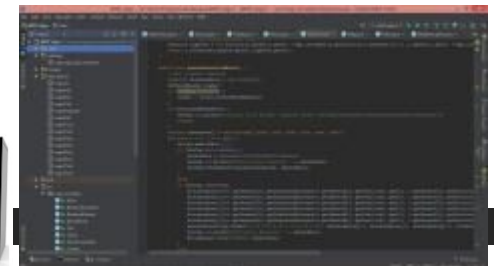
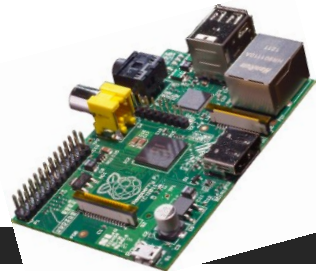
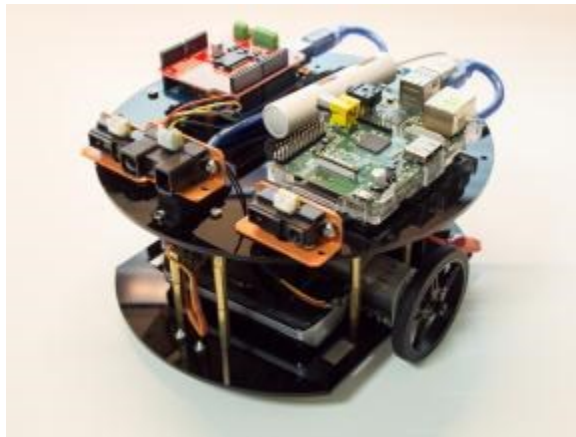
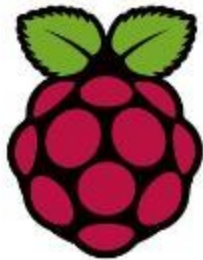
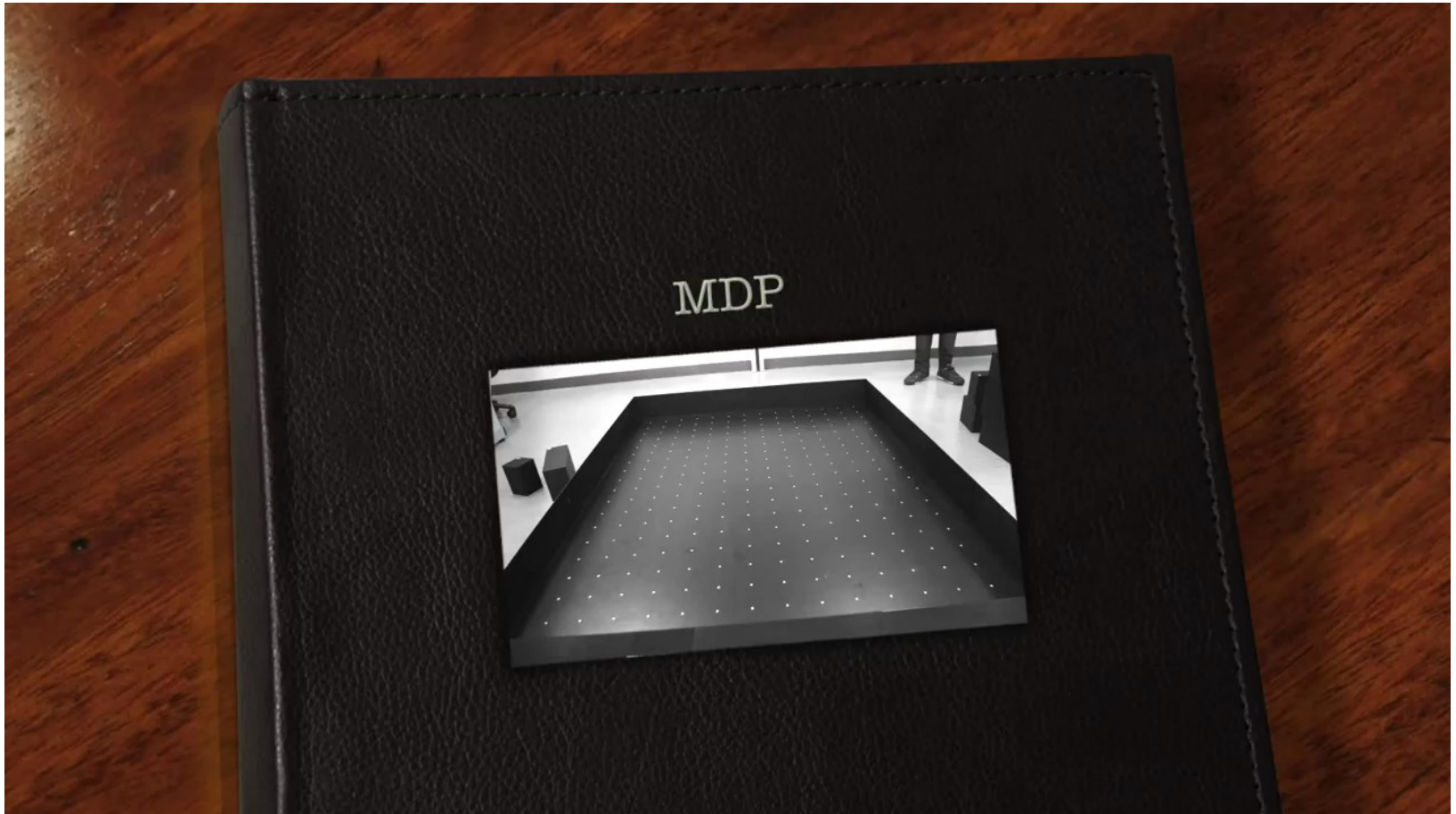


