Research Methods in computer science
Fall 2021

Lecture 5

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Agenda

Anatomy of Research Papers
HW3
Research Papers

Understanding what papers look like
Anatomy of a Research Paper

Abstract
Introduction
Related Work
Design and Implementation
Evaluation
Conclusion
Some of the contents in the next few slides from Jennifer Widom’s notes on Writing Technical Papers.
Abstract

Summary of motivation, state of the art, your algorithm or system, and results each in 1-3 sentences.
Abstract MadLibs!!

This paper presents a ________ method for ________ (synonym for new) ________. Using ________, the ________ was measured to be ________ +/- ________ ________. Results show ________ agreement with theoretical predictions and significant improvement over previous efforts by ________, et al. The work presented here has profound implications for future studies of ________ and may one day help solve the problem of ________. ________.

Keywords: ________, ________, ________ (buzzword) (buzzword) (buzzword)
Introduction

What is the problem?

Why is it interesting and important?

Why is it hard? (E.g., why do naive approaches fail?)

Why hasn't it been solved before? (Or, what's wrong with previous proposed solutions? How does mine differ?)

What are the key components of my approach and results? Also include any specific limitations.

Summary of results and contributions.
Related Work

You want to give a sense of the old and new work in this area.

Where to look for these?

Organized is better than not organized
Organizing Related Work

Lists
Figures
Diagrams
Tables
Sub-sections
Competition table
Fig. 1. Selected classes of dissemination protocols in sensor network. CodeDrip uses network coding to make dissemination of small data efficient and fast.
Table 1: Comparison of different non-intrusive people identification methods.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Sensor</th>
<th>Accuracy (%)</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hnat et al. [6]</td>
<td>Ultrasonic</td>
<td>94</td>
<td>5</td>
</tr>
<tr>
<td>Pan et al. [18]</td>
<td>Geophone</td>
<td>96</td>
<td>5</td>
</tr>
<tr>
<td>Zeng et al. [24]</td>
<td>Wi-Fi</td>
<td>93</td>
<td>4</td>
</tr>
<tr>
<td>Jenkins et al. [9]</td>
<td>Pressure</td>
<td>80</td>
<td>15</td>
</tr>
<tr>
<td>Khalil et al. [13]</td>
<td>Ultrasonic</td>
<td>95</td>
<td>20</td>
</tr>
</tbody>
</table>
### Table I: State of the Art People Counting Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Application</th>
<th>Cost ($)</th>
<th>Privacy Preserving Level</th>
<th>Scalability</th>
<th>Real Time</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break Beam Sensors</td>
<td>Counting</td>
<td>≤ 10</td>
<td>High</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PIR Sensors</td>
<td>Presence</td>
<td>≤ 10</td>
<td>High</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ultrasonic Sensor</td>
<td>Counting</td>
<td>≤ 100</td>
<td>Moderate</td>
<td>No</td>
<td>Training Required</td>
<td>No</td>
</tr>
<tr>
<td>RGB Cameras</td>
<td>Counting</td>
<td>≤ 100</td>
<td>Low</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>IR Imager</td>
<td>Counting</td>
<td>≤ 25</td>
<td>High</td>
<td>Yes</td>
<td>Training Required</td>
<td>No</td>
</tr>
<tr>
<td>Our Solution</td>
<td>Counting</td>
<td>≤ 25</td>
<td>High</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Table 1. Performance for state-of-the-art embedded VLC.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Rate</td>
<td>250 bps</td>
<td>800 bps</td>
<td>1 kbps</td>
<td>16 kbps</td>
<td>1 mbps</td>
<td>1-10 kbps</td>
<td>100 kbps</td>
</tr>
<tr>
<td>Distance</td>
<td>~10 cm</td>
<td>~2 m</td>
<td>~1 m</td>
<td>~5 m</td>
<td>NA</td>
<td>~20 cm</td>
<td>6 m</td>
</tr>
<tr>
<td>Multi-hop</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Full-Duplex</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Parallel Channels</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Implementation</td>
<td>MCU</td>
<td>MCU</td>
<td>MCU</td>
<td>ARM</td>
<td>FPGA+MCU</td>
<td>MCU</td>
<td>ARM + PRU</td>
</tr>
<tr>
<td>Antenna</td>
<td>LED-to-LED</td>
<td>LED-to-LED</td>
<td>LED-to-PD</td>
<td>LED-to-LED/PD</td>
<td>LED-to-PD</td>
<td>RGB-to-RGB</td>
<td>RGB/LED-to-LED/PD</td>
</tr>
</tbody>
</table>
IV. RELATED WORK

