Design Studio 1 - RobotKid

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Introduction

We are creating a RobotKid for those who are unable to be in a classroom physically. Those who use our robot will be able to move around the class, talk to peers, and, overall, have more of an interactive setting than a normal meeting app such as Zoom. The instructors will also benefit from being able to see their students in the lectures as well, rather than constantly checking an app to see if the student needs anything. We are making RobotKid with the idea that students learning online can have the ability to be in-person like their peers.

Functionality of RobotKid

Goal of RobotKid

RobotKid is a software company with the goal of creating an outstanding virtual learning experience. The first launch of RobotKid will be implemented in Universities and will eventually be offered to elementary and high schools. This first iteration of RobotKid will take existing platforms and enhance them to create a more interactive learning experience. Using identifiable and familiar interfaces will make an easy transition for students. In this proposal, we will address three approaches for creating a new experience for virtual learning. The first two are implementations we will not be further developing but have pulled insights from. The final approach has elements from the first two approaches but creates a more enhanced and inclusive solution.

Application Design

The underlying essence for this design is the idea of accessibility (being more inclusive) and giving users an experience beyond what other remote learning software (such as Zoom) offers. For the application design, we have sketched out an idea of what the audience will see when they open the application (located in Artifacts 2.1). There are two modes after logging into the application and booting up the robot: lecture/teacher viewing for when class is in session and a moving mode where students can talk to their peers or move around campus. For moving with the robot, students can utilize our touchpad, collision detection, and GPS to efficiently maneuver the robot. Options such as mute and raise hand will be placed in the lower left-hand corner of the screen, while not intruding on the student’s view. Less used options such as FAQs and feedback will be grouped together in one button, on the bottom left-hand corner as well. When a robot is running low on batteries (10%), a warning will appear on the screen telling the user that a charge is needed. For any blind or visually impaired users, they will have the option for voice controls to access these functions. Another bonus feature of our software includes the security, tap-authentication method (for visually impaired users) in order to log-in to our application (PassChords-like, Artifact 1.2). Any feedback given from our users will contribute towards us improving the current application design.

For the teacher (Artifact 2.1), the application will have a screen showing a whiteboard/video/screen share, participants on the side, and a direct messaging board. The teacher will have multiple options of muting, stopping video, kicking participants, and sending polls. Any feedback from the teacher will also result in the improvement of the design for instructors.

Interaction Design

When it comes to understanding interaction design with RobotKid, one of our main goals is to first deliver this product to university students and instructors. With this in mind, the design interface is centered around a user-friendly main screen with which the instructor will display and edit content. Referring to Artifacts 2.1, multimedia buttons such as mute, toggling webcam, and raise hand function are made visually apparent on the screen, but not obtrusive. Within the Learning Mode, students and instructors can interact with each other through switching screens and sharing a chat room in order to create a more inclusive learning environment. Other features which would be unique to the instructor would include creating public polls, receiving private messages, kicking unauthorized or disruptive users, control of the main screen, and giving permission to speak or share content to a student.

In terms of physical interaction design with RobotKid, there are several approaches the team has considered with how students or instructors would interact with the software. Such examples are external usage of a touchpad, an app emulating a touchpad or the use of a touchscreen with the RobotKid monitor. All of the features discussed previously will be accessible with any of the mediums mentioned above without any disruption to the learning experience. Another form of physical interaction would be collision detection and sensing the nearby presence of humans, animals, or any other moving object in order to not disrupt the everyday flow. Also, the feature of having the TeleRobots go to places like the library would allow users to interact with other students studying or doing group work, in addition to having a collaborative whiteboard. Having these modifications will allow students with disabilities to be able to use the robots with the necessary modifications.

Approach 1

The first approach we developed but didn’t choose was creating a robot with “all the features”, or creating a robot with the most functionalities and features that could do the most. This approach focused on creating the robot with the most capabilities that would expand teachers’ capabilities to teach remotely and students’ capabilities to interact with the environment around them by controlling the telerobot. Teachers would be able to interact with students and students with each other in a more meaningful and specific way through remote communication, but the UI would become too complicated and would not be user friendly to all users, especially those that are not as adept with technology or are not familiar with using more complicated software.

