Minutes for the Official Meeting on September 4, 2020
Alberto Olivares-Alarcos transcribing

IEEE SA - 1872.2 Standard for Autonomous Robotics (AuR) Ontology Working Group

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Call and Agenda

Meeting Agenda for September 4, 2020, 1PM-2:30PM UTC

You have been invited to the IEEE SA WG P1872.2 meeting. Join the meeting:
https://join.skype.com/Buruz9jby49e

1. Call to order (Howard)
2. Introduction and rosters (Alberto)
3. Approve today's agenda (Howard)
4. Approve prior meeting's minutes (Alberto; August 7)
5. Essential Patent Claims (Alberto)
6. Status updates/previous action items (Howard)
7. IEEE Copyright Policy (Howard)
8. Technical discussion (Work on the third section of the draft: Definitions (attached document)
- Focus on Function and Behavior)
9. Next meeting's topic: nomination of presentation
10. New business/announcements/events/last thoughts
11. Close meeting (Howard)

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Rosters

- Y and N state for Yes and No
- ^ means the attendee is a *Voting Member*
- Members highlighted in **green** are eligible to become a *Voting Member*
- Members highlighted in **red** are eligible to lose *Voting Membership*
- Last column contains today's meeting attendees

Attendee Name	Role	Affiliation	Current Voting	Meetings Attended / last two	4-Sep
OBSERVATIONS					
Howard Li	Chair	University of New Brunswick, Canada	Y	2	Y^
Paulo Gonçalves	Co-Chair	IDMEC, Portugal	Y	2	Y^
Veera Ragavan	Co-Chair	Monash University, Australia	Y	0	N^
Alberto Olivares Alarcos	Secretary	IRI-CSIC, Spain	Y	2	Y^
Alaa Khamis	Member	General Motors, Canada	Y	1	N^
Chris Nowak	Member	DST Group, Australia	Y	2	Y^
João M.L. Quintas	Member	Pedro Nunes Institute, Portugal	Y	1	Y^
Julia Bermejo	Member	UPM, Spain	Y	2	Y^
Ricardo Sanz	Member	UPM, Spain	Y	0	Y^
Stefano Borgo	Member	ISTC/ CNR, Italy	Y	2	Y^
Edison Pignaton	Member	UFRGS, Brazil	N	1	N
Elisa Tosello	Member	UNIPD, Italy	Y	2	Y^
Daniel Beβler	Member	University of Bremen, Germany	N	0	N
Mohammed Diab	Member	UPC, Spain	Y	2	N^
Marcos E. Bareto	Member	UFBA, Brazil	N	0	N
Joanna I. Olszewska	Member	University of West Scotland, UK	Y	1	Y^
Amelie Gyrard	Member	Knoesis, Wright State University	Y	1	N^
Hiren Nakawala	Member	University of Verona, Italy	Y	2	N^

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Abdelghani Cibani	Member	UPEC, France	N	0	Y
Maki Habib	Member	American University in Cairo	Y	1	Y^
Dormant/Inactive					
Sandro R. Fiorini	Co-Chair	IBM, Brazil	N	0	
Eren Erdal Aksoy	Member	Halmstad University / Volvo	N	0	
Carlos Hernández	Member	TU Delft, Netherlads	N	0	
Joel L. Carbonera	Co-Chair	UFRGS, Brazil	N	0	
Edson Prestes	Member	UFRGS, Brazil	N	0	
Bao U. Nguyen	Member	University of Otawa, Canada	N	1	
Kathryn Bennett	Guest	IEEE-SA	N	0	
Craig Schlenoff	Member	NIST	N	0	
Jaeho Lee	Member	University of Seul	N	0	
JiSang Hoon	Member	KITECH, Republic of Korea	N	0	
Ki-Yeop Sung	Member	KAR, Republic of Korea	N	0	
Taeyoung Uhm	Member	KIRO, Republic of Korea	N	0	
Sebastian	Guest	IEEE-RAS	N	0	
Christy Bahn	Program Manager	IEEE-SA	N	0	
Signe Redfield	Guest	United States Naval Research Laboratory	N	0	
Ali Akbari	Guest	UPC, Spain	N	0	
		Total Attendees			12
		Voting Members	16		16
		Voting Members Present			11
		Quorum			Y

Veera lost his voting membership.

