**Software Requirements Specification**

**for**

**Lightweight Educational Assistant (LEA) the Lego Robot**

**Version 1.0 approved**

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**Revision History**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Date** | **Reason For Changes** | **Version** |
| FLARE | 1/26/16 | Initial Draft | 1.0 Draft 1 |

# **Introduction**

## **Purpose**

LEA (Lightweight Educational Assistant) is a Mindstorms Lego robot, built from a kit, which will allow for the customization of software programming in order to perform prescribed requirements for its functionality and quality of performance. The robot will be able to deliver educational information from dialog with its users and provide educational materials kept on its body. As the robot moves within a controlled environment, it will be able to avoid obstacles and identify users from initiation of conversations.

The software will be based on Java programming language and utilization of a Lejos plugin for communication with the sensors and motors. The robot will be programmed to give the user two types of flyers: degree offerings and scholarship information. The user will be required to speak keywords to the robot to receive assistance. As the robot moves around, it will stop short of colliding with an object or user and speak a greeting and request for feedback.

This is the initial release of the LEA software package for basic user interaction for the purpose of providing educational material and information. The SRS describes the system’s performance capabilities developed by the team of graduates students.

## **Document Conventions**

There is no specific conventions used in this document.

## **Intended Audience and Reading Suggestions**

This document is intended to be used by developers for the production of LEA the Robot. This document will also be reviewed by the customer to ensure that all functional and non-functional requirements has been included.

Developers should be familiar with all sections of the document for the appropriate production of LEA. Customers should ensure that all information in section 4 and 5 have been interpreted correctly and become familiar with any unknown terminology in appendix A. Also, Appendix D will provide insight on keywords that are essential to the usage of LEA.

**Section 2:** Provide a description of LEA including the major functions of the robot. This section will also describe the intended users, design constraints, and all assumptions made for the development of LEA.

**Section 3:**  Description of various interfaces including front end user, hardware, and software.

**Section 4:** Detailed description of the LEA’s features. This area will also include all functional requirements.

**Section 5:**  Non-functional requirements are described in this section.

**Appendix A:** A list of terminology used throughout this document is defined.

**Appendix B:** Provides a list of functions that could be added to LEAdepended on resources

**Appendix C:** Provides a list of keywords that LEA will be programmed to respond

## **Product Scope**

In order to showcase the Electrical, Computer, Software, and Systems Engineering department (ECSSE) a robot will be developed to be the an information specialist for inquiring parties. This robot, Lightweight Educational Assistant LEA, will be able to hand out pamphlets regarding degree programs offered and scholarship information., LEA will be able to inform future students and their families about the ECSSE department Moreover, the development of LEA will showcase the capabilities of what they could accomplish by being a part of this department in an innovative way that can capture the attention of potential students.

## **References**

In Appendix B, a use case diagram has been create based off the information in this document.

# **Overall Description**

## **Product Perspective**

LEA the robot is a new design that will be used to showcase the capabilities of the the ECSSE department and provide information about degree programs and scholarship information to any inquiring users by handing out flyers and answering simple questions based off a set of keywords. LEA is a self moving robot that will be able to listen to inquiring users and handout flyers when asked.

## **Product Functions**

LEA the robot’s major functions include:

1. Giving out two different flyers
2. Answering questions about the ECSSE Department
3. Self driving on the ECSSE floor of the Lehman building without falling down the stairs
4. Recognizing when a user speaks
5. Providing the correct information when asked via flyer handout or speaking

## **User Classes and Characteristics**

LEA is designed to be used solely for the ECSSE department and is programmed to only answer questions regarding a short list of keywords. Users of LEA will be able to ask questions based of options that LEA will provide. These keyword will prompt LEA to answer verbally and physically handout flyers of information as well. LEA will be designed to be used by first time users.

## **Operating Environment**

LEA’s software is developed through LeJOS, a Java based replacement firmware for Lego Mindstorms. All components of LEA come from supplies of a Legos Mindstorms development kit.

