Final Project

Universitat De Girona

Medical Robotics

Wet Cupping

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1 Introduction

Wet cupping (as shown in Figure 1) is a form of alternative medicine that dates to hundreds of centuries ago. Today this therapy is practiced in several specialized centers throughout the world. It is claimed to help in reducing pain, boosting immunity, improving overall well-being, and so forth.

Figure 1: Illustration of Wet Cupping

1.1 Objective

Our goal for this project is to automate the wet cupping procedure which consists of 2 main steps: puncturing and cupping.

- Puncturing is about making small skin incisions at certain body locations.
- Cupping is the placement of special cups on those locations to withdraw blood through vacuum created inside the cup.

2 Implementation

The implementation of this project was carried out using the Staubli TS60 scara robot, a plastic cup (representing the cupping cup) and a needle (for making punctures). The steps taken to accomplish this task are listed below:

- The robot fetches the needle using its suction capability.
- Five points of interest are delineated on the phantom.
- The robot makes an in-and-out movement on each point of interest to create a puncture.
- The robot returns the needle and fetches the cup.

- The cup is placed over the phantom covering the punctures and kept still on that position for a few seconds while the suction is still taking place simulating the withdrawal of blood from the body.
- The robot returns the cup to its original place and then moves to its initial position.

3 Code

3.1 start()

```
begin
  userPage()
  cls()
  putln("Init program.")
  enablePower()
  mNomSpeed.vel=30 // limit of the maximum speed

  // Move to initial position
  movej(init,flange,mNomSpeed)
  close(flange)
  putln("Move to initial position finished.")

  // Fetch needle
  // Move to needle prefetch position
  open(flange)
  movej(needleout,flange,mNomSpeed)
  close(flange)
  putln("Move to needle prefetch position finished.")
  // Move to needle fetch position
  open(flange)
  movej(needlein,flange,mNomSpeed)
  close(flange)
  putln("Move to needle fetch position finished.")

  // activate suction to grasp needle
  if(io:bOut0==false)
    delay(2)
    io:bOut0=true
  endIf

  // Return to needle prefetch position
  open(flange)
  movej(needleout,flange,mNomSpeed)
  close(flange)
  putln("Move to needle prefetch position finished.")

  // Move to middle of the region of interest
  open(flange)
  movej(punctureout,flange,mNomSpeed)
  close(flange)
  putln("Move to ROI middle position finished.")
```

```
// Make puncture 1
open(flange)
movej(puncture1[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 1 position finished.")
open(flange)
movej(puncture1[1],flange,mNomSpeed)
close(flange)
putln("Move to puncture 1 position finished.")
open(flange)
movej(puncture1[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 1 position finished.")

// Make puncture 2
open(flange)
movej(puncture2[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 2 position finished.")
open(flange)
movej(puncture2[1],flange,mNomSpeed)
close(flange)
putln("Move to puncture 2 position finished.")
open(flange)
movej(puncture2[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 2 position finished.")

// Make puncture 3
open(flange)
movej(puncture3[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 3 position finished.")
open(flange)
movej(puncture3[1],flange,mNomSpeed)
close(flange)
putln("Move to puncture 3 position finished.")
open(flange)
movej(puncture3[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 3 position finished.")

// Make puncture 4
open(flange)
movej(puncture4[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 4 position finished.")
open(flange)
movej(puncture4[1],flange,mNomSpeed)
close(flange)
putln("Move to puncture 4 position finished.")
open(flange)
movej(puncture4[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 4 position finished.")
```

```
// Make puncture 5
open(flange)
movej(puncture5[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 5 position finished.")
open(flange)
movej(puncture5[1],flange,mNomSpeed)
close(flange)
putln("Move to puncture 5 position finished.")
open(flange)
movej(puncture5[0],flange,mNomSpeed)
close(flange)
putln("Move to pre puncture 5 position finished.")


// Punctures finished, return to ROI middle position
open(flange)
movej(punctureout,flange,mNomSpeed)
close(flange)
putln("Move to ROI middle position finished.")

// Return needle prefetch position
open(flange)
movej(needleout,flange,mNomSpeed)
close(flange)
putln("Move to needle prefetch position finished.")
open(flange)
movej(needlein,flange,mNomSpeed)
close(flange)
putln("Move to needle fetch position finished.")

// Stop suction and blow to drop needle
if(io:bOut0==true)
  io:bOut0=false
  io:bOut1=true
  delay(1)
  io:bOut1=false
endIf

open(flange)
movej(needleout,flange,mNomSpeed)
close(flange)
putln("Move to needle prefetch position finished.")

// Fetch cup
open(flange)
movej(cup[0],flange,mNomSpeed)
close(flange)
putln("Move to cup prefetch position finished.")
open(flange)
movej(cup[1],flange,mNomSpeed)
close(flange)
putln("Move to cup fetch position finished.")

// Apply suction to grasp cup
```

```
  if(io:bOut0==false)
    delay(2)
    io:bOut0=true
  endIf

  open(flange)
  movej(cup[0],flange,mNomSpeed)
  close(flange)
  putln("Move to cup prefetch position finished.")


  // Put cup in target
  open(flange)
  movej(punctureout,flange,mNomSpeed)
  close(flange)
  putln("Move to ROI middle position finished.")
  open(flange)
  movej(cupdown,flange,mNomSpeed)
  close(flange)
  putln("Move to target position finished.")

  // wait few seconds to pump the blood
  delay(7)

  // Return cup
  open(flange)
  movej(punctureout,flange,mNomSpeed)
  close(flange)
  putln("Move to ROI middle position finished.")
  open(flange)
  movej(cup[0],flange,mNomSpeed)
  close(flange)
  putln("Move to cup prefetch position finished.")
  open(flange)
  movej(cup[1],flange,mNomSpeed)
  close(flange)
  putln("Move to cup fetch position finished.")

  // Stop suction and blow to drop cup
  if(io:bOut0==true)
    io:bOut0=false
    io:bOut1=true
    delay(1)
    io:bOut1=false
  endIf

  open(flange)
  movej(cup[0],flange,mNomSpeed)
  close(flange)
  putln("Move to cup prefetch position finished.")


end
```