Approval today's meeting agenda

Motion Proposal : Maki Seconded by: Ricardo Accepted Agenda: Yes

Approval prior minutes

Minutes were distributed and also made available on our google drive. Thus, members could

have read them, but Alberto summarized the minutes to ensure that everyone knew about them.

Motion Proposal: Stefano Seconded by: Alberto Accepted Minutes: Yes

Call for Essential Patent Claims (Alberto)

The call was raised; no participant raised any concerns or any comments for consideration.

Status updates/previous action items (Howard)

- **[PAUSED]** Future publications
  - Book chapter suggested by Amelie - Architecture
  - Article about Knowledge driven design of robotic applications - Veera
- **[ONGOING]** Alignment with Task Representation group - Terminology harmonization:
  - **[LAST UPDATE]** Environment and Task are done. We might need to discuss Action again at some point because it is not finished yet.
- Focus on case studies to validate the vocabulary
  - **[ONGOING] Mohammed's**
  - Amelie
  - Chris
  - FAiNDER (a company) which would use our standard in a Humanitarian Robotics scenario (landmine detection)
- **[ONGOING]** Work on the draft for the standard
  - Howard has started filling up the draft's template that you can find on our drive. We have split sections, feel free to read it and choose a section to work on. Please, note that the most updated version is the .docx file, not the google doc.
  - Paulo is in charge of maintaining the stable version, should you have any comment or suggestion, please, prepare the text you want to add and present it during any group meeting. The changes will be updated during that meeting and they will be accepted during the next official meeting.
  - **[UPDATE]** During the last months, we discussed the content of sections 1, 2, 3, 4 and 7. Except from section 3, which needs more work, we agreed on the current content. We also talked about section 9, which is about the case studies, but this section will be addressed during September/October. In section 3, we discussed 'Interaction', 'Environment' and 'Situation'. We are currently discussing 'Function' and 'Behavior'.

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Copyright Policy (Howard)

Done.

Howard went through some slides about the copyright policy of IEEE. This policy is relatively large so we are not going to include all the material here, but two key points must be kept in mind:

- Anything (verbal or written) we discuss we need to make sure it has not copyright, if it has, we cannot discuss it during the meeting without official permission from the copyright holder.
- Whenever you bring some material to the group and it is discussed along with our meetings, you are granting the copyright of it to the IEEE. Either if you are the holder or your affiliation center is the holder. In the later case, you would need permission from your company or university. Note that when something which has copyright it is discussed during our meetings (sometimes permission would be needed), automatically, the copyright license will be granted to the IEEE. Note that anything developed during our group work, will have a copyright license owned by IEEE once the standard gets published.

Technical discussion

Topic: Work on the third section of the draft - Definitions - Focus on Function and Behavior

As a general reminder, note that this year we need a complete draft of the standard, then, we will have one more year to polish/validate it.

During last meetings, we discussed several aspects regarding section 3 of the standard, which is the section that will contain our proposed definitions. Specifically, the idea was to discuss those terms which are fundamental to our ontology. Interaction, Situation, Environment, Behavior and Engineering behavior, Function and Function execution (see the current definitions at the end of this section). Today, we focused on the ones that remain pending: Behavior, Function, and Function execution.

- [**Introduction**] During previous meetings, we discussed the term ‘Behavior’. Initially, Stefano tried to define behavior using a single term. However, it seems that the members of our group found it necessary to have more behavior-related concepts even though they are not reducible to a single ontological category. Hence, Stefano proposed a new approach, in which the class Behavior is a generic term without ontological commitment. Any concept that people call behavior, besides being classified in the

ontology, is also subsumed by this generic Behavior class. Then, we could have some behavior's classes: manifested, engineering, emergent, rule, architecture.