## **Design and Implementation Constraints**

The robot, LEA, is designed using a LEGO Mindstorms kit. All components of LEA are limited to what is given in the basic kit.

LEA’s programming is based off the library provided in LeJOS.

## **Assumptions and Dependencies**

DE-1: LEA is designed for only the ECSSE department

DE-2: LEA will only handout two different types of flyers

# **External Interface Requirements**

## **User Interfaces**

The interface between the user and LEA is voice activated. The administrator will be able to upgrade software specifications via the Lego Mindstorms GUI. The GUI will provide a means for establishing the environmental map for LEA’s movement, log information monitor, and conversation parameters.

## **Hardware Interfaces**

The voice conversation between the user and LEA is controlled by the speech recognition sensor. A speaker will send out voice responses such as the introductory greeting and degree information. Every movement that the robot actuates is initiated by the embedded program and servo connection. The GUI monitor with its associated keyboard and mouse input devices are part of the universal serial bus (USB) interface on the attached PC and Lego Mindstorms EV3 Brick.



## **Software Interfaces**

Speech recognition software is necessary for the usefulness of the interactions between the user and the actuators controlling LEA’s arm movement when providing flyers. This software must interface with the Java SE Development Kit, Update 65 (x64-bit) program, named “legorobot,” that accesses LeJOS libraries, initializes the EV3 SDCard, and controls the EV3 components.The legorobot software will be built on the LeJOS EV3 plug-in that will be shared across the components and speech recognition subsystem.

## **Communications Interfaces**

Communication and updates are possible using Wi-Fi or bluetooth on a smartphone device or tablet, but may not be used in this release.

# **System Features**

## Move Around

**4.1.1** **Description and Priority**

LEA will be able to move around her environment without assistance. This feature is of high priority because it is crucial that LEA can discover users to interact with. LEA will not collide with objects and will instead detect and avoid objects in her environment. This is both for LEA’s safety and the safety of those around her.

**4.1.2** **Stimulus/Response Sequences**

There are no stimuli for this feature. LEA will wander around her environment independently of user input. However, if a user starts a conversation will LEA, LEA will stop moving and converse with the user (as defined in Section 4.2).

**4.1.3 Functional Requirements**

REQ-1: LEA shall move around her environment without assistance.

REQ-2: LEA shall stop moving before colliding with an object.

REQ-3: LEA shall stop moving and wait when a user says her name (“LEA”).

## Interact with Users

**4.2.1 Description and Priority**

Upon discovering a user, LEA will interact with each user by following a menu-like setup of commands and expected responses. This feature is of high priority as it is LEA’s main requirement to be functional and useful.

**4.2.2 Stimulus/Response Sequences**

To interact with LEA, a user must first call her name. Upon hearing her name, LEA will stop and present a verbal list of options for the user to choose from. The user will say the keyword for the option they choose, as defined in Appendix D. Depending on which keyword is stated, LEA will respond with either a short informational description, presentation of a flyer (further defined in Section 4.3), or ask for the user to repeat their choice. The user can cease conLversation with LEA by choosing exit on the verbal menu or by simply walking away.

**4.2.3 Functional Requirements**

REQ-1: LEA shall introduce herself upon first meeting an object or user.

REQ-2: LEA shall prompt users with specific keyword options.

REQ-3: LEA shall respond to a keyword with the appropriate information.

REQ-4: LEA shall provide a verbal menu to the user.

## Hand Out Flyers

**4.3.1 Description and Priority**

If the user chooses the flyer keyword option while conversing with LEA, LEA will offer one of two flyers to the user. The user has two flyer options: a list of scholarships or a list of degrees offered by the ECSSE department. LEA will have the flyers in her hands and inform the user which hand is holding the flyer they are interested in. After the presentation of the flyer, LEA will repeat the verbal menu for additional requests.

**4.3.2 Stimulus/Response Sequences**

The user must choose the flyer keyword option to trigger this behavior. Upon choosing the flyer keyword, LEA will provide brief descriptions for each of the two flyers and ask which flyer the user would like. The user will use the keyword for the flyer they would like. LEA will then inform the user which hand the flyer is in and tell them to take a flyer. After a slight pause, LEA will repeat the verbal menu for additional requests.