Multi-Disciplinary Design Project

Ravi Suppiah
Tan Kheng Leong



What is it all about?



MDP Task

➤ Build a robotic system that can

- Autonomously explore + traverse an unknown area, avoiding obstacles
- Plan and follow fastest path from X to Y
- Transmit telemetry + receive control signals from mobile device
- Simulate physical robot and algorithms in software

Contact Hours

➤ Weekly lab sessions: Fri 0830-1030

➤ Wk 1-3: Briefings (1h) + group meeting (1h)

➤ Wk 4-12: Group meeting (2h)

➤ Recess Week: Mon-Fri 0930-1630

➤ Intensive development work

➤ **Overall attendance \geq 80% required to Pass**

Contact Hours

➤ Term Time:

- Report later than 15mins => LATE
- Report later than 30mins => ABSENT

➤ Recess Week

- Report later than 30mins => LATE
- Report later than 60mins => ABSENT

➤ 2 Late = 1 Absent

- AM Session (9.30am – 12.30pm)
- PM Session (1.30pm – 4.30pm)

- Both are treated as two different sessions.
- Must sign attendance for both sessions.

Attendance

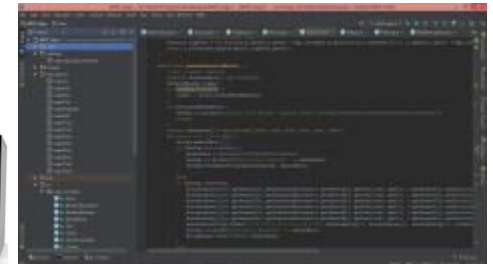
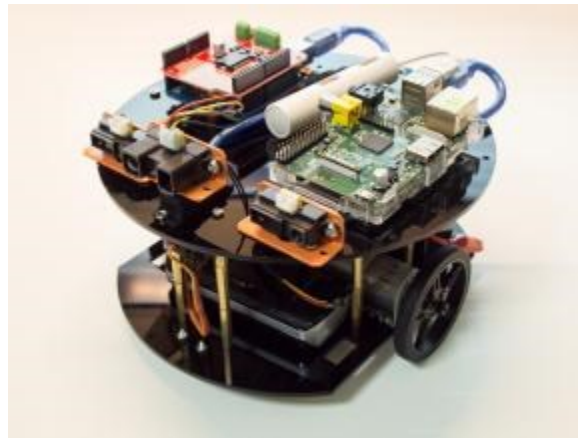
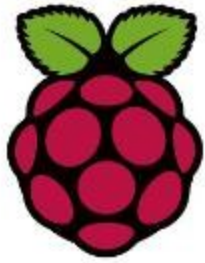
- **Overall attendance \geq 80% required to Pass.**
- **Regardless of Your Team's Performance.**
- **Those who DO NOT fulfill the criteria will not be graded and will be required to RETAKE MDP.**
- **You may only know about it towards the end-of-semester.**

