Translate:

Realising medical technologies innovation in the Leeds City Region

Summer Student Projects 2018

“The main objectives of this summer project are to explore and research the potential of soft actuators/ elastomers in rehabilitative technology which are more versatile, lighter and potentially more effective than conventional rigid materials used in rehabilitative technology.”

Sean Yong – University of Leeds

Translate

Realising medical technologies innovation in the Leeds City Region

Translate is a partnership between the universities of Leeds, Bradford, Huddersfield, Leeds Beckett, and York that works to improve health and wealth by translating early stage ideas into new medical technologies.

Funded by HEFCE (now Office for Students), the programme provides researchers at the partner universities with access to a dedicated innovation team experienced in progressing technologies to market. It also provides a model for successful innovation, innovation training and development, and collaboration within the higher education sector.

Translate aims to:

- Identify and progress technology opportunities
- Increase innovation capability among Leeds City Region academics
- Foster and facilitate research that is better aligned to clinical, patient and public drivers

In May 2018, Translate opened its summer student project scheme to support the progression of medical technologies. The scheme proved to be a great success, and 26 unique projects were funded.

Care home digitisation

My name is Michelle Sigauke and I am interested in technology, how it is used to make processes more efficient. I am a recent BSc Business Information Technology graduate at Leeds Beckett University.

Project lead
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I interact with upper management and carers at care homes to increase my understanding of the digital system that they are currently using, and analyse the information I collect in order to conduct a review of different computational methods they can use in their system to meet with their overall goal. I have conducted interviews with carers to gather their perception towards using digital devices to assist them in their daily tasks. In addition, I am teaching carers who are less confident with using computers in order to decrease the digital divide. As a person with an IT background my research interests are finding user-friendly technologies that can be used by carers to assist them in their daily tasks, for example carers using digital devices such as using voice recognition devices or iPads to input data into resident records instead of using paper records.

The aims of the project are to conduct a digital audit in care homes in order to understand the current system that is being used, and to determine data entry methods preferred by staff. Furthermore, I am to conduct an evaluation of digital methods for integrating information from various sources. I also aim to determine care home staffs' perspective on using audio based information gathering devices such as Alexa. The funding will help define the technologies that will be progressed and will support the scope of innovation. Moreover it is an opportunity to test form filling technologies and audio based technologies to determine the impact that they will have on the functionality of the care homes and staff.

Michelle Sigauke

StroMoHab android – a mobile app for fast and easy analysis of gait

My name is Jack Mckeown and I am an Electronic Engineering student in the Department of Electronic Engineering at the University of York, and I have an interest in Android development and programming in general, as well as neural networks.

Project lead
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I recently completed a student summer project at the University of York where I was responsible for creating an Android app in which a clinician can use their phone to record a short sample of a patient walking and extract basic gait parameters to assist with recognising any problems in the patient's walking ability.

The gait of person refers to the manner in which they walk, and time and distance parameters can be obtained from measuring events during a person's gait cycle. These parameters should have constant and known values, but if a person has a condition which impairs their ability to walk, these parameters will have unexpected values which can be linked to certain conditions and disabilities.

The aim of the app is to allow a clinician to make quick and easy measurements on a patient so they can assess the current condition of the patient and compare parameters to previous sessions to see how the patient's condition has changed. The patient is recorded using the phone's camera. The clinician can then analyse the video as certain gait events occur. A report is then compiled from this analysis session, which documents the patient's gait patterns. All of this can be done on a mobile phone, and only a short video is required to measure the parameters, so the app is quick, easy and convenient to use.

The app has been demonstrated to consultants and has received positive feedback, with suggestions for features to add to the app in the future.

Jack Mckeown

Development of remote and portable speech therapy systems for the treatment of Parkinson's disease

My name is Jack Whiting and I am a student at Leeds Beckett University. Having known people with Parkinson's disease and the challenges faced by those diagnosed, the chance to decrease some of the symptoms suffered drew me to engage with the project.

