

# INGIT – Limited Domain Formulaic Translation from Hindi to ISL

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# Introduction

- Objective
  - Create a scalable proof-of-concept system
  - Exhibit challenges in cross modal translation
  - Provide tangible solutions
- Scope
  - Railway Counter Domain
  - Handle Speech → Sign translation only

# Past Research

- Speech → Sign
  - Form based approaches [Veale94, Zhao02, Speers02]
  - Semantic based approaches [Marshall03, Wray04]
- Sign Recognition (Sign → Speech)
  - Reasonable accuracy rates
  - Very small vocabularies handled

# Sign Language

- Spatial Modality
- Extensive use of space
  - Iconic signs
  - Role play
  - Use of person and space deixis
  - Directional verbs
  - Non-manual markers

# Indian Sign Language



THREE



AC

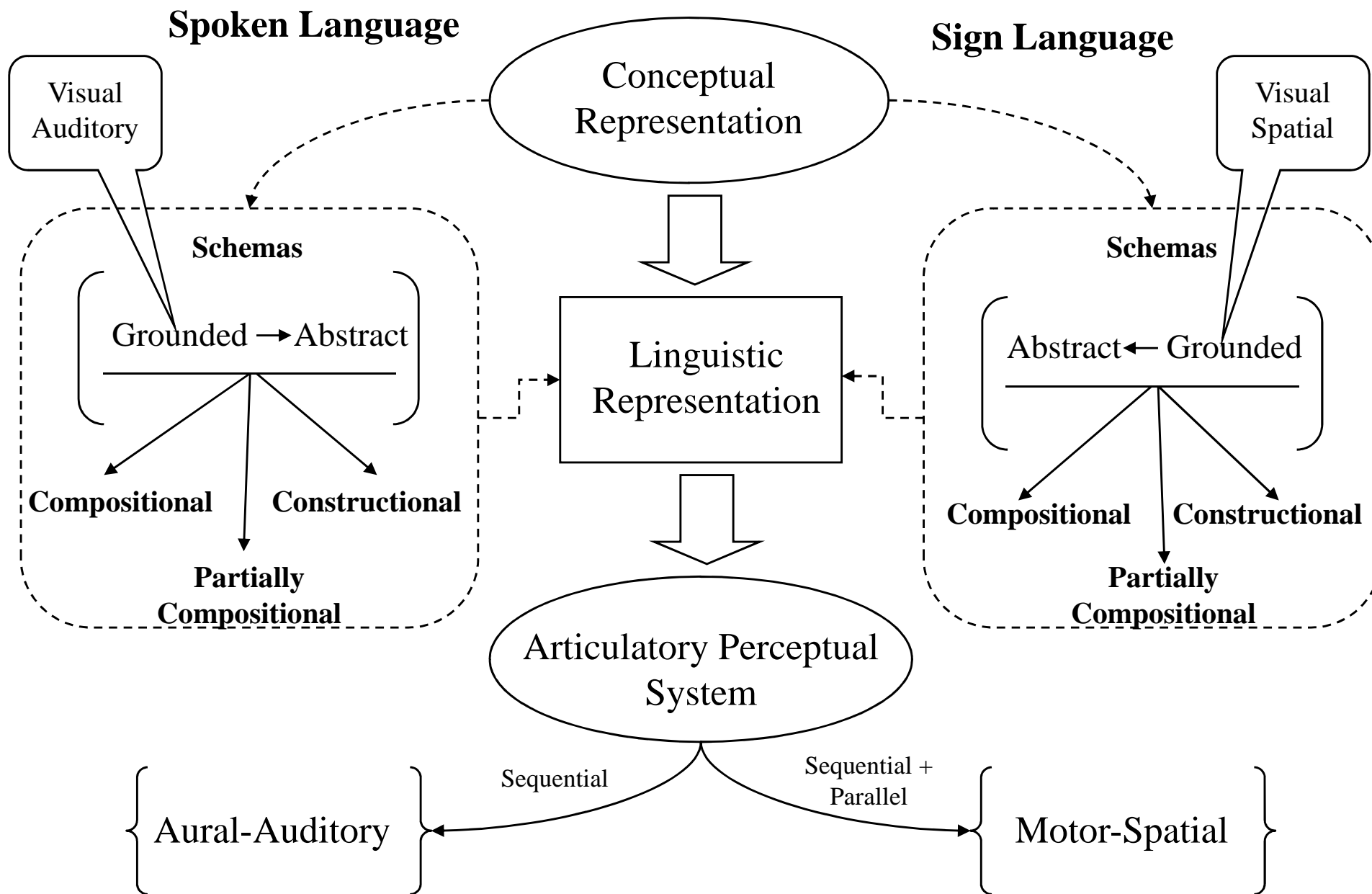


TICKET



NEG

# The Proposed Model



# Framework Adopted

- **Constructions**
  - Form-meaning maps at
  - morphological, lexical, and syntactic levels
- **Construction Grammars** [Kay, 2002]
  - The fly is buzzing.
  - What is the fly doing in my soup?
  - . . . fly in the ointment. . .
- **Unification based approach**