- [**Discussion about behavior**]
- Stefano went through all the definitions related to Behavior.
- **Maki** (about engineering behavior). Is this type of behavior capturing the meaning of the given values? **Stefano** said that this notion is only to represent the collection of data describing how the value of an object changes, not about judgements such as whether or not the values are acceptable/good/bad, etc.
- **Paulo** (about general notion of behavior). Why are you using 'none' as superclass for behavior and not event? **Stefano** said that the general class of Behavior is not an ontological class. Manifested behavior is what happens, Engineering is a representation of what happens, they have a different super-class, and the same happens with rule, emergent and architectural behaviors. Hence, we cannot put them all under the same entity. For that reason, Behavior is not an entity, but just a term that includes all the different views.
- **Paulo** (about engineering behavior). It is just a representation of a manifested behavior? [**Stefano**] Yes, you are correct. In my experience, engineers talk about the behavior of an object in terms of the expected value of the state of variables and how they change. That is why I called it 'engineering', but yes, it is a representation.
- **Paulo** (about behaviors in general). I want to define the behavior 'following a wall', which of the specializations should I use? Maybe rule or architecture? Then I could monitor state variables to check it. [**Stefano**] Let's imagine we have a robot following a wall. If we know that the robot is following some rules we can say that the behavior of the robot is rule-based, and if we detect a pattern (distance to the wall) we can say that the behavior is emergent, the behavior is happening so we can also call it as manifested, finally, there is a set of state variables about it (distance to wall, etc.) so it can also be seen from an engineering perspective. They are not disjoint classes, the user will use the one that is more suitable for them.
- **Paulo**. Rule behavior for me is a subclass of engineering behavior, don't you think? **Stefano** did not suggest that because the rule one is about what the robot would do, so it is not about something that is actually happening. As soon as we finish building a rule-based behavioral robot, the rule-base behavior exists, but if the robot cannot work (broken after building it), the manifested behavior, and thus, the engineering behavior will never exist. However, you are correct, there are relationships between them, for instance, the presence of an engineering or an emergent behavior indicates that there must be a manifested behavior. In these definitions we are not explicitly saying it yet, but in the axioms we will need to write these relationships.

- **Paulo**. If I write a finite state machine, changes in states of the machine, is that a rule behavior or an engineering behavior?, because it has changes in states. [**Stefano**], for me it is rule behavior.
- **Paulo**. Behavior representation instead of engineering behavior. [**Stefano**], for me it is ok to change the term is the conceptualization of it what really matters.
- **Maki**. Do not like representation, is an information behavior, collecting information about the states. But it is not making decisions about the data.
- **Maki**. Using engineering behavior like that we are pushing away the use of functions, it has not any outcomes, so it is not a function.
- **Maki**. Rule-based is always associated with outcome.
- **Stefano**. Engineering behavior there is only a list of variables with some values, there is not judgement, nor purpose. Rule behavior is just the list of rules. Any time you talk about purpose, that is a Function. When you have a behavior and you say that there is also a goal, and that you would like to know how close/far from the goal you are with this behavior, then what you are describing here is a function (role of a behavior).
- **Stefano**. I have a rule, 'to stay close to the wall', then we have a manifested behavior 'following the wall'. Then, consider that the robot is in a maze, and the robot wants to go out (goal), the behavior is allowing the robot to go out.
- **Paulo**. The purpose of a robot is the function, but I can change it over time.
- **Stefano**, the same behavior can play different functions. Let's consider a different function 'the robot comes to me and I am out of the maze'. Then, the same behavior works with both functions.
- **Maki**. Imagine that the rule behavior needs some information about state variables, then it is also an engineering behavior. [**Stefano**], no, for me the rule behavior is only the list of rules. Of course, you can say that having the rule behavior, if you want to see its manifested behavior, you will need an engineering behavior with the set of variables. You can also say that since you have some rules, you expect a specific change in the variables, but both are different things.
- **Paulo**. You have a robot with some type of capabilities and they could restrict the behavior. **Stefano**. You might have all the rules you want but the capability test of the robot is another thing. Every time you have a certain manifested behavior you must have the corresponding capabilities. We will take it into account.

- [**Discussion about Function and Function execution**]
- [Stefano] If we look at the robot and there is a manifested behavior that is facilitating the goal, then we call it a function, the same happens if that behavior hinders the goal, that is a function of another goal. For instance, behavior allowing us to go out of the maze, and behavior keeping us from going out of the maze.
- [Stefano] Function execution is the actual event related to the manifested behavior.

