

# **Language Bot: A Robot Teacher for Kids**

**I540 Final Report**

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Jacob Abbott, Achyut Sarma Boggaram, Yayun Zhang

{jaeabbott, achbogga, yayzhang}@indiana.edu

# **Language Bot: A Robot Teacher for Kids**

## **Problem Statement**

Robots have been used to teach many subjects to school kids since the emergence of technology in school education. While they are more motivating for kids to learn STEM subjects, few people have experimented with robots as teaching aid in language learning [1-9]. It has been proven empirically that learning a new language, especially second language, is challenging as children would not practice it everyday. Chang, C. W. et. al. 2010. [8] prove that robots can be of great help by enacting the role of foreigners in the classroom setting and thereby enable active and natural learning experience. Short-term studies such as [4, 5, 6] show increase in learning rate with using well-designed robots as teaching assistants. However, they also analyze many challenges with capturing student attention for longer periods of time. Long-term studies [1] suggest that one-on-one game playing type of interaction with rewarding mechanism increased attention span of interaction of students with robots. Furthermore, Feil-Seifer, D 2011. [3] study that minimal/incremental and stable/predictable interaction cues are very beneficial to grab children's attention. From our initial survey with center for language technologies [celt.indiana.edu] we have found out that "meaningful robotic interaction" acts on the right hemi-sphere of the brain as a great mnemonic unlike traditional teaching methods such as reading and writing which act on the left hemi-sphere. This enhances learning experience by making new vocabulary register very quickly and effectively in long-term memory. However, this "meaningful interaction" in second language learning is not studied in depth. We aim to address the challenge of design meaningful second language/vocabulary teaching robot with very minimalistic design and functionality and evaluate it with respect to standard conventions. Our

ideal robot would be mass-produced economically for further research and development of assistive technologies.

### **Literature Review**

Robots have been used to teach many subjects to school kids since the emergence of technology in school education. While they are more motivating for kids to learn STEM subjects, few people have experimented with robots as teaching aid in language learning [1,2,3,4,5,6,7,8,9]. It has been proven empirically that learning a new language, especially a second language, is challenging as children would not practice it everyday. Chang. C. W. et. al. 2010. [8] show that robots can be of great help by enacting the role of foreigners in the classroom setting and thereby enable active and natural learning experience. They also report on the design and testing of some other instructional scenarios (e.g. storytelling mode, oral reading mode) for teaching a second language.

Short-term studies such as [4, 5, 6] show an increase in learning rate with using well-designed robots as teaching assistants. However, they also analyze many challenges with capturing student attention for longer periods of time. Han et al. [6] looked at using robots in the home environment where children might have more of a one-on-one interaction with robots compared to studies of robots assisting with language learning in a classroom [5,6].

Long-term studies [1] suggest that one-on-one game playing types of interactions with a rewarding mechanism increased the attention span of interaction of students with robots. Furthermore, Feil-Seifer, D 2011, [3] study that minimal/incremental and stable/predictable interaction cues are very beneficial to grab children's attention. Distinctions between reactive

and proactive mechanisms for robots to engage children were tested by Fink et. al [11] and found the mechanisms elicited different reactions from children.

From our initial survey with center for language technologies [celt.indiana.edu] we have found out that “meaningful robotic interaction” acts on the right hemisphere of the brain as a great mnemonic unlike traditional teaching methods such as reading and writing which act on the left hemisphere. This enhances learning experience by making new vocabulary register very quickly and effectively in long-term memory. However, this “meaningful interaction” in second language learning is not studied in depth.

We aimed to address the challenge of designing a meaningful second language/vocabulary teaching robot with very minimalistic design and functionality and evaluate it with respect to standard conventions. Bethel and Murphy [10] discuss physical aspects of robot design and how color, movement, and other aspects of a robot can have an impact user perception. We hope to avoid the disconnect between people giving positive feedback for our robot, while simultaneously suggesting that it would not be something they would use, similar to opinions found by Neven [12]. Our ideal robot would be mass-produced economically for further research and development of assistive technologies.

