Article 1: "TongueBoard: An Oral Interface for Subtle Input", Richard Li, Jason Wu and Thad Starner.

We present TongueBoard, a retainer form-factor device for recognizing non-vocalized speech. TongueBoard enables absolute position tracking of the tongue by placing capacitive touch sensors on the roof of the mouth. We collect a dataset of 21 common words from four user study participants (two native American English speakers and two non-native speakers with severe hearing loss). We train a classifier that is able to recognize the words with 91.01% accuracy for the native speakers and 77.76% accuracy for the non-native speakers in a user dependent, offline setting. The native English speakers then participate in a user study involving operating a calculator application with 15 non-vocalized words and two tongue gestures at a desktop and with a mobile phone while walking. TongueBoard consistently maintains an information transfer rate of 3.78 bits per decision (number of choices = 17, accuracy = 97.1%) and 2.18 bits per second across stationary and mobile contexts, which is comparable to our control conditions of mouse (desktop) and touchpad (mobile) input.

Article 2: "Estimation of Fingertip Contact Force by Measuring Skin Deformation and Posture with Photo-reflective Sensors", Ayane Saito, Wakaba Kuno, Wataru Kawai, Natsuki Miyata and Yuta Sugiura.

A wearable device for measuring skin deformation of the fingertip—to obtain contact force when the finger touches an object—was prototyped and experimentally evaluated. The device is attached to the fingertip and uses multiple photo-reflective sensors (PRSs) to measures the distance from the PRSs to the side surface of the fingertip. The sensors do not touch the contact surface between the fingertip and the object; as a result, the contact force is obtained without changing the user's tactile sensation. In addition, the accuracy of estimated contact force was improved by determining the posture of the fingertip by measuring the distance between the fingertip and the contact surface. Based on the prototyped device, a system for estimating three-dimensional contact force on the fingertip was implemented.

Article 3: "2bit-TactileHand: Evaluating Tactons for On-Body Vibrotactile Displays on the Hand and Wrist", Don Samitha Elvitigala, Denys J. C. Matthies, Vipula Dissanayake, Chamod Weerasinghe and Suranga Nanayakkara.

Visual interfaces can provide a great density of information. However, the required focused visual attention results in a high cognitive effort. This cognitive load significantly increases when multiple tasks are performed that also require visual attention. In this paper, we evaluate the perceptual abilities of 2bit tactons on the wrist and the hand as a type of complementary feedback. Based on our evaluation, 2bit tactons are reasonably high perceivable (≈ 92%) at the hand distributed among several fingers. Additionally, the data concluded that vibrotactile feedback on hand is significantly more accurate than the wrist, which coincides with the subjects' preference. TactileHand's feasibility was demonstrated in three pilot studies, encoding ambient, explicit and implicit information into 2bit tactons in different scenarios.

Article 4: "StockSense - A Wrist-Worn Vibrotactile Display for tracking Volatile Markets", Erik Pescara, Ilya Filippov and Michael Beigl.

This paper presents StockSense, a prototype of a haptic wristband for tracking volatile markets. StockSense informs the user about current price changes via structured vibrotactile feedback. This system can be used for any volatile market: cryptocurrency market, stock market, etc. A preliminary study was carried out with 5 participants to investigate whether vibrotactile displays of smartphones could be integrated into the system for additional information transmission. Afterwards the system was evaluated in a study with 20 participants. The participants became familiar with the system within a short period of time and were able to recognize the displayed information on the vibrotactile display reliably. The participants rated the system as positive. Overall, the participants appreciated the functionality of the system and considered it to be suitable for this field of application.

Article 5: "Evaluation of a device reproducing the pseudo-force sensation caused by a clothespin", Masahiro Miyakami, Takuto Nakamura and Hiroyuki Kajimoto.

A pseudo-force sensation can be elicited by pinching a finger with a clothespin. When the clothespin is used to pinch the finger from the palm side, a pseudo-force is felt in the direction towards the palm side, and when it is used to pinch the finger from the back side of the hand, the pseudo-force is felt in the extension direction. Here, as a first step to utilizing this phenomenon in human-machine interfaces, we developed a device that reproduces the clothespin phenomenon and confirmed the occurrence rate of the pseudo-force sensation.

Article 6: "Finger Posture Modulates Grip Strength and Weight Perception", Hideyuki Asazu, Masahiro Miyakami and Hiroyuki Kajimoto.

Modulation of grip force has several applications such as sports. We speculated that as mupltiple fingers mechanically interact with each other, it might be possible to adjust grip strength by controlling the movement of single finger. We also speculated that changing grip strength may affect the weight perception of an object on grasping. In this paper, we investigated whether grip strength could be modulated by a specific finger posture, and found that it can be reduced by stretching some fingers, specifically middle finger and ring finger. Preliminary result of weight perception modulation is also reported.

Article 7: "Guided walking to direct pedestrians toward the same destination", Nobuhito Sakamoto, Masataka Kurokawa, Masahiro Furukawa and Taro Maeda.

In this paper, we propose a floor covering-type walking guidance sheet to direct pedestrians without requiring attachment/detachment. Polarity is reversed with respect to the direction of walking in the guidance sheet such that a pedestrian travelling in any direction can be guided toward a given point. In experiments, our system successfully guided a pedestrian along the same direction regardless of the direction of travel using the walking guidance sheet. The induction effect of the proposed method was also evaluated.

Article 8: "Detection Threshold of the Height Difference between a Visual and Physical Step", Masato Kobayashi, Yuki Kon and Hiroyuki Kajimoto.