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My current role within the project is to evaluate and test the microphones used for the therapy sessions. I am also developing a prototype for a portable vocal effort prompt and related software.

The aim of the project is to provide an alternative therapy system based around a remote internet connection to a speech therapist. This will help alleviate some of the issues around transport, time and cost of attending regular face-to-face sessions. The system will function as an online videoconference with a patient's therapist and will also provide after session exercises and vocal practices.

The second aim of the project is to provide a wearable device capable of measuring and evaluating a patient's vocal level based on the real-time background noise. This will take the form of a proof-of-concept prototype, which will be tested with patients in order to assess what form of feedback is most appropriate for day-to-day activities.

The university has provided much of the necessary software required to develop the project's systems.

We did however need to assess hardware that could be easily shipped and used by patients for use with the system in their own home. The funding provided has allowed us to evaluate a range of different microphones and calibration equipment. This has allowed us to ensure ease of use for the patients along with accurate and reliable data to advise more personalised therapy sessions.

To date I have tested our microphone range using an anechoic chamber. This has provided great results that we can use both in our project and to advise on practices for current voice therapy. So far some of the current methodologies tested have shown to provide somewhat inaccurate data and can easily be improved through better practice.

Jack Whiting

An artificial intelligence based system for the diagnosis of infectious keratitis in the cornea

My name is Ismael Tahir Fadl, and I have a strong background in medical science, mathematics, physics and technology. I always wanted to combine this knowledge to help detect, diagnose and treat several diseases and did my undergraduate degree course in Clinical Technology at University of Bradford.

Project lead
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Some eye diseases if not detected and treated early, such as infectious keratitis (bacterial, viral, fungal or parasitic), will dramatically alter vision, generating severe complications which may induce blindness. With the support of Dr. Mansour Youseffi, Prof. Rami Qahwaji at University of Bradford and ophthalmologists at Manchester Royal Eye Hospital led by Mr. Arun Brahma, consultant ophthalmologist, this summer I had the opportunity to continue developing my undergraduate final year project.

The aim of the project was to develop a software using artificial intelligence (AI) based methods to identify fungal presence in acquired corneal confocal microscopy images; to provide an intelligent approach that can detect early and promptly diagnose fungal corneal infection (fusarium keratitis) to save an important amount of time for ophthalmologists and clinicians. Also, as the response to treatment can be difficult to assess using clinical examinations alone, the developed system can help the clinicians to make the diagnosis then start the correct treatment more quickly.

The performance evaluation of the system was carried out by comparing the automatic with the manually traced method, where the automatic system detected the most suspected hyphae (fungal filaments). As a result, our work with Manchester Royal Eye Hospital has shown its clinical usefulness, demonstrating remarkably high efficiency and reliability.

Ismael Tahir Fadl

Distributed wearable RFID system for indoor patient tracking and monitoring

Project lead
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My name is Wafa Shuaieb and I am a PhD Student at Faculty of Engineering and Informatics, University of Bradford. My project will present an approach for monitoring and tracking patients, especially elderly patients, using a low cost and passive radio frequency identification (RFID) system.

The work I will undertake will use new methodologies based on low-cost wearable and light sensors in the form of cheap RFID tags, which can readily be embedded in regular clothing items.

The received signal strength (RSS) from the RFID tags, which are carefully placed at selected places on the body of the patient, are decoded and used for accurately tracking the vertical and horizontal positioning of a patient within a confined space and at any time. It is intended that RFID fingerprinting methodology will be used for inferring a patient position and orientation in real time.

The methodology developed could readily be applied in various health care and household settings. Six positions have been carefully selected to represent a useful set of patient positions and orientations as part of daily activity. These positions can readily be used to infer a relative patient health indicator. For example, the system could detect when the patient is in a risky situation, such as when the patient has fallen on the floor, has stayed for a longer than the normal period in bed, or simply remained static without any movement. The proposed system can be enhanced later to include automated early warning system for triggering a given help mechanism at the right time.

