Doctoral Research „Commercialization”

16th Workshop on „Software Engineering Education and Reverse Engineering”

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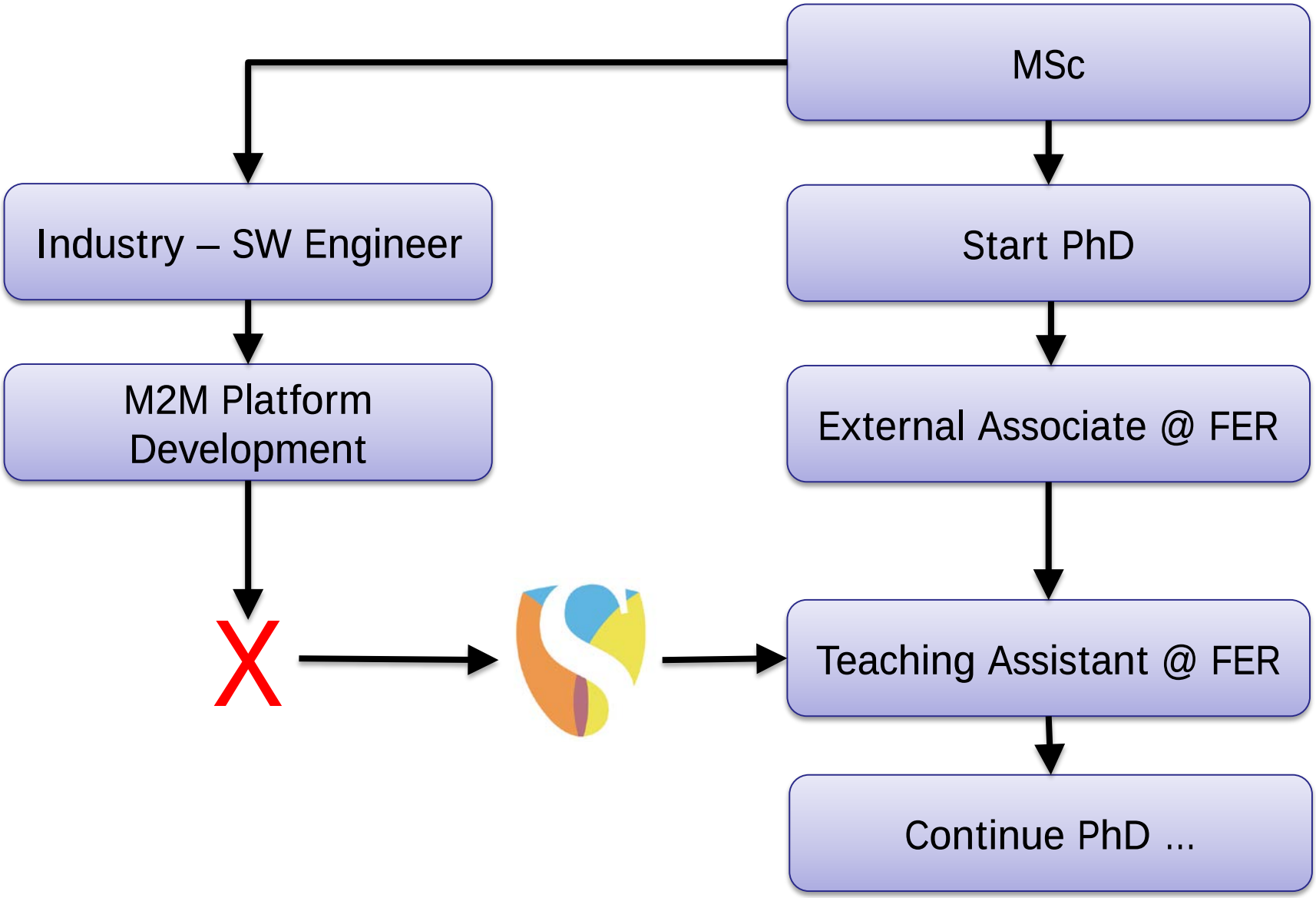
Agenda

- Round-trip: academia – industry – academia
- Motivation to go back
- Doctoral Research
- „Commercialization”
- Final words - discussion

My path ...


MSc
Industry – SW Engineer
Start PhD
M2M Platform Development
External Associate @ FER
X
Teaching Assistant @ FER
Continue PhD ...

- Singularity University Global Impact Competition CEE 2015, Budapest

  *„The competition acts as a platform to identify entrepreneurs, leaders, scientists and engineers who can propose the most innovative project to **positively impact one million people in their country or region in the next 3 years**."*

  - Must have the ability to improve the standard of living
  - Must be dealing with at least one global grand challenge: Education, Energy, Environment, Food, Health, Poverty, **Security**, Water
  - Award:
    - Sponsorship to the SU Global Solutions Program @ NASA
    - Potential access to SU Startup Labs + $100,000 seed investment

Motivation

Table 1. Thefts based on physical intrusion in Croatia, 2014.g. ([3])

	Reported cases			Resolved cases		Retrospectively resolved cases	
	Total	**Caught on act**	**Unknown**	**Total**	**%**	**Total**	**%**
Houses and flats	3795	23	3758	753	19.8	716	19.1
Weekend houses	1100	2	1095	345	31.4	340	31.1
Motor vehicles	1796	13	1778	318	17.7	300	16.9
Stores	1278	26	1248	376	29.4	346	27.7
Newsstands	736	27	707	301	40.9	272	38.5
Restaurants	989	18	968	373	37.7	352	36.4
Schools	119	2	117	44	37.0	42	35.9
Other objects	5489	77	5389	1513	27.6	1413	26.2
UKUPNO	**15302**	**188**	**15060**	**4023**	**26.3**	**3781**	**25.1**

