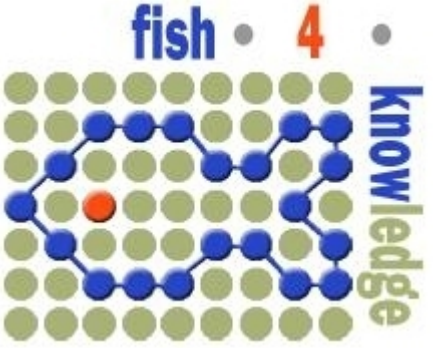
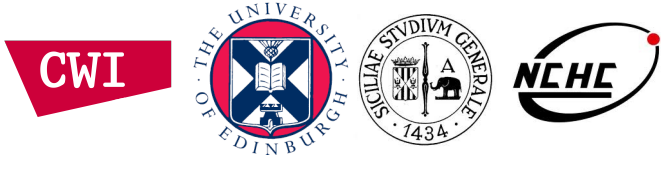
Fish4Knowledge



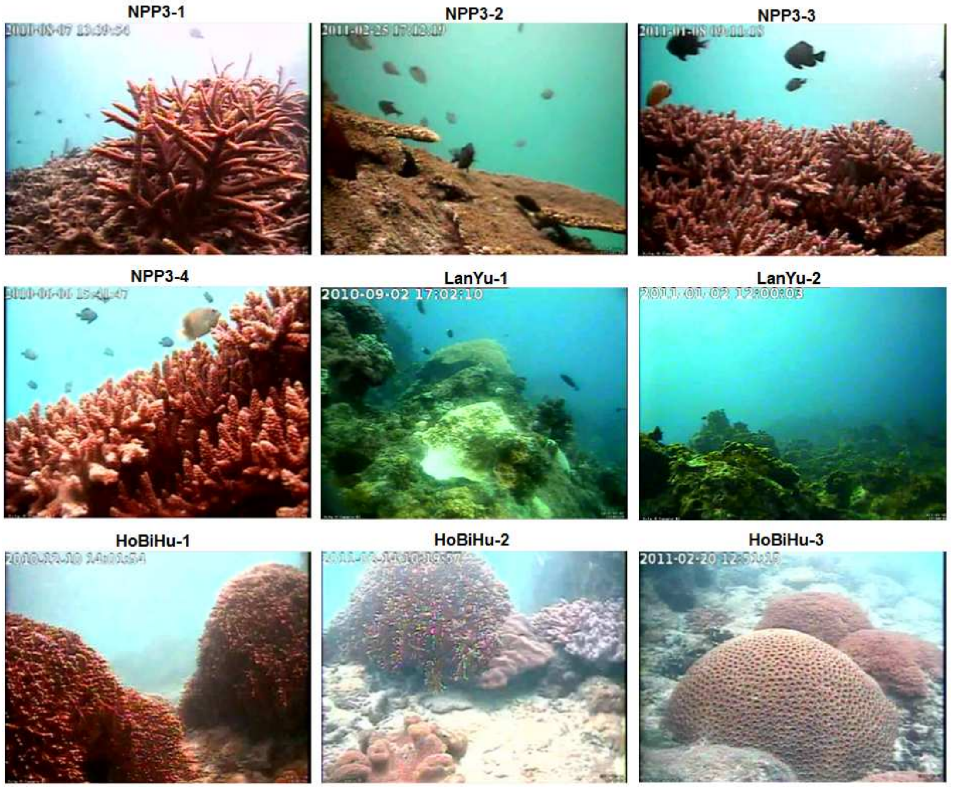
Collecting Species Population Information from 3 Years of (24 hour) Underwater Camera Footage

Bastiaan Boom



Underwater Monitoring

- 10 underwater fixed cameras recording 24 hours a day
- Expected to find 10^{10} fish in video footage
- Multiple software modules to process video footage



Goal

Undertaking research into software for marine biologists to automatically capture, store and analyse massive amounts of underwater video recordings

