CE3004/CZ3004

Multi-disciplinary Design Project (MDP)

MDP Assessment

(AY15/16 – Semester 1)

[Updated 2015-08-06]

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 a multi-disciplinary group of students comprising of undergraduates from the CE, CS, BCG and BCE programmes. The MDP comprises of only coursework assessment as this is a practical-oriented course. Since this is also a group-based project, all assessments are graded at a group level except for the peer-review components. In addition, a portion of the marking is competitive and is awarded using a performance-based ranking of all teams in the cohort.

Assessment Components

The assessment components of MDP comprises of the following:

	Due Date	Weightage
Group-based assessment components		
1. Project plan and division of responsibilities	(week #3)	(10%)
2. Video report submission	(week #12)	(15%)
3. Documentation of group project wiki	(week #11)	(10%)
4. Project deliverable checklist	(by end week #9)	(20%)
Ranking-based Group assessment components		
5. Leader board Performance Ranking	(week #8-#12)	(30%)
Individual-based assessment components		
6. Early-stage Peer Review	(week #6)	(5%)
7. Final-stage Peer Review	(week #12)	(10%)
	Total Marks	(100%)

Compulsory Attendance

Attendance for all scheduled MDP lab sessions is compulsory. 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reasons for absence (e.g. Leave of Absence) and have missed 50% or more of the scheduled MDP lab sessions, you will be withdrawn from the current MDP course without any penalty.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.

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1. Project Plan and Work Breakdown Structure

Objective and Motivation

This document is to detail the planning stage of the project and it should demonstrate the understanding of the project team in knowing the project objectives, project deliverables and the tasks to be performed. The plan will be cover the project objectives, project strategies, risk management, project team structure and the work breakdown for team members.

Learning Outcomes

As of the project planning process, students will acquire the understanding and skills to plan and manage, as a team, the tasks to be performed and mitigate the risks which may arise. They will be provided the opportunity to understand each other's strength and skills in allocating the relevant tasks. They will learn about scheduling tasks, assigning tasks ownership and be aware of tasks dependencies through the use of project planning tool/s (eg Microsoft Project).

Assessment Percentage:	**Submission Deadline**:
10%	End of week #4
Page Limit:	**Submission Format**:
No more than 15 pages (Project strategies should not be more than 1 page).	Hardcopy/Softcopy Softcopy to be in pdf format.

Assessment Criteria:	**Weightage**
1. **Project understanding and Strategy Planning –** Details clarity and relevance of the planned strategy in meeting project objectives**.**	20%
2. **Work breakdown –** Details clarity and relevance of the planned activities - tasks to be performed, tasks dependencies and timeline estimation.	20%
3. **Risk Management –** Clarity and relevance of risks to be mitigated and mitigation strategies.	10%

Contents to be Featured:

1. **Project Objectives and Scope** – Write in own words, the understanding and objectives of the project.
2. **Project Strategy** – Elaborate on the strategies and plans to adopt in meeting the project objectives.
3. **Team Structure –** Show the team structure hierarchy, eg Project Manager, Hardware

Team Lead, Software Team Lead, etc.

4. **Work Breakdown Structure (WBS) and Schedule –** Show the tasks breakdown and ownership with scheduled timeline in meeting the deadline of the project. *Make use of the project planning tools/software (Eg Microsoft Project).*

5. **Risk Management –** Tabulate and describes the approach for identifying, mitigating and resolving project risks. The risks should be classified as Low, Medium or High Impact.

Points to Note for Project Plan and Work Breakdown Structure:

a. *Point 1* – The project strategies planning should mention about:
    a. The development methodology/approach taken and explain why the relevance of the methodology in the project *context*.
    b. The rationale in resource and task allocation.

b. *Point 2* – WBS should also include tasks such as :
    a. Environment setup (eg, DB, IDE setup).
    b. Learning/knowledge acquisition (of software or programming languages).
    c. Testing, Change request (especially during leadership board challenge phase).
    d. Design/ Milestone Review.

c. *Point 3* – Some of the likely risks :
    a. Team synergy (since members are allocated ‘randomly),
    b. Learning of software/programming languages,
    c. Hardware procurement,
    d. Etc.