**4.3.3 Functional Requirements**

REQ-1: LEA shall offer one of two flyers to users that request more information regarding the ECSSE program.

REQ-2: LEA shall inform the user which hand the requested flyer is in.

REQ-3: After the flyer is taken, LEA shall repeat the verbal menu for additional requests.

# **Other Nonfunctional Requirements**

## **Performance Requirements**

5.1.1 LEA shall halt within 6 inches of the user or obstacle.

5.1.2 LEA shall keep track of the keywords used.

5.1.3 LEA shall clarify responses she did not understand initially.

5.1.4 LEA shall resume movement after 30 seconds of no user interaction.

## **Safety Requirements**

5.2.1 LEA shall be able to recognize obstacles such as the staircase and walls.

## **Security Requirements**

5.3.1 LEA’s brick panel shall not be accessible by unauthorized users.

## **Software Quality Attributes**

5.4.1 LEA shall correctly respond to each keyword.

5.4.2 LEA shall provide users with clear, easily-understood menu options.

## **Business Rules**

5.5.1 Users shall interact with LEA through the verbal menu only.

5.5.2 Users shall take flyers from LEA when prompted.

5.5.3 Only developers shall access meta data indicating which keywords LEA used.

5.5.4 Users and developers shall not interfere with LEA’s movements during normal operations.

**Appendix A: Glossary**

LEA - *Lightweight Educational Assistant*

ECSSE - *Electrical, Computer, Software, and Systems Engineering*

**Appendix B: Use Case Diagram**

:Lego.png

**Appendix C: To Be Determined List**

At this time, there are a few considerations related to the project that are yet to be determined:

* A voice recognition software must be included in order for LEA to “listen” to user responses. This software must be compatible with the Lego Mindstorms EV3 block. In addition, LEA may need to be equipped with an additional voice sensor.
* LEA will need to “speak” in some way, either through the EV3 block or a third-party speaker.
* LEA’s movement scheme will be determined upon acquiring additional information about her movement capabilities and detect and avoid capabilities. If LEA is unable to avoid obstacles dynamically she can follow a specified color path on the floor. This would allow her to move in a pre-determined path in the event that she is unable to move independently of her environment.

**Appendix D: Known Keywords**

Below is a list of the keywords and their potential responses that will programmed for LEA.

|  |  |  |
| --- | --- | --- |
| Keyword Trigger | Response | Possible Alternates |
| LEA | Stop movement, start Introduction/Menu | Lay-a, Lee-a, el-ee-a |
| Degree | Actuate degree flyer movement | program flyer |
| Scholarships | Actuate scholarship flyer movement |  |
| Goodbye | End conversation and begin movement | Bye |
| Yes | Confirm previous request | Yea, yup, right |
| No | Deny previous request | Nah, nope |
| Flyer | Request additional information | Sheet |
| Stop | Discontinue current movement | halt |

**Appendix E: Use Cases**

# Use Case: Hand Out Degree Program Flyers

Author: Team - FLAIR: Stacey Joseph, Lauren Massey, Jessica Updegrove

Date: 1/26/2016

# Description

This Use Case describes how LEA would give out flyers to a user.

# Identification of Actor(s)

User - User of LEA

System - LEA - the robotic assistant

# Pre-conditions

LEA will be moving along the third floor of Lehman, listening for her name or to recognize something that is not the ground.