Entire System Design

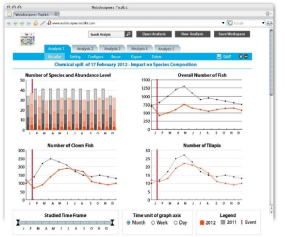
Video Database

Workflow

Fish Detection

Fish Recogition

96 CPU super computer

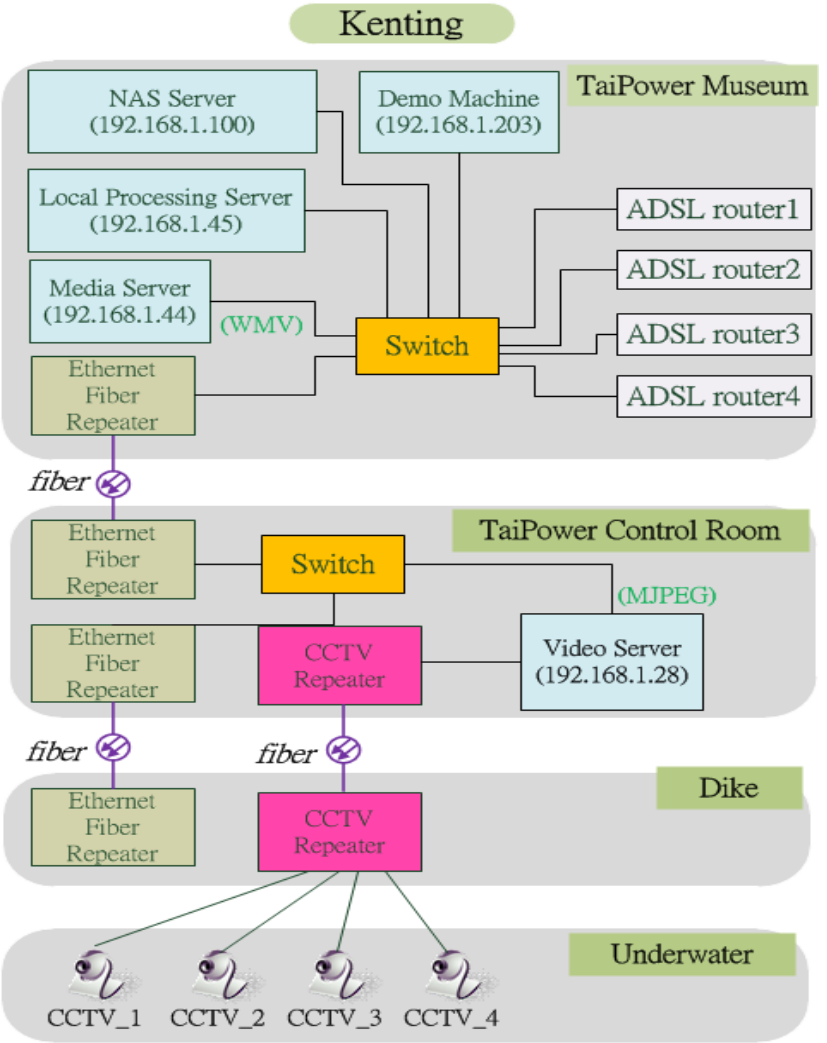


Interface

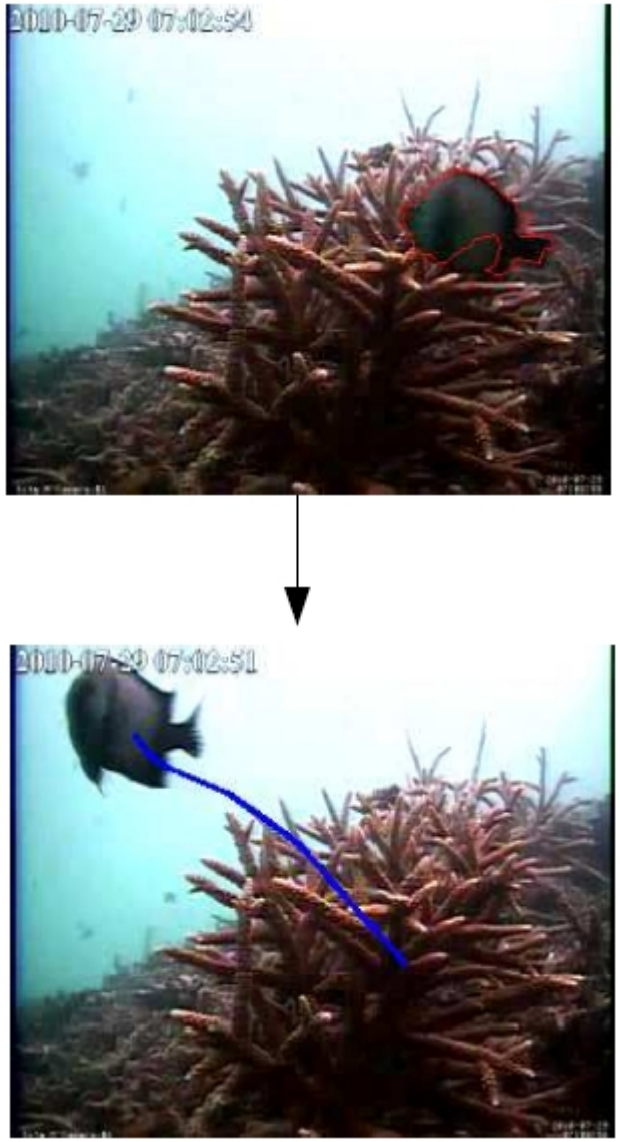
VIP Database

Infrastructure for Video data

- Underwater cameras are located at remote locations
