Proposal and Validation of a Domaine Specific Language for the Representation of the AGGIR Constants

José Manuel Negrete Ramírez[1], Philippe Roose[1], Marc Dalmau[1] and Michel Bakni[2]

[1]*Université de Pau et des Pays de l'Adour, IUT de Bayonne - LIUPPA, Anglet, 64600, France*

[2]*Université de Technologie Belfort-Montbéliard, Belfort cedex, 90010, France*

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Abstract: In this paper, we propose a Domain Specific Language (DSL), and we focus on the AGGIR (Autonomie Grontologie Groupes Iso-Ressources) grid model, in order to exploit the variety of interaction capabilities according to the performanceto current activities, users, and context over the time domain. Our aim is providing an analyis tool regarding the coherent behaviour of elderly/handicapped people within a home environment by means of data recovered from sensors using the iCASA simulator. For the DSL validation, we particularly focus on three of the AGGIR variables: dressing, hygiene and transfers; by evaluating their testbility in many scenarios, especially the abnormal ones, which contain readings representing the occurrence of accidents or unexpected behavior of the elderly, in order to see the ability of the system to understand the obtained records correctly and thus generate the appropriate event information.

1 INTRODUCTION

Due to the increase of aging population and the necessity to avoid expensive hospital-based health care (Zhang et al., 2005) for this sector, reducing medical costs and improving quality of care service (Varshney, 2003) have become in recent years a need for new care delivery mechanisms ans structures (Boulos et al., 2009).

The present article aims to achieve the monitoring of a person within a smart home environment to verify and to detect possible anomalies related to his coherent behaviour. To achieve such a goal, we will identify the activities performed by the inhabitants over a certain period of time, by means of collection and analysis of data obtained from sensors located in the sourroundings of the aforementioned environment.

In order to address such a task, we define a Domain Specific Language (DSL) which will permit to perform the analysis of the collected data.

Moreover, this DSL will be able to recognise a categorisation of activities based on the constants of the AGGIR (Autonomie Gerontologie Groupes Iso-Ressources) grid (Vetel, 1994), (which classifies autonomy levels to various environmental factors affecting a the activities and social life of a person). AGGIR is currently the legal tool in France for measuring the autonomy of the elderly.

The main objective of this paper is to present a DSL which will allow to express these constants and the activities composing the AGGIR grid. For this matter, we intend to use a representation in the form of a plot, which will help providing a history for detecting abnormal behavior of the inhabitants.

A validation will also be considered. Three constants from the AGGIR grid (transfer, hygiene and dressing) will be represented. In our validating scenario, we collect information from sensors located within a simulated environment with the aid of iCasa (Lalanda et al., 2014), by means of a data file returned by a simulation run from this tool, such as location of the inhabitant(s), date and time, among others.

2 STATE OF THE ART

The development of an intelligent indoor environment that is both context-aware and interactive is the main goal of research. In this regard, we present the basis on which this paper is based; this includes a mechanism for classifying wireless sensors. In addition, an introduction of a standard, locally developed in France, to calculate the level of autonomy is introduced.

The work of Li et al. (Li et al., 2016), suggests a classification of smart houses. According to this clas-

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sification, three generations of home automation have already existed, the first generation depends on wireless technology and a proxy server approach. The introduction of artificial intelligence marks the start of the second generation, a totally new context-aware environment was achieved. The current generation is the third one, it can be distinguished by its interactivity, the environment both understands and interacts with the needs of the user.

The work of Liau et al. (Liau et al., 2008) studies Home Automation System (HAS), although it concentrates on developing a tracking indoor system, it shows the importance of using a grid of sensors and controllable actuators in order to create active context-aware services.

Despite significant progress in this domain, the absence of a standard wireless sensor categorisation is a major problem; as stated by Arora et al. (Arora et al., 2004). Their approach employs phenomenology to establish a set of essential features that distinguish the values that are measured, which leads to categorising sensors into six groups: optical, mechanical, thermal, electrical, magnetic, and chemical.

The integration of eHealth (Arning and Ziefle, 2009) within smart environments will create a safe and intelligent environment for the disabled and the elderly, the main challenge is to determine the level of dependency of the beneficiaries, which will help reducing the economical impact to governmental institutions on this matter.