### **Design research methods**

In order to conduct research for our design we implemented a semi-structured interview method with each team member interviewing a different subset of populations. Jacob interviewed 4 teachers who primarily dealt with children between the ages of 5 and 12. He asked the instructors about different techniques they found helpful in keeping children engaged in class or to pull their attention back if they start to lose focus. He also investigated which topics or

activities children had more difficulty with and if the teachers had any previous interaction with robots before. We asked what aids teachers currently used in class and whether they thought a robot might be useful as an aid and how they imagined a robot assisting as a teaching aid. From the research we are taking the responses from our semi-structured interviews to adjust some methods of interaction and planning to add some additional movement and sound in order to help draw more attention to the robot and encourage prolonged engagement. Yayun interviewed 5 IU students who are currently learning or have taken foreign language classes in the past. She asked them questions about how they acquire new vocabulary, how often they practice newly learned words, what aids they used in class and whether they found them to be helpful, how they think about having a teacher robot in the classroom (see appendix A for the whole list of questions).

### **Research results**

**Teachers:** Initial interviews revealed some distinct themes that teachers brought up regarding their classes including:

- 1) Interaction and energy are important for keeping and calling back attention.
- 2) Use of games for teaching aids prevalent in all responses.
- 3) Small activities to engage children desired for a robot aid.

One teacher had previously interacted with a Plio robot, but not in the context of a classroom. They expressed a great interest in using a robot as a teaching aid to assist in facilitating small games for students to play. Other teachers expressed an interest in robots as teaching aids, but reported no previous experience with robots.

The results from our semi-structured interviews led to our adjustment in some additional communication and modality aspects of design. The feedback of using more verbal and physical movement cues to call attention to keep children focused or to regain their attention is an important reflection of our research. The adjustment of modality to include the option to choose between a game and study mode would facilitate a better experience for the teachers to use as an aid in their classes.

**Students:** By interviewing 5 college students, we found that:

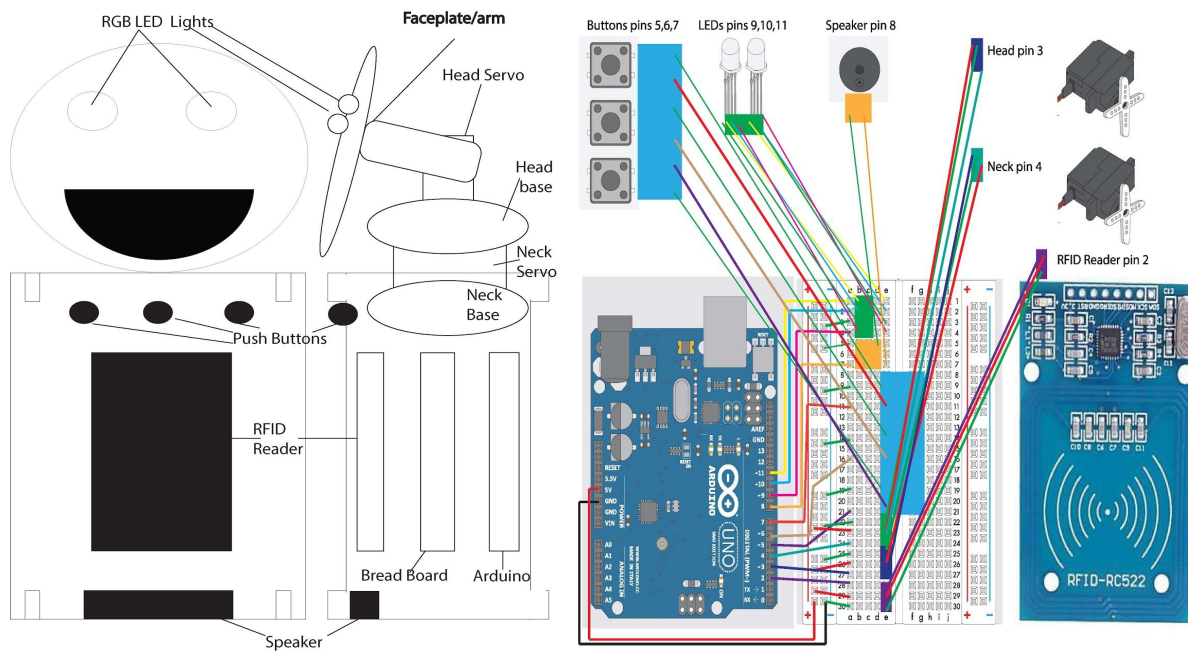
1. Some students are more open to having robot teachers in classroom than others. One student mentioned that if robots can understand not-so-perfect pronunciations, then they can help learners correct it. One other students said that she needs to see someone's mouth and ask questions about how exactly they are saying the words to get the pronunciation correct. So she would want a robot to do that.
2. Common media students use to study languages are books, audio recording. Some students also used movies, videos, and songs. For example, in one student's French classes, students learned songs to remember verb conjugation, and rhymes to remember words for things. Also, they also got up and said the French words and performed the corresponding actions to hammer it in our brains.
3. Most language classes are on a daily basis. However, time learners spent on practicing after class vary. Some students would practice when the environment permit, some practices mainly before tests.