The cost would also be another barrier to this solution being viable, as features such as a 360 camera and an OLED display would add significant costs to the robot which are largely unnecessary for general education purposes. Additionally, adding availability for fingerprint or facial recognition log in would not add significant costs, however, they are unnecessary (two-factor authentication is secure for student purposes) and require the user to have certain software capabilities that socioeconomically disadvantaged students may not have access to. These are accessory features, so this version of the robot is not a feasible option to sell given the cost to build the robot compared to the potential profit margin.

Approach 2

The second approach that we developed but did not choose was creating a user-friendly option. This approach focused on creating a system that put the at-home students first. Keeping the at-home students in mind and the intent to create an environment of ease and efficiency for virtual learning, this approach featured stationary robots in each classroom. Having robots assigned to each room would put less stress on the students to find and control the robot. With the robots stationary, there will be less chance that things could go wrong. Having less control of the robot would allow the student to focus on the professor and class material.

The main goals of this approach were the ability to see the board and room, the ability to speak, and the ability to have a physical raise hand feature. The student would also be able to chat via the robot speaker. The security for the robots would include a two-step authentication method, either by phone or email.

One reason we did not choose this approach is that it did not offer enough features. This approach would allow the students to have a physical presence while not physically being there. The student could be at home but physically be represented by the robot. Regardless of the many benefits this approach offers, the solution seemed too close to what Zoom already provides. The only difference would be that the student would get a physical presence in the classroom rather than just having a name on the screen.

While this robot is the most user-friendly for able-bodied students it doesn't take into consideration those individuals with disabilities. This approach did not address those individuals that might not be able to use the robot in the same way. This lack of inclusion was a contributing factor to why our team did not pick this approach. Learning from this approach, we wanted to assure those individuals were a priority in the software and UX design.

Approach 3

Goals

a. **Robot Student View**
    i. Android, iOS, and web app software that students use to interact with the robot
    ii. Upon first login students will be guided through a tutorial on how to use/ navigate the robot
    iii. Be able to see the board/room
        1. Can switch between teacher and teacher’s screen share
    iv. Listening/speaking capabilities
        1. Can mute/unmute
    v. Video capabilities
        1. Can show/un-show video
    vi. Raise hand feature
    vii. Display battery life
    viii. Ask questions in Q&A panel
    ix. Ability to answer polls the teacher sends students
        1. Answer one question for multiple choice
        2. Answer as many as they want for multiple select
        3. Type a short answer for open-ended text-based answer questions
    x. Ability to view poll answers teacher sends
    xi. Ability to move robot camera 180 degrees
    xii. Ability to see all participants
        1. Bar on the top of the screen
        2. Bar on side of the screen
        3. Gallery view
    xiii. Ability to create own breakout room or join different breakout rooms given permission by the teacher
    xiv. Collaborative whiteboard
        1. Students can use the teacher’s whiteboard when given permission by the teacher

    2. Students can have their own whiteboards which can be shared with other remote and in-person students using the software
    3. Whiteboard capabilities - write text, draw, make shapes and lines, erase, zoom in and out, expand and shrink whiteboard size, add new pages

xv. Login with password
    1. Sign up with two-factor authentication
    2. Log-in with Duo two factor authentication - use phone to confirm your log-in

xvi. GPS/navigation - robots move automatically given a destination
    1. Helps robot find students classrooms
    2. Helps robot find nearest charging station with available charge docks) after student logs off and return to it
    3. Helps students find buildings and areas on campus when using robots outside of the classroom - the robot moves on its own after destination is set

xvii. Collision detection
    1. Prevents robots from crashing into people when going to classrooms
    2. Prevents robots from crashing into people when returning to the dock
    3. Prevent robot from crashing into other students or objects when going to the destination set by student - for use outside of classrooms

xviii. Charging station where robots automatically head to when not in use - given available charging docks

xix. Twenty Percent threshold to log in and use a robot

xx. Students can connect to a robot at the nearest location to the student’s class with the highest charge level (given robot charge above 20%) - nearest station

xxi. For longer lectures, make sure the robots are able to be used throughout the day - with charging docks in classrooms

xxii. If the robot does not charge when docking at the panel, find another charging dock

xxiii. Robot software connects to student’s schedule on log-in, and student automatically connects to a meeting room at the scheduled time