**** COME FOR ALL YOUR MDP CLASSES ****

Learning Outcomes

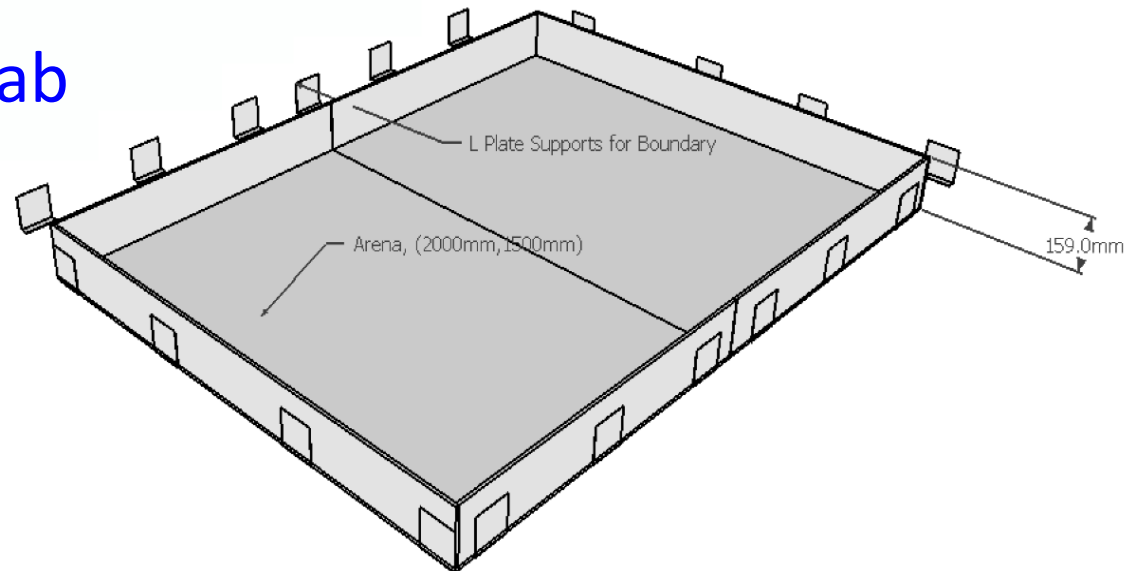
- Design and implement a complete system based on given specifications
- Plan and follow project development schedule
- Apply skills and knowledge gained in courses so far
- Get exposure to learn and use current technical platforms
- Learn to work in a Multidisciplinary team
- Present your work using various Media

The System



Arena

- Internal dimensions 2m x 1.5m, walls 15cm high
- Floor surface coated with high-grip material
- Obstacles scattered in arena
- One full arena per lab



Challenge Task

- Refer to MDP_Challenge.pdf
- I will announce more details during the 'Arduino' briefing.

Student Teams

- Teams of about ~8 students : 2CE + 6CZ
- CE/CZ ratio ~ matches scope of hardware vs software work
 - But if (you're CE and prefer to write code) || (you're CZ and want to work with hardware), that's perfectly fine
 - Work with your teammates to determine a good distribution
 - It's ok to rebalance/redistribute work as you go along

Lab Supervisors

- Each lab has 3-4 supervisors assigned
- Big, multidisciplinary project - too many parts for any one person to understand/build everything
- Don't expect lab supervisors to answer all your technical questions!

Supervisor & Lab Allocation

Lab Allocation - Y1516S2		
Lab	Supervisors	Teams
HW Lab 1 (N4-01a-03)	Goh Wooi Boon	1 to 6
	Suresh Sundaram	
	Oh Hong Lye	
	Zheng Jie	
HW Lab 3 (N4-b1a-05)	Li Fang	7 to 12
	Smitha Kavallur Pisharath Gopi	
	Vivek Chaturvedi	
	Chng Eng Siong	
SW Lab 2 (N4-01c-06)	Clement Chia	13 to 19
	Chan Syin	
	Ta Nguyen Binh Duong	
	Owen Noel Newton Fernando	

Timeline



Assessment

Group assessment (55%)