- Challenges:
  - Maintenance of cameras
  - Uploading and storage of videos
  - Displaying to public



Fish Detection



Obtain the contour of the fish using Background Subtraction:

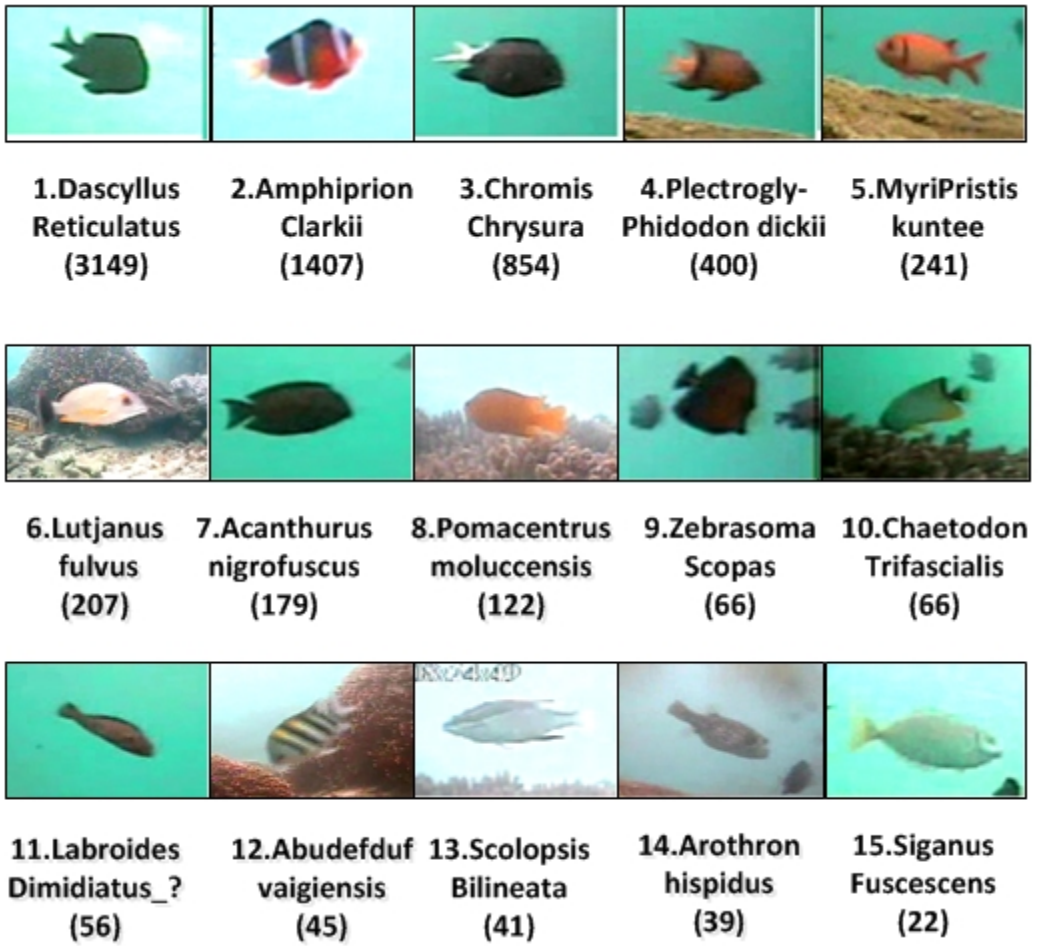
- Adaptive GMM
- Intrinsic Model (Robust against changing Illumination)

