WESTERN SYDNEY UNIVERSITY

MARCS Institute

Summer Scholarship Research Program 2020

Project Lists

Project 61: Virtual Reality Rehabilitation for people with a brain injury

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Project description

After a brain injury many people suffer from substantially reduced body mobility and require routine training for performing simple tasks such as reaching for an object, grabbing an object, etc. These tasks are both mundane and challenging at the same time. Performing many repetitions can be very frustrating and demoralising. Our approach is to gamify this experience with Virtual Reality. Under supervision from Liverpool Hospital rehabilitation staff the student will participate in developing a Virtual Reality rehabilitation environment for people with brain injury.

Project Aims

The aim of the project is to develop an interactive Virtual Reality environment suitable for training people with a brain injury.

Project Methods

The student would be developing the prototype in the Unity environment. Student's task will be to interact with Liverpool Hospital staff and translate their requirements into 3D models and code. Conducting the study related to the effectiveness of this prototype is outside the scope of this project.

Opportunity for Skill Development

The student would learn how to develop a Virtual Reality simulation in Unity and how to understand requirements of medical practitioners into a software prototype.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

Good programming Skills and basic knowledge of Unity are essential. 3D modelling experience is a plus.

Project 62: Digital technologies that support memory

Supervisor(s): Celia Harris - celia.harris@westernsydney.edu.au
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Project description

A large literature in psychogerontology focuses on the "memory compensation strategies" used by older adults, which include asking them about external tools like diaries and calendars they use to support their day to day memory function. In experimental psychology, some research has examined how taking digital photos or storing information impairs later memory for it, but also how automatic "lifelogging" cameras can be used as memory prostheses especially for people with memory impairments. And in aged care, novel technologies are used to support reminiscing in people with dementia. There are currently therefore mixed approaches and mixed findings on whether, how, and for who digital technologies might support memory, and measures of memory compensation strategies have not yet been updated for the digital age and particularly smart phones as a memory device. The aim of this project is to review and summarise the different literature on digital and non-digital memory supports. We will use this knowledge to develop and pilot a new questionnaire measure of memory compensation, that updates the existing measure to include digital technologies.

Project Aims

1. Review the literature on memory compensation strategies that older adults use; taxonomies what kinds of tools have been studied in the context of different kinds of memory tasks (e.g. calendars for supporting prospective memory tasks).
2. Compare the taxonomy developed to the memory compensation questionnaire to identify whether it asks older adults about support strategies for the full range of memory tasks
3. Create an adapted version of the questionnaire which asks open-ended questions about how older adults might support different kinds of everyday tasks
4. Measure the frequency with which older adults report using non-digital tools (diaries, calendars, photo albums) vs. digital tools (smartphone reminders, automation, digital photo displays) to support their remembering.
5. Update the memory compensation questionnaire to cover a fuller range of remembering tasks and memory compensations strategies including digital technologies.

Project Methods

There are two main components of the project that the intern will be involved in. The first component involves contributing to a literature review on the use of digital technologies as memory aids, determining

1. What kinds of memory tasks;
2. What kinds of technologies have been developed; and
3. For what populations/end-users.

Secondly, based on the findings of the literature review, the intern will be involved in conducting a survey to ask older adults about the supports they use for different kinds of memory tasks, so we can learn about the full range of non-technological and technological memory compensation strategies. We will use these findings to develop a new version of the Memory Compensation Questionnaire that is updated for the digital age, and includes a fuller range of memory supports and memory tasks.

Opportunity for Skill Development

The intern will gain general skills in searching and synthesising academic literature, as well as in conducting survey research with human subjects and coding, scoring, and interpreting results. They will gain specific knowledge in the area of ageing and memory, and ways of compensating for memory impairments that develop in older age.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

The student will be required to have a basic understanding of how to search for scientific literature, survey research methods, and using Excel to display data and calculate means (the student will be supported and mentored in the conduct of the specific project).