Motivation

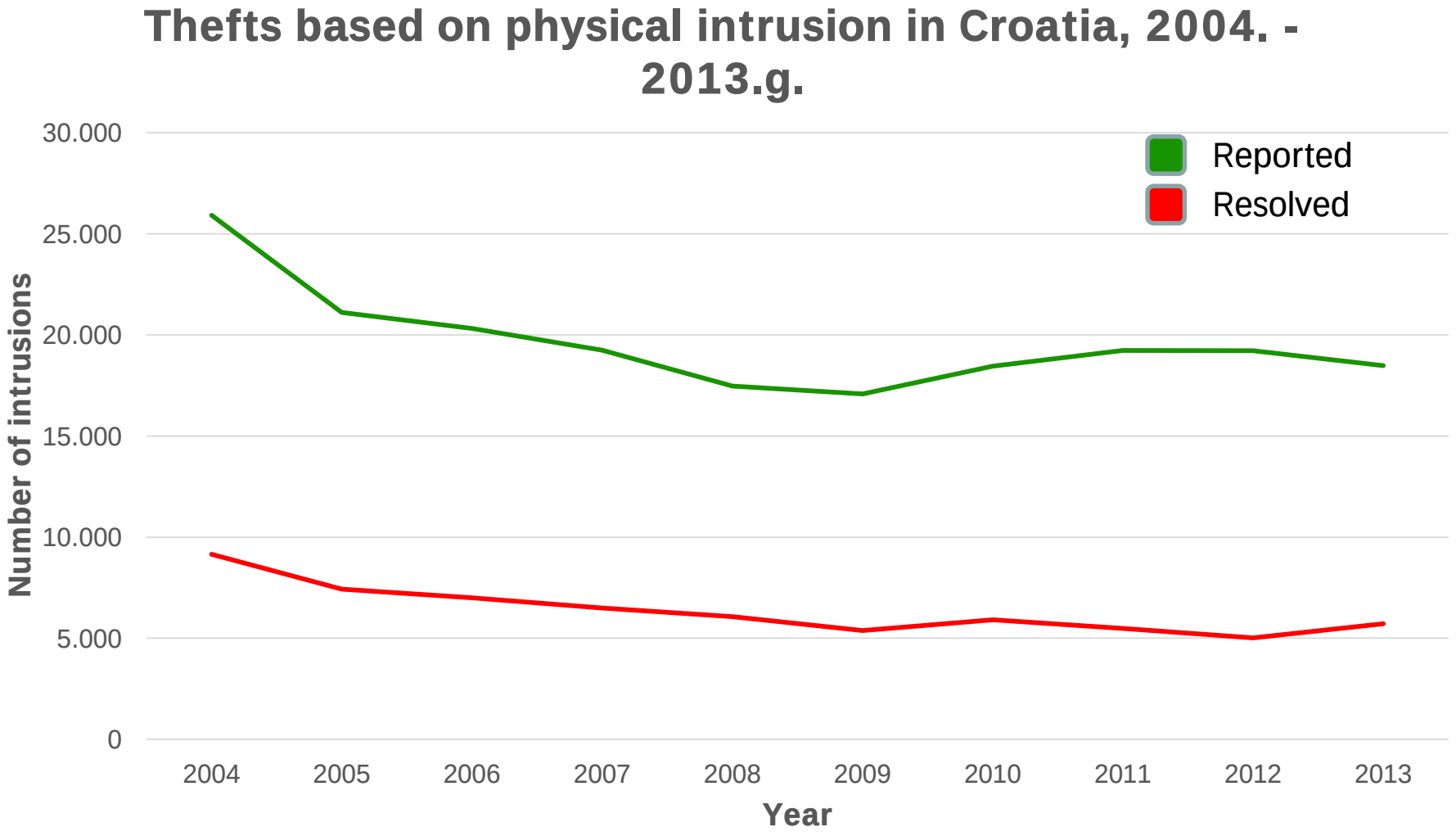


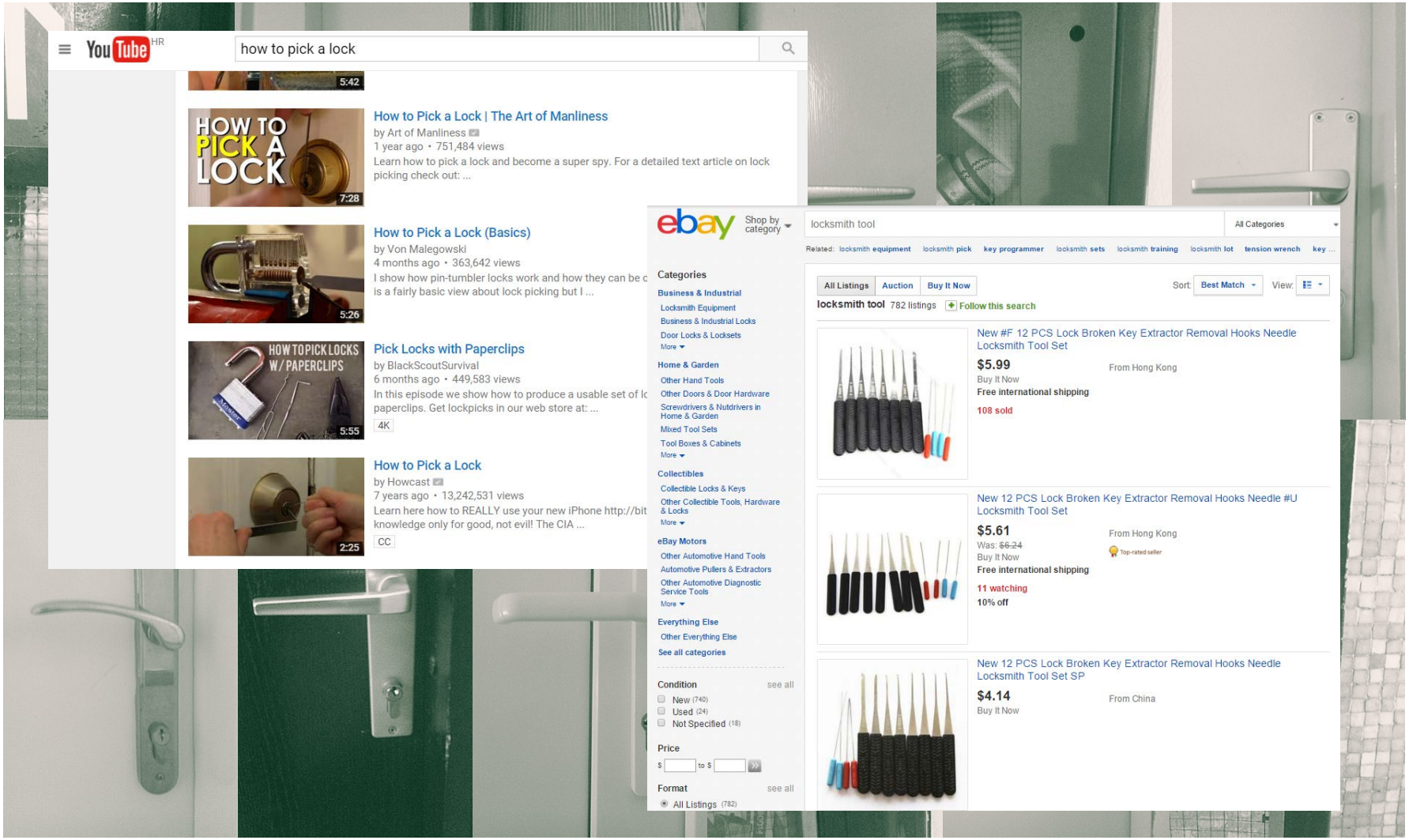
Figure 1. Physical intrusion trends in Croatia, 2004. – 2013.g. [3]

Motivation

- Intrusion detection - different types of sensors:
  - infrared
  - ultrasonic
  - microwave
  - **inertial**
  - other

- Many different devices / alarm systems available on the market
  - Expensive!
  - Mostly **not used** by average people

Motivation


YouTube HR
how to pick a lock
5:42
HOW TO PICK A LOCK
7:28
How to Pick a Lock | The Art of Manliness
by Art of Manliness
1 year ago • 751,484 views
Learn how to pick a lock and become a super spy. For a detailed text article on lock picking check out: ...
5:26
How to Pick a Lock (Basics)
by Von Malegowski
4 months ago • 363,642 views
I show how pin-tumbler locks work and how they can be c
is a fairly basic view about lock picking but I ...
HOW TO PICK LOCKS W/ PAPERCLIPS
5:55
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Mixed Tool Sets
Tool Boxes & Cabinets
More
Collectibles
Collectible Locks & Keys
Other Collectible Tools, Hardware & Locks
More
eBay Motors
Other Automotive Hand Tools
Automotive Pullers & Extractors
Other Automotive Diagnostic Service Tools
More
Everything Else
Other Everything Else
See all categories
Condition see all
New (740)
Used (24)
Not Specified (18)
Price
$ to $
Format see all
All Listings (782)
All Listings Auction Buy It Now
Sort: Best Match View:
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Was: $6.24
Buy It Now
Free international shipping
11 watching
10% off
New 12 PCS Lock Broken Key Extractor Removal Hooks Needle Locksmith Tool Set SP
$4.14
From China
Buy It Now