Determine trajectory of fish:

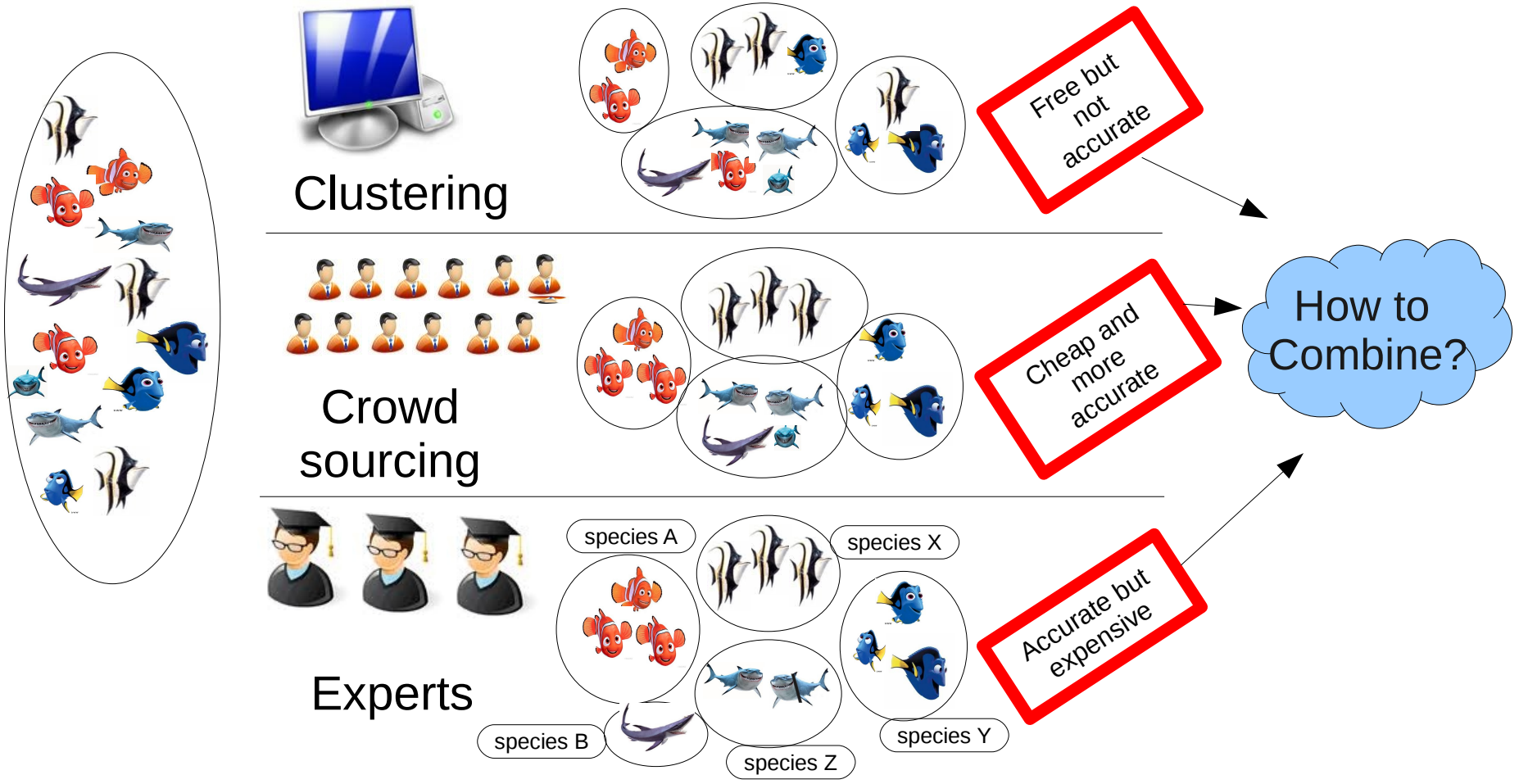
- Mean shift
- Covariance tracking

Fish Recognition

- 15 Species
- Contour,Colour and Texture clues
- Decision tree (Taxonomy Tree)
- Support Vector Machine classifier