    Workload (Time management) should NOT be a risk if planning is done properly and members understand ownership and responsibility.

2. Video Report Submission

Objective and Motivation

The video report provides students with a non-traditional but increasingly important communication medium for reporting their contributions and achievements. It will form part of the assessment of what the team considers are highlight of their achievements and the teamwork demonstrated within the group. 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 of the necessary tools for creating and editing video media.

Assessment Percentage:	**Submission Deadline**:
15%	End of week #12
Duration of Submitted Video:	**Video Formats**:
No more than **5 minutes**.	mp4, mov or wmv

Assessment Criteria:	**Weightage**
1. **Creativity** – Creativeness of how all the features in the video submission are put together such that it makes the report interesting and original.	25%
2. **Presentation** – Effectiveness in communicating contributions through the use of features available in a video presentation.	25%
3. **Teamwork** – Demonstration of effective teamwork in the way the team has carried out their project and in the process of creating the video report.	25%
4. **Content** - Quality of team's effort and implementation highlighted in the video report. The content that is expected in your video is listed below.	25%

Video Contents to be Featured:

1. **Team members** – Introduce the team members and the project responsibilities assigned to each of the members.
2. **Implementations** – Highlight the team's implementation of various aspects of the project. You should take advantage of the video medium and demonstrate that your implementations are functioning correctly and robustly.
3. **Special Achievements** – Highlight what is special about your team's effort and the solutions that you have implemented.

Points to Note for Video Report Submission:

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. *Content* – Think carefully what aspects of your team's effort you wish to feature in the short 5 minute video. You want to focus on aspects that are specifically unique compared to the implementation of other teams. But you also have to bear in mind that the video needs to convey a good sense of teamwork in the group. So do not over emphasize the contributions of only a few members. You want to highlight good design attributes 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. This information in your video report will contribute towards the **Content** component of the assessment.

c. *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.

d. *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.

e. *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 elements will contribute towards the **Creativity** component of the assessment.

3. Documentation of Group Project Wiki

Objective and Motivation

The group project wiki provides students the opportunity to use a modern platform for recording and documenting their technical achievements, in lieu of a traditional written technical report report. The focus of this assessment component is the technical content; design and aesthetics of the project wiki will not be considered in the grading process. Teams should ensure that their wiki contains clear descriptions of all components in their system design. These descriptions should cover all aspects of the planning, design and implementation of system components. Where necessary, photos and videos should be incorporated to demonstrate key points.

Learning Outcomes

Students will acquire an understanding of how the design and implementation of a large technical project should be documented for future reference. Students will learn to structure their project documentation in appropriate sections depending on the system architecture. They will also learn to create clear, readable descriptions of the technical accomplishments of their group that can be easily understood by external readers, making use of photos and videos where necessary to illustrate key points.

Assessment Percentage:	**Submission Deadline**:
10%	End of week #11
Page Limit:	**Submission Format**:
No more than 20 pages (A4 Print-Screen).	Wiki site

Assessment Criteria:	**Weightage**
1. **Comprehensiveness** – Think carefully about all the aspects of your technical accomplishments that need to be documented. Make sure that all relevant aspects of the planning and implementation processes are included in your wiki site.	60%
2. **Clarity/readability** – Your wiki site documentation should serve as the repository for all design choices made by your team, and should be sufficient for an external reader to reproduce your work. Technical descriptions in your project wiki should be written clearly, with supporting photos, videos and other media used wherever appropriate.	20%
3. **Structure** – The sections/subsections and individual pages chosen for your wiki site should be coherent and contribute to an external reader's understanding of your team's accomplishments.	20%

Points to Note for Project Documentation Wiki:

1. We will only be assessing the technical content of the wiki, and not its aesthetic merits. While you are welcome to spend time improving its aesthetic appeal, please note that points will not be given for wiki sites that are more aesthetically pleasing.