1. The nearest robot with a charge above 20% will undock and start moving to the classroom at the appropriate time to make it to the student classroom at class time

xxiv. The phone app that updates students on robots position
   1. Alerts students when the robot has undocked from the charge station and is on the way to the classroom
   2. Alerts students when the robot has docked inside the classroom

xxv. Students can log in and see video of the robot, move the camera, and hear audio while
   1. The robot is auto-routing to the classroom or docking station
   2. The robot is auto-routing to another area on campus given student is using the robot outside of the classroom
   3. When the robot is in a classroom or in use at any time by the student

b. **Collaborative Student View - a stripped-down version of Robot Student View meant for In-Person Students to interact with Remote Students (does not involve physical Robot), and to make in-person learning experience more dynamic by supporting another way to ask questions and view the teacher and presentation**

   i. Android, iOS, and web app software that in-person students use to interact with remote students

   ii. Be able to see the board/room - may be difficult for some students to see far, or they may have an awkward angle in relation to the screen
      1. Can switch between teacher and teacher’s screen share

   iii. Listening/speaking capabilities
      1. Can mute/unmute

   iv. Video capabilities
      1. Can show/un-show video

   v. Login with password
      1. Sign up with two-factor authentication
      2. Log-in with Duo two factor authentication - use phone to confirm your log-in

   vi. Collaborative whiteboard
      1. Students can use the teacher’s whiteboard when given permission by the teacher
      2. Students can have their own whiteboards which can be shared with other remote and in-person students using the software

            3. Whiteboard capabilities - write text, draw, make shapes and lines, erase, zoom in and out, expand and shrink whiteboard size, add new pages
    vii. Ability to see all participants
        1. Bar on the top of the screen
        2. Bar on side of the screen
        3. Gallery view
    viii. Ability to create own breakout room or join different breakout rooms assuming given permission by the teacher
    ix. Ask questions in Q&A panel
    x. Ability to answer polls the teacher sends students
        1. Answer one question for multiple choice
        2. Answer as many as they want for multiple select
        3. Type a short answer for open-ended text-based answer questions
    xi. Ability to view poll answers teacher sends

c. **Teacher View**
    i. Login with password
        1. Sign up with two-factor authentication
        2. Log-in with Duo two factor authentication - use phone to confirm your log-in
    ii. Android, iOS, and web app software that teachers use to interact with remote students
    iii. Listening/speaking capabilities
    iv. Video capabilities
    v. Collaborative whiteboard
        1. Whiteboard can be the view of the screen being shared with students
        2. The teacher can control which students can or cannot edit the whiteboard
        3. Whiteboard capabilities - write text, draw, make shapes and lines, erase, zoom in and out, expand and shrink whiteboard size, add new pages
    vi. Be able to screen share and ability to see what is being shared with students
        1. Can be a computer screen, tab on the computer, or collaborative whiteboard, or teacher’s own camera
    vii. Ability to see, answer, and resolve questions in Q&A panel
    viii. Ability to send polls to students
        1. Can see all answers in one panel with names

2. Can send one answer multiple-choice, multiple select or open-ended question poll
3. Can end poll at any time
    a. Can show poll results to students - percentages for one answer multiple-choice and multiple select, or an open-ended answer to an open-ended question - anonymously

ix. Ability to mute all participants
x. Ability to ask students to unmute or show video
xi. Ability to spotlight students on screen
xii. Ability to switch between video and screen share
xiii. Ability to keep participants out of a class
xiv. Ability to see all participants
    1. Bar on the top of the screen
    2. Bar on side of the screen
    3. Gallery view

xv. Ability to pre-assign students to breakout rooms or randomly create breakout rooms that equally split students (most even splits)
xvi. Ability to give students permission to create their own breakout rooms of a certain size (can control max size)
    1. Students can either create a room or enter into an existing one

xvii. Ability to close breakout rooms and jump between breakout rooms
xviii. Ability to give a time limit to breakout rooms
xix. Ability to give a one-minute warning to close breakout rooms

Constraints

d. Constraints

i. Hardware; we can only go so far as what available hardware is already there.
ii. Financial situation: the company doesn't have any problem financially, but we would need to get funding for those who want to use it
iii. Sticking to scheduled meetings and deadlines with the company and stakeholders.
iv. Tutorial and software, in general, is intuitive and easy to teach and use, even for people with less experience with technology
v. Battery life to get through 6-7 hrs and interchangeable battery in case charging doesn't work before meeting

vi. Ability to navigate without colliding with people and objects when robots are going to and from classrooms and returning to charging stations
vii. Has to lock into charging docks (at charging stations and charging docks in classrooms) while charging - to prevent theft
viii. Has to check for updates and auto-update during inactive hours - set by “administrator” of the university in backend when setting up robot software
ix. Compatible with IOS, Android, Linux, PC, etc.
x. Software is well documented for teachers and IT support either front the company selling the robots or the school can diagnose any issue that comes up with the software

