

Interoperable Rule-based Alert Management for Patient Telemonitoring

Citation for published version (APA):

Khanshan, A., Van Gorp, P., & Markopoulos, P. (2024). *Interoperable Rule-based Alert Management for Patient Telemonitoring*. Poster session presented at Healthy Heart @ Home Symposium, Eindhoven, Netherlands.
<https://doi.org/10.13140/RG.2.2.22473.11367>

DOI:

[10.13140/RG.2.2.22473.11367](https://doi.org/10.13140/RG.2.2.22473.11367)

Document status and date:

Published: 08/02/2024

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/378078309>

Interoperable Rule-based Alert Management for Patient Telemonitoring

Poster · February 2024

DOI: 10.13140/RG.2.2.22473.11367

CITATIONS

0

READS

36

3 authors:



Alireza Khanshan

Eindhoven University of Technology

14 PUBLICATIONS 47 CITATIONS

SEE PROFILE



Pieter Van Gorp

Eindhoven University of Technology

111 PUBLICATIONS 2,461 CITATIONS

SEE PROFILE



Panos Markopoulos

Eindhoven University of Technology

458 PUBLICATIONS 7,924 CITATIONS

SEE PROFILE

Alireza Khanshan
Industrial Design Department of
Eindhoven University of Technology,
Eindhoven Artificial Intelligence
Systems Institute
Eindhoven, Netherlands
a.khanshan@tue.nl

Pieter Van Gorp
Industrial Engineering Department of
Eindhoven University of Technology,
Eindhoven Artificial Intelligence
Systems Institute
Eindhoven, Netherlands
p.m.e.v.gorp@tue.nl

Panos Markopoulos
Industrial Design Department of
Eindhoven University of Technology,
Eindhoven Artificial Intelligence
Systems Institute
Eindhoven, Netherlands
p.markopoulos@tue.nl

Abstract

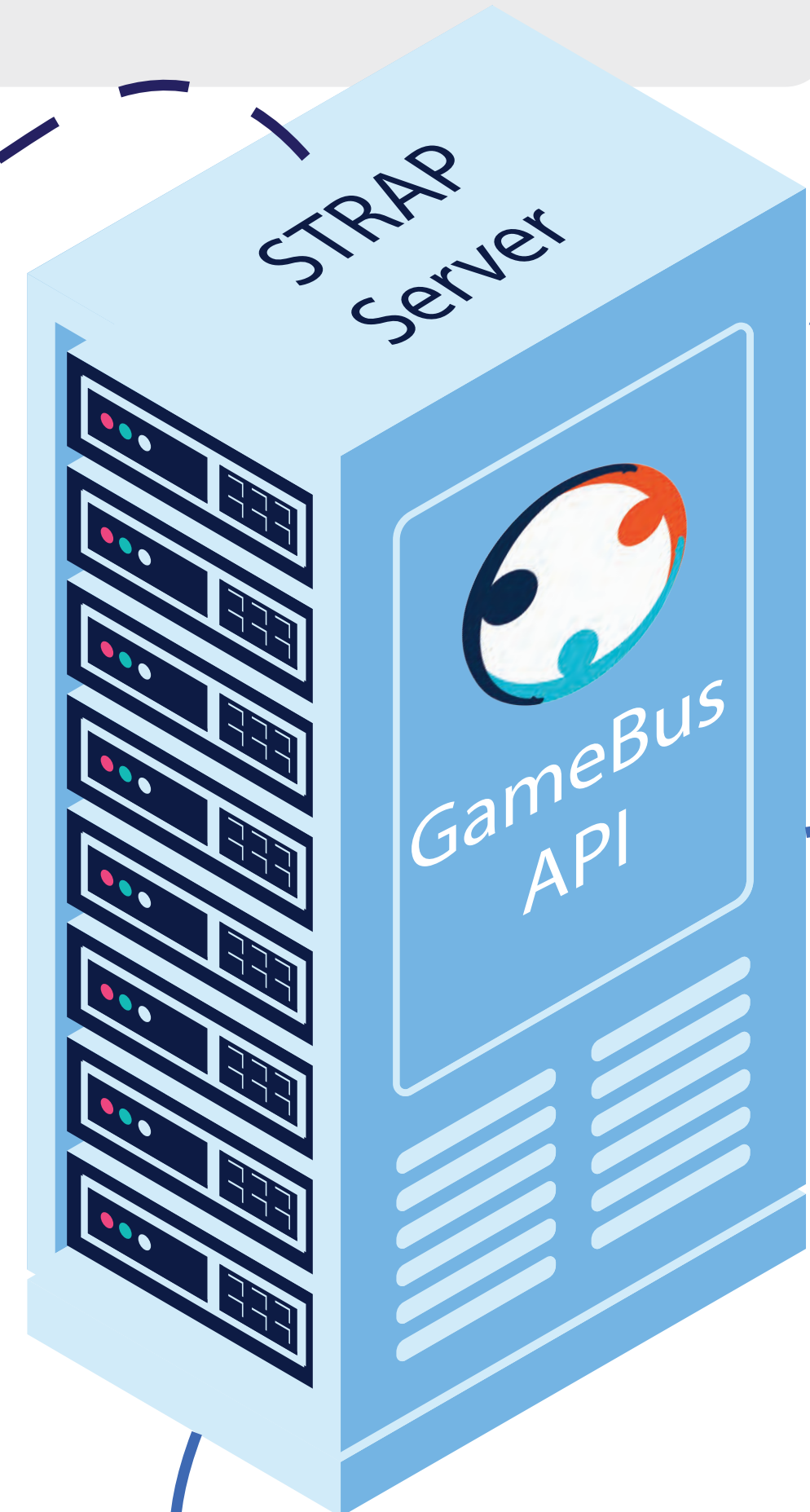
This poster showcases the use of JSON structure to create software rules based on expert knowledge to generate alerts based on patient data. We utilize JsonLogic to implement such rules. The JsonLogic format is designed to allow you to share rules (logic) between front-end and back-end code (regardless of language difference), even to store logic along with a record in a database (<https://jsonlogic.com/>).

