CE3004/CZ3004

Multi-disciplinary Design Project (MDP)

MDP Assessment

(AY2023– 2024-Sem1)

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CE/CZ3004 - Multi-disciplinary Design Project (MDP)
(Assessment Component)

Introduction

The Multidisciplinary Design Project (MDP) is a practical-oriented group-based design project undertaken by undergraduates. The MDP comprises of only coursework assessment as this is a practical-oriented course. Since this is also a group-based project, so most of the assessments are graded at a group level.

Assessment Components

The assessment components of MDP comprises of the following:

	Due Date	Weightage
Group-based assessment components		
1. Project deliverable checklist	(week #7, Friday)	(20%)
2. Video report submission	(week #10)	(15%)
3. Image recognition evaluation task	(week #8)	(12.5%)
4. Fastest car evaluation task	(week #9)	(12.5%)
Individual-based assessment components		
5. Individual quiz	(week #7, Friday)	(20%)
6. Early-stage Peer Review	(week #5)	(5%)
7. Final-stage Peer Review	(week #10)	(15%)
	Total Marks	(100%)

Compulsory Attendance

Attendance for all scheduled MDP lab sessions is compulsory. No attendance will be taken for the lab sessions during recess week.

The group-based nature of MDP makes it important that the disruptive absence of members with allocated responsibilities is strongly discouraged. Students missing more than **20% of scheduled lab sessions** without valid reasons (e.g. MC) will be deemed to have **failed MDP**.

If you have approved reasons for absence (e.g. Leave of Absence) and have missed 50% or more of the scheduled MDP lab sessions, you will be withdrawn from the current MDP course without any penalty. You will then be re-registered when MDP is next offered.

Description of MDP Assessment Components

The following sections will describe in detail what is expected of you for each of the listed MDP assessment components.

Video Report Submission

Objective and Motivation

The video report provides students with a non-traditional but increasingly important communication medium for reporting their contributions. It will form part of the assessment of what the team considers are highlights of their achievements and the teamwork demonstrated within the group, **including a visual demo of unique distinguishing features of the team's Android user interface design.** Lastly, the video submission also evaluates the team's creativity and skill in using the video medium for effective communication.

Learning Outcomes

As part of the process of composing and creating the video report, students will acquire the understanding and skills to communicate effectively using a multimedia platform. They will be provided the opportunity to learn how to design, select and compose appropriate features of their work in order to create concise and informative video that can market their contributions and achievements in an impactful manner. They will also acquire knowledge and competency in using software tools for creating and editing video media.

Assessment Percentage:	**Submission Deadline**:
15%	End of week #10
Duration of Submitted Video:	**Video Formats**:
No more than **5 minutes**	mp4, mov or wmv

Assessment Criteria:	**Weightage**
1. **Android UI Design** – User interface's usability features and aesthetic appeal. Focus is on ease of use, uniqueness, creativity of UI design effort.	20%
2. **Creativity** – Creativeness of how all the features in the video submission are put together such that it makes the report interesting and original.	20%
3. **Presentation** – Effectiveness in communicating contributions through the use of features available in a video presentation. Individual contribution should be clearly shown.	20%
4. **Teamwork** – Demonstration of effective teamwork in the way the team has carried out their project.	20%
5. **Content** - Quality of team's effort and implementation highlighted in the video report. The content that is expected in your video is listed below.	20%

Video Content to be Featured:

1. **Team members** – Introduce each team members and the project responsibilities assigned.
2. **Implementations** – Highlight and communicate the team's implementation of various aspects of the project by using the advantages of the video medium. Special attention and coverage must be given to highlighting the team's unique implementation of the Android tablet user interface. Distinguishing usability features and visual aesthetic elements of your UI design must the visually demonstrated in the video.
3. **Special Achievements** – Highlight what else is special about your team's effort and the solutions that you have implemented.

Points to Note:

a. *Duration constraint* - Be precise and concise in your video presentation. Think carefully what you want to feature in the video report and how it can be most effectively featured. You may need to do some serious editing to your raw video segments to keep the length of your overall video submission to 5 minutes. The imposed time limit is an important constraint that will teach you to be selective and creative about to the way you can effectively convey information using video. **Only the first 5 minutes of your video submission will be graded**.

b. *Android User Interface (UI) Design* – Many important aspects of your UI design cannot be evaluated based on its functional used during competitions. Video demo is an ideal medium to demonstrate aspects of their UI design that has to do with ease-of-use, well-thought out UI design features specifically for small touchscreen usage, aesthetic appeal of UI's visual design and layout, intuitive and efficient navigation to different functional features, etc. Given the limited video duration, teams should just focus on what they consider are unique UI design features that stand out from typical implementation and are particularly original.

c. *Content* – Think carefully what aspects of your team's effort you wish to feature in the short video. You want to focus on aspects that are specifically unique compared to that of other teams. You want to highlight good design features that you have incorporated into your system to make it more robust, flexible and intelligent. Especially features that gives your system a superior performance over other teams. These contribute towards the **Content** assessment component.

d. *Teamwork* - Ensure that all team members participate and is seen to be participating in the production of your video report. Think carefully how you can convey a strong sense of teamwork within your group when composing your video report. This will contribute towards the **Teamwork** component of the assessment.

e. *Presentation* - Use the video medium effectively. Remember, this multimedia platform allows you to feature both moving and static pictures. Use these capabilities to convey movement in your robotic system, transitions in your user interface design, screenshots, schematic drawings, etc. Other elements of video such as text (in the form of subtitles), audio narrative voice-over, zoom in-out views should be exploited to produce effective video communication. Ensure text and audio narratives (if used) are correct, concise and clearly articulated. Your effective use of all these elements will contribute towards the **Presentation** component of the assessment.

f. *Creativity* - Be as creative as possible in putting together your video report. Remember, this is a multimedia medium which allows you much more scope to think out of the box. Ask yourself, "How can I be original in reporting the work done, demonstrate teamwork and highlight our achievements?" Think carefully what you want to feature first before putting the video report together. Discuss as a team how you can make the presentation of the content interesting. Consider how you want to link the various feature segments and ideas in your video so the narrative flows smoothly and concisely in the short 5 minutes allowed. Consider how humour could be incorporated into your production to make the video both informative and entertaining. All these contribute towards the **Creativity** assessment component.

Project Deliverables Checklist

Objective and Motivation

The project deliverable checklist provides a list of functional specifications for the various modules in the MDP. It defines the minimal functionality expect of each module so that students have a clear target of the minimum scope of what they have to design, implement and demonstrate to their respective supervisors within the limited duration of MDP.

Students are strongly encouraged to go beyond just meeting the minimal functional requirements given. They should highlight how their design and implementation has gone beyond the minimal checklist requirements when presenting their accomplishments in the video presentation.

Learning Outcomes

Students will learn to design and develop their allocated project module based on a clearly defined set of functional specifications. The given specifications also teaches students how different sub-teams tackling a large project can develop, test and verify the proper functionality their respective modules as independently as possible from other modules.

Assessment Percentage:	**Submission Deadline**:
20%	Friday of week #7

Assessment Format:

- Whenever students have completed any checklist item or set of items, they can request to do a face to face demonstration to the MDP supervisor present during the lab timings.
- If the students are able to show that their implementation has met the stated specifications in the checklist, the supervisor will sign against both his and the team's checklist form. They can then proceed to implement other outstanding checklist items.
- All teams are required to submit their signed checklist form to the MDP supervisor at the end of the lab session on week #7 for grading.

Assessment Criteria:	**Weightage**
The project deliverable checklist uses a progressive marking scheme. Each group is encouraged to meet as many of the checklist items as possible before the submission deadline. Groups completing all their checklist items will receive a 100%. Different checklist items carry different marks and the mark allocation is not disclosed in order to encourage students to meet as many checklist items as possible (within the stipulated time).	100% (max)

Important Note:

1. Ensure that your group prints out one master copy of the checklist assessment form (see next few pages) so that you can pass this form to the MDP supervisor for signing during each verification session. Make sure the form is kept safe over the various lab sessions.
2. This master form is to be submitted to the MDP lab supervisor during **week #7**.

Project Deliverable Checklist Assessment Form

Group Name and Number: _____ MDP Lab: _____ **Group Leader: _____**	

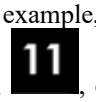
No.	A. Mobile Robot Module Functional Specifications	MDP Supervisor Signature / Date	Name of the Student Contributor
A.1	**The Raspberry Pi board (RPi) is able to execute the following three functions at the same time:** **1. The Raspberry Pi board (RPi) can be accessed via a PC/notebook over Wifi** Note: RPi should have fixed static IP address assigned and act as a Wifi Hotspot such that it can be uniquely identified and connected. To demonstrate that the Wifi link is working, you can install a webserver program (E.g. Apache) on RPi, and access the RPi through a web browser on the PC/Notebook., which display the default Apache's message **2. The Raspberry Pi board (RPi) can be wirelessly connected to the Android tablet using the Bluetooth.** Example: You can use a Bluetooth terminal program (e.g. BT Term) on the tablet as Master to display the characters sent by the RPi. On the RPi, you can create a rfcomm channel and run simple terminal program (e.g. Kermit, Minicom) to send characters to android tablet, as well as to display the characters send from the android tablet. **3. The Raspberry Pi board (RPi) is able to communicate with the STM board through over a USB->Serial connection.** Here RPi acts as master and the STM as the slave. To demonstrate their successful communication, you could develop a simple program on RPi to communicate with STM related to a movement activity (forward or backward movement) and demonstrate that the communication is successful. **During your demonstration, you should be able to pass information among the various devices.** Example: A button pressed from Android tablet (example button to move forward) will be transferred to STM board via RPi and the nano robot is able to execute the motion.		

A.2	**Rpi able to detect and recognize the image** Detect and recognize the images from the image pool accurately using Rpi. The image will be placed between 20-50cm away from the midpoint of the robot. You should demonstrate your detection and recognition of any of the given images by plotting a bounding rectangle around the detected image and labelling which image number has been identified. Note: The recognized labelled image with the bounding rectangle can be shown on your PC for verification.		
A.3	**Accurate straight-line motion** Demonstrate that your robot can traverse a straight line and stop at a distance between 80 and 120cm specified by your supervisor. Your robot should not deviate from a straight line during the run and must end its run accurate to within +/- 6% of the target distance.		
A.4	**Accurate rotation** Demonstrate that your robot can complete rotation, turning through an angle between 90 and 360 degrees specified by your supervisor Note that the robot cannot do on the spot turn and hence if speed of the robot increases, the robot will take a larger turning angle.		
A.5	**Navigating around the obstacle** Demonstrate that your robot can navigate towards a given obstacle having a visual marker  indicating obstacle. Your robot needs to navigate around the obstacle in search of face which has a valid image from the image list.		
No.	**B. Robot Path Planning Module** **Functional Specifications**	**MDP Supervisor Signature / Date**	**Name of the Student Contributor**
B.1	**Robot Movement Area Simulator** Your simulator should be able to display the robot's 2.0m x 2.0m movement area, the start zone, the locations of the obstacles and the positions of the images. The simulator should be able to show the position of the robot as it moves forward/backward and turns. This should be shown on a simulator displaying a grid map of the area.		
B.2	**Hamiltonian Path Computation Simulator** Your simulator should be able to demonstrate the implementation of an algorithm that guides the robot to traverse the 2.0m x 2.0m movement area, starting from the start zone and visiting each image position once. The recognition of the 5 images should be completed within the time limit. In other		

	words, the number of images recognized within the time limit is accepted. This should be shown on a simulator displaying a grid map of the movement area of the robot.		
B.3	**Shortest-time Hamiltonian Path Computation** Your simulator should demonstrate the robot following a shortest-time Hamiltonian path to recognize the 5 images. This should be shown on a simulator displaying a grid map of the movement area of the robot.		