In France, an autonomy assessment tool was locally devolved under the name: Autonomy Gerontology Iso-Resources Groups (Autonomie Gérontologie Groupes Iso-Ressources (AGGIR)), it is based on a standard adopted by the French government in 2008 (dec, 2008). The AGGIR grid (Roudier and Al-Aloucy, 2004) is a six-level scale (GIR1 to GIR6), these dependence levels can be defined based on set of seventeen three-state variables. Each variable can have one of these values: **A** for complete dependency, **B** for partial dependency, and **C** for complete independency. The variables are classified into two groups: discriminatory and illustrative variables. Table 1 provides an overview for those variables previously mentioned.

3 DOMAIN SPECIFIC LANGUAGE

In this section, we will make a brief presentation of the proposed DSL. After that, we will show how can DSL be used to describe the events that are sensed by the sensors within a specific time range.

Table 1: AGGIR discriminatory variables.

Discriminatory Variable	**Evaluated Concept**
Coherence	Logical and sensible behavior
Location	Place and time recognition
Toileting	Body toileting
Dressing	Body dressing
Self-feeding / Alimentation	Self-Serving and eating
Elimination	Hygiene management
Transfers	Basic movements abilities
Indoor movement	Need of technical assistance
Outdoor movement	Need of technical assistance
Distant communication	Use tele-communication technologies

We propose a Domain Specific Language (DSL) in order to express to situations related to the AGGIR constants that respond to the activities performed by people with a physical or mental disability, support for elderly, diseases connected to aging; which will allow to express situations related to the maintenance of people at home (Ramírez et al., 2016); due to the fact that domain specific languages are recognized as an effective manner to increase the productivity and quality of software development [1].

Depending on both the scope and the user community it targets, there exist several definitions for a DSL (Mernik et al., 2005; Consel, 2004; Van Deursen et al., 2000). The language must be able to describe the data that one wishes to recover from the various sensors present in a house and the operations related to them.

We propose to represent the DSL by means of a graphical user interface (GUI), in order to describe complex events. In this context, a complex event is considered as an activity performed by an inhabitant that is detected by several sensors at the same time. We consider that a graphical DSL would be easier to handle than a textual language, since the the future user might not be necessarily a person who is acknowledged in the programming field.

We propose to represent activities performed by the elderly or handicapped people within a home environment, for this reason it is imperative to be aware when such activity takes place, as well as if there exists repetition or periodicity during the interval of its performance. By implementing such a metholody, we intend to detect anomalies on the behaviour of the inhabitants, so we can assure coherence of the activities on their daily living.

The textual specifications generated by DSL Graphical User Interface (GUI) can be used to describe events from an operation perspective. Such as an operation is measuring one of the following options: a value, a maximum or minimum value, an average of a

[1] http://www.dsmforum.org/

set of values, or graphically displaying measured values within a time domain. The operations described below were employed for developing the aforementioned interface:

- The `Value` operation: which returns the value (s) of the device
- The `Maximum` operation: which returns the maximum value of the value (s) of the device
- The `Minimum` operation: Returns the minimum of the value (s) of the device
- The `Average` operation: which returns the average of the value (s) of the device
- The `Graphic` operation: returns a graphic with the value (s) of the device

In addition, there are multiple possibilities to describe time using DSL. This includes determining a specific date or description of a time range starting from a particular date or between two-time points representing the beginning and end of the domain. The specified time points can be either a date for a day or hours within a day:

- The operation `Value` can be calculated for the values:
  - On a specific date
  - Between two hours
  - Between two dates
  - From a specific date
- The operations: `Maximum`, `Minimum`, `Average`, `Graphic`, will be calculated for the values:
  - Between two dates
  - From a date
  - Total (all available values for the device)

After selecting the operation as well as the desired calculation means, it only remains to specify the date or the time according to what has been previously selected.

Moreover, the feaures presented on the DSL are:

- When a device is placed on the manager, the different operations which are available for it will appear.
- Depending on the operation that has been chosen, several options will be displayed in order to select a suitable means for the calculation.
- Once the previous step has been completed, it will be possible to select the parameters for the calculation
- When all the choices have been made, a summary will be shown on the DSL manager interface; right where the parameters were previously displayed. All that remains is to validate the choices that have beeen made.