4. People also different strategies for remembering new vocabularies. Some students prefer auditory input by listening to others speak or saying words out loud, other prefer more visual method and try to remember words by their spelling.

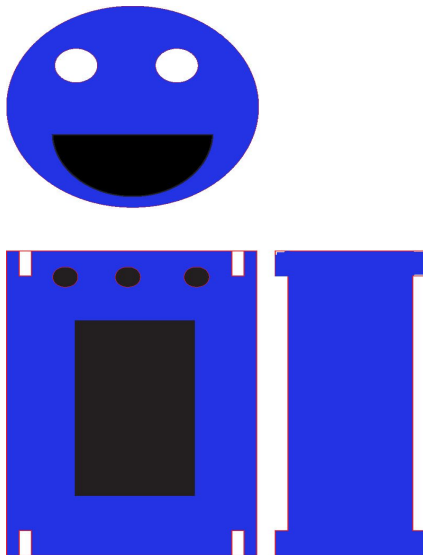
Although people still have some concerns regarding how well robots are going to function in classroom settings, all students have positive attitudes towards robots. One thing we should consider incorporating in our design is we should try to provide both auditory and visual feedback to students as they may have difference preferences. Also, it would be nice if our teacher robot is also portable, so students can practice and get feedback whenever they need. Most student have never interacted with robots before, so portable robots also allow students to spend more time interacting with robot teachers and encourage students to use them more frequently.

