

## Biological Species Recognition with a Mobile Application

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# Agenda

- 1 The objective
- 2 About the app
- 3 Benefits
- 4 Conclusion

# The Objective of the Project

- to collect information on the occurrence of dragonflies at the territory of the Czech Republic
- to intensify interdisciplinary cooperation at the university
- to popularize ecology and conservation of the nature

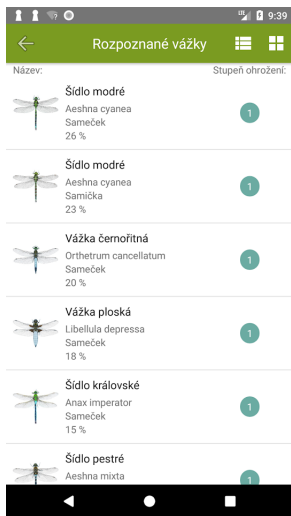


# Dragonfly Hunter CZ



- Android app for the reporting of a dragonfly occurrence (1000+ downloads)
- Catalogue of all 75 dragonfly species with high quality photographs of both males and females
- Brief description of the species, map of occurrence
- Allows species recognition based on: date, GPS coordinates, biotope, sub-order, and colors

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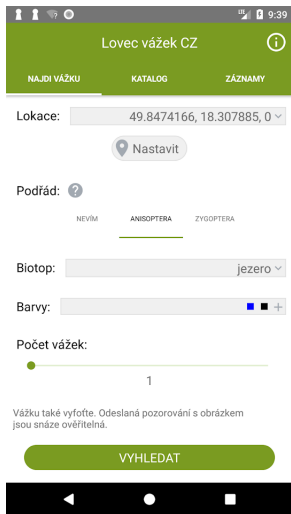
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# The Architecture of the Application

- client/server architecture
- client app works offline (browsing, searching, recognition)
- occurrence reports are sent to our server via Internet (date, GPS location, photo)
- biologists validate the reports and notify the user

## Technical Details:

- client app for Android tablet/cell phone (iOS is work in progress)
- server is powered by Apache + PHP + MySQL



# Species Recognition

- computer-aided recognition of dragonfly species
- 148 classes (74 species male/female)
- based on expert knowledge (date, colors) and machine learning (from the database of occurrence in previous years)
- mathematical model of the expert knowledge developed at our institute (compositions of fuzzy relations)
- works offline on the mobile device

## Accuracy:

- the correct classification is in median at the 3rd position
- the correct classification is on the first screen of the display (5 items per screen) with 69 % probability

# Finances

- Start-up financed from the institute's internal student grants
- Now we are applying for the grant of the national grant agency

# Benefits from the Project

- Cooperation
- Publications
- Citizen Science

## Interdisciplinary Cooperation

Dept. of Biology + Dept. of Computer Science + Institute for research and applications of fuzzy modeling:

- 4 biologists (professionals & Ph.D. students)
- 4 mathematicians (from the IRAFM institute + Ph.D. students)
- 2 computer scientists (MSc. and Ph.D. students)

# Publication Results

- Ožana, S., Burda, M., HYKEL, M., Malina, M., Prášek, M., Bárta, D. a Dolný, A. Dragonfly Hunter CZ: Mobile application for biological species recognition in citizen science. PLOS One. 2019, 14(1), s. 1-13. ISSN 1932-6203.
- Štěpnička, M., Cao, T. H. N., Burda, M. a Dolný, A. Typicality of features in fuzzy relational compositions. In: IFSA/NAFIPS 2019 Lafayette, Louisiana, USA.
- Štěpnička, M., CAO, T. H. N., Běhounek, L., Burda, M. a Dolný, A. Missing Values and Dragonfly Operations in Fuzzy Relational Compositions. INT J APPROX REASON. 2019,, ISSN 0888-613X.
- Cao, T. H. N., Štěpnička, M., Burda, M. a Dolný, A. How to Enhance, Use and Understand Fuzzy Relational Compositions. In: Beyond Traditional Probabilistic Data Processing Techniques: Interval, Fuzzy, etc. Methods and Their Applications. Springer, 2019.
- Cao, T. H. N., Štěpnička, M., Burda, M. a Dolný, A. On the Use of Subproduct in Fuzzy Relational Compositions Based on Grouping Features. In: Information Processing and Management of Uncertainty in Knowledge-Based Systems: IPMU 2018 (Communications in Computer and Information Science, vol. 855) 2018 Cádiz. Heidelberg: Springer, 2018. s. 175-186. ISBN 978-3-319-91478-7.
- Ožana, S., Burda, M., HYKEL, M., Malina, M., Prášek, M. a Dolný, A. A new era of technologies in dragonfly biomonitoring. In: ECOO 2018 5th European Congress on Odonatology. Brno. 2018.

# Citizen Science

- scientific research conducted (in whole or in part) by amateurs or non-professionals
- brings advances to the research
- increases the public's understanding of science

# Conclusion

- Stable team across departments of the university
- Positive feedback from the users
- Boost in ideas (and publications)

## Future Work

- cooperation with biologists from Slovakia (Europe is the target)
- iOS version, web-based version (almost done)
- image recognition (neural networks, promising results already)
- new animals (snakes, frogs, locusts) – sound recognition



Thank you...