# Constituent-Level operations in cross-modal mapping

- Constituent Level

- Complete

- गाड़ी सात बजे जाएगी → {train time seven go}  
*train seven O'clock go-fem-future*

- Partial

- Constituent Deletion

- राजधानी रात में चलती है → {rAjdhAni night go}  
*rAjdhAni night in go-fem*

- Constituent Insertion

- आप दस रुपये दीजिए → {money ten give {you → me}}  
*you-hon ten rupees give-hon*



# Construction-Level operations in cross-modal mapping

- Construction Level

- Compositional

- टिकट नहीं मिलेगा क्योंकि वेटिंग है

- ticket neg get because waiting be* →

- @n {ticket get neg} {Q-why} {waiting-list}

- Non-Compositional

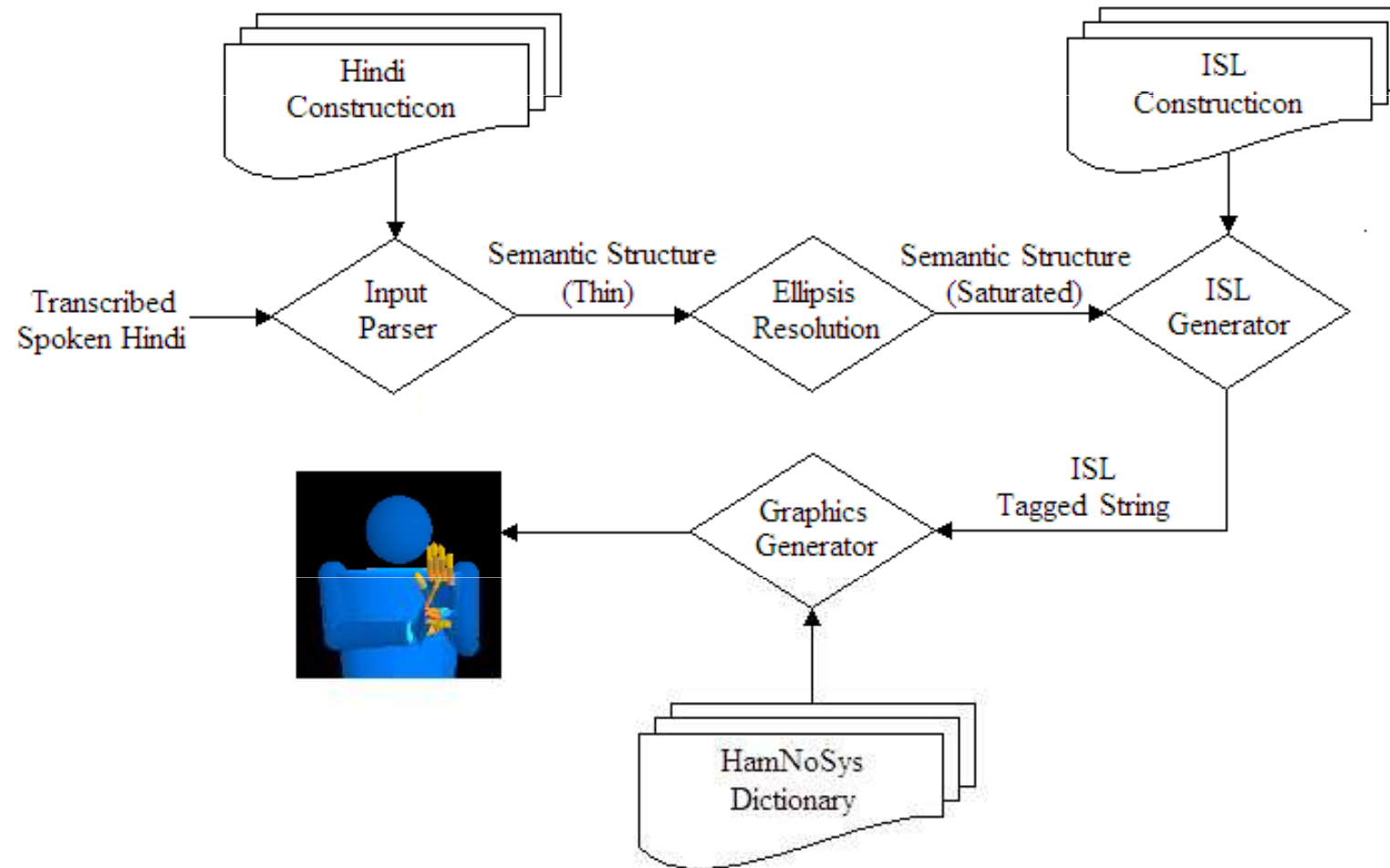
- X में Y वेटिंग है → {x waiting-list y}

