Software Development Methods
Project 2019/2020
Magellan's Race - 500 years
V 1.0 - 25/09/2019

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1 The Context

The famous navigator Ferdinand Magellan set off from Spain 500 years ago on an epoch-making voyage to sail all the way around the globe for the first time. Magellan's fleet consisted of five ships, carrying supplies for two years of travel. The crew consisted of about 270 men.

The Portuguese explorer was killed by islanders in the Philippines two years into the adventure, leaving Spaniard Juan Sebastian Elcano to complete the three-year trip. But it is Magellan's name that is forever associated with the voyage.

Here are five ways in which Magellan's voyage marked human history and continues to inspire scientists and explorers today:

Historical: Magellan's voyage was a turning point in history, as unique as the first manned journey into outer space and the later moon landings, said NASA scientist Alan Stern, leader of its New Horizons interplanetary space probe.

"When the first one circled the plant, (that) sort of meant that we now had our arms around the planet for the first time", he said.

"That just transformed humanity in my view. I would call it the first planetary event, in the same way that Yuri Gagarin was the first off-planetary event" when the Soviet cosmonaut went into outer space.

Geographical: Magellan's voyage rewrote the maps and geography books. He was the first to discover the strait, which now bears his name, linking the Atlantic and Pacific oceans at the tip of South America.

"Perhaps his greatest feat, and still considered today one of the greatest feats of the history of navigation, was negotiating this strait, of which there were no maps and whose existence was vaguely rumoured", said US historian Laurence Bergreen, author of a biography of Magellan.

Philosophical: The voyage transformed humans' own conception of their place in the world.

"It wasn't just geography and anthropology, it showed something philosophical: that it's all one world", said Bergreen.

"Before Magellan people didn't really know that. They didn't know how the world was connected or how big it was."

Astronomical: The voyage contributed to Europeans' knowledge of the universe and has marked the worlds of space exploration and astronomy to this day.

While crossing the Magellan Strait, the explorer and his crew observed two galaxies visible to the naked eye from the southern hemisphere, now known as the Magellanic Clouds.

Some recently-designated areas of the surface of Mars have been given the same names that Magellan gave to parts of South America, with Bergreen's help. A giant telescope being developed in Chile will also bear the explorer's name.

Inspirational: Magellan's achievement was a landmark in the history of exploration still hailed by his modern-day successors.

"In the space program, to prepare for these long duration missions, we say 'the lessons for the future are written in the past' ", said Dafydd Williams, a former NASA astronaut, now 65, who went on two space missions.

"So many in the space program have read about Magellan."

2 Problem description

It is required to build a system to support the activities of the 500 years Magellan's Race. The system is compliant with the race rules and required automation features covered next.

3 The Race

To celebrate the 500 anniversary of Magellan's circumnavigation voyage, the race departs from Spain in October (the original fleet departed on the 20th of September, 500 years ago). The overall race will conclude in Spain, with stopovers in several ports around the world. It will have around 10 legs (i.e. a leg is a race between two ports to be defined in the system by the Race Organizers, RO). At many of the stopover cities (not all of them) were the fleet stops there will be in-port races (local).

Crew combos Each of the entries has a sailing crew who race day and night for more than 20 days at a time on some of the legs. There is a dedicated media crew member called the On Board Reporter (OBR); they do not contribute to the sailing of the boat (registered in the system by the OBR in terms of start and end times, gps coordinates, speed, status/manoeuvre, crew), but are responsible for using the system to send images and video to race headquarters via satellite from the middle of the ocean. The intention is that boats' On-board Reporters (and crew) share thrilling videos and stories with millions of fans via TV, websites and social media channels competing for the Communications Award for the most outstanding content contributor overall.

The OBR will be able to follow the status of each boat at any time and watch the Board Reporter information. The OBR will edit the material and select what can be viewed by the general public. Sometimes, the OBR team can issue a black-out situation for security purposes of the racers (unfortunately, in some seas the boats are good prey for pirates, therefore information regarding location, status etc., should be hidden from the general audience).

In each leg (during the race), the crew is also able to check the status of its own boat but not the status of the rivals.

The race number of crew ranges between 7 and 10 (plus the OBR) depending on the gender ratio; with the rules providing an incentive to having women sailors on board.

