**Mechanical Archer R2:  
The Re-Archering**

Software Requirements Specification

v0.2

20FEB2013

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| 17FEB2013 | Initial setup | 0.1 |
| 20FEB2013 | Review by S/W Lead | 0.2 |

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# 1 Purpose

Mechanical Archer R2 software will work with the physical Mechanical Archer to control its basic operations from a laptop and extend functionality to include visual aiming and shot queuing. The software will include safety to measures to ensure the Mechanical Archer will operate without endangering users, observers, or the machine itself.

# 2 Product Scope

## 2.1 Constraints

1. The laptop must communicate with the archer unit over Cat 6 Ethernet cable.
2. Standard libraries will be used for Ethernet communication.
3. The webcam must be connected directly to the laptop via USB.
4. The webcam must have a horizontal resolution of at least 30 pixels per degree of view.
5. The user interface shall be written in C#.
6. Laptop software shall be run on a Windows platform.

## 2.2 Assumptions

1. Specified webcam resolution will be sufficient to conduct rangefinding.
2. Hardware provided lasers will be sufficient to conduct rangefinding.

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# 3 Requirements

Note: “system”, in this context, refers to the portion of the software that is installed on the laptop.

## 3.1 Functional Requirements

1. The system shall have a secure logon.
   1. Login shall be locally authenticated
   2. There shall be separate login credentials for each user, and actions shall be logged
   3. Passwords shall be stored in SHA-512 hashed form, and shall be salted prior to hashing
2. The system shall display live video from the webcam.
3. The system shall allow users to define a valid shooting area during startup outside of which the system may not be aimed.
   1. The system shall restrict the maximum size of the valid shooting area to be the edge of the webcam’s field of view from the central starting position.
   2. The system shall display a clear line on the video feed to represent the edge of the valid shooting area.
4. The system shall prevent users from aiming or firing the archer unit outside the valid shooting zone.
5. The system shall allow users to initiate an emergency stop (E-stop) of the system.
   1. The system shall lock down and require a manual reset when E-Stop has been initiated.
6. The system shall require users to hold a key combination before issuing commands.
   1. The system shall disable the Draw, Retract, Fire Manual and Fire Automatic buttons when the key combination is not held down.
   2. The system shall not disable the E-Stop button when the key combination is not held down.
7. The system shall display detailed information about the machine status to users.
   1. The system shall display the current state of the machine.
   2. The system shall display whether the machine is loaded with an arrow.
   3. The system shall display whether sensors detect an arrow in the front and rear positions.
      1. The system shall display an error message if an arrow is detected in the rear position but not the front position.
      2. The system shall display an error message if an arrow is detected in the rear position and the front bump sensor reads high.
8. The system shall safely disengage if an error occurs.
   1. An error is any state in which an invalid fire may be attempted
   2. If this state is achieved, the system shall
      1. Lock down the system and require a manual reset
9. The system shall support queuing shots from the archer unit.
   1. The system shall restrict the size of the queue to six shots.
   2. The system shall display a listing of shots in the queue below the video feed.
   3. The system shall allow users to add shots to the queue by clicking on points on the video feed.
      1. Shots will not be added if the user clicks on a point outside the valid shooting range.
   4. The system shall allow users to remove shots from any position in the queue.
10. The system shall display queued targets on the live video feed.
    1. The system shall adjust the location of queued shots on the video feed when the archer unit moves.
    2. The system shall indicate which target on the video corresponds to which target on the queue
11. The system shall allow automatic management the firing sequence.
    1. The system shall disable the Fire Automatic button when not in the Ready state.
    2. The system shall disable the Draw, Retract, and Fire Manual buttons when the automatic fire sequence has been initiated.
    3. The system shall support single shots from the firing queue.
    4. The system shall support sequential shots from the firing queue.
       1. The system shall support interruption of sequential firing without requiring the use of the e-Stop.
12. The system shall allow manual operation of the firing sequence.
    1. The system shall prevent the user from giving invalid commands when manually operating the fire sequence
       1. The system shall disable the Draw button when in the Idle, Drawing, Drawn, Firing, Fired, and Retracting states.
       2. The system shall disable the Retract button when in the Idle, Ready, Drawing, Firing, Fired, and Retracting states.
       3. The system shall disable the Fire Manual button when in the Idle, Ready, Drawing, Firing, Fired, and Retracting states.
13. The system shall synchronize states between the laptop and Arduino once per second.
14. The system shall be able to calculate the range of user selected targets
    1. The system shall have a granularity at least 0.5 ft from 5-20 yards
    2. The system shall be able to resolve the distance within 1 second

## 3.2 Non-Functional Requirements

1. Images and/or video from the webcam shall be displayed in real time.
   1. Minimum of 20 FPS

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# 4 Original Requirements

Interface /Communication

* The Interface shall be over Cat 5 ethernet
* The interface shall use arduino libraries for Ethernet
* Possible Messages include MoveClockwise, MoveCounterclockwise, NoseUp, NoseDown, LaserOn, LaserOff, Draw, Fire, Retract, ESTOP
* Internally the Software shall utilize a Command pattern structure for sending messages.

Video

* The system shall utilize a USB Webcam
* The webcam shall be connected directly to a computer through USB.
* The system shall show a real time image taken from the webcam.

Range Finder

* The system shall have 2 laser lights mounted 1 ft apart - http://www.amazon.com/532nm-Astronomy-Powerful-Green-Pointer/dp/B0019D12WW/ref=sr\_1\_1?ie=UTF8&qid=1361128787&sr=8-1&keywords=laser+pointer
* The system shall be able to turn both on and off by command through the microcontroller
* The webcam in the system shall have a horizontal resolution, of at least 2560 px
* The system shall calculate distance by pulsing the lasers, and taking still pictures with the lasers on and off. The system shall then use trigonometry to calculate the distance.

Software

1. Users shall be able to queue up to 6 shots before indicating that the fire sequence should start
2. Users shall be able to queue shots by clicking on locations on the live video feed.
3. Users shall be able to remove shots from the queue before indicating the start of the fire sequence.
4. The system shall display a clear line where the edge of the valid shooting zone is.
5. The system shall prevent users from firing outside the valid shooting zone.
6. Users shall be able to initiate an emergency stop of the system.
7. The system shall display detailed information about the machine status to users.
8. The user interface shall be written using C#. The terminal shall be run on a Windows platform.
9. The system shall have a secure logon.
10. The system shall safely disengage if an error occurs.
11. Users shall be able to initiate each step of the fire sequence manually.
12. Users shall have the option to fire a single arrow from the queue.
13. Users shall be able to interrupt automatic firing from the queue before all arrows in the queue have been fired.
14. The system shall display queued targets on the live video feed.
15. The system shall display a listing of the target queue with a way to distinguish between listings on the queue and targets on the screen.
16. The system shall calculate end positioning by first moving to the horizontal location of the target, calculating its range, calculating vertical angle, and moving to that angle.