Media Lab Focus: MOBILITY
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The MIT Media Lab promotes an interdisciplinary research culture that brings together diverse areas of interest and inquiry. Art, science, design, and technology build and play off one another in an environment designed for collaboration and inspiration. Our faculty, students, and researchers work together on hundreds of projects across disciplines as diverse as novel materials, conformable sensor platforms, artificial intelligence, data visualization, privacy and cryptocurrency research, new models and tools for learning and community building, and sustainable cities. The Lab’s unique research culture is reflected in the broad spectrum of projects supported by Member Companies. In this report, we highlight projects that look into the future of Mobility, and grouped them into three themes: Car Experiences, Mobility Systems, and Data/Privacy/Ethics.

Car Experiences

**Affective Computing:** Advance human wellbeing by developing new ways to communicate, understand, and respond to emotion

- **Project:** Emotion Navigation for Kids — The purpose of this study is to examine the effect of the use of a ride-on car on physiological responses, distress, and anxiety before the physical examination inside the hospital or during the preoperative experience. [Video](#).
- **Project:** Promoting Healthy Commuting — This project aims to change the perception of commuting from a stressful experience to a joyful one.

**Camera Culture:** Making the invisible visible — inside our bodies, around us, and beyond — for health, work, and connection.

- **Project:** Seeing Through Fog — The system relies on ultrafast measurements, used to computationally remove inclement weather conditions such as fog, and produce a photo and depth map as if the fog weren’t there. [Video](#).

**Fluid Interfaces:** Designing systems for cognitive enhancement

- **Project:** AttentivU — The device can be used for passive or active interventions, for example to monitor the state of the user, providing gentle audio or haptic feedback when the user is less attentive (driving scenario) or adapting the environment when cognitive overload is detected (blocking the notifications). [Video](#). [Research Paper](#).
- **Project:** MoveU — MoveU is a wearable vestibular stimulation device for providing proprioceptive haptic feedback in virtual reality (VR). The device induces sensations of motion corresponding to virtual motion, thereby increasing immersion in VR and reducing cybersickness. [Video](#). [Research Paper](#).

**Tangible Media:** Giving dynamic physical form to digital information and computation to seamlessly couple the dual world of bits and atoms.

- **Project:** aSpire — A clippable pneumatic-tactile feedback device that helps users regulate their breathing. It has three inflatable silicone air pouches in an array that mimics the motion of a human’s breathing. When you sit on the chair, the aSpire delivers different breathing patterns by varying its air pouch shapes. [Video](#).
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**E14 Fund**: Early stage venture capital firm for the MIT/Media Lab startup community to serve the whole community by investing in scalable, deep tech startups

Company: **Affectiva**—Software that measures all things human, from nuanced emotions and complex cognitive states, to people’s behaviors, activities and the objects they use. We use deep learning, computer vision, speech science, and massive amounts of real-world data to build solutions from improving road safety to supporting mental health research.

Company: **Butler**—A plug-and-play, eraser-sized sensor with advanced network and edge compression algorithm that can measure occupancy, headcount, and posture in almost any built-environment. The 110 degree FOV specialty lens empowers the sensor to have 1000sqft coverage at 12ft height.

**Mobility Systems**

**Biomechatronics**: Advance technologies that merge the body and the machine, including device architectures that resemble the body’s own musculoskeletal design, actuator technologies that behave like muscle, and control methodologies that exploit principles of biological movement.

Project: **Rotary Ankle**—A compact, lightweight, integrated rotary actuator powerful enough to provide the positive energy required to restore walking to near-biological behavior.

**City Science**: New approaches to create the places where people live and work, and the systems that connect them.

Project: **Autonomous Bicycle**—A shared, on-demand, autonomous bicycle that offers users the ease of mobility, without ownership. [Video](#).

Project: **Persuasive Electric Vehicle**—The PEV is a low-cost, agile, shared-use autonomous bike that can be either an electrically assisted tricycle for passenger commuting or an autonomous carrier for package delivery. [Video](#).

