A Printed Bio-mimetic Fish

for the Detection of Chemical Pollutants in Water Bodies

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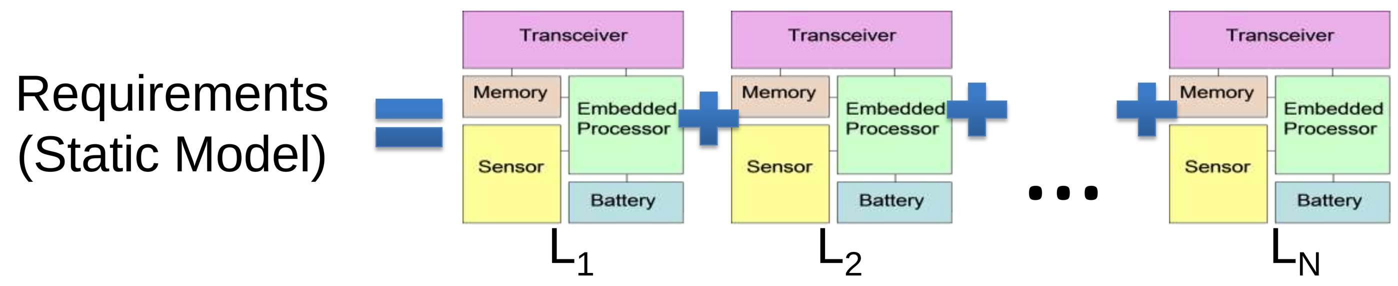
Rational

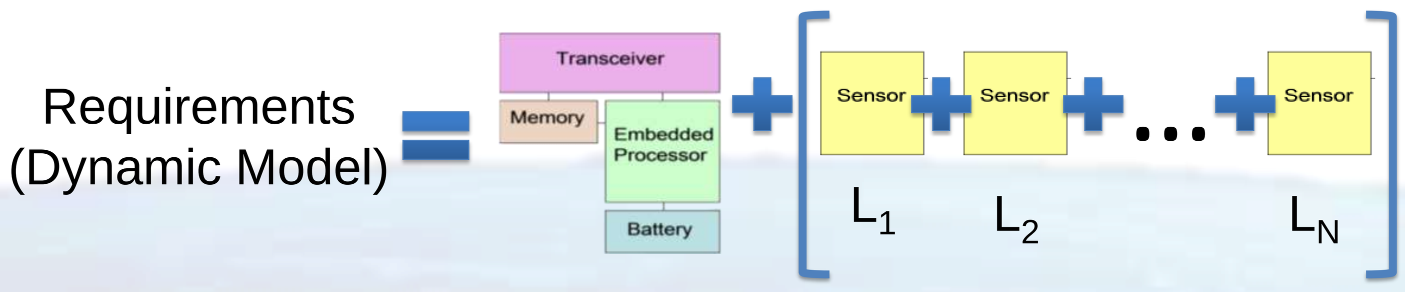
Monitoring of chemical contaminants within the Environment operates predominantly through manual gathering of samples, transportation to centralised laboratories, and analysed by means of sophisticated instruments. This process is expensive and therefore faces limitations under the demands of current and forthcoming bodies of legislation, e.g. the Water Framework Directive.

Recent technological breakthroughs have allowed for the realisation of static analytical systems capable of autonomously monitoring key chemical targets *in situ*. The challenge at present is to reduce the cost of such systems while meeting the demands of legislation. An alternative approach may exist in a moveable device capable of monitoring large water bodies using a single platform.