# Scenarios

# Basic/Normal Flow

|  |  |
| --- | --- |
| **User** | **System** |
| 1. Calls out the name “LEA” |  |
|  | 2. Acknowledges the keyword and stops moving. Introduces herself. Prompts the user based off keywords programmed. “Would you like to know about degree programs or scholarship information?”. |
| 3. Responds with keyword “degree information” |  |
|  | 4. “Would you like a flyer or for me to tell you about the programs offered?” |
| 5. Responds with “Flyer” |  |
|  | 6. Lifts arm that holds the degree flyers. “Here. Would you like to know anything else?” |
| 7. Responds “No” |  |
|  | 8. Returns back to pre-condition |

# Alternate Flow 1: LEA Does Not Hear User

This case describes the situation where LEA does not “hear” the user. LEA will continue to move as if she heard nothing.

|  |  |
| --- | --- |
| **User** | **System** |
| 1a. Calls out the name “LEA” |  |
|  | 2a. Continues to move around third floor of Lehman |
| Go to Step 1 |  |

# Alternate Flow 2: User Wants More Information

This case describes the situation where LEA gives flyer to user and the user would like more information from the original prompt.

|  |  |
| --- | --- |
| **User** | **System** |
| 1b. Calls out the name “LEA” |  |
|  | 2b. Acknowledges the keyword and stops moving. Introduces herself. Prompts the user based off keywords programmed. “Would you like to know about degree programs or scholarship information?”. |
| 3b. Responds with keyword “degree information.” |  |
|  | 4b. “Would you like a flyer or to tell you about the programs offered?” |
| 5b. Responds with “Flyer” |  |
|  | 6b. Lifts arm that holds the degree flyers. “Here. Would you like to know anything else?” |
| 7b. Responds “Yes” |  |
|  | 8b. Returns back to Step 2 without reintroducing herself |

# Post-conditions

On successful handout of a flyer, LEA will return to pre-condition.

# Additional Notes

LEA will prompt users only twice if she does not hear the user’s response after 10 seconds. If LEA does not understand after the second attempt she will return to the precondition.

# Use Case: Hand Out Scholarship Flyers

Author: Team - FLAIR: Stacey Joseph, Lauren Massey, Jessica Updegrove

Date: 1/26/2016

# Description

This Use Case describes how LEA would give out flyers to a user.

# Identification of Actor(s)

User - User of LEA

System - LEA - the robotic assistant

# Pre-conditions

LEA will be moving along the third floor of Lehman, listening for her name or to recognize something that is not the ground.

# Scenarios

# Basic/Normal Flow

|  |  |
| --- | --- |
| **User** | **System** |
| 1. Calls out the name “LEA” |  |
|  | 2. Acknowledges the keyword and stops moving. Introduces herself. Prompts the user based off keywords programmed. “Would you like to know about degree programs or scholarship information?”. |
| 3. Responds with keyword “scholarship” |  |
|  | 4. “Would you like a flyer or to tell you about the scholarships offered?” |
| 5. Responds with “Flyer” |  |
|  | 6. Lifts arm that holds the degree flyers. “Here. Would you like to know anything else?” |
| 7. Responds “No” |  |
|  | 8. Returns back to pre-condition |

# Alternate Flow 1: LEA Does Not Hear User

This case describes the situation where LEA does not “hear” the user. LEA will continue to move as if she heard nothing.

|  |  |
| --- | --- |
| **User** | **System** |
| 1a. Calls out the name “LEA” |  |
|  | 2a. Continues to move around third floor of Lehman |
| Go to Step 1 |  |

# Alternate Flow 2: User Wants More Information

This case describes the situation where LEA gives flyer to user and the user would like more information from the original prompt.

|  |  |
| --- | --- |
| **User** | **System** |
| 1b. Calls out the name “LEA” |  |
|  | 2b. Acknowledges the keyword and stops moving. Introduces herself. Prompts the user based off keywords programmed. “Would you like to know about degree programs or scholarship information?”. |
| 3b. Responds with keyword “Scholarship.” |  |
|  | 4b. “Would you like a flyer or to tell you about the scholarships offered?” |
| 5b. Responds with “Flyer” |  |
|  | 6b. Lifts arm that holds the degree flyers. “Here. Would you like to know anything else?” |
| 7b. Responds “Yes” |  |
|  | 8b. Returns back to Step 2 without reintroducing herself |

# Post-conditions

On successful handout of a flyer, LEA will return to pre-condition.

# Additional Notes

LEA will prompt users only twice if she does not hear the user’s response after 10 seconds. If LEA does not understand after the second attempt she will return to the pre-condition.