# NAFSTR: Networked Automated Fingerprint Scanner Robot

1. Features:
   1. Four independently actuated fingers
   2. Interchangeable fingerprints
   3. Can detect when the scanner has captured a fingerprint
   4. Can monitor force being applied to each finger
   5. Controllable through a serial connection over USB, through a TCP connection over Ethernet, and through a UDP connection over Ethernet.
2. How it works:
   1. Fake Fingerprints:
      1. 3D printed in MakerBot Flexible Filament.
      2. Consist of 3 layers: .2 mm thick plastic backing, .2 mm thick fingerprint and 8 mm thick foam.
      3. <Insert Image>
   2. Finger Motion and Sensors:
      1. Each finger is connected to a servo motor which can provide about .8 N⨯m of torque.
      2. Each fake fingerprint is mounted onto a fingerprint holder. Sandwiched between the holder and the fake fingerprint is a Force Sensitive Resistor (FSR).
      3. The fingerprint scanner has 4 lights which turn green when the fingerprint has been read. The robot uses 4 Light Dependent Resistors (LDR), one for each light on the fingerprint scanner, to determine when the lights turn green.
      4. <Insert Picture>
   3. Control
      1. The robot accepts text commands over USB and Ethernet. When operating over Ethernet, the commands can be send over either TCP or UDP.
      2. The robot stores one move for each finger. The move can be changed by sending a set command.
      3. When the robot receives a move command, it reads the stored moves for the selected fingers and moves the fingers.
      4. Move Types:
         1. Position moves: the robot moves one of the fingers to a specified position and waits for a specified amount of time.
         2. Sensor moves: the robot moves one of the fingers at a specified angular velocity until the reading from the light sensor moves into a certain range or the fingers position has exceeded a specified limit. When the sensor move ends, it reads the force sensor to determine how much force was exerted on the fingerprint scanner.
      5. Communicating with the robot
         1. There is an easy to use graphical Java program that allows the user to connect to the robot and send it commands.
         2. <Insert picture>
         3. The same Java program, when run from the command line, can send a text file of commands to the robot for execution.
         4. Commands can also be sent over Telnet.
         5. C# and Java libraries to control the robot.
3. Uses
   1. Stress testing for WS-BD standard.
      1. The robot could put thousands of finger combinations down onto the scanner to see if the scanner adheres to the WS-BD standard. The robot could operative for days for a long term test.
   2. Analyzing spoof detection methods
      1. The robot can place fingerprint spoofs with a consistent position and consistent, selectable force onto fingerprint scanners. This process could be repeated for hours and with different forces and fingers prints to determine how well spoof detection methods work.