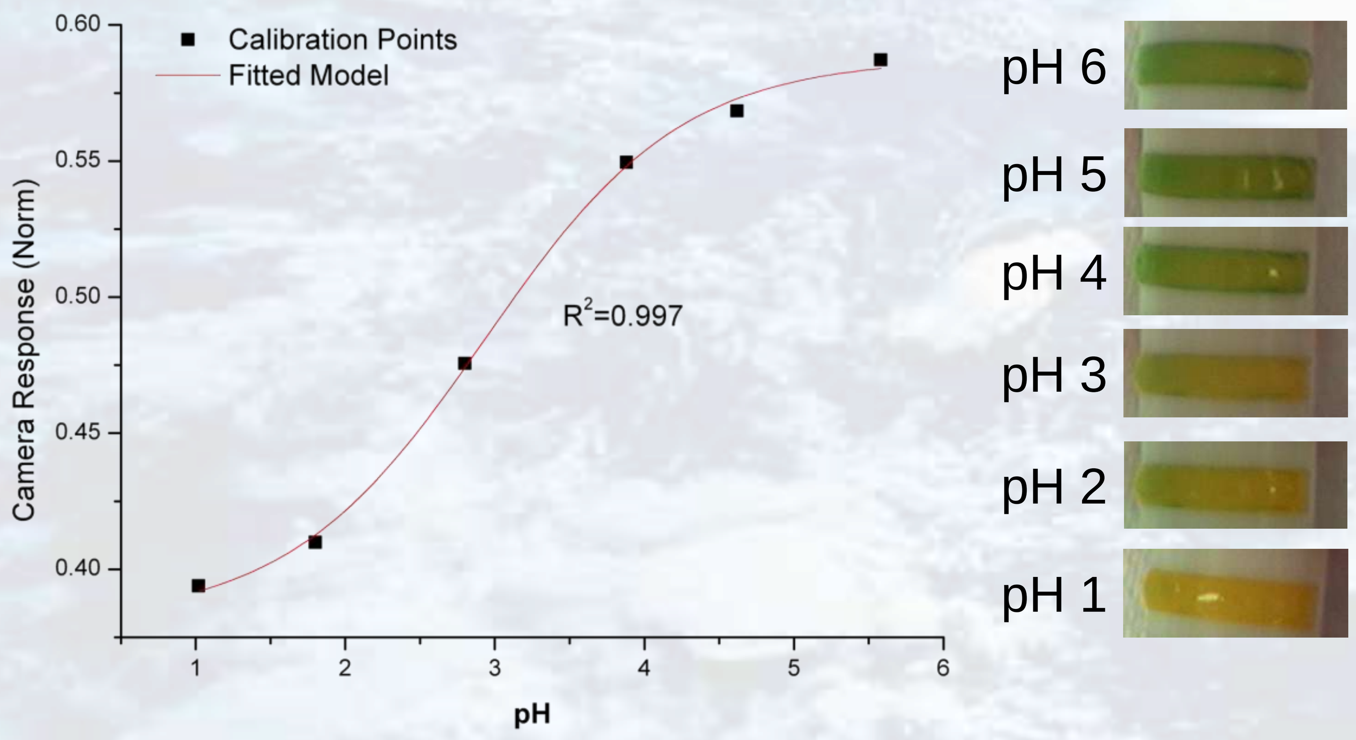
Concept



The *static* distributed sensing model requires a number of individual components per location/device (above). By encapsulating most components within a single device and placing the chemo-responsive sensor at designated locations (below), a more cost effective model is achievable. The common components are embedded within a moveable platform giving rise to a *dynamic sensing* model.

