Poppy Generation Robots Replayer

How to use

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1. Presentation of the application

1.1. Context

Today, the open-source Poppy robot owns a lot of varied applications developed by the community. Some applications especially exist to record positions or moves in order to play them then.

The need today is to record moves on the Poppy Humanoid robot that allows then a reproduction of the moves which is as closest as possible to the orginal one. For this reason, it is not possible to use application like *FIRE*, an advanced recording application that only records positions.

Moreover, some tools permit to record moves, like the MoveRecorder primitive, but these tools are not developed enough for the project.

As a result, it has been decided to create a new move recording application, that particularly allows to customize the application. One of the main interest of the application is to allow the user to modify the recorded moves while keeping the ergonomy and simplicity when recording. This application, developed by Generation Robots, is named ***Poppy GRR*** (***Poppy Generation Robots Replayer***).

1.2. Principle

In order to meet the ergonomy criteria during the recording, it has been decided to split Poppy up in several parts. Indeed, it is quite difficult to record on the entire robot body in one time for a lonely person. The idea is to save a move on one or sereval parts, and then to assemble the moves to finally create a move on the entire robot.

By using this principle, synchronisation problems can appear. It is the point that makes the Poppy GRR application. Poppy GRR is not only an application to record moves part by part on Poppy, but also an application which gives the necessary tools to create, assemble, modify and synchronise the moves, in order to obtain moves that correspond to the user expectations. The application also has a player for the recorded moves, which is smooth and offers control to the user (monitoring, break, resume…).

1.3. Communication

The application is made of 3 parts:
- Poppy : the robot and its HTTP server.
- The user interface: a web interface permitting the mastery of the robot.
- The web server and the database: where all the data are saved.
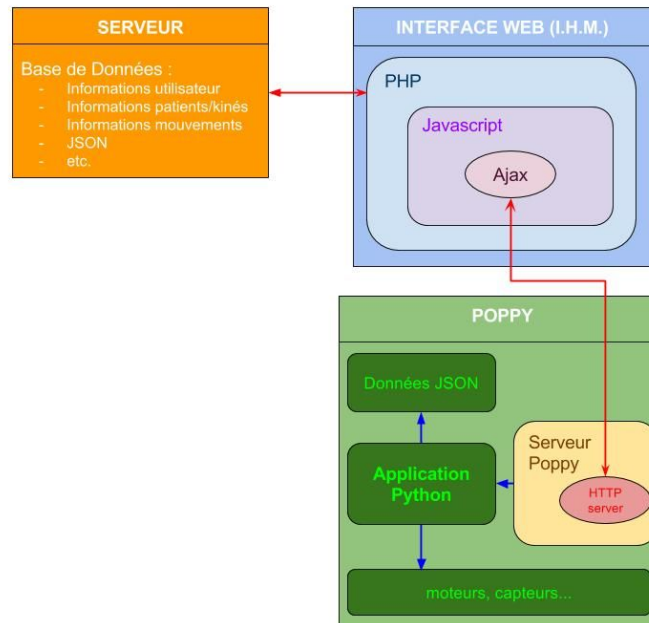
This architecture allows the user to use the application by connecting to the webserver. Consequently, any user can connect to the server from anywhere to use the web interface, and can master any Poppy robot assigned for the application, since he has the access to the server. Moreover, the data are centralised on the web server, that allows every users to have access to up-to-date data without having to manually download them.

The architecture is the following: on one side, a program in Poppy handles all the robot features and open a HTTP server which is waiting for requests; on the other side, the web interface communicates to the robot by sending HTTP requests, and allows the data saving and data processing to be done.

1.4.   Create a move

The application enables the creation of complex moves through several steps. It is also possible to create a move without going through all the steps, but only doing the recording phase. The different steps are really useful for complex and/or hard to save moves, whether the user is alone or not.

The principle of creation is the following: the moves are directly recorded on the Poppy parts. Then, they have to be combined to get a complete move on al the robot. Finally, it is possible to concatenate several moves in order to create a long move or a dance for example.