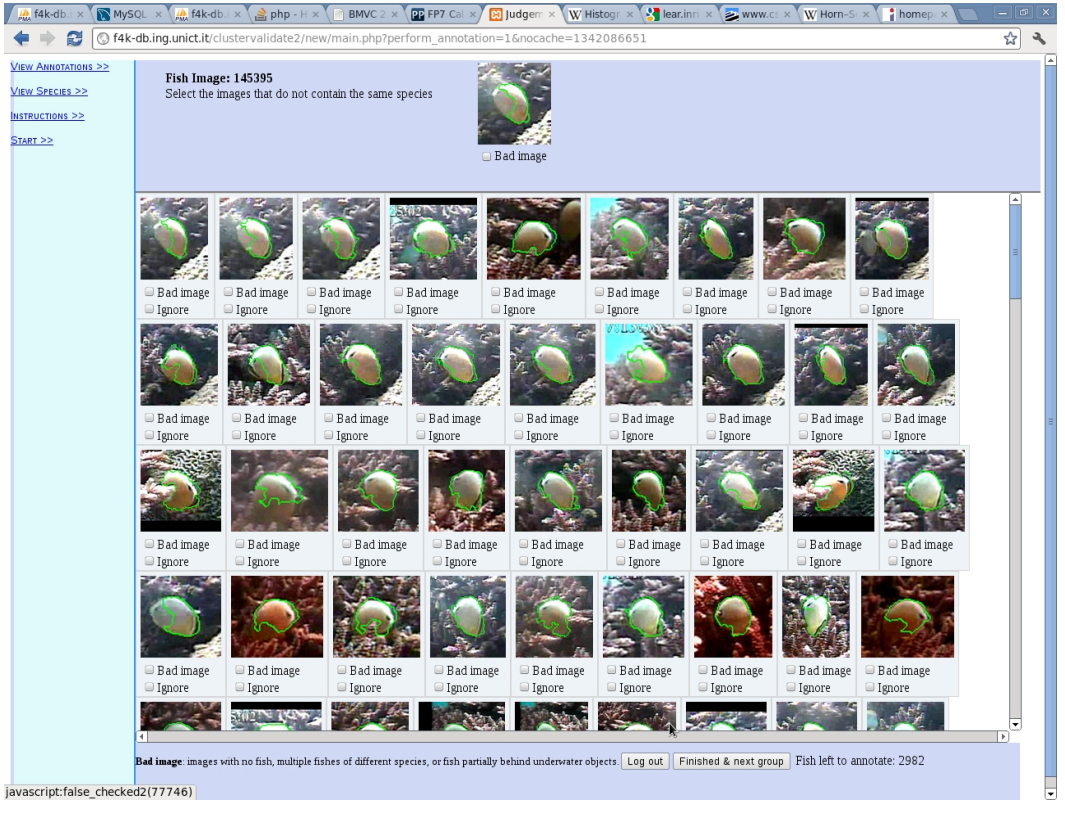


Evaluation Problem

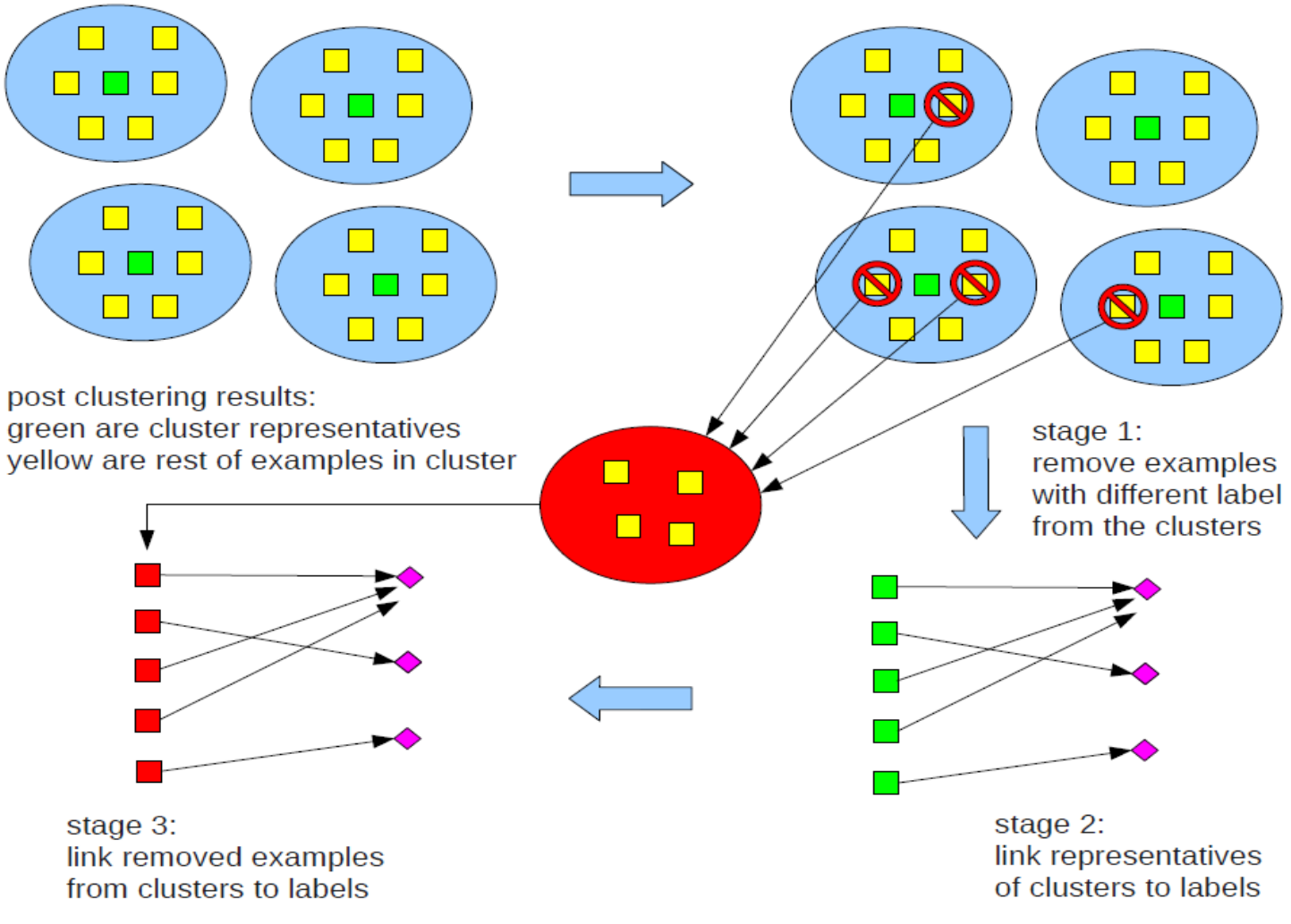


Clustering - Image Retrieval