In recent years, virtual reality (VR) applications that accompany real-space walking have become popular. In these applications, the expression of steps, such as a stairway, is a technical challenge. Preparing a real step with the same scale as that of the step in the VR space is one alternative; however, it is costly and impractical. We propose using a real step, but one physical step for the expression of various steps, by manipulating the viewpoint and foot position when ascending and descending real steps. The hypothesis is that the height of a step can be complemented to some extent visually, even if the heights of the real step and that in the VR space are different. In this paper, we first propose a viewpoint and foot position manipulation algorithm. T hen we measure the detection threshold of the height difference between the visual and physical step when ascending and descending the physical step using our manipulation algorithm. As a result, we found that the difference can be detected if there is a difference of approximately 1.0 cm between the VR space and the real space, irrespective of the height of the physical step.

Article 9: "Enhancement of Subjective Mechanical Tactile Intensity via Electrical Stimulation", Ryo Mizuhara, Akifumi Takahashi and Hiroyuki Kajimoto.

Naturalistic tactile sensations can be elicited by mechanical stimuli because mechanical stimulation reproduces a natural physical phenomenon. However, a mechanical stimulation that is too strong may cause injury. Although electrical stimulation can elicit strong tactile sensations without damaging the skin, electrical stimulation is inferior in terms of naturalness. Here, we propose and validate a haptic method for presenting naturalistic and intense sensations by combining electrical and mechanical stimulation. Prior to the main experiment, we measured the appropriate temporal gap between the two stimuli such that they are perceived as simultaneous, since nerve activity directly elicited by electrical stimulation is generally considered to be perceived faster than mechanical stimulation. We confirmed that enhancement of subjective strength took place when two stimuli were given simultaneously. The main experiment with simultaneous electrical and mechanical stimulation confirmed that addition of electrical stimulation enhances the sensation of mechanical stimulation, and participants' comments implied that electrical stimulation was interpreted as part of the mechanical stimulation.

Article 10: "Glove-Through Tactile Information Transmission System", Hideki Kawai, Hidenori Itoh, Takuya Nakano, Hiroyuki Kajimoto and Yasuyuki Yanagida.

By covering the skin with clothes such as gloves, humans have managed to survive in severe environments and undertake dangerous work. However, when we wear covering materials, tactile information is lost; this may decrease working efficiency and degrade the performance of object perception at the moment of contact. In order to address this issue, the concept of a “haptic-through” system that transmits tactile information through a covering material has been proposed. However, the effectiveness of this concept has been verified only by vertically pushing a surface of an object with one finger; there have been no systems proposed that can be used in actual complex finger motion. We constructed a glove-style haptic-through system that can be used in practical finger motion. By using this system, we conducted an experiment to investigate the discrimination threshold of the angle of a rod-shaped object. As a result, the angle discrimination threshold through a glove, with the support of our system, was equivalent to that obtained with bare hands.

Article 11: "fSense: Unlocking the Dimension of Force for Gestural Interactions using Smartwatch PPG Sensor", Thisum Buddhika, Haimo Zhang, Samantha Chan, Vipula Dissanayake, Suranga Nanayakkara and Roger Zimmermann.

While most existing gestural interfaces focus on the static posture or the dynamic action of the hand, few have investigated the feasibility of using the forces that are exerted while performing gestures. Using the photoplethysmogram (PPG) sensor of off-the-shelf smartwatches, we show that, it is possible to recognize the force of a gesture as an independent channel of input. Based on a user study with 12 participants, we found that users were able to reliably produce two levels of force across several types of common gestures. We demonstrate a few interaction scenarios where the force is either used as a standalone input or to complement existing input modalities.

Article 12: "Haptic Collar - Vibrotactile Feedback around the Neck for Guidance Application", Stefanie Schaack, George Chernyshov, Kirill Ragozin, Roshan Peiris and Kai Kunze.

In this paper, we present a Haptic Collar prototype, a neck worn band with vibrotactile actuators for eyes-free haptic navigation. We evaluate the system for guidance applications on over 11 users, analyzing 4 different tactile patterns regarding comfort and ease of understanding as well as the number of actuators to encode 8 directions (4, 6 and 8). Overall, users can recognize the directional signs well (up to 95 % recognition rates for over 528 triggers). We also present a use case applying our prototype for a haptic navigation walk.

Article 13: "OSense: Object-activity Identification Based on Gasping Posture and Motion", Thisum Buddhika, Haimo Zhang, Chamod Weerasinghe, Suranga Nanayakkara and Roger Zimmermann.

Observing that, how we grasp objects is highly correlated with geometric shapes and interactions, we propose the use of hand postures and motions as an indirect source of inputs for object-activity recognition. This paradigm treats the human hand as an always-available sensor, and transforms all sensing problems to the data analysis for the “sensor hand”. We envision this paradigm to be generalizable for all objects regardless of whether they are acoustically or electromagnetically active, and that it detects different motions while holding the same object. Our proof-of-concept setup consists of six IMU sensors mounted on the fingers and back of the hand. Our experiments show that when the posture is combined with the motion, the personalized object-activity detection accuracy increases from 80% to 87%.

Article 14: "TherModule: Wearable and Modular Thermal Feedback System based on a Wireless Platform", Tomosuke Maeda and Kurahashi Tetsuo.

