Liquid level detection in standard capacity measures with computer vision

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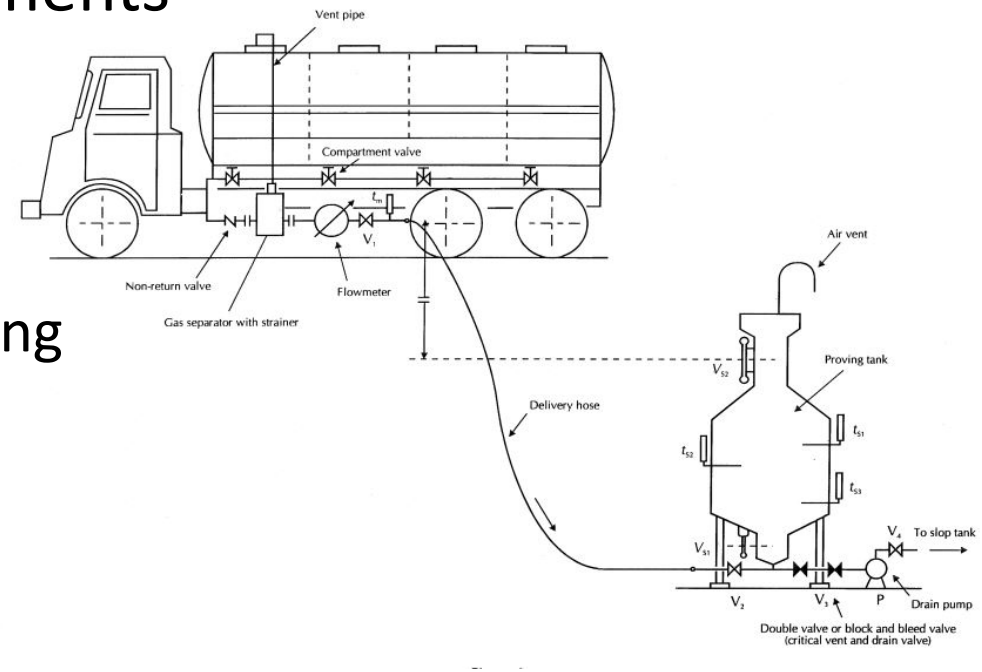
Purpose nad reqirements

Used for:

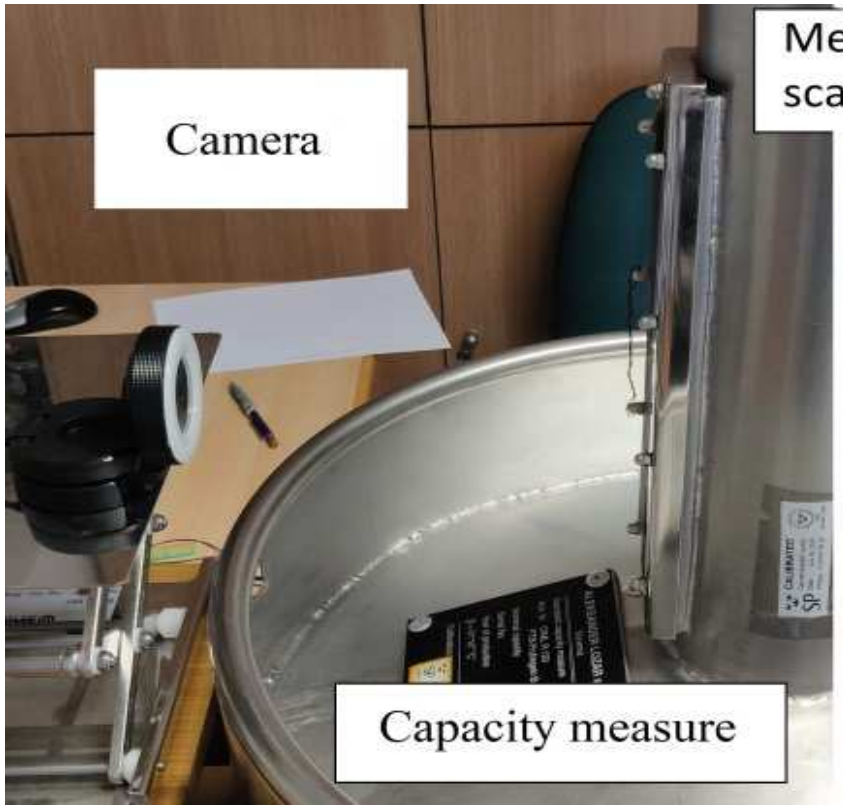
- Preforming measurements in inaccessible places
- Automating measurements

