MODULE SPECIFICATION

Part 1: Information			
Module Title	Assistive Robotics		
Module Code	UFMFSR-15-M	Level	Level 7
For implementation from	2020-21		
UWE Credit Rating	15	ECTS Credit Rating	7.5
Faculty	Faculty of Environment & Technology	Field	Engineering, Design and Mathematics
Department	FET Dept of Engineering Design & Mathematics		
Module Type:	Standard		
Pre-requisites	None		
Excluded Combinations	None		
Co-requisites	None		
Module Entry Requirements	None		
PSRB Requirements	None		

Part 2: Description

Overview: Between 2000 and 2040, the proportion of the world's population of those over 60 years old is expected to double from about 11% to 22%. Ageing, particularly due to sedentary lifestyles and long-term illness, results in increased frailty and prevalence of chronic diseases, resulting in difficulties in performing activities of daily living activities. Providing cost-effective and high quality support for an aging population, who have to cope with a range of disabling conditions, is a high priority issue for all governments. Assistive robotics is increasingly becoming recognised as a potential enabler in helping people improve their quality of life and live independently, particularly in later life. As a result, Assistive robotics, which include systems for use in domestic, social care housing, and healthcare settings, is one of the fastest growing sectors in robotics. According to a recent business report, the assistive robotics market is expected to register a compound annual growth rate of 21% over the forecast period of 2019-2024.

This module will introduce you to the fundamentals of assistive robotics. Starting with understanding a range of typical assistive scenarios and robots, together with the associated human physical, sensory and cognitive conditions and disabilities that need to be considered when designing and deploying such systems, you will also gain knowledge of key areas within robotics that are core to realising assistive robotic solutions.

In order for assistive robots to be successfully deployed, their operational safety is required at multiple levels - from safe navigation to safe cognitive and physical human-robot interaction and collaboration. This requires developing contextual and social intelligence for robots so that they are able to interact appropriately and reliably in real-time. In this module, you will learn about the state-of-the-art research in recognising and integrating both environmental contexts and human user behaviour and health status through heterogeneous sensor data fusion and adaptive machine learning. To prove that an assistive robot is dependable in a highly dynamic environment, a series of tests and analysis with end-users must be carried out, followed by embedding the safety rules in the overall robot's architecture. As such, you will be introduced to current techniques for validation and verification in different scenarios, specifically considering operation in unstructured environments where the end-users interacting with these are likely to have a range of sensory, cognitive and mobility impairments.

Educational Aims: The key aim of this module is to enable students to gain knowledge and experience of a key application area - assistive robotics.
Learning about assistive robotics can only be accomplished in conjunction with a clear and critical understanding of the contexts in which these technologies are needed. This will therefore include learning about a range of disabilities and user needs, and being able to use this knowledge to evaluate the appropriateness of different assistive robotic solutions in relation to multi-dimensional criteria.
By the end of this module students will therefore have the skills to identify functional and non-functional requirements for assistive robots by considering specific user accessibility needs and disabilities, for use in a given context.
Another education aim is to give them the skills to be able to critically review the challenges and limitations of providing assistance through the use of an assistive robot in a specific real-world context from the perspectives of different stakeholders.
In order to ensure that they understand the risks and safety related issues that need to be considered when designing and implementing assistive robots they were learn how to apply a Hazard and Safety Analysis method to identify risks for a given assistive use case which will be done as part of programming a robot to perform assistive functions.
In working on a group project and producing their individual report they will review the state-of-the-art research literature so that they have the skills to consider, select and implement approaches to solve a particular fundamental challenges as part of an assistive robotic task.
Another educational aim is to ensure that students can define an appropriate set of evaluation criteria and critically appraise the functional and non-functional performance of assistive robots. This will be reinforced through the practical work.

Outline Syllabus: Syllabus Outline:

1. Introduction to Assistive Robotics

2. Understanding Physical, Sensory and Cognitive Disabilities and Long-term conditions
- International Classification of Disability and Clinical Frailty Index
- Assistive Technology Assessment Process Model and Basic Definitions
- Human Factors and Ergonomics-

3. Accessible Human-Robot Interaction Design and Evaluation
- Universal Design Principles and Accessible Interaction Devices and Methods
- Participatory Design Methodology and challenges
- Inclusive evaluation approaches

4. Socially and Physically Assistive Robots
- Review of State-of-the-art
- Critical evaluation of scope, function and fundamental challenges

5. Rehabilitation Robotics, Prosthetics and Exoskeletons
- Review of the State-of-the-art
- Materials and Adaptable form factors (including soft robotics and wearables)

6. Interdisciplinary Aspects of Assistive Robot Design, Development and Deployment

- Health and social care professionals – roles and responsibilities
- Current care provision and contexts
- Role of product design and aesthetics – user acceptance models

7. Intelligent Sensing and Instrumentation in a Health Context
- Invasive and non-invasive sensing
- Biometric, physiological and environmental sensing
- Approaches for temporal data analysis and learning

8. Safety – Methods, Standards, Regulations and Regulatory bodies in Health and Social Care
- Review of existing standards (ISO13482, ISO421, BS8611, ISO17069)
- NICE – role and guidelines, MHRA, Care Quality Commission
- Hazard Analysis and Safety Assessment methods (ESHA, FMECA, OSHA)

9. Ethical and Legal issues in Assistive Robotics
- This session will be organised as a series of min-debates, with students provided with key papers and guidelines in advance to develop an understanding of the ethical and legal concerns. In the session, they will need to identify and argue relevant ethical and legal concerns for a selection of assistive scenarios.