Division of responsibilities, project plan	10%	End Week 4
System functionality	20%	End Week 9
Project wiki	10%	End Week 11
Final report video	15%	End Week 12

Competitive group assessment (30%)

Leaderboard performance ranking	30%	Weeks 8-12
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Individual assessment (15%)

Early-stage peer review	5%	Week 6/7
Final-stage peer review	10%	Week 12

Functionality Demos

- Group assessment component (20%)
- Important functionality that you will need to complete your system
- “Checklists” for: Robot hardware; Software and algorithms; Android remote controller.
- Demonstrate that a functionality item has met the requirements in the list -> your supervisor will sign your checklist
- To be submitted no later than end of lab, Week 9

Functionality Demo

No.	C. Android Tablet 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 text 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.	

Project Wiki

- Group assessment component (10%)
- Technical documentation for your entire project
 - System Arch, Design & Implementation, algorithms, etc
- Might not be assessed by your own lab supervisor
- NTU wiki system, uses existing sign-in (active from Week 4)
- To be ready for evaluation by end of Week 11
- **Limited to 20 A4 (Print-Screen) Pages**

Final Report Video

- Group assessment component (15%)
- Create a video to report achievements and contributions
- In lieu of a traditional written report + presentation
- Demonstrate creativity, presentation skills, teamwork, etc
- Max 5 minutes long (5:01 onwards will NOT be graded)
- To be submitted by end of Week 12

Leaderboard Challenge

- Competitive group assessment component
 - LeaderBoard A (15%)
 - LeaderBoard B (15%)
- Weeks 8-12 during lab - teams decide whether to participate
- **One attempt per week**
- Lab supervisors to referee attempts
- Slightly different arena layout each week
- Obviously important to do well if aiming for top grades

Leaderboard Challenge

➤ A recap of how the leaderboard progressed for the last batch.

Week8

(Updated 13/10)

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	✗	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
2	8	21	295.2	296	1	3

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	8	8	00:17	00:00	00:17
2	8	2	00:25	00:00	00:25

Leaderboard Challenge

Week9

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	✗	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
2	9	3	297.8	298	0	2
3	8	21	295.2	296	1	3
4	9	5	291.0	294	6	0
5	9	14	288.0	292	8	0
6	9	9	262.5	275	25	0

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	8	8	00:17	00:00	00:17
2	9	5	00:20	00:00	00:20
3	8	2	00:25	00:00	00:25

Leaderboard Challenge

Week10

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	✗	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
2	9	3	297.8	298	0	2
3	8	21	295.2	296	1	3
4	9	5	291.0	294	6	0
5	9	14	288.0	292	8	0
6	9	9	262.5	275	25	0
7	10	1	259.2	264	3	33

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	10	5	00:13	00:00	00:13
2	10	3	00:15	00:00	00:15
3	10	1	00:16	00:00	00:16
4	8	8	00:17	00:00	00:17
5	8	2	00:25	00:00	00:25

Leaderboard Challenge

Week11

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	X	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
2	11	14	298.5	299	1	0
3	9	3	297.8	298	0	2
4	11	20	297.0	298	2	0
5	8	21	295.2	296	1	3
6	9	5	291.0	294	6	0
7	9	9	262.5	275	25	0
8	10	1	259.2	264	3	33

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	10	5	00:13	00:00	00:13
1	11	2	00:13	00:00	00:13
1	11	20	00:13	00:00	00:13
2	10	3	00:15	00:00	00:15
3	10	1	00:16	00:00	00:16
4	8	8	00:17	00:00	00:17
5	11	7	00:13	00:10	00:23
6	11	14	00:44	01:20	02:04

Leaderboard Challenge

Week12

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	✗	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
1	12	9	300.0	300	0	0
1	12	1	300.0	300	0	0
1	12	23	300.0	300	0	0
1	12	24	300.0	300	0	0
2	12	3	298.9	299	0	1
3	11	14	298.5	299	1	0
4	11	20	297.0	298	2	0
5	8	21	295.2	296	1	3
6	9	5	291.0	294	6	0
7	12	4	213.7*	233	19	48
8	12	17	200*			

