Application Development and Automating Scoring with Machine Learning

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NIH Training in Gerontechnology, Computer Science

Introduction

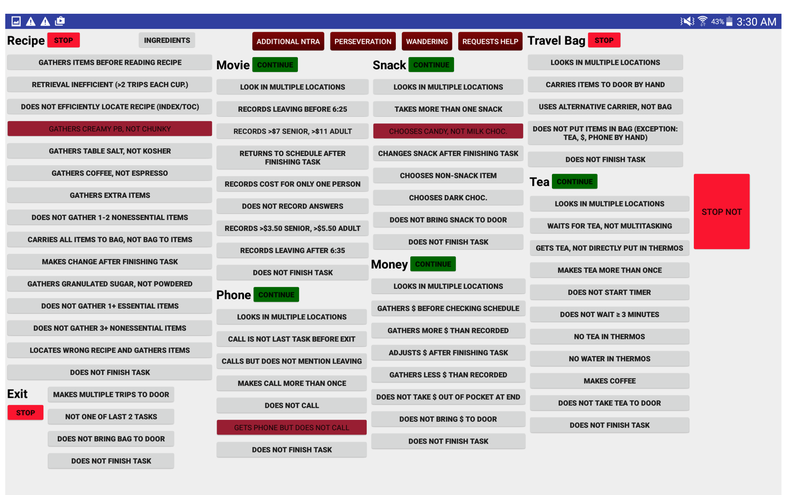
One way psychologists and trained clinicians measure cognitive impairment is observing individuals as they perform a set of daily activities. While observing the participant, the clinician must record information about the performance such as start and stop times, and what types of errors were made. This is difficult to do in real-time and often requires reviewing taped sessions to verify data accuracy.

The purpose of this research was to develop an android application to give trained clinicians the ability to record efficiently and in real-time the performance of volunteers attempting to complete nightly tasks in a controlled environment. The Night Out Task or NOT app then uses the data entered to calculate a set of scores which the clinician can use in evaluating the level of cognitive impairment of an individual.

We hypothesize that many of the hard-coded formulas used in the NOT could be successfully replaced with machine learning algorithms and still maintain a high degree of accuracy. We therefore use the NOT data and Weka[1], a machine learning software application, to predict the same scores that are currently being calculate by the NOT app.

Background

Similar tools for real-time annotation have been developed previously. The development of the Real-time annotation tool (RAT) [2], like the NOT app allows observers to annotate experiments in real-time. However, the RAT does not run on a mobile platform and is therefore less portable. The RAT also does not provide any aggregation or calculation of scores.



Methods

NOT Development

•In conjunction with the Psychology department at Washington State University we constructed the user interface and the determined the scoring requirements for the application.

•The NOT is designed to allow all buttons to be available to efficiently record the activities. Different interfaces are used for different sized devices.

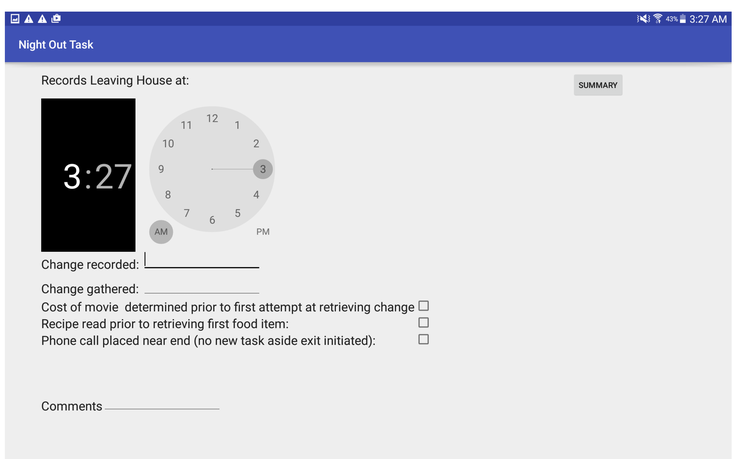
Machine learning Approach

•We gathered data using a prototype of the NOT app at Washington State University. Two sets of data were gathered, one with older individuals, and the other with younger individuals.

•Using the data from the experiments, we calculated various attributes including number of inefficient, incomplete and inaccurate error totals for individual activities, and combined totals for each experiment. Other variables calculated include planning time and total time.

•We predicted scores for each activity, an overall quality score, and an overall accuracy score using 10-fold cross validation.

•In order to get the best results for each data mining experiment we tried different classifiers including, naïve bayes, linear regression, and a decision tree.



Results

Using the inefficient, incomplete and inaccurate totals for each activity, we were able to correctly predict the correct activity score 99% of the time using a Naïve Bayes classifier.

Using the scores of each activity for each experiment the overall quality was predicted correctly 65% of the time.

With each activity score for each experiment we were able to predict the correct overall accuracy score 90% of the time. A linear regression classifier reproduced the exact formula we used to calculate the overall accuracy score in the NOT app.

Using the three error totals for each activity for every experiment we were able to predict the correct overall quality 65% of the time.

Using the three error totals for each activity for every experiment we were able to predict the overall accuracy score with a correlation coefficient of 0.766, and a mean absolute error of 2.05.

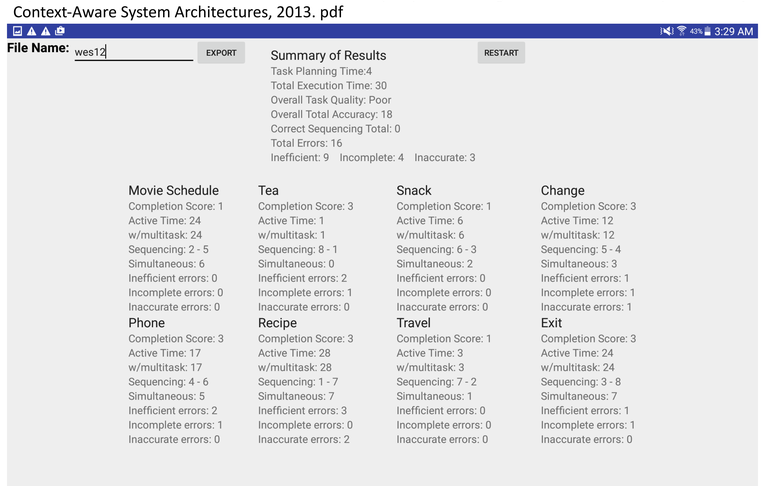
Conclusions

The NOT app will continue to be used to collect data to assist other research projects. The machine learning is able to accurately predict individual activity scores and the overall accuracy score. However, it struggles to correctly predict the overall quality. With more data we hope to improve this prediction.

References

[1] Mark Hall, Eibe Frank, Geoffrey Holmes, Bernhard Pfahringer, Peter Reutemann, Ian H. Witten (2009); The WEKA Data Mining Software: An Update; SIGKDD Explorations, Volume 11, Issue 1

[2] K.D. Feuz and D. Cook. Real-time annotation tool (RAT). Proceedings of the AAAI Workshop on Activity Context-Aware System Architectures, 2013. pdf



This research is funded by NIA grant R25AG046114