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Designing a Novel Robot Activist Model for Interactive Child Rights Education

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Abstract
The paper presents an original research titled, 'SUHAKAM Going Digital with Monash', a two years Human Right Education initiatives in Malaysia. SUHAKAM is the National Human Rights Institution established by the Malaysia Parliament and is actively finding innovative approach for Human Rights public awareness, especially child rights education in Malaysia. Monash University Malaysia is a prominent University in Malaysia that have the latest educational technologies with effective pedagogy. The synergy between SUHAKAM and Monash for child rights education innovation aimed to bring the ground breaking Robot Activist across schools in Malaysia. The research seeks to understand the educational barriers that SUHAKAM are currently facing in meeting their obligations, to assist SUHAKAM in promoting child rights agenda across Malaysia in an innovative approach. A Robot Activist is thoughtfully designed, developed and deployed to introduce what SUHAKAM is, the Child Rights Conventions (in both Malay and English) with smart Q&A; followed by an interactive game session, "Simon Says" with pupils. This paper discusses the Robot Activist design research, operation and fun interactions. The finding shows that the educational robot acts as a catalyst to formalise the international human rights education in Malaysia, with the inter-disciplinary synergies of educational sessions using humanities aspects of advanced robotics for next generation engagement. The key constraints, reflections and recommendations are critically discussed on how an educational robot, the Robot Activist can engage children with the heavy-weighted topic such as child rights conventions. Recommendations to the next phase of the model design is proposed.

Keywords Educational robot · Child rights education · Game-based learning · Intelligent agent-based learning environments

1 Introduction and Background

The National Human Rights Institution of Malaysia, SUHAKAM, is established under the Human Rights Commission of Malaysia Act 597, which mandates SUHAKAM to carry out some functions such as to promote awareness of and provide education relating to human rights, and to advise the Malaysian Government in formulating legislation [1]. SUHAKAM shared the educational barriers for human right agenda and challenges it faced in promoting and protecting civil liberties and fundamental freedoms in Malaysia in its 2016 Annual Report [2]. Since it came into operation in 2000, SUHAKAM has been confronted by various challenges in discharging its statutory functions as an independent national human rights institution, including criticism by civil society that the Commission as a "toothless tiger" [3] and non-debate of SUHAKAM's Annual Reports by Malaysian Parliament despite the facts that SUHAKAM was created by the Parliament [4]. With the past political and economic circumstances in Malaysia, SUHAKAM has played a key role to raise public awareness and monitor the conduct of the national authorities and people in various events and plan of actions [5, 6]. However, the human rights educational barriers is challenging due to certain constraints in Malaysia [7, 8]. With the recent change of government in

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Malaysia, changes for educational system and human rights begin to reform [9]. One of the initiatives SUHAKAM made was to collaborate with the Ministry of Education to introduce "Human Rights Best Practices in Schools" (HRBPS) [10]. Hundreds of schools from both primary and secondary levels participate in this programme that aims to integrate child rights' values into every aspect of school life. However, the current literatures and deliveries are in traditional face-to-face teaching forms. Children may lose interest in the heavy, serious and 'boring' child rights agenda.

Notwithstanding the challenges, we respond to the vision through establishing for strategic collaboration, between robotics researchers and Suhakam, for child rights educational research innovation, to design and deploy an educational robot, namely Robot Activist to advocate the rights of children by interacting with audiences in SUHAKAM events and seminars with students. The research project seeks to understand the educational barriers that SUHAKAM are currently facing in meeting their obligations, to assist SUHAKAM in promoting child rights agenda across Malaysia in an innovative approach. The educational robot in this paper acts as a catalyst to formalise the international human rights education research with the inter-disciplinary synergies of educational sessions using humanities aspects of advanced robotics for next generation engagement.

2 Convention on the Child Rights and Educational Robotics

The Convention on the Rights of the Child (CRC) was adopted by the United Nations General Assembly in 1989 and Malaysia acceded to this Convention in 1995 [11]. To date, Malaysia maintains eight reservations to the CRC such as (1) Article 2—Principle of non-discrimination; (2) Article 13—Freedom of expression; (3) Article 14—Freedom of thought, conscience and religion. SUHAKAM [12] initiated a Roundtable Discussion (RTD) in 2004 involving Government Ministries, Agencies, Non-Governmental Organisations (NGO) and individual experts to provide an avenue for a broad-based forum to discuss challenges relating to the rights of children and to chart the way forward [13]. One of the two recommendations are to make sure children have access to appropriate media information and to make public schools as Information Communication Technology (ICT) points. In line with this, SUHAKAM adopted the HRBPS program in 2009 with the cooperation of Ministry of Education: to integrate human rights education with school management, curriculum, co-curriculum and student affairs [10]. However, most of the teaching materials in HRBPS are traditional (paper-based). ATHAM reports that there are lack of technical knowledge and skills on imparting human rights among teachers and students, and the lack of support and commitment of all teachers and students in implementing the program [10]. The key point here is that, can innovative technology transform the mean of delivery and enhancing pupils' interest in the agenda of child rights education.

In order to carry out the vision of SUHAKAM of nurturing children to human rights at an early stage, the involvement of the computer science academics and students to commence a project, namely SUHAKAM goes digital with Monash open up a new digital chapter for child rights education innovation across Malaysia [14]. This program is the research, design and development of three digital educational tools:

(1) mobile apps design and development based on an educational activity book jointly published by SUHAKAM and NSTP with the aim of enhancing children's understanding of basic human rights principles through games [15];
(2) animation story about Ramu, a student with disability who has a dream of becoming a tennis player [16];
(3) Educational robot, the Robot Activist, who can introduce SUHAKAM and basic child rights awareness to children, with interactivities during SUHAKAM's HRBPS educational sessions across primary schools.