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	10	3	00:08	00:00	00:08
2	12	1	00:10	00:00	00:10
3	10	5	00:13	00:00	00:13
3	11	2	00:13	00:00	00:13
3	11	20	00:13	00:00	00:13
4	8	8	00:17	00:00	00:17
5	12	24	00:21	00:00	00:21
6	11	7	00:13	00:10	00:23
7	12	4	00:20	00:20	00:40
8	11	14	00:44	01:20	02:04

Leaderboard Challenge

Week12

#1 Ranked team awarded full 15 points

Rest of the teams will have a distribution of points

**** Leaderboard A – Teams with similar exploration score will be ranked based on exploration timing ****

LEADERBOARD A - EXPLORATION

Rank	Week	Team	Score	✓	✗	?
1	8	2	300.0	300	0	0
1	8	7	300.0	300	0	0
1	8	8	300.0	300	0	0
1	12	9	300.0	300	0	0
1	12	1	300.0	300	0	0
1	12	23	300.0	300	0	0
1	12	24	300.0	300	0	0
2	12	3	298.9	299	0	1
3	11	14	298.5	299	1	0
4	11	20	297.0	298	2	0
5	8	21	295.2	296	1	3
6	9	5	291.0	294	6	0
7	12	4	213.7*	233	19	48
8	12	17	200*			

LEADERBOARD B - FASTEST PATH

Rank	Week	Team	Fastest path	Penalties	Final score
1	10	3	00:08	00:00	00:08
2	12	1	00:10	00:00	00:10
3	10	5	00:13	00:00	00:13
3	11	2	00:13	00:00	00:13
3	11	20	00:13	00:00	00:13
4	8	8	00:17	00:00	00:17
5	12	24	00:21	00:00	00:21
6	11	7	00:13	00:10	00:23
7	12	4	00:20	00:20	00:40
8	11	14	00:44	01:20	02:04

Peer Evaluation



- Individual assessment component (15%)
- Only non-group marks
- Confidential/anonymous
- Week 5 (5%)
- Mainly to assess contributions to design and planning phase
- Week 12 (10%)

Components

➤ Please refer to [MDP_Component_List_1516S2.pdf](#) in ntuLearn.