The moves directly recorded can be called **sub-moves (*sous-mouvements*)**. These sub-moves are then combined to create **moves (*mouvements*)**. Afterwards, these moves are concatenated to create **exercises (*exercice*)**, and then **sessions (*séances*)**
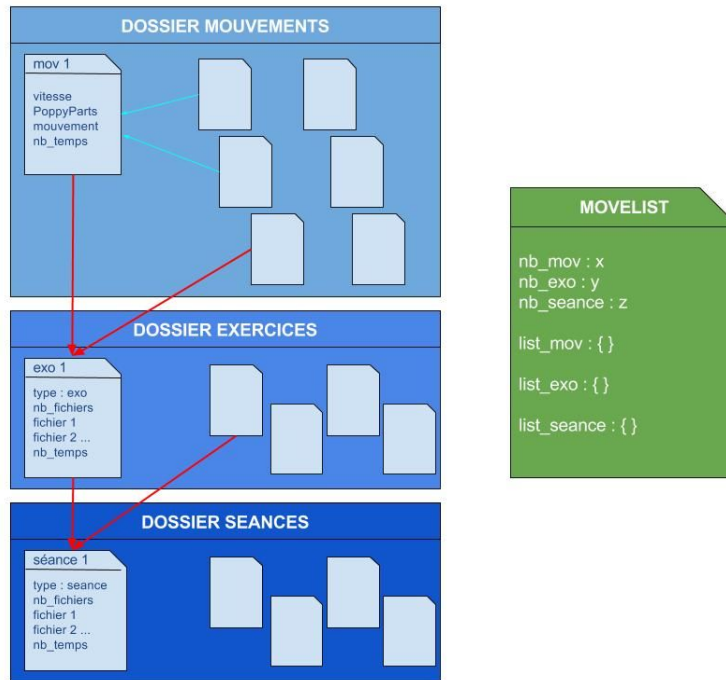
The idea is to get a package of moves and exercises/sessions, that will then be at the disposal of the user, who will be able to play them thanks to the Poppy GRR application.

2. Poppy GRR features

There are 3 main features in Poppy GRR application. The first one is to **record moves** directly on Poppy. The second one is to **process the moves** and the data. The last one is to **play the recorded or created moves**.

2.1. Recording sub-moves

The sub-move recording is done by part. In other words, it is possible to record sub-moves on only one or several parts of Poppy, that makes the manipulation easier. The different Poppy parts are the **head** (*tête*), the **spine** (*colonne*), the **left arm** (*bras gauche*), the **right arm** (*bras droit*), the **left leg** (*jambe gauche*) and the **right leg** (*jambe droite*).

To record a move, the only thing to do is to execute the recording function. The chosen parts are locked for a few seconds, and then are unlocked when the recording begins. The recording continues as long as the chosen parts are moved. If the motion is stopped for a while (about 2s), the recording stops and is saved. When it ends, a sound is played to inform the user.

2.2. Moves combination and modifications

This part is the most important of the Poppy GRR application. It is thanks to this part that the application allows the user to record moves by the most ergonomic way as possible.

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Once the sub-moves are obtained, they must be combinated to get a move on all the Poppy parts that are essential for the final move. But this step can be problematic because of the synchronisation, that's why this step is crucial. Indeed, the application must give the necessary tools to synchronise moves, while being ergonomic.

Actually, there are 3 types of processing:

➔ **moves modification**: enables the transformation of recorded moves like doing a symmetry or a time reverse.
➔ **combination**: enables the combination of several sub-moves to create a move.
➔ **concatenation** : enables the assembly of several moves to create an exercise or a session.
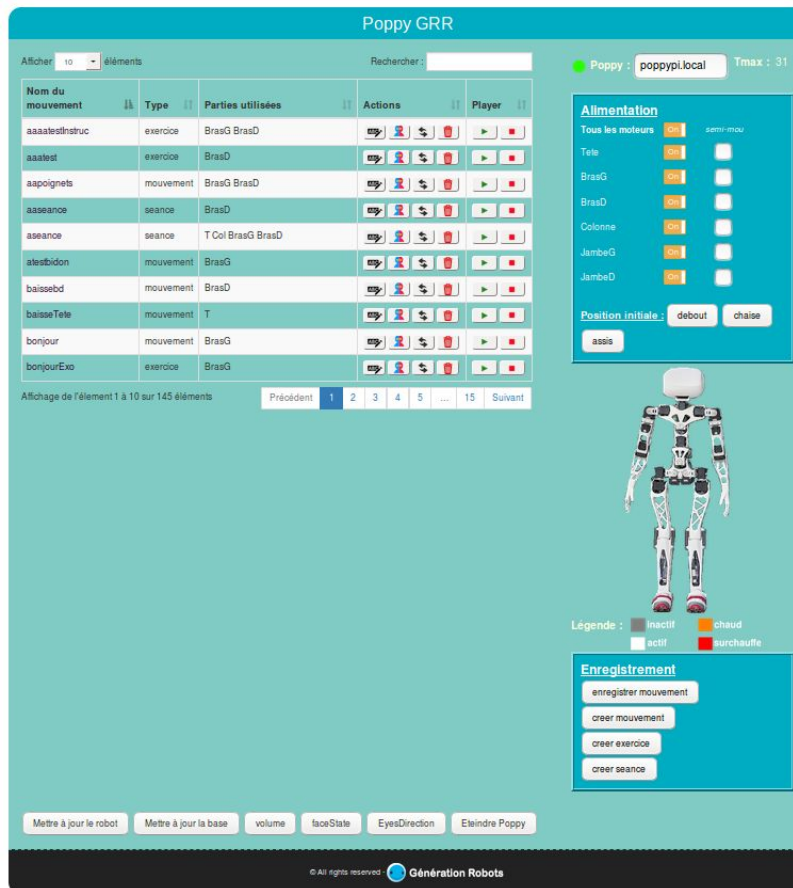
2.3.   Move player

This feature allows the user to play moves, completely or partly, with a move monitoring, and to put the played move in pause, to resume and to stop it.

This part is integrated in a simple interface: that is the purpose of the program, and must allow any user to use it.

3. Web interface

We are now going to see how the application works using its web interface. A picture of the main page of the web interface is just below.

4 parts can be distinguished:
- **Moves list**: a table that includes a list of the moves, exercises and sessions, with information about them. Actions are possible for each of them to modify or to play them. It is the table on the left of the page.
- **Power supply**: enables the activation and deactivation of the robot, or its parts, to activate the compliant mode (*semi-mou*) and to put the robot in an initial position. This part is located in the "*Alimentation*" box at top right of the page.
- **Moves recording**: enables the move recording on the robot, the combination and concatenation of the moves to create exercises and sessions. This part is located at bottom right of the page, in the "*Enregistrement*" box.
- **Robot connexion**: located above the "Alimentation" box, it allows the user to choose to which robot to connect and to verify the state of the connection to the robot.

The picture of the Poppy Humanoid robot is a display of the robot state.

The buttons at the bottom left of the page permit to update the database and to download the new moves in the robot or in the database.

3.1.   Connection to the robot

In the "Connection to the robot" part located at top right of the page, the robot to which to connect is chosen. The name of the robot (default: poppy.local) or its IP address must be provided.

Please note that for an Android phone or tablet, the IP address of the robot must be provided since there is no mDNS on Android. Furthermore, the last version of Chrome must be used (v.49 minimum). In any case, whether using a tablet or not, the execution of the web server is required (LAMP, WAMP…).

If the robot is connected, the indicator light before "Poppy" is green. If the indicator is red, the robot is not connected. If it is orange, the robot is connected but the data of the robot or the data of the database are not up-to-date. An update of the robot data or/and of the database must be done, thanks to the buttons at bottom left.

The temperature "Tmax" displays the temperature of the hottest motor of the robot.

3.2.   Move creation

To create a move, in other words to record a move, the **first button** in the **"Enregistrement" box** is used.