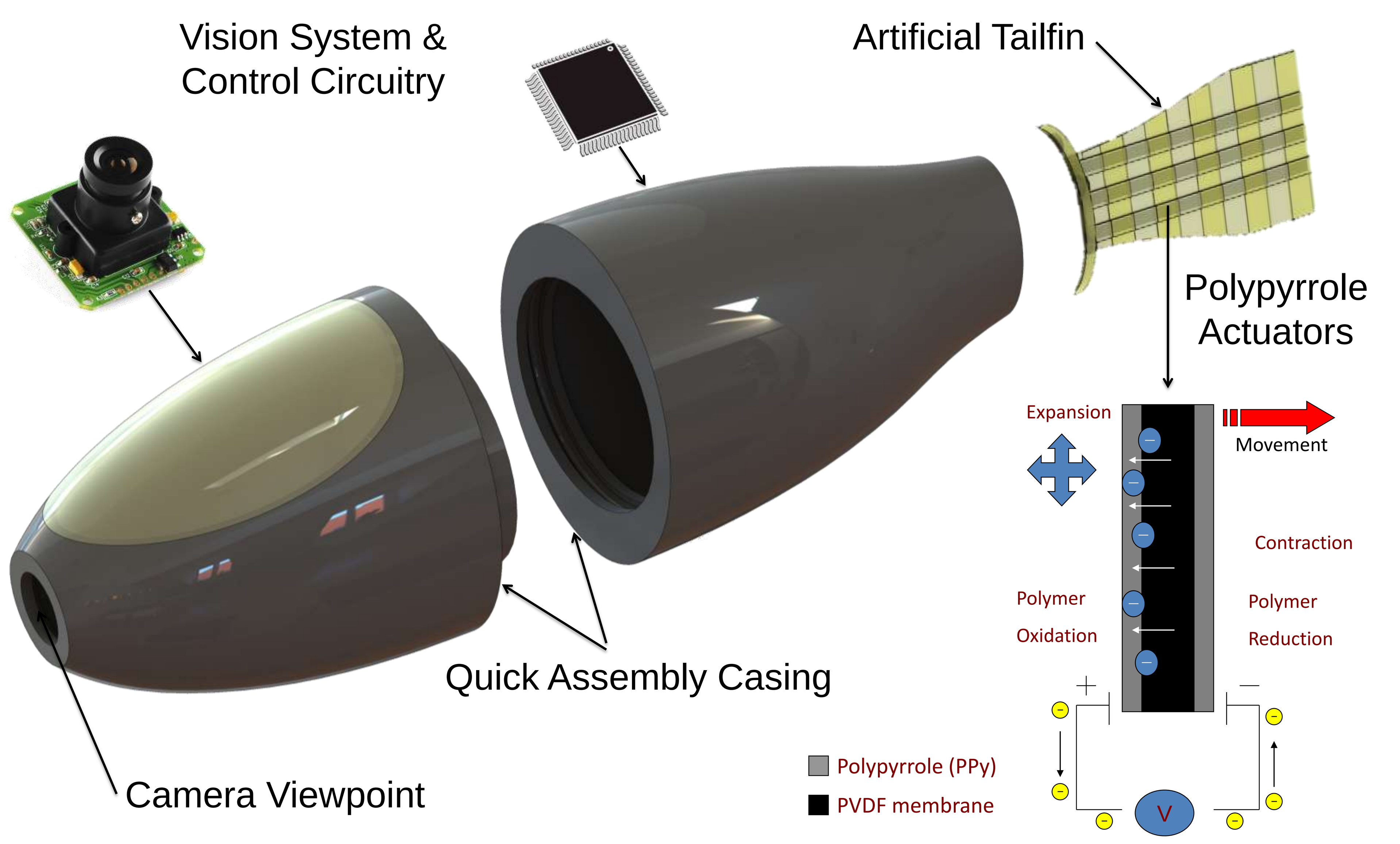


Chemical Detection



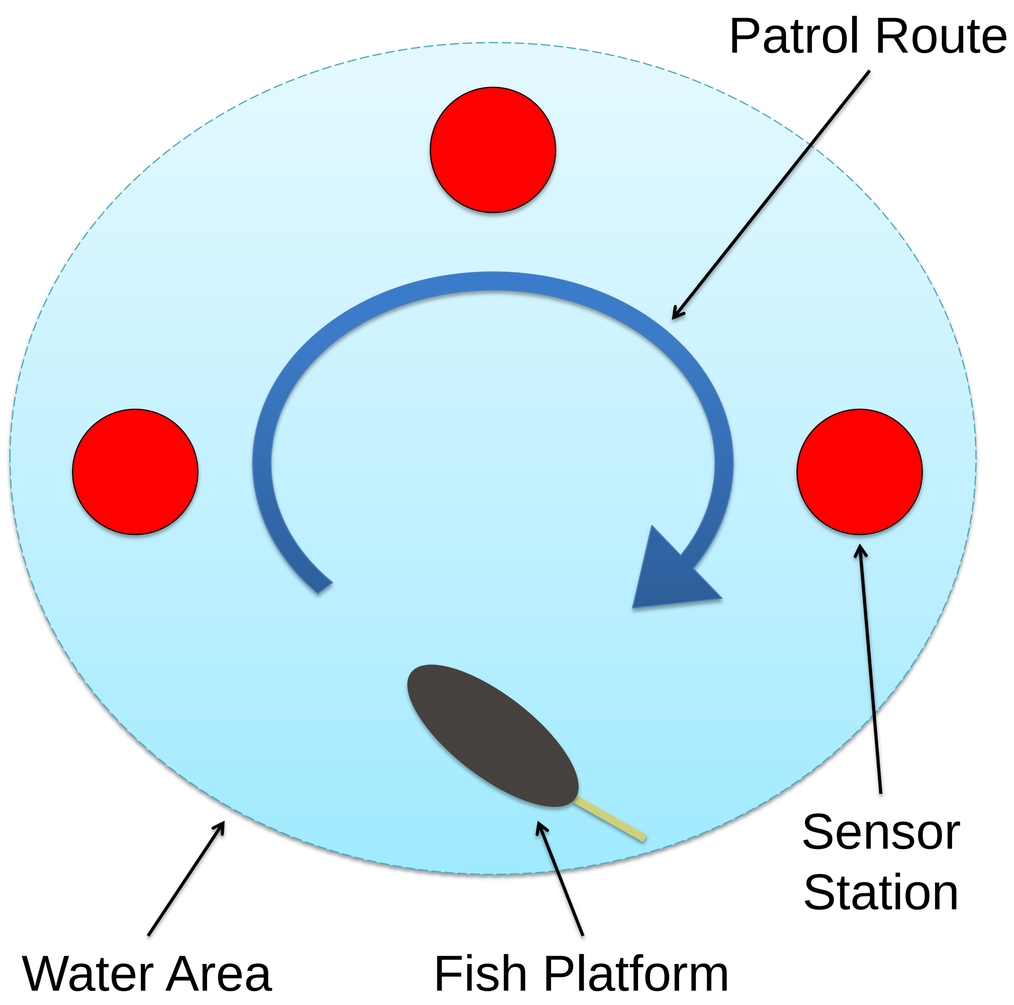
Chemical analysis is achieved through image processing and analysis as captured via the embedded camera on the platform. A pH dye is immobilised within the ionic liquid polymer gels (ionogels). As the pH increases, the the camera can detect the colorimetric changes of the indicator and report it as a singular colour value (Hue). The calibration plot (above) demonstrates this ability, R^2=*0.997, n=6*.