Project 63: Characterisation of event-based sensors

Supervisor(s): Damien Joubert - D.Joubert@westernsydney.edu.au
Principal Supervisor

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Second Supervisor

Project description

The monitoring of satellites in orbit around Earth is becoming an increasingly challenging task as the number of these objects soars. New cameras are necessary to detect and track them, and the silicon retinas, or event sensors, have shown promising advantages over other sensing methods. The International Centre for Neuromorphic Systems (ICNS) is developing its own event sensors thanks to grants from the Defence Innovation Hub (DIH) and is designing a module for the International Space Station to host event cameras and validate their capabilities. These new sensing devices require unconventional characterization method to optimize their performances. A silicon retina uses more than 20 parameters to behave properly, whose value could critically change the data generated. This internship aims at developing the methods to understand the influence of these parameters, or biases, and optimize them. Currently, these parameters are set according to conventional metrics like the Signal to Noise Ratio (SNR), the sensitivity, the background noise and the latency. For a given application, it's difficult to determinate which feature prevails on the others. The internship will also enquire how to include the characterization in a final application to observe how the different features of the sensor are optimized compared to the conventional metrics. This could be done for example by closing the loop of the system moving a motor to follow a target. The characterization is indeed between the design of a sensor and the design of the algorithms and then provides indicators to both different fields to improve a final perception system.

Project Aims

The characterization and the optimization of a conventional sensor involves hundreds of engineers from manufacturers like Sony, Samsung, ST Microelectronics etc. Full characterization of a sensor requires a significant engineering efforts, and the aim of this project is not to achieve a comprehensive optimization. However, through simple experiments, this internship will explore which parameters might be more critical than some others. The final goal is then to provide feedback to the hardware design team, who are currently building the sensors at ICNS, in order to improve the design of the next round of fabrication of our next generation of sensors. The purpose of this internship aims to help implement, describe and summarize the result of the characterization experiments to build better event cameras for space applications.

Project Methods

The student will work alongside the researchers of ICNS who are currently working on sensor characterisation. After few weeks during which the student will be shown the entire pipeline of characterizations that have already been implemented in the optics laboratory, the student will try to reproduce basic experiments to demonstrate understanding of the different components of the system. The following step will include more experiments as well as continuous discussions with researchers in the algorithm and hardware design teams to deliver feedback concerning the results obtained.

The final supervisor will meet the student twice a week between 30 and 60 minutes to organise the experiments, provide feedback and monitor the student's progress.

A more detailed planning will be provided at the beginning of the internship to adjust the planning to the last milestones of the characterization project.

Opportunity for Skill Development

The student will develop skills in sensor characterization, which includes:

- Understanding the physic of the light and the radiometry
- Understanding the physic of the semiconductors to analyse the data produced by the sensors
- Understanding event vision and its differences compared to conventional imaging

Students are required to have the following skills/meet the following pre-requisite(s) to apply

- Background in electrical, electronics, and computer science engineering.
- Knowledge in project management, software development, and a taste for experiments.

Project 64: HASEL Actuator for pumps and prostheses

Supervisor(s): Gaetano Gargiulo - g.gargiulo@westernsydney.edu.au
Principal Supervisor

Upul Gunawardana - u.gunawardana@westernsydney.edu.au
Second Supervisor

Project description

This project aims to test feasibility of HASEL actuators in prosthesis. Specifically, the project will assess implementation of pump/squeezing actuators that can be implemented as grasping actuators as well as circulatory aid i.e. embedded in pressure bandages, pressure cuffs etc.

A HASEL actuator is a soft actuator either fluidic actuators or dielectric elastomer actuators. A HASEL actuator utilize a pressurized fluid (usually air or water) to drive shape change of a deformable architecture (usually based on flexible or stretchable polymers). This project will largely involve Finite Element Modelling and Electrical Modelling to design and virtually prototype a fully functional actuator focusing on the “squeeze” action.

Project Aims

This project aims to simulate and develop an HASEL actuator to be employed as artificial muscle in a prosthesis and or as pump/pressure cuff for the monitoring of a prosthesis socket/biomedical apparatus.

Project Methods

Soft actuators that mimic the universal performance of natural muscle (HASEL) are critical components for creating the next generation of prosthesis/biomedical actuators that achieve levels of functionality seen only in biological systems. These soft actuators either fluidic actuators or dielectric elastomer actuators. utilize a pressurized fluid (usually air or water) to drive shape change of a deformable architecture (usually based on flexible or stretchable polymers). With this project the best structure to achieve a squeezing action suitable for grasping of small object/pumping of small fluid volume will be investigated. Methods will include:

- Critical analysis of low cost manufacture of electro-mechanical parts and components
- Low computational load closed loop actuator control
- Finite Element Analysis of proposed structure
- Literature review targeting the existing structures for the grasp and pump action.