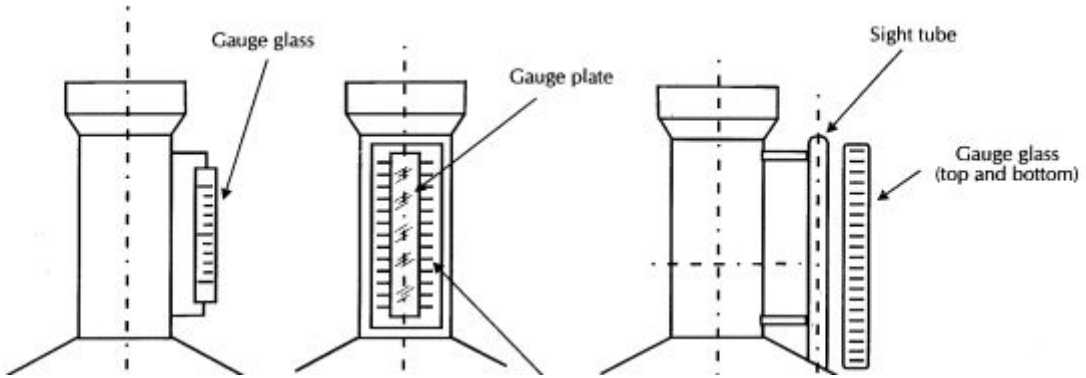
Requirements:

- Accuracy of manual reading
- Simple to setup



Testing setup





Program

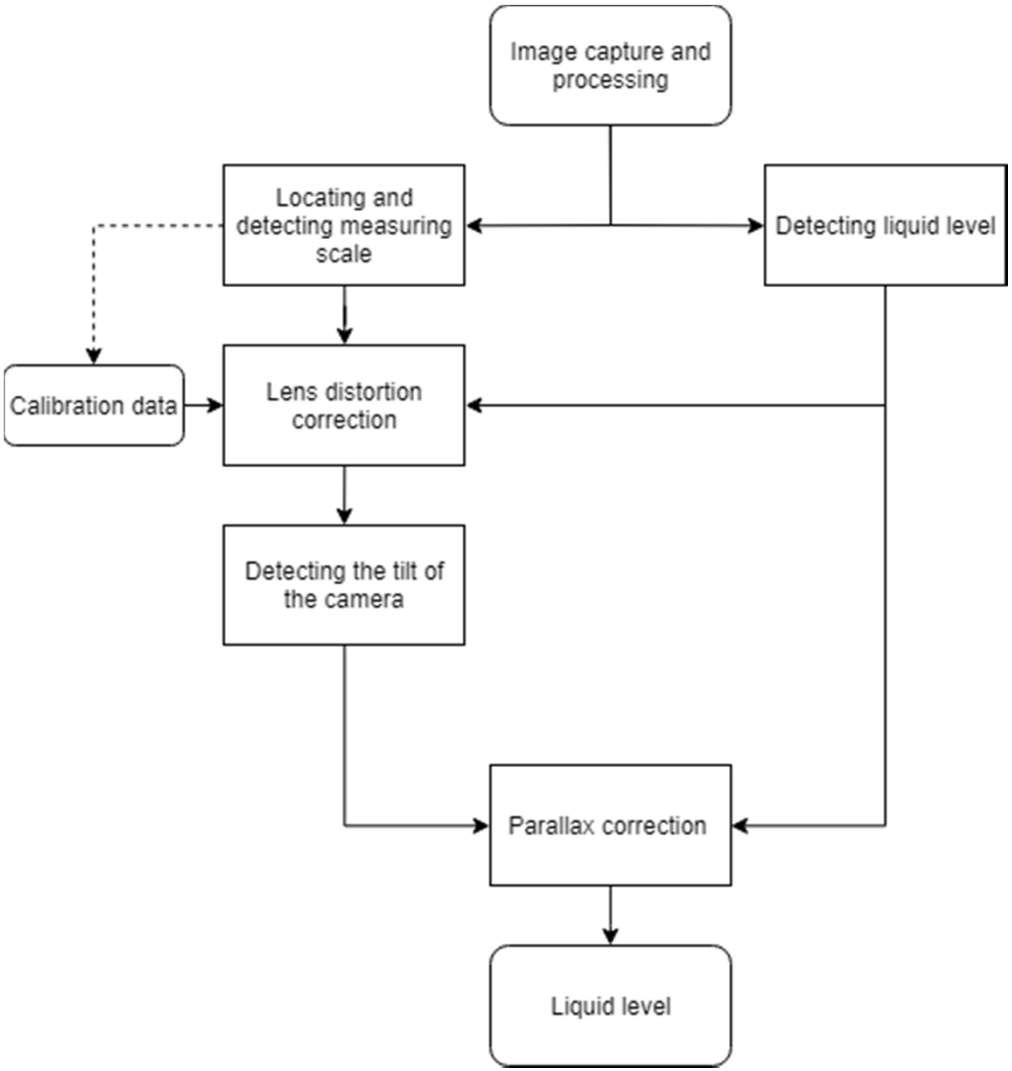
