The Protocol Coach: A Role-Based Decision Aid

Jessica N. Gonzales
Faculty Mentor: Dr. R. Murphy

Abstract –This project creates a "coach" to visually remind a user of a sequence of activities (or protocol) that need to be accomplished. In this case, the coach aids a remote medical specialist interacting with a trapped victim through a rescue robot by displaying the Robot-Assisted Simple Triage protocol. The Robot-Assisted Simple Triage protocol is used to categorize victims in a multiple casualty incident. It is based on the Simple Triage and Rapid Treatment (START) triage protocol and categorizes each victim based on the four signs of mobility: mental state, perfusion, and respiratory. The category the victims are placed in will determine what order they receive medical attention. As robot-assisted triage is new, it is expected that it will be difficult for a medical specialist to remember the protocol and keep up with current state of evaluating each victim. Furthermore, different rescue robots may have different sensors, obviating some tests. This research addresses these problems by representing the protocol for a *role* by using the *script* mechanism from artificial intelligence, instantiating the script with the capabilities of a specific robot ("*props*"), and visually displaying each resulting step; the output is called the Protocol Coach. The Protocol Coach is written in Java and is part of a web-based user interface that works with the NLP toolkit to support user-victim interaction. In the future the framework of the Protocol Coach will be implemented for other rescue roles (responder, structural specialist, etc.).

I. Introduction

Rescue robotics is becoming a vital tool in responding to natural disasters or multiple casualty incidents. While the protocols that are often associated with those roles aren't necessarily new, the way of visually representing them and making the system more intelligent has become a driving new factor. The "*Protocol Coach*" is a web-based interface acts as a visual aid to direct a user in a given script. It is also an application that is implemented to work with the Natural Language Processing toolkit aid in user-victim interaction. This purpose of this project is to explain the Protocol Coach application that is based on parsing a script with specific actions to be done based on the role that is loaded and how the script is to be demonstrated to assist the victims.

II. Related Work

The overall use of roles and scripts is commonly seen in previous work coordinating robots' behaviors, as demonstrated in these examples here [1], [2], [3], [4]. Thus, it was important to set the framework to accommodate the various actors by encapsulating their actions in a specific script. However, the underlying foundation for this project is to implement the Robot-Assisted Simple Triage for the doctor role specifically. This new protocol implements a robot's version of the START (Simple Triage and Rapid Treatment protocol) which is used in human-human triage processes.

According to Dr. Chang and Dr. Murphy, the victims are evaluated in the following areas, according to Dr. Chang and Dr. Murphy:

- **Mobility:** Determining if the victim is able to walk or move, done through request, using two-way communication. If the victim does not respond to a verbal command the robot may be operated to try and physically prompting the victim to move.
- **Mental State:** Using a list of commands with the two-way conversation that can help determine the mental state of the victim. This would be done once movement has been confirmed.
- **Perfusion:** Checking the pulse or doing a blanch test on the conscious victim in order to check their perfusion. Since these victims would be able to move and maintain a

conversation they would be able to assist in this self-performed test using the sensors provided.

- **Respiratory:** Using the robots cameras or the sensors, the doctor could either visually see the victim's chest movement or determine respiration based on the output of the carbon dioxide or oxygen sensors. Checking the respiratory could be the last step, or in some cases, the second step if the victim does not respond to movement.

Depending on the results the victim then categorized in the following categories [5], which is depicted in Figure 1:

- Minor (Green): Even though they have injuries, these people are the less affected by the incident. They can wait for treatment until plenty medical resources are available, and they can even help take care of other victims.
- Delayed (Yellow): These victims have serious injuries that prevent them from standing up and walking. Nonetheless, they are stable, since they have normal respiratory frequency, good perfusion, consciousness, and mental capabilities unaffected by the incident. Therefore, medical resources are not assigned to them immediately, but to victims in more critical conditions.
- Immediate (Red): These people are alive, but have signs of shock, hemorrhage, or brain injury. Their lives can be saved, but they need to be transported urgently to a facility where they can receive advanced medical care.
- Expectant (Black): People that do not breathe are deceased or very unlikely to survive. Therefore, available resources must be assigned to other victims that have more chances of survival.