This paper reports the research, design and deployment of the third initiative above, the Robot Activist for child rights education. House of Common Science and Technology Committee [17] asserts that "advances in robotics and artificial intelligence (AI) hold the potential to reshape, fundamentally, the way we live and work" and "there is no AI without robotics; intelligence and embodiment are tightly coupled issues". Educational robotics can perceived as the application area of AI with the educational use of robots. Robots with personalised learning and teaching capabilities has the ability to act as educators for children and adults, in effective language learning, particular subject or skill-based learning [18, 19]. The advances in educational robotics has enabled safe, rich and fun face-to-face interaction between children and robots for a better learning and teaching outcomes [20–22]. A robot can be designed and programmed to interact with learners for formative and real-time feedback [23, 24]. In addition, a programmable robot are now capable of making educational decision when combing with AI techniques such as knowledge representation and reasoning, which allow a machine to determine responses to queries, to ask evaluation-typed of questions, calculate the students' marks and learning performance [25–27]. Aligning with the literature, the research design the "Robot Activist" for SUHAKAM with these objectives: (1) producing a general purpose "Activist Robot" which SUHAKAM may use at their seminars in schools, social occasions or extra

curriculums for pupils, or any other child rights education related events; (2) developing a robotics programme that is engaging and interactive while it promotes SUHAKAM and spreads awareness about the institution and their mission, in conjunction with the HRBPS to bring the child rights education into schools. This educational robot designed and introduced in this research has no intention to replace the role of a human educator but as "an extension of men" that shape the educational context [31]. The high cost of robot may lead to the poor cost-effectiveness that will be investigated and discussed in the later part of the research.

3 Robot Activist Design and Pupil-Robot Interactions

3.1 Technical Information About the Robot

Nao is a humanoid robot produced by the Japan company, Softbank Robotics [32]. Due to its popularity across the globe through its human-like body movements and voices [33, 34], the selected robot model for this research is Nao model V5. Nao robots are open architecture medium sized robots which are being used worldwide by universities for educational and research purposes. The development software of Nao is based on Gentoo Linux and supports a variety of programming languages such as Python, C + + and Java. The robot also has its own graphics based programming software called Choregraphe. The NAOqi framework controls the overall operation of Nao when the system and the user communicates. The device communication manager (DCM) handles communication between the different parts of Nao such as the actuators and sensors. Nao robot has a variety of devices attached to it like sensors, cameras, microphones, speakers, sonar, and LEDs.

Nao is a very versatile, advanced and capable robot. It is especially suited for this research because of its capability to interact with humans due to all its sensors and cameras. One of the main reasons that Nao is ideal for educating Child Right is its children-friendly appearance. Nao is relatively one of the most child-attractive-humanoid looking robots available. Since one of the key aims of the project is for the robot to interact and engage with students, it is important for the robot to be as humanoid as possible. Nao is also fully compatible with the event driven script language called URBI and we are able to use any NAOqi method by using the URBI API for Nao. Choregraphe has "QiChat", which is a language that is used to program complex dialogue that Nao would need to perform: a rule-based scripting language provides a greater control of the dialogue functions in Choregraphe, which was used as the main language to develop the Robot Activist.

3.2 Overview Design for the Robot Activist

The design research method is used where the researchers carefully investigate human experience and behaviour of SUHAKAM by (1) empathise and define the users' requirements; (2) ideate and discuss with SUHAKAM educators in an iterative approach; (3) Pilot, test and deploy the Robot Activist with SUHAKAM educators and pupils from two schools. Figure 1 below shown the activity diagram of the Robot Activist. When the Robot Activist powers on it will wait for a command. At this point there are three options for a pupil to interact with the Robot Activist: (i) to command it to say "hi", and it will do so while waving its hand; (ii) to ask Nao "What is SUHAKAM?" to which it will respond with an introduction about SUHAKAM. After the introduction, a student can proceed to a Questions and Answers (Q&A) session with Nao. When the Q&A session is finished, Nao will ask if the student wants to play a game with it as a reward for listening to it. The game is the well-known "Simon Says" activity; and (iii) to command Nao to go to sleep. After the introduction to SUHAKAM where Nao informs students about the institution and outlines what the institution does and stands for, Nao will then move on to the Q&A session with its audience. Consequently, Nao will ask if its audience wants to play the game "Simon Says" as a reward for listening.

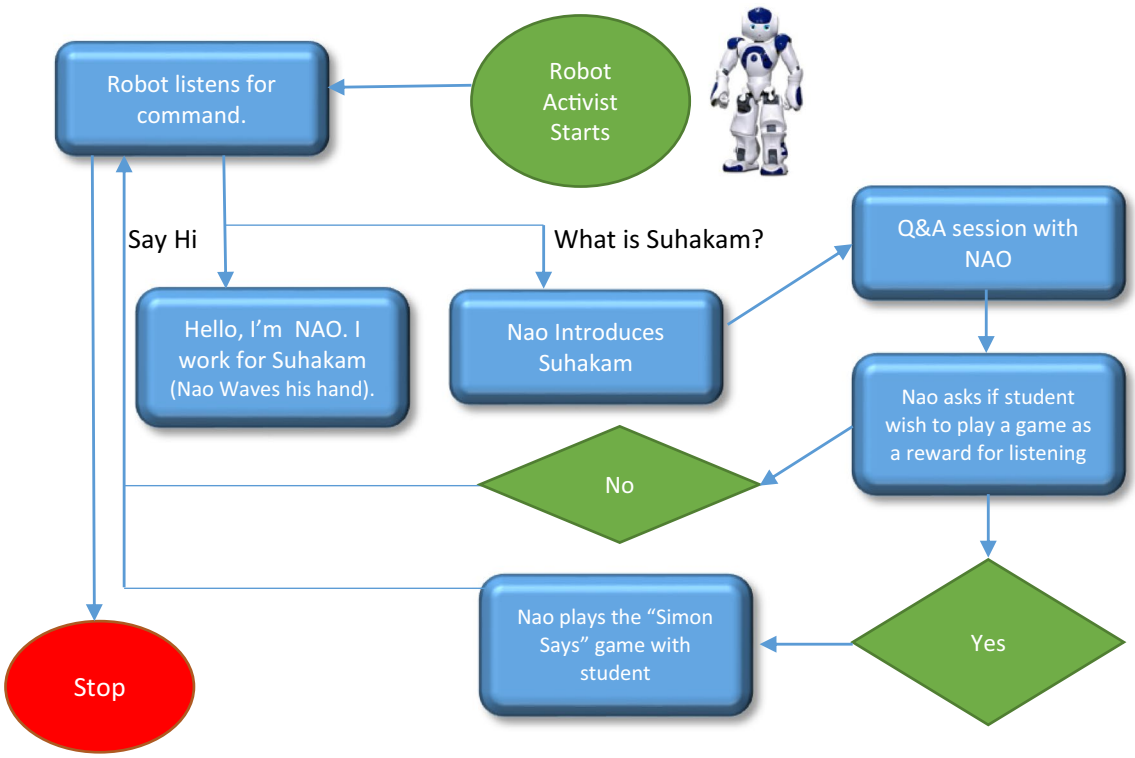

Fig. 1 High level flow diagram for robot activist

3.2.1 The Question and Answer Session

When the application enters into this module, the Robot Activist proceeds to ask the first question. If the answer given by the user is incorrect, the Robot Activist asks the user to try again. If the answer is correct, Robot Activist checks, if there are any remaining questions pesrsonalised to the level of the student. Otherwise, it thanks the user for participating and exits the module as shown in Fig. 2.