Designed to add flexibility for teams, and create a clearer pathway for female sailors to take part in the race, the new rules mean that skippers have the option to change the line up of their crew on a leg-by-leg basis.

With the return to more Southern Ocean racing meaning that teams are likely to face gruelling conditions for longer, skippers can take up to three extra sailors members by opting for a mixed crew – and that will have huge implications in terms of life on board, such as the watch system, and general duties.

The possible crew combinations are as in Figure 1.

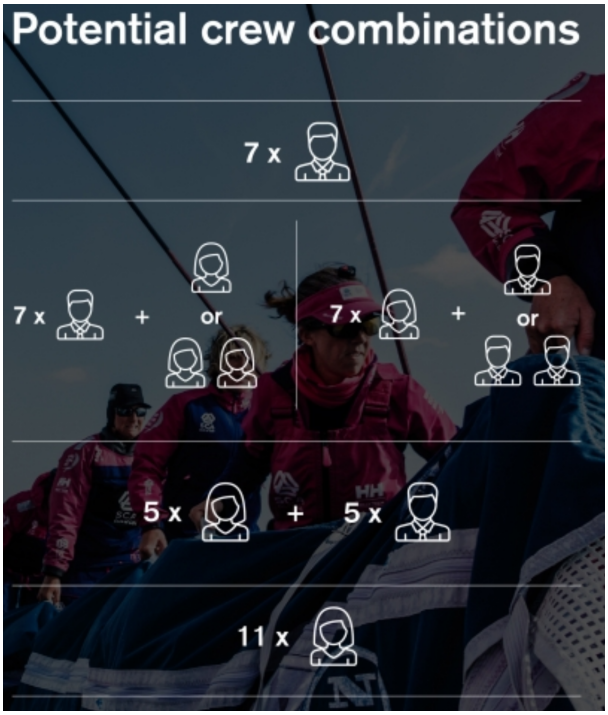

Figure 1: Possible crew combinations.

One of the crew members, with exception to the OBR, must be the skipper. The team is composed by the crew and the support team (technical people that will be based in the departure or destination ports of each leg, with access to the communication channels to the crew). The members of the support team will help with repairs and maintenance when the boat is docked in each portr.

All crew members have biosensor devices for location (where they are on-board to be sure that no crew member fell in the see) and Health monitoring (with biosensors for heart condition, temperature). Besides, the OBR can access real-time to the all the cameras on-board. The OBR will monitor each crew member individually and can decide to notify the skipper for action if some problem is detected. The remote doctor assistance can be activated. In extreme situations, the skippers can decide to activate the SOS alarm for assistance action.

Ocean Legs

In-Port Race series and Scoring Rules The In-Port Races are scored separately from the ocean legs but the series is used as a tie-breaker in the final points tally, so teams will take the discipline very seriously. The races themselves are short, action packed and held as close as possible to land. Winning the start is often the key to victory and the fight for the best

starting position in the final minutes before the sound signal can be fascinating. The crew for the In-Port Race will consist of crew members who sailed the previous leg or who will start in the next leg, with any changes having to be approved by Race Management. In-Port Races are scheduled in all of the Host Cities.

4 Logistics

Fresh food is not permitted to be taken on board after the start, so the crew lives off freeze-dried fare; they will experience temperature variations from -5 to +40 degrees Celsius and will often only take one change of clothes. The system will allow the crew to buy provisions (including fresh water) to the port authorities where they are docking.

The crew is also responsible for checking via the system, with the port authorities, for availability of a place to stay in the harbour.

5 Communications

Essential safety services are offered to the crew. Fleet tracking and voice and data communications to each of the race boats, accessed via a global phone satellite network. The intention is to have advanced use of technology to enhance the media coverage of sailing, making it a more immersive and accessible sport.

The reliable maritime services and satellite phone are:

- Fleet Broadband – to power high-speed, always-on voice and data communications;
- Inmarsat C – two-way data connection for emergency services and 24/7 tracking;
- IsatPhone 2 – reliable and robust satellite phone is stowed away in each boat's emergency grab bag;
- Inmarsat C beamed back the boats' GPS locations to race HQ every 10 seconds. This, together with FleetBroadband voice safety services and the GPS tracking and alert functions on the satellite phone, keeps the crew as safe as possible on the most challenging environment on Earth.

