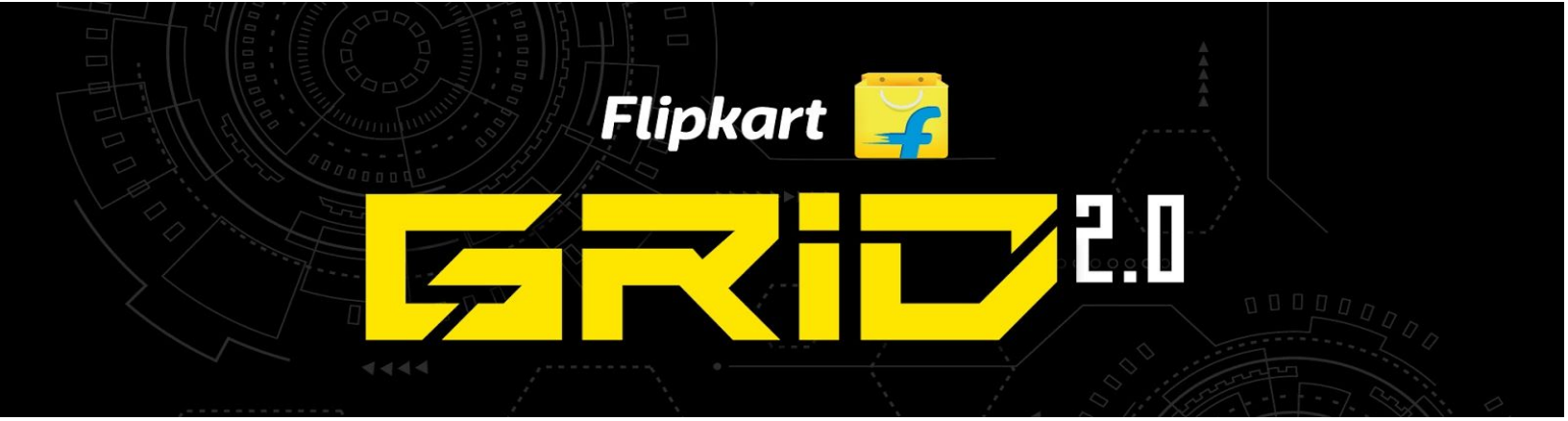


Intelligent Picking

Updates
1. In the “details” section, under “Pick Area and Drop Area”. The square areas have been corrected to (2m * 2m)

Brief

A lot of manual effort is required today in a warehouse in locating and picking the items. While there have been advancements in picking automation in terms of robotics arms and what not, There are still unique challenges if there are different types of SKUs which also require lighting-fast picking.

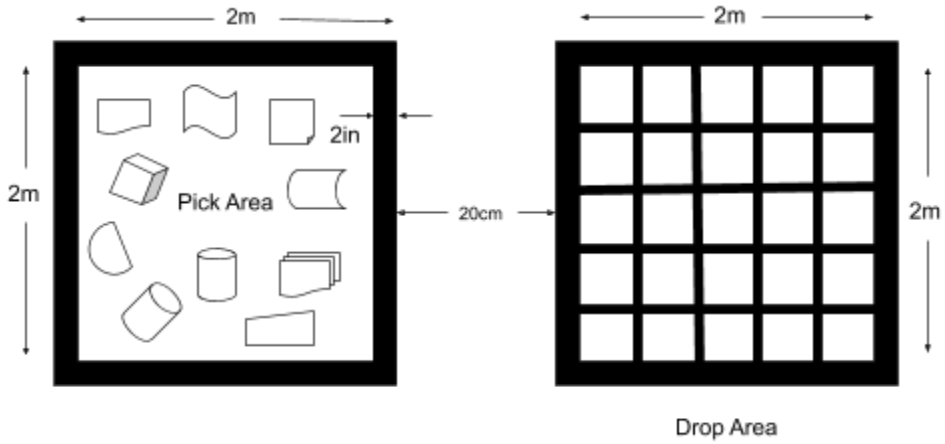
This problem statement tries to replicate the quintessential warehouse problem of picking in which the participants are supposed to build their own robot hardware and software (collectively, a “Robot”) that is capable of doing general tasks of picking items from a pick area and place them into a cell in th drop/stow area. The problem statement requires a combined knowledge of object recognition, grasp planning, motion planning and error recovery.

Details

1. **Objective :**
   The robot needs to demonstrate following capabilities
   a. Ability to pick an object from the pick area
   b. Ability to move the object from the pick area to the drop area
   c. Ability to stow the removed object into a cell in a drop area.

2. **Pick Area/Drop Area:**
   a. The pick area and drop area are two square areas (2m*2m)
   b. The drop area is further segmented into a grid (5rows x 5cols)
   c. The pick area will be 750-900mm higher than the drop area.
   d. The pick area and drop area should be identified by a colored tape (~2 inches) running across the boundary of the square.

e. The pick area and drop area should have a distance of at least 20 cm between them.