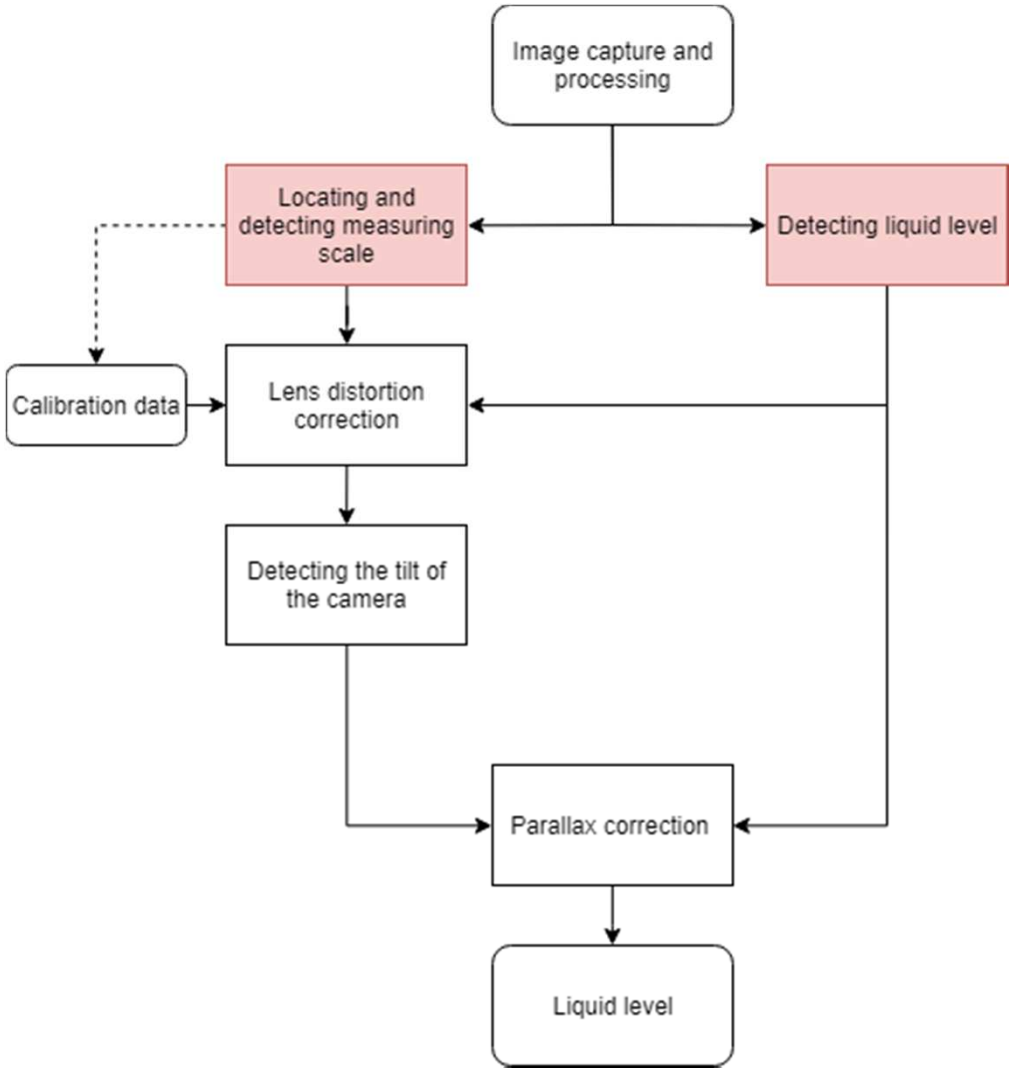
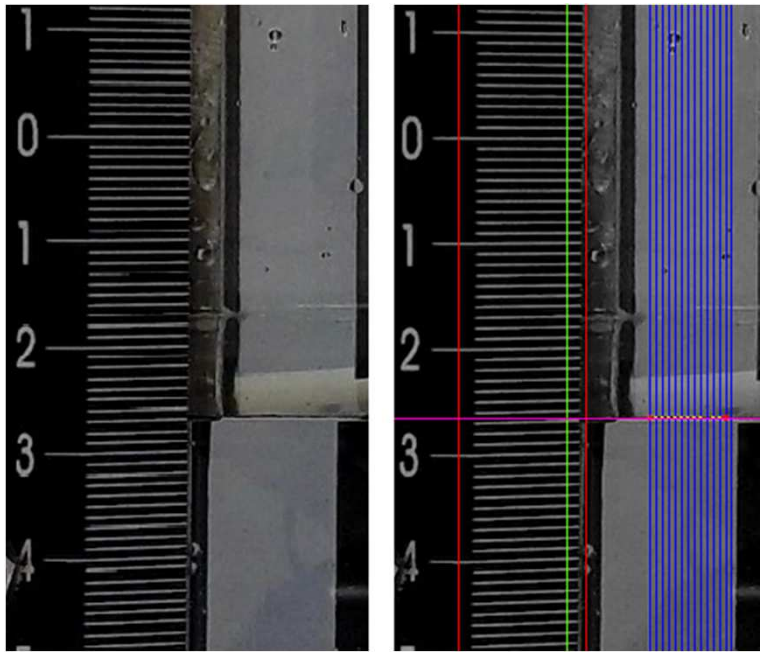