No.	C. Android Remote Controller Module Functional Specifications	MDP Supervisor Signature / Date	Name of Student Contributor
C.1	**The Android application (AA) is able to transmit and receive text strings over the Bluetooth serial communication link.** Note: You can use the AMD tool to help verify that your AA has successfully achieved bi-directional data transfer.		
C.2	**Functional graphical user interface (GUI) that is able to initiate the scanning, selection and connection with a Bluetooth device.** E.g. when the Connect button is touched, a list of available devices is presented to the user for selection. Once a device is selected, a connection is established with the device. You can use C.1 to show evidence of a successful connection.		
C.3	**Functional GUI that provides interactive control of the robot movement via the Bluetooth link** (e.g. move forward, left and right). The interactive control of the robot movement can be done using several labeled buttons (minimal requirement), appropriate touch gestures, button cum device tilt or any other method you can think of. You can use the AMD tool to demonstrate control of the virtual robot movement. Caution: Manually entering different string commands in a text box to control the robot movement is not a valid implementation of this requirement.		
C.4	**Functional GUI that shows remote update & status messages** (e.g. ready to start, looking for target 2, etc). You can implement this using a TextView box (minimal requirement). You can use the AMD tool to simulate information update by devising your own string-based protocol representing the various possible status of your robot. Note: Your TextView box must only display selective information and not all the text data that is being streamed to Android tablet.		

C.5	**2D display of the exploration arena with obstacles and the robot's location.** E.g. you can create a drawing canvas on your GUI where square numbered obstacle blocks (from 1, 2, 3,..n) can be drawn within a bounded exploration arena The number text drawn inside your obstacle should be in small white colored fonts and it represents your assigned number to each new obstacle added to your map (e.g  or ). A robot is also drawn at a specified coordinate (x,y) and its facing direction (N,S,E,W) can be clearly inferred from the robot icon displayed.		
C.6	**Interactive movement and placement of obstacles in map.** You GUI must allow you to interactively place the square obstacles into the map through touch interactions on your map area. You must also allow these obstacles in the map to be moved around within the map through a "touch and drag" interaction. Dragging the obstacle outside the map area will remove the obstacle from your map. Once the positioning of the obstacle is completed and the finger is lifted, the (x,y) coordinates and number assigned to the obstacle is transmitted out via the Bluetooth channel. You are free to devise the string format for this information.		
C.7	**Interactive annotation of the face of the obstacle where the target image is located.** Your GUI must provide functionality that will allow you to indicate which of the side of any particular obstacle touched has the target image. If your obstacles are too small to touch one of the four sides, device another method that will allow you to do this task. Any alternative method to specify which side of the four faces has the target image must still be a touch-based interaction. Once the target face has been registered, the appearance of the obstacle must change to indicate which obstacle face has the target image (e.g. ) and the target face and obstacle coordinate must be communicated via the Bluetooth channel. You are free to devise the string format for this information.		
C.8	**Robust connectivity with Bluetooth device.** Your Android application (AA) must not hang up if connectivity with the Bluetooth device is temporarily lost (e.g. by executing a Disconnect at the AMD tool after connection has been established). Your AA should automatically re-established connection automatically once the Bluetooth device connects with the AA again (e.g. by executing a Connect again at the AMD tool after connection was earlier broken with a Disconnect).		
C.9	**Displaying Image Target ID on Obstacle Blocks in the Map.**		

	The appearance of any numbered obstacle block can be changed to display a Target ID (in large white fonts) when the Bluetooth channel receives the string "TARGET, <Obstacle Number>, <Target ID>". For example, the obstacle block appearance changes to  ,  , etc. The face in which the target image is located is displayed with a thick visible line of a distinguishing color (e.g. from  to  when target ID of 4 is received)		
C.10	**Updating Position and Facing Direction of Robot in the Map.** The position of the robot and the direction the robot is facing can be updated in the map of your Android tablet when the Bluetooth channel receives the string "ROBOT, <x>, <y>, <direction>", where <x> and <y> are valid integer coordinates in your map and <direction> is any one of four directions (N, S, E, W).		

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