## HRI Prototype Design

### Initial Sketch, Schematic, and Description (see Appendix D & E for more details)



### Language Bot Sketch



### Language Bot Body Sketch

### Language Bot Schematic

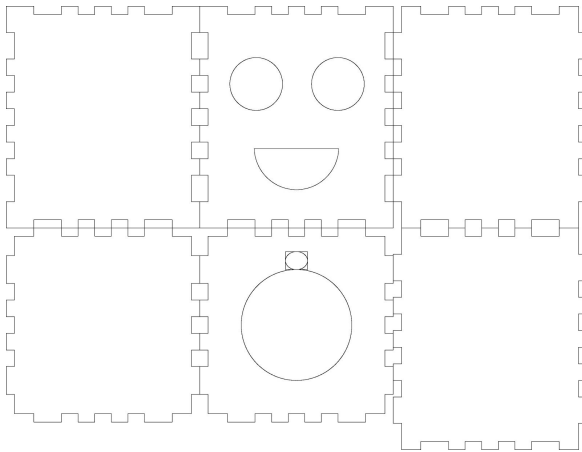


### Language Bot Body Prototype

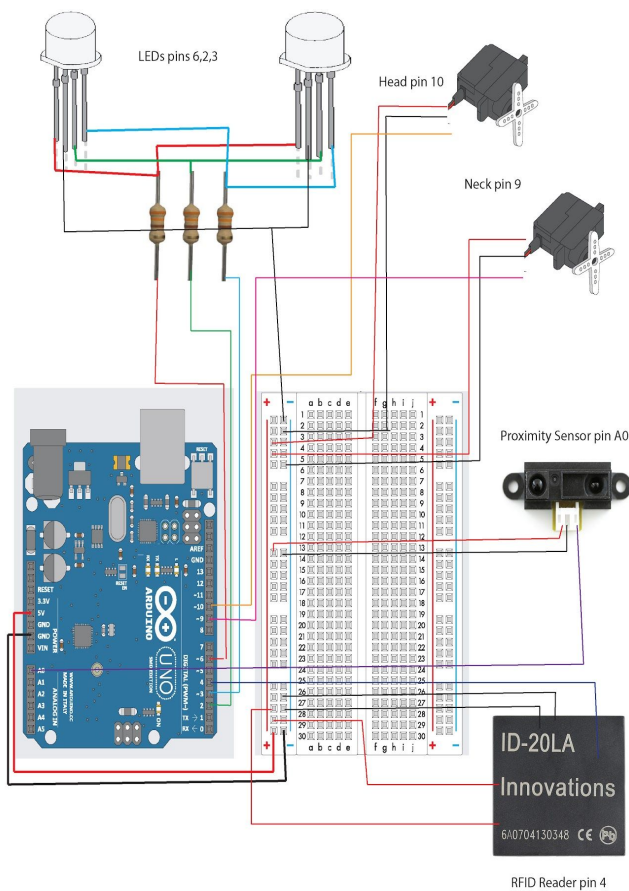
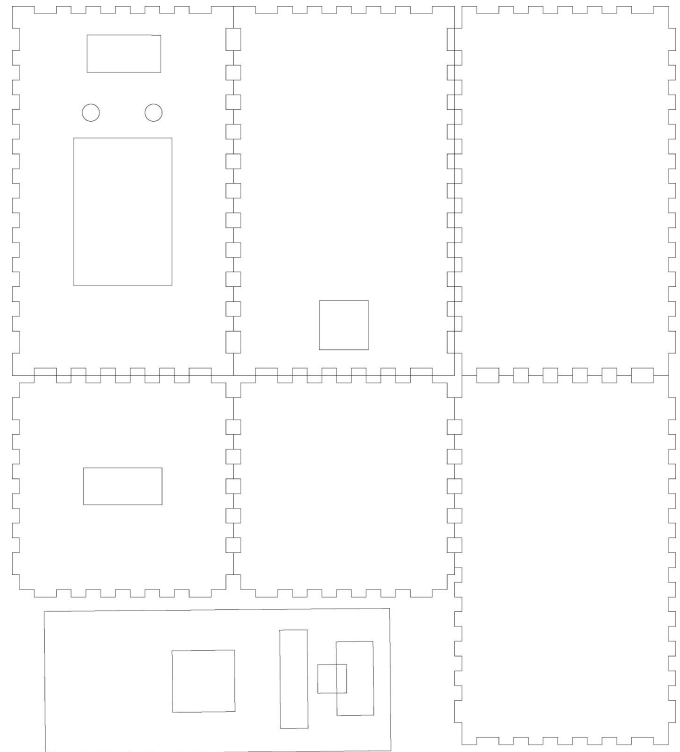


## Presented Sketch, Schematic, and Description (see Appendix D & E for more details)

### Language Bot Head



### Language Bot Body



### Language Bot Schematic

### Language Bot Final

## **User Evaluation**

We acquired evaluations from a mix of populations after the completion of our Language Bot prototype. We received some comments and evaluations from other students presenting and exploring the Fall Symposium, as well as from a variety of faculty members who attended the Fall Symposium to judge different projects. Our group also got additional evaluations from other people after the Symposium through the use of photos and video of our Language Bot prototype.

### **Student Evaluations**

To get some user feedback, we asked some students from the Psychology department and Media school to watch our robot videos/pictures and fill out our questionnaire listed in Appendix B. Some questions are skipped because they require users to interact with the robot for a longer period of time. Most people reported that they were willing to interact with the robot for about 10-15 minutes at least. They think Language Bot is a very user-friendly robot and they can easily learn at least 5 words during the interaction. They found our robot to be very engaging and they felt comfortable interacting with it, such as repeating after the robot or answering robot's questions. In general, people like the robot, especially its appearance. However, people have different opinions in term of how knowledgeable they think the robot is and how much they would like to trust the robot.

Some people believe that Language Bot would a great addition to have in class when teachers are not around, but teachers are still helpful and more effective as they can provide more real-time feedback. When asked about the benefit of having different modes, people also have very different opinions. One user believes that having different modes is very beneficial as it will keep kids attentive and allow them to interact with the robot more. Another user thinks that

parents or teachers need to have some control over how often kids switch modes or there need to be some built-in sequences of switches. For example, kids can only change to play mode after the learning mode, or they can only stay on play mode for a certain amount of time. People also think that this robot is very portable and easy to carry around, it could be a very useful teaching tool for both parents at home and teachers at school. Some suggestions people have in terms of improving the robot's' design and other features:

1. Keep robot voice consistent. Kid's voice would be ideal
2. Add multiple languages so kids can learn words in different languages at the same time
3. Add a screen, so kids can see the spelling of the word and lip movements in addition to the sound
4. Soft body
5. Instead of repeating the same sentence over and over, we can add more sentences with various structures in different contexts
6. Add more instructions on how to use the robot and what functions it has
7. A more responsive robot that can understand user's command and talk back to them

### **Symposium Evaluations**

Multiple students from various classes presenting their own projects wandered around to other booths and visited our project. Many of the students mentioned the design of the Language Bot and commented on how cute it was and how they automatically viewed it as something for children based off the design. Very few students looked at the accompanying poster (see Appendix C) and solely focused on the robot. Quite a few students were excited by the idea of being able to select multiple languages and thought the RFID cards were cute, yet they did not

inherently know how to use the rfid cards. It was observed that many people thought the proximity detector was a camera to identify the cards and had to be instructed that the RFID cards had to be held to the robot's body to be detected.

