Fight the Pandemic: Highlights From the 2020 IEEE 5-Minute Video Clip Contest

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The annual IEEE 5-Minute Video Clip Contest (5-MICC) was launched by the IEEE Signal Processing Society (SPS), and the selected topic for the competition at the 2020 IEEE International Conference on Image Processing (ICIP 2020) was "Fight the Pandemic". Three finalist videos were selected by the organizing committee and placed online for public voting. The first one is about a visual analytic system for pandemic management, the second concerns machine learning screening of COVID-19 patients based on X-ray images, and the third deals with a COVID-19 test strip reader. Taking into consideration the public voting results from more than 800 participants, the panel of judges decided the final ranking of the three videos. In this article, we present an overview of the 5-Minute Video Clip Contest (5-MICC) at ICIP 2020, describing the competition setup, the teams, and their approaches. We also share our experience and the feedback we received from the finalists.

I. The topic

In the last year, the outbreak of the COVID-19 pandemic has disrupted the world as we knew it, endangering our health and, tragically, taking hundreds of thousands of lives. The disease has been a great equalizer, showing that in sickness we are all alike: in fragility, in suffering, in grief. We have erected barricades to protect ourselves, but the pandemic has disregarded our defenses and united us all, and united we must battle it. There has been a tremendous global medical and pharmaceutical effort to subdue this disease by seeking accurate diagnostics, effective treatment, and reliable vaccines. At the time of writing this paper, a number of vaccines are undergoing final development stages and schedules for their delivery to the most endangered sectors of the population have been announced. But fighting COVID-19 is not only about medicine; it is also about technology and how technologies can contribute to the fighting the pandemic. Many engineers, technicians, researchers, and scientists from our Society have participated in this fight (see e.g. [1]–[8]). The technologies developed have addressed, for instance, diagnosis of the disease [9]–[12], identification and tracking of infected people and regions [13], remote monitoring of patients, isolated hospitalized patients' communication with persons outside the hospital, controlling the spread of disease [14], and modeling of COVID-19 time-series data [15]. Novel solutions have been examined specifically to cope with the problems triggered by COVID-19.

When possible topics for the ICIP 2020 5-MICC were discussed, a resounding chorus was heard: "Fight the Pandemic". It was unanimously agreed to invite contributions presenting novel image and video processing approaches addressing any aspect that could help in fighting the COVID-19 pandemic. The submitted video could cover any role that image and video processing may play in the management of pandemics, including related areas. Suggested topics were: detection of the coronavirus, identification and tracking of infected people or people with fever in airports, image acquisition and processing for managing the pandemic, COVID-19 detection from chest X-rays (CXRs) and computed tomography (CT) images, new developments in medical diagnosis, treatment, and patient monitoring, as well as future directions for using image and video processing tools for analysis, modeling, and understanding pandemics. It was decided to also accept "open topic" video submissions, dealing with image and video processing for medical applications, even if they were not exclusively related to the pandemic. The rationale for this was to engage our very diverse community to put forward creative ideas. The open topic submissions would compete together with submissions under this year's chosen topic of Fight the Pandemic, and would be evaluated by the panel of judges with the addition of experts in the submitted open topic areas.

II. The contest

Since the 45th International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2020), the Signal Processing Society, through the Student Services Committee, has organized the 5-Minute Video Clip Contest (5-MICC). The objective of this competition is to promote the creation of video clips that highlight and convey excitement about signal processing in the broad sense - including fundamentals, image, video, audio, speech, communication, radar, language, knowledge, human and machine learning and other forms of information bearing data and signals. After the great success of the first run of the 5-MICC at ICASSP 2020 [16], the initiative was extended to the International Conference on Image Processing (ICIP). Of course, in the case of ICIP, the topic of the competition has to be related to video and image processing.