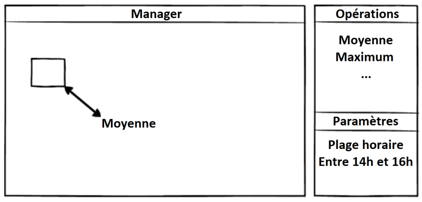

Figure 1: Display of results.

- The result will be displayed in different manners, depending on the operation and the selected parameters (Fig. 1).

For this previous matter, the general formula for describing an event determined by a sensor $<v1>$ that measures an operation $<v2>$ created by person $<v3>$ activates on date $<v4>$ within a specified time range specified using the hours $<v5>$ and $<v6>$ is:

$$Dispositif<v1>operation<v2>Personne<v3>$$
$$Date<v4>Heure1<v5>Heure2<v6>$$

If the variable $<v2>$ is selected to be the *Graphic* operation (`Graphique`) or the *Average* operation (`Moyenne`), then an additional option must be selected, it represents the time unit in which the results need to be displayed, and the formula takes the following form:

$$Dispositif<v1>operation<v2>TypeOperation$$
$$<v3>Personne<v4>Date<v5>Heure1<v6>$$
$$Heure2<v7>$$

The textual information present in the result can be saved in order to be reused, and thus facilitating to find the analysed data without performing any manipulation once again, as shown below. It allows its reusability by different context-aware applications, thus, not being limited only to the AGGIR constants.

```
Dispositif[EMGSensor-11917ef4c0] Operation[Graphique]
TypeOperation[horaire] Personne[aucune]
Date[25/04/2017] Heure1[11] Heure2[13]
```

3.1 Sensors

With regard to identification of activities of daily living (ADL) by means of several sensors for providing non intrusive monitoring, we propose a group of sensors that can describe such activities. Those ones are enlisted in Table 2, where some examples of their use are proposed. Additionally data attributes and data types for each sensor are indicated.

Additionaly, relevant data for each performed task by the inhabitants is considered, in order to obtain information to achieve the identification of the AGGIR constants after every activity has been carried out to completion.

The above-mentioned data is represented on Table 3. Such data collection is necessary to keep history of

Table 2: Activity recognition.

Sensor type	Attributes / Data type
Electromagnetic sensor (*Examples*: Cooker/Stove, oven, light switch)	On–Off / `Boolean`
Proximity sensor (*Example*: Sink)	On–Off / `Double`
Capacitive sensor (*Examples*: Kitchen counter, chair).	On–Off / `Boolean`
Magnetic sensor (*Examples*: Refrigerator door, cupboard doors).	Open–Close / `Boolean`
Presence sensor	On–Off / `Boolean`

all the activities performed by the inhabitants, by means of a log file which will be able to precise whether an activity begins or ends, helping to manage which activity has begun, or which activity has already ended; as well to specify if an activity has already begun, while in the meantime, there is another one that occurs at the same time and/or that has not been finished yet.

Table 3: Additional data for each activity.

Extra data type for each task	Data type
startTime	`Date` / `String`
endTime	`Date` / `String`
Duration	`Integer` / `Double`
Location	`String`
Day	`String` / `Integer`

Furthermore, the created history log file will consider the logical aspect to describe situations, i.e, if the inhabitant is eating and its noon, it might seem logical, but the fact that the inhabitant eating in the toilet is not logical.

The proposed criteria to determine the parameters for the example of the precedent paragraph, are: time and space, and within the time dimension, we can also find (i) Concurrency: for recognizing activities which take place simultaneously, but they do not necessarily require the user's interaction at the same time. That is, activities that have been started but not yet ended by the inhabitant (Helaoui et al., 2011). (ii) Precedence: for establishing a logical order of the activities, i.e. going to the bathroom; and then washing his hands. (iii) Simultaneity: for identifying which activity takes most of the time from the user, when multitasking capabilities might be present, i.e. preparing meal and calling on the phone; or watching television while eating. (iv) Recurrence: for determining a logical sequences of situations.

In the case where there is a recurrence of an activity, it is essential to define at what this activity is carried out regularly; i.e., the fact that someone eats ten times in one day can not be considered very coherent.

Besides the explanation given in the previous paragraphs, it is possible to have situations that are not logical; one activity after another one that is not considered normal, i. e.: do the dishes and then eat.