10. Rethinking Assistive Robots
- Internet of Robotic Things
- Robotic furniture and objects

Teaching and Learning Methods: The practical sessions for this module, which will contribute to the coursework assignment and run in parallel to the lecture sessions, will involve working in teams on a mobile robot platform to achieve an assistive task. Each sub-group within a team will focus on a specific functionality to achieve the task, such as human-robot interaction, scene analysis, person recognition, navigation, object recognition, grasping and manipulation, culminating in integrating the different functions to realise the overall task. This will give you the opportunity of developing and applying in-depth knowledge and skills in a specific area of interest as related to assistive robotics, but also understanding the scope of the different fundamental areas and the pragmatic challenges of working on a real-world assistive task.

Scheduled Learning includes lectures and practical laboratory sessions

Independent Learning includes time spent on essential and further reading, coding and testing in the practical sessions, completion of the coursework assignment and exam preparation.

Part 3: Assessment

First Sit

Component A (30%) consists of one assessment:

A1. Online Exam. Length: Two hours (24 hour window)

This examination will consist of short descriptive textual questions as well as those requiring reflection and critical thinking, some questions will require information interpretation based on specific use cases and scenarios. The questions might require short textual answers and providing rationales on conceptualisation of solutions with diagrams to describe the proposed solutions.

Component B (70%) consists of two assessments. These will be both based on a group project involving a programming task related to a robot completing an assistive task. B1 is the group component and B2 is the individual component comprising the student's own contribution to the group project.

The details of B1 and B2 are as follows:

B1 (40%) A group demonstration of their implementation of a robot completing the specified functions for a defined assistive task. The functions will include human-robot interaction, navigation, object recognition and

manipulation, person identification with marks allocated for each function according to benchmarking metrics. The demonstration will be followed by a short viva examining what and how evaluation criteria was used to assess the performance of the individual functions and overall task, and the group's hazard analysis and safety assessment for the task. The students will have access to and use the available assistive robot platforms and simulation environments.
The demonstration will be 15 minutes and viva 10 minutes.

B2 (60%) A 3000 word individual report of not more than 6 pages (including figures, tables and references - not included in the word count) based upon their practical work carried out for the group project. The report will be structured as a short scientific research paper.

Second Assessment Opportunity

Students who fail Component A will have an opportunity to sit a resit exam.
Students who fail Component B will have an opportunity to write a detailed 4000 word report comparing and contrasting different approaches (including options for hardware and software) for implementing key functions to enable an assistive robot to perform a specified task. References (not included in the word count) should also be included.

No further attendance to lectures or labs is required.

First Sit Components	**Final Assessment**	**Element weighting**	**Description**
Examination (Online) - Component A		30 %	Online exam of two hours duration on the topics covered in the module. This examination will consist of short descriptive textual questions as well as those requiring reflection and critical thinking, some questions will require information interpretation based on specific use cases and scenarios. The questions might require short textual answers and providing rationales on conceptualisation of solutions with diagrams to describe the proposed solutions.
Report - Component B	✓	42 %	A 3000 word individual report of not more than 6 pages (including figures, tables and references - not included in the word count) based upon the work carried out for the group project. The report will be structured as a short scientific research paper. A template will be provided for this. A link to a video demonstrating the specific aspect they have written about will need to be included. This is help to prevent plagiarism.
Presentation - Component B		28 %	This will be presented as a 15 minute group demonstration with a 10 minute group viva.
Resit Components	**Final Assessment**	**Element weighting**	**Description**
Examination (Online) - Component A		30 %	Online exam
Report - Component B	✓	70 %	Students who fail Component B will have an opportunity to write a detailed 4000 word report comparing and contrasting different approaches (including options for hardware and software) for implementing key functions to enable an assistive robot to perform a specified task.

Part 4: Teaching and Learning Methods

Learning Outcomes

On successful completion of this module students will achieve the following learning outcomes:

Module Learning Outcomes	Reference
Compare and contrast different assistive robotic solutions to address a range of disabilities and user needs	MO1
Identify functional and non-functional requirements for assistive robots by considering specific user accessibility needs and disabilities, for use in a given context	MO2
Critically review the challenges and limitations of providing assistance through the use of an assistive robot in a specific real-world context from the perspectives of different stakeholders	MO3
Apply a Hazard and Safety Analysis method to identify risks for a given assistive use case	MO4
Review the state-of-the-art research literature to select and implement an approach to solve a particular fundamental challenge as part of an assistive robotic task	MO5
Define a set of evaluation criteria to critically appraise the performance of an assistive robot to perform a series of functions	MO6

Contact Hours

Independent Study Hours:	
Independent study/self-guided study	114
Total Independent Study Hours:	114
Scheduled Learning and Teaching Hours:	
Face-to-face learning	36
Total Scheduled Learning and Teaching Hours:	36
Hours to be allocated	150
Allocated Hours	150

Reading List

The reading list for this module can be accessed via the following link:

https://rl.talis.com/3/uwe/lists/CA456E77-39B8-7FC3-7D0A-0C41AE8DFA60.html?lang=en-US&login=1

Part 5: Contributes Towards

This module contributes towards the following programmes of study: