Executive Summary

What are the key takeaways?

- The Facial Emotion Recognition or FER is a technology with a lot of potential for many applications, in this case for clinical psychology emotion detection

- CNN is the best approach for facial emotion classification because of its potential to extract features and important characteristics from an image

- The different models and its performance is strongly related to the amount and quality of data, in this case, images that we can have for each one of the emotions. The small quantity of images and the poor quality of them in a dataset make complex models, as vgg16 or resnet to underperform, so for this dataset that we used in our project we build up a custom model with CNN and fully connected blocks that for this case can perform better.

- The solution can be deploy with actual hardware or in cloud application for the implementation at the office of the clinical psychology team

Executive Summary

What are the key next steps?

- The system implementation and cost estimation.

- The whole system deployment that will be composed of 02 HD cameras and a computer with internet connection (it is assumed that the premises already has internet connection) to run the system from it, the camera will take pictures of a person every 5 seconds in the first deployment and analyze the emotion at that moment in a 45 minute session of consultation or interview. Generating a time annotated list with the emotion detected report to be evaluate by the psychologist after finish the interview.

- Better interpretation of the interviewee emotions is expected with the system as a help to psychologist team. The psychologist should evaluate the report for a better assessment of the patient or interviewee.

- Keep training the model with more images sets to improve its performance.

Problem and Solution Summary

What problem was being solved?

- The problem to solve is quite an important one, that is facial emotion expression recognition, as this play a vital role in non-verbal communication. It can help to detect intentions, map behaviour, mental state, customer engagement, personality and many other characteristics of a person that sometimes are not reading by a human in a fast way.

- These technology make possible to detect potential emotions in a person and make possible a more efficient communication and diagnostic.

- In this project we implement a solution for facial emotion recognition for a Gesell chamber (Appendix A.1) in a clinical psychology office in where the practitioners psychologists want to detect the facial emotions and improve the recognition of the sentiment of the interviewees and patients for a better diagnosis or assessment.

Problem and Solution Summary

Final proposed solution design

- Finally we come with a solution for the facial emotion recognition for the dataset gave with a model of a complex neural network using the type model sequence.

- It was proposed an ANN using CNN, the model is composed of 7 CNN blocks and 2 fully connected blocks. The complexity was reduced from the ANN proposed in the milestone 2 in order to increase the accuracy of the model a little bit. All the input images has been converted to grayscale for reducing complexity and training times.

- The other models as VGG16 and even a resnet implementation that was modeled for comparison were not able to achieve the same or better performance than the ANN proposed.

- So the final proposed design chosen was the ANN that layout the best performance

Problem and Solution Summary

Why is this a 'valid' solution that is likely to solve the problem?

- This is a valid solution using the dataset given as it is an small number of images and for the training purposes and fine tuning is the faster one, besides that offer the best performance for this dataset.

- The ANN proposed using CNN blocks in its structure make the model to be able to identify and extract features that in conjunction are specifics for a type of facial emotion expression.

- That is why the reason of using a Convolutional Neural Network model will give the best classification performance as it can identify and correlate the fine details of each facial expression.

Recommendations for Implementation

What are some key recommendation to implement the solution?

- The deployment for the solution is a key factor and the automation of it with the less of intervention from the user. So the system should work just with the push of a button to start and when the interview is finished, the system shows the final report.

- The use of the reports as an assessment for the clinical psychologist as a help in the diagnostic, not to replace the psychologist.

What are the key actionables for stakeholders?

- Improving in Health Care Practice (HCP) as the clinical psychologist team can make better and more precise diagnosis of the patients and interviewees, giving this an increase in consultation fees and quantities for a better and more precise service.

- Improve the assessment of each one of the consultations or interviews as the FER system will generate a report of the possible emotions expressed by the patient or interviewee that can be critical in a trial or in psychology evidence when the Gesell chamber is used.

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- Expand the business to other areas as marketing research in product and experience evaluation research to determine customer engagement using focus groups.

Recommendations for Implementation

What are the expected benefit and/or costs?