3.2.2 Simon Says Session

This module is based on the well-known game "Simon Says". The Robot Activist waits for a command which has the words "Simon Says" in it and a corresponding "action" (Fig. 3):

4 Implementation of the Robot Activist

4.1 Introduction to SUHAKAM Module

First, the Robot Activist will introduce itself after the specified command from user (e.g. "hi"). After the specified command is issued, the Robot Activist will choose a greeting at random from the stored options of greetings. After it greets the user, the user must reply with "what is SUHAKAM?". This will initiate the "introduction to SUHAKAM" module in which the Robot Activist will give a summary of what SUHAKAM is. The introduction is divided into 3 main parts. In the first part, the Robot Activist will explain what SUHAKAM is, when it was established, and what its main goals are. After this first part the robot will initiate a behaviour called "Ask for Attention" which is used to get the attention of the user. This was implemented due to the nature of the information the Robot Activist is conveying to the user. The information is very factual and heavy and thus some fun and engaging behaviours need to be developed to attract the attention of students.

After the "Ask for Attention" behaviour, the second part of the summary will begin in which SUHAKAM talks about which parties were involved in establishing SUHAKAM and what the logo signifies. At the end of this part, a second behaviour will be initiated, to keep the attention of the audience. In this behaviour the Robot Activist sneezes and mentions the current haze that has been plaguing Malaysia. The last part of the summary provides more general information about SUHAKAM and elaborates on what SUHAKAM actually does on a daily basis. The whole of the summary is carried out with the Robot Activist playing music in the background to make

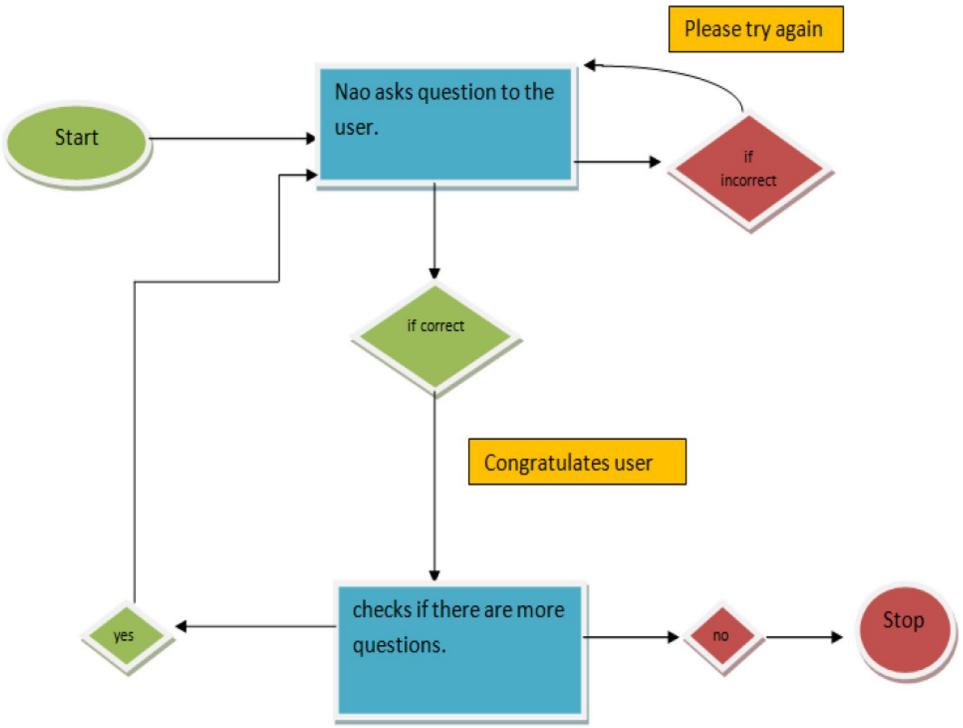

Fig. 2 Flow chart for the "Question and Answer"

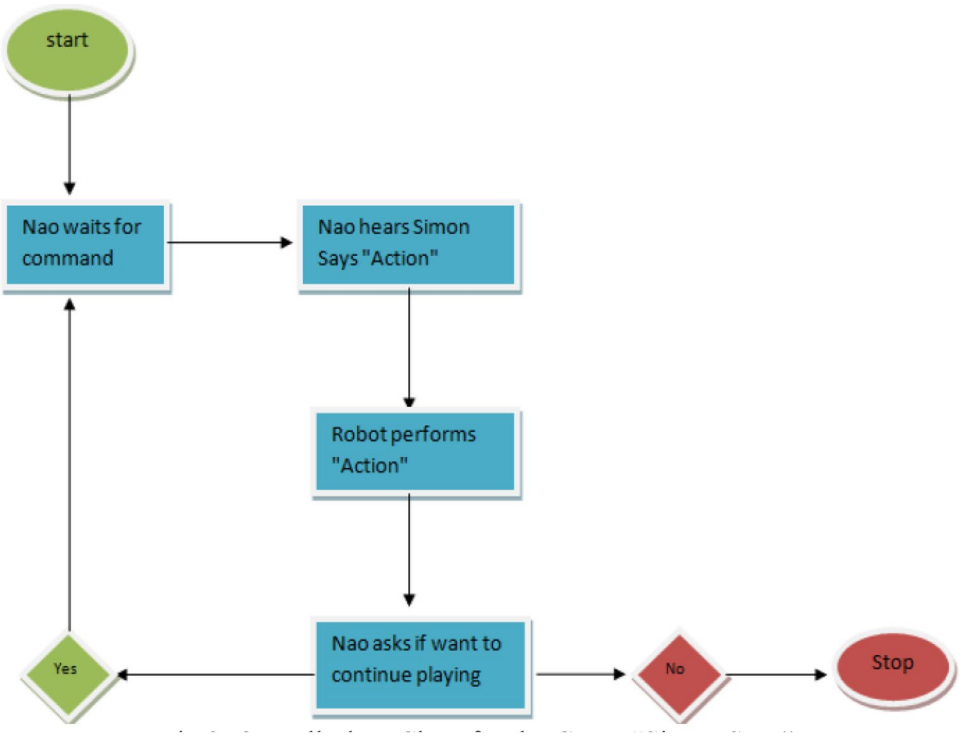

Fig. 3 Overall flow chart for the game "Simon Says"