Opportunity for Skill Development

- Finite element simulation (FEM)
- Advanced electronic/control design
- Advanced circuit manufacturing
- Advanced Matlab programming

Students are required to have the following skills/meet the following pre-requisite(s) to apply

- Electronic design skills
- Matlab and general programming skills.

Project 65: Using creative arts to cope in changing times

Supervisor(s): Jennifer MacRitchie - j.macritchie@westernsydney.edu.au
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Second Supervisor

Project description

In the current backdrop of Australia in 2020, Australian individuals and communities have had to adjust to rapidly changing circumstances with various events including bushfires, drought, floods and social isolation from COVID-19. However, the creative arts appear to be providing an avenue for coping with these changes. The Australian Audience Outlook Monitor data (collected in May 2020) confirms that 46% of participants (drawn from arts audiences) are engaging in arts activities more frequently in social isolation and 75% participating in online arts activities. People who engage with the creative arts are doing so for the purposes of encouraging general wellbeing, and maintaining social contact with others. Engaging in the arts, as well as a range of other activities that provide stimulating mental challenge and/or an avenue to appreciate life is understood to contribute to wellbeing and reduced posttraumatic stress.

Researchers at Western Sydney University across the Schools of Psychology, Education, and Humanities and Communication Arts are collaborating to explore how we use the creative arts (e.g. music, dance, art, crafting, making) as tools to build connectedness to people and place in these changing environments. As part of extending current international work, we aim to understand the relationship between engagement in these arts practices and the individual, particularly for Australia.

This internship will focus on distributing and analysing results from a nationwide survey capturing how Australians are engaging with the arts, their digital access, and how this might relate to information about individuals' personality and coping strategies.

Project Aims

Our main research questions are:

- How are the creative arts used to help us adapt to a changing world and facilitate cultural wellbeing?
- Is the usage of creative arts in relation to changes to lifestyle and circumstances resulting from worldwide events (e.g. COVID-19, bushfire, floods)?

Project Methods

The project includes distribution of an online survey (quantitative and qualitative data) to the general population of Australia (aged 18+) with questions on

- General demographics,
- Digital access,
- Engagement in the arts and
- Personality and coping styles.

The student will be involved in the recruitment strategy for the survey, as well as conducting analysis of data, guided by the supervisors. If time allows, this may be supplemented by developing questions for follow-up interviews.

Opportunity for Skill Development

Students will learn about research design, particularly how to develop research questions and hypotheses, as well as ensuring that these are properly tested once data has been collected, and how to interpret these results in the wider literature. This will be a valuable experience for any student progressing onto Honours research or further HDR work in any field as these skills are crucial to completing a successful research project.

The successful student will have the opportunity to continue with this project after the internship has been completed in helping to disseminate the results of this research through conference presentations and journal articles.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

Any student will be able to apply for this internship – no previous knowledge or experience of the creative arts is required, although it would benefit if the student has an interest in creative arts. Reasonable computer skills will be desirable as the survey is likely to be distributed using an online system and analysis techniques performed through excel (no specific knowledge of these techniques required as a pre-requisite). These specific computer and analysis skills can be learned at the time if needed.

Project 66: Developing and evaluating a citizen science project in language sciences and education

Supervisor(s): Mark Richards - m.richards@westernsydney.edu.au
Principal Supervisor