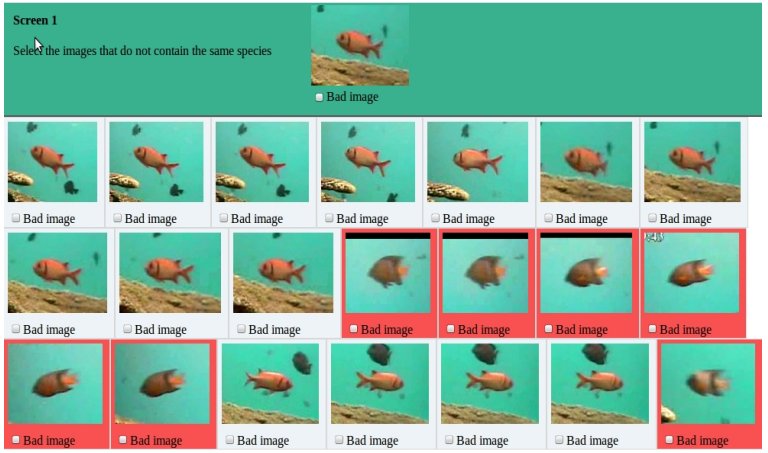
- Finding similar fish in set of 300000 images
- Contour,Colour and Texture clues
- Locality Sensitive Hashing