Having communication services on-board means that the Race crews have the best communications from boat-to-shore and shore-to-boat to:

- Request health support – seek medical advice to doctors;
- Send message to family – e.g. wish a desperately-missed loved one a happy birthday. This is subject to censorship, with due permission, from the OBR to avoid that the crew gets information about the other race boats;
- Request advice to the support team, so that they give instructions to the crew on how to repair things on-board;
- Activate SOS in case of emergency like for instance men overboard, medical assistance, collision, etc.;
- In case of SOS activation, if it is not possible immediate assistance (helicopter or OBR support ships are not available), the system makes a broadcast to the nearby ships for help.

- Get information regarding the weather condition forecast (tides/wind intensity/wind direction/temperature/etc.);
- Port authorities are able to broadcast announcements (like harbour closed, construction works, attention to container floating in the sea, etc.) in the system.

6 On board electrical system and technical support

Each Electrical installation must be identical on every yacht: from the smallest screw to the cable binders. This means that only the performance of the crew will make any difference in the use and control of the electrical system.

To produce energy for the electrical installation, each yacht will be equipped with an extra water-powered charging system.

The output of all devices including charge point inputs can be monitored in real time via the Electrical System monitoring page on the official website.

What the system needs to power and control:

- Port and starboard water ballast pumps;
- Sat C (satcom messaging and positioning);
- All lighting (both internal and external);
- Fleet broadband 250 and 500;
- Cockpit and navigation MFDs;
- LAN network;
- Multi-functional displays;
- Gas alarm;
- Radar;
- Bilge pumps;
- Two on-board PCs;
- VHF radio;
- AIS (Automatic Identification System);
- Watermaker;
- Freshwater pumps;
- Electric-hydraulic keel pump and PLC controls;
- Media equipment for the on-board reporters.

The support team is responsible for monitoring the boat, and give support to the technical operation of its equipment. If something is detected or the skipper requests for advice (e.g. something broke or is malfunctioning), the support team can provide some technical advice. During the communication, to disclose any information regarding the other boats or to interfere in tactics is strictly forbidden. If detected, the ORB starts the process of disqualifying the team. Therefore, the ORB will also monitor both the boat data stream as well as the communications between the crew and the support team.

Disclaimer: This text does not describe exhaustively the problem. It is deliberately open for each group to interpret and complete with its vision of how such a system should work. Be creative. Your model must comply with the information in this document, but you can and should expand on it. Think of these as "minimal requirements". If you think you found any ambiguity or undefined issue in this description, good. This description is supposed to be like that. Call for project proposals are like that, in real life. Feel free to discuss ambiguities and open issues with the lab teacher.

7 Intermediate report - 1st phase (Due 23/10/2019)

The report shall comply with the following guidelines:

1. Front page with the name of the course, title of the work, name and number of the team members and date. Besides, it should explicitly state the lab where the group is enrolled and name of the teacher that is lecturing the lab.

2. A chapter with a list of assumptions found relevant to explain options made (shouldn't go over 1500 words). These assumptions should cover issues that the group may have found as open, or even ambiguous, in the high-level problem description provided in this document.

3. A chapter with the results of the analysis phase organised by sections:

   (a) 1 complete Use Case Diagram

   (b) 5 complete Use Case specifications, including 2 alternative scenarios per use case. **Hint:** make sure you choose interesting use cases to model. Trivial, or too common use cases (e.g., doing the login into the system) are **NOT** interesting for this report, because you can normally reuse them from one project to the next. Choose use cases which are specific to **THIS** project.

   (c) 1 Activity Diagram per Use Case must be the same as the ones selected in the item before.

   (d) 1 Class Diagram (Domain Concepts, not the architecture design with control, boundary classes etc). This should be a fragment diagram that covers completely the classes and required relations used in the Use Cases selected in b).

8 Final report - 2nd phase (Due 4/12/2019)

The report shall comply with the following guidelines:

1. Front page with the name of the course, title of the work, name and number of the team members and date. Besides, it should explicitly state the lab where the group is enrolled and name of the teacher that is lecturing the lab.

2. A chapter with a list of assumptions found relevant to explain options made (should not go over 1500 words). These assumptions should cover issues that the group may have found as open, or even ambiguous, in the high-level problem description provided in this document.