**Space Enabled**: The group’s mission is to advance justice in Earth's complex systems using designs enabled by space.

Project: **Candlewax Rockets**—Wax-based hybrid rocket propellants, including paraffin (common candlewax) and beeswax show promise as high-performing hybrid rocket propellants for chemical propulsion systems. We are investigating the centrifugal casting of waxes into annular geometries on Earth as well as in microgravity.

**E14 Fund**:

Company: **Elroy Air**—An end-to-end, fully autonomous, cargo delivery system with 250-500lbs (100-225kg) payload, 300mi (500km) range, no airport required, no electric charging station required, efficient hybrid-electric powertrain, and advanced safety architecture.
Data, Privacy, and Ethics

Affective Computing

Project: Affective Privacy—Information rich data types - such as speech data - are increasingly being used in digital products for a variety of purposes such as authentication, language translation and emotion detection. Though users are often willing to share some parts of the information contained within these data modalities, they may feel that the data's other information components are irrelevant to the product/service they are using. Thus, in the interest of user privacy, we are investigating how to disentangle information in multimodal data to allow users to selectively control the information that they share. Our project addresses the technical, ethical, and societal details of enabling this type of privacy within affective computing products and research.

Biomechatronics

Project: Personalized Gait Models—A number of advanced motion-capture, electromyography, indirect-calorimetry, digital image correlation, and system-identification techniques will be integrated into a single, open-source data-acquisition pipeline, enabling near-real-time data processing. This rapidly collected data will subsequently be used to tailor 2D and 3D neuromuscular models to specific individuals.

Camera Culture

Project: NoPeek—Reduction in information leakage by adding an additional loss term to the commonly used classification loss term of categorical cross-entropy. The information leakage reduction loss term we use is distance correlation; a powerful measure of non-linear (and linear) statistical dependence between random variables. Optimization of this combination of two losses helps ensure the activations resulting from the protected layer have minimal information with regards to reconstructing the raw data while still being useful enough to achieve reasonable classification accuracies upon postprocessing of these activations. Research Paper.

Project: Splintering—A stochastic scheme for splitting the client data into privatized shares that are transmitted to the server in such settings. The server performs the requested operations on these shares instead of on the raw client data at the server. The obtained intermediate results are sent back to the client where they are assembled by the client to obtain the final result. Research Paper.

Fluid Interfaces

Project: Control of Virtual Environments—A set of three tools for selection and manipulation tasks, for interacting with menus, and for navigating quickly between different locations without confusing the player or causing excessive simulator sickness.

Human Dynamics: Tools of computational social science to ask how we can better organize society, government, and companies.

Project: Voyage Viewer—An online, open source interactive tool especially designed to visualize and study human mobility and migration. Video.

Personal Robots: Building intelligent personified technologies that collaborate with people to help them learn, thrive, and flourish.
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Project: Migratory AI—A platform where a personal conversational assistant (agent) could migrate across different form factors and environments to always accompany and assist its user, to support a far more continuous, personalized, and collaborative experience. Research Paper.

Tangible Media

Project: HERMITS—A way to greatly advance the versatility of Robotic Tangible Interfaces. Inspired by hermit crabs, we designed a modular system for table-top wheeled robots to dock to passive attachment modules, defined as "mechanical shells." Different types of mechanical shells can uniquely extend and convert the motion of robots with embedded mechanisms, so that, as a whole architecture, the system can offer a variety of interactive functionality by self-reconfiguration. Video.

E14 Fund

Company: Enigma—Enigma builds and supports groundbreaking privacy-focused technologies and networks. We are a core contributor to the Secret Network, a unique blockchain-based network where computations can be performed on encrypted data. Enigma’s mission: improve the adoption and usability of privacy-first products, for the benefit of all.

Company: Stable—A cloud-based platform driven by data to help businesses deploy EV Charging stations where it is needed. Compare thousands of TOU rates, flat rates, and PPAs against your historical and expected load profiles to help select an energy tariff that will manage unpredictable energy costs. Maximize credits and incentives by analyzing trade-offs between equipment size and the number of concurrent charging sessions, delivery speed, and available credits for your site.

Company: Wise Systems—An AI-driven dispatch and routing software that automatically schedules, monitors, and adjusts routes in real time, ensuring the most efficient routes. Wise Systems continuously learns from fleet data, helping to optimize and improve fleet performance over time.