Humans have specific sensory organs and they can feel tactile sensation on the whole body. However, many haptic devices have limitations due to the location of the body part and might not provide natural haptic feedback. Thus, we propose a novel interface, TherModule, which is a wearable and modular thermal feedback system for embodied interactions based on a wireless platform. TherModule can be worn on multiple body parts such as the wrist, forearm, ankle, and neck. In this paper, we describe the system concept, module implementation, and applications. To demonstrate and explore the embodied interaction with thermal feedback, we implemented prototype applications, such as movie experiences, projector-based augmented reality, navigation, and notification based on a wireless platform, with TherModule on multiple parts of the body. The result of an experiment on movie experience showed that participants felt more interactions between temperature and visual stimulus.

Article 15: "Augmented Recreational Volleyball Court: Supporting the Beginners' Landing Position Prediction Skill by Providing Peripheral Visual Feedback", Koya Sato, Yuji Sano, Mai Otsuki, Mizuki Oka and Kazuhiko Kato.

Volleyball is widely popular as a way to share a sense of unity and achievement with others. However, errors detract beginners from enjoying the game. To overcome this issue, we developed a system that supports the beginners' skill to predict the ball landing position by indicating the predicted ball landing position on the floor as a visual feedback. In volleyball, it is necessary to pay attention to the ball that has been launched in air, and visual feedback on the floor surface must be perceived through peripheral vision. The effect of such visual feedback in supporting beginners' prediction skill was not clear. Therefore, we evaluated the effectiveness of the proposed system via a simulated serve-reception experiment. As a result, we confirmed that the proposed system improved the prediction skill in terms of the prediction speed and accuracy in the left-right direction, and that beginners felt an improvement in the prediction accuracy and ease of ball manipulation, thereby increasing the enjoyment. These results also indicate that it is possible to utilize peripheral vision supports in other disciplines in which there is a distance between the object of attention and the sports field on which visual feedback can be presented.

Article 16: "Prediction of Volleyball Trajectory Using Skeletal Motions of Setter Player", Shuya Suda, Yasutoshi Makino and Hiroyuki Shinoda.

In this paper, we present a method that predicts the ball trajectory of a volleyball toss 0.3 s before the actual toss by observing the motion of the setter player. We input 3D data of body joints obtained using Kinect into a simple neural network, and 2D data estimated using OpenPose is used for comparison. We created simple neural networks for the two players and tested them. The trajectory of a volleyball toss is properly predicted by the proposed method and the error of the toss trajectory was approximately equal to the size of the ball. This technology can provide a new spectating experience in sports by superimposing the predicted images onto a live broadcast. We also show that this method can be used to identify the important body parts that contribute to the toss prediction. A professional volleyball analyst stated that this technology can be used for analyzing the peculiarities of opponent players.

Article 17: "Identifying Muscle Fatigue and Hyperthermia in Sports Activities Using Thermal Imaging and Facial Recognition Software", Christopher G. Harris.

Hyperthermia and muscle fatigue during sports activities are a challenge to detect because body temperatures cannot be unobtrusively evaluated from the field of play. Recently, inexpensive portable thermal imaging devices have become available, allowing accurate monitoring of players from a distance. In this paper, we examine the accuracy of thermal imaging devices by distance and monitoring angle. Using thermal imaging, object recognition, and facial recognition techniques, we develop a visualization tool to display core body temperature information for each player. This augmented display allows us to detect potential heat-related player injuries on a sports field in near real time.

Article 18: "Virtual Super-Leaping: Immersive Extreme Jumping in VR", Tomoya Sasaki, Kao-Hua Liu, Taiki Hasegawa, Atsushi Hiyama and Masahiko Inami.

People sometimes imagine and yearn for a “Super Power,” an ability they do not have naturally. In this paper, we propose Virtual Super-Leaping (VSL) as an immersive virtual experience that provides the feeling of extreme jumping in the sky. First, we define the necessary feedback elements and classify the action sequence of Super-Leaping, including the design of the multimodal feedback for each action state. Then, we describe the design of the VSL system, which has two components: (i) visual a head-mounted display-based feedback, and (ii) a VSL-enabling haptic device, which provides both kinesthesia and airflow using multiple synchronized propeller units. We end by reporting on our technical evaluation and public demonstrations. This work contributes to the enhancement of immersive virtual experiences and development of devices for human augmentation.

Article 19: "Social Activity Measurement by Counting Faces Captured in First-Person View Lifelogging Video", Akane Okuno and Yasuyuki Sumi.

This paper proposes a method to measure the daily face-to-face social activity of a camera wearer by detecting faces captured in first-person view lifelogging videos. This study was inspired by pedometers used to estimate the amount of physical activity by counting the number of steps detected by accelerometers, which is effective for reflecting individual health and facilitating behavior change. We investigated whether we can estimate the amount of social activity by counting the number of faces captured in the first-person view videos like a pedometer. Our system counts not only the number of faces but also weighs in the numbers according to the size of the face (corresponding to a face's closeness) and the amount of time it was shown in the video. By doing so, we confirmed that we can measure the amount of social activity based on the quality of each interaction. For example, if we simply count the number of faces, we overestimate social activities while passing through a crowd of people. Our system, on the other hand, gives a higher score to a social actitivity even when speaking with a single person for a long time, which was also positively evaluated by experiment participants who viewed the lifelogging videos. Through evaluation experiments, many evaluators evaluated the social activity high when the camera wearer speaks. An interesting feature of the proposed system is that it can correctly evaluate such scenes higher as the camera wearer actively engages in conversations with others, even though the system does not measure the camera wearer's utterances. This is because the conversation partners tend to turn their faces towards to the camera wearer, and that increases the number of detected faces as a result. However, the present system fails to correctly estimate the depth of social activity compared to what the camera wearer recalls especially when the conversation partners are standing out of the camera's field of view. The paper briefly descibes how the results can be improved by widening the camera's field of view.