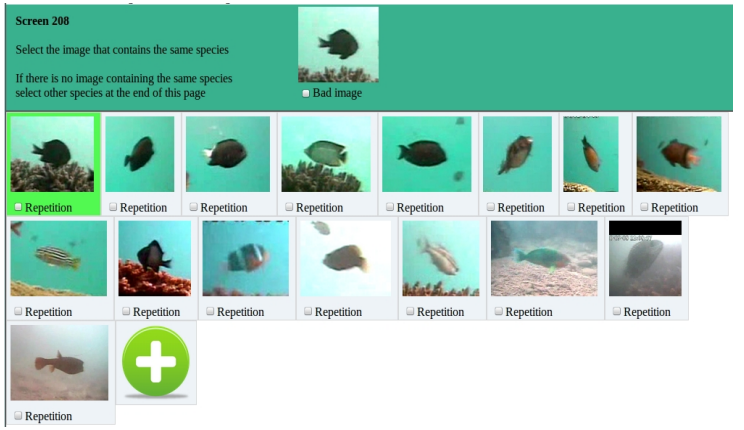


Ground Truth Annotation



Annotation Interfaces





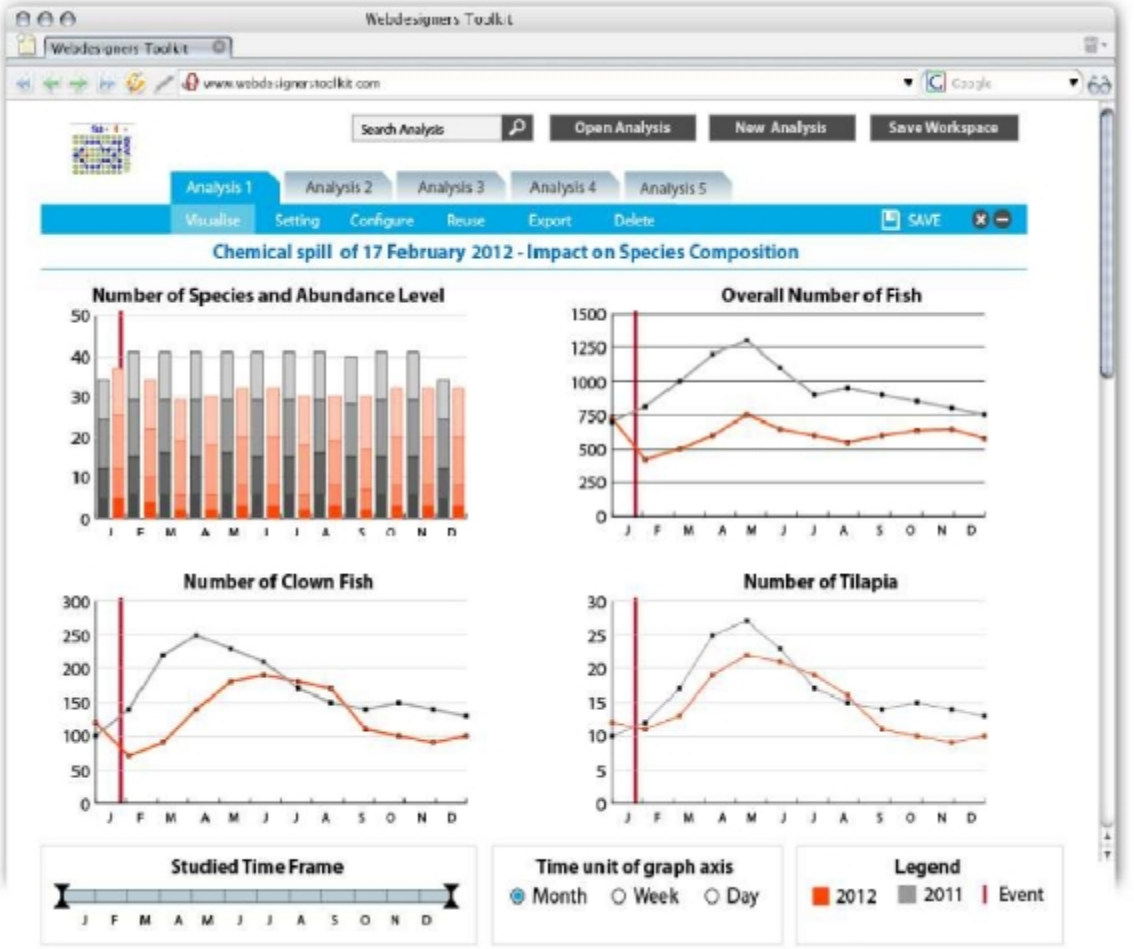
- Use Image retrieval as first filter
- Remove other species

