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**ETHICS APPLICATION**

**Name of Study: EMG removal from ECG with deep neural networks**

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| 1. DESCRIBE THE BASIC PURPOSES OF THE PROPOSED RESEARCH.  The main purpose of this study is to provide statistical evidence to prove the use of deep neural network to effectively clean electromyography(EMG) out of electrocardiogram(ECG) signal.  EMG is the electrical signal initiated from the nerve cells associated with various muscles of human body. It is considered noise to other bio-signal recording because local EMG will unavoidably be picked up along with the desired bio-signal with electrodes.  ECG is the electrical signal initiated from the nerve cells associated with heart muscles. It has unique characteristic waves. Many heart diseases are detected from the abnormality of the waves.  Deep neural network had been introduced to wide range of applications. The use of deep neural network in healthcare field had also advanced considerably in recent years because they can handle very complex procedures and calculations that human cannot manually cope with. |
| 2. INDICATE WHO IS FUNDING THE RESEARCH (IF COMMERCIALLY FUNDED, ENSURE THAT PARTICIPANTS ARE INFORMED).  This research is unfunded undergraduate MEng project. |
| 3. DESCRIBE THE DESIGN OF YOUR EXPERIMENT (E.G. CONDITIONS, NUMBER OF PARTICIPANTS, PROCEDURE AND EQUIPMENT WHERE APPROPRIATE).  **Participants**  Minimum of 15 and maximum of 30 self-reported neurologically intact adult volunteers are to be used in this experiment.  **Equipment**  -CE certified Ag/AgCl ECG electrodes  -Attys: CE certified bluetooth portable data acquisition device and its software  -Computer for recording the data  -Skin cleaning kit  -Camera and camera holder for recording the video  **Procedure**  Initially, participants will be asked to have three one-time-use electrodes placed on their right wrist, right shoulder, and left hip to record ECG and EMG of the right forearm. Consequently, Attys, a portable data acquisition device will be attached to their abdomen with a belt. Next, some wires will be used to connect the electrodes and the device. Participants will be asked to lay relaxed and still for clean ECG to be recorded. Finally, participants will be asked to conduct right forearm muscle contraction in some of the recordings. Multiple recordings, ideally 12, will be taken. The sampling rate of the recordings will be 250 Hz. Each recording should take about 2-4 minutes. Participants may ask for a 5 minutes break at anytime. The whole session should last no more than 1 hour.  After the data has been collected, the electrodes and other wirings will be removed. |
| 4. DESCRIBE HOW THE PROCEDURES AFFECT THE PARTICIPANTS.  When each participant arrives, the experimental procedure will be explained clearly to them and they will have the opportunity to ask any questions or raise any concerns.  Each participant will be attached with the electrodes and data acquisition equipment. The weight of the equipment may slightly discomfort participant’s ability to move. There may be tickling sensation upon removing the electrodes after the experiment. |
| 5. STATE WHAT IN YOUR OPINION ARE THE ETHICAL ISSUES INVOLVED IN THE PROPOSAL.  There are no major ethical issues associated with the study.  All medical device used on the participants are CE certified. Minimum inconvenience to the participant is to be anticipated. Participants will be supervised and monitored closely at all time by at least one of the researchers and will be informed that they are free to withdraw from the study at any time.  The participants’ identity will not be revealed in any published results. Information regarding participants’ identity will be treated with serious confidentiality. |
| 6. SPECIFY THE NATURE OF THE PARTICIPANTS. INDICATE IF THE RESEARCH INVOLVES CHILDREN OR THOSE WITH MENTAL DISABILITIES OR HANDICAP. IF SO, EXPLAIN THE STEPS TAKEN TO OBTAIN PERMISSION FROM L.E.A.s, HEADTEACHERS, PARENTS, ETC. GIVE A BRIEF DESCRIPTION HERE AND FILL IN THE CHILDREN RESEARCH ETHICAL PLAN. THE FORM MUST BE UPLOADED TOGETHER WITH THE CONSENT AND INFORMATION FORMS.  Participants will be self-report neurologically intact volunteering adults of age 18 or more. |
| 7. STATE IF PAYMENT WILL BE MADE TO PARTICIPANTS.  No payment will be made to the participants. |
| 8. DESCRIBE THE PROCEDURES FOR ADVERTISING, FOR RECRUITING PARTICIPANTS, AND FOR OBTAINING CONSENT FROM PARTICIPANTS.  Posters with the project topic, a brief explanation and contact information will be put around the public area such as co-working spaces, library or the cafeteria of University of Glasgow after applying for the Student Representative Council’s permission. People who are interested then must contact the researchers regarding their interest and make an appointment to participate in the research.  Participants will be provided with an Information Sheet and a Consent Form. They will be given time to read and consider the Information Sheet. One of the researchers will explain the procedures to the participant and ensure that the participant understands that they are free to withdraw from the study at any time without reasons and without consequences. The participant will have an opportunity to ask questions. If the participant is willing to participate, they will be invited to sign the consent form. |
| 9. STATE WHETHER THE PROPOSAL IS IN ACCORD WITH THE BPS CODE OF CONDUCT OR THE ESRC FRAMEWORK OF RESEARCH ETHICS.  The proposed experiment is in accordance with the BPS code of conduct. |
| 10. DESCRIBE HOW THE PARTICIPANTS' ANONYMITY AND CONFIDENTIALITY WILL BE MAINTAINED.  Participants will be given an individual number and will only be referred to by this number in any published articles/data. This will be such that the participant cannot be identified from the data published or in other ways viewed by those not involved in the research. The consent form which contains participants’ name will only be kept in a locked cabinet accessible only by the researchers in the study and only for at most 10 years.  Videos may be taken during the experiment only after given consent and may be used in publication with the result from the study. Both videos and ECG recordings will be stored digitally in the University of Glasgow’s open access database. Any publication to videos will be pixelated on participants’ face, so the identity of participants are kept confidential. |
| 11. DATE ON WHICH PROJECT WILL BEGIN AND END.  The project will begin in September 2021 and will end in December 2021. |
| 12. LOCATION AT WHICH THE PROJECT WILL BE CARRIED OUT.  CRE Lab, Level 3 Room 361, James Watt South Building, University of Glasgow. |
| 13. DESCRIBE HOW PARTICIPANTS WILL BE DEBRIEFED AT THE END OF THE EXPERIMENT (THIS MUST INCLUDE THE OPPORTUNITY TO CONTACT THE EXPERIMENTER - OR SUPERVISOR - FOR FEEDBACK ON THE GENERAL OUTCOME OF THE EXPERIMENT).  After all tests are concluded, the participants will be informed by a member of the research team of the reasons for the undertaking of the experiment and of how their results will be used/how they may impact later research. The participants will also be able to contact the research team at any time via phone, email, etc. to ask for further information on the use of the results or on the successfulness of the results. |