- The cost for the system implementation will be base in the hardware that will be 2 HD cameras (Appendix A.3), the PC and the google cloud service making a total of fix cost of 1684 USD plus a 168 USD per month for google cloud services. (Appendix A.2)

- Benefit will be the increase on services consultations and interviews in quantity and fee as more precise diagnosis could be delivered by the psychologists team.

- Enter to new markets as psychology applied to customer behaviour in marketing research

What are the key risks and challenges?

- A key risk it could be about data privacy as not all people allow or are ok to be taken images of its face and keep it recorded unless it is a Gesell's chamber's interviewee in which it is mandatory. This risk needs to be minimized, for example explaining to the people that the images will not be kept and to get its consent.

- A challenge will be to keep the image data of the persons's face safe during and after the interview or consultation as it is personal private data that should not be shared.

Recommendations for Implementation

What further analysis needs to be done or what other associated problems need to be solved?

For further analysis:

- Improvement of the model performance feeding the model for new training with more datasets, more images of facial emotions

- Usage of other model or toolboxes like py-feat to work in conjunction with our actual model to improve performance

- A cost reduction and protection of the data improvement could be the deployment of the model in an embedded system like a jetson nano (Appendix A.4) that is one payment of 199 USD instead of a monthly payment with google cloud of 168 usd.

- On potential analysis will be to extend the application of the system in the association of facial emotions or expressions with mental disorders, stress, anxiety, depression, criminal behaviour, lies telling, trauma of a victim and others to identify potential threads in the patients or interviewees that could be with the right psychology assessment key for a diagnosis or evidence for a trial.

- It will be interesting to use thermal imaging or multispectral imaging cameras to make a model using this type of inputs that can detect emotions in wider range of features and characteristics, in this case will be need to use multi channel imaging and relate the outputs with emotions outpus detected from the standard RGB cameras images for further analysis

Associated problems need to be solved:

One associated problem is for the security of the data protection need to analyzed deeply to avoid any potential breach as information is moving through the network
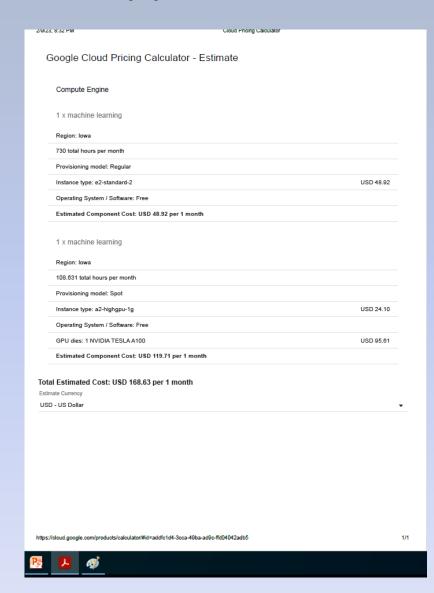
Recommendations for Implementation

Associated problems need to be solved:

- One associated problem is for the security of the data protection need to be further analyzed to avoid any potential breach as information is moving through the network.

- The overconfidence in the predictions of the system so the team can assume that the system is doing all the work 100% right and left the human assesment on the side. It is very important that always the psychologist team, evaluate the data output from the system with their own insights to increase the precision of a diagnosis or a potential problem in a patient or interviewee. And to give feedback to the system too to correct potential error in the early stages of the system deployment

Appendix

A.1: Gesell Chamber

A.2: HD Camera

Google Cloud Pricing Calculator - Estimate

Compute Engine

1 x machine learning

Region: Iowa

730 total hours per month

Provisioning model: Regular

Instance type: e2-standard-2   USD 48.92

Operating System / Software: Free

Estimated Component Cost: USD 48.92 per 1 month

1 x machine learning

Region: Iowa

108.631 total hours per month

Provisioning model: Spot

Instance type: a2-highgpu-1g   USD 24.10

Operating System / Software: Free

GPU dies: 1 NVIDIA TESLA A100   USD 95.61

Estimated Component Cost: USD 119.71 per 1 month

Total Estimated Cost: USD 168.63 per 1 month

Estimate Currency

USD - US Dollar

A.3: Google Cloud service price per month

A.4: Jetson Nano