We expanded the functionality of JsonLogic by adding custom operators enabling advanced data processing and analytics. The following system is designed in the context of the assessment of the feasibility of recommending diuretics to heart failure patients, based on monitoring weight, blood oxygen saturation, blood pressure, and self-report by patients.



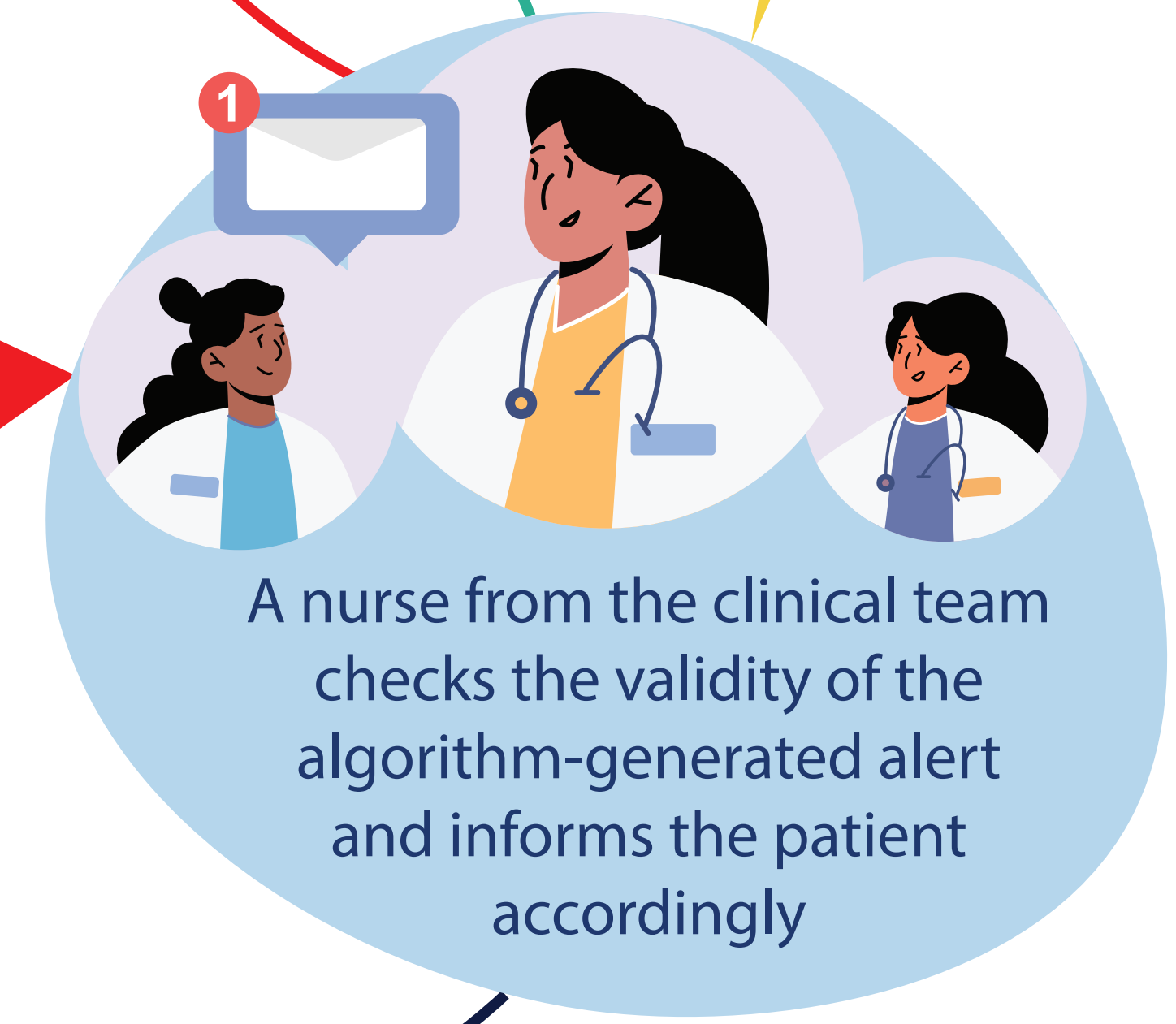
The nurse dashboard signifies whether a task is already picked up by another nurse and in which stage the procedure is

