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Datasheet for the decision of 29 October 2025

Case Number: T 1763/23 - 3.5.06

Application Number: 16801977.6

Publication Number: 3538327

IPC: B25J9/16, G05B19/418, G06F9/44

Language of the proceedings: EN

Title of invention:
A METHOD FOR DETERMINING POSSIBLE TRANSITIONS OF SYSTEM STATES

Applicant:
ABB Schweiz AG

Headword:
Compositing FSMs/ABB

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no)

Decisions cited:

Catchword:

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0

Case Number: T 1763/23 - 3.5.06

D E C I S I O N
of Technical Board of Appeal 3.5.06
of 29 October 2025

Appellant: (Applicant)
ABB Schweiz AG
Bruggerstrasse 66
5400 Baden (CH)

Representative:
Kransell & Wennborg KB
P.O. Box 27834
115 93 Stockholm (SE)

Decision under appeal:
Decision of the Examining Division of the European Patent Office posted on 15 June 2023 refusing European patent application No. 16801977.6 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman M. Müller
Members: T. Alecu
K. Kerber-Zubrzycka

Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division to refuse the application for lack of inventive step. The decision cited documents:

D1: WO 01/38978 A1
D2: US 2015/018977 A1
D3: Seshia Sanjit A.: "Introduction to Embedded Systems, Chapter 5: Composition of State Machines", Lecture slides for class EEGS 149/249A at the UC Berkeley, Fall 2015.

II. The Appellant requested that the decision be set aside and that a patent be granted on the basis of the main request (filed on 17 November 2021), which is the one underlying the decision, alternatively based on auxiliary request 1a (filed with letter of 18 September 2025), or on one of the first to third auxiliary requests (filed with the statement of grounds of appeal on 25 September 2023), or on auxiliary request 4 (filed with letter of 18 September 2025).

III. The decision was taken in oral proceedings.

IV. Claim 1 of the main request defines:

A method for determining possible transitions of system states in an industrial system (10) with a plurality of agents (60, 70) with discrete agent states, wherein the method comprises the steps of:
- defining a plurality of rules (R), each rule (R) comprising a pre-condition of at least one agent state that is to be changed, a post-condition of the at least one agent state, and an action or actions (130)

resulting in a corresponding transition of the at least one agent state;
- defining a plurality of nodes (90), each node (90) comprising a system state;
- evaluating for a plurality of pairs of nodes (90), whereby one node (90) of each pair acts as a pre-condition node (90) and the other node (90) of each pair acts as a post-condition node (90), whether the pair can, given the rules (R), be directly connected by means of an edge (100), each edge (100) comprising an action or actions (130) required for a transition between the respective pre- and post-condition system states; and
- controlling the industrial system (10) based on determined direct transitions between the system states.

V. Claim 1 of auxiliary request 1a differs from that of the main request by defining a system state as follows:

[...] *each node (90) comprising a system state* *<u>expressed as a combination of all agent states</u>*; [...]

VI. Claim 1 of the first auxiliary request differs from that of the main request defining an automatic evaluation step:

[...] <u>automatically</u> evaluating for a plurality of pairs of nodes [...]

VII. Claim 1 of the second auxiliary request differs from that of the main request by amending the evaluation step as follows:

[...] *evaluating for <u>all</u> pairs of nodes (90) <u>existing in the industrial system</u>, whereby* [...]

VIII. The third auxiliary request combines the amendments of the first and second auxiliary requests.

IX. The fourth auxiliary request combines the amendments of the third auxiliary request with those of auxiliary request 1a.

Reasons for the Decision

The application

1. The application relates to control of industrial systems comprising a plurality of agents, using finite state machines (from here on: FSM). Each agent is assumed to have a finite number of discrete states. One example is an industrial robot with two arms: each of the arms can be in a limited number of different states, for instance "empty" or "hold an item" (bottom of page 5).

1.1 According to the application such systems are difficult to program, in particular if multiple collaborative robots are used, inter alia because of the vast number of incorrect states and error cases that need to be handled (page 1).

2. The application proposes to pre-determine the possible direct transitions between system states, defined e.g. as combinations of all agent states (page 6, lines 9-10). Rules governing the changes between agent states, which are caused by actions, are defined by a programmer (page 7, from line 15), based on the specific hardware constraints and the given tasks (page 8, bottom).

2.1 It is then determined according to these rules which system state transitions are possible. This helps the developer to identify states in which the system might get stuck (page 10, lines 11 to 16), and also to optimize "preferred chains of transitions" (see top of page 15).

Main request

3. The Examining Division considered two different starting points (D1 and D2) for their analysis of inventive step.

4. D1 and D2 disclose systems modelled as one or more FSMs, each, as usual, behaving according to a set of rules (see D1 pages 39 and 40, but also sections 6.5 and 6.6 on pages 53 to 55; D2 see abstract, paragraphs 5 and 6, and figure 6). The rules define the transitions from one state to another upon certain (inputs or events). The term "agent" is not specifically used in these documents, but is - in the Board's view and as the Examining Division also considered - disclosed by the "objects" of D1 and the "software modules" of D2 (see decision at 2.1.3 and 2.2.2).

5. In the Examining Division's view, the transitions between agent states in D1 and D2 were also transitions between system states, notwithstanding the fact that "system states" were not explicitly defined (see e.g. the decision at 2.1.2 and 2.1.5).

6. The Examining Division accepted that a difference existed between the agent states and the system states in that "*redefining the state machine based on system states is more than just aggregating the agent state*

machines as it occurs in D1 and D2" (decision, points 2.3 and 2.5).