- Link the clusters to species label
- Allow for discovery of new species

Web Interface

Easy access:

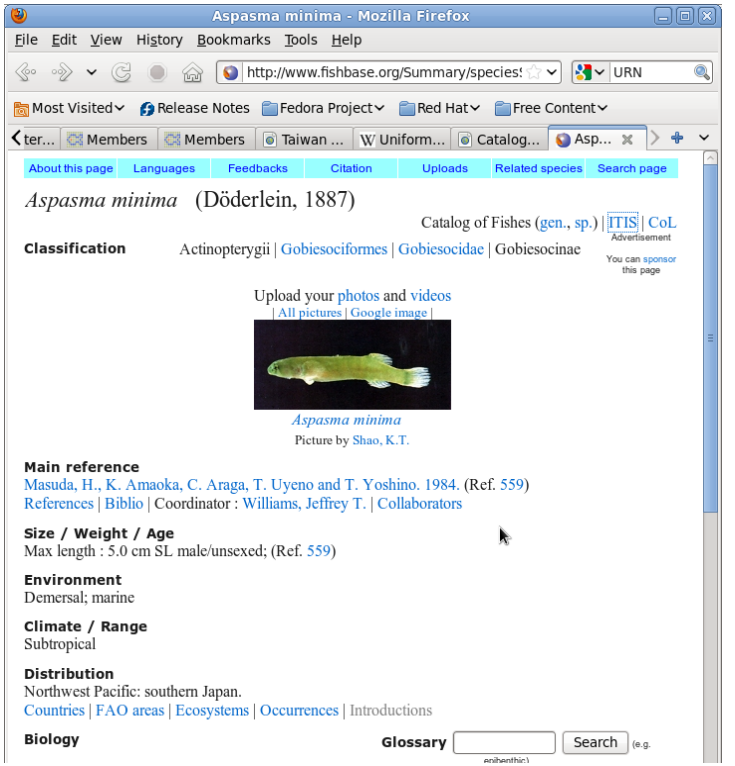
- Statistical, verifiable and reproducible data
- Showing uncertainties due to mistakes in fish detection/recognition
- Ability to share information



Linking to other resources

- Related other resources:
  - Fishbase.org – Taiwan Fish DB
  - Catalogue of Life

urn:lsid:catalogueoflife.org:taxon:dc9c602e-29c1-102b-9a4a-00304854f820:ac2009



- People using our data ...

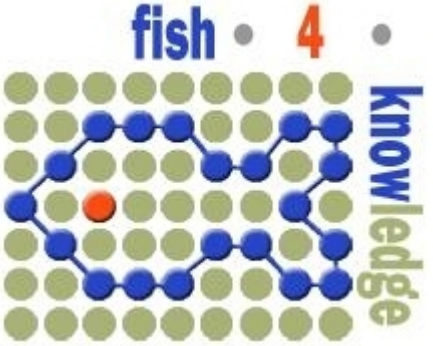
Workflow

- Compute backlog of underwater footage
- Distribute computation between CPUs
- Process user requests running VIP software with customisable settings

Current State of Project

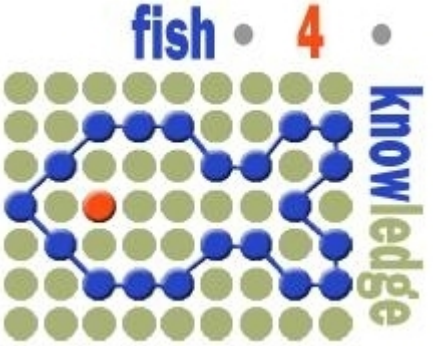
- Everything shown today is implemented
- Working towards first prototype of entire system:
  - Both first versions of fish detection and recognition software work on supercomputer in Taiwan
  - Components are currently running on a one year backlog of videos in Taiwan (Workflow)
  - Web interfaces are being developed to enable access to the processed data stored in Taiwan

Challenges



- Convincing users (marine biologists) using the web interface to trust the processed data for their research
- Collecting quality annotation data given the size of the dataset
- Storage and retrieval of data (summary tables for fast retrieval)
- Processing all the videos (3 years worth of footage from 10 cameras)

Questions?



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