Hardware

Arduino



Raspberry Pi



Nexus 7 tablet



PC



Briefings

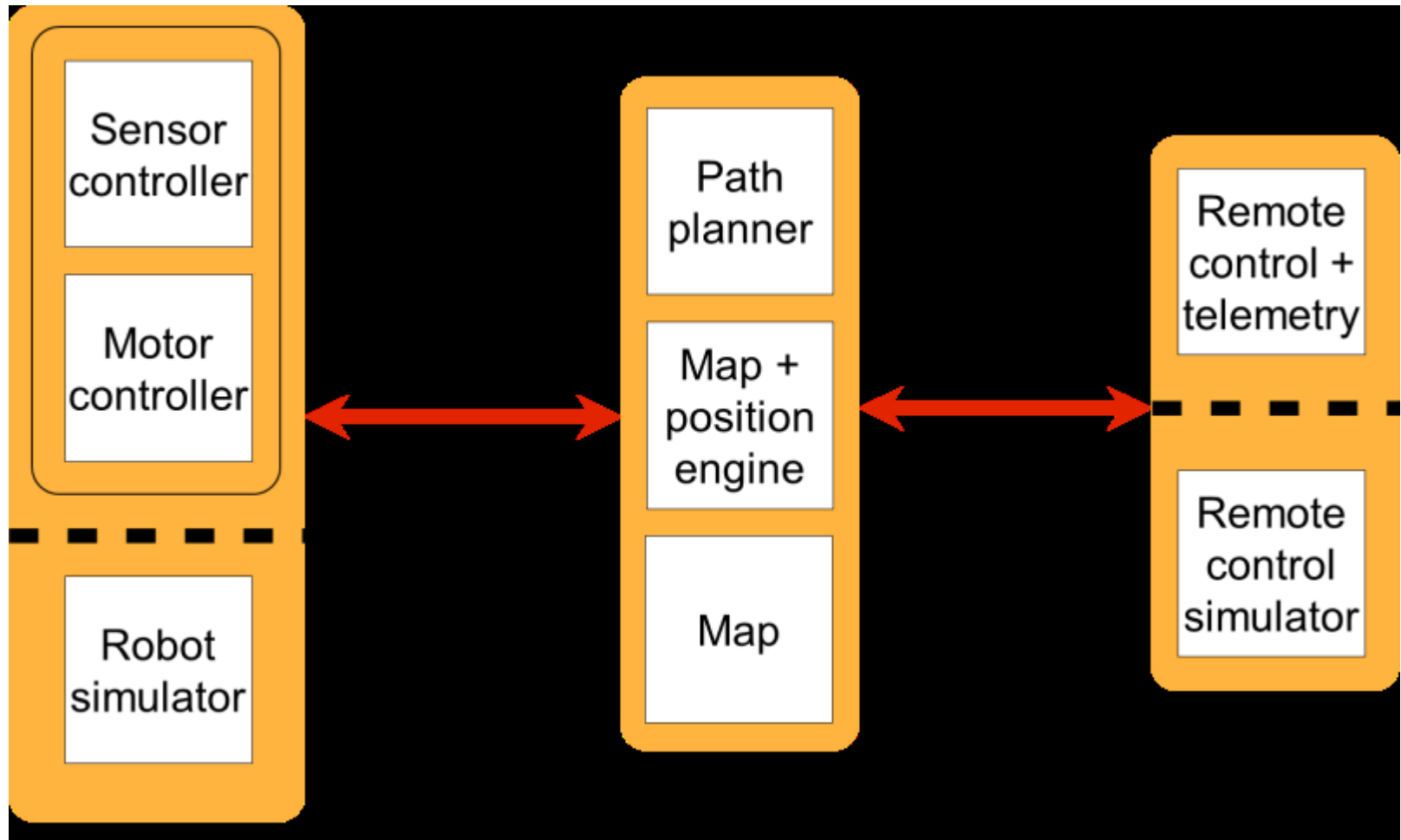
➤ All held from **0830-0930**