Project Wibelock – intrusion detection accessbile to everyone

Figure 2. Wibelock project concept

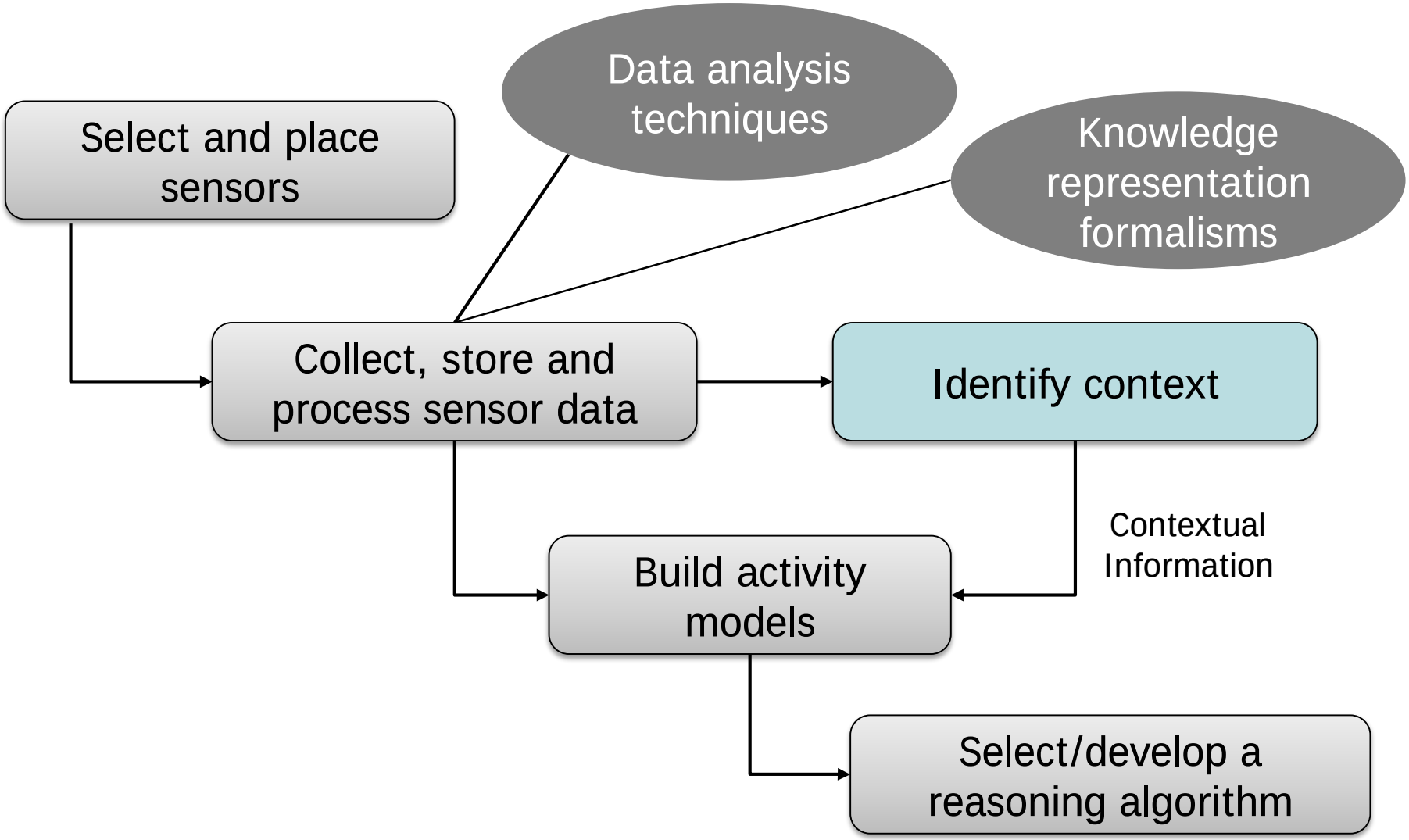
Is there any science?

- Human activity recognition
  - One of the most perspective topics in various domains (mobile computing, surveillance-based security, context-aware computing, ambient asissted living, ...) [2]

- Type of sensors used:
  - Vision-based activity recognition
  - **Sensor-based activity recognition**

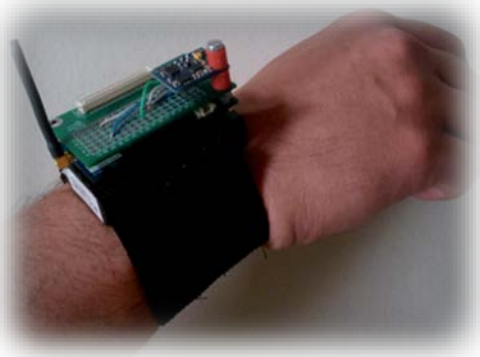
- Approaches for building activity models
  - **Data-driven activity recognition**
  - **Knowledge-driven activity recognition**

Activity recognition – general process



Sensor-based Activity Recognition

- **Wearable sensors** – attached to the person under observation



- **Dense sensing** – Large number of low-cost sensors attached to the objects in the environment
  - Activities are monitored by detecting user-object interactions
  - Suitability and performance of selected sensor(s) – depend on the type of activity and specifics of the selected domain

PhD Thesis

- Existing work - limitations:
  - In most cases – wearable sensors
  - Need to record entire data-set corresponding to each activity
  - Activities performed withing the same context

- Research goal:
  - Develop a **context-aware method**
  - for **real-time** activity recognition
  - based on the **data-stream**
  - from a **single accelerometer**
  - placed **on the object in the environment** where the activity is being performed

Collecting the data …

- No existing data set for research/evaluation purposes
- Prototype Wibelock device developed
  - Raspberry Pi 3
  - Analog Devices ADXL345 3-axis accelerometer

- Predefined set of activities:
  - Burglary attempt using a bump-key method
  - Burglary attempt using a lockpicking method
  - Open/Close the door
  - Knocking
  - …

