Project number

AO1

Project title

Realtime profanity filtering system for podcasting from live input in a noisy environment

Study leader

Mr Alex Oloo

Project concept note

The demand for live entertainment as well as distance education has been on the rise for the last decade. This demand has been further accelerated by COVID-19. Content creators do not have the time or resources to edit their content as a result lose out on revenue from platforms or sponsors with strict content guidelines.

Good engineering design can eliminate the need for content editors by automating the removal of profanity. Formant estimation and digital signal processing can be combined to achieve this outcome in real time with no human intervention, thus solving a very real problem in an elegant and efficacious way.

The challenge in this particular project will be to design and build a system that can isolate speech in a noisy background, estimate speech formants, and filter out prohibited words. This project involves the design and construction of an integrated system, the use of signal processing algorithms, the implementation of these algorithms on an embedded platform, and will require the student to master a significant amount of theoretical background. Implementation should be from first principles. This means that while algorithms will be based on literature, the implementation will be developed from scratch by the student and no libraries may be used for any core processing functionality.

The student will be expected to deliver a system that can filter out words from a predefined list of prohibited words in real time with a quality suitable for live streaming or radio broadcast. The student will design and implement the software algorithms to capture speech, filter profanity, and finally play back the clean output. The system performance must be compared to the relevant literature.

Note: Actual profanity is not to be used in this project, but rather appropriate substitutions.

Project number

AO2

Project title

Headphones with Active Noise Cancelling that deactivates in emergencies

Study leader

Mr Alex Oloo

Project concept note

With the rise of working and schooling from home, more and more families are finding the homes are not spacious enough. Having multiple individuals on separate video calls in the same room has proven to be problematic. Without a solution to this problem these living arrangements are no longer viable.

To allow families to work and learn together in peace headphones with active noise cancelling are to be developed. Parents cannot use any noise cancelling headphones as their parental responsibility requires them to be alert to danger or the needs of their children while they work. These headphones as a result need to be able to detect specific words such as a cry for help or the parents name and automatically shut off the noise cancelling so the parent can attend to the issues in their home, thus solving a very real problem in an elegant and efficacious way.

The challenge in this particular project will be to design and build a system that greatly attenuates environmental noise using active noise cancelling, listens for emergency words using formant estimation, and deactivates the noise cancellation should any emergency words be detected. This project involves the design and construction of an integrated system, the use of signal processing algorithms, the implementation of these algorithms on an embedded platform, and will require the student to master a significant amount of theoretical background. Implementation should be from first principles. This means that while algorithms will be based on literature, the implementation will be developed from scratch by the student and no libraries may be used for any core processing functionality.

The student will be expected to deliver an integrated system that can dynamically attenuate various noise sources using active noise cancelling (in real time) until emergency words are detected. The student will design and implement the software algorithms to suppress noise, capture speech, detect emergency words, and finally provide a noise free listening experience for the wearer. The system performance must be compared to the relevant literature.

Note: Ethics approval is required before testing with live subjects may be performed

Project number

AO3

Project title

A CCTV-connected vest that predicts points of impact from an attacker and hardens to protect the wearer

Study leader

Mr Alex Oloo

Project concept note

The current level of crime in South Africa has resulted in gated communities, a proliferation of closed-circuit television (CCTV) and numerous security guards. Though all of these deter criminals, they do not eliminate crime. Furthermore, they focus the risk on the security guards.

To increase the safety of security guards a protective vest connected to CCTV that shields them from impact from assailants is to be developed. The CCTV analyses the movement of the assailant, determines the point of impact on the guard and sends a signal to the vest to protect the guard by hardening at the site of impact or absorbing the blow, thus solving a very real problem in an elegant and efficacious way.

The challenge in this particular project will be to design and build a system that can detect human subjects in real time, analyse their movement, determine points of impact and lastly develop hardware that protects against the impact. This project involves the design and construction of wearable hardware that can change its physical properties, the use of computer vision, movement analysis and finally the implementation of these on an embedded platform. The project will require the student to master a significant amount of theoretical background. Implementation should be from first principles. This means that while algorithms will be based on literature, the implementation will be developed from scratch by the student and no libraries may be used for any core processing functionality.

The student will be expected to deliver an integrated and wearable system that can detect human subjects, determine the point of impact, and adapt its properties to protect against the impact. The system performance must be compared to the relevant literature.

Note: Ethics approval is required before testing with live subjects may be performed

Project number

AO4

Project title

A vest for runners that detects human threats in low light, sounds an alarm and uploads a picture

Study leader

Mr Alex Oloo

Project concept note

The current level of crime in South Africa makes running in some neighbourhoods particularly unsafe. The low light of the early morning or evening makes it difficult for runners to identify threats before it's too late. A number of runners do so music which eliminates the possibility of them hearing a possible assailant before it's too late.

To increase the safety of runners in low light situations a runner's vest that can identify people in low light environments, determine the likelihood of them being an assailant, and then deter the would-be attacker by sounding an alarm and taking a photograph of them.
Gait analysis and computer vision can be combined to reliably detect these assailants, thus solving a very real problem in an elegant and efficacious way.

The challenge in this particular project will be to design and build a system that can detect human subjects in real time in low light environments and analyse their gait to determine their threat level. This project involves the design and construction of wearable hardware, use of computer vision, gait analysis and finally the implementation of these on an embedded platform. The project will require the student to master a significant amount of theoretical background. Implementation should be from first principles. This means that while algorithms will be based on literature, the implementation will be developed from scratch by the student and no libraries may be used for any core processing functionality.

The student will be expected to deliver an integrated and wearable system that can detect human subjects and determine their threat level based on gait. The system performance must be compared to the relevant literature.

Note: Ethics approval is required before testing with live subjects may be performed

Project number

AO5

Project title

A school intercom system that filters inappropriate phrases and plays emails as announcements in the voice of the sender

Study leader

Mr Alex Oloo

Project concept note

With the changing nature of schooling and the rotational systems in place can no longer be taken for granted that teachers making announcements and the students hearing them are in the same physical location. Furthermore, it no longer makes sense to employ someone whose sole job is collating announcements and making them at the specified time.

Good engineering design can eliminate the need for announcers by allowing teachers to submit announcements via email and then broadcasting the announcement to the students in a voice that mimics that of the sender. Natural language processing, speech synthesis and digital signal processing can be combined to achieve this outcome in real time with no human intervention, thus solving a very real problem in an elegant and efficacious way.

The challenge in this particular project will be to design and build a system that can remove inappropriate phrases from text, convert it to human sounding speech, and play it back without any human intervention. This project involves the design and construction of an integrated system, linguistic analysis of text, the use of signal processing algorithms, and the implementation of these algorithms on an embedded platform. The project will require the student to master a significant amount of theoretical background. Implementation should be from first principles. This means that while algorithms will be based on literature, the implementation will be developed from scratch by the student and no libraries may be used for any core processing functionality.

The student will be expected to deliver a system that can linguistically analyse text, remove inappropriate phrases, convert the text to speech signal that is designed to sound like the sender, and play it back over a speaker system. The system performance must be compared to the relevant literature.