➤ Week 1 (15th Jan): Initial briefing @ LT 8

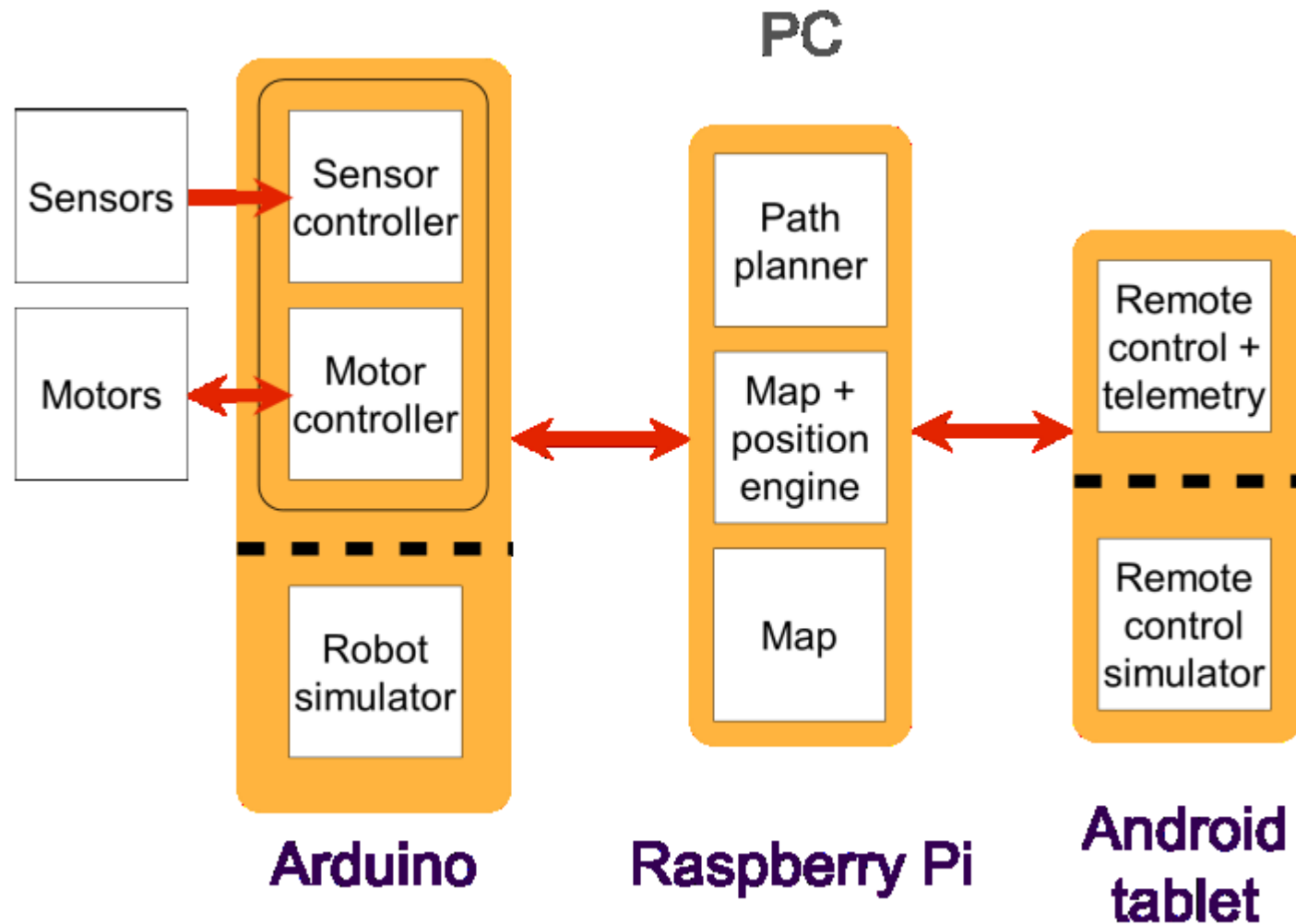
➤ Week 2 (22nd Jan): Arduino @ LT 8
 Raspberry Pi @ LT 3