Different faculty members also stopped to inspect the Language Bot prototype and had some additional insights as well as repeating many of the comments from students. Faculty members saw the design of the robot and interpreted that it was designed for children and were surprised that we had multiple languages. A few instructors specifically referenced the idea of being able to upload multiple languages and add new cards to the robot, and made suggestion of adding more languages that might not as readily be studied, such as Czech for one example, due to a typical lack of available materials. Some instructors asked how the Language Bot would teach additional parts of language such as verbs or adjectives since nouns are typically easier to represent through pictures, and suggested that we consider how to make more complex actions be represented for use with the RFID cards.

### **Additional Evaluations**

We presented photos and video of the Language Bot prototype to the teachers previously interviewed and took general impressions of their reaction and evaluation of the prototype. All of the teachers commented on the prototype's appearance and how they thought it was cute and something that would attract the attention of children. They were unsure how long the robot could keep the attention of children in the long term, but thought kids would enjoy using it. They expressed similar concerns as some of the faculty members regarding how to convey more complex ideas using the robot, but overall they enjoyed the prototype. They were positive with

their reactions to using the RFID cards to convey the words and liked the idea of being able to update and expand the vocabulary the robot could use.

### **Reflection**

Throughout working on the Language Bot we learned that there has been significant work done already in teaching children with the use of robots and many of those studies revolved around teaching English, yet we attempted to look at a robot that could be used for multiple languages citing the ability of young children to more rapidly learn languages than adults. We got interesting insights and advice from people we originally spoke with while brainstorming and preparing the initial prototype design. After we managed to finalize the design for our prototype, we learned some interesting things about our Language Bot.

Some highlights included that people enjoyed the cute face and body from an aesthetic point and thought it fit well with the target of teaching children. We received positive feedback in regards to how the robot's eyes lit up and the head movements. Many people also expressed positive feedback on the concept of Language Bot and suggested they would like to see something like our robot in classrooms.

Like in any prototype there were some drawbacks that we found in our design. Placing the proximity sensor to detect when people are around and ready to interact with the robot in an area that people could easily see it led people to assume it was a camera. Many people tried to hold the RFID cards used to interact with the robot up so the sensor could see them and recognize the image. We also found that the head was difficult to attach to the servo we were using and suffered problems of stability. We discovered that after we attached all the components together that something was interfering with the RFID card's ability to function, but

unfortunately we were unable to correct this by the time of the presentation, so we performed the demonstration using a Wizard of Oz method for the Fall Symposium.

Language Bot transformed slowly over the course of the research and design process and our team made iterative changes as we gathered information from literature, interviews, and discussions. We believe that there is ample room for further investigation and research in the area of robot assisted language learning for children especially in the area of multiple language acquisition. Another aspect of robot assisted language learning that is not addressed by Language Bot and seems to have limited representation currently in the literature is robot assisted language learning focusing on the written aspect of language as opposed to verbal.

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## **Appendix A: Interview Questions**

### **Interview Questions for Teachers**

What subject do you teach?

How old are the students you teach?

How many students do you typically have in one class?

When teaching a new concept or vocabulary, do you find any techniques useful in keeping the students engaged?

If students lose focus, how do you usually pull their attention back to the topic?

What topics do students usually have the most difficulty with?

How would you want to interact with a robot as a teaching aid?

What would you imagine it doing?

### **Interview Questions for Students**

What language do you study?

How long have you been studying this language?

When learning a new set of vocabulary, how do you practice and study the information?

How often do you practice speaking vocabulary aloud?

How would you want to interact with a robot for learning another language?

### **Interview Questions for Both Groups**

Have you ever interacted with a robot before?

Do you believe a robot could be an aid in learning and practicing vocabulary?

What aids do you use for your classes?

## **Appendix B: Evaluation**

### **Observation:**

We will evaluate our prototype by watching how people interacting with it and also asking their feedback via questionnaire. During our observation, we will pay attention to the following aspects:

1. How long did the user interact with the robot?
2. How easy is it to use?
3. How many words did the user learn?
4. Are users engaged with robots? E.g. repeat after the robot, answer robot's questions, etc
5. Is the whole interaction smooth? Did the user seem to be happy, bored, or confused during the interaction?

