# RobotCub: An Open Research Initiative in Embodied Cognition

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We describe a new research initiative in embodied cognition that will create and exploit a 54 degree-of-freedom humanoid robot. It has the two-fold goal of (1) creating an open and freely-available humanoid platform – RobotCub – for research in embodied cognition, and (2) advancing our understanding of cognitive systems by exploiting this platform in the study of cognitive development.

We plan to construct an embodied system able to learn: i) how to interact with the environment by complex manipulation and through gesture production and interpretation; and ii) how to develop its perceptual, motor and communication capabilities for the purpose of performing goal-directed manipulation tasks.

The design of the humanoid robotic platform – RobotCub – is presently at its incipit. The final system will be made freely available to the scientific community through an open systems GNU-like general public license together with any software developed within this research initiative. RobotCub will have physical size and form similar to that of a two year-old child.

In addition, the project will further a research agenda in cognitive systems centered on manipulation in its widest sense including exploration, manipulation of objects, imitation, and communication through gestures. This agenda borrows heavily from experience in developmental psychology and cognitive neuroscience. The project includes interdisciplinary collaboration between neuroscientists and developmental psychologists on one side and roboticists and computer scientists on the other.

Our guiding philosophy – and the motivation for creating RobotCub – is that cognition cannot be hand-coded but has to be the result of a developmental process through which the system becomes progressively more skilled and acquires the ability to understand events, contexts, and actions, initially dealing with immediate situations and increasingly acquiring a predictive capability.

The RobotCub approach rests on three pillars: (1) its scientific stance on cognition: that cognition emerges through embodied development, (2) its research methodology: that cognition is best studied through a programme of progressive development, and (3) its research strategy: that progress in the global scientific community is best served by creating an open systems platform and by exploiting consequent synergies in that community.

To enable the investigation of relevant cognitive aspects of manipulation the design of the robot will be aimed at maximizing the number of degrees of freedom of the upper part of the body (head, torso, arms, and hands). The lower body (legs) will be designed to support crawling on four legs and sitting on the ground in a stable position with smooth autonomous transition from crawling to sitting. This will allow the robot to explore the environment and to grasp and manipulate objects on the floor. The sensory system will include a binocular vision system, touch, audition, and inertial sensors. Functionally, the system will be able to coordinate the movement of the eyes and hands, grasp and manipulate lightweight objects of reasonable size and appearance, crawl on four legs and sit.

Finally, we wish to emphasize again that one the principal goal of this initiative is to help foster the study of embodied cognition throughout the global research community by making the RobotCub humanoid and cognitive software freely available.

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