4. 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 project wiki (technical) and video report (technical and non-technical) submission.

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%	Latest by end of week #9

Assessment Format:

- Whenever students have completed any checklist item or set of items, they can request to do a live demonstration to the MDP supervisor present in the lab.
- 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 #9 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 at the end of **week #9**.

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Project Deliverable Checklist Assessment Form

Group Name: _____ **MDP Lab: _____**

Group Leader: _____

No.	**A. Mobile Robot Module** Functional Specifications	MDP Supervisor Signature / Date
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 through the Wifi dongle provided.** 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 (or your group number) **2. The Raspberry Pi board (RPi) can be wirelessly connected to the Nexus 7 tablet (N7) using the Bluetooth dongle provided.** Example: You can use a Bluetooth terminal program (e.g. BT Term) on the N7 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 N7, as well as to display the characters send from the N7. **3. The Raspberry Pi board (RPi) is able to communicate with the Arduino board through over a USB->Serial connection.** It is most likely that you will create a Virtual COM serial port over the USB, with the RPi as master and the Audrino as the slave. To demonstrate their successful communication, you could develop a simple program on Arduino that capture the character sent from the RPi (e.g. using the Kermit or minicom program), increment the ASCII value by one, and transmit it back to RPi for diaply. (So a 'A' that is sent will be echoed back as 'B' for display) **During your demonstration, you should be able to pass information among the various devices.** Example: A character sent from N7 will be transferred to Arduino which increment it by 1, and then route to the PC through Wifi for display. You can run the three programs as three separate tasks using certain inter process communication (IPC) mechanism (e.g. Pipes, Socket) to pass the data. Or you can create a multithread program to run the 3 functions as 3 separate threads.	
A.2	**Sensors calibrated to correctly return distance to obstacle.** Building the world map correctly requires accurate data from ranging sensors. Using either any combination of IR and/or ultrasonic sensors, demonstrate that you can correctly return the distance to two targets (obstacle blocks) selected by your supervisor. The first target will be placed between 30-50cm away, and the second target will be	

	placed between 50-70cm away. Your range readings must be accurate to within +/- 6%.	
A.3	**Accurate straight line motion** Motors will generally exhibit slightly different motion characteristics given the same input signals – two motors given the exact same input voltage and duty cycle signals may still spin at different speeds. The accumulation of this error over time leads to errors in localization and mapping. The robot may actually be located a significant distance away from where it thinks it is. Demonstrate that your robot can traverse a straight line within the arena and stop at a distance between 100 and 150cm 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 an on-the-spot rotation within the arena, turning through an angle between 720 and 1080 degrees specified by your supervisor. Start your turn with the robot's center point over a yellow dot. Your robot's center location should not deviate more than 10cm in any direction, and must end its run accurate to within +/- 6% of the target angle. For example, when asked to pivot through 850 deg, your robot should end up facing between 79 and 181 deg from its original heading.	
A.5	**Obstacle avoidance and position recovery (straight line)** While moving forward along a 150cm straight line, your robot should be able to detect the presence of a single 10x10cm obstacle at any point in its path and take evasive action to avoid colliding with it, eventually returning to the original line on which it was moving.	
A.6	**Extension beyond the basics.** Demonstrate movement primitives other than straight lines and pivot (on-the-spot) turns. For example, demonstrate the execution of a continuous turn instead of stopping and performing a 90 degree pivot.	
No.	**B. Maze Exploration and Traversal Module** Functional Specifications	MDP Supervisor Signature / Date
B.1	**Arena exploration simulator** You should be able to demonstrate the implementation of an algorithm to explore an unknown space of size 1.5m x 2.0m, avoiding obstacles and successfully returning eventually to the start zone. Your simulator must demonstrate the **complete** exploration of all unknown space. (However, when carrying out an actual competition run with the physical robot, you may choose to terminate your exploration at any time and return to the start position to begin your fastest path run). This should be shown on a simulator displaying a grid map of the arena environment. Your simulator should be able to load grid maps from disk. (See file format description document).	
B.2	**Fastest path computation simulator** You should be able to demonstrate the implementation of an algorithm to compute the fastest path from the start position to the goal position, given a **known map of fully explored space** of 1.5m x 2.0m. This should be shown on a simulator displaying a grid map of the arena environment. Your simulator should be able to load grid maps from disk. (See file format description document).	
B.3	**Generate map descriptor** Generate a map descriptor for any map. (See map descriptor file format document).	