Robotic Platform



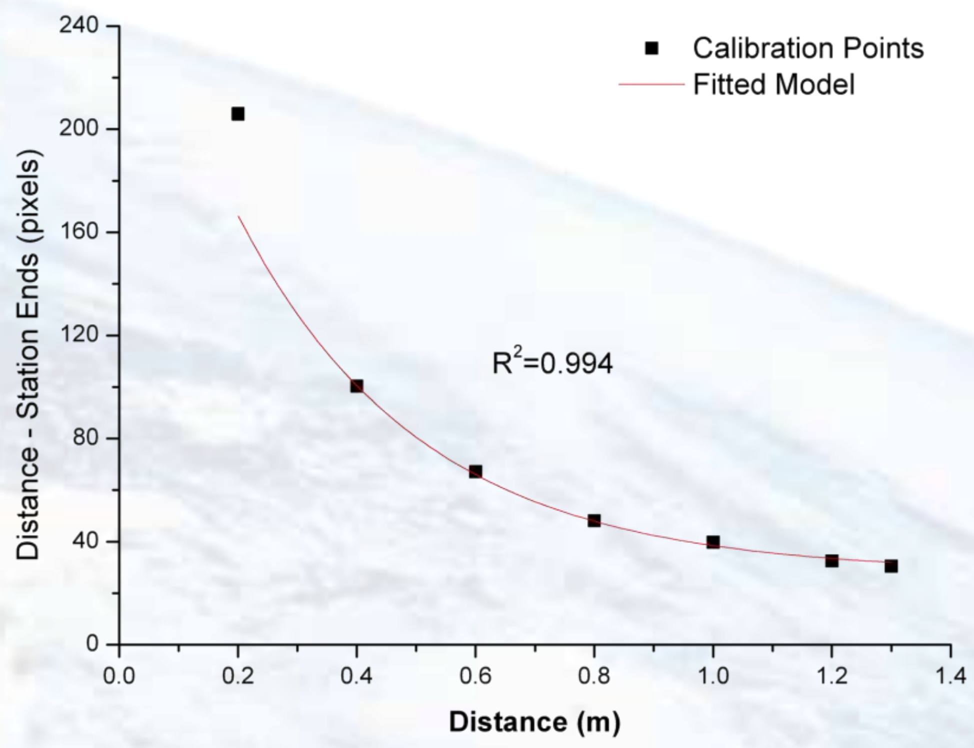
On Patrol

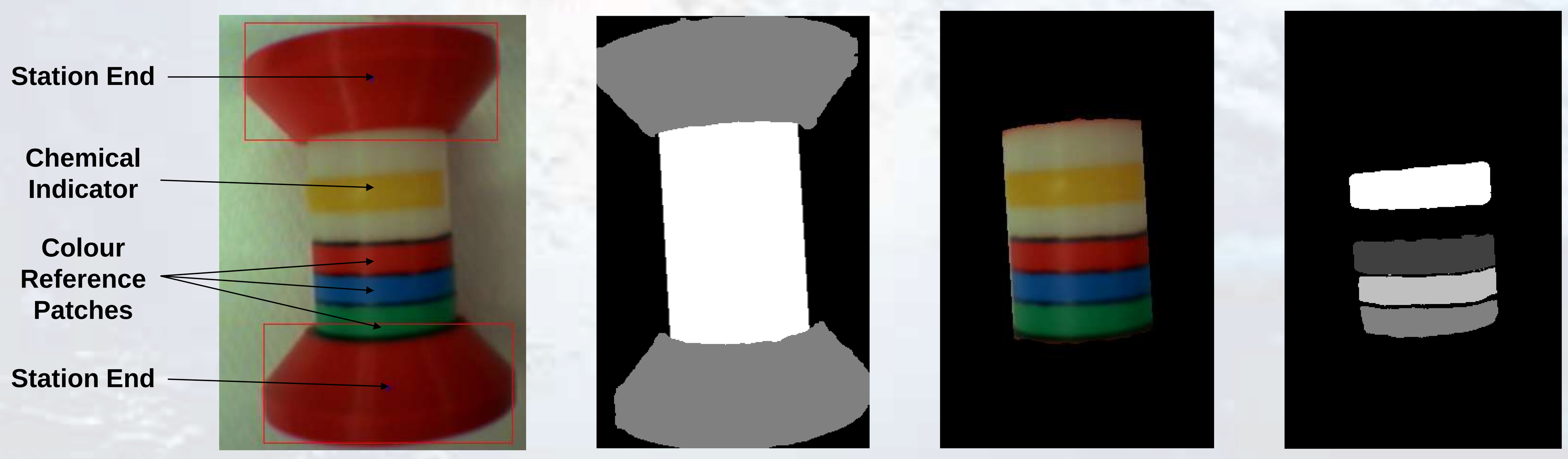
The robotic platform is capable of patrolling a water body where the images (provided by the camera) allows for navigation and chemical analysis of the chemo-responsive chemical indicator. This process is illustrated in the diagram (right). A desired patrol route is programmed, the platform captures images of the stations *en route*, and information related to the localised chemistry of the water body is harvested. This process is more cost effective than the currently adopted static model and therefore more scalable.



Station Tracking

Real-time image processing allows for navigation, colorimetric analysis, and station identification. Sensor stations are detected through a series of segmentation techniques (below) and the known distance to the stations' chroma-key and distinctively shaped ends. Distance to each station is determined through a calibration régime (right).





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