# Automatic size and weight measurements of fish

## Primary contact for the team

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## Team

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Silvia is a fisheries scientist with extensive expertise in fish stock modeling and marine field work. She is also a data analyst at Addenbrooke's Hospital. Silvia will specify the requirements of the device and write the image analysis software.
Oliver Hadeler, oh209@cam.ac.uk, Department of Chemical Engineering and Biotechnology
Oliver is a physicist and engineer with expertise in electronics, sensors and open source microcontrollers. He will be responsible for the hardware aspects of the project.

## Summary

Fish stock assessment is important to prevent overfishing. One element in the monitoring chain is to weigh the amount of fish caught by a fishing vessel. However, determining the size and weight of individual fish would give scientists, policy enforcers and fishermen much more detailed information, e.g. the number of juvenile fish in a catch, the size and weight distribution within a catch. As it is impractical to manually measure and weigh individual fish, we would like to combine an electronic scale with a camera and machine vision to determine weight, length and width of individual fishes automatically. A device which would be useful on an industrial scale is outside the scope of this challenge, however, we propose to develop a much smaller and simpler device which can be used by scientists during field work, making measurements much quicker and more reliable.

## Proposal

### The problem

Effective fish stock assessment and modeling relies on the detailed knowledge of the fish in the sea. This includes number of fishes, their size, weight and age distribution. The more information scientists have about a fish stock the better they can inform policy makers and fishermen about sustainable limits to the fishery activities. To date typically only the overall weight of a catch is measured. While nets are designed to catch only fish above a certain size, the actual size of fishes inside a catch is unknown. During field work scientists take more detailed measurements, however this takes time and skill so that precise data is sparse. The lack of information limits the precise modeling and monitoring of fish stock, leading to potential overfishing and disputes between policy makers and fishermen.

### Biological systems

In principle any common commercial fish species could be used, e.g. cod, haddock, plaice. During development and testing we would use plasticine or clay models rather than real fish.

### Hardware design goals

The hardware should be portable and easy to use. Ideally a scientist would put a fish on the scale without having to align it and the measurements will be taken fully automatically. Result will be saved for future analysis.

### Project implementation

The device would combine a scale and a camera. An Arduino microcontroller will collect the analog output from the scale and control the camera. Images will be passed to a Raspberry Pi where image processing will be carried out. Processed images will be displayed on the 4duino screen together with the weight and size of the individual fish.

We plan to use a loadcell (e.g. Omega LCEB minibeam or Proto-Pic TAL220) and a compact serial camera (e.g. uCAM-III) which interfaces with an Arduino or Raspberry Pi. The image processing software will run on a Raspberry Pi and either be implemented in Python or R.

**Outcomes and benefits**

We plan to demonstrate a working prototype which can weigh and automatically determine the size of an individual fish. This would allow fisheries scientists to make quicker and more precise measurements, leading to more accurate fish stock assessment.

The project would also demonstrate how low-cost off-the-shelf hardware can be integrated into a complete measurement system.

**Estimate the components and budget that you need to complete the project**

1. Load cell TAL220, £8, Proto-Pic
2. Load cell amplifier HX711, £10, Cool Components or Proto-Pic
3. uCAM-III, £38, Mouser Electronics

A Raspberry Pi, prototyping board, electronics components are available to me.