OMNIDIRECTIONAL VISUAL TRACKING

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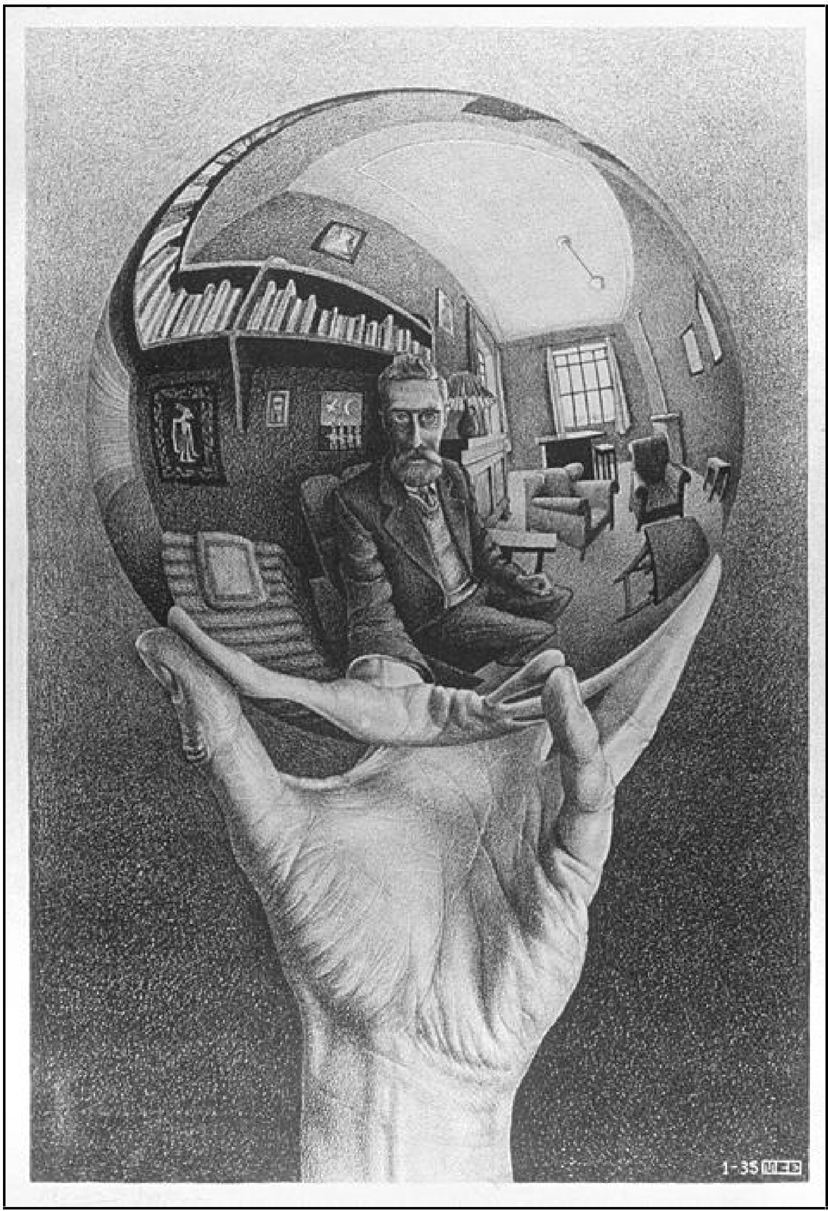
September 2003

A dissertation in partial fulfilment of the
requirements for the degree of
Master of Science in
Engineering and Information Sciences

The University of Reading
School of Systems Engineering
Department of Computer Science



Hand with Reflection Sphere (Self-Portrait in Spherical Mirror)
M. C. Escher, 1935 lithograph.

"*The picture shows a spherical mirror, resting on a left hand. Such a globe reflection collects almost one's whole surroundings in one disk-shaped image. The whole room, four walls, the floor, and the ceiling, everything, albeit distorted, is compressed into that one small circle. Your own head, or more exactly the point between your eyes, is the absolute centre. No matter how you turn or twist yourself, you can't get out of that central point. You are immovably the focus, the unshakable core, of your world.*"

M. C. Escher (1898 – 1972).

Abstract

Omnidirectional vision is the ability to see in all directions at the same time. Sensors that are able to achieve omnidirectional vision offer several advantages to many areas of computer vision, such as that of tracking and surveillance. This area benefits from the unobstructed views of the surroundings acquired by these sensors and allows objects to be tracked simultaneously in different parts of the field-of-view without requiring any camera motion.

This thesis describes a system that uses an omnidirectional camera system for the purpose of detecting and tracking moving objects. We describe the methods used for detecting objects, by means of a motion detection technique, and investigate two different methods for tracking objects – a method based on tracking groups of moving pixels, commonly referred to as blob tracking methods, and a statistical colour-based method that uses a mixture model for representing the object's colours. We evaluate these methods and show the robustness of the latter method for occlusion and other problems that are normally encountered in tracking applications.

For this thesis, we make use of a catadioptric omnidirectional camera based on a paraboloidal mirror, because of its single viewpoint and its flexibility of calibration and use. We also describe the methods used to generate virtual perspective views from the non-linear omnidirectional images acquired by the catadioptric camera. This is used in combination with the tracking results to create virtual cameras that produce perspective video streams while automatically tracking objects as they move within the camera's field-of-view.

Finally, this thesis demonstrates the advantage that an omnidirectional visual tracking system provides over limited field-of-view systems. Objects have the potential of being tracked for as long as they remain in the scene, and are not lost because they exit the field-of-view as happens for the latter systems. This should ultimately lead to a better awareness of the surrounding world – of the objects present in the scene and their behaviour.

Acknowledgements

I would like to express my sincere gratitude to Dr. James M. Ferryman for his continuous guidance, valuable advice and helpful discussions. I would also like to thank him for giving me the opportunity to work on a related project during my studies, from which I learned a lot about computer vision.

I also wish to thank the company I work for, Mosaic Software, for allowing me to take extended periods of leave to pursue my studies, and my colleagues at work for having to share the extra workload during my absence from the office.

Finally, many thanks to my family for all the encouragement and support they have always given me.

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