Designing Information Gathering Robots for Human-Populated Environments

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UNIVERSITY OF WASHINGTON

IROS 2015
Hello there
Hello there

CMU Cobots

Aethon TUG

Savioke Relay
Is my advisor in her office?

Can you find me an empty study lounge?

Let me know when my advisor becomes available

What was your day like?
INFOBOTS

• Information gathering agents in human populated environments

We seek to better understand the value of the services that InfoBots can provide
TASK TYPES FOR INFOBOTS

- Is my advisor in her office? - Checking
- Can you find me an empty study lounge? - Searching
- Let me know when my advisor becomes available - Monitoring
- What was your day like? - Summarizing
**TASK TYPES FOR INFOBOTS**

- **Checking**
- **Searching**
- **Monitoring**
- **Summarizing**

- Is my advisor in her office?
- Can you find me an empty study lounge?
- Let me know when my advisor becomes available
- What was your day like?
STUDY DESIGN

Study 1: A User Survey
• to determine types of useful information
• to identify constraints and requirements

Study 2: Deployment
• to study practical usage of the service
STUDY DESIGN

Study 1: A User Survey
- to determine types of useful information
- to identify constraints and requirements

Study 2: Deployment
- to study practical usage of the service
Q1. Is John in his office?

Q2. How many people are in the lounge?

Q3. Are there any empty tables in the study room?

Q4. Are there any bagels at the coffeeshop?

Q5. Is there free food in the kitchen?

Q6. Is the conference room occupied?
FINDINGS: USEFULNESS

The ability to ask this type of question would be
FINDINGS: USEFULNESS

The ability to ask this type of question would be

People think InfoBots can be useful
FINDINGS: USAGE FREQUENCY

Average % of responses over 6 questions

- Multiple times a day: CS 15%, LAW 30%
- Every day: CS 15%, LAW 30%
- Once/twice a week: CS 30%, LAW 45%
- Once/twice a month: CS 45%, LAW 60%
- Never: CS 60%, LAW 15%

I would ask this type of question

People will not ask questions frequently
The ability to ask this type of question would be

People think InfoBots can be useful
FINDINGS: USAGE FREQUENCY

Average % of responses over 6 questions

Multiple times a day: 25%
Every day: 21%
Once/twice a week: 25%
Once/twice a month: 15%
Never: 15%

I would ask this type of question

People will not ask questions frequently
FINDINGS: TIME CONSTRAINT

Average % of responses over 6 questions

<table>
<thead>
<tr>
<th>CS</th>
<th>LAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>45%</td>
<td>45%</td>
</tr>
<tr>
<td>60%</td>
<td>60%</td>
</tr>
</tbody>
</table>

CS: Immediate
LAW: No rush whenever

I would require a response

High expectation
STUDY DESIGN

Study 1: A User Survey
  • to determine types of useful information
  • to identify constraints and requirements

Study 2: Deployment
  • to study practical usage of the service
Is there any free food in the lunchroom?
Is there any free food in the lunchroom?
Is there any free food in the lunchroom?

DUB-E Today at 8:39 am

Working on your question!
Is there any free food in the lunchroom?

DUB-E Today at 8:39 am
95% confidence

Yes.
## FINDINGS: QUESTION TYPES

<table>
<thead>
<tr>
<th>Checking questions</th>
<th>Non-checking questions</th>
<th>Total questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Is there anyone in {location}?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Is {person} in his/her office?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Is there any food in the downstairs kitchen?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Is there anything in my mailbox?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Does {name}’s office have a sofa?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Is the reception still open?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Who let the dogs out? :)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Has {person} arrived yet today in the {} building?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Which meeting room has the best visibility of the {} landmark today?</strong></td>
<td></td>
<td></td>
</tr>
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<td><strong>Non-checking questions</strong></td>
<td><strong>Total questions</strong></td>
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<td><strong>Non-checking questions</strong></td>
<td><strong>Total questions</strong></td>
</tr>
</tbody>
</table>
## FINDINGS: CHECKING SUBTYPES

<table>
<thead>
<tr>
<th>Question</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there anyone in {location}?</td>
<td>presence</td>
</tr>
<tr>
<td>Is {person} in his/her office?</td>
<td>presence</td>
</tr>
<tr>
<td>Is there any food in the downstairs kitchen?</td>
<td>presence</td>
</tr>
<tr>
<td>Is there anything in my mailbox?</td>
<td>presence</td>
</tr>
<tr>
<td>Does {name}’s office have a sofa?</td>
<td>presence</td>
</tr>
<tr>
<td>Is the reception still open?</td>
<td>state</td>
</tr>
</tbody>
</table>

**presence:** e.g. Is {object} in {location}?

**state:** e.g. Is {location} {state}?

<table>
<thead>
<tr>
<th>Presence questions</th>
<th>State questions</th>
<th>number of questions</th>
<th>76%</th>
<th>24%</th>
<th>( \kappa = 0.89 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>76%</td>
<td>24%</td>
<td></td>
</tr>
</tbody>
</table>
FINDINGS: TARGET OBJECTS

<table>
<thead>
<tr>
<th>Question</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there anyone in {location}?</td>
<td>person</td>
</tr>
<tr>
<td>Is {person} in his/her office?</td>
<td>person</td>
</tr>
<tr>
<td>Is there any food in the downstairs kitchen?</td>
<td>food</td>
</tr>
<tr>
<td>Is there anything in my mailbox?</td>
<td>mail</td>
</tr>
<tr>
<td>Does {name}’s office have a sofa?</td>
<td>other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Questions</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Food</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>Mail</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>13%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Long tailed distribution $\kappa = 0.93$
POST-DEPLOYMENT SURVEY

Please rate how satisfied you were with InfoBot's speed in answering your question.

- Completely satisfied
- Very satisfied
- Moderately satisfied
- Slightly satisfied
- Not at all satisfied

Despite initial high expectation, only 5% was “Not at all satisfied”.
PROGRESS ON AUTONOMOUS INFOBOTS

Input: \( Q \). Is there breakout area occupied?

- **language parsing**
- **presence**\( (cse400, person) \)
- **viewpoint estimation**

Output:

Submitted to ICRA2016
CONTRIBUTIONS

1. Categorization of InfoBots’ task types
2. Findings on people expected InfoBot usage
3. Findings on actual InfoBot usage

Thank you!