By clicking on "enregistrer mouvement", the following modal appears:

This window allows the user to define the settings of the move that will be recorded, which are:
- The **move name (*nom du mouvement*)**, which must be unique.
- The **played move while recording** (***nom du mouvement joué pendant la sauvegarde***), which enable a move to be played on other Poppy parts than the chosen ones, while the user is recording on the chosen Poppy parts. This part is optional.
- The **Poppy parts (*parties de Poppy*)**, which are the parts of Poppy body concerned by the recording. The checked parts are the ones which will be recorded while the user is moving these parts. 1 or several Poppy parts can be selected.
- The **compliant mode (*mode semi-mou*)**, if checked, allows the user to record the move on a resisting robot (compliant state).

When the "Sauvegarder" is clicked, the recording begins. The selected Poppy parts are first blocked for a few seconds, before being unlocked. The recording begins when the unblocking happens. The program lets about 2 seconds to the user to begin moving the robot.

The recording automatically stops when the chosen parts are stopped for 2 seconds. A sound announces the end of the recording.

3.3. Modifying a move: symmetry, time reverse

It is possible to modify a move. To do that, the wanted move has to be found in the table. In the "Actions" column, 4 actions are possible, in the order:
- **Rename (*renommer*)**: enables the existing moves to be renamed, knowing that the accents are automatically removed.
- **Symmetry (*symétrie*)**: creates the left/right symmetry of the chosen move, and saves it with the following name: "nameSym".
- **Time reverse (*inversion temporelle*)**: Creates the time reversed move, that means that the move is played from the end to the beginning, and saves it with the following name: "nameInv".

- **Remove (*suppression*)**: remove the chosen move from the robot and the database.
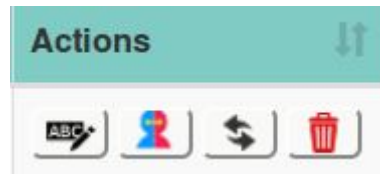
3.4. Move combination

The move combination, which enables the assembly of 2 or more sub-moves to play them at the same time, is executed by clicking on the **second button** of the **"enregistrement" box**.

By clicking on "creer mouvement", the following modal appears:

This window enables the creation of a move from other moves. The name of the new move has to be defined in the "Nom du mouvement" field, as well as the sub-moves which compose the new move. It is possible to add other sub-moves by clicking on the "ajouter" button.

Warning : When several sub-moves on the same Poppy parts are combined to create a move, it is better to put them chronologically (offset)! Use preferably the function to create exercise to concatenate moves with the same Poppy parts.

The 3 parameters of the sub-moves are the following:
- **ss_mov_name** : The name of the sub-move to integrate.

- **speed** : The speed of the sub-move, from 1 to 10. A 9 value corresponds to the default speed. The lower the speed is, the slower the move will be.
- **offset** : corresponds to a time lag. An offset of 10 will make the sub-move begin at the frame 10 (a frame is the time unit of the moves).

Once the parameters are defined, simply click on the "Sauvegarder" button to create the move.

It is possible de preview the move in order to check the parameters. The preview makes the robot move without saving the move.

Note: *If a line is not filled, that means the "ss_mov_name" field is not completed, the line will not be considered.*

3.5.   Concatenation

The concatenation permits to put several successive moves to create an exercise, or to put several successive exercises to create a session.

3.5.1.   Exercise creation

The concatenation is executed by clicking on the **third button** of the **"Enregistrement" box**.

By clicking on "creer exercice", the following modal appears:

This window permits to create an exercise from moves. The **name of the exercise (nom de l'exercice)** must be filled with the new name.

The modal is made of 3 parts: the instructions (consignes), the movements and the timeline.

The **instruction part** permits to add important instructions to an exercise, those will be said by the robot at the beginning of the exercise when Kinect is activated. The wanted instructions have just to be checked.

The **movement part** contains the list of the movements and their associated oral comments. It is possible to add other moves by clicking on the "ajouter" button. For each movement, there are 3 parameters:
- **nom du mouvement**: the name of the move or exercise to concatenate
- **vitesse** : The speed of the sub-move, from 1 to 10. A 5 value corresponds to the default speed. The lower the speed is, the slower the move will be.
- **pause** : corresponds to a break after the concerned move. A pause of 10 corresponds to a break of 10 frames (robot time unit).