3.2 stop()

```
begin

  movej(init,flange,mNomSpeed)
  open(flange)
  putln("Move to init position finished. End program.")
  resetMotion()

end
```

4 Points

Tasks	x	y	z	rx	ry	rz
init	288.088313	54.924603	200.1	-180	0	-61.143713
cup[0]	124.289847	490.388457	200.094423	180	0	-99.173002
cup[1]	124.289847	490.388457	115.15	180	0	-99.173002
cupdown	404.201795	8.15849	137.916785	-180	0	-34.702113
needlein	66.093191	371.076038	60.45	180	0	-117.75571
needleout	66.093191	371.076038	200.1	180	0	-117.75571
punctureout	437.408851	11.374673	195.6	-180	0	-29.609713
puncture1[0]	404.201795	8.15849	82.4	-180	0	-34.702113
puncture1[1]	404.201795	8.15849	43.3	-180	0	-34.702113
puncture2[0]	404.201773	26.614129	82.4	-180	0	-34.702564
puncture2[1]	404.201773	26.614129	44.6	-180	0	-34.702564
puncture3[0]	420.712164	8.158466	82.4	-180	0	-34.701621
puncture3[1]	420.712164	8.158466	45.95	-180	0	-34.701621
puncture4[0]	404.201784	-7.068949	82.4	-180	0	-34.701721
puncture4[1]	404.201784	-7.068949	46.45	-180	0	-34.701721
puncture5[0]	387.205416	8.158495	82.4	-180	0	-34.70261
puncture5[1]	387.205416	8.158495	44.82	-180	0	-34.70261

Table 1: List of points