As a result, the history log file is necessary to deduct the possible activities which will be performed in the future, and to find a relationship among them to assure a coherent behaviour. Such a file will permit to obtain information whether it is from long or short periods of time (i.e. one hour); making possible the identification of complex situations such as displacement inside the home environment, where data collected through the timeline of activities is useful to determine if the behaviour of the inhabitant can be considered as normal.

The main objective is to present a DSL which will allow to express the constants and the activities composing the AGGIR grid. For this matter, we intend to use a representation in the form of a plot. Moreover, this plot will help providing a history for detecting abnormal behaviorhealth status of the inhabitants, as shown on Fig. 2. The validation and representation are described in the next section.

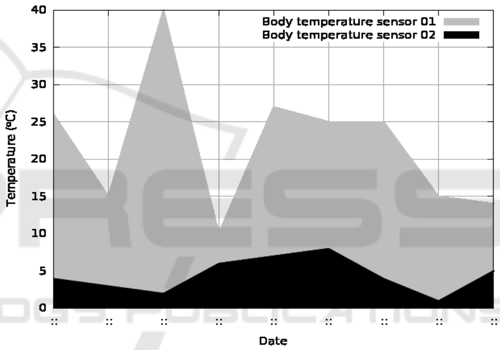

Figure 2: Saving of results.

4 REPRESENTATION AND VALIDATION OF THE DSL

4.1 Methodology and Criteria

This section is dedicated to discuss the methodology and criteria used to gather and analyze information. Firstly, we explain the structure of information collected from the wireless sensor network. Secondly, we explain the mechanism used to analyze the information using DSL to describe events. Finally, we show how to apply the previous criteria to calculate the values of variables in the AGGIR grid.

4.1.1 AGGIR in-depth and the Complex Activity Detection

AGGIR is an assessment system used to determine the Autonomy of individuals by measuring a number of capacities and possibilities by means of describing their existence in terms of fully or partially present or nonexistent.

The system measures seventeen variables divided into two groups, the first is called the discriminatory, it includes ten variables: Coherence, Orientation, Toileting, Dressing, Hygiene, Alimentation, Transfers, movements (indoor, outdoor) and distant communication. As for second Group, it is called the illustrative, it contains seven variables as follows: Management, cooking, Housekeeping, transportation, Medical Purchases, Medical treatment and leisure activities.

In the following set of experiments, three variables are concerned, they are Dressing, Hygiene and Transfers. Dressing variable assesses the ability to wear clothing, upper and lower parts of the human body. Hygiene variable monitors an elderlys ability to maintain his personal hygiene. Transfers variable measures the possibility of getting up, lying down and sitting, as part of daily activities.

The difficulty in determining the values of these variables in a simulated environment lays in the variables' nature itself. While some can be measured directly, such as sitting or lying down, some of them, such as hygiene, have a complex context to determine, based on the values of a number of sensors within a limited time range.

The importance of DSL is shown in determining complex events. It has the potential to describe events that can be indirectly observed in the time domain. The ”indirect” term in this context means that there is no sensor to measure value immediately, but it rather refers to collecting and analyzing the readings of a number of sensors to calculate a value associated with a complex event.

For example, personal hygiene is a complex event. It is associated with a number of simple activities that are performed within a limited time range, such as bathing, toilet use, and hand hygiene. There is no standard approach to measuring such things, but it can be estimated on average according to the existing routines of elders.

4.1.2 Proposal

The proposed methodology is described in the next paragraphs:

Step 1. The first step is to prepare the scenario for an elderly indoor daily routine over the course of one week. The primary source of information used to generate the scenario is the schedule proposed by the work of (Yuan and Herbert, 2014) (Fig. 3), but many modifications take place in order to make the scenario more suitable for the simulation. However, the XML format is used to describe the scenario programmatically. By means of XML, it is possible to describe events chronologically so the simulator can process these files. Even though writing scenarios using XML might seem impractical, we suggest this format in order to develop the DSL appropriately.

Step 2. After the simulation is done, the simulator organizes the resulting data into a set of records, each of which represents an action captured by a sensor (Fig. 4). Each record consists of data fields, such as the time it occurred (according to the simulator clock), the sensor ID and the sensed value. These are raw data and need to be analyzed in order to generate events and then calculate the values of the variables.