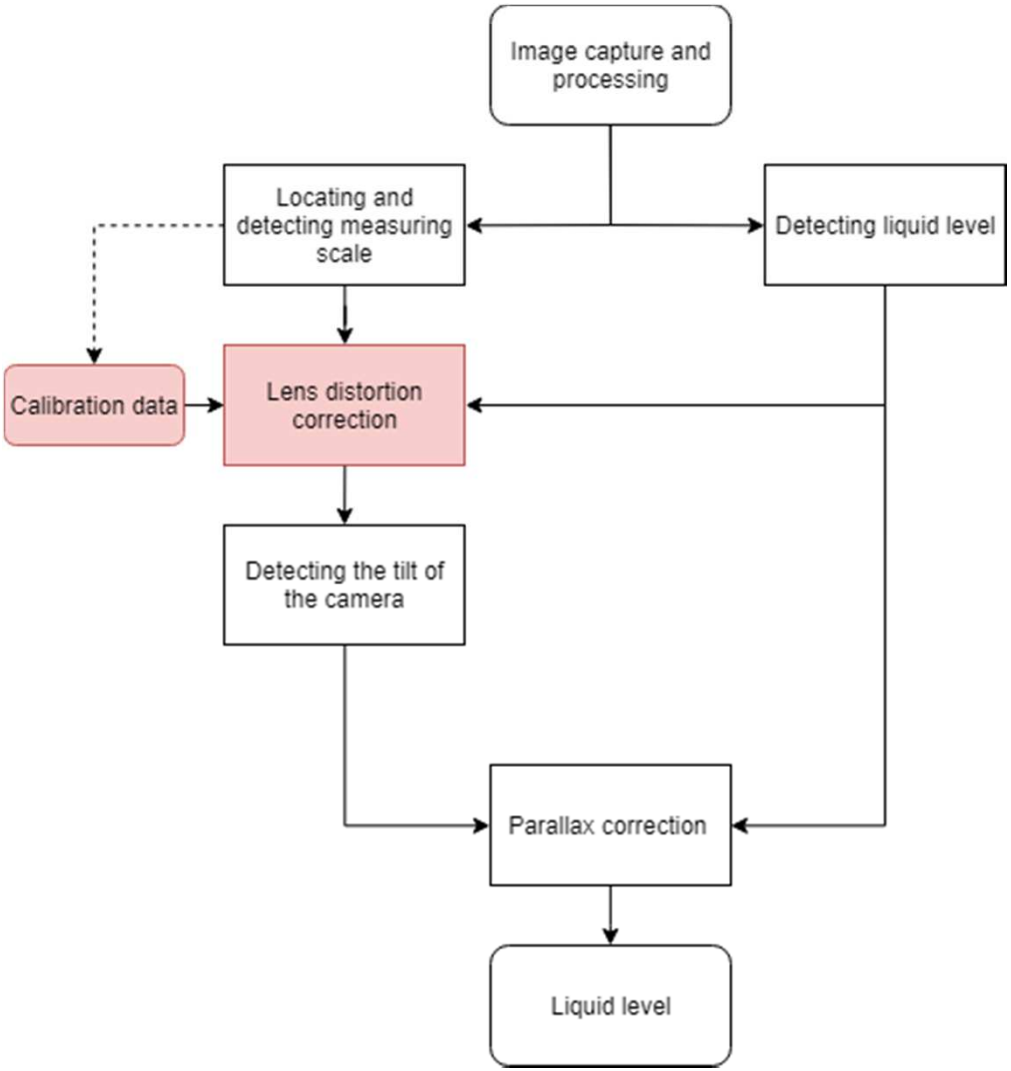
Image capture and processing
Locating and detecting measuring scale
Detecting liquid level
Calibration data
Lens distortion correction
Detecting the tilt of the camera
Parallax correction
Liquid level