Article 20: "Augmented taste of wine by artificial climate room", Toshiharu Igarashi, Tatsuya Minagawa and Yoichi Ochiai.

In previous research, there is a augmenting device limited taste influences due to limited contact with utensils. However, in the situation such as enjoying wine while talking with other people and matching cheese with wine, the solution that limits human behaviors must not have been acceptable. So, we focused on changing the temperature and humidity when drinking wine.

To study the influence of temperature and humidity on the ingredients and subjective taste of wine, we conducted wine tasting experiments with 16 subjects using an artificial climate room. For the environmental settings, three conditions, i.e., a room temperature of 14 ℃ and humidity of 35%, 17 ℃ and 40% humidity, and 26 ℃ and 40% humidity, were evaluated. In one of the two wines used in the experiment, significant differences in [Color intensity], [Smell development] and [Body] were detected among conditions ($p < 0.05$). We further investigated changes in the components of the two wines at different temperature conditions (14 ℃, 17 ℃, 23 ℃, and 26 ℃). Malic acid, protocatechuic acid, gallic acid, and epicatechin were related to temperature in the former wine only.

In conclusion, we confirmed that we can change the taste evaluation of wine by adjusting temperature and humidity using the artificial climate room, without attaching the device to human beings themselves. This suggests the possibility to serve wine in a more optimal environment if we can identify the type of wine and person’s preference.

Article 21: "GANs-based Clothes Design: Pattern Maker Is All You Need to Design Clothing", Natsumi Kato, Hiroyuki Osone, Kotaro Oomori, Chun Wei Ooi and Yoichi Ochiai.

Machine learning have been recently applied to multiple areas, including fashion. Fashion design by generated images makes it possible to inherit design without fashion designer and get inspiration, however, little research has been done on usage of machine learning for creation of designer clothing. The state-of-the-art works aim for high-definition output images. However in fashion design image generation, it has not been thoroughly investigated to what extent the quality of the generated image should be provided to the pattern makers that draw the costume pattern from the design images. Therefore, in this paper we propose a method of generation of clothing images for pattern makers using Progressive Growing of GANs (P-GANs) and conduct a user study to investigate whether the different image quality factors such as epoch and resolution affect the participants' confidence score. We discuss the results and possible applications of the developed method.

Article 22: "Brain Computer Interface for Neurorehabilitation With Deep Learning Classification and Virtual Reality Feedback", Tamás Karácsony, Sadasivan Puthusserypady, John Paulin Hansen and Helle Klingenberg Iversen.

Though Motor Imagery (MI) stroke rehabilitation effectively promotes neural reorganization, current therapeutic methods are immeasurable and their repetitiveness can be demotivating. In this work, a real-time electroencephalogram (EEG) based MI-BCI (Brain Computer Interface) system with a virtual reality (VR) game as a motivational feedback has been developed for stroke rehabilitation. If the subject successfully hits one of the targets, it explodes and thus providing feedback on a successfully imagined and virtually executed movement of hands or feet. Novel classification algorithms with deep learning (DL) and convolutional neural network (CNN) architecture with a unique trial onset detection technique was used. Our classifiers performed better than the previous architectures on datasets from PhysioNet offline database. It provided fine classification in the real-time game setting using a 0.5 second 16 channel input for the CNN architectures. Ten participants reported the training to be interesting, fun and immersive. “It is a bit weird, because it feels like it would be my hands”, was one of the comments from a test person. The VR system induced a slight discomfort and a moderate effort for MI activations was reported. We conclude that MI-BCI-VR systems with classifiers based on DL for real-time game applications should be considered for motivating MI stroke rehabilitation.

Article 23: "SubMe: An Interactive Subtitle System with English Skill Estimation Using Eye Tracking", Katsuya Fujii and Jun Rekimoto.

Owing to the improvement in accuracy of eye tracking devices, eye gaze movements occurring while conducting tasks are now a part of physical activities that can be monitored just like other life-logging data. Analyzing eye gaze movement data to predict reading comprehension has been widely explored and researchers have proven the potential of utilizing computers to estimate the skills and expertise level of users in various categories, including language skills. However, though many researchers have worked specifically on written texts to improve the reading skills of users, little research has been conducted to analyze eye gaze movements in correlation to watching movies, a medium which is known to be a popular and successful method of studying English as it includes reading, listening, and even speaking, the later of which is attributed to language shadowing. In this research, we focus on movies with subtitles due to the fact that they are very useful in order to grasp what is occurring on screen, and therefore, overall understanding of the content. We realized that the viewers' eye gaze movements are distinct depending on their English level. After retrieving the viewers' eye gaze movement data, we implemented a machine learning algorithm to detect their English levels and created a smart subtitle system called SubMe. The goal of this research is to estimate English levels through tracking eye movement. This was conducted by allowing the users to view a movie with subtitles. Our aim is create a system that can give the user certain feedback that can help improve their English studying methods.

Article 24: "Sentiment Pen: Recognizing Emotional Granularity Based on Handwriting Features", Jiawen Han, George Chernyshov, Dingding Zheng, Peizhong Gao, Katrin Wolf and Kai Kunze.