Erin Mackenzie - e.mackenzie@westernsydney.edu.au
Second Supervisor

Project description

This project is framed within the context of Citizen Science, the 'public participation and collaboration in scientific research with the aim to increase scientific knowledge. It's a great way to harness community skills and passion to fuel the capacity of science to answer our questions about the world and how it works' (https://citizenscience.org.au/who-we-are/). We are seeking to engage with and harness the skills of older members of the public who are not trained in linguistics but have an interest in language or language revitalisation (for example, retired language teachers), to help with editing a set of archival recordings of Mangarrayi (an Aboriginal language from the Northern Territory) into smaller chunks containing potentially useful phrases. The audio chunks will contribute to a bank of Mangarrayi audio phrases for a language learning app being developed in conjunction with the Jilkminggan community. The Summer Scholar will play a crucial role in the development and evaluation of a resource kit that will guide participants through the necessary steps to convert longer archival recordings into smaller chunks that can be used in the app. The Summer Scholar will first experience the project from the point of view of a citizen scientist, going through the process of editing the recordings themselves. Using this experience, they will create materials to communicate the project efficiently and effectively to prospective participants; for example, by creating advertising materials and tutorial videos. The Scholar will then test these materials with one or more citizen scientists, and receive feedback on the effectiveness and usability of the materials. From this, they will write a short report on the project with a clearly written methodology section that could contribute to a journal article on the project, on which they would be credited as co-author. By the end of the project, the Scholar will have developed and tested a citizen scientist toolkit that will significantly contribute to the development of content for the Mangarrayi learning app as well as providing a model for other communities interested in developing audio content for learning resources in their language.

Project Aims

- Develop a resource kit to support older citizen scientists to complete the task of editing a set of archival recordings of Mangarrayi to capture smaller phrases and attribute a meaning
- Maintain and strengthen cognitive skills and a sense of social worth in older Australian 'citizen scientists' through engaging them in a meaningful real world task making a contribution to the revitalisation of Mangarrayi
- Increase speed of editing specified corpus of archival audio recordings to increase the number and range of captured audio exemplars
- Provide a model process that could be extended to other archival audio corpora and other Aboriginal and Torres Strait Islander languages

Project Methods

The project is divided into three phases.

Phase 1: Presentation and training

- Presentation of project and initial training in use of Audacity audio editing program and procedure for editing audio chunks
- Student to practise segmenting some files and identifying meaning from the recording, initially with support (transcriptions and feedback from supervisor) then more independently
- Student to write a personal reflection about their own experience, how easy/hard it was, how motivating it was etc.

Phase 2: Resource kit development

- Use the experience from Phase 1 to create and edit a short video resource appropriate in an online context to explain and demonstrate the task. The design should use creative and engaging strategies appropriate to the target group to clearly and effectively guide users through all aspects of the task.
- Student to write a short personal reflection on the process of developing the resource kit – challenges, decisions that had to be made, lessons learnt etc

Phase 3: Case study

- Student to write up an advertisement calling for volunteers to try the toolkit in which they explain the concept of citizen science and what participants are required to do
- Communicate with potential participant(s) to get the resource kit to them
- Develop a short semi-structured questionnaire that would allow the participant to give feedback on the process
- Write a clearly written methodology section that could contribute to a journal article on the project. they would be credited as co-author.

Opportunity for Skill Development

- Oral and written communication skills:
    - Clear and engaging explanation and demonstration through video resource
    - Communicate with potential participants
    - Write reflections, advertisement and final report
- Research skills:
    - Develop a simple case study
    - Develop a semi-structured questionnaire
    - Write up clear methodology section
- Digital editing skills
    - Develop audio editing skills using Audacity
    - Apply / develop video editing skills
- Linguistic skills:
    - Increased knowledge and understanding of language revitalisation context
    - Develop basic skills of analysing an unfamiliar language

Students are required to have the following skills/meet the following pre-requisite(s) to apply

- Students of Aboriginal or Torres Strait Islander heritage are strongly encouraged to apply, as their cultural and linguistic background knowledge will provide some advantage in using the contextual Aboriginal English / Kriol information on the recordings to decode the Mangarrayi.
- Students studying Education, Languages or Linguistics are likely to have skills relevant to this project.

Project 67: Long range drone tracking and characterisation using neuromorphic event-based cameras

Supervisor(s): Gregory Cohen - g.cohen@westernsydney.edu.au
Principal Supervisor

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Second Supervisor

Project description

Detecting and tracking drones at distance is a pressing concern for authorities in modern cities due to the threat they pose to nearby aircraft and infrastructure. Drone tracking is a challenging task, especially in urban environments, given that drones are small, capable of high-speed flight and complex manoeuvring. Additionally, aerial monitoring systems are typically required to detect these objects at ranges up to 4km from an exclusion zone and must also discriminate between distractors such as birds and other aircraft. Conventional image sensors currently struggle with this task; as high-speed tracking often results in poor imaging data due to the inherent motion blur of frame-based cameras.

At the International Centre for Neuromorphic Systems (ICNS), biologically inspired neuromorphic image sensors or “event-based sensors” are used as alternatives to conventional sensing. These event-based sensors operate at significantly higher speeds than conventional sensors, consume less power and produce less data. The researchers at ICNS have demonstrated the use of these sensors for novel applications, such as space imaging (Cohen et al. 2019) and in aircraft imaging (Afshar et al. 2019, Ralph et al. 2019).

Students will be required to use two existing neuromorphic imaging systems based at Werrington South ICNS to investigate this tracking task. The final system will feature a scanning wide Field Of View (FOV) system to first detect aerial objects at distance and then the “Astrosite” mobile containerised telescope observatory platform as a second narrow FOV telescope system to characterise the magnified features of the aerial object. The image systems and algorithms required to perform the detection and characterisation have been established at ICNS, the main task is in coordinating these existing systems and algorithms to solve this urban drone tracking problem.

Project Aims

The aim of this project are:

1. To investigate solutions to drone tracking in urban cities using an established neuromorphic event-based imaging system and various image processing methods.
2. Coordinate the existing imaging systems at ICNS to:
    a. Detect aerial objects at distance using an established detection algorithm and a wide FOV scanning imaging system
    b. Track detected objects using the Astrosite’s telescopic imaging system
    c. Characterise objects based on their features using an established classification algorithm

Project Methods

1. Research the fundamentals of the event-based camera's operation
2. Interface with the existing neuromorphic imaging systems at ICNS
3. Communicate detections from a scanning wide field of view imaging system to the Astrosite telescope imaging system
4. Interface with the Astrosite telescope
5. Actively track the detected object using the Astrosite imaging system
6. Work with the project supervisors to build a preliminary system for characterising detected objects as birds, drones or aircraft

As a preliminary study, most aerial objects recorded in this project will be commercial aircraft travelling overhead or artificial stimulus.

Opportunity for Skill Development

This project will allow the student to become familiar with the principles of neuromorphic engineering, more specifically the principles of event-based vision. The student will strengthen their general skills in instrumentation, computer vision and applied control theory.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

Students are recommended to have a basic understanding of computer vision and instrumentation. Moderate experience in programming is recommended. Either python, matlab or C++ is ideal. Students from computer science or engineering are encouraged to apply.

Project 68: The impact of music and musical abilities on word learning

Supervisor(s): Paola Escudero - paola.escudero@westernsydney.edu.au
Principal Supervisor

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Second Supervisor

Project description

A growing body of literature has examined the possible benefits of musical abilities on non-musical cognitive domains, including linguistic abilities and phonological encoding abilities (Zeromskaite, 2014). The latter have been found to be important for the development of reading and writing (Patcheke, Degé, and Schwarzer, 2016). Acquiring awareness of the novel phonological units of a second language is a difficult but essential skill. Music training has been found to help phonological awareness in 4- to 6-year old children of immigrant families learning a second language (Patcheke, Degé, and Schwarzer, 2016); furthermore, adults with higher musical abilities are better able to detect lexical tone variation than non-musical adults (Zeromskaite, 2014). However, most research has focused on explicit learning tasks when comparing linguistic and musical abilities so very little is known about the role of musical abilities for the implicit learning of language. Although a variety of studies have looked at implicit word learning to demonstrate implicit learning for different types of language learners (such as young infants, children and adults, and L2 learners, Escudero et al., 2016a; 2016b; Mulak et al., 2019; Smith, 2008; Suanda, 2014; Yu, 2007), none of these have incorporated musical interventions or analyses of participants' musical experience and expertise.

Current studies have looked at implicit word learning in a unimodal setting, with participants tested in a soundproof lab environment without distractions. However, implicit word learning in daily life occurs in a variety of environments very different to the lab, often including surrounding sounds and background noise (such as music). For example, a child will acquire new vocabulary in a dynamic environment with other speakers present, possibly music playing in the background or will acquire new words implicitly through music (by listening to the lyrics of a song). There is no consensus on the influence of background music on learning and, to our knowledge, no studies have looked at implicit word learning in relation to music. We are, therefore, interested in the effects of music on implicit word learning. We will conduct a series of online experiments testing the influence of background music or noise on implicit word learning. Participants will be doing an implicit word learning task on an online platform while musical stimuli will be played in the background. It is also suggested that musical abilities are beneficial for language learning, therefore we are also interested in testing whether individuals with higher musical abilities are performing better in the task, which with the Goldsmiths' Musical Sophistication Index questionnaire (Müllensiefen et al., 2016).