➤ Week 3 (29th Jan): Android @ LT 8
 Algorithms @ LT 3

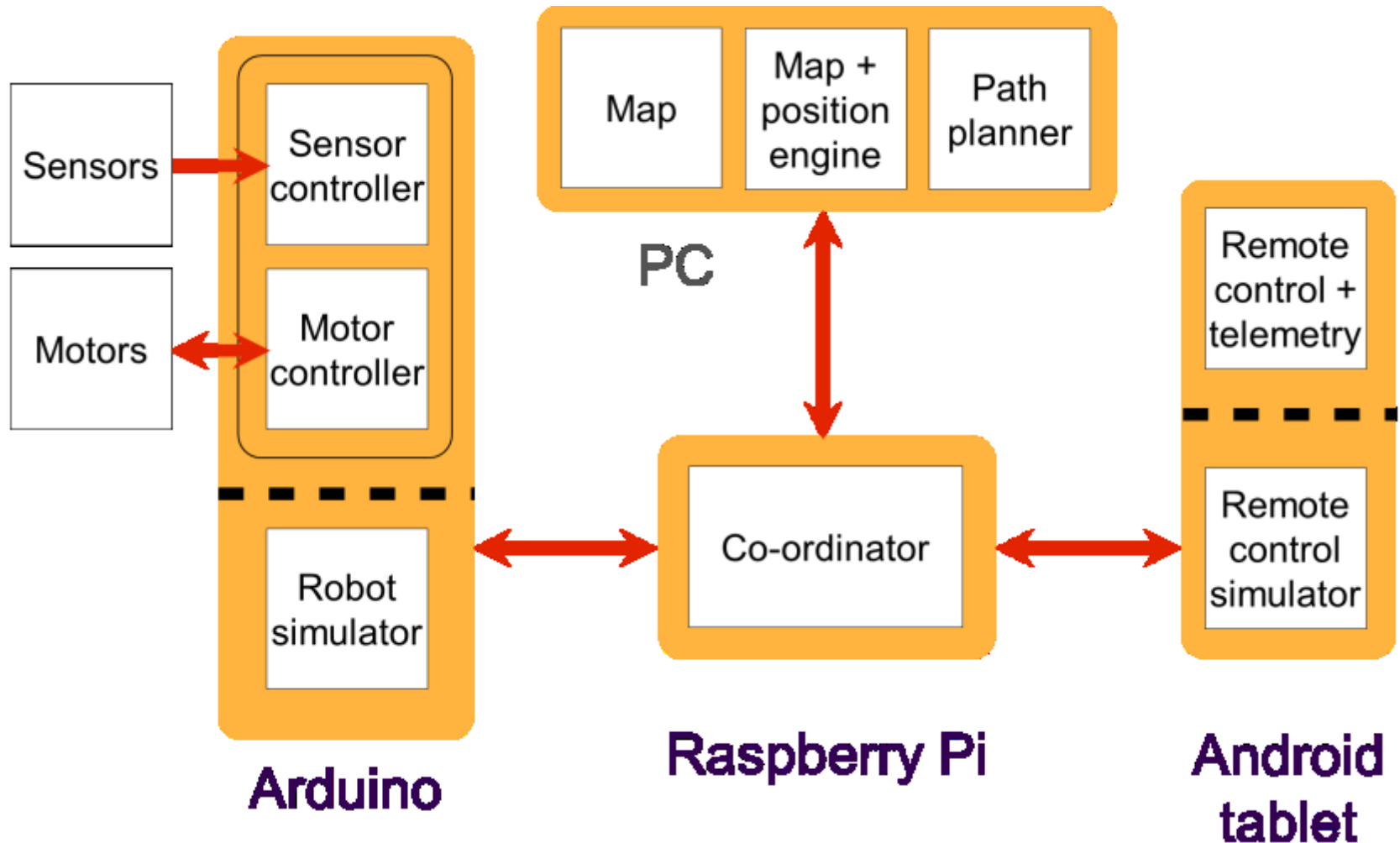
Subsystems Example



Subsystems Example



Subsystems Example



Team Dynamics

- You won't agree on everything all the time
- **Raise issues/concerns early - don't wait till Week 11!**
- Accommodate different working styles while making progress towards the same goal
- Try to resolve any conflicts within your groups
- If (unsuccessful) {Talk to your team supervisor}

Don't Procrastinate

- If you leave everything untouched until the Recess week
 - **You won't finish!**
- Get started early
- It will take you a few weeks to get familiar with boot procedures, IDE setup, code compilation, soldering/wiring techniques, etc

Technical Tips

- Establish some form of code versioning framework
- BitBucket <https://bitbucket.org/> offers free private repositories for Git/Mecurial w/ Windows/Mac clients
- Don't be afraid to share information with other groups and learn from each other
- Unless maybe it's a super secret special trick you've come up with

What do I do Today?

- Go to your assigned labs, Meet your teammates
- Choose a team leader (administrative contact)
- Collect hardware kit from lab executives
- Ensure that all items are present. After today, all missing items will be considered as being LOST by the team.
- Start discussing division of responsibilities
- Determine who attends which briefings in Weeks 2-3, who gets what hardware to play with, etc
- Contact missing members and ensure that they understand their role

Exchange & Replacement

- Within the **first 4 weeks**, items can be exchanged only if the team can prove to the Lab Supervisor/Lab TE that the item is faulty.
- After that, all damaged items will be considered as due to improper use by the group.
- In this case, the group has 2 options
 - Replace with SAME item (on their own) without Penalty.
 - Request for replacement item from Lab (subject to availability) with Penalty Marks being deducted.
 - In this case, the item is considered to be an additional draw-out.
 - At the end of the MDP, the group must return BOTH (original + additional) items.

Return of Equipment

- At the end of MDP, you will be required to dismantle and return all the items to your respective labs.
- Only selected groups will be asked to keep their robots.
- Failure to return your items by due date
 - **Penalty Marks Deducted**

Arena Availability

- During Lab Hours, you can access the Arena in your allocated lab, subject to the lab's schedule and free-access timeslots.
- SCE Student Lounge will host one set to help you in your development after Lab Hours.
 - **Please comply with their Opening & Closing Hours!**

A Note From Your Seniors...

Our Take on MDP

On a completely serious note, MDP has definitely been one of the best subjects taken by the members of our team and we have learned more than any single course attempting to teach us the same. Also, it has brought people who previously never knew each other, together into a big family who kept supporting and encouraging each other to work harder. Apart from exercising our own brains, it has helped us learn different ways of thinking from our colleagues taking the course with us. Two important takeaways from the course apart from the knowledge are:

- 1) Humility: No matter how smart you think you and your team is, there is always someone doing better than you.
- 2) Murphy's Law: No matter how good you think your robot runs, things will fall apart at the moment you need it the most.

The End!

Q & A!