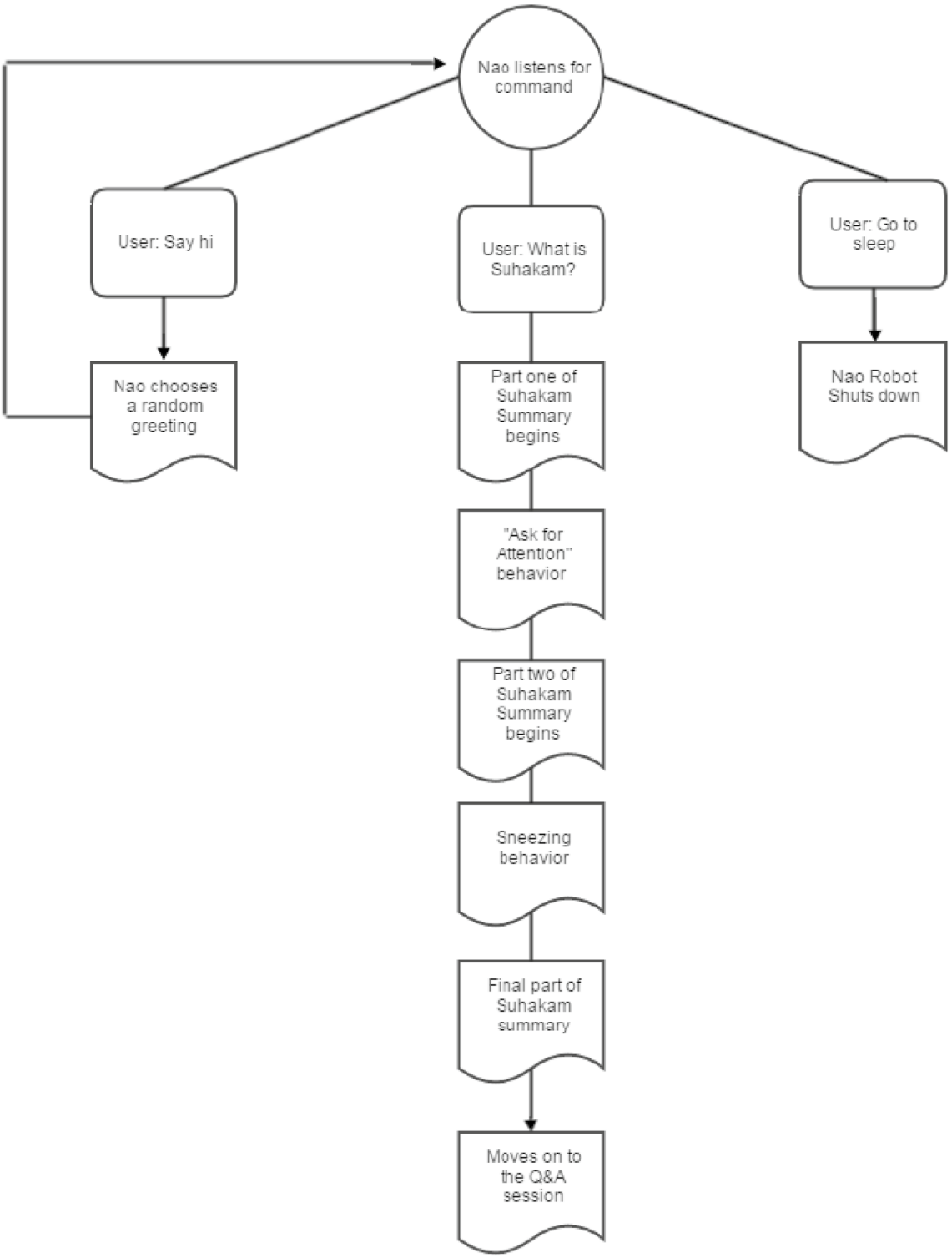

Fig. 4 Detailed flow chart for the game "Simon Says"

Fig. 5 Snippet of the code (QiChat) for the Introduction to SUHAKAM module

```
topic: ~Suhakam()
language: enu

concept:(greetings) ^rand["hi." "hello." "hey there."]
u:(say hi) $output=1 ~greetings My name is nao. I am a robot activist working for Suhaukam.
u:(what is Suhaukam?) Glad you asked!$output1=1 Suhaukam... Otherwise known as the human rights Commi
is a national human rights     institution..... It was established in 1999 based on the Human Rights
Malaysia Act. Its mandate is to promote awareness of... and provide education on human rights, advise
government formulate legislation, recommend to the government actions in the field of human rights, a
complaints about infringement of human rights.....$output2=1
^start(animations/Stand/Emotions/Neutral/AskForAttention_1) ^wait(animations/Stand/Emotions/Neutral/A
```

it a more interesting experience for the audience. Figure 4 depicts an overall introduction educational flow-chart. A snippet of the code of the module is shown below (Fig. 5):

4.2 Three-Phase Implementation

To perform decision-making, AI planning methods use a set of planning operators to code the state changes in the environment produced by a robotic action [25]. Thus, the decision-making and human-like natural communication design for the Robot Activist were completed in three phases:

4.2.1 Phase 1

Phase 1 of the implementation consisted of developing a simple interactive introduction for SUHAKAM and the Child Rights Convention, with question and answer sessions. A student needs to go through every question until all questions were completed. This was a "bare bones" implementation with the robot showing minimal emotion and merely feedback the right or wrong answer. If the answer is wrong, the question will be repeated. In this phase there were seven questions implemented. The first implementation was piloted in the SUHAKAM headquarter by their staff. Some suggestions in enhancing the interactions were documented to proceed to the next interactive Phase as follows.