3. A chapter with the results of the analysis phase organised by sections:

(a) 1 complete Use Case Diagram

(b) 5 complete Use Case specifications, including 2 alternative scenarios per use case. In the five UCs should cover different aspects of the system. It will be mandatory that the group presents: One UC covering the Race Management rules, one UC covering Logistics, one covering Communications, and another covering Boat or team maintenance/operation/monitoring. **Hint:** make sure you choose interesting use cases to model. Trivial, or too common use cases (e.g. logging into the system) are **NOT** interesting for this report, because you can normally reuse them from one project to the next. Choose use cases which are specific to **THIS** project. The Use Cases should be agreed with the Lab teacher, to be sure that the selected use cases have enough relevance and complexity to be accepted.

(c) 1 Activity Diagram per Use Case must be the same as the ones selected in b.

(d) 1 Sequence Diagram per Use Case detailed in b).

(e) 1 Class Diagram (Domain Concepts, not the architecture design with control, boundary classes etc). This should be a fragment diagram that covers completely the classes and required relations used in the Use Cases selected in b).

(f) OCL about the Class Diagram e) with reasonable complexity properly discussed with the teacher in the lab: 3 invariants, 3 Pre-conditions; 3 post-conditions.

(g) Statechart Diagrams per control Class.

4. Chapter with the results of the design phase, organized in sections. Suppose the implementation will be using Java with Oracle Databases and a three level architecture.

   (a) Class Diagram clearly differentiating Entity, Control and interface Classes, organized using packages.

   (b) 1 Component Diagram

   (c) 1 Deployment Diagram

5. Chapter with conclusions (limit 500 words). This can contain self assessment statements that, in retrospective, can include main limitations and difficulties felt during the project along the semester.

6. Bibliography. Book/white papers/ technical reports/other references and links of websites used to gather information either related to the domain of the problem or to the domain of the solution.

9 Project submission

1. The date for submitting in Moodle the written report in PDF for the first phase is: 23/10/2019 at 24h00 (hard deadline). For every slot of 4 hours past this deadline (starting with 1 point penalty at 0h00), you will receive a 1 point penalty in the classification (*i.e.* 6 points per day).

2. The date for submitting in Moodle the written report in pdf for the second phase is: 4/12/2019. Again, For every slot of 4 hours past this deadline (starting with 1 point penalty at 0h00), you will receive a 1 point penalty in the classification (*i.e.* 6 points per day).

3. We will schedule oral discussions for defending this work is scheduled for the week of 9/12/2019 to 13/12/2019. **The presence of all the four team members is mandatory**. All team members must be knowledgeable of the whole content of the written report to be discussed. The discussions will happen after the delivery in the second phase. For that you should go to the secretary of the department after submitting the project and block your slot in the agenda in paper that will provided to you there.

10 Deliverable format

In both phases, your project is to be submitted on Moodle. In order to create it, you will need to use appropriate model and text editors. No hand-written reports or diagrams within those reports will be considered.

1. In the **first** phase, please submit your written report **in *pdf* format (no other formats are acceptable)**. The *pdf* file must be named as:

   [Lab number]-[student 1]-[student 2]-[student 3].pdf

   For example, for a group enrolled in the lab P2, we would have:

   P2-34234-65444-83221.pdf

2. In the **second** phase, please submit a *zip* file named:

   [Lab number]-[student 1]-[student 2]-[student 3].zip

   For example, the same group would be identified as

   P2-34234-65444-83221.zip

   The zip file should contain:

   (a) the written report **in *pdf* (no other formats are acceptable)**

   (b) the *.use* file (and *.soil* file with the instances used for testing your models with OCL). **Note that the *.use* file only needs to cover the fragment of the class diagram that you are using for your OCL expressions. You do not need to put ALL your class diagram in this format.**

   (c) any other document found relevant

11 Inspiration references

The current project proposal is an imaginary situation inspired in real life Yacht Races, where technology is being introduced at an astonishing pace. Here are a few links to sites that inspired the text of this problem and historical context.

1. Volvo Oceans Race: `http://archive.theoceanrace.com`
2. "500 Years on, How Magellan's Voyage Changed the World", By Agence France-Presse" `https://www.voanews.com/science-health/500-years-how-magellans-voyage-change`
3. History: `https://en.wikipedia.org/wiki/Ferdinand_Magellan`