In this paper, we discuss the assessment of the emotional state of the user from digitized handwriting for implicit human-computer interaction. The proposed concept exemplifies how a digital system could recognize the emotional context of the interaction. We discuss our approach to emotion recognition and the underlying neurophysiological mechanisms. To verify the viability of our approach, we have conducted a series of tests where participants were asked to perform simple writing tasks after being exposed to a series of emotionally-stimulating video clips from EMDB[6], one set of four clips per each quadrant on the circumplex model of emotion[28]. The user-independent Support Vector Classifier (SVC) built using the recorded data shows up to 66% accuracy for certain types of writing tasks for 1 in 4 classification (1. High Valence, High Arousal; 2. High Valence, Low Arousal; 3. Low Valence, High Arousal; 4. Low Valence, Low Arousal). In the same conditions, a user-dependent classifier reaches an average of 70% accuracy across all 12 study participants. While future work is required to improve the classification rate, this work should be seen as proof-of-concept for emotion assessment of users while handwriting aiming to motivate research on implicit interaction while writing to enable emotion-sensitivity in mobile and ubiquitous computing.

Article 25: "Automatic Smile and Frown Recognition with Kinetic Earables", Seungchul Lee, Chulhong Min, Alessandro Montanari, Akhil Mathur, Fahim Kawsar and Youngjae Chang.

In this paper, we introduce inertial signals obtained from an earable placed in the ear canal as a new compelling sensing modality for recognising two key facial expressions: smile and frown. Borrowing principles from Facial Action Coding Systems, we first demonstrate that an inertial measurement unit of an earable can capture facial muscle deformation activated by a set of temporal micro-expressions. Building on these observations, we then present three different learning schemes - shallow models with statistical features, hidden Markov model, and deep neural networks to automatically recognise smile and frown expressions from inertial signals. The experimental results show that in controlled non-conversational settings, we can identify smile and frown with high accuracy (F_1 score: 0.85).

Article 26: "Prospero: A Personal Wearable Memory Coach", Samantha Wei Ting Chan, Haimo Zhang and Suranga Nanayakkara.

Prospective memory, which involves remembering to perform intended actions, is essential for independent daily living especially as we grow older. Yet, majority of everyday memory failures are due to prospective memory lapses. Memory strategy training can help to tackle such lapses. We present Prospero, a wearable virtual memory coach that guides users to learn and apply a memory technique through conversation in natural language. Using physiological signals, Prospero proactively initiates practice of the technique during opportune times where user attention and cognitive load have more bandwidth. This could be a step towards creating more natural and effective digital memory training that could eventually reduce memory decline. In this paper, we contribute with details of its implementation and conversation design.

Article 27: "An Implicit Dialogue Injection System for Interruption Management", Tomoki Shibata, Alena Borisenko, Anzu Hakone, Tal August, Leonidas Deligiannidis, Chen--Hsiang Yu, Matthew Russell, Alex Olwal and Robert Jacob.

This paper presents our efforts in redesigning the conventional on/off interruption management tactic (a.k.a. “Do Not Disturb Mode”) for situations where interruptions are inevitable. We introduce an implicit dialogue injection system, in which the computer implicitly observes the user’s state of busyness from passive measurement of the prefrontal cortex to determine how to interrupt the user. We use functional Near-Infrared Spectroscopy (fNIRS), a non-invasive brain-sensing technique. In this paper, we describe our system architecture and report results of our proof-of-concept study, in which we compared two contrasting interruption strategies; the computer either forcibly interrupts the user with a secondary task or requests the user’s participation before presenting it. The latter yielded improved user experience (e.g. lower reported annoyance), in addition to showing a potential improvement in task performance (i.e. retaining context information) when the user was busier. We conclude that tailoring the presentation of interruptions based on real-time user state provides a step toward making computers more considerate of their users.

Article 28: "Hearing Is Believing: Synthesizing Spatial Audio from Everyday Objects to Users", Jing Yang, Yves Frank and Gábor Sörös.

The ubiquity of wearable audio devices and the importance of the auditory sense imply great potential for audio augmented reality. In this work, we propose a concept and a prototype of synthesizing spatial sounds from arbitrary real objects to users in everyday interactions, whereby all sounds are rendered directly by the user's own ear pods instead of loudspeakers on the objects. The proposed system tracks the user and the objects in real time, creates a simplified model of the environment, and generates realistic 3D audio effects. We thoroughly evaluate the usability and the usefulness of such a system based on a user study with 21 participants. We also investigate how an acoustic environment model improves the sense of engagement of the rendered 3D sounds.

Article 29: "MusiArm: Extending Prosthesis to Musical Expression", Kaito Hatakeyama, Mhd Yamen Saraiji and Kouta Minamizawa.

The emergence of prosthetic limbs where solely focused on substituting the missing limb with an artificial one, in order for the handicap people to manage their daily life independently. Past research on prosthetic hands has mainly focused on prosthesis' function and performance. Few proposals focused on the entertainment aspect of prosthetic hands. In this research, we considered the defective part as a potential margin for freely designing our bodies, and coming up with new use cases beyond the original function of the limb. Thus, we are not aiming to create anthropomorphic designs or functions of the limbs. By fusing the prosthetic hands and musical instruments, we propose a new prosthetic hand called "MusiArm" that extends the body part's function to become an instrument. MusiArm concept was developed through the dialogue between the handicapped people, engineers and prosthetists using the physical characteristics of the handicapped people as a "new value" that only the handicapped person can possess. We asked handicapped people who cannot play musical instruments, as well as people who do not usually play instruments, to use prototypes we made. As a result of the usability tests, using MusiArm, we made a part of the body function as a musical instrument, drawing out the unique expression methods of individuals, and enjoying the performance and clarify the possibility of showing interests.