4.2.2 Phase 2

The main enhancement in the Phase 2 is to develop the concepts of emotion to the robot. The two basic concepts that were added are “happy” and “sad”. If a student answered correctly the Activist Robot would show a happy behaviour. Likewise, if a student answered incorrectly the robot would show a sad behaviour. The appropriate chosen behaviour will be selected at random from the inserted behaviours. Below is a snippet of the code used to implement the concept of happy and sad for the robot during the question and answer session (Fig. 6):

Fig. 6 Code snippet for emotion concept at phase two

```
concept:(Affirmative) ["Okay." "Sure." "Yeah."]
concept:(sad) ^rand[$nonono=1 ^start(animations/Stand/Emotions/Negative/Hurt_1)
^wait(animations/Stand/Emotions/Negative/Hurt_1) $nostop=1"
" $aw=1 ^start(animations/Stand/Emotions/Negative/Sorry_1) ^wait(animations/Star
" $trombone=1 ^start(animations/Stand/Emotions/Neutral/Confused_1) ^wait(animati
"^start(animations/Stand/Emotions/Negative/Frustrated_1) ^wait(animations/Stand/

concept:(happy) ^rand["^start(animations/Stand/Emotions/Positive/Winner_1)
^wait(animations/Stand/Emotions/Positive/Winner_1)" "^start(animations/Stand/Emo
^wait(animations/Stand/Emotions/Positive/Winner_2)" "^start(animations/Stand/Emo
^wait(animations/Stand/Emotions/Positive/Happy_4)^start(animations/Stand/Emotion
^wait(animations/Stand/Emotions/Positive/Happy_3)" "^start(animations/Stand/Emot
^wait(animations/Stand/Emotions/Positive/Happy_1)"]
```

In addition, a break in between the questions were inserted. The Activist Robot would carry out a behavior in which it would say that it is tired and proceed to a stretching motion. This was added due to the pilot test in Phase 1: it would be quite difficult for the children to sit through 7 heavy-weighted child right questions at one go. Therefore, to keep them interested and stay focus, the break is inserted between question 4 and 5.

The second implementation was deployed in the SUHAKAM headquarter with a Primary School visit of 20 pupils. Some suggestions in enhancing the interactions have been made to proceed to the next interactive Phase as follows.

4.2.3 Phase 3

Although there was a behavior added in the question and answer session to give the user a break it still seemed too long for the user to sit through and answer seven questions in Phase 2 deployment during the observations. The total number of questions were suggested by SUHAKAM staff to reduce to six from seven and divided into three sets of two questions each. The main feature developed in this phase is a lightweight intelligent ability for the robot to track the performance of the user. At first, the Robot Activist would ask the default set to the user. From this default set, it would track the performance of the user and based on that it would choose from the remaining two sets, an easy set of questions, or a hard set of questions. This means that the total number of questions are six but the actual number of questions that are to be asked will be four. The following is a snippet of the code to implement this feature.

The Robot Activist makes the decision of which set of questions to ask by keeping track of a number of "counter" values that all cumulate to a final counter value, which can be either 0, 1, or 2. If the value is less than 2 then the Robot Activist will choose the hard set of questions to ask. If the value is equal to 2 the Robot Activist will choose the easy set of questions. The counter value initializes at zero. Generally how the algorithm works is that whenever the user gets the question wrong the value is incremented by one to a maximum value of two. However, there is an exception in the first question to allow the user to get used to interacting with the robot and provide him/her some leeway. The exception is that in the first question the counter value will only be incremented once, after which the user will get any number of "free tries" meaning that after the first time if the user gets the question wrong again the counter value will not be incremented again. This exception only applies in the first question where as in the second question the counter value will be incremented for every attempt it takes the user to get the question right (Fig. 7).

While the final condition to make the decision is relatively simple (with only three possible values 0, 1, or 2) the actual tracking of the performance of the user and upkeep of the counter value can get quite convoluted. This is due to the many possible scenario's the user can take

Fig. 7 Code snippet showing how robot activist makes performance based decision to choose set of questions

```
u:(e:LeftBumperPressed) Okay..... lets start with an easy question.....Please answer by reply
three.....to hear the question again please say.repeat.....
ready?....^start(animations/Stand/BodyTalk/Thinking/Remember_3)^wait(animations/Stand/BodyTalk/Thi
^nextProposal

proposal:  here we go ! $count0=0 ^nextProposal

proposal: %Question1 $count=$count0 What do you know about Suhaukam..... Is it...one...
Organization that champions human rights... Two...An enforcement agency under the purview of the M
Affairs... or three...    An independent statutory body that.. promotes and protects human rights.
    u1:(one) $count=1  ~sad that is not correct. Please try again. ^gotoReactivate(Question1)
    u1:(two) $count=1  ~sad I'm sorry. please try again.^gotoReactivate(Question1)
    u1:($count==0 three) $output1=1 ^start(animations/Stand/Gestures/Applause_1)
^wait(animations/Stand/Gestures/Applause_1) $output2=1 That is correct... let us move on to the ne
$count=0 ^nextProposal
    u1:($count==1 three) $output1=1 ^start(animations/Stand/Gestures/Applause_1)
^wait(animations/Stand/Gestures/Applause_1) $output2=1 That is correct... let us move on to the ne
$count=2 ^nextProposal
    u1:(repeat) ^gotoReactivate(Question1)
```

(See Fig. 9. depicting scenario) and because of how the user can have multiple attempts at answering the question wrong with each attempt adding a layer of complexity. For example, the user may get the first two questions correct on the first attempt, or the user might get the first question correct on the first attempt, and the second question on the second attempt, or the user might get both questions correct on the second attempt, so on and so forth. Due to the multiple-paths, the user can take keeping track of his/her performance can become quite tricky.

There are 4 possible paths to reach the hard set of questions and 5 possible paths to reach the easy set of questions.Thus the algorithm to make the performance based decision is quite balanced in the sense that there are almost an equal number of possible ways to reach either set of questions and it is not skewed towards one set.

4.3 Simon Says

After the intelligent Question and answer session, the Robot Activist will ask the user to play the game "Simon Say's" with it and proceed to explain how the game works. This game was developed and inserted to the child rights educational programme as a reward/incentive for the user to go through the question and answer session. The game includes random "fun" actions the robot can perform but at the same time has some actions, which relate to SUHAKAM, human rights, and the fact that the robot is an Activist for SUHAKAM.

4.4 Targeted Sample and Qualitative Research Design

The Robot Activist for Child Rights Education programme is developed and deployed with two schools. The convenient sampling method is used with a poorer school visit to SUHAKAM headquarter in Phase 2 and an elite school visit in Phase 3. The students' engagement and interactivities with the Robot Activist educational sessions were observed. After the deployment, qualitative feedback forms were distributed to 10 students to collect their fresh experience for interview. Further data were investigated and analysed from the 4 SUHAKAM staff / educators' and 4 school teachers' feedback. Due to the sensitive data collected from pupils under 16, no direct quotations will be presented. Instead, triangulated case study data with technical evaluation of stakeholders' experiences are presented in Sect. 5.3 for the constraints and key findings. The stakeholders are consisted of 10 selected students, 4 SUHAKAM staff, 4 teachers and researchers' observation during the educational sessions with more than 80 audiences (Fig. 8).