Activity examples - intuition

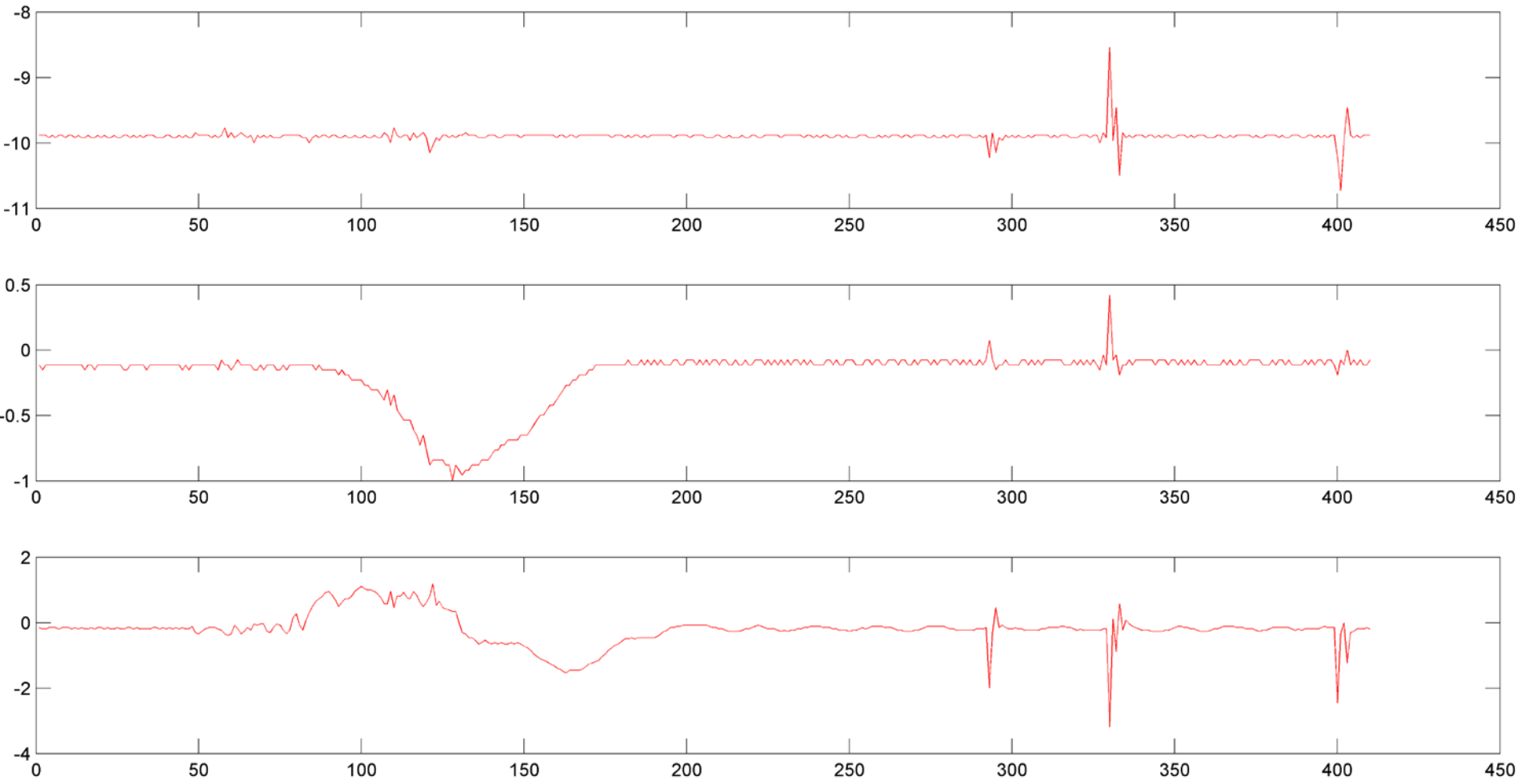


Figure 3. Opening the door

Activity examples - intuition

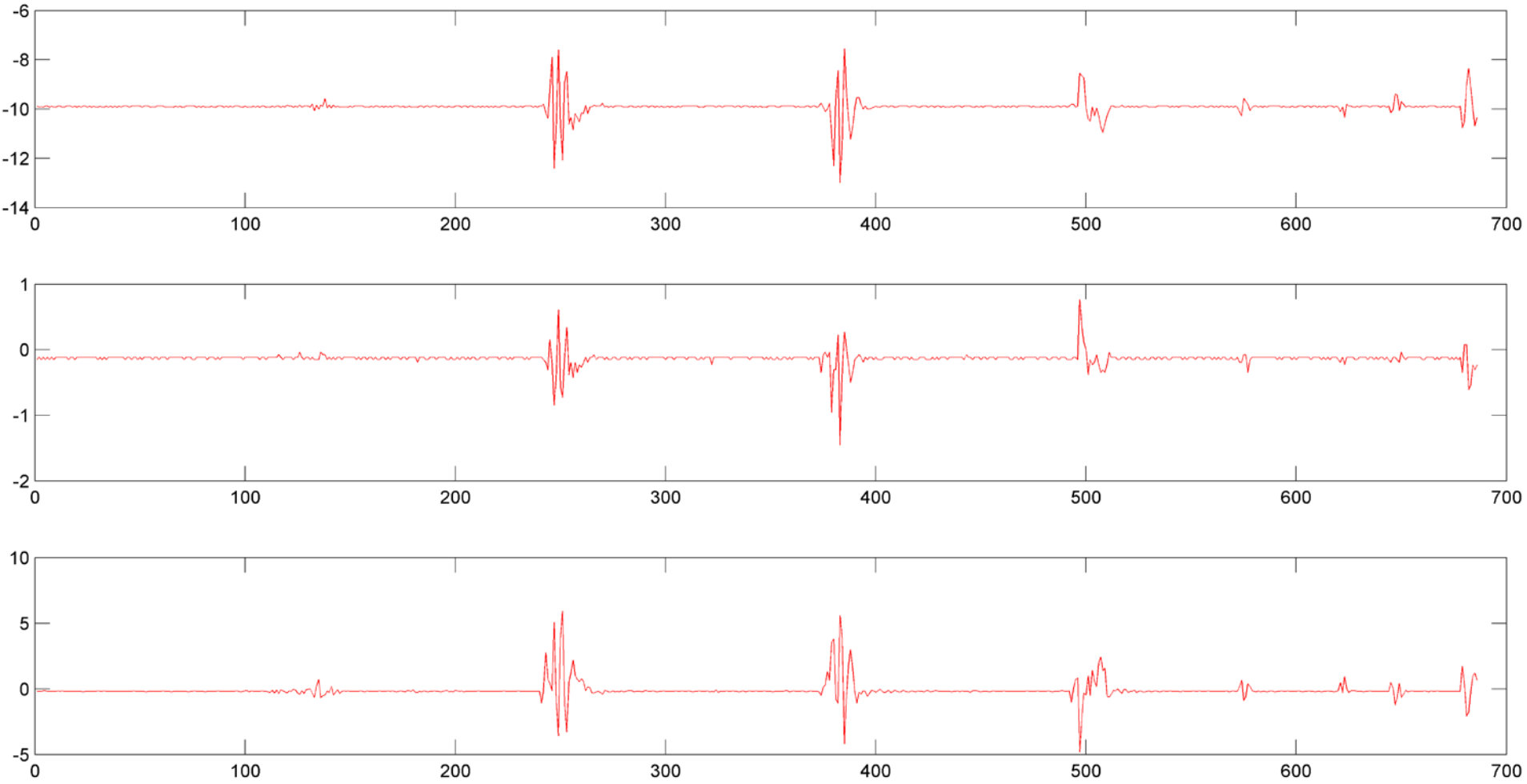


Figure 4. Intrusion attempt using a *bump-key method*

Activity examples - intuition

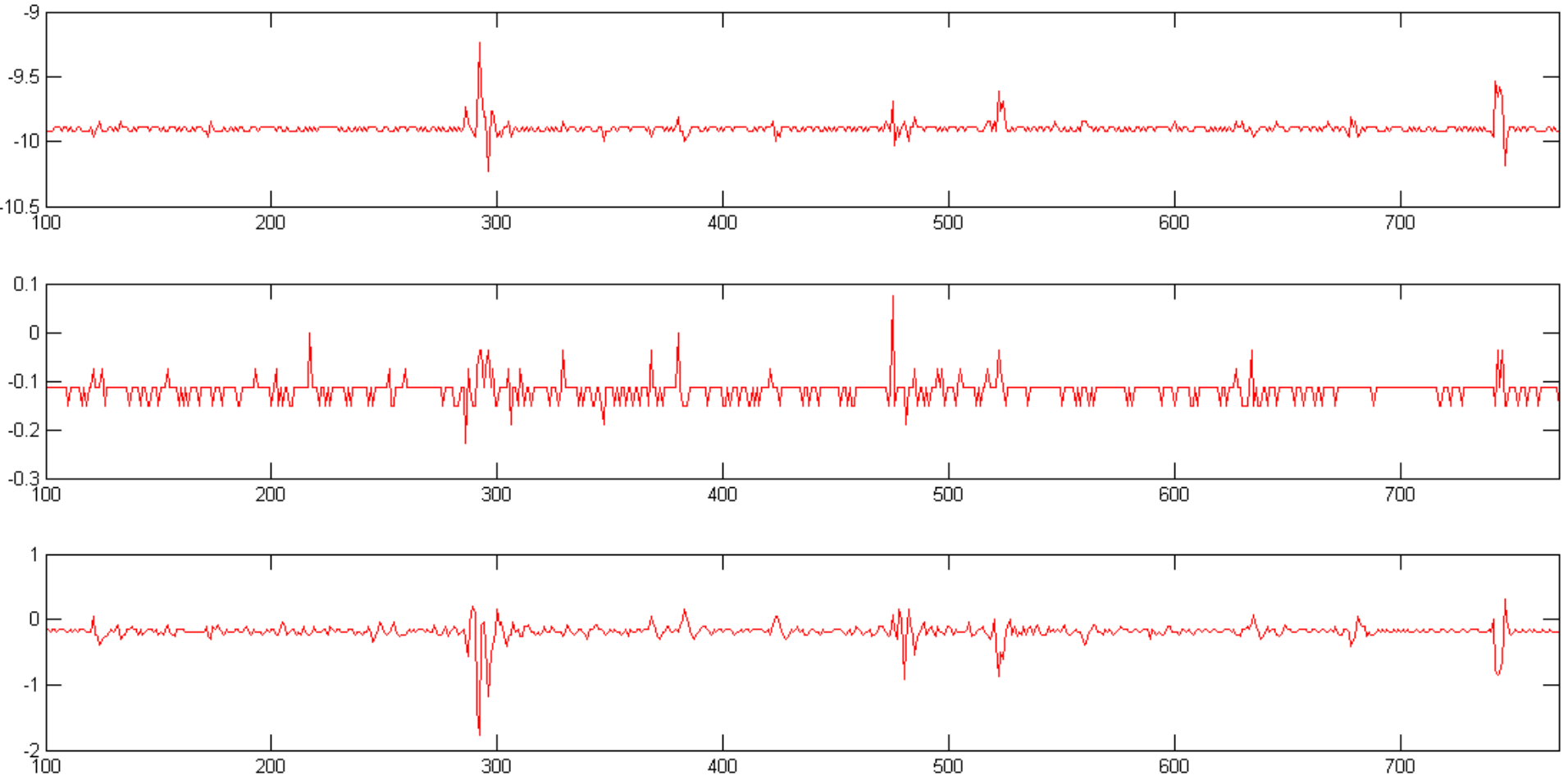


Figure 5. Intrusion attempt using a *lockpicking method*

Activity examples - intuition

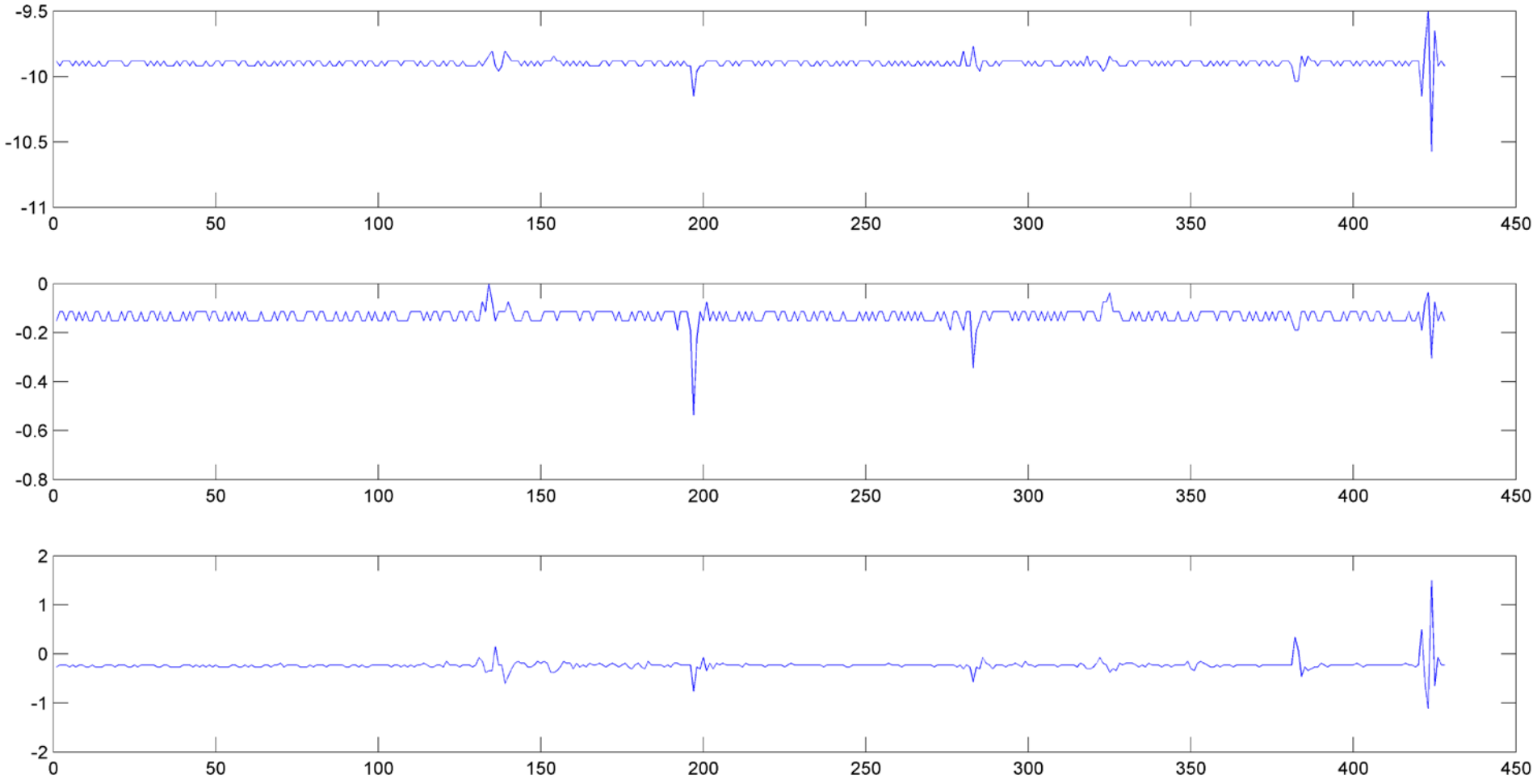


Figure 6. Inserting a *correct key*

Activity examples - intuition

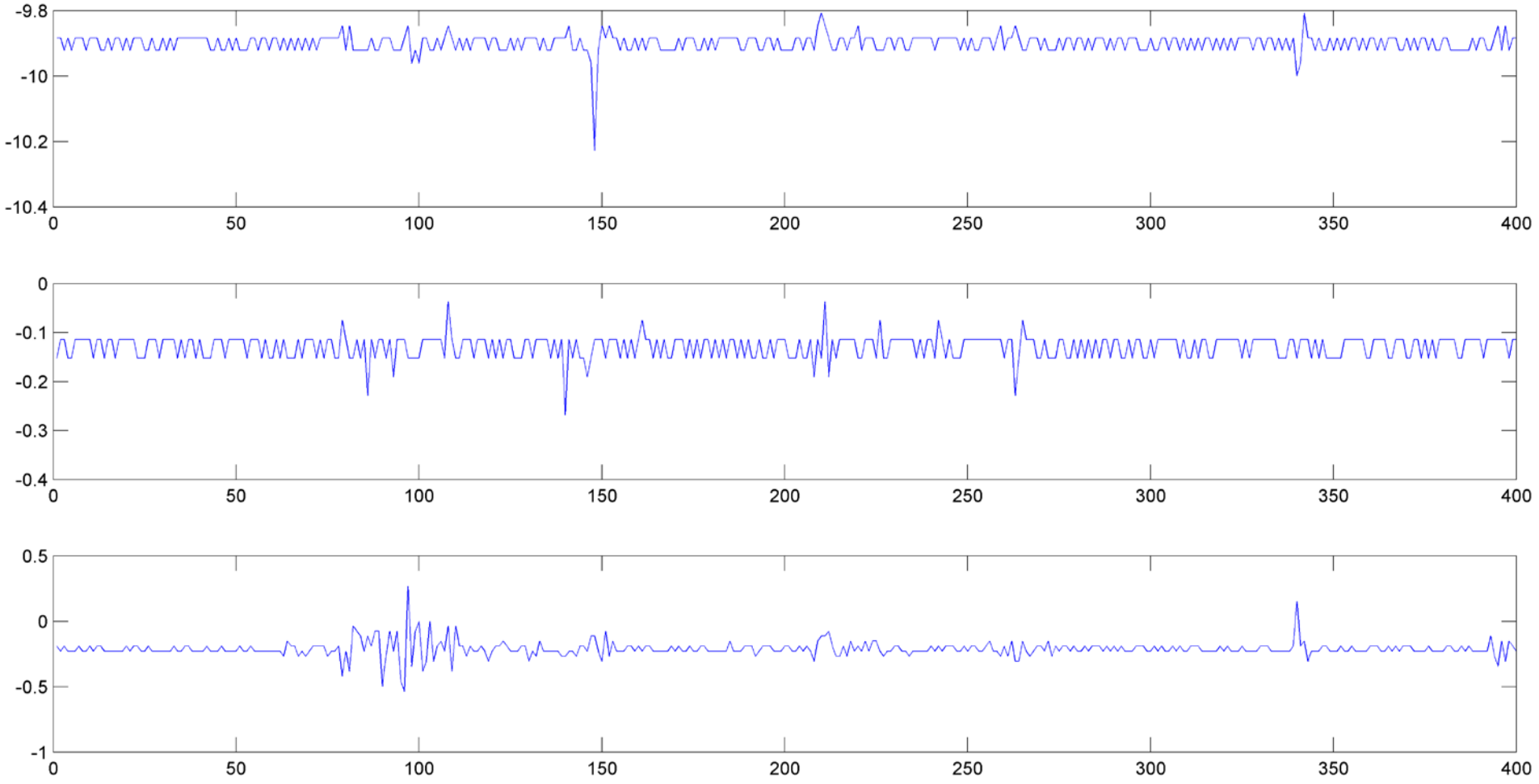


Figure 7. Inserting *incorrect key*

Reaching the research goal …

1. Data-set collection methodology
2. Context modeling in activity recognition (knowledge-driven approaches)