B.4	**Time and coverage-limited exploration simulation** Demonstrate a timed simulation of a time and coverage-aware exploration algorithm: 1. Your simulated robot should move through the arena exploration simulation at a user-selectable speed of X steps per second (1 step = 1 forward square, 1 pivot turn, etc if following the grid layout for movements). 2. Demonstrate the automatic termination of your exploration once a user-selected coverage figure (in % of the maze squares) has been achieved. 3. Demonstrate the automatic termination of your exploration once a user-selected time limit (in minutes:second) has passed.	
B.5	**Extension beyond the basics.** Your robot should be able to generate and display **(on a desktop/laptop screen)** a map of the environment when exploring an enclosed space of size 1.5m x 2.0m. This map should be updated in real time as the physical robot is exploring the arena. It should also display the location of the robot as it performs its fastest path run.	
No.	**C. Android Remote Controller Module** Functional Specifications	MDP Supervisor Signature / Date
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 indicates the current status of the robot** (e.g. stop, moving, etc). You can implement this using a TextView box (minimal requirement) or some form of graphical display with animation. 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.	
C.5	**Update of Robot Start Coordinates from Android GUI to PC** The start coordinates of the robot must be entered in the Android Interface and through the wireless link, transmitted to the PC. Groups can decide on their own coordinate system.	
C.6	**2D display of the maze environment and the robot's location.** E.g. you can create a drawing canvas on your GUI where a 2D grid map (minimal requirement) showing all the positions of the known obstacles, the current location of the robot and its heading. The display can be update either manually or automatically as in C.6.	
C.7	**Functional GUI that provides the selection of Manual or Auto updating of graphical display of the maze environment.**	

	E.g. you can use a toggling labeled button (minimal requirement) to achieve this toggling selection. *Manual Update* means the Grid map refreshes at the interactive request of the user by pressing an update button (minimal requirement) or touching the grid map. *Auto Update* means the Grid map is updated (as a background thread) automatically based on a regular interval or whenever there is a change in state over at the robotic module. Note: The AMD tool can be used to verify that you have correctly implemented both the Manual and Auto mode. Sending the string "GRID" to the AMD tool will get it to send you the current Grid Map data that can be used to render your Grid Map. The "Send Grid" button on the AMD tool can be used to simulate an auto update when the robotic module senses a change in the grid map state.	
C.8	**Functional GUI that provides two buttons that supports persistent user reconfigurable string commands to the robot.** These buttons when pressed send a predefined string via the Bluetooth link. The predefined string can be changed by the user interactively. Once the new string has been entered, it will remain persistent or non-volatile. That is, if your Android app is closed and then re-started, the reconfigured string will remain the new string and not revert back to some default value.	
C.9	**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.10	**Extension beyond the basics.** Novel robot movement control - Demonstrate novel remote motion control of the robot using other sensing capabilities of the Android tablet (e.g. Tilt sensing or continuous touch control) AND/OR Go beyond your basic 2D grid map display. For example, you could provide a button-activated toggle between your basic 2D grid map display and a 3D first person-view or a 2.5D view of the current known map and the robot. See visual samples in the Android briefing slide 10.	

END OF DOCUMENT