Step 3. The next step is to generate events. An event is a composite act that is observed using more than one sensor, which means that an event has more than one record in raw data. The DSL is used to provide an accurate and unified description of the events.

To illustrate this, we offer a typical example of an event related to hygiene: when the toilet is used, the inhabitant should wash his hands after such an action is finished. This is an event related to personal hygiene. In order to analize this event, the records created by the presence of the sensor in the bathroom, along with those ones issued by the use of the toilet flush and the washbasin, must be examined.

Because of the nature of the AGGIR variables, there is an urgent need to set up a criteria to be applied to generate the analysis of such events. If such criteria is met, then the so-called variable will take a positive value that means the elderly has the ability to perform the activity/event that is being evaluated; otherwise, it means that the individual does not have the ability to carry out suach a task.

Although every variable in the AGGIR grid are based on three major states, which state that the elderly can either possess the ability to perform the activities concerning one variable, whether it is completely, partially or does not possess it at all; this study covers a proposition where only two cases out of three AGGIR variables are accomplished by the inhbitant, meaning that whether they are in complete possession of the skills for perfoming the activities composing the evaluated variable or simply not. In the conclusion, we suggest a solution to this problem.

As a matter of fact, from the seven variables in the AGGIR grid, we are able to automatically measure three by tracking and analyzing events resulted of the inhabitant performed tasks from the simulation within the icasa environment. The selected variables are: toileting, transfer, and dressing. The mechanism of the calculation of these variables is as follows:

- To calculate the hygiene variable the following

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
0 H - 6 H	23:00 H - 7H Sleeping	23:00 H – 6:30 H Sleeping	22:30 H - 7H Sleeping	23:00 H– 7:00 H Sleeping	23:00 H– 7:00 H Sleeping	22:30 H - 6:30 H Sleeping	22:30 H – 7:00 H Sleeping
6 H		6:30 H -7:30 H				6:30 H -7:30 H	
7 H	7-8 H Toiletting 7:30 H – Bathing	Toiletting 7 H – Bathing 7:30 H -8:30 H	7-8 H Toiletting 7:30 H – Bathing	7-8 H Toiletting 7:30 H – Bathing	7-8 H Toiletting 7:30 H – Bathing	Toiletting 7 H – Bathing 7:30 H Eating	7-8 H Toiletting 7:30 H – Bathing
8 H	8-9 H Eating 8 H - Cooking	Cooking 8 H – Eating 8:30 -10:30 Resting	8 H Eating 8:30 H – 10:30 H Watching TV	8 H Cooking 8:30 H Eating	8 H Cooking 8:30 H Eating	8 H -10 H Watching TV	8 H Cooking 8:30 H Eating
9 H	9-10:30 Going Out			9 H- 11 H Resting	9 H- 11 H Resting		9 H – 10:30 H Going Out
10 H	10:30 H-Toiletting	10:30 H-Toiletting	10:30 H – 12:00 H			10 H – 11:30 H Going Out	10:30 H Toiletting

Figure 3: Schedule employed in the simulation.

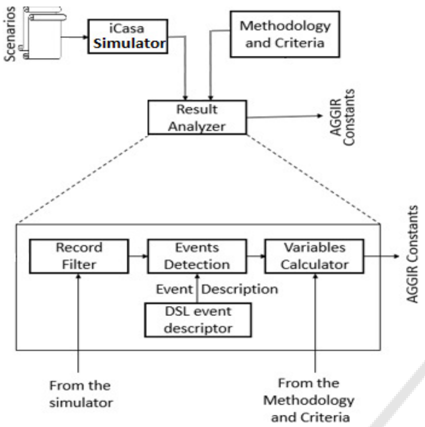

Figure 4: Graphical description of the proposed methodology.

conditions must be met: the person must have a bath four times a week at least, wash his hands after eating or using the toilet, for at least three times a day.

- To calculate the transfer variable, namely the ability of a person to perform the basic movements of his dayly routine, such as rising from bed, sitting down and standing up from a chair; We consider that there must be at least three sitting events a day, either taking place in the living room or in the kitchen, and at least rising from the bed one time per day. The mechanism to measure the ability of the persönto wake up after falling on the ground is not covered in this approach.
- To verify if the dressing variable is achieved, dressing events like approching the wardrobe must be encountered at least twice a day.