In this section, we overview the types of tools the networking community has built to evaluate network protocols.

**Link Emulation:** Single link emulation can be done on hardware (using channel emulators) or on software (using tools such as Netem). Prior work has shown that when correctly configured, Netem provides a realistic estimation of impaired network conditions and is sufficient for most networking experiments [15].

**Network Emulation:** Mininet [4] [5] uses light-weight virtualization by isolating certain OS resources, thus allowing emulation of large networks in a single machine. However, scalability becomes an issue when we want to emulate larger networks than can be tested in a single physical machine. Emulab [16] light-weight virtualization technique, FreeBSD jails, to setup multiple virtual interfaces per process group, similar to Mininet and CloudNet. CloudNet provides better resource isolation across the emulated nodes than Emulab and shows how we can use it on the commodity clouds. There is some prior work in data centers to optimize VM placement and routing [17]. CloudNet uses the concept of placement groups in Amazon EC2 where the virtual machines are placed as close to each other so that we can efficiently use the resources.

**Network Emulation Timing:** Time-Warp [18] explores the possibility of using time dilation in network emulation experiments. Future version of CloudNet may use this technique to offer added consistency in performance for emulations that requires very high-bandwidth. Slicetime is another effort to provide scalable and accurate network emulation [19]. Slicetime makes the simulations independent of real time constraint thus allowing simulation of complex and high performance networks when we have limited physical resources.
Competition

Affordable

Offline Transaction

AirBed & Breakfast

Online Transaction

Expensive

CouchSurfing

Craigslist

BedandBreakfast.com

Hostels.com

Rentobi.com

VRBO

Hotels.com
## Competition

$90M raised on concept of SMB loyalty in 2011 and 2012…
LevelUp, FiveStars, BellyCard, Mogl, Shopkick, etc.

*Loyalty in nightlife is wide open!*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Flowtab</th>
<th>SOPAGO</th>
<th>coaster</th>
<th>TabbedOut</th>
<th>barTab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bars &amp; Nightclubs</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Multiple Cities</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>0% CC Processing</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Distribution Partner</td>
<td>✔️</td>
<td>✔️</td>
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<td>Table Ordering</td>
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<tr>
<td>POS Integration</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>
Related work variations

Merged with Introduction
Inter-mingled with relevant sections
Placement of Related Work
The Body of the paper

Depending on the area of work may describe the proposed algorithm, proofs, systems, implementations
Evaluation

Description of experiments and metrics

Results of experiments

Implications of those results

More applicable to the applied areas of computer science.
Conclusions

Not the same as abstract
Short summary of what you did in the project and the implications of the results
Can include lessons learnt and future directions
Quick Exercise

Look through three research papers
Identify the sections we discussed so far
Share with the class any variations
Slightly different take from other disciplines
Figure 3.1. This diagram shows the headings that must be used for this science paper. Please pay careful attention to the boxes with arrows pointing at each elliptical heading box. These boxes are reminders of the content that belongs with each heading.

How do the answers map to these questions to the different parts of a paper?
HW3

Pick ten papers related to your research

Summarize each paper in 2-3 sentences
Why is it important?
Contributions? Strengths? Weaknesses?

Improve related work organization for one of the papers.