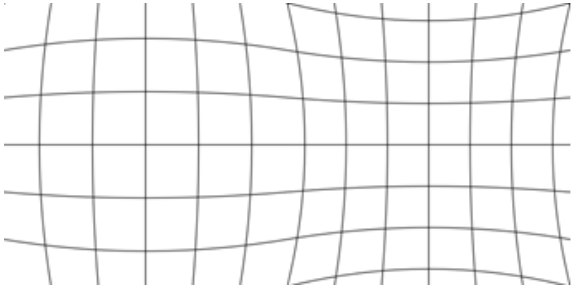
Measuring scale and liquid level detection

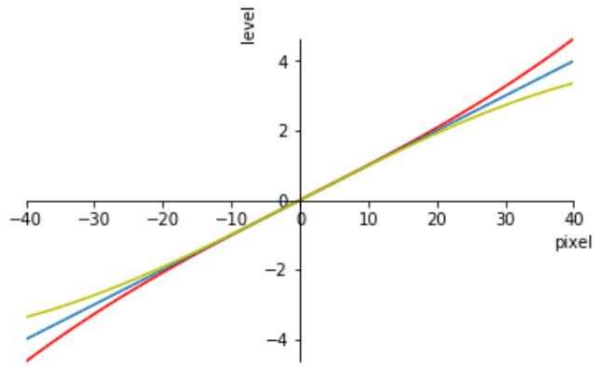




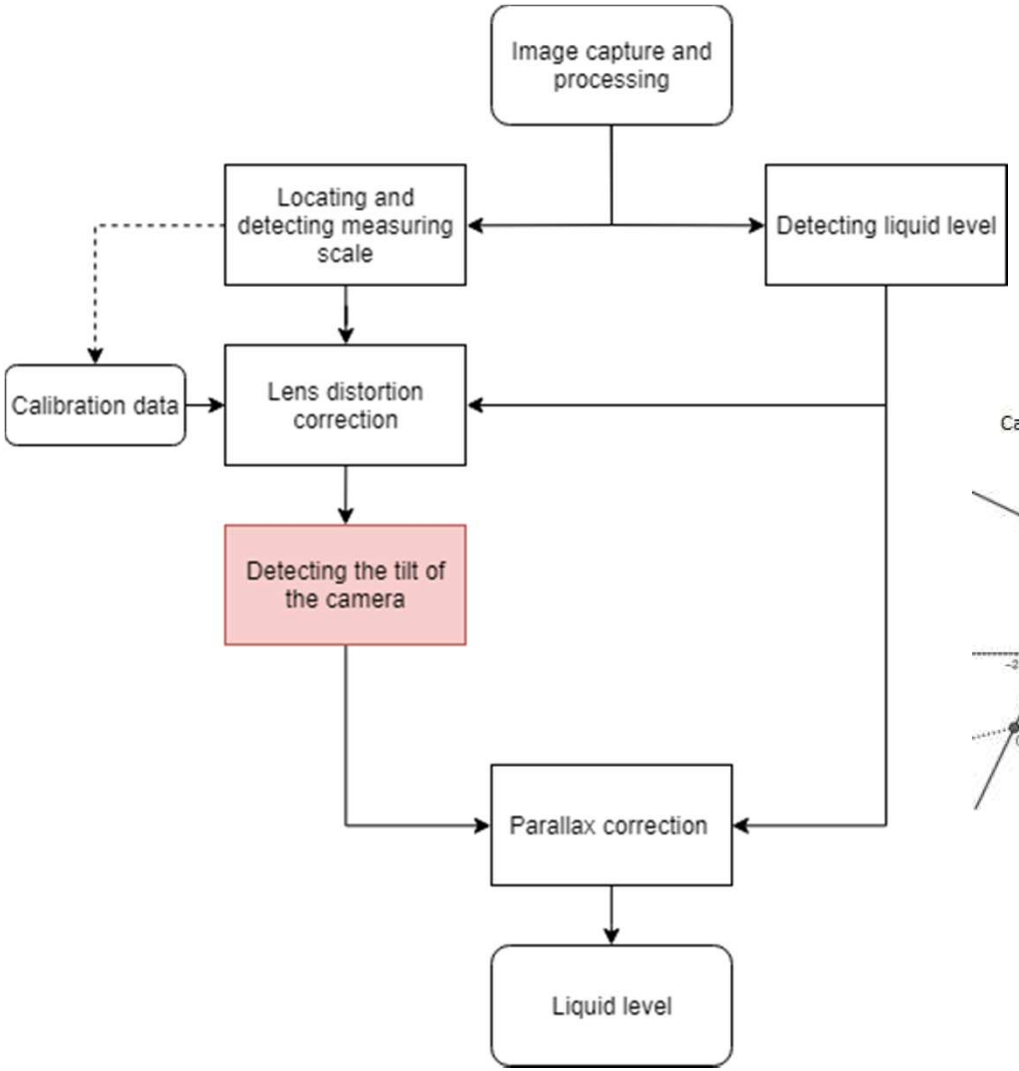
Lens distortion correction

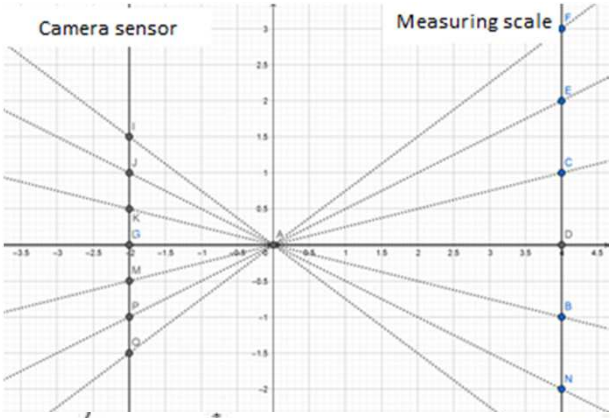


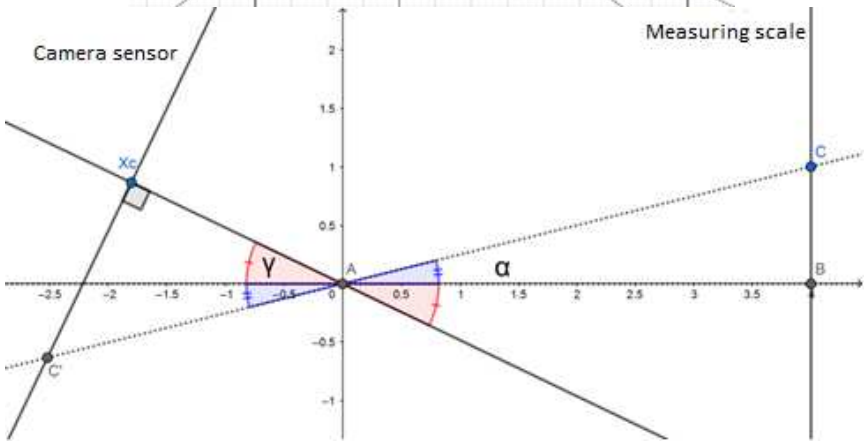




Camera tilt

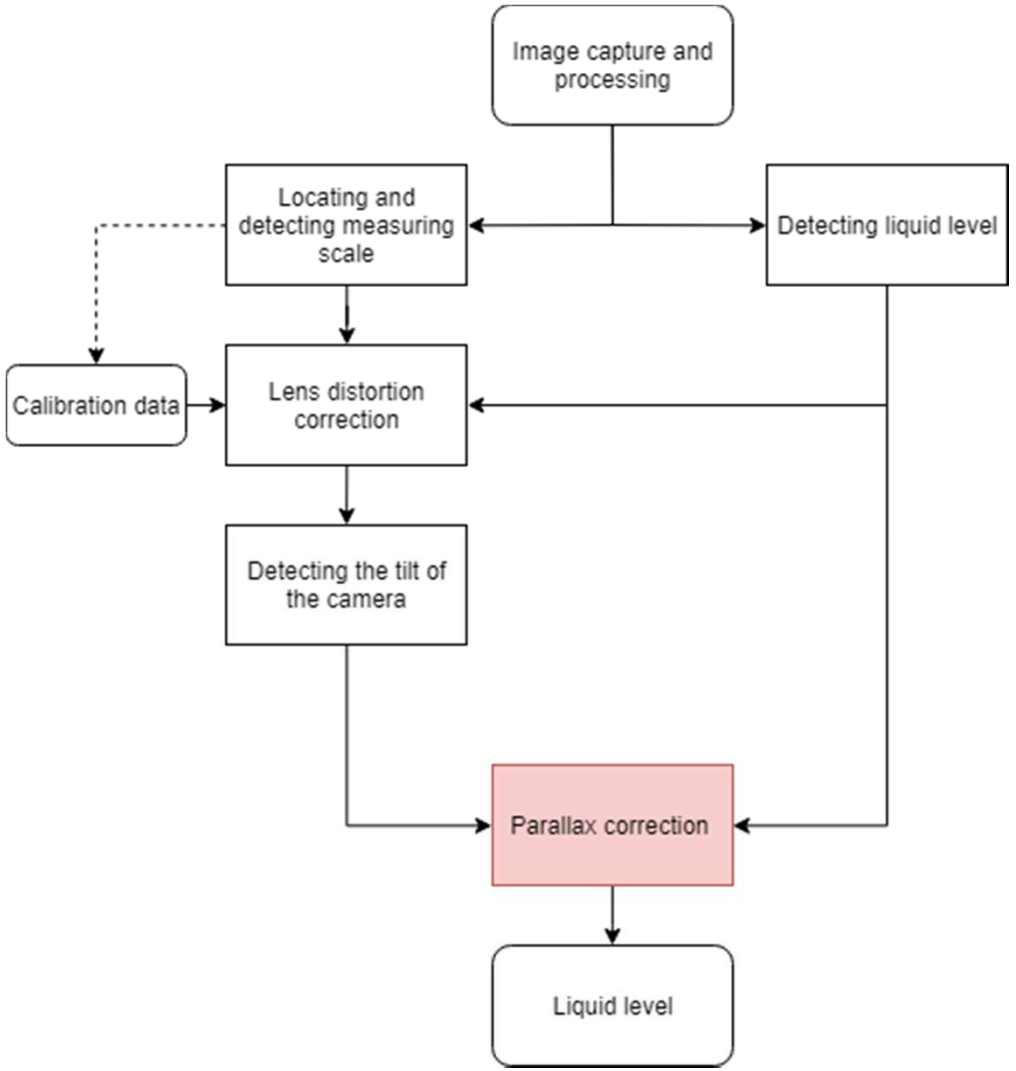


