

My Virtual Patient Speaks

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ABSTRACT

The Virtual Patient is a dialogue-based human project created to aid in training student nurses at the Clemson University School of Nursing. It was created to improve their clinical interview skills using different question to matching answer scenarios. To simulate the interview, the student nurse presents a series of questions to the virtual patient. In turn the virtual patient responds with the appropriate answer.

The application has different components to it which includes DI-GUY and Motion Editor to create the character and environment along with the characters animation, Dragon NaturallySpeaking for the Speech Recognition, where the student nurses speech is converted into text, the database with a timer control table to ensure the virtual characters speech and animation happens in response to a question asked by the nurse and the other tables in the database with the questions and answers pertaining to the patient-nurse interaction scenario.

My focus was on implementing the database processes to retrieve the matching questions to answers via behind the scenes coding and queries.

Keywords

Virtual patient, Student nurse, MySQL, C++.

1. PROBLEM AND MOTIVATION

The Virtual Patient is a dialogue-based human project created for the Clemson University School of Nursing. The project was introduced due to the dilemma the student nurses faced as they attempted to practice interviewing patients.

Practicing written scenarios is challenging due to the different schedules the professors and student nurses have, which prevents the student nurses from getting the full benefit of using this method. Another challenge is with attempting to work with children. This process involves completing a lot paperwork and waiting for a decision to be made, which would take too long and thus making this a difficult option to use. Training independently 24/7 would be a great benefit to the student nurses in completing their course of study. The School of Computing approached them with a solution and thus the virtual patient project came to be. My goal was to create a program that would cater to the student nurses need to train more efficiently.

The virtual patient that was created is a five year old female along with her mother (who responds to questions that the young patient does not answer). The student nurse asks the patient a series of questions stored in the database using a headset. The patient and her mother respond with the answers which are also retrieved from the database. The language component of the application draws on technology from question-answering systems [3]. This is necessary to ensure the mapping of question type (student nurse input) to expected answer type (database output) occurs.



2. BACKGROUND AND RELATED WORK

Through research, it has been shown that people respond to virtual characters in many of the same ways that they react to other people [1]. The way people interact and treat computers is based on perceived human characteristics such as a computer's expertise, helpfulness, and friendliness [6].

"Evidence suggests that human communication consists of a high bandwidth of modalities such as gestures, facial expressions, speech, and body language [4], and research shows that using both speech and gestures contributes to making virtual human interfaces more lifelike and believable [2]. Researchers have also shown that virtual human interfaces can provide feedback to human users using multiple channels such as speech, gestures, and facial expressions. For example is Gandalf, a humanoid who guides a user through the solar system. Gandalf responds to user speech, gaze, and motion with appropriate gestures, speech, and head movement [7]. Gandalf's behavioral rules are derived from psychology literature on human to human interaction."

The development of spoken dialogue systems has gained popularity as the use of spoken user interfaces or speech-based user interfaces is rapidly growing. Bigram resolution is a method used to process natural language [8].

3. RESULTS

My focus was on planning, designing and implementing the database processes programmatically using MySQL and C++. This involved brainstorming on an efficient method to use to insert and retrieve the appropriate data to and from the database.

To begin with I created the database using MySQL, which is a relational database management system that allows access to the database [5]. I needed to use more than one table to implement my program and using MySQL made this possible.

To be able to get the program to automatically run after a user initiates interaction with it, I used C++ programming language.

I wrote three separate programs to achieve the series of algorithms needed to efficiently carry out the processes needed to allow functionality of my programs.

3.1 Program I

The first program created had two tables associated with it containing the question the student nurse would ask the virtual patient and a question id number used to in a query to match it up with data in the other tables contained in the database.

To create this table, I used excel spreadsheet with a sample of ten questions the student nurse would ask the virtual patient. I created another column with the question id number and exported the spreadsheet into my database.

I then wrote a program to get the application to listen for and retrieve the question asked by the student nurse from the database. The database contained many variations of each question created through the use of synonyms in order to make the application smart enough to recognize a question even if it is asked in a different manner than the script the student nurses use during their interview.

Below is a sample question the nurse would ask the virtual patient:

What is your question?
Tell me more about this

3.2 Program II

The second program involved getting the question asked and running another program to break down the question asked into parts. Different methodologies can be used to break down a question into parts to achieve the desired results. In this case, I used bigrams, which essentially is breaking a question into a set of two matching words.

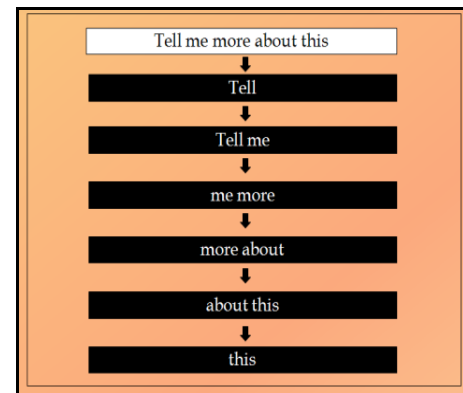
Once the bigram was programmatically created, I inserted the bigram along with an automatically generated bigram id number into a second table that I named bigrams table.

Now that I had two tables created with the question, question id number, bigram and bigram id number, I

created another table to map the questions with the bigrams using their respective id numbers and named this table the mappings table.

Before actual inserting the id numbers, I wrote various queries using C++ to check for bigrams already contained in the database so as not to insert duplicate bigram id numbers into the mappings table. This will help in ensuring the appropriate answer is matched up with a question.

Below is an illustration of the sample question asked broken into bigrams:



3.3 Program III

The third program matches the question to answer. This was accomplished by writing a nested query where the question id number from the mappings table and the bigrams id number from the bigrams table were retrieved and only return the question id number with the highest count of matching occurrences of that question id number.

Once the question id number was obtained, it was used within another query to obtain the matching answer from another table. This table called the responseid table also had a timer control program that was used to ensure the virtual patient spoke and displayed the animation after the student nurse posed the question.

It is thus at this point that the answer is spoken out by the virtual patient with coordinating animations displayed on the screen.

Below is the sample response query and matching response that the virtual patient would speak out and animate:

```
SELECT * FROM responseid WHERE aID = 4;
4, child, face, Neutral_exp, 1, 1
1000
4, mom, speak, She has been complaining of her ear hurting
for the past two days., 1, 2
2016
```

4. CONCLUSION

This was the first proof of concept prototype created and tested for the School of Nursing.

The application achieved the desired results, which was to create a virtual patient to aid in training student nurses to improve their clinical interview skills.

5. FUTURE WORK

The next step in the project is to run a usability study in conjunction with the School of Nursing.

The purpose of the study is to get feedback on what improvements can be made with the application to enhance the student nurses training process.

The study will also help gather information on how to make the application smarter based on user needs.

After this, a specific study still in conjunction with the School of Nursing will be conducted to determine the effectiveness of the application.

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