To achieve our aim, very cheap RFID tags, each with a known ID value, is attached to 7 selected locations on the patient body, and each location is monitored by a set of 8 tags. The summer project funding will help me to achieve my aim and develop the methodology for providing useful heath behaviour metrics of a patient at risk.

Wafa Shuaieb

Designing and building a prototype UV exposure and control system

Project lead
Dr Pete Twigg

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My name is Aun Ahmed and after finishing my BEng degree in Medical Engineering, I was looking for a way to apply my knowledge and build upon skills that I had acquired. This summer research has project allowed me me to do just and provided me with relevant experience in my field of interest.

The main aspect of this project is to design, model, build, and program a UV exposure control system. The reason for building this device is that the research incorporated into it is innovative and can help change the face of laboratory diagnostics. Currently, biopsies are used for many diagnostic procedures; however, they can often be long and inaccurate. This new method was thus developed that was as easy as a simple blood test.

I have been working on an exposure system that was modelled and then translated into Solidworks. There were many trial and error experiments we had to go through that meant the designs required considerable alterations. The final designs were then sent to be cut and milled in the workshop. I am also working with programming the Arduino Nano to control the UV light control system, which will allow us to have complete control over the duration of the exposure system.

I am applying and relying upon various aspects of past knowledge gained from my degree, such as using 3D cad-cam Solidworks software and healthcare technology skills such as designing and building medical instruments.

This project has allowed me to think outside of the box in designing the perfect application, work independently to find creative solutions to problems and build my confidence in working to convert theory and paper ideas into concrete tangible products.

Aun Ahmed

User interface for a voice therapy biofeedback device for clients with Parkinson's disease

My name is Mark Rochman and I am interested in Acoustical Sciences and Audio Software Engineering. My previous research has been primarily focussed around Acoustics: more specifically the standardised measurement and characterisation of acoustical diffusers, and the measurement of performance and listening rooms for their acoustical attributes.

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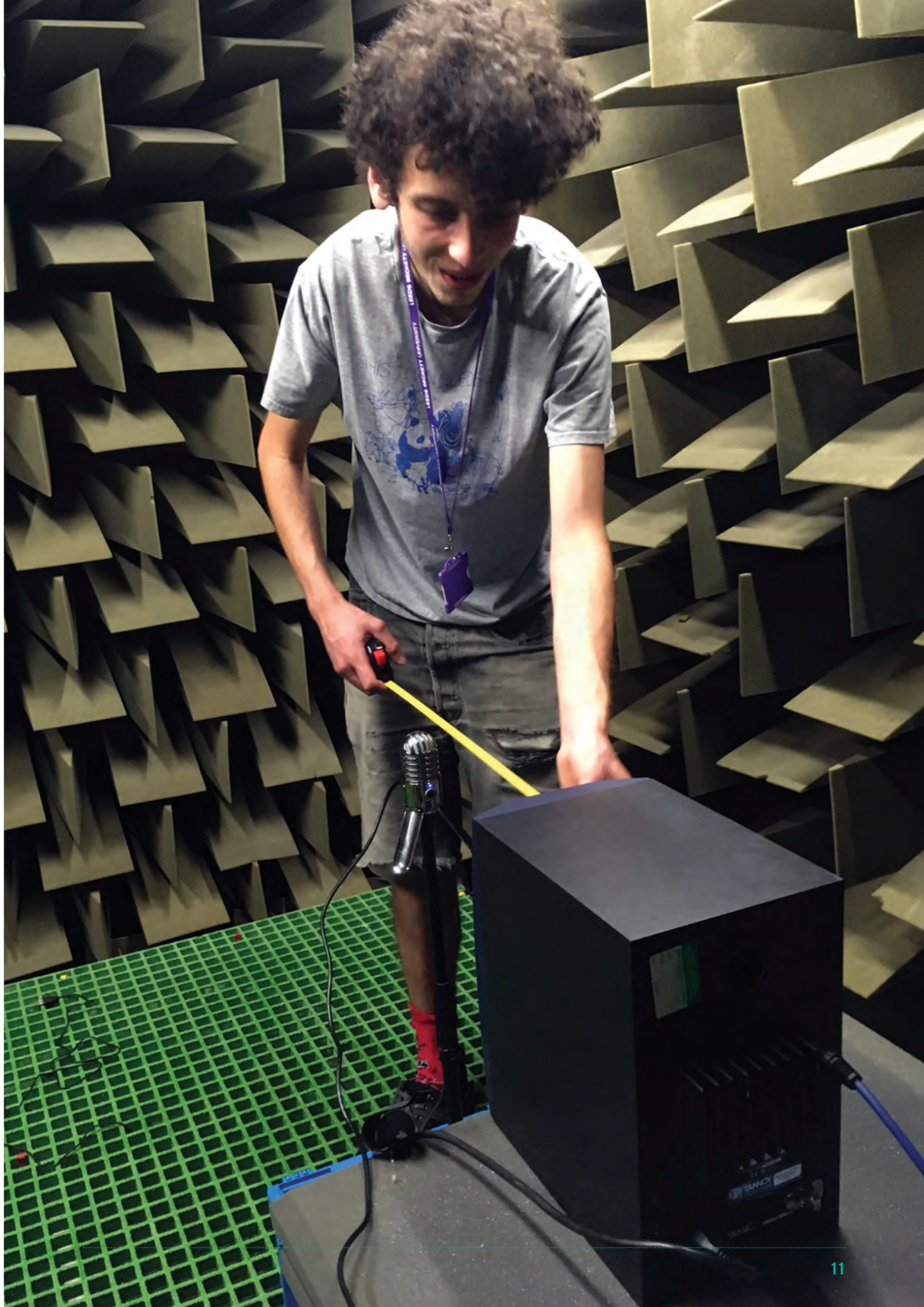
Prior to graduating, I was approached by senior lecturer in Acoustical Sciences Joy Tasker, who was working with Naomi de Graff and Anne Hurren, senior lecturers in Speech and Language Sciences, to help develop software for use by Speech & Language Therapists for patients with Parkinson's Disease (PD). They had identified a promising area of research and development around assessment and therapy for patients with PD, which requires further exploration.