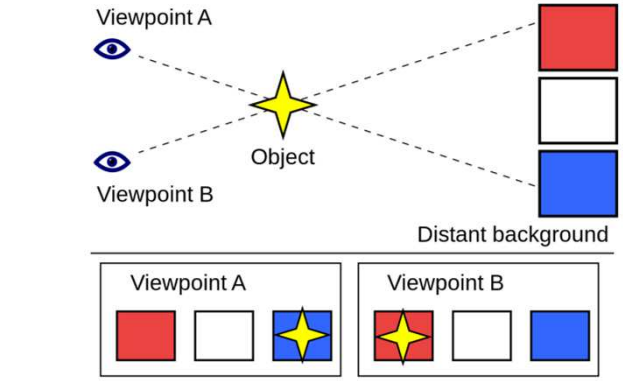


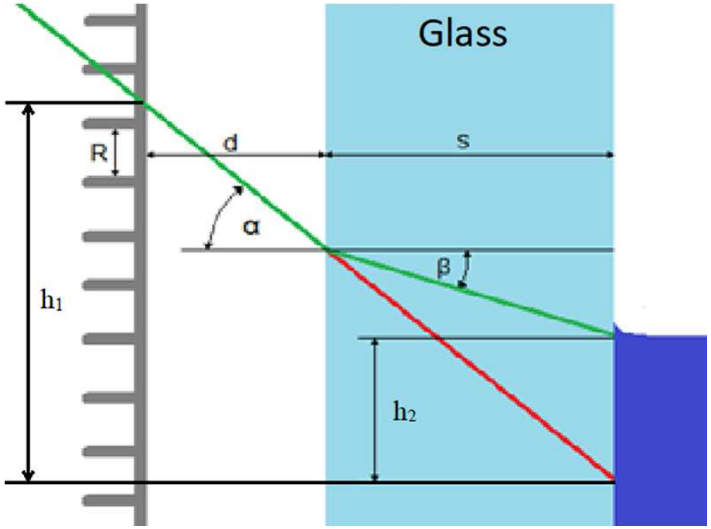


$$L = \frac{\tan\left(\arctan\left(\frac{r}{f}\right) - \gamma\right) s}{R} + LS$$

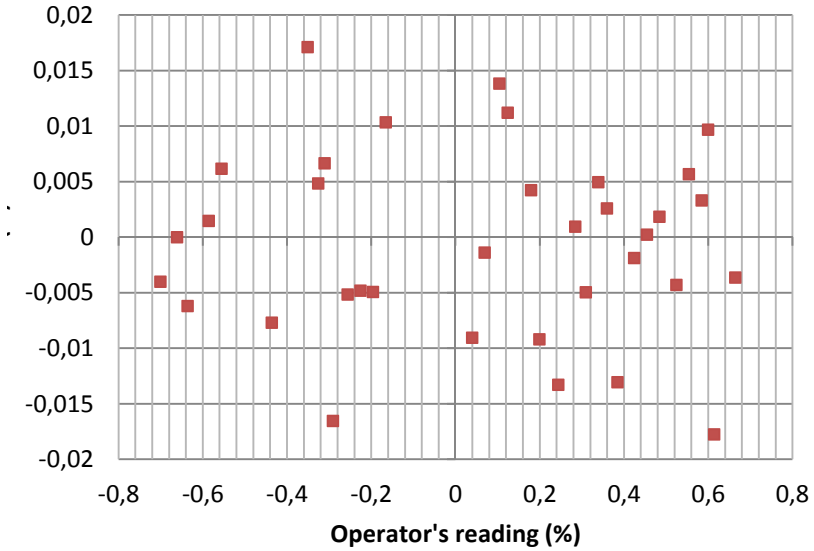
Parallax correction







Testing and results



Conclusions

- Systems has satisfied our requirements
- Suitable for transparent liquids
- Dependent on good lightning

References

- OIML R120: *Standard capacity measures for testing measuring systems for liquids other than water,* 2010.
- Szeliski, R., *Computer Vision: Algorithms and Applications* (Springer), 2010.
- Hornberg, Alexander., *Handbook of Machine Vision* (Wiley-VCH-Verl.), 2011.