Article 30: "Automatic Eyeglasses Replacement for a 3D Virtual Try-on System", Takumi Kobayashi, Yuta Sugiura, Hideo Saito and Yuji Uema.

This paper presents a 3D virtual eyeglasses try-on system for practical use. For fitting eyeglasses in a shop, consumers wish to look at themselves in a mirror while trying on various eyeglass styles. However, for people who need to wear eyeglasses for correcting problems with eyesight, it is impossible for them to clearly observe their face in the mirror without wearing eyeglasses. This makes fitting them for new eyeglasses difficult. This research proposes a virtual try-on system that can be used while wearing eyeglasses. We replace the user's eyeglasses in the input video with new eyeglasses virtually. Moreover, a fast and accurate face tracking tool enables our system to automatically display 3D virtual glasses following a user's head motion. Experimental results demonstrate that the proposed method can render virtual glasses naturally while the user is wearing real eyeglasses.

Article 31: "Effects of Monocular Laser-Based Head-Mounted Displays on Human Night Vision", Evangelos Niforatos and Mélodie Vidal.

Head-mounted displays (HMDs) are expected to dominate the market of wearable electronics in the next 5 years. This foreseen proliferation of HMDs yields a plethora of design opportunities for revolutionizing everyday life via novel use cases, but also generates a considerable number of substantial safety implications. In this work, we systematically investigated the effect of a novel monocular laser-based HMD on the ability of our participants to see in low ambient light conditions in lab settings. We recruited a total of 19 participants in two studies and performed a series of established vision tests while using the newly available Focals by North HMD. We tested our participants' night vision after being exposed to different levels of laser luminous power and laser colors while using Focals, either with one or both eyes open. Our results showcase that the image perceived by the non-exposed eye compensates for the loss of contrast sensitivity observed in the image perceived by the laser-exposed eye. This indicates that monocular laser-based HMDs, such as Focals, permit dark adaptation to occur naturally for the non-exposed eye.

Article 32: "MagniFinger: Fingertip probe microscope with direct micro movements", Noriyasu Obushi, Sohei Wakisaka, Shunichi Kasahara and Masahiko Inami.

By adulthood, our fingers have developed a high level of dexterity: sensory and motor skills that developers have only just started to make use of in modern interfaces. Previous research has unveiled the possibilities of enhancing touch modalities by introducing visual feedback of the magnified touch image. Yet, most of the microscopes on the market require a complicated procedure to operate and this makes it difficult to move the felt/observed area. To address this, we introduce MagniFinger, a new finger-based microscope that allows users to magnify the contacting surface on their fingertips using two means of control: sliding and tilting. The tilting-based control enables a more precise movement under micro-environments. According to the results of our experiments, it shortens the time of reaching targets compared to the simple sliding-based control.

Article 33: "Let Your World Open: CAVE-based Visualization Methods of Public Virtual Reality towards a Shareable VR Experience", Akira Ishii, Masaya Tsuruta, Ippei Suzuki, Shuta Nakamae, Junichi Suzuki and Yoichi Ochiai.

Virtual reality (VR) games are currently becoming part of the public-space entertainment (e.g., VR amusement parks). Therefore, VR games should be attractive for players, as well as for bystanders. Current VR systems are still mostly focused on enhancing the experience of the head-mounted display (HMD) users; thus, bystanders without an HMD cannot enjoy the experience together with the HMD users. We propose the "ReverseCAVE": a proof-of-concept prototype for public VR visualization using CAVE-based projection with translucent screens for bystanders toward a shareable VR experience. The screens surround the HMD user and the VR environment is projected onto the screens. This enables the bystanders to see the HMD user and the VR environment simultaneously. We designed and implemented the ReverseCAVE, and evaluated it in terms of the degree of attention, attractiveness, enjoyment, and shareability, assuming that it is used in a public space. Thus, we can make the VR world more accessible and enhance the public VR experience of the bystanders via the ReverseCAVE.

Article 34: "Double Shellf: What Psychological Effects can be Caused through Interaction with a Doppelganger?", Yuji Hatada, Shigeo Yoshida, Takuji Natumi and Michitaka Hirose.

Advances in 3D capture technology have made it easier to generate a realistic avatar, which can represent a person in virtual environments. Because avatars can be easily duplicated in the virtual environments, there can be an unrealistic situation where a person sees her/his own doppelgangers. Doppelganger is a double of a person and sometimes portrayed as a sinister existence. To investigate how people feel and react when they face their doppelgangers, we developed "Double Shellf", a virtual reality experience in which people can interact with their virtual doppelgangers in various situations. In this paper, we introduce the design of Double Shellf and discuss the reactions of 86 users. The user study revealed that most people felt intense eeriness when they see their doppelgangers which acts autonomously and when they were touched by their doppelgangers. We also found that there is a gender difference in reactions to their doppelgangers. We explore the effective way of utilizing doppelgangers.

Article 35: "Augmenting Human with A Tail", Haoran Xie, Kento Mitsuhashi and Takuma Torii.

