Research Proposal

The use of Humanoid Robots as Interactive Lectuers

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Outline Idea

The use of humanoid robots in the classroom is a relatively new area of study with few experiments being conducted in the past few years. However, published work has shown that this implementation can be seen as benefitial, with increases in motivation levels and engagement being observed (Hameed, et al., 2018). One major limitation of this research is that the interaction between the 'teacher' and the student has been omitted. Whilst this is not so much of an issue initially, there must be consideration on the long-term relationships that students will create with robots (Westlund, et al., 2018).

This project would look at the possibility of implementing similar interactions that are widely used in conventional classes, such as the asking and answering of questions at random intervals during lessons. Building on existing research, the technology would be tested in a larger setting such as a lecture hall where considerations such as number of students and size of room would have to be considered.

Motivation

There has been significant research to suggest that the use of humanoid robots in education has the possibility to have vast improvements in motivation, focus and knowledge retention of students. Humanoid robots have already been used to deliver subject content to students and can do so at a much faster rate than teachers (Hameed, et al., 2018). The benefit of this is that lessons can include more thorough content which could envelop a greater understanding, however as students learn at different rates, the amount of information absorbed could be much more variable.

Moreover, unlike a small group implementation, a University lecture is likely to include a wider range of students of different nationalities. Humanoid robots have already been used in EFL teaching (Hong, et al., 2016), and some concepts learned are useful when considering implementation of this nature. The language barrier provides difficulty, particularly in a University setting where a number of students have limited understanding of the English language.

Overall, most research has been conducted on elementary students, and so the impact of humanoid robots in a more mature setting is somewhat unknown, with assumptions and adaptation of results being the only form of evidence to suggest the impact of this technology at this level. Specifically, the long-term relationships (Westlund, et al., 2018) would be different as older students are less interested in the human element of the robot (Fernandez-Llamas, et al., 2017).

Research Objectives

Ultimately, the objective of the research is to evaluate the possible implementation of student interaction with a robot teaching assistant in the setting of a University lecture. This experiment brings about several considerations that must be dealt with before implementation can take place.

Evaluate Whether Facial Recognition Software is Suited to Lecture Halls

Technology already exists to detect the number of faces using the Haar cascade classifier, adapted in the Viola and Jones algorithm (Viola & Jones, 2001) which despite advances in deep learning, is still successfully used today. Several software solutions are available, however each one is suited to different scenarios. Hameed, et al. (2018) showed this software can be used to measure attention levels, however can be further improved by measuring noise levels for a more accurate evaluation.

Evaluate Whether Speech Recognition Can Be Implemented in Lecture Halls

Speech recognition is a field that has advanced massively in the past few years with most social and humanoid robots such as the NAO robot, incorporating sophisticated versions of this software. However, there are external software available with can be used such as the Google Cloud Speech Recognition, which has an ever-expanding database of words and voices to ensure speech is interpreted as accurately as possible. As well as this software, there is the incorporation of a Natural Language Toolkit (NLTK). This, along with the facial recognition, would allow the creation of user profiles for more personal interactions with students.

Evaluate Interactive Robot Lecturer vs Human Lecturer

Assuming the previous issues are overcome, the project would then look to implementing the system in a classroom setting. The challenge here would be seeing whether the system can perform well enough that students are delivered the information they require, however at the same time, having the opportunity to ask and answer questions in the same way that they would if a teacher was delivering the lecture.

Methodology

The project will be split into three main stages ensuring the system is tested thoroughly to allow for adaptation of certain software should issues arise.

Facial & Gesture Recognition

Firstly, each facial recognition software solution would be tested in a variety of lecture halls and classrooms in University to see which solution is best suited to working in different size rooms and in different light levels. This is important is some lecture halls have different lighting and some lecturers prefer little light to maximise the visibility of the lecture slides.

Once the most effective software has been selected, the project will look at the possibility of being able to detect whether a students' hand is raised, signifying that they want to ask or answer a question. This will be easier to implement in the answering of questions as the system can be programmed to detect gestures after asking a question, whereas if the students are asking questions, the system would have to constantly keep checking whether there are any hands raised and stop the lecture at a suitable point.

Speech Recognition

Secondly, the Google Cloud Speech Recognition system would be used as it has a much more extensive library and so would likely be more accurate and more efficient. One main issue that is likely to arise is that of background noise which is especially relevant in large lecture halls, or rooms with air conditioning systems. There are already software systems available which can eliminate background noise, such as OBS Studio which allows users to apply filters such as 'Noise Gates' which can eliminate noise within a certain dB threshold, making voices clearer.

Interactive Lectures

Finally, the system will be trialled in a group of lectures delivered to different year groups to test its effectiveness. The method of experimentation will be 'between subject experimental design' (Charness, et al., 2012), meaning that each experiment scenario (robot lecturer and conventional lecturer) will have its own set of students, allowing each scenario to be independently evaluated.

In terms of preparing for the lecture, the material will have to be uploaded to the robot so that it can 'learn the content'. When it comes to a student asking a question, the robot will have to know what information is contained within the lecture to determine whether the question is related. If the question can be answered by re-reading a lecture slide, the system will do this. Similarly, if the question can be answered with a simple internet search, this will be done. Finally, if the answer requires more thought, the robot will be able to request the assistance of the teacher. By using this hierarchy, the emphasis is put on the robot taking the lead, however due to limitations in technology and the application of artificial intelligence, there will always be the necessity for teacher presence to provide a complete experience for students.

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