The aims of this project were to create software and protocols which will facilitate the remote delivery of speech therapy to patients' homes, and create portable therapy biofeedback devices to unobtrusively monitor and display a patient's speech level in their daily lives, along with programmed "homework" exercises to help maintain gains made in therapy sessions.

My role within this project has been to apply my knowledge of Acoustics and Software Engineering to build a user-friendly and easy to use system, which is fully calibrated to account for the user's acoustic environment. The impact that a room's acoustic can have on sound measurements is largely overlooked in this area of research, and this marriage of Speech and Language Sciences and Acoustical Sciences could potentially have international significance.

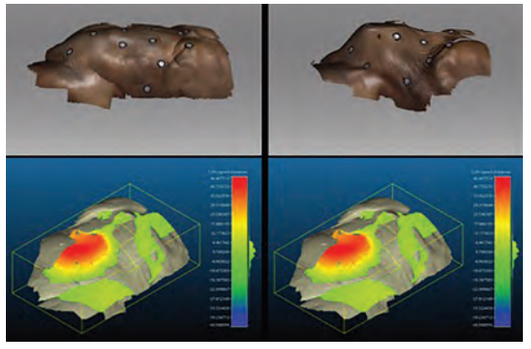
With input from interviews with Speech and Language Therapists and patients with PD, we seek to identify and refine exactly what would be desirable in our new software system. The feedback thus far has been positive and we aim to implement evidence based protocols with stakeholder contributions into our system.

Mark Rochman



Low-cost laparoscopic (key-hole) surgical equipment for developing countries

Rigorous evaluation of the mechanical lift device used to facilitate gasless lift laparoscopic surgery is required to ensure it is safe and effective. The lift device holds up the front of the abdominal wall to give the surgeons space to insert instruments and manipulate tissues.