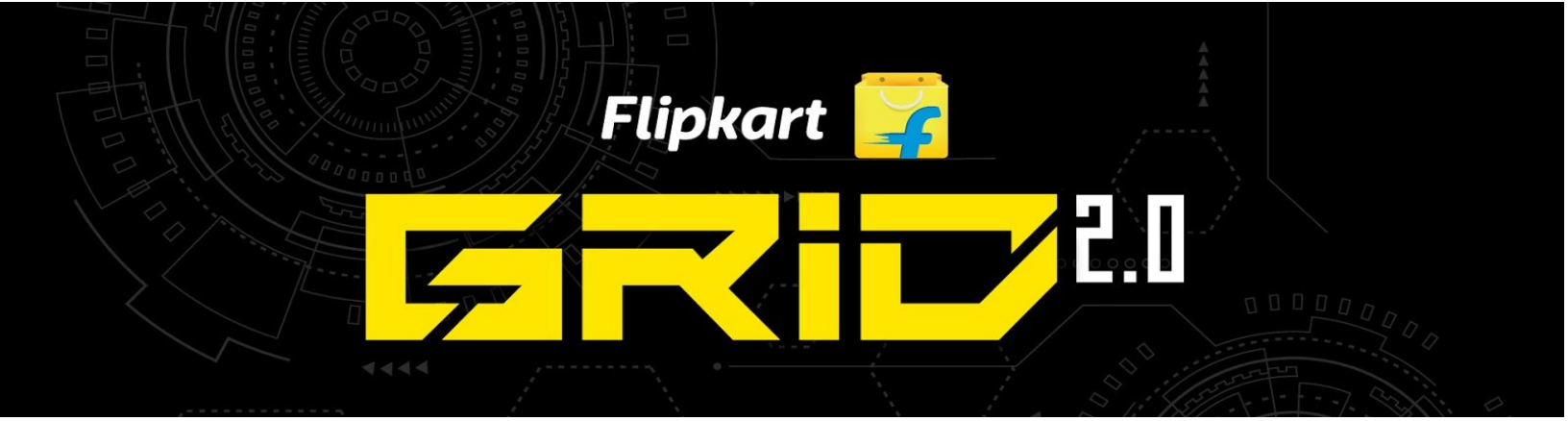
3. **Items:**
   a. A total of 25 items will be used in the challenge and will be a mix of household products. It can include a book, pen stand, duster, water bottle etc. (Possible item list will be shared in next phases to help team test their robots)
   b. The items will not be more than 20cm in any dimension and the weight of the item will be < 2kg
   c. The items can be placed in any orientation, for e.g. a water bottle can be placed upright or lying down.

4. **Layout:**
   a. The teams are allowed to place their robot anywhere.
   b. The robot can't be moved for the entire duration once it is placed.

Deliverables/Expectations

Proposal Submission Phase I (Focus on this for Phase I)

1. 3D models, CAD drawings or even detailed hand drawn sketches on paper work if they are well thought out. The idea is to understand the solution at breadth and evaluate its feasibility.
2. If you are proposing a software/image processing based solution, share the references and research in brief that helped you arrive at the proposed solution.



3. Include the tentative execution plan with high level action items that helps us understand how you can reach from the whiteboard to a prototype and how your expertise enables you to do that.
4. Refer to the **Phase I proposal template** for further details.

Proposal Submission Phase II

1. Detailed 3D model, CAD drawings, Simulations of the robotic system you are trying to build along with the block diagrams of the different components you plan to use, such as cameras, motors, sensors, microcontrollers/PC. The more detailed the document the better.
2. List of components/software(s) required for the solution along with specifications and tentative cost (BOM & BOQ)
3. Details around the software aspects of the robot in terms of tech stack and algorithms used.
4. Detailed execution plan with timelines and requirements (if any).
5. Further details can be asked for on the basis of the proposed solution by the team.

Finale

1. The participants are expected to build their own robot (both hardware and software) which is able to pick items from a pick area and place them into a stow area. In case any third party hardware kit/software is being used participants need to declare it.
2. The robot is expected to work in an autonomous way. Once the picking is initiated there should ideally be zero intervention and the robot should continue to pick and stow autonomously until
    a. The pick area is empty OR
    b. The process is terminated due to a timeout
3. The robot should be able to pick different types of items, which might require different grasping mechanisms hence all participants are encouraged to explore a combination of different gripping/grasping mechanisms.

Judging Criteria

The solution will be scored and judged on following aspects

1. Number of items picked and stowed in a fixed time.
2. Accuracy (Number of times the pick was intended but wasn't successful and vice versa)
3. Accuracy of the items stowed in the cell (If any object is going beyond the cell boundary)
4. Penalty if the item is dropped outside the pick/drop area.