Human-augmentation devices have been extensively proposed and developed recently and are useful in improving our work efficiency and our quality of life. Inspired by animal tails, this study aims to propose a wearable and functional tail device that combines physical and emotional-augmentation modes. In the physical-augmentation mode, the proposed device can be transformed into a consolidated state to support a user's weight, similar to a kangaroo's tail. In the emotional-augmentation mode, the proposed device can help users express their emotions, which are realized by different tail-motion patterns. For our initial prototype, we developed technical features that can support the weight of an adult, and we performed a perceptional investigation of the relations between the tail movements and the corresponding perceptual impressions. Using the animal-tail analog, the proposed device may be able to help the human user in both physical and emotional ways.

Article 36: "Prosthetic Tail: Artificial Anthropomorphic Tail for Extending Innate Body Functions", Junichi Nabeshima, Mhd Yamen Saraiji and Kouta Minamizawa.

For most mammals and vertebrate animals, tail plays an important role for their body providing variant functions to expand their mobility, or as a limb that allows manipulation and gripping. In this paper, we propose an exploratory biomimicry-inspired anthropomorphic tail design to allow engineering and expanding human body functions. The proposed tail consists of adjacent joints with a spring-based structure to handle shearing and tangential forces, and allow managing the length and weight of the target tail. The internal structure of the tail is driven by four pneumatic artificial muscles providing the actuation mechanism for the tail tip. Here we describe the design and implementation process, and highlight potential applications for using such prosthetic tail.

Article 37: "Orochi: Investigating Requirements and Expectations for Multipurpose Daily Used Supernumerary Robotic Limbs", Mohammed Al-Sada, Thomas Höglund, Mohamed Khamis, Jaryd Urbani and Tatsuo Nakajima.

Supernumerary robotic limbs (SRLs) present many opportunities for daily use. However, their obtrusiveness and limitations in interaction genericity hinder their daily use. To address challenges of daily use, we extracted three design considerations from previous literature and embodied them in a wearable we call Orochi. The considerations include the following: 1) multipurpose use, 2) wearability by context, and 3) unobtrusiveness in public. We implemented Orochi as a snake-shaped robot with 25 DoFs and two end effectors, and demonstrated several novel interactions enabled by its limber design. Using Orochi, we conducted hands-on focus groups to explore how multipurpose SRLs are used daily and we conducted a survey to explore how they are perceived when used in public. Participants approved Orochi's design and proposed different use cases and postures in which it could be worn. Orochi's unobtrusive design was generally well received, yet novel interactions raise several challenges for social acceptance. We discuss the significance of our results by highlighting future research opportunities based on the design, implementation, and evaluation of Orochi.

Article 38: "Naviarm: Augmenting the Learning of Motor Skills using a Backpack-type Robotic Arm System", Azumi Maekawa, Shota Takahashi, Mhd Yamen Saraiji, Sohei Wakisaka, Hiroyasu Iwata and Masahiko Inami.

We present a wearable haptic assistance robotic system for augmented motor learning called Naviarm. This system comprises two robotic arms that are mounted on a user's body and are used to transfer one person's motion to another offline. Naviarm pre-records the arm motion trajectories of an expert via the mounted robotic arms and then plays back these recorded trajectories to share the expert's body motion with a beginner. The Naviarm system is an ungrounded system and provides mobility for the user to conduct a variety of motions. In this paper, we focus on the temporal aspect of motor skill and use a mime performance as a case study learning task. We verified the system effectiveness for motor learning using the conducted experiments. The results suggest that the proposed system has benefits for learning sequential skills.

Article 39: "BitoBody: Real-time human contact detection and dynamic projection system", Erwin Wu, Mitski Piekenbrock and Hideki Koike.

In this research, we propose a novel human body contact detection and projection system with dynamic mesh collider. We use motion capture camera and generated human 3D models to detect the contact between user's bodies. Since it is difficult to update human mesh collider every frame, a special algorithm that divides body meshes into small pieces of polygons to do collision detection is developed and detected hit information will be dynamically projected according to its magnitude of damage. The maximum deviation of damage projection is about 7.9cm under a 240-fps optitrack motion capture system and 12.0cm under a 30-fps Kinect camera. The proposed system can be used in various sports where bodies come in contact and it allows the audience and players to understand the context easier.

Article 40: "CompoundDome:A wearable dome device that enables interaction with the real world by partially transmitting the screen", Eriko Maruyama and Jun Rekimoto.

The head-mounted display (HMD) is widely used as a method to experience virtual space. However, HMD has problems in mounting, such as skin touching the equipment used by others, functional issues such as easy to induce VR sickness. In this research, we propose a wearable dome device named "CompoundDome", which enables interaction with the real world by projecting images on the dome. In our system, we used a 600 mm diameter dome, and a projector projects images to the dome to cover the wearer's field of view. With this configuration, the equipment does not touch the skin, and motion sickness can be reduced. HMD also lacks in providing face-to-face communication, because it hides user's face. In addition, the wearer can not see the outside when wearing the HMD. Hence, we applied screen paint to the transparent dome in a mesh form. With this configuration, users can see the image when the image is projected, and they can see the outside of the dome when the image is not projected. Furthermore, users and the surrounding people can make face to face communication by photographing the face with the camera installed in the dome and projecting the face in the virtual space. In this paper, we describe the composition of CompoundDome, in comparison with other virtual space presentation means, and various applications enabled by CompoundDome.

Article 41: "Investigating Universal Appliance Control through Wearable Augmented Reality", Vincent Becker, Felix Rauchenstein and Gábor Sörös.