3D surface scan raw images comparing the abdominal wall shape of conventional laparoscopic surgery and gasless lift laparoscopic surgery

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With the help of Translate and the NIHR GHRG-ST, we delivered an interdisciplinary student driven project to address two main challenges of translating gasless lift laparoscopic surgery (GLLS) into clinical practice more widely. These were:

1. Concerns around poorer field of view in GLLS compared to conventional laparoscopic.
2. The abdominal wall lift device may put too much force through the abdominal wall and cause damage inadvertently.

Laparoscopic (key hole) surgery offers many advantages over open surgery including quicker recovery for the patient, less pain post-operatively and better cosmetic results. It is the gold-standard technique for several common life-threatening conditions such as appendicitis and gallbladder disease, as well as gynaecological procedures. In low-resource settings, such as developing countries, laparoscopic surgery is difficult to perform as the conventional laparoscopic technique requires piped gases, air tight equipment and a general anaesthetic. These all greatly increase the cost of the procedure. A technique known as gasless lift laparoscopic surgery (GLLS) overcomes these challenges and can be done under a simple spinal anaesthetic which is more readily available in low-resource settings. GLLS has the potential to dramatically increase the number of patients who can access this minimally invasive technique. The advantages of key hole surgery are just as great, if not greater, for poorer underserved populations.

The project involved engineers and medics in a multidisciplinary team. The engineers focused on the development and calibration of force meters to ensure the lift device is applied at the correct force. The medical student in this project provided the essential clinical insight necessary to inform the delivery of the project and design of the device. They provided day-to-day clinical expertise and worked alongside the engineers in this project. In particular they helped lead a cadaveric trial where we evaluated the field of view created by conventional vs GLLS using a range of surgeons. This element of the project was vital to get key stakeholder feedback from clinical team members.

The main outcomes from the study were that in cadavers, the field of view is equivalent and adequate according to a range of surgeons and objectively validated using a surface scanner, helping us allay fears that GLLS is detrimental to operative field of view. We were able to 3D print and prototype an ultra-low-cost simple mechanical lift force sensor which was successfully installed into the existing lift device and validated via a series of bench tests.

This project has given us the data required to translate this technology to the next stage along the innovation pipeline. Future work this year and in 2019 will be focused on evaluating this device further, this time in humans. Ultimately, we believe this device can completely transform the way laparoscopic surgery is delivered for some of the world's poorest populations, greatly improving access to this life saving surgical treatment.

Importantly, this project allowed an interdisciplinary team of students to develop some essential translational skills and knowledge including research methodology, laboratory skills, device design skills and scientific writing skills. They are currently in the process of writing the project up as a manuscript for submission to a peer-reviewed journal and the results are being presented at the Association of Rural Surgeons of India (ARSI) Conference in November 2018.

The use of multiview videos in measuring depression

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My name is Bruhanth Mallik and I am finishing a PhD on 3D videos under Dr Akbar Sheikh Akbari's supervision at School of Computing, Creative Technology and Engineering in Leeds Beckett University.

My PhD research is primarily focused towards developing 3D video processing techniques. The class of 3D videos I am looking into are texture based multiview videos. In addition to multimedia uses, multiview videos have been used in a range of applications in the medical field.

I am keen on broadening my knowledge of 3D video applications as this is one of the actively studied fields in computer vision. I am interested in the application of multiview videos in the field of medicine especially for the study of depression, due to its non-invasive nature of diagnosis.

The aim of the project is to develop a proof of concept of an autonomous system that can read changes in facial features and quantify the severity of depression in adults that would complement questionnaire based psychometric diagnosis results. In this project my role is to develop a multiview video based algorithm to accurately analyze and precisely measure the subtle motion changes in facial muscles, which would assist in identifying the intensity of a patient's depression condition. The multiview video based algorithm will then be used to develop a test model, which would then be used to conduct a feasibility study. Ultimately, this research could result in developing a non-invasive technology for helping doctors to measure the level of depression in patients.

Bruhanth Mallik

Scaffolds for breast cancer and tissue regeneration

Project lead
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My name is Morteza Bazgir and I'm a PhD research student at the University of Bradford.