Moreover, the source code that analyzes the records and generates the events is written in Python and run on the simulation host. It is written using a function-oriented approach, this makes the Original code scalable and future additions can be made to calculate the rest variables in a facile way.

4.2 Experimental Results

All simulating and processing operations were performed by means of two sets of inputs for the simulator, in order to generate different scenarios. The employed inputs are text files written using the XML format. The files present the analyzed activities and indoor movement of an elderly during a period of time of one week. It is possible to simulate the whole week in one file, but in order to facilitate the managing of results, we separate the week into seven days, each of which is represented using one file.

The first scenario is a simulation of an ideal week where all the activities were performed by the inhabitant with no impediment into seven files, one file for each day. The activities of the elderly were monitored using a simulated sensor network in the house environment. The daily activities are: waking up, preparing food, hygiene, going to the toilet, watching television or reading, accessing and leaving the house for short periods of time. See Table 4.

In the second scenario, we deliberately dropped some daily activities in a way that we can cause a malfunctioning on the criteria we developed, the days were randomly chosen. The simulation result of this scenario are issued on seven files, one for each day of the week. See Table 5

Due to the fact that the methodology employed in the calculation is event-oriented and not record-

Table 4: Results of the first scenario.

		Transfer	Hygiene	Dressing
No. of events	MON	☑ 7	☑ 8	☑ 3
	TUE	☑ 6	☑ 8	☑ 3
	WED	☑ 7	☑ 11	☑ 2
	THU	☑ 7	☑ 10	☑ 2
	FRI	☑ 8	☑ 8	☑ 3
	SAT	☑ 8	☑ 6	☑ 4
	SUN	☑ 6	☑ 9	☑ 3
	Total	☑ 49	☑ 59	☑ 19

Table 5: Results of the second scenario.

		Transfer	Hygiene	Dressing
No. of events	MON	☑ 7	☑ 7	☑ 3
	TUE	☑ 7	☑ 7	☒0
	WED	☑ 7	☑ 11	☑ 2
	THU	☑ 6	☑ 11	☑ 3
	FRI	☑ 8	☑ 8	☑ 3
	SAT	☒3	☑ 6	☑ 4
	SUN	☑ 6	☒6	☑ 2
	Total	☑ 44	☒56	☑ 16

oriented, that makes it more intelligent and context-aware oriented. It is capable of understanding and analyzing the complex activities of the proposed environment, and then calculating the value of the variable on this basis.

Table values show that our method was able to determine the values of the three variables in both scenarios although the change in the number of transfer and hygiene events was not significant. However, the days on which the variable's value was negative were determined.

The success of detection is accomplished because the method does not relie on the number of simple events when calculating the variables, but it depends on the generation of complex events.

The experiment was designed to examine three concepts: the first is calculating the constants of the AGGIR grid: dressing, transfer and hygiene. using the suggested method. The second is the scalability, where we expand the time frame to verify the ability of the algorith to deal with larger time domains and thousands of records and events. Finally, we examined algorithm performance for different simulation times.

Firstly, the method succeeded in identifying three simulated problems within a week. The days were chosen randomly. Fig. 5 and Fig. 6 show that despite the number of records in the second scenario related to personal transfer and personal hygiene did not change significantly compared to the first analyzed scenario, however a problem with the dressing variable was detected. This, in turn, reflects the how the methodology can perform a smart analysis of events.

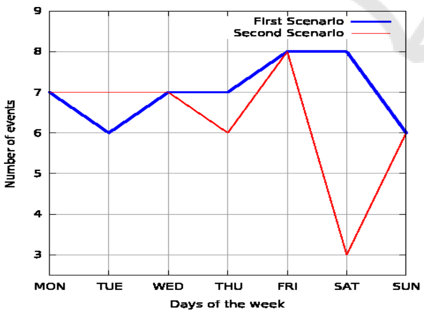

Figure 5: Transfer events.

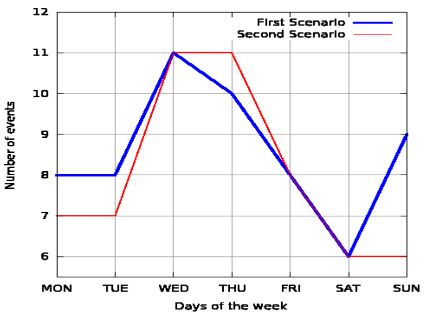

Figure 6: Hygiene events.