This study is of particular relevance for education research in the current situation with COVID-19, where an increasing number of children and students are learning outside of their school environment, thereby dealing with more background sounds while learning, such as listening to music. Obtaining a better understanding of how learning experiences are impacted by background sounds or music, and how it may be possible to improve learning by incorporating music, will be beneficial for these students' well-being. As this study will be conducted online, we will be able to test learners in their own environments. By conducting online research, this study will help to inform and train researchers on the new ways of collecting high-impact cognitive and perception

research in the current COVID-19 situation, that involve language, arts, telecommunication and music.

Project Aims

Previous research has established that music and musical abilities can be beneficial for the development of non-musical cognitive domains, for example linguistic and phonological encoding abilities. Here, we will investigate whether language learning processes are similar to those of music; whether such processes are affected by music; and whether they are facilitated by musical abilities. So far, research has mostly used explicit learning methods; instead, we will investigate the effect of music and musical abilities on implicit language learning. In order to achieve this, we will expand current implicit learning paradigms by adding musical components and by testing whether participants' musical abilities impact performance in the tasks. The results of this research will uncover useful learning strategies that can be applied for educational development.

Project Methods

The student will be shown how to conduct a literature review. The data collection for this research involves online testing using the platforms Zoom, Pavlovia and Qualtrics. The student will be asked to help with this data collection. As the testing takes place online, the student can do this from their home office. The data will then subsequently need to be sorted in Excel.

Opportunity for Skill Development

The student will gain insight into scientific methods and experimental design. The student will be able to experience a research project from beginning until the interpretation of the results and will be involved in all the in-between steps. This includes learning to conduct a literature review, data collection, and data analysis.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

There are no specific skills required for the student, but experience with psycholinguistic research online is desirable. The computer software involved in the project can be learned easily.

Project 69: Using computer vision to analyse interpersonal coordination between mothers and babies

Supervisor(s): Peter Keller - p.keller@westernsydney.edu.au
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Second Supervisor

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Third Supervisor

Project description

Movement is an integral aspect of how humans communicate with each other when face-to-face. The movement's interpersonal timing and contours carries emotional and cognitive meaning. We are interested in the very beginnings of this human meaning-making during the playful interactions of mothers with their babies. The project will investigate these interactions using computer vision techniques implemented in the software OpenPose. OpenPose is a real-time multi-person key point detection library for body, face, hands and foot estimation. We will use OpenPose to detect the movement from pre-recorded videos of mother and babies as the mother sings and chats with her baby with the aim of better understanding the music- and dance-like dynamics of this interaction.

Project Aims

- To use computer vision techniques to investigate the beginnings of human meaning making during the playful interactions of mothers with their babies in existing video recordings from the MARCS BabyLab.
- To develop a software pipeline based on established techniques for capturing key features of interpersonal coordination, and apply this pipeline in the domain of mother-infant interaction.

Project Methods

The student will assist in developing a software pipeline for video analysis of mother-infant interaction using OpenPose and either the R or Python programming language. The videos of mother-infant interaction (mothers speaking or singing to their babies) have already been recorded in the MARCS BabyLab. A first step will involve synchronising the different video angles, and then using multiple angles to track a baby's and mother's movements. A second step will be to conduct computer vision based video analysis with OpenPose to identify body segments in the videos. A third step will involve exporting the movement data from OpenPose and creating data structures using R or Python. A final step will be applying filters to the data and extracting statistical parameters including quantity of motion and measures of interpersonal coordination in R or Python. These steps are aligned with a project currently being conducted with collaborators at the University of Genoa in Italy, albeit in a different behavioural domain (musical group interaction). Therefore, the feasibility of meeting the technical demands of the proposed student project is ensured.

