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INTRODUCTION

Smart environments have been of growing interest in recent years due to their potential for assisting elderly individuals in activities of daily living. In order to deploy a smart environment, several weeks worth of data must first be annotated with corresponding activities. This process can be very time consuming, tedious, inaccurate, and somewhat invasive. We came up with a tool that would automatically provide annotations and tried to determine how beneficial it was.

APPROACH

Our approach involved combining two previously developed technologies to create automatic annotation.

- Naïve Bayes classifier
- Smart home visualizer

The Bayes technique was borrowed from another paper[1]. Five features are used for the Bayes model.

- Time
- Location
- Water
- Burner
- Cabinet door

The probabilities are based on the relative frequencies of each feature for each activity. Before predictions can occur, some data must first be annotated by hand. The Bayes model is then trained on this data and used to annotate the remaining data. As more data is annotated, the Bayes classifier error rate decreases.

VISUALIZER

The visualizer used is called PyViz developed by Brian Thomas. PyViz generates a 2D view of the smart home blueprints and allows you to see individual sensors go off in real time. The automatic annotation feature was integrated into PyViz which displays predicted annotations generated by the naïve Bayes model, and allows the predictions to be applied to the data.

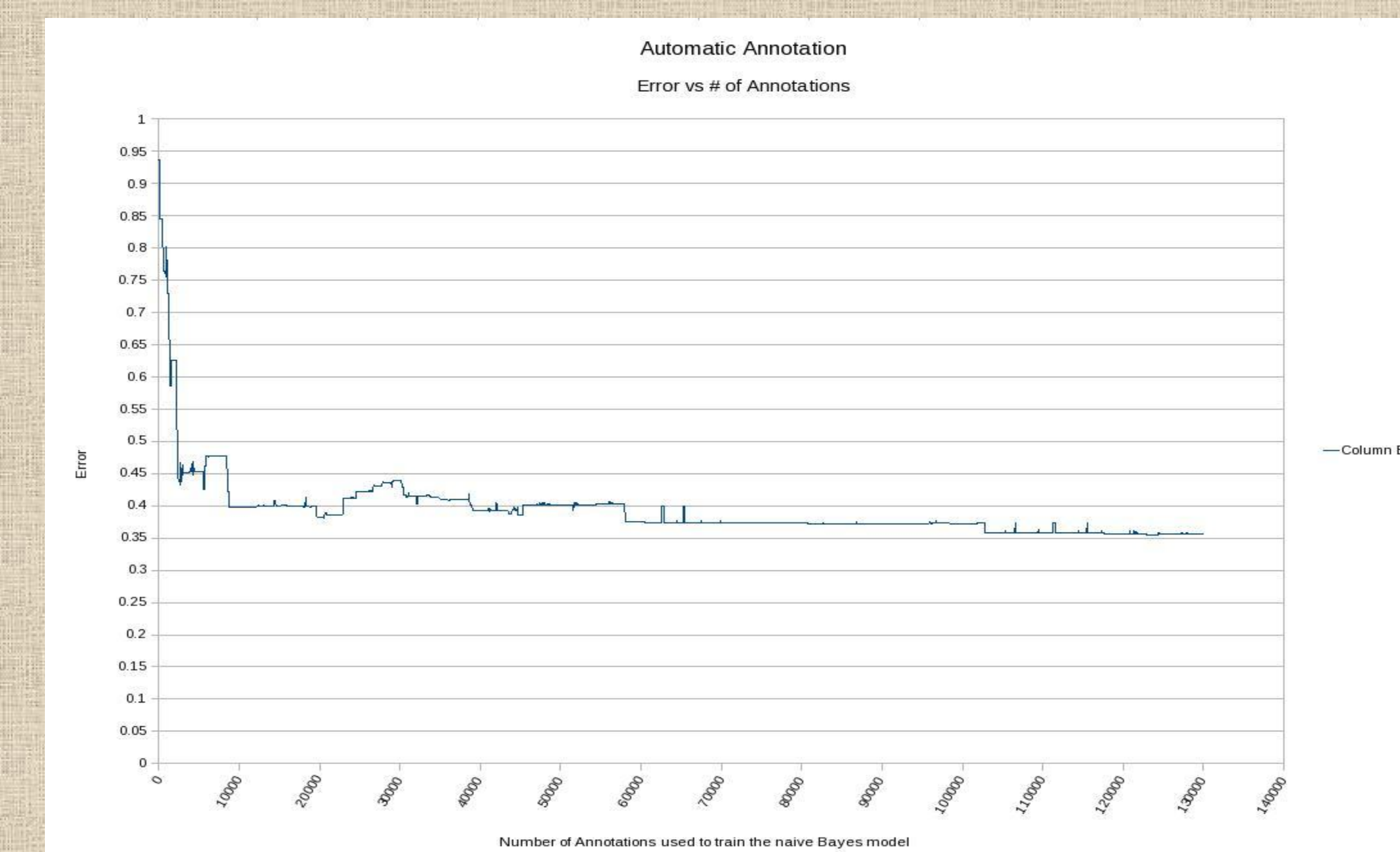


PyViz – Advanced CASAS Visualizer

DATA

The data was collected from a single resident in the winter of 2008. Each day was broken up into two time frames, the first being from 6:00 am to 10:00 am, and the second from 3:00 pm to 11:00 pm. Nine activities were observed, which are listed on the right hand side of the screenshot above.

To test the tool, we'll have one person annotate five days worth of data using just the visualizer, and another person annotate five days using the visualizer along with the prediction viewer. Before we can say anything conclusive about the results, more testing will need to be done, involving more annotators and more data sets.



The above graph was generated by training the Bayes model on intervals of 30 annotations, and on each interval predicting the entire dataset. Error is calculated as number of incorrect predictions divided by total number of predictions. Only one dataset is depicted here, ideally this should be averaged over many datasets to get a smoother curve. This is left for future work when more data has been collected.

FUTURE WORK

- Run tests over a much larger data sample and involving more people.
- Replace the naïve Bayes classifier with a hidden Markov model.

REFERENCES

1. S. Szewczyk, K. Dwan, B. Minor, B. Swedlove, D. Cook. Annotating Smart Environment Sensor Data for Activity Learning. Technology and Health Care, special issue on Smart Environments: Technology to support health care, 2009.