STRAP (Self-TRACKing for Prevention and diagnosis of heart disease) is an NWO funded project in response to acute needs in cardiac care as these were experienced in cardiology clinics, combined with the gradual commodification of health tracking technologies



Alert! Patient might require a boost of diuretics

Review Patient Data programmatically based on pre-defined rules



A nurse from the clinical team checks the validity of the algorithm-generated alert and informs the patient accordingly

Nurse feedback and interaction is stored for future analysis/learning

An Example



I want to be notified if our patient has gained weight over 2 kilos in the past 30 days

Transformation from natural language

```
if {current weight} - min(weights in past 30 days)
  >= 2
  then
    make an alert!
```

1. Primitive operators like if, -, >=, and min already exist in JsonLogic
2. Fetching current weight, list of weights in the past 30 days and making an alert require custom expansions

Transformation to JsonLogic



The same technique can be applied in a variety of other use cases. New JsonLogic rules can help analyze other sensor types. For example, to make an alert when blood glucose level passes a threshold. Such alerts, integrated within GameBus can result in positive and negative points. In turn, these points can enable gamification techniques on top of JsonLogic rules.

```
{
  "if": [
    {
      ">=": [
        {
          "-": [
            {
              "getGameSessionPropertyValue": [
                "SCALE",
                "WEIGHT",
                [
                  "APPROVED_BY_PATIENT",
                  "=",
                  "YES"
                ]
              },
              [-1]
            ]
          ]
        },
        {
          "min": {
            "getGameSessionPropertyValues": [
              "SCALE",
              "WEIGHT",
              [
                "APPROVED_BY_PATIENT",
                "=",
                "YES"
              ]
            ],
            [
              "created_at",
              ">=",
              {
                "manipulateDate": [
                  {
                    "getCurrentDate": []
                  },
                  -30,
                  "day"
                ]
              }
            ]
          }
        ]
      ]
    }
  ]
}
```

Benefits

- Due to the rapid prototyping nature of our project and many change requests for updating the algorithm, JsonLogic allowed such updates and changes by just updating a JSON resource file without modifying the API's body of code.
- Currently, our JSON resource is bundled within the compiled Java binary; however, it can also be externally served, eliminating the necessity for recompilation and redeployment.
- Same logic can be evaluated in different programming languages

Limitations

- Debugging JsonLogic can become difficult especially when dealing with built-in operators.
- The custom operators are not necessarily interoperable and need to be reimplemented in the destination programming language and imported accordingly