**MSc Project Proposal**

Proposal 1: Extending sensing capabilities to enable efficient assistance provisioning

Proposal 2: Improving user interaction methods for non-technical users for assistive system

Proposal 3: E-Learning environment that provides personalised learning path according to learning styles.

Proposal 4: Extending eye tracking moodle system to motivational personalised learning system

Proposal 5: Using wearable sensors, i.e. smartphone and smart watches, to monitor diabetes and obesity

Proposal 6: Using smart sensing for assisted living for people with hearing problems

**MSc Project Proposal 1**

**Title: Extending sensing capabilities to enable efficient assistance provisioning**

# **Project Outline**

Ambient Assisted Living (AAL) systems are being developed to support aging population to perform their Activities of Daily Living (ADL). The system not only provides a great tool for health services to provide efficient care to the patients but also enable one to live independently and potentially improve the quality of their life. Collecting contextual, behavioural, object interactions within the smart environment is critical in performing activity recognition (AR) and on demand assisting inhabitants. Thanks to the advancement of sensing capabilities and the notion of Internet-of-Things (IoT), the sensing can be carried out in three manners; environmental (ambient), object interaction based (dense) and physiological (wearables).

One of the challenge in collecting data is to not only deploy large varieties of sensors in non-intrusive manner but also efficiently communicating the data generated from the sensors to one hub/smart system. Although, there are many off-the-self sensors available in the market today, the sensing parameters are limited and the communication protocols may also vary.

The smart lab developed by Context, Interaction and Interaction Research Group (CIIRG) at DMU has already developed the smart system to collect data from off-the-self and custom devices in real-time; view a quick demonstration video here: [https://1drv.ms/v/s!AgEZTTl9Fd75mXH9Lmnp7XHsXm-c](https://1drv.ms/v/s%21AgEZTTl9Fd75mXH9Lmnp7XHsXm-c). The system is continually evolving and it can currently collect ambient data using sensors supported by and Securifi Almond router(off-the-self) and dense sensing using Arduino boards (wired and wirelessly). However, number of sensors are also available. For example, UHF RFID readers, NFC tags, Estimotes beacons, and SmartThings starter kit for Ambient sensing; Mini-/Arduino boards based sensors using XBee/Bluetooth/WiFi/RF shields for Dense sensing; and Smart watches, SensorTag, and Shimmer platform for Wearable sensing.

# **Project Objectives**

The objectives are to extend the CIIRG smart lab system’s current sensing capabilities which involves:

* Integrating some of the off-the-self/custom sensors described above (i.e., SensorTag, Shimmer, SmartThings, Estimotes and Smartwatch).
* Store, query and update and delete sensor data into the database via web service.
* Viewing sensing data in real-time on a mobile application and web browser.
* Improving methods to add new sensors with minimal setup efforts.
* Evaluating the quality of the data generated by the sensors.

# **Prerequisite**

Basic programming skills in Java/C.

Some exposure of developing Web Service/Website, Mobile application (Android) and working with Arduino board would be beneficial.

Technical Requirements: YELLOW (Traffic light indicator)

# **Expected Deliverables**

A system prototype with documentations and dissertation report covering following aspects:

* Extending data collection capabilities from varieties of off-the-self/custom ambient sensors, wearable sensors and dense sensors wired/wirelessly to efficiently capture relevant inhabitant data.
* Each collection method must be described and documented.
* Storing and manipulating sensor events into the database via web service.
* Enable data to be viewed in real-time on a mobile application and web browser via web service.

# **Supervisor – Prof Liming Chen/ Darpan Triboan**

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**MSc Project Proposal 2**

**Title: Improving user interaction methods for non-technical users for assistive system**

# **Project Outline**

As the aging population rising, it can be seen as a human evaluation advancement. However, along with positive effects, there are also some side effects that it brings in for the elderly to even perform their Activities of Daily Living (ADLs). Therefore, Ambient Assisted Living (AAL) systems are being developed for the elderly, professional health services and even for their family members and relatives to monitor, provide efficient care and support for the elderly when required non-intrusively.