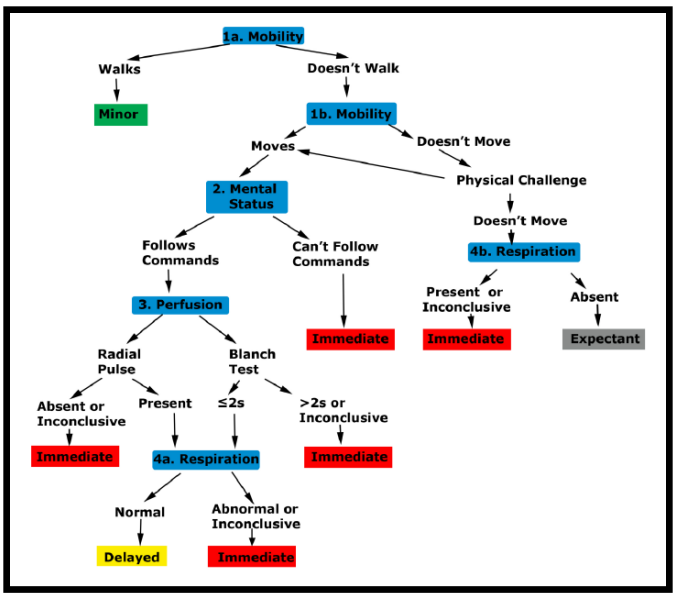

Figure 1: Robot-Assisted Medical Triage [6]

III. Approach

The approach of this project is to take the concept of representing a role using a script from Artificial Intelligence. The script provides a way to sequence actions for a given role. The script can be described as a *casual chain* which will provide both sequence and connectivity of a series of actions. Each script is also identified with a given actor. In this case, the robot and the user are both viewed as actors since both the user and the robot complete actions to arrive at the goal state of categorizing the victims. The actor carries out the given actions through doing certain tasks and using appropriate props.

The Protocol Coach's components are directed to make note of the various things that make up a role (Figure 2):

Role Options drop-down list: Provides a list of the available roles for the various responder roles

Script Overview box: Provides an overview of the script with a list of all the steps.

Equipment Cues: Lists the various hardware props which are used to aid in the script

Current Script Step & Dialog box: conveys the current state which the process is in and displays the messages that are inputted to communicate with the victim.

User Input box: Text field which allows the user to input text to be sent to the NLP toolkit and communicate with the victim using the text-to-speech method.

The End button: Provided in some of the steps that are solely based on user input or dialog, such as the Introduction or Conclusion step.

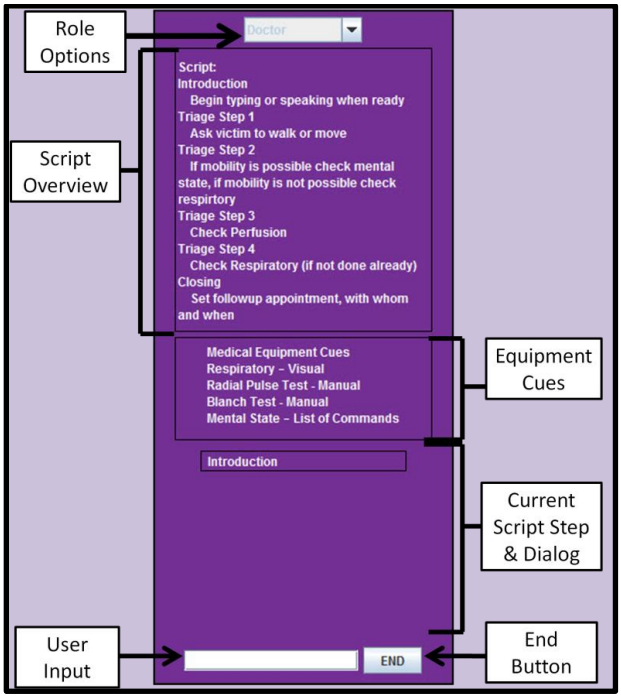

Figure 2: The Protocol Coach Overview

IV. Implementation

The Protocol Coach approach was implemented in Java by using both a graphical user interface and a script for a given role. The script is composed of an XML file which provides the name of the step and the step information. Once the user selects the role from the Role Options drop down box the script file is loaded and parsed. Then the information is used in the Protocol Coach components.