Opportunity for Skill Development

This project will allow the student to develop technical skills in the analysis of human movement. These skills are relevant in diverse domains ranging from psychological research on human communication to applied fields including medical diagnosis, virtual reality, robotics, and security surveillance.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

- Background in computer science or engineering
- Programming experience with R or Python

Project 70: Honey Bee Waggle Dance Detection via Neuromorphic Vision Algorithms

Supervisor(s): Saeed Afshar - s.afshar@westernsydney.edu.au
Principal Supervisor

James Makinson - j.makinson@westernsydney.edu.au
Second Supervisor

Project description

Honey bees are the only animal besides humans that is known to possess a referential communication system, called the waggle dance. Using the waggle dance, honey bees communicate the direction, distance and perceived quality of resources such as patches of flowers yielding nectar and pollen, water sources, and to new nest-site locations. All this is done in the pitch-black darkness of their hive. In this project, we develop an automated system that detects these waggle dances in the bee-hive. Using high-speed cameras and special illuminators, we are able to image the entire hive and can observe the waggle dances in high quality. The developed system will provide information that farmers and industry can use to better manage beehives.

Project Aims

To investigate and compare two different processing methods a standard machine learning algorithm and the developed neuromorphic processing algorithm on the collected honey bee waggle dance data.

Project Methods

The data to be used for this project has already been collected and the student project will only involve processing this data using Matlab on their own computer where they are to examine different processing methods.

Opportunity for Skill Development

Improve programming skills. Learn about the field of machine vision and neuromorphic vision and principles of algorithm design.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

Essential: Experience with Matlab programming.

Project 71: "Mummy let's see grandma again": Making video chats fun and engaging for babies and young children

Supervisor(s): Tijl Grootswagers - t.grootswagers@westernsydney.edu.au
Principal Supervisor

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Second Supervisor

Project description

The Covid-19 pandemic has presented us with a unique and unprecedented situation. Our social lives were completely disrupted by sudden nation-wide lockdown rules that restricted our movement. However, unlike crises in the past (e.g., pandemics, wars, or natural disasters), current technology allowed us to maintain regular social interaction with family and friends. As a result, we have seen a huge increase in video calling. In our work environments, we have quickly come to terms with the virtual meeting. However, interactions with children over video calls have proven difficult, particularly when talking to their grandparents, as per a recent article in The Conversation (Lam-Cassetari, Escudero & Schmied, 2020). On the one hand, grandparents seem to have issues with quickly adapting to the new web-based technologies (e.g., having trouble pointing the camera, or operating the controls). On the other hand, babies and young children are often not engaged in the interaction or lose interest quickly, as young children's attention span is very limited. This project aims to enhance these interactions combining lab-based infant and child attention research with computer science technology.

Recent developments in computer vision, artificial intelligence, and machine learning, including those used within Dr Grootwagers' research, have made tremendous progress in real-time analysis and enhancement of video streams (e.g., changing backgrounds in a zoom meeting). However, current video calling applications have very limited options to help maintain attention especially when the interlocutor is a young child who loses attention after a few minutes. We propose to use the underlying algorithms in available video calling applications to, for instance, notify grandparents when their face is not in view and to make the interaction more engaging by adding cartoon images, or changing grandpa into a talking panda.

This project thus aims to draw from the MARCS Baby Lab experience (including Prof Escudero's experience with infant visual preferences at the UCLA Baby Lab) on how to gain infants' and young children's attention to develop a video-calling application prototype that enhances video-based social interaction with children. This application will not only directly improve video communication between grandparents and their grandchildren during the pandemic, but also will apply more generally to situations where people are away from their children for longer periods of time (e.g., in remote work or overseas deployment).

Project Aims

- Use our lab-based experience and existing literature on what infants and young children find attractive and what calls their attention
- Use cutting-edge computer vision techniques (e.g., face detection, object tracking) to enhance video-based social interaction
- Combine infant visual perception knowledge and computer vision techniques to develop a prototype application that makes video calling more engaging for infants and young children.

Project Methods

In order for the student to get a sense of the end-user problem, the student will learn about infant and child visual perception research and the type of problems grandparents have when calling young children over video. The student will be familiarised with cutting edge computer vision algorithms that can be used to augment video data in real-time. Examples are object-background segmentation, object detection, and computer generated imagery.

Opportunity for Skill Development

The student will gain experience in developing basic research into an end-user application in collaboration with a research team. The student will gain knowledge on infant visual perception research and experience with state-of-the-art computer vision techniques. The student will learn to work with researchers to specify project development goals and milestones, and implement them in a structured fashion.

Students are required to have the following skills/meet the following pre-requisite(s) to apply

Programming experience is essential. Experience in software development would be beneficial.