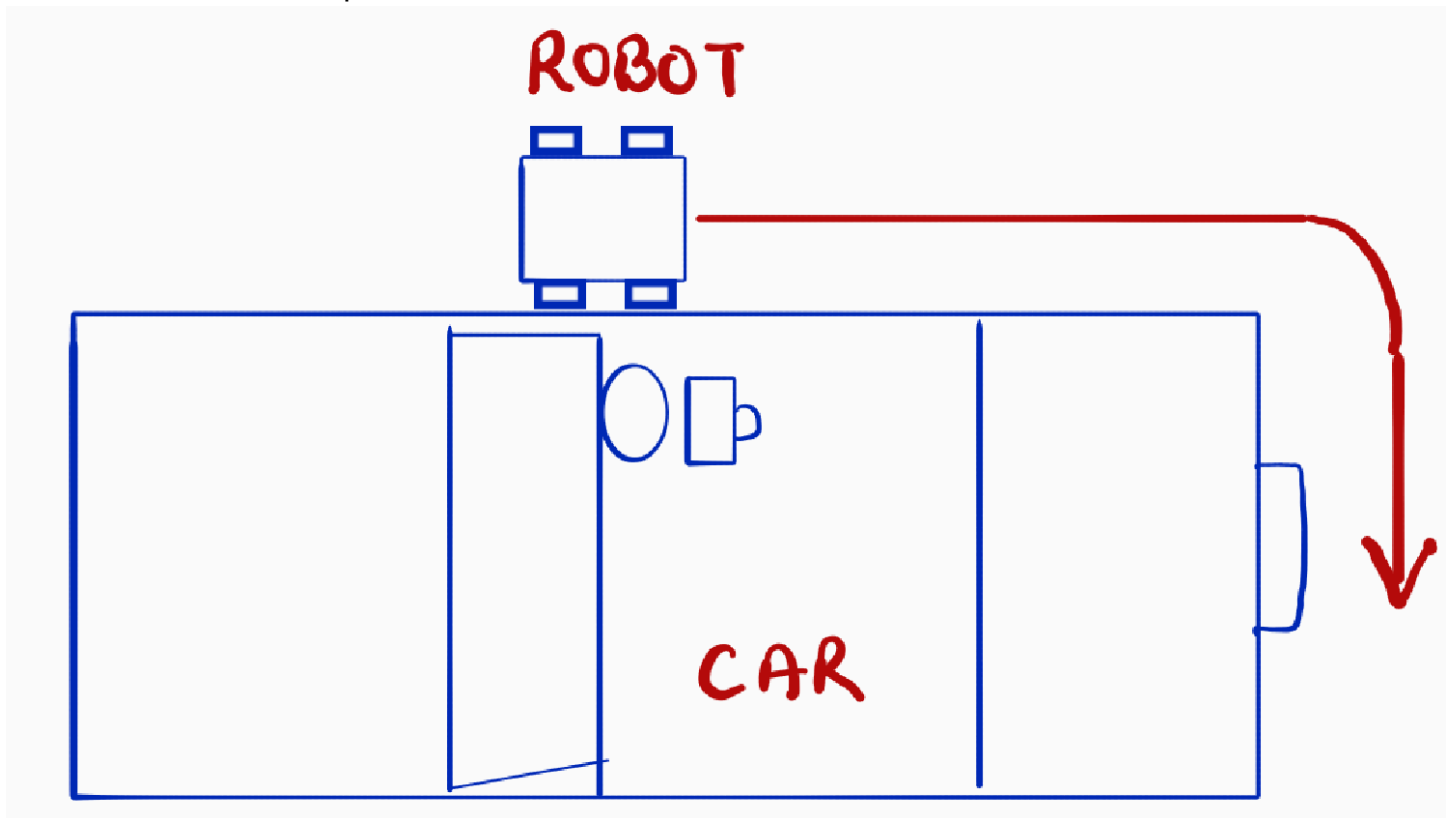
Requirement:
Design a robot with 3 or more wheels, to move the wheelchair to the back of the car autonomously. The robot should maintain a gap of >1 cm from the car's right side as it moves to the back of the car. It should take a left turn once it comes to the rear end of the car and stop after moving a fixed distance parallel to the trunk of the car.

Note: You cannot use machine vision based solutions since these are the starting years of X-Men and in this universe, Prof X is broke (hence the mechanic). Use a single or combination of sensors and a simple microcontroller like Arduino or ESP32, to automate this process.

For the purpose of this project assume:
1. The car to be a cardboard box at least 60 cm in length, 40 cm in width and 15 cm in height.
2. Your robot should fit in a box of dimensions 10x10x10 cm.
3. At the press of a button, the robot should automatically move to the back of the "car" and stop close to the center. You cannot add anything to the car, your robot should be a self contained unit.

Note:
1. **Care must be taken to prevent any injury.**

Suggested Project kit items: Motor, Electrical Tape, Jumper wires, Arduino UNO/ ESP32, Sensor – suitable one, Double sided tape, Bread Board, Propellers (2), USB cable, L293D / L298N (motor driver IC) , Wire stripper & cutter, Multimeter, Appropriate-Battery, body – design and fabricate out of wood, polycarbonate or other rigid material.

Budget: Cannot exceed *Rs. 4500* (bills must be submitted as part of the report)

Project Assessment:
1) **Required project report (40%)** (in A4 sized pages) with the following contents:
   a) Title, authors, roll numbers
   b) Aims and objective
   c) Chassis design and component placement
      1) Component list and sizing justifications
   d) Controller design and tuning method used
      1) Control system block diagram and transfer function model; MATLAB or Simulink model description
      2) Controller design and Arduino program – what type of control, how did you tune, final parameter values (provide the program)
   e) Conclusion
   f) Team member contributions
   g) Photos of your project, team members, team-discussions, working model etc..
   h) Report must be formatted properly and look professional. Keep the following points in mind:
      1) Section numbering and sub-section numbering must be proper
      2) Figures/tables must be auto numbered with captions below the figure (Tables have captions above)
      3) All figures/tables must be cited in the text
   i) Videos of the model working

2) **Working model demonstration (60%)**: There will be a project demonstration day in an open space (location to be informed later; likely in CFI) where all groups can show-case their working models.
   A box representing the car will be set up. Teams will compete on time to achieve the task (best of 2). The winner and runner up will be recognized on my lab's website.
   The project will be judged on:
   a) Structure design and placement of components
   b) Arduino programming (concise with plenty of comments, etc..)
   c) Controller design (mode, tuning etc..)

d) Working demonstration

References:
1. Lecture notes
2. Course textbook
3. www.instructables.com
4. www.arduino.cc
5. MATLAB Simulink documentation
6. MATLAB + Arduino documentation