Most of the AAL systems focus on trying to collecting appropriate sensing data and recognising the ADLs performed by the inhabitant in a given smart environment. However, little has been done for the elderly or the users who are have very limited knowledge of using ever-growing technologies. Therefore, many systems proposed fail in providing Human-computer interaction (HCI) capabilities for non-technical users and natural interaction methods. With the recent advancements of smart home technologies and evolution of HCI methods, it is now possible to provide natural HCI to non-technical expert users. For instance, conversional methods of voice-based devices such as Amazon Echo and Google Home, touch and gesture based method using Smartphone and Smart TV devices are now being integrated within AAL systems. A typical use case scenario could be to remind the elderly to take their afternoon medicines using voice-based device or prompting while entertaining themselves on Smart TV.

The smart system developed by Context, Interaction and Interaction Research Group (CIIRG) at DMU has already developed an Android mobile application and a website that is able to receive real-time sensing data and recognition of simple and composite user activities; view a quick demonstration video here: [https://1drv.ms/v/s!AgEZTTl9Fd75mXH9Lmnp7XHsXm-c](https://1drv.ms/v/s%21AgEZTTl9Fd75mXH9Lmnp7XHsXm-c). This system can be expanded with some of the devices that we already available (Amazon Echo, Smartwatches, and SmartThings), being considered/ordered (i.e. Smart TV and Google Home) and the new devices can also be acquired.

# **Project Objectives**

To extend current CIIRG smart lab system with natural HCI by doing the follow:

* Integrating voice based services such as Amazon Echo/Google to inform inhabitant/user with a bespoke assistance instruction (i.e. suggesting to take medicine, reminding for doctor appointments)
* Extend Android mobile application to support Smart TV/Tablet application.
* Improve current graphical user interface (GUI) design of the Android application and create maintainable code.
* Create 2D/3D model of the smart environment and show where real-time events are occurring.
* Evaluate with the system with non-technical users.

# **Prerequisite**

Basic programming skills in Java/C.

Some exposure of developing Web Service/Website, Mobile application (Android) and programming to display graphical model of the room within the application would be beneficial.

Technical Requirements: YELLOW (Traffic light indicator)

# **Expected Deliverables**

A system prototype with documentations and dissertation report covering following aspects:

* Improving HCI by integrating voice based services and gesture/touch methods on Android application that supports Smart TV/Tablet.
* Improve GUI design with 2D/3D model simulating sensor events and create maintainable code.
* Evaluation of the system by non-technical expert users.

# **Supervisor – Prof Liming Chen/ Darpan Triboan**

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**MSc Project Proposal 3**

**Title: E-Learning environment that provides personalised learning path according to learning styles.**

**Project Outline**

Learning difficulties is not related to the subject material, but in fact to the way we perceive information. The recent eLearning industry is concerned to improve on-line courses through the computer assistance in order to reach a higher degree of learning monitoring. To improve a learning course, the system must be capable of monitoring the user behaviour to decide his learning style, and then decide the course content or the presentation into adaptive learning path according to his learning style. However, current learning systems are very limited. There is a need for refined adaptive learning approach.

C programming course was built on MOODLE platform. The course was embedded with eye tracker to track the eye gaze for behaviour monitoring. The system annotates the images, texts, and videos in the screen. Then it collects and gives a data of the time percentage that the user spent on (texts) or (images and videos). In a later phase the user model of learning style is determined and stored. Also, ontology was built for modelling the course content and learning style.

This course could be expanded to have more features of providing the best recommendations for the most suitable learning path according to the learner learning style (whether it is visual or verbal). The ontology model is to be embedded in the system to determine learning style. And based on that learning style , using the mechanism of inferencing to determine the best content to deliver to the user. Also, we need the use to make a run-time event inferencing to continuously adjust the user model and the recommended path.

**Project Objectives**

The objectives are to extend the existing C programming course capabilities which involve:

* Using the Ontology, the prototype gives a recommendation of content items like texts, or images.
* When there is equality in usage percentage, a prompt message should appear asking the user what is preferable to watch.
* Delivering the recommended content type to the user.
* Storing, and updating and data.

**Prerequisite**

Basic programming skills in Java/C.

Awareness of modifying a course with MOODLE.