Assumptions

e. **Assumptions** - suppositions **without** immediate proof that entails our software.
   i. Teachers will have taken a course on proper training prior to the beginning of the school year, knowing the ins and outs of the telerobot’s features in case they need immediate assistance in class.
   ii. Teachers and/or IT support from school will be available to help students learn how to use software
   iii. Teachers will have live chat with the contracting company and IT support from the school.
   iv. We assume that there is adequate Internet connection throughout the institution, as our software will be based on connectivity.
   v. We assume that the audience (specifically the teachers and the students in the classroom) are comfortable with being with and interacting with the TeleRobot(s) in an educational setting.
   vi. We assume that the software being implemented will be able to run in most OS, such as Windows/macOS/Linux for PC, Android/iOS for mobile devices.
   vii. We assume that the institution is heavily-equipped with inclusive technologies for the TeleRobot such as sensors for the door to open, charging stations around different parts of campus for ease of access, charging docks in classrooms and other buildings, ramps dedicated to maneuverability, etc.
   viii. We assume that the institution would have a budget NOT ONLY to purchase enough TeleRobots for users, but also to provide extra

features such as enough charging pads for classrooms (longer lectures).

ix. We assume that socioeconomically disadvantaged students who may not be able to afford the proper technology to access the software will be provided with the proper equipment by the school
x. We assume our engineers are skilled enough to create the software we design and within cost and time constraints
xi. We assume robot sensors can sense far enough to avoid collision using collision detection

Audience

f. **Audience** - people who will **directly** interact with our software.
    i. Students that will use the software.
    ii. Classmates that will be with the presence of the TeleRobot.
    iii. The teacher will manage and oversee the use of the TeleRobots in the classroom.
    iv. IT Support and Hardware Mechanics that will maintain the TeleRobot.
    v. The school/institution itself.
    vi. (For library) Librarians who will keep track of the TeleRobots being used inside the library.

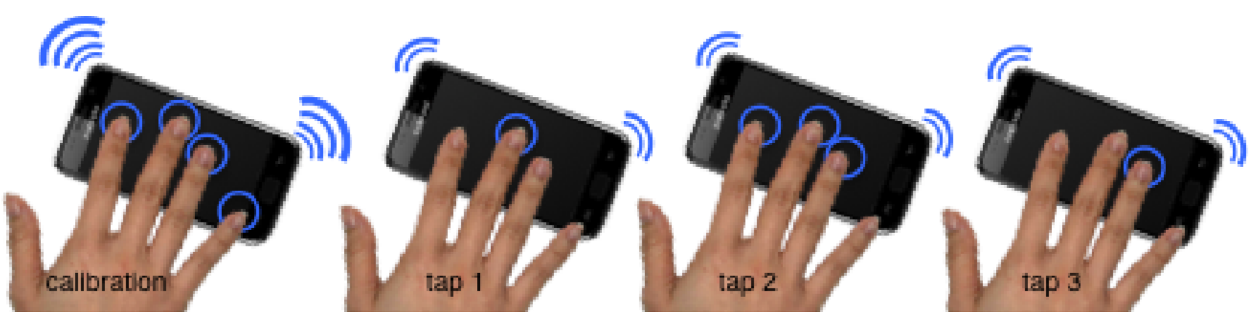
Stakeholders

g. **Stakeholders** - people who will be **affected** by our software
    i. Universities partnering with the RobotKid company will need to fund both software and hardware unless subsidized.
    ii. Maintenance workers such as IT support or mechanics will be given opportunities to work for the RobotKid company
    iii. Federal or state governments could be involved to subsidize the RobotKid company to provide for educational institutions.
    iv. Insurance companies would provide coverage for any cause of a RobotKid that cannot function properly due to damage or bugs.
    v. People who are not students but visit campus.