A. The Doctor Role

Once the doctor role is selected the complete script is then printed in the Script Overview Box. Using the Robot-Assisted Simple Triage discussed in section II, the script steps would be tailored to check those steps. The props in this case would be considered medical equipment options provided by the robot and a list would be placed in the Equipment Cues box. The box is also renamed to Medical Equipment Cues to better signify its purpose. In order to determine what the current triage step is in progress the step would be printed in the Current Script Step & Dialog box, along with any dialog the doctor would want to send to the victim to communicate. Once the doctor goes through the triage process and the victim is marked accordingly then that conclusion is also printed in this area (Figure 3).

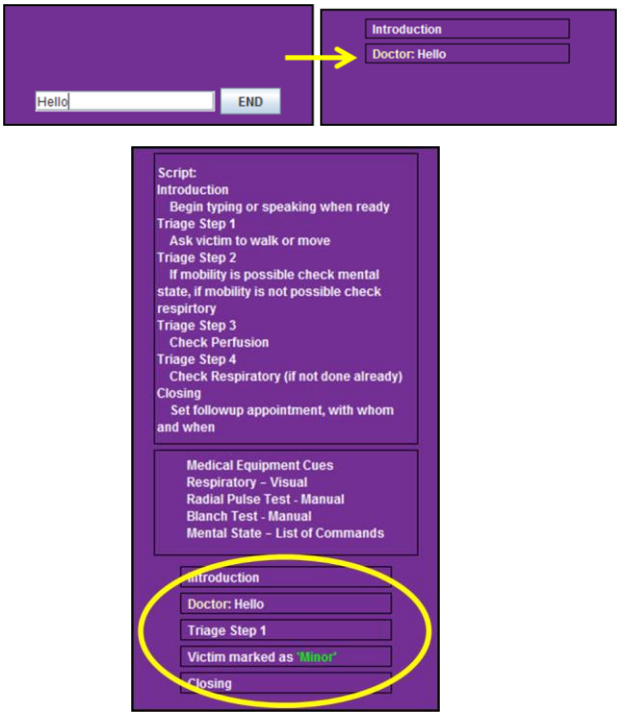

Figure 3: Input dialog (top), Conclusion of marked victim (bottom)

In order to properly assess the victims the use of ‘context questions’ serve useful to determine the results of each step (Figure 4). This is also another way to help cue the visual in each step of the triage since the steps may not be a memorable process. The responses from the context questions are then sent to a conditional-based method which will direct the process of what steps to follow through with in the script.

Figure 4: Context Question

The following questions are provided for each step:

Mobility has two possible options (Figure 5). The first question asks, “Can the victim can walk?” If the victim does not respond to verbal command, then the second option is tried. Through the camera the doctor would determine if the victim responds to physical contact done by the robot. Then the second question is asked, “Can the victim move?” Depending on if movement was successful the triage proceeding step would be check mental state or check respiratory.

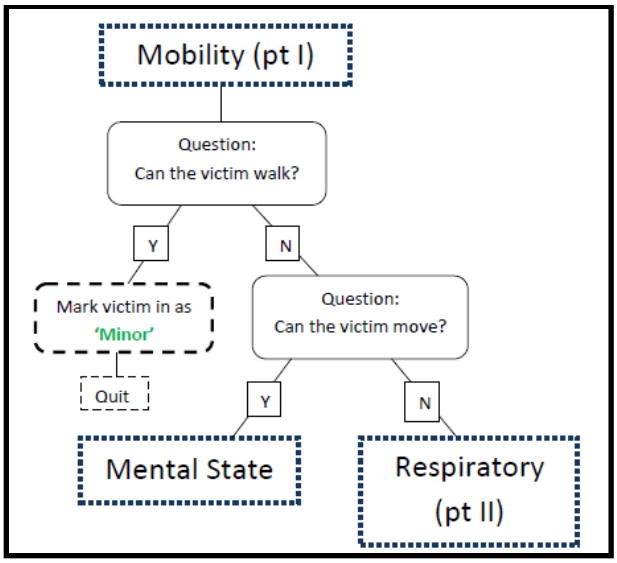

Figure 5: Step 1

Mental State has one context question “Can the victim follow commands?” If the victim successfully follows commands then the triage process proceeds to the next step of checking perfusion. However, if they do not respond or respond fluently then they are marked as “immediate” (Figure 6).

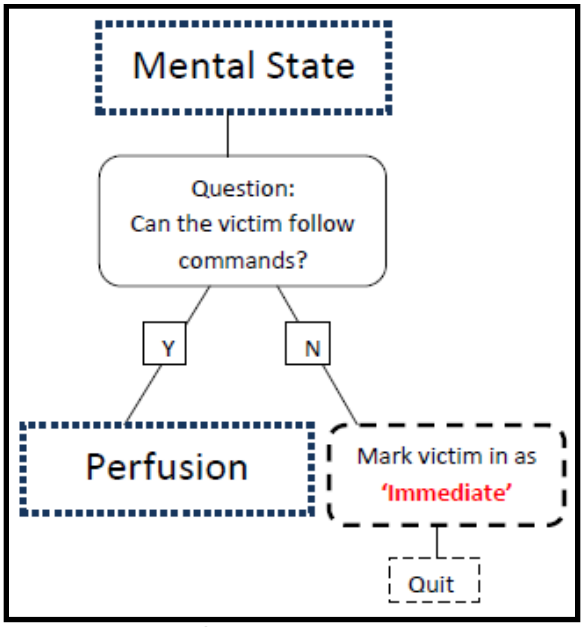

Figure 6: Step 2a

Perfusion has two options (Figure 7). The first context question presented to the doctor is “Can you check pulse?” If that is unsuccessful then the latter question is

asked “Can you do a blanch test?” If the sensors output is present and the doctor can determine the state of the victim from the results then the triage process continues to the Respiratory (part II) step. If the results are absent or inconclusive then the victim is marked as “Immediate.”

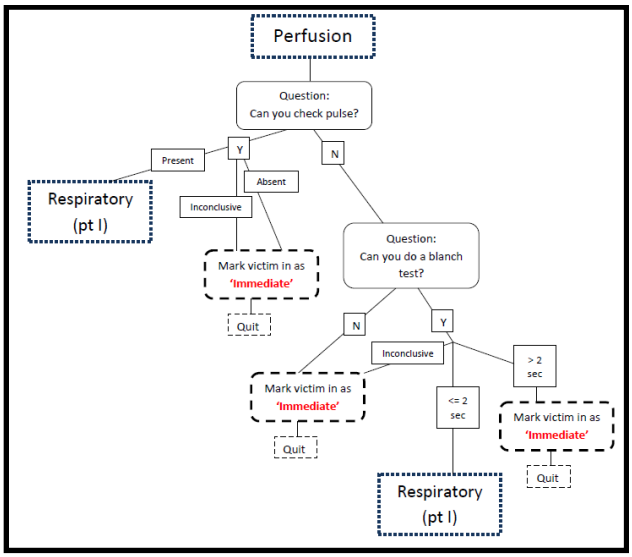

Figure 7: Step 3

Respiratory consists of two parts one for conscious victims and another for unconscious victims (Figure 8a & 8b). As previously stated, the first part of respiratory is for victims that responded to movement; appeared to have a stable mental state; and had successful, positive results for pulse or the blanch test. The victims will either be marked “Delayed” if the result is normal; or marked as “Immediate” if the results are abnormal or inconclusive. The second part is arrived by if the victim does not respond to movement and thus the results of this respiratory step will be either marked as “Immediate” or “Expectant”

