Machine Translation

Jacquin Buchanan
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Introduction

• VoxTec International develops speech-to-speech translation devices.
  – Chief product, the Phraselator® P2 already used by thousands of military, law enforcement customers worldwide

• Lead software architect of this project since early 2001.
  – Personal mission to create practical solutions for human-to-human interaction using speech and language technologies
Discussion Topics

• **Machine Translation (MT) Challenges**

• Current MT Technologies

• Several Reasonable Solutions
Setting Expectations

- The “Universal Translator” is harder than every other part of the Star Ship Enterprise
- The universal translator is not necessary to meet most needs

![Graph showing technical difficulty vs. machine translation accuracy]
Communication Complexities

• Artistic Expression of Language
  – Colloquialisms
  – Double Entendre
  – Euphemisms
  – Satire

• Cultural Differences
  – “You’re a Chicken” is a compliment in some cultures and an insult in others
Added Difficulties of Low Resource Languages

• The military is interested in languages with very little resources
• Few trained linguistic resources
• No written dictionary
• Very different morphology than English
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“Speech-to-Speech” Diagram

SPEECH Input

Automatic Speech Recognizer

Conversion to Input (Source) Language TEXT

Machine Translation

Conversion to Output (Target) Language TEXT

Speech Synthesizer

= SPEECH Output
Various Machine Translation Technologies

- Pre-Translated Phrases
- Statistical Machine Translation
- Rule Based Systems
  - Transfer
  - Interlingua
Statistical Machine Translation (SMT)

1. Gather lots of pre-translated phrases
2. Train the engine based on those phrases
3. New translations are statistically similar to the original training data based on word order
How Does SMT Define Domain?

• By Choosing your training data you are defining the domain
  – The selection of words
  – The order of the words
  – What you train the engine with is what the engine knows
Example Domains

• Simpler, Tightly Restrained Topics
  – Military Check Point
  – Emergency Medical Technician
  – Police Traffic Violation

• Harder, Complex Topics
  – Business Negotiation
  – Interview
  – Training
Relationship Between Domain Complexity and Translation Accuracy

- **Easy**
- **Possible**
- **Hard**
- **Useless**
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The Good News

• We don’t need a universal translator

• We can keep our speech simple and avoid using complex patterns

• In a dialog we can dynamically recover from misunderstandings
Solution One: Tightly Trained SMT

• “Raise your hands” could be:
  – Doctor saying, “raise you hands over you head and cough, while I listen to your lungs”
  – Police saying, “drop the weapon and raise your hands over your head”

• The three words could be translated differently in these two contexts, so don’t train with both phrases
Solution Two: Phrase Based Translation

• For domains with a low complexity, communications can be divided into an explicit set of phrases

• Resolve syntactical differences of speech to pre-translated phrases

• “Raise your hands” and “Put your hands over your head” are the same concept, therefore are stored as one translation
Example Solution - Phraselator®

• English phrases are pre-determined according to a domain, then translated into multiple languages

• Translations are recorded by native linguists

• A different “Module” is built for each domain of interest
The Conclusion

• It is possible to make a handheld speech-to-speech machine translation device that’s practical enough to help people perform their jobs

• Primary customer is Military, Law Enforcement and Emergency Medical
Phraselator® P2 Demonstration
THANK YOU!

Jacquin Buchanan
Director of Software R&D
jacquin.buchanan@voxtec.com

VoxTec International, Inc
20 Ridgely Ave. Ste. 201
Annapolis, MD 21401
410.626.1110

Phraselator® Translation Products
www.phraselator.com