- **Maki**. Task vs function, how to differentiate them. [**Stefano**], I do not know, I have not any definition of task.
- **Ricardo**. How do you define role? **Stefano** said that role should be taken from the upper ontology. It does not make sense to define it here.
- **Ricardo**. Manifested behavior, why do not we also use desired behavior? Desired behavior is how you expect the variables to change, that is a judgement. Shouldn't we have two definitions? The expected and the manifested? Engineers also talk about functions in terms of expected behavior. [**Stefano**] I think that it is interesting, we could add it as a different class. Expected depends on an agent who expects. Hence, I would not include it in this set of definitions.
- **Ricardo**. I personally look for robots that are able to change their behavior to fulfill missions. [**Stefano**] Then, we would need to include a meta-agent that knows about itself.
- **Howard**. Are we happy with the definitions? [**The rest of attendees**] It seems we are ok, Stefano said that the only pending term would be 'Architectural behavior', we need to discuss it again after we have a definition of architecture. We all agreed on moving on to the next section of the standard, in a next iteration, we might work more on function and architecture.
- **Howard**. Stefano, you have modified your definitions during the last months, have you coordinated with Mohammed for the case study? [**Stefano**], no for a long time, but I am open to help him.
- **Alberto** will contact Mohammed about case study. He should review our current definitions.
- **Paulo** (about the term of action). Paulo sent an article about it one week ago. **Stefano** could not do anything about it yet, maybe after the middle of September.

- About the next section to discuss, Section 4 **Paulo** said that for sure, we will not discuss it next week. **Paulo** will coordinate with the rest of the members who are going to work on that section.
- Next week, we will probably discuss Section 7 (Howard will work on it).

NOTE: we write "object" to be general, the relevant cases are when objects are agents or devices.

############################
INTERACTION:
############################

DEF.
An INTERACTION is the combination of relationships holding between two or more objects during their participation in an event.

SUPERCLASS: Quality (of the set of objects)

Examples:
1) The book is on the table (interaction between the book and the table).
2) As Mary walked into the room the robot moved closer to her (interaction between Mary and the robot).
3) The robot detecting a crack in the pipe (interaction between the robot and the pipe).

Rationale: an interaction is among two or more objects and is the network of relationships that they manifest during an event. The very happening of the event grounds these relationships. Relationships can be of different types: relative movement, exertion of physical forces, exchange of information etc. but not negative. For instance, "the robot is not seeing (or cannot see) the mug" is not expressing a relationship relevant for an interaction. An interaction does not require goals, purposes or intentions.

[[NOTES FOR AUR (internal use only, to be deleted): the following was triggered by the need to separate explicit vs implicit interaction, it goes in a slightly different direction]]

DEF.
A DIRECT Interaction is an interaction in which there are direct exchanges of physical forces.
Example: a robot picking up a mug [this is a direct interaction between the robot and the mug during the picking up event].

DEF.
An INDIRECT Interaction is an interaction in which there are no direct exchanges of physical forces.
Example: a robot visually searching for cracks in a pipe [this is an indirect interaction between the robot and the pipe during the inspection event].

[[NOTES FOR AUR (internal use only, to be deleted): do we still want the following?]]

DEF.
A no-gap interaction is an interaction relative to an event spanning a convex time interval and without interruptions.
Examples:
1) The book is on the table.
2) A robot navigating from location A to location B without interruptions.

####################################
ENVIRONMENT
####################################

DEF.
The ENVIRONMENT of an object is a complex entity including the object itself, its internal parts, and all the entities (with their properties and relationships) that are in a delimited spatial region and temporal interval and that can potentially interact with the object during that period of time.
SUPERCLASS: Physical object

Example:
1) the environment of an industrial robotic arm is the area it can reach and the objects in it with which it can physically come into contact during the given temporal interval.
2) a robotic system composed of a rover and a drone has an environment that includes the environment of the rover and that of the drone.
3) a vacuum cleaner robot and a surveillance robot have different environments even when they are in the same location (say, the same a room) because they have different perception systems.

DEF.
The External Environment of an object is the environment of the object external to the object itself.

DEF.
The Internal Environment of an object is the environment of the object restricted to the object itself.

DEF.
The Environment Description of an object is the description that an object has of its environment.
SUPERCLASS: Information object

Rationale: the environment description of an industrial robotic arm is what the robot knows about itself, the area it can reach and the objects it detects (or is aware of) and with which it can interact. Two robots may have the same environment (if in the same location) but different environment descriptions as the latter depend on the robots' capabilities (e.g. perception, reasoning) and the robot's knowledge base.