Fig. 8 Implementation phase 3

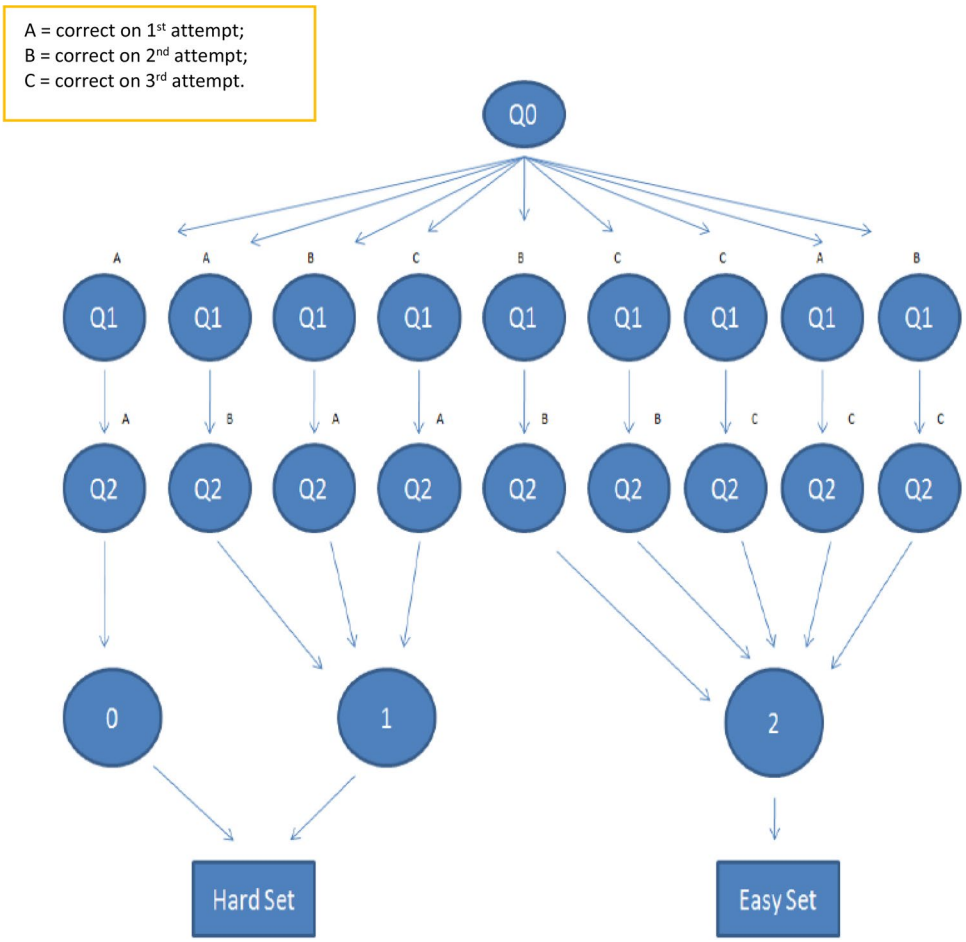

Fig. 9 Diagram showing different possible paths user can take

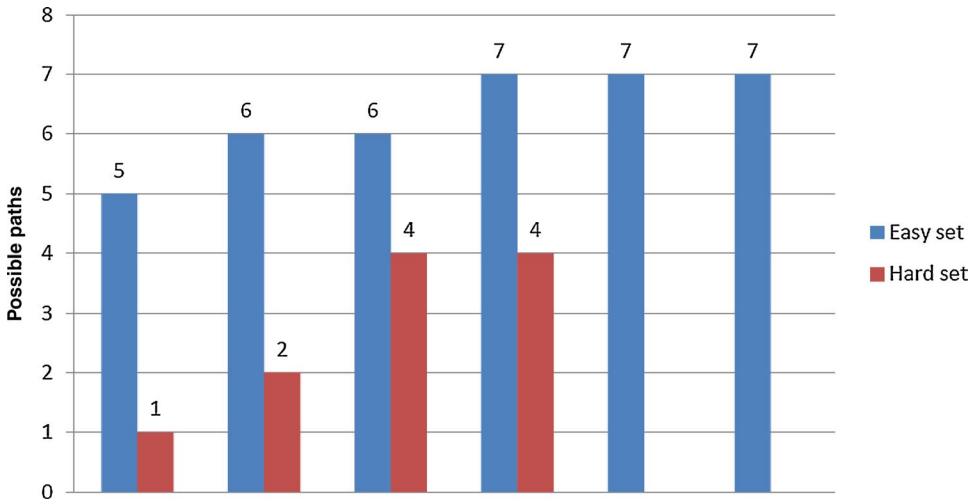

Fig. 10 Chart showing how many people were able to reach the easy and hard set and which path they took

5 Key Findings, Constraints and What's Next

5.1 Technical Results and Issues

The functional evaluation of the Robot Activist for interactive Child Rights Education suggested that most trigger word was detected and responded well by the Robot. The pace of speech, however, could be viewed as a little too fast after the testing and there were some pronunciation errors of specific names and terminologies that needed to

be fixed. The Robot Activist reacted appropriately to implemented commands if they were given without saying "Simon Say's". The newly added behaviour "Simon Say's destroy all humans" was also functional and working as intended. The default reaction from Nao was also successfully seen whenever an unrecognised command was given. The field trip in Phase 2–3 concluded that the Robot Activist reacted appropriately to implemented commands if they were given without saying "Simon Say's". The default reaction from Nao was successfully seen whenever an unrecognised command was given.

The question and answer session in Phase 2 was much more interactive than Phase 1. The break in between the questions was also a positive addition and definitely helped the whole session be more interesting. The shutting down function worked as intended without any problems. All implemented behaviours were functional and running smoothly with initial issues of slow Wi-Fi. The command detections was satisfactory, however, there was a need to repeat sometimes especially if the user did not say the command at the appropriate speed. This is due to the command being relatively large in terms of words. Due to the large size of the commands, in terms of the words, there is the risk of the Robot Activist did not detect the command if it is not well said at the proper pace/speed. In addition, the behaviours in between the parts of the introduction were all carried out smoothly although the jump from the dialogue to the behaviour was quite fast and felt unnatural. The results also showed that the Robot was able to recognise the students' answers; however, sometimes there was a need to repeat due to the noises in the large hall. The major risk that was identified in the evaluation is that Robot Activist might not recognise the commands with more "natural communication".