- X in Y waiting be*

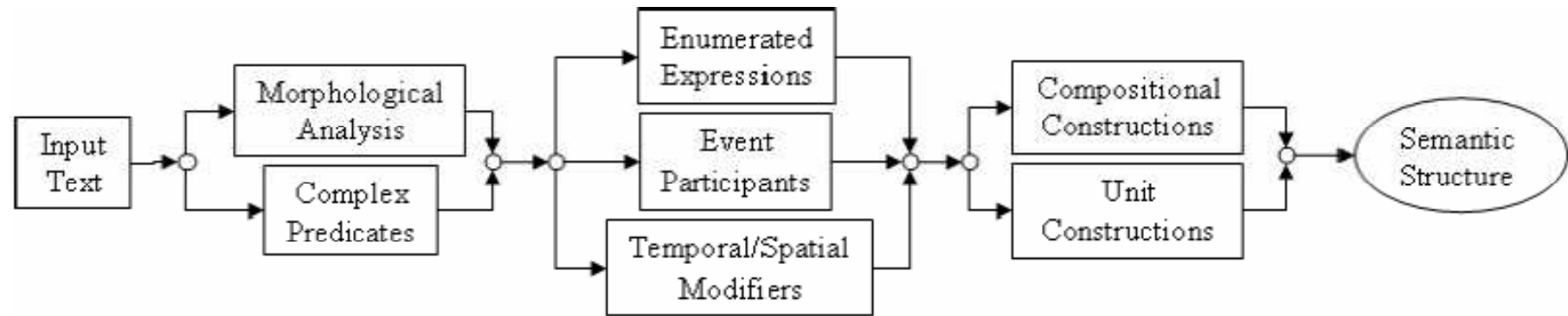
# Polysemy and Anaphora

- Polysemous Expressions
  - attributive and existential senses of 'है' (*hai*, be)
  - alienable vs. inalienable possession as in मेरी किताब (*meri kitab*, my book) and मेरा भाई (*merA bhai*, my brother)
  - transactional and non-transactional senses of the verb 'ले' (*le*, take)
- Anaphoric expressions
  - May be resolved to saturate event semantics
  - May be replaced with deictic signs
    - Default deixis
    - वह गाडी कानपुर नहीं जाएगी → {train -dei @n{kAnpur go neg}}
    - that train kAnpur neg go-future*

# INGIT - Architecture



# Input Parser



- Accepts transcribed spoken expressions
- Analyses the input morphologically, identifying phrases (viz. modifiers, polarity items)
- Uses a simple dictionary look-up approach on the input language construct-icon
- Outputs a (possibly incomplete) semantic structure

# INGIT - Architecture

- शताब्दी शाम को कानपुर नहीं जाती  
*shatAbdi evening in kAnpur neg goes*
- जा(jA, go)  
((MOTION-VERB EV) (GO EV) (VERB-CLASS EV UNARY)  
(ARGUMENT-1 EV OBJ) (TIME-FRAME EV X)  
(ARGUMENT-1-PREREQ EV MOBILE))
- {SUB-NOMINATIVE MODIFIER-1 MODIFIER-2 NEGATION  
UNARY-VERB}

# INGIT - Architecture

- शताब्दी शाम को कानपुर नहीं जाती
- ((MOTION-VERB X-95) (GO X-95) (VERB-CLASS X-95 UNARY) (ARGUMENT-1 X-95 X-96) (TIME-FRAME X-95 PRESENT))
- (SHATABDI X-96) (DISCOURSE-ROLE X-96 EXTERNAL) (GENDER X-96 FEMININE) (MOBILITY X-96 MOBILE)
- (NEG X-73)
- (KANPUR X-61)
- (EVENING X-58) (TEMPORAL-MODIFIER X-30 X-58)
- (SATURATED X-41) (EVENT X-41 X-95) (MODIFIERS X-41 X-95 X-30 X-61) (NEGATOR X-41 X-95 X-73)))

# INGIT - Architecture

- Ellipsis Resolution Module

- दस रुपये दीजिए → {money ten give {you → me}}

- ten rupees give-hon*

- Attempts to saturate the incomplete semantic structures given by input parser

- Assumes simple constraints imposed by the limited domain

- Viz. constraints of animacy on participants in a transactional event

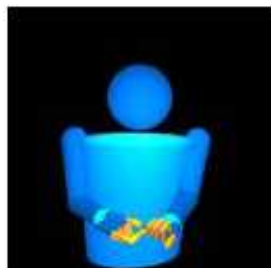
# INGIT - Architecture

- ISL Generator
  - Very similar to input parser in operation
  - Uses ISL construct-icon to build up ISL sign-gloss
  - Constituent reordering
  - Negation and Q scope resolution
- {SUB @n{MODIFIER-1 MODIFIER-2 UNARY-VERB NEGATION}}
- {SHATABDI @n{EVENING KANPUR GO NEG}}



# INGIT - Architecture

- Graphical Simulator
  - Convert the tagged ISL strings into HamNoSys notation
  - Graphics generation final step in the system



SHATABDI



EVENING



KANPUR



GO



# Summing Up

- Problem of cross-modal translation
- Semantically mediated procedure
- Adapt CG to specific objectives
- Develop working implementation
- Groundwork
  - Identify representational, conceptual issues in cross-modal linguistic processing
  - Provide implementable solutions for the same

# Future Directions

- Describe ISL in terms of a framework allowing parallel processing
  - Define such a framework and develop formalisms for the same
- Develop robust graphical front end
- Explore cognitive processes underlying generation of spatial language