Vicarious Movement: Human-Drone Interactive Painting

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Abstract— Vicarious Movement is an experimental painting system involving a drone as a flying extension of a human artist's hand drawing.

Keywords—painting, gesture-controlled drones, drone

I. ON THE SYMBIOSIS AND TENSION BETWEEN A HUMAN ARTIST AND HER ROBOTIC EXTENSION

Historically, painting has evolved through technological innovations involving pigments, mediums, substrates and many periods of creativity in human expression. Radical applications of paint onto canvas through gestural mark making has been in focus since the middle of the 20th century with Action painters and the Gutai group amongst other movements, provoking further investigation into experimental methods of applying painted and printed marks progressing into 21 century technologies. The project Vicarious Movement envisions an evolution of such a nature. A quadrotor becomes a flying extension of an artist's hand, providing a bypass to inherent physical limitations of ourselves to carry out a drawing or painting on a remote canvas. Through an intentional disconnect between a pen and the artist's hand, the interplay between human control and the peculiar motion dynamics of the quadrotor is embodied through the final artwork. Through juxtaposing something as fundamental as drawing, with technology that challenges human agency and the notion of self-control, we aim to raise a dialogue leading to an evolution of human and machine creative capacities.

The resulting human-robot collaboration can be *directive*, responsive, suggestive, or resistive. The most intuitive coupling between the artist and the quadrotor is the resulting painting which is a direct translation of the artist intention and response to the artist's movement. The artist approaches the drawing desk with a pen lying on top, and picks up the pen. The quadrotor then begins following the drawing operation of the person, letting the person channel his/her artistic intention on the wall. The quadrotor can also resist the command and create noisy maneuvers due to the aerodynamic constraints. This suggests new ideas or even new ways to use the system. Ultimately, through the gesture based dialogue with the quadrotor, guiding the quadrotor at different speed or rate of turns, a user can go from strokes that are abstracted due to the quadrotor's slow turns, to deliberately observing the noise from the quadrotor during slow and steady maneuvers. The potential of the project is to develop co - agency of mark making, both

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the artist and drone have impacts on the quality and expression of painted lines.

Current developments in the interdisciplinary fields of experimental drawing and creative robotics offer new approaches for human and machine interaction to produce artworks. While existing research has focused on the autonomy of machine creativity, or programmable, and therefore predictable, machine drawing & painting methods, the potential for projects connecting the live gesture of an artist's hand drawing and semi-autonomous machines as a mark making proxy is largely unexplored. This work explores the potential for co-agency between humans and machine in producing drawings and paintings.

Through the hybrid agency between the human mind and algorithms, we intend to see how a corporeally extended means of expression can affect our internal model of artistic acts. On the level of the drawing operation itself, the motion coupling between the hand and the quadrotor realizes a bodily extension via teleoperation. However, the system's unique machine motions and aesthetics push the expression beyond human intuition and familiarity. The system induces a tension between this embodiment of extended body and a mundane act of pen drawing, as well as mental detachment from our physical body template.

This tension leads to a blend of qualities of expression that originate from human creativity as well as the mechanism and algorithm that drive robotic movement. Not only the style of expression, such a symbiosis between humans and machines opens up a series of dialogues around the scalability of creative action. The resulting strokes can be made in industrial scales way beyond the range the human body can access, or be multiplexed by a number of drones making marks in parallel. This work critically investigates this physical gateway through which the highly natural gesture of making a stroke on canvas translates across aesthetic, spatial, and numeric scales.

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