Next, we tested the scalability of the algorithm in a time domain greater than one week. For this matter, we simulated three months and generated the corresponding records. After that, we applied the criteria used to create the events, and finally, we measured the values of the previous three constants; as shown in Table 6.

Table 6: Number of generated events in three months.

	Month 1	Month 2	Month 3	Total
Transfer	210	207	206	623
Hygiene	253	249	245	747
Dressing	90	88	80	258

We assumed that each month consisted of thirty days, precisely four weeks and two days, which allowed flexibility when processing the records and generating events. By doing so, there is a possibility to use the actual number of days within the months, i.e. (28, 29, 30 and 31) days (Fig. 7), requiring further processing.

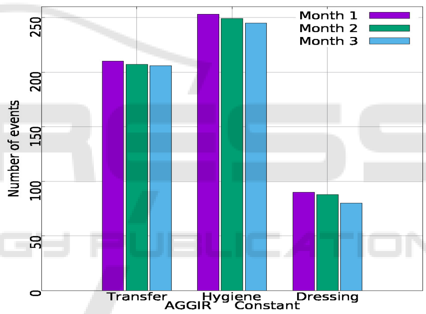

Figure 7: Algorithm scalability.

Finally, to make sure that the algorithm is scalable, we monitored the time elapsed to calculate the constants in order to simulate a day, a week, two weeks, three weeks, a month, two months, and three months. Table 7 shows the elapsed time for each case. The values displayed include the time spent for each simulation, as well as results analysis, events generation, and finally the calculation of the constants variable.

Table 7: Real time elapsed to calculate the constants in seven different simulation time ranges (***D***ay, ***W***eek, ***M***onth).

Time period	1*D*	1*W*	2*W*	3*W*	1*M*	2*M*	3*M*
No. of days	1	7	14	21	30	60	90
Time (*s*)	62	434	867	1301	1863	3713	5590

Fig. 8 shows the performance of the algorithm with simulating scenarios with different time ranges. The resulting diagram is linear, which corresponds to the complexity of the algorithm, represented by $O(n)$, where n represents the number of events, meaning that the algorithm is scalable.

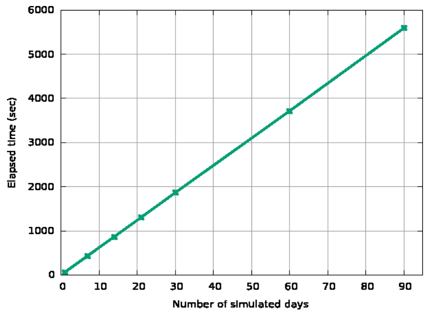

Figure 8: Analysis of Algorithm performance.

5 CONCLUSION

In this Article, we introduced the AGGIR model, a special system for determining the autonomy of an inhabitant adopted by the French government in the past decade. After that, we show a special language, the DSL, which is intended to describe activities in the time domain. Next, we explained our own mechanism for calculating three of AGGIR variables. Finally, we presented the results of two simulated scenarios were analyzed using the previous methodology in order to examine the criteria we developed. In addition to that, we tested the scalability of the algorithm.

The automation process of AGGIR is a long-term process. The system must be tested in many scenarios, especially the abnormal ones, which contain readings representing the occurrence of accidents or unexpected behavior of the elderly, in order to see the ability of the system to understand the records correctly and thus generate appropriate events.

We also look forward to developing the value of the variables being calculated. As noted above, the variables in AIGGR are three-fold, whereas in our study they are binary. Moving to triple-value variables requires a deeper understanding of the ability that is being checked, especially as many of variables represent principles that cannot be measured using sensors such as the coherence. In this context, we suggest developing a point system in which an individual gets a number of points based on activities, and the outcome is assessed at the end according to the earned points.

The current system is neither proactive nor interactive. It depends on analysis of pre-existing sensors results. In the next step, we are looking forward to including the concept of real time. In this case, appropriate mechanisms for generating events should be developed. Finally, the speed of response when a problem is identified must be taken into account.

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