3. Real-time (online) activity recognition / classification
4. Feature extraction methodology – using features from time and frequency domain as learning examples
5. Machine learning methods and algorithms
6. Prototype implementation of proposed method
7. Evaluation

Commercialization? Creating impact?

- Funding
  - How do I write a good application for available state funding opportunities?
  - How do I prepare a good pitch for investors?
  - What is the investor deck and how do I prepare a good one?
  - How do I start a company? Where should it be located?
- Intellectual property - patenting
  - How to file a patent? Where? Where do I find funds for it? How to prepare an application
- Marketing
  - How do I present the project in a way that it can create a significant social impact?
- Scaling
  - Local/ Regional / Global

Final words - Discussion

- Are these the issues that any SW engineer / scientist should deal with?
  - Should we have at least some formal knowledge to start with?
- Should we bring at least some parts of SU philosophy to existing study programmes?
  - Mind shift from „Create profit" to „Create social impact"
  - What are the current global challenges to deal with?
  - How can we use technology to solve them?
  - Motivate students to think in a way that anything they do should be directed towards positive social impact
  - Formulating seminars/projects/thesis in a way that its results can affect real-world problems
- World needs such people more than ever!

Thank you!

Questions / Discussion

References

- [1] João Gama, Mohamed Medhat Gaber, Learning from Data Streams: Processing Techniques in Sensor Networks, Springer, 2007.
- [2] Chen L., Hoey J., Nugent C.D., Cook D.J., Yu Z., „Sensor-based activity recognition”, IEEE transactions on systems, man, and cybernetics—part c: applications and reviews, vol. 42, no. 6, Nov. 2012.
- [3] Statistički pregled temeljnih sigurnosnih pokazatelja i rezultata rada u 2014. godini, Ministarstvo unutarnjih poslova RH, Služba za strateško planiranje, analitiku i razvoj http://www.mup.hr/main.aspx?id=180991, Zagreb, Siječanj 2015.g.