The number of interconnected devices around us is constantly growing. However, it may become challenging to control all these devices when control interfaces are distributed over mechanical elements, apps, and configuration webpages. We investigate interaction methods for smart devices in augmented reality. The physical objects are augmented with interaction widgets, which are generated on demand and represent the connected devices along with their adjustable parameters. For example, a loudspeaker can be overlaid with a controller widget for its volume. We explore three ways of manipulating the virtual widgets: (a) in-air finger pinching and sliding, (b) whole arm gestures rotating and waving, (c) incorporating physical objects in the surrounding and mapping their movements to the interaction primitives. We compare these methods in a user study with 25 participants and find significant differences in the preference of the users, the speed of executing commands, and the granularity of the type of control.

Article 42: "CapMat: Smart Foot Mat for User Authentication", Denys J.C. Matthies, Don Samitha Elvitigala, Sachith Muthukumarana, Jochen Huber and Suranga Nanayakkara.

We present CapMat, a smart foot mat that enables user identification, supporting applications such as multi-layer authentication. CapMat leverages a large form factor capacitive sensor to capture shoe sole images. These images vary based on shoe form factors, the individual wear, and the user's weight. In a preliminary evaluation, we distinguished 15 users with an accuracy of up to 100%.

Article 43: "CricketCoach: Towards Creating a Better Awareness of Gripping Forces for Cricketers", Sachith Muthukumarana, Denys J.C. Matthies, Chamod Weerasinghe, Don Samitha Elvitigala and Suranga Nanayakkara.

In this paper, we demonstrate a smart system that creates awareness of the hand-grip force for cricket players. A custom Force-Sensitive Resistor (FSR) matrix is attached to the bat's handle to sense the gripping. Two wrist bands, incorporating vibration motors, provide feedback that helps non-expert users to understand the relative forces exerted by each hand while performing a stroke. A preliminary user study was conducted to collect first insights.

Article 44: "Second Language Vocabulary Learning While Walking", Shogo Fukushima, Ari Hautasaari and Takeo Hamada.

Second language (L2) learners often lack opportunities or motivation to dedicate their time to vocabulary learning over other daily activities. In this work, we introduce a mobile application that allows L2 learners to instead leverage their "dead time", such as when walking to and from school or work, to study new vocabulary items. The application combines audio learning and location-based contextually relevant L1-L2 word pairs to allow L2 learners to "discover" new foreign language words while walking. We report on the evaluation of the approach from three aspects: L2 vocabulary retention after 1 month, system usability and workload.

Article 45: "Build your Own! Open-Source VR Shoes for Unity3D", Jens Reinhardt, Eike Lewandowski and Katrin Wolf.

Hand-held controllers enable all kinds of interaction in Virtual Reality (VR), such as object manipulation as well as for locomotion. VR shoes allow using the hand exclusively for naturally manual tasks, such as object manipulation, while locomotion could be realized through feet input – just like in the physical world. While hand-held VR controllers became standard input devices for consumer VR products, VR shoes are only barely available, and also research on that input modality remains open questions. We contribute here with open-source VR shoes and describe how to build and implement them as Unity3D input device. We hope to support researchers in VR research and practitioners in VR product design to increase usability and natural interaction in VR.

Article 46: "Design of Enhanced Flashcards for Second Language Vocabulary Learning with Emotional Binaural Narration", Shogo Fukushima.

In this paper, we report on the design of a flashcard application with which learners experience the meaning of written words with emotional binaural voice narrations to enhance second language vocabulary learning. Typically, voice used in English vocabulary learning is recorded by a native speaker with no accent, and it aims for accurate pronunciation and clarity. However, the voice can also be flat and monotonous, and it can be difficult for learners to retain the new vocabulary in the semantic memory. Enhancing textual flashcards with emotional narration in the learner's native language helps the retention of new second language vocabulary items in the episodic memory instead of the semantic memory. Further, greater emotionality in the narration reinforces the retention of episodic memory.

Article 47: "AR Pottery Wheel-Throwing by Attaching Omnidirectional Camera to the Center of the User's Palms", Yusuke Maruyama and Yasuyuki Kono.

This research describes our system for AR pottery wheel-throwing employing an HMD and omnidirectional cameras each of which is attached to the center of a user’s palm. The omnidirectional cameras enable the user’s finger postures and the three-dimensional relative position and orientation between the user’s hands and virtual clay model on the wheel to be estimated. Our system detects a marker on the desk and the wheel is set on its coordinate system along with the finger posture estimation in real time. The system then simulates the collision between the virtual clay model and the left/right hand model based on the above information. Pottery wheel-throwing is reproduced in Unity software environment by deforming the clay model by contact with hand models in this simulation.

Article 48: "Demonstrating Naviarm: Augmenting the Learning of Motor Skills using a Backpack-type Robotic Arm System", Azumi Maekawa, Shota Takahashi, Mhd Yamen Saraiji, Sohei Wakisaka, Hiroyasu Iwata and Masahiko Inami.

We present a wearable haptic assistance robotic system for augmented motor learning called Naviarm. This system comprises two robotic arms that are mounted on a user's body and are used to transfer one person's motion to another offline. Naviarm pre-records the arm motion trajectories of an expert via the mounted robotic arms and then plays back these recorded trajectories to share the expert's body motion with a beginner. The Naviarm system is an ungrounded system and provides mobility for the user to conduct a variety of motions. In our demonstration, the user will experience the recording of arm movement with backpack-type robotic arm. Then, the recorded movement will replayed and the user can experience the haptic feedback.