### **Questionnaire:**

We will also ask users to fill out a questionnaire after interacting with our prototype for a week.

Some questions include:

1. Do you like this robot?
2. Do you like the look of this robot?
3. How often did you use it? How long did you use it in one sitting?
4. How effective is the robot in terms of helping you learn new words?
5. How many new words did you learn?
6. Do you think you learn more words using robot compare to without?
7. Is the robot interactive/friendly?
8. Do you think the robot is knowledgeable?

9. Do you find the multiple learning modes distracting or helpful?
10. Will you keep using it in the future?
11. Will you use this robot in classroom? At home? In library?
12. What do you like the most about this robot?
13. What do you dislike the most about this robot?
14. What changes do you want to make? Why?
15. What other features do you want this robot to have? Why?

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## Goal

Robots have been used to teach many subjects to school kids since the emergence of technology in school education. While they are more motivating for kids to learn STEM subjects, few people have experimented with robots as teaching aid in language learning. We aim to address the challenge of designing meaningful second language/vocabulary teaching robot with very minimalistic design and functionality and evaluate it with respect to word learning in school settings.

## Design Research

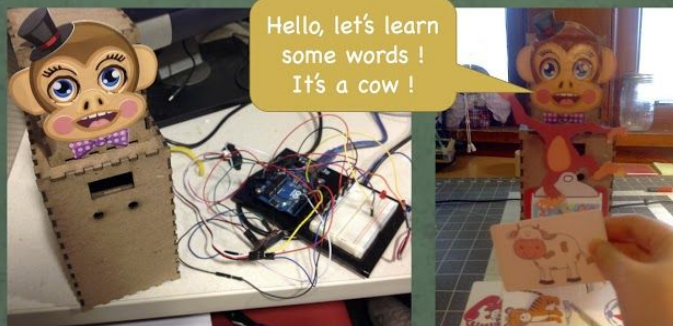
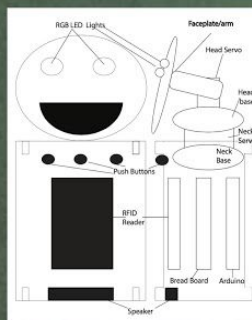
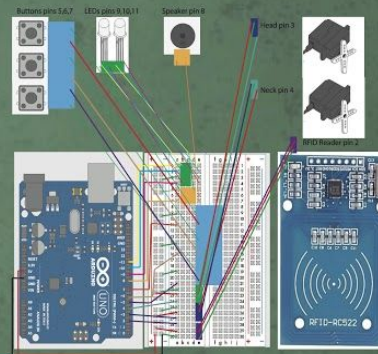
In order to conduct research for our design, we implemented semi-structured interviews with 4 elementary school teachers and 5 undergraduate students. We found that:

- 1) Interaction and energy are important for keeping and calling back attention
- 2) Use of games for teaching aids prevalent in all responses
- 3) Small activities to engage children desired for a robot aid
- 4) Individuals' learning environments and learning styles vary a lot

## Prototype

Robot Features:

- 1) RFID: We use a RFID reader to identify objects on the flash cards
- 2) LED Lights: robot eyes will flash and change color to keep kids interested and attentive
- 3) Buttons: buttons allow kids to switch among learning and quiz modes
- 4) Servos: Two servos allow language bot to nod or shake its head when giving kids feedbacks
- 5) Speakers: speakers allow the robot to pronounce the words and provide other verbal feedbacks



## Evaluation Plans

- 1) Bring our language bot to classrooms and get feedback from both teachers and children on what they like and dislike about our design
- 2) Give parents and teachers surveys to assess how often their kids use Language bot and how many word they can learn and test kids' vocabulary

## Future Work

- 1) Add more features that allow personalization of the robot, such as designing robot to remember the words each individual kid has already learned
- 2) Improve robot looks to make it more kid-friendly
- 3) Bring it to other learning contexts, such as home

## Appendix D: Robot photo and videos



<https://drive.google.com/open?id=0B212cCczck6JNGdkVEUzQ1EySVU>



## **Appendix E: Code**

[https://github.com/achbogga/Robo\\_Guru](https://github.com/achbogga/Robo_Guru)

[https://drive.google.com/file/d/0B\\_MfT2oO1aXON2wxajVvT3BuM3c/view?usp=sharing](https://drive.google.com/file/d/0B_MfT2oO1aXON2wxajVvT3BuM3c/view?usp=sharing)