For each movement, oral comments can be added by cliquing on the "Voix" button. For each comment, the following fields must be completed:
- the **time (temps)**: corresponds to the number of frame when the robot starts to say the comment.
- the **comment (commentaire oral)**: corresponds to the text said by the robot.

The **timeline part**, at the top, shows temporaly the integrated movements and when a comment is said. The unit is the frame. The black numbers corresponds to the numbers of

the exercices and the red numbers corresponds to the numbers of the comments. The little line delimits the pause. This timeline is only to show temporaly the exercises and the comments in order to better synchronise them.

Once the parameters are defined, simply click on the "Sauvegarder" button to create the exercise. The order of the moves is the same order as the lines, from top to bottom.

Note: If a line is not filled, that means the "nom du mouvement" field is not completed, the line will not be considered.

It is also possible to create new instructions by clicking on "créer instruction". The following window opens:
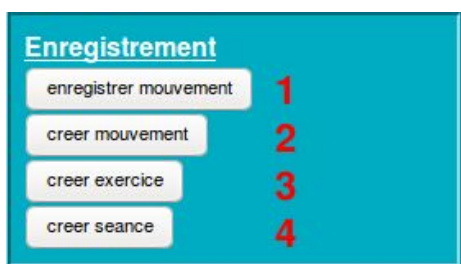

The title (titre de l'instruction) corresponds to the identifying name of the instruction. It must not have any special characters (accents…).

The name of the instruction (nom de l'instruction) corresponds to the name that is displayed, especially in the list of instructions to check.

The text (texte de la voix) correspond to the instruction said by the robot at the beginning of the exercise. Be careful! Only french exists for now, and the following sentence has to be completed: "pensez à…".

3.5.2. Session creation

The session creation is executed by clicking on the **fourth button** of the **"Enregistrement" box**.

By clicking on "creer seance", the following modal appears:

This window permits to create a session from exercises. The **name of session (nom de la séance)** must be filled with the new name. It is possible to add other exercises by clicking on the "ajouter" button.

The 4 parameters of the moves are the following:
- **nom de l'exercice** : the name of the exercise to concatenate
- **vitesse** : The speed of the exercice, from 1 to 10. A 5 value corresponds to the default speed. The lower the speed is, the slower the move will be.
- **repetitions** : number of repetitions by the person when Kinect activated.
- **pause** : corresponds to a break after the concerned move or exercise. A pause of 10 corresponds to a break of 10 seconds.

Once the parameters are defined, simply click on the "Sauvegarder" button to create the session. The order of the exercices is the same order as the lines, from top to bottom.

Note: If a line is not filled, that means the "nom de l'exercice" field is not completed, the line will not be considered.

3.6.   Player

The playback of the created moves, exercises and sessions is done in the table, in the "player" row.

The Player enables the basic features: playing the move, puting it in pause, to resume and to stop it.
To execute a move, simply click on the Play button of the desired move. When a move is being played, a blue circle appears around the first button so that the user sees which move is been playing.

During the move playback, the concerned Play button is replaced by the Pause button. When the move is paused, the Pause button is replaced by the Play button.

A monitoring box appears when an exercise or a session is played. This one allows the user to know the composition of the file, to know which move of the file is being played and to know the general progress state of the exercise or session.

33 %

nageur

papbras

brasse
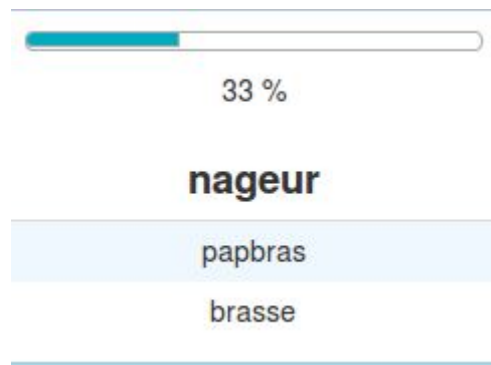
In the above example, the exercise "nageur" is being played. The general progress is of 33% and the "papbras" move is being played (its case is colored).