For each contest, the submitted videos focus on a particular topic that is selected from proposals received from IEEE SPS members and endorsed by one or more SP Technical Committees or Working Groups, with the aim that the topic

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will promote the field in a compelling and effective manner. The SPS Technical Committee (TC) Chairs will vote on the submitted proposal to determine the selected contest topic. The video competition also accepts "open topic" submissions, even if they are not related to the year's selected topic. The video must be original and cannot have been previously published, nor published during the competition period. The video must be submitted in English or with English subtitles and can only be submitted once. The rationale for this is to engage the broad Signal Processing community to put forward creative ideas. Open topic submissions will compete together with all yearly topic submissions.

The technical organizing committee of the contest for ICIP 2020, consisted of six members of the IEEE Technical Committee for Signal Processing Theory and Methods (SPTM), including Dr. Tirza Routtenberg (Ben-Gurion University of the Negev, Israel), Prof. Alberto Carini (University of Trieste, Italy), Dr. Emilie Chouzenoux (Inria Saclay, France), Prof. Piya Pal (University of California, San Diego, USA), Prof. Alejandro Ribeiro (University of Pennsylvania, USA), and Prof. Jose Bermudez (Federal University of Santa Catarina, Brazil).

The contest was open for submissions from IEEE SPS members, including undergraduate and graduate students of all majors, as well as researchers from all over the world. It was decided that each team should be composed of: (i) One faculty member (the Supervisor); (ii) at most one graduate student (the Tutor), and; (iii) at least three but no more than five undergraduates. At least three undergraduate team members had to be either IEEE SPS student members or SPS members by the time they submitted the full 5-minute video.

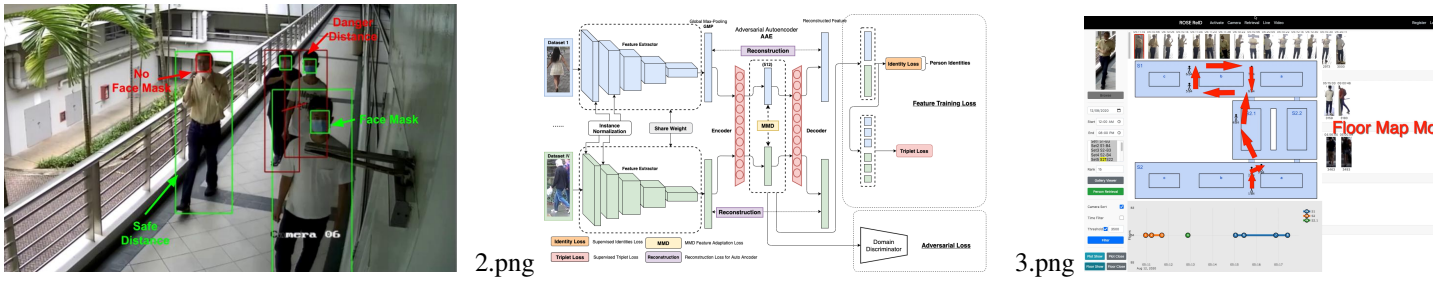
The call to the ICIP 2020 5-MICC consisted of three stages.

1) Submission of 30-second Trailers: The submission deadline was August 30, 2020. Each submission had to include a report, in the form of an IEEE conference paper, up to 2 pages, on the main idea/concept of the full video that was submitted with the related written script. The selected best teams, once identified, were invited to send the final 5-minute video to participate in the final competition.
2) Submission of the Full 5-minute Video: The submission deadline was October 10, 2020, and this stage culminated in the announcement of the 3 best videos on October 16, 2020. The three finalist teams were selected by the organizing TC.
3) The Final Contest was held at the ICIP 2020 virtual conference in the United Arab Emirates (25 - 28 October 2020). It was decided that voting would continue until October 23, 2020. Then, the final ranking was decided by the judging panel, also taking into account the popular vote.

III. The finalists

The winners and final team ranking were announced during the conference. The finalist teams and their final ranking were as follows.

