Electronic ID for Inventory
2012-2013

Test Plan

Version 2.0
25 October 2013

Student: Justin Fritzler
justinlf@rams.colostate.edu
Adviser: Dr. Ali Pezeshki
1 PROJECT ABSTRACT

Lab Animal Resources (LAR) is a facility on the Colorado State University Campus, which houses and cares for animals that are part of scientific studies. LAR requires an efficient system for performing occupancy checks (“census”) across three facilities, comprising a total of 3500 cages, and 20,000 ft², as well as tracking the care history and location of each. Cages range in size from approximately 0.2 ft³ to approximately 9 ft³, and most frequently house rodents and small mammals.

A wireless system is sought to reduce the time required to perform the census, enable them to be conducted on a weekly bases, and further automate the process of checking for completeness. Each cage is identified with a small cage card, which is attached to the front of each cage, and to which a radio-frequency ID tag will be affixed. Commercially available wireless solutions exist, but these are all a magnitude of order more expensive than the budget LAR has for this application. The best system configuration was determined to be passive RFID tags on the cages, with a mobile hand-held RFID reader with Wi-Fi capabilities plus hardwired connections available for direct transfer of information, and application software written in C#.

2 DELIVERABLES

<table>
<thead>
<tr>
<th>DELIVERABLE</th>
<th>ESTIMATED DATE OF DELIVERY</th>
<th>LEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID Reader Software</td>
<td>11/30/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>Application Installation Method</td>
<td>11/30/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>Application Documentation</td>
<td>11/30/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>Updated Oracle Database</td>
<td>12/20/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>Web Interface Template</td>
<td>12/20/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>RFID Reader and Accessories</td>
<td>12/20/13</td>
<td>Justin Fritzler</td>
</tr>
<tr>
<td>Continuation Plans</td>
<td>12/20/13</td>
<td>Justin Fritzler</td>
</tr>
</tbody>
</table>

3 REQUIREMENTS

3.1 Functional Requirements

R1. Cages must be uniquely identifiable by RFID scan.

R1.1. The RFID number associated with each card cage must be linked via software to the cage card number.
R1.2. At no time should two RFID tags with the same RFID number be present on the shelves.

R2. Cage location must be identifiable.
   R2.1. Rooms must be identifiable, either by user or by RFID scan.
   R2.2. System should allocate tags to one room only.
      R2.2.1. If tags are identified in multiple rooms; duplicates should be eliminated, either by filter or user input.

R3. Database integrity must be maintained.
   R3.1. Scans should not update the database until user indicates acceptance of the changes.
   R3.2. The system will record which team member performs each census action.

R4. Census must generate a complete and correct log of the occupied cages and locations upon completion.
   R4.1. A log of rooms & cage cards therein should be created from each successful census scan.
      R4.1.1. The log should not be deleted except by clear user intent.
      R4.1.2. The log should be able to handle up to 300 cages per room.
   R4.2. Any RFID tag scanned in the course of a census, but without an active database association, must generate an error.
   R4.3. Any RFID tag indicated by scan in multiple rooms must be addressed by an error-handling procedure.
      R4.3.1. Software procedures should be used for low-probability cases to minimize the requirement for user input.
      R4.3.2. Users must be able to confirm or override room locations if needed.
   R4.4. Log must be formatted to facilitate transfer to the database.

3.2 Operational Requirements

R5. The system must facilitate a scan time of five minutes or less per room.

R6. The system must function within the environment of the lab facilities, which include a significant presence of metal.

R7. The system must function with the use of metal and plastic cage card holders.

R8. System must be amenable to modular deployment – able to be used for all or part of the census, without disrupting the remaining census
4 FUNCTIONAL TESTING

4.1 Stimulus

The input for functional testing shall be RFID tags with the ID printed on the tag. Tags used for identifying a room location will include a room identifier written to the user memory bank of the RFID tag. Tags associated with cage cards shall not have anything written to the user memory bank. RFID tags placed on metal cage card holders will be affixed to foam insulation prior to attaching to the cage card. Tags that will be placed on plastic cage card holders will be affixed directly to the cage card.

4.2 Procedure

The correct user credentials will first be input to the device application. Once the user has been identified, the appropriate room tag will be scanned and verified in the application. Then scanning should be initiated on the RFID reader from an orthogonal approach greater than 3ft from the targeted tag. The reader will continue scanning until the tag is read or physical contact is made with the tag. A successful read will be identified by comparing the tag ID indicated on the device with the ID printed on the tag. The distance at which the tag was successfully scanned shall be recorded. A read should then be attempted with the targeted tag directly behind the device. This session will be recorded to a file by the device application. The procedure will then be repeated from a 45 degree approach to the targeted tag.

4.3 Validation

Upon completion, the distance of successful reads will be compared to the acceptable ranges. Failure to read the targeted tag or a successful read from behind the device will result in an automatic failure. Read ranges should be 18-24 inches for an orthogonal read and 12-18 inches for a 45 degree read. The output file should be verified to contain the appropriate user and tags identified by the correct room. The room tag should not appear in the inventory. Failure to meet these criteria will result in a retest with adjusted power or filter levels on the RFID read.

5 OPERATIONAL TESTING

5.1 Stimulus

Operational testing will be performed in the Painter Center. Two adjacent rooms containing metal racks for mice will be selected for test. 150 cage card tags will be
attached to the cages in each room. A room tag will be placed at the entrance of both rooms as well as both the rooms across the hall from the selected rooms. A rack in the second room will be pushed up against the wall adjacent to the first room.

5.2 Procedure

A user from the LAR staff will be selected to officially perform this procedure. The user will be given the RFID reader, instructed to start the device application, and login. The user will scan the room tag for the first room and proceed to scan all the cage cards in the room. The user will exit the room and scan the room tag for the second room. The staff member will read all tags in the second room, assign/verify the proper room for duplicate read tags, save, and exit the application.

5.3 Validation

The output from this procedure will be manually verified against the setup. All cage card tags must be accounted for in the correct room. Room tags should not show up in the census and only the correct rooms should have cage card associations. An incorrect number of tags in the census will result in changing the read range requirement. The change in requirements would require functional testing be performed. Cage card tags assigned to the incorrect room will require a software change. Software changes will require additional software testing. Any discrepancy will ultimately result in another operational test.

6 SOFTWARE TESTING

6.1 Stimulus

Input for incremental testing will be all possible types of user input for the additional feature. Input from the radio and network will also be used if required by the feature. The input should be tested on all the possible states of the software. For regression testing, all features should be retested as though it were part of an incremental test. Input from users will include tapping from the stylus or fingers, and the pressing of keys on the keypad. Input from the radio will only be from RFID tags chosen for implementation. Input from the Wi-Fi will be tested on CSU’s network.
6.2 Procedure

User input will be selected from edge cases and must fit all conditionals. Radio and network input will be used on a per feature basis with volume taken into consideration. All input will be checked against the expected output. Individual features shall be checked as they are added. A full regression test shall be performed prior to delivery of software and prior to release of any updates.

6.3 Validation

All output should match the expected output for a given input. Expected outputs are defined by the requirements of section 3. Any deviation must result in either a software update or a change in requirements. The end user should receive no errors or exceptions during use. The user should be prevented from making invalid input wherever possible and all exceptions handled appropriately by warnings. All exceptions raised to the user level require a software update.