Artifacts

1. **Robot Hardware Artifacts:**
    1.1. Touch pad example:
    https://www.amazon.com/Keymecher-Precision-Multi-Gesture-Bluetooth-Rechargeable/dp/B08686K1YX/ref=asc_df_B08686K1YX/?tag=hyprod-20&linkCode=df0&hvadid=459623382939&hvpos=&hvnetw=g&hvrand=15398152404701543888&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9031326&hvtargid=pla-961020543528&psc=1

    1.2. PassChords (non-visual authentication method):
    PassChords (non-visual authentication method)



1.3. Docking station:
https://store.irobot.com/default/roomba-vacuuming-robot-vacuum-irobot-roomba-clean-base/4626191.html?source=google&medium=cpc&ds_campaign=US_EN_ACCS_SHOP_CNV_Roomba_Accessories&ds_content=Roomba+i+Series+Accessories&ds_keyword=PRODUCT_GROUP&&_campaign=&gclid=CjwKCAjwws

mLBhACEiwANq-tXAvNIfHjf6w_QVjIGIGdiWjCZKVopUBZ_yhhA5VhqKxVEQ9cn_AEyxoCKPQQAvD_BwE&gclsrc=aw.ds

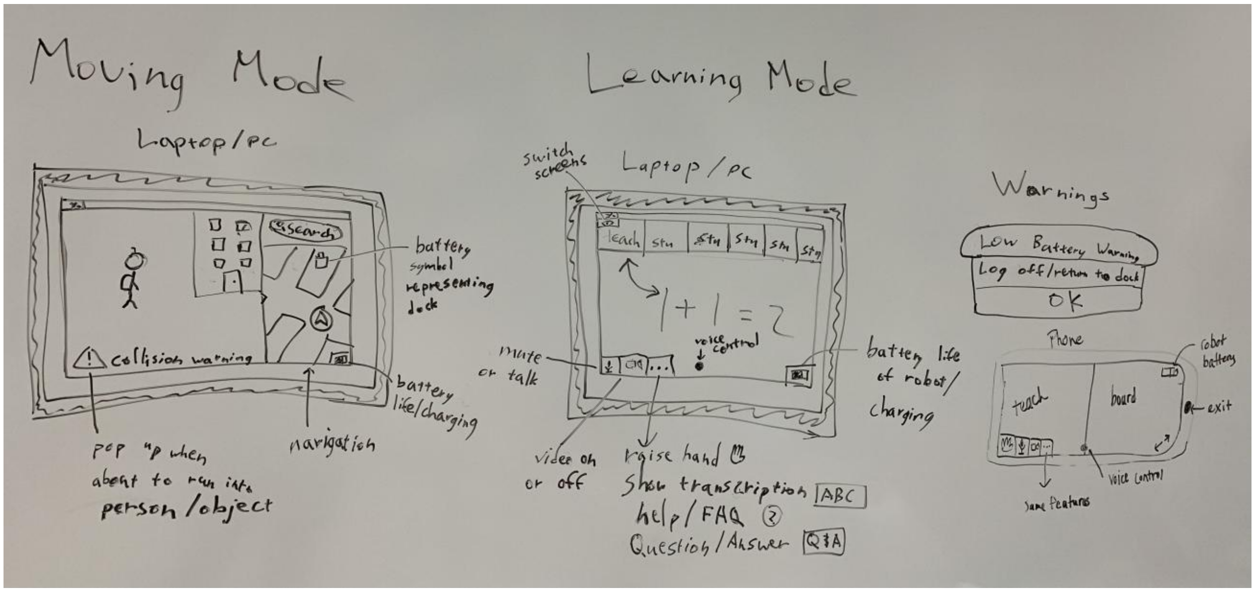
1.4. Robot Physical appearance:

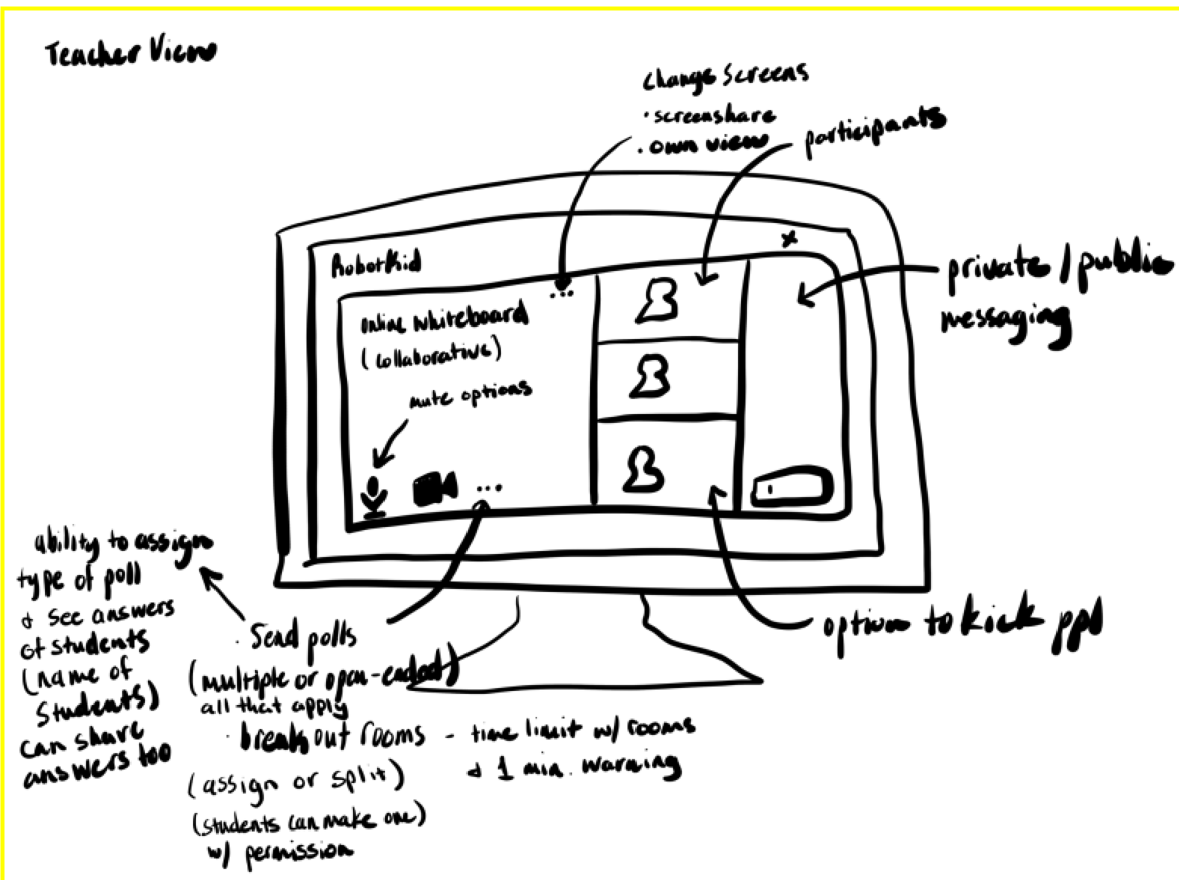
RobotBodySchema

Nao - humanoid robots from Softbank Robotics (formerly Aldebaran). The robots are used for developmental robotics as well as human-robot interaction research.

2. **Interface Artifacts:**

2.1. Whiteboard prototype:





Appendix

Design Studio Part 1

Group Member Names:

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Design Studio 1: TeleRobot!
We are choosing <u>University</u> to further analyze for Part 2.

Elementary Students
Audiences:
- Classmates of those that are in the presence of the TeleRobot
- Students using the TeleRobot
- The teachers (on all levels: Elementary, HS, College)
- Schools
- IT Support / Maintenance people

Stakeholders:
- Actual stakeholders
- Electric company
- Government - taxes
- Insurance companies that we might get in the case of Telerobot breaking

Goals:
- The company wants to go beyond the current technological experiences of those that are using the TeleRobot; more than just going around campus and talking to people.
    - Specifically for those that are disabled
- Voice chat
- Raise hand feature
- Messaging - so robots can communicate
- Teacher can mute all
- Security feature to prevent non-student from logging in
- Auto connect to designated robot
- For Elementary kids, having the option to customize/personalize the robot in some way
- Student account is connected to a specific robot
- GPS and collision detection to be able to return to dock after students log off

Constraints:

- Hardware; we can only go so far as what available hardware is already there.
- Financial situation: the company doesn't have any problem financially, but we would need to get funding for those who want to use it
- Sticking to scheduled meetings and deadlines with company and stakeholders
- Parental controls
    - Limited access to internet
- Intuitive
- Have an adjustable height for the robot - electronically controlled from user at home
- 3 hr battery life and interchangeable battery in case charging doesn't work before meeting.
- Ability to navigate without colliding with people and objects when students log off and ability to return to charging dock
- Check for updates and auto-update during inactive hours
- Compatible with IOS, Android, Linux, PC, etc.