- Visual Analytic System for Pandemic Management During COVID-19 (the winner)
  - Affiliation: Nanyang Technological University
  - Students: Shan Lin, Fu Long Tan, Chen Hongyu, Kuan Yang Tang, Yingtian Tang, and Nemath Ahmed.
  - Supervisor: Prof. Alex Kot
  - Technical Approach: The proposed visual analytic system for pandemic management utilizes artificial intelligence (AI) models to address two critical problems in the monitoring and managing of the disease: 1) the attire of a face mask and social distancing management; and 2) the surveillance and movement path tracing of individuals. By using face detection, pedestrian detection, and face mask classification models, the system can proactively monitor the area and raise an alarm on detecting either social distancing violation or people without a face mask. The surveillance and path tracing functions are developed based on the Multi-task Mid-level Feature Alignment with Adversarial Auto-Encoder (MMFA-AAE) person re-identification models. The MMFA-AAE model aims to learn a well-generalized universal representation of pedestrians in any unseen system. It alleviates the domain difference via adversarial training and also matches the distribution of the mid-level features across multiple datasets. With the help of the MMFA-AAE models, quick searches can be performed. The proposed visual analytic system enables 24/7 monitoring and delivers actionable intelligence with in-depth insights to combat the spread of COVID-19. The technical approach is demonstrated in Fig. 1.
- Machine Learning Screening of COVID-19 Patients Based on X-ray Images for Unbalanced Classes (second place)
  - Affiliation: Qatar University
  - Students: Ilyes Mrad, Hatem Jebari, and Amine Ghattasi
  - Supervisor: Prof. Ridha Hamila
  - Technical Approach: Efficient detection of infected patients is a key phase in the battle against COVID-19. Standard chest X-ray images aid to detect suspected cases at an early stage. However, the images of different viral cases of pneumonia are typical and overlap with other inflammatory lung diseases. The goal of this approach is to use chest X-ray images to detect COVID-19 pneumonia patients while optimizing detection efficiency. The group proposes a deep convolution neural network-based transfer learning approach to automatically identify COVID-19 cases using an unbalanced dataset of chest X-ray images. The fundamental challenges to solve are: 1) How to design a model that can detect COVID-19 cases without any human-supervision. 2) How to deal with the unbalanced dataset and especially with the low number of COVID-19 samples. 3) How to improve a model that has already produced a good performance in terms of accuracy and sensitivity. The proposed



(a) (b) (c)

Fig. 1. The video for Visual Analytic System for Pandemic Management During COVID-19: (a) Identifying people with/without face masks and safe/dangerous distancing ; (b) an overview of the MMFA-AAE framework for Person Re-ID multi-domain generalization; and (c) floor map movement tracing.

model combines three techniques named: Convolution Neural Network, transfer learning, and the focal loss function to build three binary classifiers, which are COVID-19 versus Normal, COVID-19 versus pneumonia, and COVID-19 versus Normal Pneumonia (Normal and Pneumonia). The focal loss is aimed at addressing the scenario of object detection where there is a radical imbalance between classes. The performance of different networks was evaluated utilizing five metrics which are the average accuracy, sensitivity, specificity, precision, and F1-score using 10-fold cross-validation. Some challenges tackled by the proposed method are presented in Fig. 2.

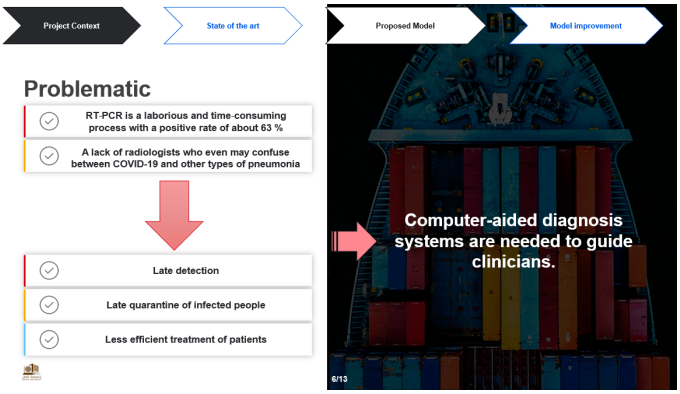


Fig. 2. Machine Learning Screening of COVID-19 Patients Based on X-ray Images for Unbalanced Classes: Project overview.