5.2 Analysis of the Performance Based Decision Making Algorithm

Further user testing determined how often users would reach the easy set of questions and how often they would reach the hard set of questions. To determine this a sample size of 10 pupils (3 female and 7 male from year 4–6) were utilised where they went through the question and answer session and the results were noted. The results is shown as follows:

Figure 9 shows that that there were nine possible paths or scenario is that the user can take in the question and answer session. Figure 10 depicts the results of 10 people went through the question and answer session, which possible path they happened to take, and if that path led them to the easy set or the hard set. There are a few analysis:

1. No one took paths 3, 8, or 9.
2. There was one person each that went through the 1st and 2nd path, two people that went through the 4th path, one person that went through the 5th path, 2 people that went through the 6th path and 3 people that went through 7th path.
3. In total six people took paths that led them to the easy set of questions and four people took paths that led them to the hard set of questions.

One of the key reflections is that the algorithm is quite balanced and the ratio of people who are able to reach the hard set and easy set is quite close, more specifically 4/6. Granted the sample size is quite small, which might make this analysis not that accurate, however due to limited resources, and people this is the best that could be done in this research.

5.3 Are Robot Activist Addressing the Educational Barriers Affecting the Child Rights Education?

The interview data were collected manually and analysed with thematic coding method. The analysis metrics are based on three themes: (1) how well Robot Activist to address the educational barriers affecting Child Right education from the students' experiences? (2) What are the educators' and teachers' views for theme (1); (3) Is this cost effectiveness to scale up to large sample size with empirical data collection? From the researcher's observation and triangulated emotion analysis by photos taken during the implementations, all students paid full attention during the first module, "Introduction to Suhakam and child right" with excitement due to their first encounter with Robot Activist. Most selected students evaluated the educational Q&A sessions with Robot Activist as "engaging", "very fun session" and "novel experiences" from the interviews. The automated total Q&A scores calculated by the Robot Activist showed that Robot Activist improved the students' knowledge in child right after the intervention. These transformed experiences are supported by all SUHAKAM staff and most school teachers. Only one teacher had less interaction with the Robot Activist and expressed her concern of job to replaced by educational robot, "children love this robot, he seems to do a better educational job than me. Will my job be replaced by robots in the future?" All Suhakam educators and another 3 school teachers were very motivated for the transformed teaching experience brought by Robot Activist. Some of the quotes are strong evidences to support the enhancement:

Certainly the Robot Activist can introduce Suhakam much better than I do and draw a complete attention from students, that's amazing.

Robot Activist is the star of today! I would love to have him to follow me to all the chid rights workshops and public awareness event.

He can openly discuss and chat with the students about human right agenda, and provide personalise and hilarious feedback, excellent workshop.

How much is the robot cost? I don't think all school can afford….

Can you program the exactly same educational programme but in a cheaper robot?.

As the qualitative finding from the triangulated Case Study, Robot Activist Nao enhanced the delivery of "Human Rights Best Practices in Schools" (HRBPS) programme in the school he visits by:

(a) transforming the traditional face-to-face teaching delivered by human right educator from Suhakam or school teachers to collaborative and active learning educational session;
(b) engaging children who thought that child rights agenda is heavy, serious and boring to a fun and stimulating educational experience;
(c) enhancing the interactions with personalised hard or easy set of questions in the Q&A module.
(d) attracting the full concentration in the "Introduction module" to learn more about Suhakam.
(e) releasing the stress of the educators when delivering sensitive topic in the country with stricter surveillance issues.

On the other hand, the high cost of Nao robot may lead to the poor cost-effectiveness. With the similar conceptual model, 3D printed humanoid robots are suggested for the extended empirical implementation to other 100 schools.

5.4 Further Insights, Challenges and Recommendations

This educational robot designed and introduced in this research has no intention to replace the role of a human educator but as "an extension of men" that shape the educational context [31]. The high cost of robot may lead to the poor cost-effectiveness: not all institutions or schools can afford an expensive Nao robot. This is a dilemma where cheaper robots may not lead to the similar experience as adorable Nao. In addition, while the session improved dramatically in terms of pupils-Robot Activist being engaging, affirmed by both pupils and SUHAKAN educators compare with the previous sessions without the Robot Activist. Seven questions about child rights still seems to be too heavy for the user to sit through with the Robot Activist due to the educational topic area. Johnson & Lester [20] argue that these advances in capability enrich the interactive user experience, but they also raise new questions about how users will respond to and use the technology. The educational programme provided positive results, such as "wow, first time I have seen a Robot Activist!" and "pupils learnt child rights agenda in a very innovative, fun and engaging way", stated firmly by the educators from SUHAKAM and schools' teachers. A controversial observation emerged is that pupils would love to interact with Robot Activist (the teaching assistant) and stay very focused to the Robot Activist' teaching, compared to the SUHAKAM educators.

Through the design and deployment of the Robot Activist, the research asserts that pedagogical agents can be of beneficial in educating human rights agenda, but not equally for all learning problems, applications, and learner populations. Although there is a growing body of research findings

