install.packages("scatterplot3d")

require("scatterplot3d")

**# read csv files**

data <- read.csv("p1\_a.csv");

data <- data[complete.cases(data),]

handdata <- cbind(data[2],data[12] ,data[14] ,data[13] ,data[3])

**# 1. visualize the trajectory of the dominant hand**

s3d <- scatterplot3d(handdata[2:4], type="l", lwd=2, color="green4", xlim=c(-1.0,1.0), ylim=c(-1.0,1.0), zlim=c(0.0,2.0))

**# 2. calculate the moving distance of the dominant hand**

# moving distance when inserting the card into the ATM

result1 <- 0

taskhanddata <- handdata[which(handdata$task.num == 0), 2:4]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result1 <- result1 + distance

}

# moving distance when selecting the ‘withdraw’ menu

result2 <- 0

taskhanddata <- rbind(handdata[which(handdata$task.num == 1), 2:4], handdata[which(handdata$task.num == 2), 2:4], handdata[which(handdata$task.num == 3), 2:4])

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result2 <- result2 + distance

}

# moving distance when selecting the amount to withdraw

result3 <- 0

taskhanddata <- rbind(handdata[which(handdata$task.num == 4), 2:4], handdata[which(handdata$task.num == 5), 2:4])

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result3 <- result3 + distance

}

# moving distance when selecting the bill type

result4 <- 0

taskhanddata <- handdata[which(handdata$task.num == 6), 2:4]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result4 <- result4 + distance

}

# moving distance when entering the PIN (personal identification number

result5 <- 0

taskhanddata <- handdata[which(handdata$task.num == 7), 2:4]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result5 <- result5 + distance

}

# moving distance when selecting the receipt option

result6 <- 0

taskhanddata <- handdata[which(handdata$task.num == 8), 2:4]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result6 <- result6 + distance

}

# moving distance when removing the card

result7 <- 0

taskhanddata <- handdata[which(handdata$task.num == 9), 2:4]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result7 <- result7 + distance

}

# moving distance when taking the money from the ATM

result8 <- 0

taskhanddata <- handdata[which(handdata$task.num == 10), 2:4]

taskhanddata <- taskhanddata[complete.cases(taskhanddata),]

for(i in 2:nrow(taskhanddata))

{

distance <- sqrt((taskhanddata[i,1]- taskhanddata[i-1,1])^2 + (taskhanddata[i,2]- taskhanddata[i-1,2])^2 + (taskhanddata[i,3]- taskhanddata[i-1,3])^2)

result8 <- result8 + distance

}

# total moving distance

moving distance <- result1 + result2 + result3 + result4 + result5 + result6 + result7 + result8

**# 3. calculate the time to completion**

# time to completion when inserting the card into the ATM

taskhanddata <- handdata[which(handdata$task.num == 0), 2:5]

time1 <- taskhanddata[nrow(taskhanddata),4]

# time to completion when selecting the ‘withdraw’ menu

time2 <- 0

taskhanddata <- handdata[which(handdata$task.num == 1), 2:5]

time2 <- time2 + taskhanddata[nrow(taskhanddata),4]

taskhanddata <- handdata[which(handdata$task.num == 2), 2:5]

time2 <- time2 + taskhanddata[nrow(taskhanddata),4]

# time to completion when selecting the amount to withdraw

time3 <- 0

taskhanddata <- handdata[which(handdata$task.num == 4), 2:5]

time3 <- time3 + taskhanddata[nrow(taskhanddata),4]

taskhanddata <- handdata[which(handdata$task.num == 5), 2:5]

time3 <- time3 + taskhanddata[nrow(taskhanddata),4]

# time to completion when selecting the bill type

time4 <- 0

taskhanddata <- handdata[which(handdata$task.num == 6), 2:5]

time4 <- time4 + taskhanddata[nrow(taskhanddata),4]

# time to completion when entering the PIN (personal identification number)

time5 <- 0

taskhanddata <- handdata[which(handdata$task.num == 7), 2:5]

time5 <- time5 + taskhanddata[nrow(taskhanddata),4]

# time to completion when selecting the receipt option

time6 <- 0

taskhanddata <- handdata[which(handdata$task.num == 8), 2:5]

time6 <- time6 + taskhanddata[nrow(taskhanddata),4]

# time to completion when removing the card

time7 <- 0

taskhanddata <- handdata[which(handdata$task.num == 9), 2:5]

time7 <- time7 + taskhanddata[nrow(taskhanddata),4]

# time to completion when taking the money from the ATM

time8 <- 0

taskhanddata <- handdata[which(handdata$task.num == 10), 2:5]

time8 <- time8 + taskhanddata[nrow(taskhanddata),4]

# total time to completion

time to completion <- time1 + time2 + time3 + time4 + time5 + time6 + time7 + time8