- COVID-19 Test Strip Reader (third place)
  - Affiliation: Nanyang Technological University
  - Students: Annan Wang, Xinyu Wang, and Rui Li
  - Tutor: Jingwen Hou
  - Supervisor: Prof: Weisi Lin
  - Technical Approach: This project aims to provide an automatic tool for reading the results from images of COVID-19 test strips. There are two essential problems to be solved. First, the likelihood of infection is hard to quantify merely from the grayscale intensities of test bands due to illuminance variation. Thus, the proposed approach quantifies the likelihood of infection by the ratio of the grayscale intensity of test band to control band, and hence the grayscale intensity can be automatically extracted by the proposed method. Second, the test band and control band need to be accurately detected for correct readings. Therefore, inspired by the Quick Response (QR) code, robust detection of test bands and control bands is realized by taking advantage of a positioning template with position markers. Each test strip is associated with a predefined positioning template. By taking a picture of the test strip correctly placed on the positioning template, the proposed image processing algorithm can robustly detect the position markers, and locate the diagnostic signals (i.e. test band and control band) on the test strip accurately in order to compute the viral load. An example of the proposed approach is shown in Fig. 3.

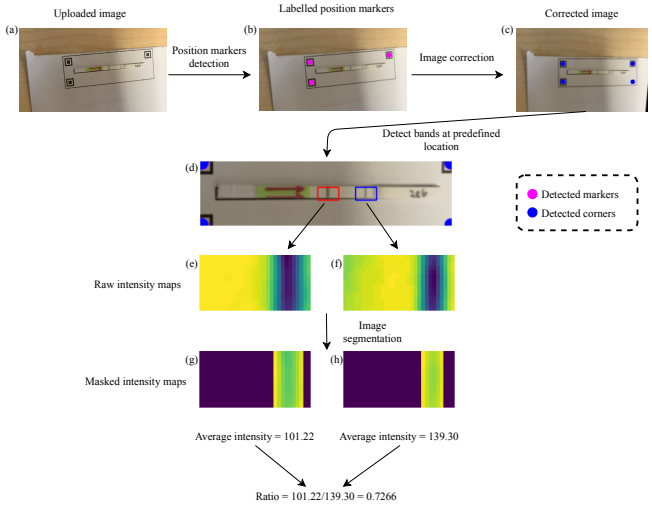


Fig. 3. COVID-19 Test Strip Reader: Schematic example of the detection process

IV. Summary

As a new event launched by our SPS, the 5-MICC has proved to be a success in terms of public engagement, as seen from the large number of public votes cast for the three finalist videos. Due to the COVID-19 pandemic, the contest was virtual. The topic of this contest has been chosen as part of our research community effort for the public good

and as part of the SPS vision: ”being intimately involved in the education of signal processing professionals at all levels”. When organizing a novel 5-MICC, the timeline should take into consideration the time required for preparing for the submission and advertising. The 5-MICC has been highly appreciated by our community and we look forward to more contests next year, at ICASSP 2021.

V. Acknowledgments

We would like to thank all the participating teams at the 5-MICC for their valuable contributions, without which this event would not have been possible. We are also grateful to the IEEE SPS staff, particularly Jaqueline Rash, who provided crucial help with the preparation and handling of the contest, and Prof. K. V. S. Hari, Chair of the SPS Membership Board. We also thank ICIP General Chairs, Prof. Moncef Gabbouj and Prof. Mohammed Al Mualla, and the Student Activities Chair, Prof. Gozde Bozdagi Akar.

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