In the case of a session, another hierarchy appears in order to know each move of each exercise composing the session:
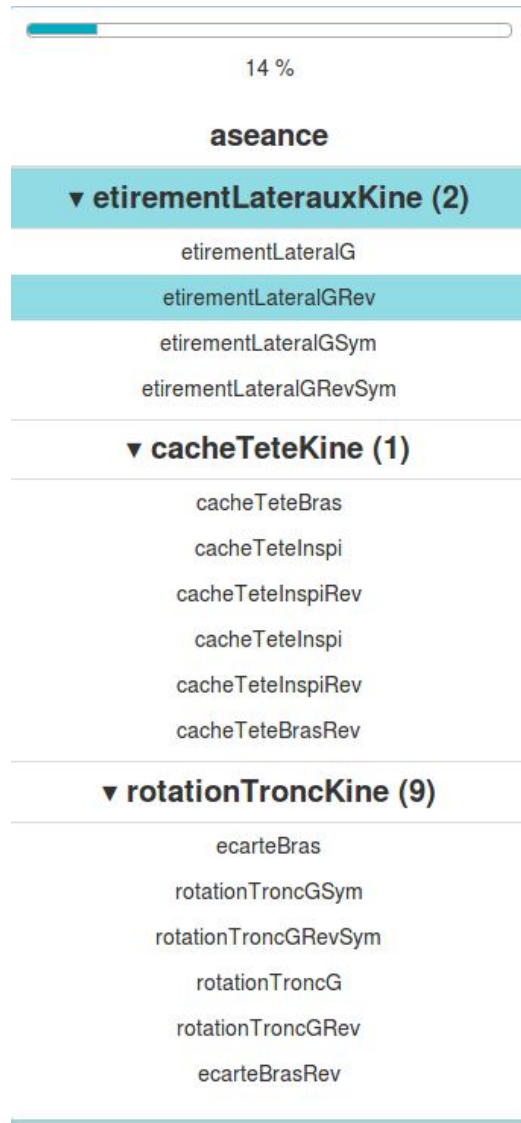
In this example, the session "aseance" is played. The exercise "etirementLaterauxKine" is being executed, and the move "etirementLateralGRev" is being played. the number "(2)" means that the person in front of the Kinect will have to repeat the exercise 2 times (useful if the Kinect mode is activated).

This interface will be modified so that a direct interaction would be possible. Playing another move of the list would be possible by clicking on the wanted move of the list.

4. Robot safety

The application owns its own safety management of the motors. A display and sound system exists on the interface informing the user if one or several motors are overheating.

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In addition to seeing the temperature of the hottest motor in the robot at top righ, this temperature is displayed in red if it is critical.

But the main feature is tin the "Alimentation" box, which allows the user to know which Poppy part is overheating. Indeed, the name of the Poppy part changes its color when overheating. 2 temperature thresholds exists. The first one is a warning alert. If the temperature of a Poppy part exceeds this threshold, its name become orange and a sound rings. Then, if the temperature exceeds the second threshold, the critical one, the name becomes red and another sound rings.

When the second threshold is exceeded, the robot goes in safety mode. This safety is made of 3 steps:
- The robot stops any move.
- The robot goes to compliant mode, that allows it to slowly go to a rest position in few seconds.
- The robot is deactivated, that enables the cooling.

Moreover, the robot picture enables the visualisation of the state of each Poppy part of the robot. Each part is differenciated and colored depending on its state, using the same color code as above:
- grey : the Poppy part is deactivated.
- white : the Poppy part is activated.
- orange : the Poppy part is in overheating warning (first threshold).
- red : the Poppy part is in overheating alert (second threshold). The robot deactivates itself.

In the following example, the spine and the legs are deactivated, the left arm is activated, the right arm is in overheating warning and the head is in overheating alert.

5. Debugging

It is possible to access to the logs by typing the following url:
http://poppy.local:4567/getLogs
It is also possible to get the past month logs:
http://poppy.local:4567/getPreviousLogs

It is finally possible to access to the logs directly in the robot, in the directory: */serverPoppy/log/.*