6.1 This difference however amounted merely to a different mathematical formulation as it did not produce any technical effect: "*establishing the system-wide state machine according to the rules will yield the exact same input-output behaviour as leaving the individual agents to determine control actions based on their individual state machines*" (decision, points 2.4 and 2.5).

6.2 Further, the specifically described manner of combining FSMs was anyway generally known, as evident for instance from D3 (decision, point 2.5).

The Appellant's arguments

7. The Appellant disagreed that the claimed system FSM will behave as that of the prior art, because its states and transitions were different. The differences also resulted in technical effects.

8. Each of the nodes of the system FSM expressed a combination of all agent states. Even if claim 1 did not state this explicitly, this was clear when interpreting the claim in view of the description - where system states were always defined this way.

8.1 This meant a very large number of system states. The potential number of transitions was also very large. Taking the example of a two-agent system, depicted in figure 2a and explained on page 10 of the description, with respectively three and four states (table 1 in the description), the system would a priori have 3*4 = 12 states and 132 transitions. But not all theoretically possible transitions are *actually* possible. The invention enabled the automatic determination of all *actually possible* transitions between system states.

8.2 To this end, the claimed evaluation step took into consideration not only the rules for the individual agents, but also those relating to the interaction between agents (as exemplified in figure 2a). This was, for the person skilled in the art, implicit in the claimed wording "*evaluating [...] whether the pair can, given the rules (R), be directly connected*".

8.3 In D1 or D2, aggregating the agent-level FSMs would lead to a system-level FSM which was a straightforward mapping to system level of the agent states and their rules. The system states so-obtained would not be combinations of all agent states and the transitions would not consider interaction or cooperation between agents.

9. The advantages of the invention were thus clear: it could identify direct transitions between states in a better way than the prior art, and, by providing a better representation, it could be used to identify a better chain of transitions from one initial state to a desired state. One could also identify undesirable states. The difference was therefore not merely a mathematical formulation, but it made possible to obtain a better system.

10. Regarding obviousness, the Appellant conceded that document D3, to which the Examining Division and the Board referred, showed a system where the nodes were combinations of agent states, but stated that D3 did not disclose any rules and did not explain how the evaluation of the possible transitions took place.

Therefore, the person skilled in the art would not arrive at the invention even in view of D3.

The Board's opinion

11. The Board remarks that some of the features of the invention on which the arguments of the Appellant rely are not part of the claimed invention. This is the case at least for any matter related to cooperation between agents or combination of rules.

12. The claim refers to a pre-condition and a post-condition of "at least one agent state" and therefore, literally, only requires rules for individual agents. Rules regarding agent interaction or cooperation are not required. This interpretation is consistent with the description which, while disclosing rules involving multiple agents, also discloses rules involving only individual agents. The description does not disclose as mandatory the use of rules requiring cooperation between agents.

13. More importantly, the same holds true for the claimed evaluating step. The phrasing "*evaluating [...] whether the pair [of nodes] can, given the rules (R), be directly connected*", does not imply that the system *must* consider interaction or cooperation between agents as a condition on whether nodes can "*be directly connected*".

13.1 An evaluation where, for each considered pair of nodes, the rules are verified *only* for individual agents and a direct connection is established if (and only if) it corresponds to individual agent rules falls under the scope of the claim.

13.2 Also consulting the description does not lead to a different interpretation. Specifically, individual examples in the description where two nodes are connected based on a combination of individual rules do not imply that the term "can be directly connected" has to be interpreted as requiring the combined evaluation of several rules.

14. As discussed above, D1 and D2 disclose rules and FSMs for individual agents. In order to model the behaviour of a system comprising multiple agents, the individual FSMs have to be combined.

14.1 In some cases, the individual FSMs may simply be "aggregated", i.e. connected to each other in an ad-hoc manner, and the system states will reflect in essence individual agent states (referred to as a "straight-forward mapping" in 8.3 above; see, for instance, figure 10 of D1).

14.2 A more formal approach is based on considering all possible combinations of states of the individual sub-systems, and defining each system state as a combination of individual agent states. This is what the Examining Division termed the "Cartesian approach", and it is indeed a well-known approach, as evidenced by D3 (see the definitions on slides 5 to 7, and the example on slides 8 and 9).

14.3 Whichever the approach, when the system FSM is created, it will contain transitions reflecting the actions of individual agents and the associated rules (see again for an example D3, slides 8 and 9). The connections in the system FSM so-obtained will be created by "*evaluating [...] whether the pair can, given the rules*

(R), be directly connected" (see interpretation in 13 above).

15. The Board therefore agrees with the Examining Division and concludes that claim 1 lacks inventive step starting from D1 or D2 in view of the common general knowledge in the art (for instance as evidenced by D3).

15.1 The Board understands that the Appellant intended to seek protection for a different method which would provide advantages for modelling more complex systems. But the claim is too general to imply such a method.

Auxiliary requests

16. The same conclusion applies to the auxiliary requests.

16.1 The amendment introduced in the auxiliary request 1a is already considered in the analysis above (see 14.2).

16.2 The one introduced in the first auxiliary request requires automation, which is a common desideratum and therefore obvious *per se*.

16.3 Regarding the amendment introduced in the second auxiliary request, the Appellant argued that D3 did not show that an evaluation was carried out for all pairs of nodes. In the Board's view, this is at least an obvious option. When all possible combinations of states are considered, it is obvious to consider all possible connections as well.

16.4 A combination of amendments as carried out in the third and fourth auxiliary requests does not change the above assessment.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Stridde Martin Müller

Decision electronically authenticated