Assumptions:
- Assume we will have a large enough team to design the software for the robot
- Assume the engineers will have the skill set required for this project
- Assume we will be able to deliver the completed robot in a set duration
- The scope will not change once the stakeholders sign off on scope
- We will find the appropriate hardware for the software
- Assume someone at school has basic knowledge of technology and can teach others - teachers, students
- Assume access to internet or that school will provide it
- Assume parent/guardian is at home to assist

High School

Audiences:
- Classmates of those that are in the presence of the TeleRobot
- Students using the TeleRobot
- The teachers (on all levels: Elementary, HS, College)
- Schools
- IT Support / Maintenance people

Stakeholders:
- Actual stakeholders
- Electric company
- Government - taxes
- Insurance companies that we might get in the case of Telerobot breaking
- Construction workers - for dock

Goals:

- The company wants to go beyond the current technological experiences of those that are using the TeleRobot; more than just going around campus and talking to people.
    - Specifically for those that are disabled
- Voice chat
- Raise hand feature
- Messaging - so robots can communicate
- Record the class audio and video feed for later review
- Teacher has the ability to share screen
    - Student has ability to toggle between screen and camera
- Teacher can mute all
- Speech filtering, auto-translate
- A zoom feature to capture white board/ chalkboard writing from a distance
- In case internet outage, emergency recording
- Alarm system, just to see if someone is “messing” with the robot on the way to the docks, or robot(s) don’t get back to their designated positions (missing)
- Auto-assign to robot with highest charge on log-in
- GPS and collision detection to be able to return to dock after students log off

Constraints:

- Hardware; we can only go so far as what available hardware is already there.
- Financial situation: the company doesn’t have any problem financially, but we would need to get funding for those who want to use it
- Sticking to scheduled meetings and deadlines with company and stakeholders
- Intuitive
- Battery life to get through 6-7 hrs and interchangeable battery in case charging doesn’t work before meeting.
- Ability to navigate without colliding with people and objects when students log off and robot returns to charging dock
- Check for updates and auto-update during inactive hours
- Compatible with IOS, Android, Linux, PC, etc.

Assume:

- Assume we will have a large enough team to design the software for the robot
- Assume the engineers will have the skill set required for this project
- Assume we will be able to deliver the completed robot in a set duration
- The scope will not change once the stakeholders sign off on scope
- We will find the appropriate hardware for the software
- Assume someone at school has basic knowledge of technology and can teach others - teachers, students
- Assume access to internet or that school will provide it
- Students have a way to take notes

University

Audiences:

- Classmates of those that are in the presence of the TeleRobot
- Students using the TeleRobot
- The teachers (on all levels: Elementary, HS, College)
- Schools
- IT Support / Maintenance people
- Military

Stakeholders:

- Actual stakeholders
- Electric company
- Government - taxes
- Insurance companies that we might get in the case of Telerobot breaking
- People walking on campus
- Construction workers - for dock

Goals:

- Teacher has the ability to share screen
  - Student has ability to toggle between screen and camera
- Teacher can mute all
- Translate feature
- Be able to have an emergency protocol - records, goes back to charging stations
- Have a fleet of robots with their own docking station in a nearby radius to be able to return to charging dock - will need collision detection (especially against bikes and scooters)
- Alarm system, just to see if someone is “messing” with the robot (picked up or moved) on the way to the docks, or robot(s) don’t get back to their designated positions (missing)
- Auto-assign to robot with highest charge at a certain docking station on log in
- GPS and collision detection to be able to return to dock after students log off

Constraints:

- Hardware; we can only go so far as what available hardware is already there.
- Financial situation: the company doesn’t have any problem financially, but we would need to get funding for those who want to use it
- Sticking to scheduled meetings and deadlines with company and stakeholders.
- Intuitive
- Battery life to get through 6-7 hrs and interchangeable battery in case charging doesn’t work before meeting.
- Ability to navigate without colliding with people and objects when students log off and robot returns to charging dock
- Lock into charging station while charging - to prevent theft
- Check for updates and auto-update during inactive hours
- Compatible with IOS, Android, Linux, PC, etc.

Assume:

- Assume we will have a large enough team to design the software for the robot
- Assume the engineers will have the skill set required for this project
- Assume we will be able to deliver the completed robot in a set duration
- The scope will not change once the stakeholders sign off on scope
- We will find the appropriate hardware for the software
- Assume someone at school has basic knowledge of technology and can teach others - teachers, students
- Assume access to internet or that school will provide it
- Assume a way to take notes