Test Project

Module E – Vision

Duration - 3 Hours

Autonomous Mobile Robotics

Submitted by :

James Taylor – Studica, Independent Test Project Designer
Derek Murphy – Studica, Independent Test Project Designer

Mohammad Alshamsi – RoboHitec, Independent Test Project Validator

Contents

1. Introduction 3
Detect and Classify Items 3
Table/waypoint identification with precise pose estimation 3
2. Description of project and tasks 3
2.1 Required Components 3
2.1 Control Mode 3
2.2 Schedule 4
2.3 Task 4
2.3.1 Court Information 4
2.3.2 Object Location 4
2.3.3 April Tags 5
2.3.4 Report Requirements 5
2.3.4 Evaluation Procedure 5
At the start of the evaluation: 5
3 Competitor Instructions 5
3.1 Prepare during allotted prep time 5
3.2 Cleaning up before Evaluation 5
3.3 During Evaluation 6
4 Equipment, machinery, installations, and materials required 6
4.1 Equipment provided by Competition Organizer 6
4.2 Equipment and material not permitted 6
5 Court 7

1. Introduction

A wheeled service robot navigates a mid-sized restaurant (10–15 tables, bar area, kitchen pass-through) delivering food and bussing dishes. It has a forward-facing camera, camera for tray/tabletop inspection.

Vision Sub-Tasks

Detect and Classify Items

- Detect Individual item on the tables/shelves (cans, bottles, glasses, condiment containers, napkins)
- Distinguish static furniture (tables, chairs)
- Identify open floor path vs. blocked aisle

Table/waypoint identification with precise pose estimation

Instead of relying purely on vision-based scene understanding (which struggles with lighting, occlusion, and table numbers that look similar), the restaurant uses small AprilTags on or near each table. The robot's camera detects the tag, decodes its ID instantly, and knows "this is Table 7" with near-zero ambiguity — no need for OCR on a printed number or fuzzy floor-plan matching. The vision system can also compute the tag's exact 3D position and orientation relative to the camera. That gives the robot:

- Distance to the table (how far to stop)
- Angle of approach (so it doesn't back the tray into a chair)
- Sub-centimeter alignment for placing a tray or docking at a delivery point

2. Description of project and tasks

READ THE ENTIRE DOCUMENT BEFORE PROCEEDING.

Workplace safety procedures and protocols must be always demonstrated.

If you are advised of a safety infraction during this module, 0.5 of a mark will be deducted for each infraction. On the 3rd infraction, the Competitor will be stopped, and the evaluation will be based on work already completed.

Experts will not intervene unless there is a safety concern.

2.1 Required Components

The list of required components to complete the task.

- Competitor robot built on C1
- 3D Depth Camera

NOTE: Competitors are allowed to use their supplied laptops for processing. No extra time or appeals can be made if the Wi-Fi between the robot and computer is interrupted or dropped.

2.1 Control Mode

Competitors may use **manual** or **autonomous** control of the robot to complete the task. The task is to evaluate vision tasks not other aspects of the robot.

2.2 Schedule

The total duration of this module is **3 hours**.

TIME	ACTIVITY
00:00 – 02:30	Prep-Time and shared court access
02:30 – 02:45	Team 1 and 2 Evaluation time on courts 1 and 2
02:45 – 03:00	Team 3 and 4 Evaluation time on courts 1 and 2

Competitors should refer to the official competition schedule to determine the start and finish time of their allocated session. Before the end of the time block, competitors must:

- clean and organize their workstation;
- prepare for rotation to the next module;
- leave the assembled base robot on the workbench;
- leave the completed Task Allocation Report and Commissioning Report with the robot; and
- wait in the designated briefing area until released by the Chief Expert.

Note: Competitors are not **allowed** to work on the robot or anything else during the evaluation time.

2.3 Task

Competitors are required to navigate the vision court and identify all objects and April Tags using the camera that is mounted on their robot. Competitors are required to generate a report that is displayed at the end of the run.

When evaluation is starting the experts or competitors will roll a die. The die will indicate which of the tasks are to be completed. There are 6 tasks all different. Note each task is the same in terms of complexity and objects / April tags that must be found and reported. Competitors will not know which task is to be completed until the run.

It is expected that no part of the robot (or object attached to or carried by the robot) will contact any walls or court objects during the evaluation run. A contact is any touch, a continuous touch will be scored as multiple touches (1 per second of contact)

Note: The robot must start in the home location and end in the home location. A run is not considered completed if the robot is not in the home location with a solid red light on the light tower.

2.3.1 Court Information

The Vision court measures **2 m x 4 m** and has 4 object locations and 5 April Tags. The robot home base is located directly in the centre of the court. See section 5 for the court layout.

2.3.2 Object Location

Object locations are the same and never change however, the object that is placed in these locations can change. Some locations have multiple steps or platforms in that location. The object can be placed in any of these platforms based on the roll of the dice at the start of the run. Multiple of the same object can be placed in the same location.

© WorldSkills International

2.3.3 April Tags

The April Tag locations do not change. The tag inside the location does change. The tag placed inside the location is chosen by the roll of the dice at the start of the run.

2.3.4 Report Requirements

The generated report at the end of the run must contain the following:

- April Tag (Must be a section for each tag)
  - Count – How many tags the robot has seen so far
  - ID – of the Tag
  - Pose – Pose Tag reports
  - Robot Pose – Current Pose of the Robot
  - Timestamp – Timestamp of when the Tag was read
- Object (Must be a section for each object)
  - Object Location – The location the object was found
  - Object – What object was found
  - Number – The number of objects found at that location
  - Picture – A picture of the object at the location with bounding box around the object
  - Timestamp – Timestamp of when the object was found

This report can be displayed on the competitor host computer screen or save in a text based report format to be transferred to the competitors USB Drive.

2.3.4 Evaluation Procedure

At the start of the evaluation:

1. The competitor places the robot in the home location.
2. The die is rolled to determine all object locations.
3. The competitors confirm that the robot is ready and the experts give permission to begin the evaluation.
4. The competitors begin the vision run.
5. The robot completes the search task and the report is generated.

3 Competitor Instructions

3.1 Prepare during allotted prep time

Competitors will have the preparation time during each module to practice and get the robot ready for the evaluation run. During this time the vision courts are free to use and may be used by any of the teams currently completing the module. Courts may have more than 1 robot on it at time. Competitors will be required to show good communication skills to manage the area.

3.2 Cleaning up before Evaluation

Competitors must clean up the work benches before the evaluation time starts to prepare for rotation to the next module when required.

3.3 During Evaluation

During evaluation competitors must place the robot in the start location and wait for permission to begin from the experts. When permission is given the competitor must push the start button on the robots control panel to start the run.

Competitors will indicate to the experts when the run is complete if the robot does not show the solid red light in the home location of the court.

Competitors not being evaluated must sit at their workbenches. These competitors are not allowed to work on their robot during this time.

4 Equipment, machinery, installations, and materials required

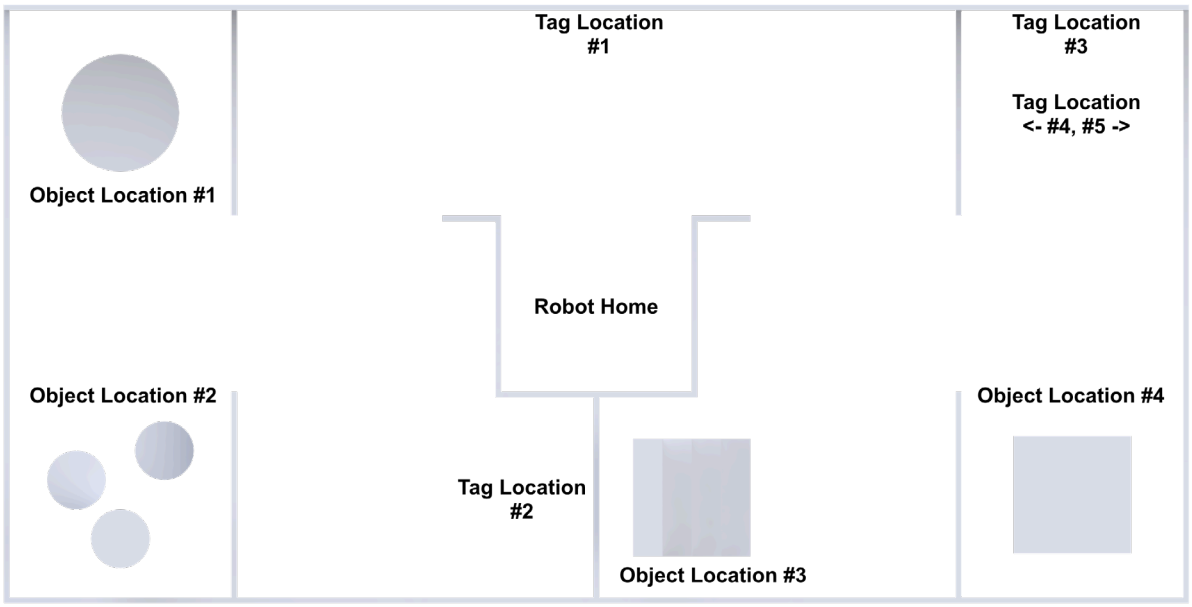
4.1 Equipment provided by Competition Organizer

- All equipment, tooling, and materials in the Infrastructure List – see AMR Discussion Forum and Technical Description; ;
- Testing equipment such as a multimeter, and scale to weigh additional items; .

4.2 Equipment and material not permitted

- Non Worldskills Supplied Laptops or portable computers;
- Tablet's e.g. Android, IPAD etc.;
- Memory sticks/ Digital Storage;
- Digital music Player;
- Electronic organizer/diaries;
- Wireless communication devices;
- Non approved SD Cards – approval by Experts or delegate is required for all SD Card images;
- Any additional software not supplied by Competition Organizers unless approved by Experts;
- Purchased items modified in any way prior to the Competition;
- Equipment that is similar or operates in similar manner as supplied equipment. Example – if a metal cut-off saw is provided by Competition Organizers, then no team may provide their own metal cut-off saw;
- All raw materials, components, parts, purchased item, tools and equipment not permitted in the Technical Description and List of Materials Allowed and Not Allowed of the skill.

5 Court



© WorldSkills International