**Expected Deliverables**

A system prototype with documentations and dissertation report covering following aspects:

* Giving a recommendation of the best material items, according to stored learning style whether it was verbal or visual. This must be using the mechanism of semantic inferring.
* When there is equality in usage percentage, a prompt message should appear asking the user what is preferable to watch.
* Filtration of the material items into two parts which are suitable, and not suitable.
* Delivering the recommended material items for the learner.
* Storing interactions and recommendations in user profile.

**Supervisor – Prof Liming Chen/ Khawlah Alhasan**

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**MSc Project Proposal 4**

**Title: Extending eye tracking moodle system to motivational personalised learning system**

# **Project Outline**

Students’ high level of motivation to learn is associated with their learning success. User motivation is a response to the interaction process and is fundamental for the success of the interaction process. Recognition of the role of identified motivational factors can contribute to an assessment of the interface and can be an indicator of how well design has addressed user needs. That’s why we need to recognise and use techniques to enhance user motivation in the interaction process, in order to attract and sustain the interest of the target audience. Specifically, students with various kinds of learning difficulties such as dyslexia can cause young people not to engage fully with the education system or drop out. Thanks to the advancement of assistive learning system and user modelling techniques for personalised learning, the different individual learning needs and preferences can be taken into account and met by personalising the learning environment based on user models.

One of our DMU students has already developed an eye tracking learning system with course materials based on Moodle learning platform. View a quick demonstration video here: http://xxxxxxxxxxx. The system can continually monitor learners’ eye movements when they are using the system along with the percentage of eye gaze time spent on text, images and out of the screen and monitor learner behaviour such as clicking history and navigation behaviour as well as record learning task performance including test score, learning completion time, etc.

However, the motivational factors that are essential to learning success are not included in the system yet. By incorporating motivational factors into student modelling in the system, personalisation can be further applied based on student motivation model. We already have a motivation model and the corresponding motivation questionnaire and the inference rules as well, and we will need the system to collect the user behaviour data combined with the motivation model and inference rules, to output the learning content based on the inferenced results. The initial personalisation of learning content will be performed based on the motivation questionnaire and the rules, and then the real-time user behaviour data will be recorded and used to update user’s motivation, according to the real-time motivation, adaptive feedback will be output to user to sustain and enhance their motivation. The basic system architecture and its working principles is shown here:



The motivation plays a role in the teaching process primarily in the quantity of course materials presented to the student. For example, high motivated students tend to learn faster and to accept learning content in bigger quantities, while low motivators must be presented with smaller knowledge chunks with appropriate feedback, trying to increase their motivation. Another interesting perspective on motivation includes the idea of positive feedback as a kind of retribution or praise with a series of studies showing the effects of feedback interventions as altering user's motivational state. Therefore, based on the data collection combined with the motivation model and inference rules, the output will be different quantities of course materials with feedback to user.

# **Project Objectives**

The objectives are to extend the current eye tracking Moodle system that involves:

* Identifying user’s motivation at the beginning and in real-time.
* Recording and storing user’s real-time data including eye movement and learning task performance (i.e., time spent on a page, time spent on a test, test score, etc.).
* Updating the motivational state with the aforementioned real-time data.
* Providing learning content (i.e., feedback and course quantity) for user based on the real-time motivational state.

# **Prerequisite**

Basic programming skills in C++/Java/Python.

Some experience of developing e-learning system will be beneficial.

Technical Requirements: YELLOW (Traffic light indicator)

# **Expected Deliverables**

A system prototype with documentations and dissertation report covering following aspects:

* Incorporating a motivation questionnaire (developed already) in the registration form.
* Recognising user attention by collecting eye-tracking data using given analysis method.
* Updating the motivational state with eye-tracking data and other recorded indicators such as browsing time using pre-defined rules.
* Allowing the motivation model and inference rules to be entered in the system
* Outputting the course content (with feedback and course quantity) based on the inference results.

# **Supervisor – Prof Liming Chen/ Ruijie Wang**

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**Ruijie will provide:**

1.The motivation model and questionnaire along with the pre-define weight of motivational factors in the motivation model/questionnaire; 2. Which user behaviour data serves as the indicators of which motivational factors to be collected; 3. Inference rules (input: motivation; output: Levels of course quantity; Feedback expressions and messages); 4. Levels of course quantities and Feedback expressions and messages.