As a PhD student, my current project mainly focuses on the fabrication and characterisation of various biodegradable scaffolds for tissue engineering of tubular vascular graft as well as developing tissue engineered scaffolds for individuals who have been diagnosed with breast cancer.

The aim of this project is to develop a new composite scaffold with a dual functional purpose by using an electrospinning device. This will be used in breast cancer treatment due to metastatic risk and tissue regeneration being high following surgery. To date, the tissue engineered scaffolds have been successfully obtained using an electrospinning machine. We have carried out various tests to validate the characteristics of our scaffolds and currently we are working on scaffold cell viability.

This project will open up opportunities for further funding and eventual commercialisation. The commercialisation opportunities will be aimed to advanced medical technology products through the in-house manufacturing of a prototype with multi-purpose regenerative possibilities. This work will lead to the production of a single device with unique and state-of-the-art properties including drug targeting for the post-surgical treatment of breast cancer and other types of cancer which can be exploited further. For future work, the polymers used for targeting are implantable in animal models and we aim to carry out subsequent pre-clinical trials in 2019-20.

Morteza Bazgir

Application of hyper-spectral imaging for vein detection

Project lead
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My name is Md Akmol Hussain and I am finishing a PhD on image colour constancy adjustment under Dr Akbar Sheikh Akbari's supervision at School of Computing, Creative Technology and Engineering in Leeds Beckett University.

My research interests include computer vision and image processing. I have started exploring hyper-spectral imaging technologies and their application for vein detection after having a discussion with my supervisor last year, when he showed me some hyper-spectral images that he captured on his secondments at Strathclyde University. Having previous knowledge of image classification techniques, I was intrigued at the potential of hyper-spectral imaging for veins, as the veins are more apparent in some hyperspectral sub-bands. To my knowledge, no research is currently being conducted into the use of hyper-spectral imaging for vein detection, making it an exciting research project which has potential to help both nurses and patients.

The aim of this summer student project is to assess the performance of various image classification algorithms for detecting and locating veins within hyper-spectral images in order to help nurses with injection. This summer student funding helps me explore existing vein detection technologies and investigate the application of hyper-spectral imaging in conjunction with image classification methods for vein detection. This investigation may lead to further research in developing a new non-intrusive medical device to help nurses. On success of this summer student project, we are hoping to secure knowledge and expertise that we need to seek additional research funding to continue this research, with the aim of developing a product that can directly help patients and improve NHS visit satisfaction.

Md Akmol Hussain

Development of CEAS (Corneal Endothelium Analysis System)

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My name is Alaa Nassar and I am a student at the University of Bradford.

I am working on improving the performance and the accuracy of an automated real-time system called the Corneal Endothelium Analysis System (CEAS) used for the segmentation and computation of endothelial cells in images of the human cornea obtained by in vivo corneal confocal microscopy.

The main aim of my summer student project was to develop new diagnostic tools for extracting clinical features from the cornea's endothelium layer. Abnormalities of the corneal endothelial cells may be associated with a number of corneal and systemic diseases. For instance, damage to the endothelial cells can significantly affect the corneal transparency by altering the hydration of the corneal stroma, which is associated with irreversible endothelial cell pathology requiring corneal transplantation. To date, quantitative analysis of corneal sub-basal nerve and endothelial cell abnormalities has been manually performed by ophthalmologists using time-consuming and highly subjective semi-automatic tools, which require an operator interaction. The effectiveness and robustness of the endothelial cell segmentation system have been demonstrated with an execution time of only 6 seconds per image.

This funding enabled me to work on further improving the performance of the CEAS software. For example, we were able to test two different pre-processing methods to reduce noise and enhance the image quality of endothelial cell boundaries. In addition, the effectiveness and robustness of the CEAS software has also been used in processing different types of images acquired by in-vivo specular microscopy.

Alaa Nassar

More summer student projects from 2018

Touchless radio-frequency identification for patient monitoring
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Translate:

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