DEF.
The External Environment Description (EED) of an object is the description that an object has of its external environment.

DEF.
The Internal Environment Description (IED) of an object is the description that an object has of its internal environment.

####################################
BEHAVIOR
####################################

DEF.
The BEHAVIOR of an object (usually agent or device) is an entity in one of the following classes:
Manifested behavior, Engineering Behavior, Emergent Behavior, Architectural Behavior, Rule Behavior
SUPERCLASS: none

[[NOTES FOR AUR (internal use only, to be deleted): is the list above ok, are other relevant notions missing?]]

DEF.
The MANIFESTED Behavior of an object is the combination of relationships that the object manifests with entities in its environment during an event.
SUPERCLASS: Interaction

Example: the car rattle when hitting the curve.

Rationale: the manifested behavior depends on the object's environment and is a restriction of the interaction in which the object participates. A manifested behavior is object-centred and does not depend on an observer.

DEF.
The ENGINEERING Behavior of an object is the description of the manifested behavior given by a set of state variables.
SUPERCLASS: Information object about an interaction

Example: the car vibration increases from X to Y in the first 5 seconds when the car hits a 90 degree curve at 30kmh.

Rationale: The engineering behavior provides an operational view of the manifested behavior as it requires to choose a set of relevant state variables and to focus on how their changing describes what happens.

DEF.
The EMERGENT Behavior of an object is the set of relationships chosen to describe the object relevant interactions.
SUPERCLASS: Information object about an interaction

Example: the robot moves away from any source of light.

Rationale: The emergent behaviour is the result of a choice of what to focus upon in the interaction at stake. The emergent behaviour differs from a manifested behavior because the latter considers all the relationships manifested by the object. The emergent behaviour differs from the engineering behavior because the latter fixes the set of state variables once for all, i.e., independently from the focused event.

DEF.
The RULE Behavior of an object is the set of rules and decision methods that an agent has and uses to decide its actions.
SUPERCLASS: Object

Example: the robot's behavior accords to the law's safety requirements.

DEF.
The ARCHITECTURAL Behavior of an object is the internal organization of the flow of information which determines the object's actions.
SUPERCLASS: Quality

Example:
1) the robot's behavior is deliberative.
2) the robot's behavior is reactive.

##
FUNCTION
##

DEF.
The FUNCTION of an object is the role that the manifested behavior of the object plays in an event.
SUPERCLASS: Role

Example: The robot is surveilling the area, it is sensing and analyzing the data. (The robot has the function to surveil the area by manifesting the sensing and data analyzing behaviors.)

Rationale: an object has a function in an event if its behavior causally contributes to the achievement of the function goal. A function needs a goal/task to be identified. Examples of functions are: acquisition of information (via sensing behavior), physical modification of objects (via force exertion behavior through actuators), object classification (via reasoning behavior), etc.

##
FUNCTION EXECUTION
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DEF.
A FUNCTION EXECUTION is an event in which the manifested behavior of an object plays a role with respect to a goal.
SUPERCLASS: Event

Example: the robot communicates its position. (The robot executes the function `making its location known' via a sending behavior where data are its coordinates.)

[[NOTES FOR AUR (internal use only, to be deleted): These definitions are based on discussions in the AUR group and a series of papers that I wrote with several collaborators. Feel free to use these def.s, for references here are the works on which they are based upon:
1) Borgo, S. (2019). An ontological view of components and interactions in behaviorally adaptive systems. Journal of Integrated Design & Process Science, 23(1):17–35.
2) Mizoguchi, R., Kitamura, Y., and Borgo, S. (2016). A unifying definition for artifact and biological functions. Applied Ontology, 11(2):129–154.
3) Borgo, S., Cesta, A., Orlandini, A., and Umbrico, A. (2019). Knowledge-based adaptive agents for manufacturing domains. Eng. Comput., 35(3):755–779.
4) Borgo, S. (2014). An ontological approach for reliable data integration in the industrial domain. Computers in Industry, 65(9):1242–1252.
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Next meeting's topic: nomination of presentation

- [Next weeks] Standard draft: sections 7 and 4

New business/announcements/events/last thoughts

- Found Patent from Magazino (see here) - Howard working on it
- Next official meeting for October 2

Close meeting (Howard)

Adjourned 2:30 PM UTC