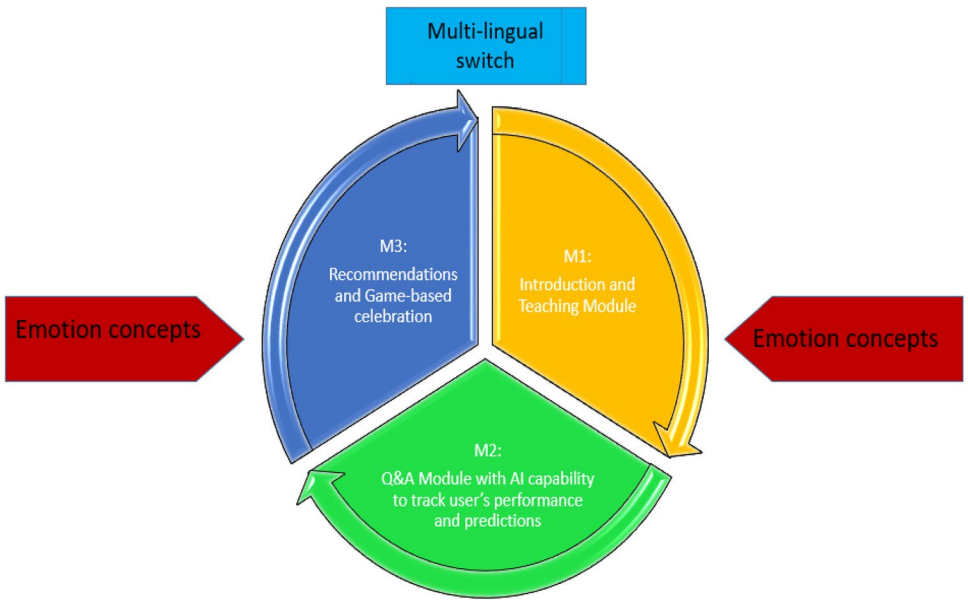

Fig. 11 The robot activist design and deployment framework

about pedagogical agents, many questions remain and much work remains to be done [20] such as technical language recognition and noise or echoes in the large assembly hall. NAO's speech recognition is poor in a noisy environment. Most participants assert that the voice recognition and noise filtering must be improved for various accents. Psychologically, students might feel difficult to interact with the Robot Activist if this is their first time speaking with a humanoid robot. Therefore, a user manual guide needs to be provided. The Robot Activist might not understand what the pupils say if their pronunciation is inaccurate or their voice is unclear. Thus, the Robot Activist should be able to react to the users and ask them to repeat their words. The Robot Activist can only recognise one voice at a time. If there are multiple voices at once, the Robot Activist cannot interpret the voice correctly and hence, causing voice recognition problem. Some constraints of the project are obviously the limited time frame and as well as a language barrier as some of the events are carried out in Malay while the robot activist will most likely be only programmed for an English speaking audience at least for the initial part of the project. Malay language may be considered in the future as another project or an extension to this one if there is time available. There are seven recommendations for the future works:

1. It is recommended that the pace of the dialogue be reduced manually by adding more stops in between words. It is also suggested to add a delay between the dialogue and behaviours as to make it seem more natural. It would also be helpful to retrieve the proper pronunciations from SUHAKAM, the content provider.
2. It is recommended to add more "emotion" concepts across all modules. This can be done by giving the Robot Activist more humanised characteristics. A break in between the questions where the robot continues with an interesting behaviour are essentials. It was noticed that the Nao robot will detect the answer of the person it is currently looking at much more optimally. Thus, it is recommended to face the Robot Activist and get it to detect the pupil before commencing the Q&A session.
3. It is also of note to mention that preloading the application made everything else run smoother as well (no lag), thus it is recommended to preload the application into the robot before showcasing it. It is also recommended to reduce the number of questions asked using a performance based decision-making algorithm.
4. It is recommended to inform the user to give the commands at a constant and steady speed so that the Robot Activist can recognise them more optimally. Since it is a pivotal part of the game to only react when the command is preceded by "Simon Say's", it is recommended to add functionality in phase two where the Nao robot will react appropriately to the implemented commands that have been issued without saying "Simon Say's" first. It is also recommended to give a general statement the robot can say if it is given an un-recognised command.
5. The Wi-Fi connection is a major constraint. NAO cannot connect to the school's Wi-Fi due to limited access and constraint proxy setting. NAO will react slower and its voice recognition will become less accurate if the Wi-Fi connection is weak. The work around is to insert the IP address to the institutional proxy server.
6. It is recommended to use Bayesian predictive algorithms to provide intelligent learning predictions, with multilingual switch.
7. For schools with more resources, it is recommended to use the latest NAO V6 model [34] with better capability, i.e. faster boot times, dual camera-mode, Dialog and QiChat enhancements including semantic engine (knowledgeAPI + sentence structure) that allows the robot to give clearer and more coherent answers. Interaction with the robot are much improved.
8. For schools with fewer resources, 3D printable robots such as EZ Robot[1] or Robot Baby Newton[2] is recommended for the similar child right education.

Hence, please see the following design framework proposed to enhance the Robot Activist programme in the next phase(s). The design framework can be adapted by other heavy-weighted educational subjects or use other cheaper model of humanoid robot as depicted in Fig. 11:

6 Conclusion and Future Work

The Robot Activist research undertaking being carried out for the National Human Rights Commission, SUHAKAM, which aims to spread awareness and educate with regards to child rights in an innovative manner. The Robot Activist comes with its own software framework as well as compatibility with multiple languages. The Robot Activist "behavior" that is to be developed for Nao will include three main functions: (1) the introduction where Nao will introduce itself and speak about SUHAKAM and child right convention. (2) The question and answer session where the Robot Activist will interact with the audience by asking questions about SUHAKAM and child right convention based on the initial introductory teaching. (3) Simon Says game. The Robot Activist are used by SUHAKAM at their seminars, social occasions, or any other human rights related events. A few key constraints that became evident from the deployment are (1) technical issues such as Wi-Fi connection; (2)

[1] https://www.ez-robot.com/

[2] https://bit.ly/3723zwj

speech recognition with ascent and pace of speech; (3) the question and answer session was quite tedious to sit through and lacked "emotion".

The Robot Activist framework proposed in the research, nevertheless, has the potentials for the future reference of educational agents research and design. One key future component is to develop multiple languages, e.g. Chinese and Tamil that are widely used across Malaysia. The Robot activist can then spread child right awareness to a bigger user base across the country. The application can also be expanded to focus on teaching and having dialogues about human rights, for instance, to have two robots instead of one where the two robots would conduct a "play" in which one robot would violate the rights of the other. From this play the audience could learn a valuable lesson about human rights. Having two robots conduct a play may bring to a final possibility for future work which is making the application more performance-based rather than dialogue. The recent report from the UK Parliament, Select Committee in AI [28] explains that the general public have an unduly negative view of AI, robotics and its implications due to employment are at risk for automation. The question, "will educators' jobs be taken by educational robots", is a potential threat posed in the heart of human teachers. Other key resistance to the acceptance of educational robots are the cost-effectiveness of robots and affordability; their limited application in curricular activities and partially unknown environments that were not originally designed for robots; speech recognition with different ascent and environmental noises; natural and multi-modal communication which mandates common-sense knowledge; and the lack of training of teachers and their inclusion in the robot's design [26, 29, 30]. These issues lies need to be resolve in the heart of the (1) continued development of hardware, natural language processing capabilities; (2) cost effectiveness for language translations capacity and highly motiving Robot Activist, as compare to human teaching assistant.

The Robot Activist research insert further controversial into the debates and bring new insights from the data of a real national deployment. We reject the view of replacing educators with robots but instead, the Robot Activist is still a long way to be a whole-rounded teaching assistant, in contrasting to human teaching assistant. Arguably, with the thoughtful design, i.e. proposed framework, the Robot Activist can of effective teaching assistant for structured educational tasks, fun interactions and predictive learning paths as "an extension of men" that can shape the child rights education agenda [31]. The Robot Activist can become a stronger message across the pupils—"the media is the message" as advocated by McLuhan [35]. We would argue that the Robot Activist can certainly be the novel "message" spreading across stakeholders to raise the child rights agenda.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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