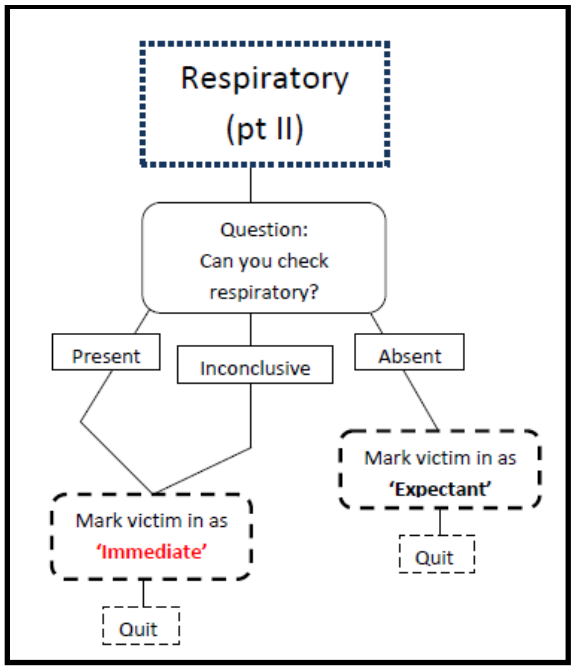

Figure 8a: Step 2b

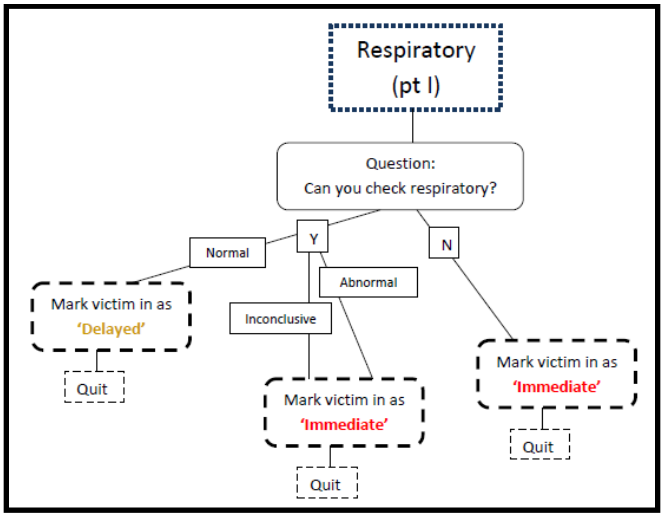

Figure 8b: Step 4

The End button would only be provided in the steps that are based on dialog. For the doctor role the introduction step, is where the doctor introduces themselves to the victim before beginning the triage process. In the conclusion stage the doctor is also expected to state when the victim will have a follow-up appointment as well as which doctor would be returning to work with the victim.

V. Conclusion and Future Work

This paper has discussed the use of implementing roles and scripts from artificial intelligence to aid in providing visual cues to the user and to direct the process. The approach that was taking to create such an application is to create a basic framework with the common components to display the script, list the available props and to denote the current step as well as dialog which is sent to communicate with the victim. The application of the “Protocol Coach” been shown to implement the doctor role in order to encapsulate the Robotic-Assisted Simple Triage process in order to treat and categorize victims involved in an incident. Due to the integration of the NLP toolkit the doctor can also communicate with the victim throughout the triage process. Through the hardware implemented on the rescue robot the triage process can perform various tests to assist in assessing the victims.

On a practical note, while this implementation has been very useful there is still need to expand the roles that are within the rescue robotics responder roles. It is more than likely that this framework will be implemented to incorporate such roles in future work.

References

[1] Coleman, P; “Social Roles for Simulating Group Behaviors”, 2007
[2] Barnes L.E., Murphy R.R., Craighead, J.; “Human-Robot Coordination Using Scripts”, 2006
[3] Long, M; Murphy, R.R.; “Using Roles and Persona to Adapt Robots to New Domains”, 2006
[4] Long, M; Murphy, R.R.; “Preliminary Report: Roles and Scripts for FIGHT-R, 2007
[5] Chang, C; Murphy, R.R.; “Towards Robot-Assisted Mass-Casualty Triage”, 2007
[6] Fig. 2; Chang, C; Murphy, R.R.; “Towards Robot-Assisted Mass-Casualty Triage”, 2007