Special Projects for ESP1617

Last modified: May 8, 2017.

Each project can be selected by a single group of students unless otherwise noted.
Collaboration among groups for such projects is not allowed in any case.
Verbatim reuse of sample code you can find in software libraries, tutorials or other online sources is forbidden.
After selecting a project, a group should expand the short description provided into a full, 1-page project proposal.

The Next Generation of Addiction 4

Addiction 4 is an implementation of the well-known game "Connect 4" that collects data in the background for research purposes. In this project, the group will work to a radical redesign of "Addiction 4" data collection backend, including in-app data analytics. A second – but not secondary – key task of the group would be to ensure that the app operates correctly on a range of Android devices. In this sense, this project poses a unique, instructive challenge in software engineering.

https://doi.org/10.1109/IMCTL.2016.7753774

http://tesi.cab.unipd.it/49626/

The Brain of Cyber Robot [ASSIGNED]

Cyber Robot is a cheap, sensorless, toy robot that can be remotely controlled via Bluetooth LE. In this project, the group is required to reverse-engineer the communication protocol of the robot via the Bluetooth HCI snoop log, then build an app that guides it to reach a target object that is framed by the phone's camera. The most challenging part of the project will be the extraction and tracking of the target object from camera images by relying on computer vision techniques.
A robot will be provided by the instructor.

http://www.clementoni.com/it/13941-cyber-robot/
http://fte.com/WebHelp/Sodera/Content/Documentation/WhitePapers/BPA600/Encryption/GettingAndroidLinkKey/RetrievingHCIlog.htm

Panorama Stitching [ASSIGNED]

Design and implement an app that stitches multiple, partially overlapping images to build a single panoramic picture. Ideally, the stitching should be performed in real time from images taken via the Android Camera2 API (the iPhone does it in real time…).

https://goo.gl/8vz0io
http://docs.opencv.org/3.2.0/d8/d19/tutorial_stitcher.html
http://3dvision.princeton.edu/courses/COS429/2014fa/ps/ps3/
See also Chapter 9 of Richard Szeliski's book "Computer Vision: Algorithms and Applications", Springer, 2011.
https://www.youtube.com/watch?v=j6Gp2_bQcTg

Mobile Visual Search

Design and implement an app to recognize objects from images taken with the device camera. You can select among two different contexts for the project.

1. Disability context [ASSIGNED]: recognize everyday objects such as chairs, doors, lamps. The app targets visually impaired people, hence the name of the recognized object should be speak aloud (the Android TextToSpeech class can be readily adopted for this purpose).
   Motivation: https://goo.gl/U8kRie.
   Useful for training your classifiers: synsets from the ImageNet image database, e.g., http://image-net.org/synset?wnid=n03001627.

2. Business context [ASSIGNED]: recognize documents or commercial goods such as books.
   Motivation: https://developer.amazon.com/public/solutions/devices/fire-phone/docs/understanding-firefly.
   Useful for training your classifier: https://purl.stanford.edu/rb470rw0983.

The project can be selected by two groups of students – one group for each context.

The visual search algorithms must be run in the mobile device.

Further reference papers and links:
http://dx.doi.org/10.1109/MSP.2011.940881
http://tesi.cab.unipd.it/51999/

Multiple Exposure HDR Imaging [ASSIGNED]

Design and implement a camera app that captures a scene at different exposures, then blends the captured images into a single HDR picture, and finally applies tone mapping

to obtain an LDR image for conventional displays. The HDR and tone mapping algorithms must be run in the mobile device. In Android, the exposure can be manually set via the Camera2 API.

Exploration of HDR strategies different from Debevec and Malik's will be rewarded in the grading process.

http://docs.opencv.org/3.2.0/d3/db7/tutorial_hdr_imaging.html
http://docs.opencv.org/3.2.0/d6/df5/group__photo__hdr.html
https://goo.gl/s2XPN6

Denoising [ASSIGNED]

Implement and compare (image quality, execution time) multiple denoising algorithms. The algorithms must be run in the mobile device.

http://docs.opencv.org/3.2.0/d1/d79/group__photo__denoise.html

APP4ALL

L'accesso al mondo del lavoro per i soggetti con Sindrome di Down (SD) è ostacolato dalla necessità di un training in azienda per i nuovi lavoratori, che ne scoraggia l'assunzione. Per tale motivo, è nata l'idea di un'applicazione mobile (APP4ALL) che riduca il più possibile la fase di training e aiuti i lavoratori con SD a rendersi sempre più indipendenti nel mondo del lavoro. Il progetto vede la cooperazione del Dipartimento di Psicologia per lo Sviluppo e la Socializzazione e della Cooperativa Vite Vere Down Dadi.

La app è un'agenda delle attività lavorative che il lavoratore con SD deve effettuare. In particolare, l'operatore della cooperativa che segue l'inserimento del lavoratore dovrà organizzare le attività lavorative del ragazzo con SD; quest'ultimo potrà visualizzarle sul proprio dispositivo mobile e indicare il completamento o meno delle attività assegnate. L'esito dell'attività potrà essere visualizzato dall'operatore. Per incentivare il conseguimento delle attività lavorative, si è pensato a un sistema di premi (virtuali o reali). Dal punto di vista tecnico, la gestione delle attività da parte dell'operatore sarà effettuata tramite Google Calendar, e la sincronizzazione con la app tramite Android Calendar API.

De-Flicker
Implement a time-lapse app with de-flickering, or a de-flickering app for high-FPS videos.
Examples of flickering: http://youtu.be/lCpERztQGbk.

A recent paper on the topic of flickering, with bibliography and a proposed algorithm: http://dx.doi.org/10.1137/090766371.

High-FPS flicker:
http://youtu.be/bOnRKQAeinQ
http://youtu.be/3LFNXpqgYNg
http://youtu.be/96kmIa5Zwik
http://youtu.be/vBd9fu4lkTg
http://youtu.be/Zlv07fEaSD0
http://youtu.be/s5jSAHuIQV4

Time lapse flicker:
http://youtu.be/U_MG_29OrKc
http://youtu.be/t56jdLtke64
http://youtu.be/uA_WJ3AUA1s
http://youtu.be/JqgMcCoiOFg
http://youtu.be/evNhNw_9zRM

Common Issues in ESP1617

The group of students that tackles this project will

1. interact with all the other groups of fellow students,

2. collect the issues and difficulties faced by their fellow students, trying to cluster them into homogeneous sets,

3. propose possible solutions,

4. write a report on the issues, the solutions, and the outcome of the solutions.

Issues and difficulties can be both organizational and technical, hence at least one (better: more than one) of the members of the group must be familiar with Android (better: familiar with both Android and software engineering).

Removing Reflections

Analyze and implement the algorithm of Shih et al. to remove reflections from photos taken through windows.
Reference page, with source code: https://dilipkay.wordpress.com/reflection_ghosting/.