AI Lie Detector

COMPGC27 – Programing for Business Analytics

Group Project Report

Group 2

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1 Introduction

Lie detection is not a new idea but rather a technique that humans have always wished to obtain, but yet to discover the best one. In the past decades, there has been plenty of research of different methods, leading to many products for the market. To list a few, people have tried to use polygraph, voice stress analysis, brain observations electroencephalography (EEG) and even drugs in the past. However, none of these have been very reliable in telling lies and truths apart. A well-trained person could easily deceive the method, especially when lying about something less important (i.e. white lies). Today, lie detection is mainly being used in law enforcement, and the “most reliable” method being used has mostly remained unrevealed to avoid educating the criminals.

Micro-facial expression recognition has evolved over the last couple of years and has been reliable enough to build intelligent systems on top of them. Many researches have suggested that frequency, duration and intensity in micro-facial expressions, using the Facial Action Coding System (FACS), can function as a good signal of deception. Some gestures are simply hard to control when one is nervous lying or tend to be overdone when the deceivers are trying too hard to hide.

Given this, we decided to create and develop an interactive web application that uses this theory to detect lies, using micro-facial expression recognition technology and machine learning algorithms. Our goal is to allow people to have access to lie detection technology using only their laptops, without having to invest in any special equipment. We believe that there is a huge business potential for this application, as this technology can be utilized in many different areas such as education, recruitments, consulting, etc.

2 Methodology

AI Lie Detector is an interactive web application that uses machine learning algorithms to detect whether a person is telling the truth or a lie. For this, we use the commonly played ice breaker game Two Truths and A Lie. The application will present 3 questions to a person, who has to answer two with the truth and one with a lie. Then, our AI Lie Detector will try to guess in which question the person lied on using micro-facial expression recognition technology.

Using this game-like setup, we are capturing and storing a lot of expression data from people playing it, allowing us to train a machine learning algorithm which will lead to it being able to pick up the main characteristics of a lying person, thus improving in its ability to detect a liar.

Approaching this product development in an evolutive way, this stage is going to be regarded as phase zero where we created the baseline of the application, and further improvements will come in the form of context-aware questionnaire videos, data acquisition analysis and improved model selection after more data has been accumulated.

The design and development of the phase zero of AI Lie Detector has been done using python, and can be separated in three main parts: the front end, the data storage and the modelling.

2.1 Front end

The front end of AI Lie Detector consists in a simple web page that allows interaction between the application and the user. It uses Flask, a simple python web framework, to display and handle all the data and events.

It starts with an initial page that displays the instructions of the game, a button that initializes the camera to do the real-time capturing of facial expressions, and a button to start the game. When the page is loaded, we assign a unique session id and retrieve 3 random questions from the database. More detail about this part will be explained in the Data Storage section.

For the facial expression analysis, we use two existing public and free APIs: Facial Expression Analyzer by Affectiva[1] (affdex) and Eye Gazer Tracker by xLabs[2] (eyetracker). Both of them uses the camera (no mic) to do real-time analysis, and return the results in a table format with timestamps. The affdex API gives you, for each timestamp, a list of facial features and expressions, such as joy, anger, smile or openness of mouth (full list in the appendix), with a number between 0 and 100 that indicates how present is the feature in the person's face. Similarly, the eyetracker API give you, for each timestamp, the coordinates within the screen where the person was looking.

In terms of privacy, it is important to note that we send only image data (no audio) to these API, and that we nor them store any video or picture but only text data with the results.

[1] https://affectiva.readme.io/docs/using-the-emotion-sdk

[2] http://xlabsgaze.github.io/docs/home.html

Once the user has started the camera and the connection is made between the AI Lie Detector and both API, the “Give it a try!” button activates.

Once started, the user will be presented with 3 questions. For each question, they will have 3 seconds to read the question and then 10 seconds to make an answer. This is important, because although we store the data from the whole 13 seconds per question, only data collected within the 10 second window to answer will be used in our analysis. We have figured that the facial expressions between questions are not accurate, as there are possibilities that the user may have not “reset” their emotions from the last question or that they are laughing at the new question as they simply find it funny.

Once finished, we retrieve all the information from the affdex and eyetracker API and store it in the database using the session id. Also, we send it to a predictive function that uses a pre-trained model to guess in which question (1, 2 or 3) the user lied on. We then store this prediction in the database.

Lastly, the user is presented with the 3 questions he was asked, and the one the model predicted as a lie colored differently. Also, the app will ask the user to confirm in which question he actually lied on. This answer allows us to correctly “label” our data with the correct answer, thus helping in the collection of data for training purposes.

The Figure 1 is a simplified diagram showing the flow of our application. The detailed sequence diagram can be found in the Appendix A.

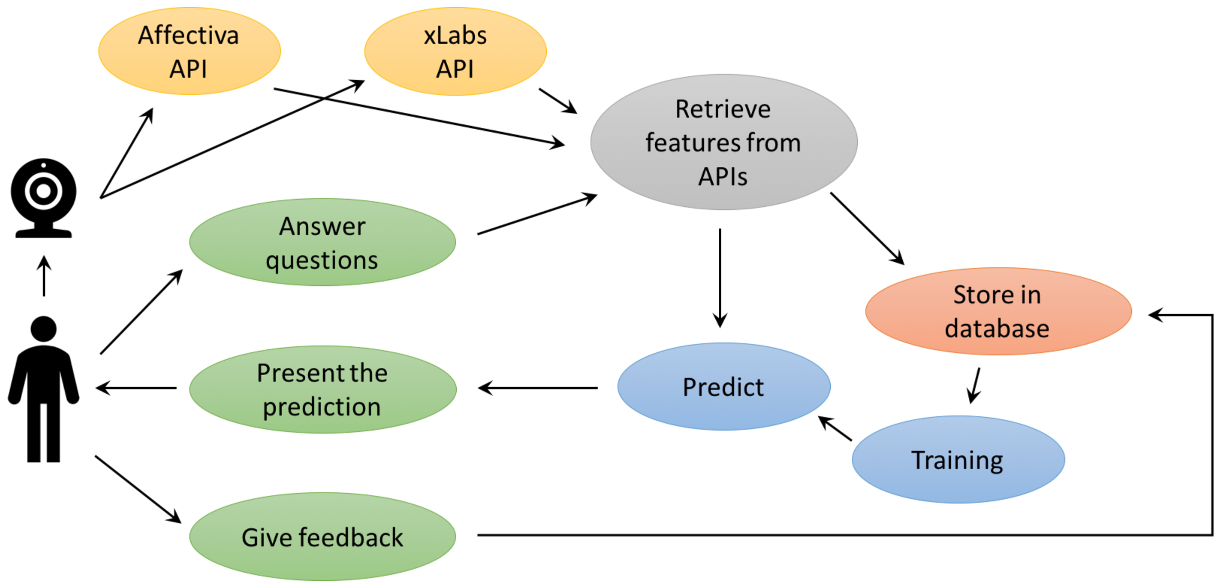

Figure 1: Use case diagram of the AI Lie Detector.

2.2 Data storage

For the data storage, we use a mysql database and a python script to process it and interact with the database engine.

The database is composed of six tables: Question, Session, Session_question, LogEvent, Expression, and Gaze. Except for Question table, all the other tables are real-time updated, which means once a piece of new data is generated and collected it will be inserted into a specific table. Among the tables, LogEvent, Expression and Gaze are used for storing user activities/features data captured by the APIs. The Entity Relationship diagram is shown in Figure 3 which illustrates the relationship between entities and the attributes of each entity.

Question: There are 23 test questions stored in this "Question" table (see Figure 4) with each assigned a question ID. This table is static and will not be frequently changed. The three questions in each test will be randomly selected from this table.

Session: Once a user enters the system and conducts a test, we call it a session. This "Session" table (see Figure 5) stores the ID of all user Sessions along with its *timestamp* (the time the user starts doing the test).

Session_question: There are 3 questions within each session, and each question is a unit to train the model. This "Session_question" table (see Figure 6) keeps an account of the three questions in each session (by assigning each question a unique *sessionQuesID*) together with its corresponding *sessionID*, *questionID*, *sequence* (the order of the three questions in a test, with a value equaling to 1,2 or 3), *pLabel* (the answer predicted by the model) and the *tLabel* (the ground truth provided by the user on whether the answer to the question is a lie or not). This table is the core table of the database as it connects other tables in our system. *sessionID* and *questionID* are the foreign keys from "Session" table and "Question" table. Attribute *sessionQuesID* also acts as a foreign key which appears in "Expression" table and "Gaze" table (discussed later). This helps retrieve each user's expression data for each question to train our model.

LogEvent: For each session, this table (Figure 7) keeps a record of the timestamps of the individual activities within the session. Specifically, it stores the start time and the end time for each test as well as for each question, and this helps assign a *sessionQuesID* for each record in Expression table and Gaze table.

Expression: This table (see Figure 8) keeps track of facial expression data which is captured every 50 milliseconds by affdex API. Each facial expression data contains 34 attributes which can be used to analyze the user emotion. Apart from that, *sessionQuestionID (assigned by comparing the expression timestamp with timestamps in LogEvent table)* will also be included in each tuple so that different tables can be connected for further analysis.

Gaze: This table (see Figure 9) records users' eye gaze data captured every 60/70 millisecond by eyetracker API. It tracks coordinates (*x*, *y*) of gaze and *confidence* of the result. Similarly, this table also contains *sessionQuestionID* and *timestamp*.

2.3 Modelling

The modelling part can be separated in 3 stages: data cleaning and preprocessing of raw data, training a machine learning algorithm and predicting the question in which a user is lying.

2.3.1 Data cleaning stage

As explained before, all the data provided by the affdex and eyetracker API are grouped with the same question and session id. The affdex API gives around 20 rows of data per second (timestamp) and more than 30 gesture variables such as joy, anger, surprise, smile, chin raise, lip press, etc., which means that for each question, that lasts for 10 seconds, we have a 200 x 30 matrix of data. This is why a cleaning process and dimensionality reduction techniques must be used.

When we first looked at the raw data, we checked the relevance of each feature of the data to our application purpose. We then manually decided to filter out irrelevant data such as age, ethnicity, gender, glasses etc. Also, the data collected by the eyetracker API has shown to have very low accuracy, thus for this first version of the application we have excluded it from the modelling. Here we ended up with 30 features for each row (timestamp) of data.

Afterwards, we reduced the number of rows of data by dividing them into 10 groups (each group tries to represent each second), and take the mean for each of the features or columns. With this, we ended up with 10 rows of data, each one with 30 features.

Lastly, we reshape all the data to 1 row and 150 features - similar to the data manipulation for image recognition - which is then loaded into our models as the X variables.

2.3.2 Training stage

After cleaning the data, we used it to train our model. Because of the limited data we had for training at this stage, we chose to construct four machine learning algorithms and make them compete in accuracy:

1. Support Vector Machine Classifiers
2. Random Forest Classifiers with Adaboost
3. Logistic regression with Adaboost
4. Decision Tree Classifier with Adaboost

Each model will use the 150 features (X) to determine whether the user lied or not in that question ($Y \in \{0,1\}$). The training stage will run once per day, using all the labeled data available in the database. During this stage, all 4 models will be trained, and each one will have an accuracy score. At the end, the model with the best accuracy will be selected, and it will be saved using pickle as the best model of the day.

2.3.3 Predicting stage

When a user is using the lie detector, the application will send only the data of the current session (data associated with the 3 questions presented to the user) to a predicting function. This function will, as in the training stage, clean and preprocess the data to prepare it to the model. Then, it will load the model saved with pickle (the one with highest accuracy), and use it to estimate the probability of each question being a question answered with a lie. Finally, the function will return the number of the question (1, 2 or 3) with the highest probability of being a lie. In case of more than one answer having the same highest probability, then there will be a random selection among them to return it to the user.

2.3.4 System limitations

One issue we have faced in our project is that we didn’t have big enough data to train our models well before the due date. Therefore, we have included more modeling methods and have come up with our daily training model as some different model works different with different size of training data set. However, our all models we built do have shown to be capable to learn by themselves, thus we do have confidence that the accuracy will improve as the data size increase.

While many research has suggested the eye gaze is a good indicator of deception, we have faced issue in incorporating the data collected by the eyetracker API, as the accuracy was just too low. It has roughly been able to tell which direction the user is looking at (left/ right), but the data would be a mix of the user reading the question and gazing around as a subconscious reaction of lying. We eventually had to give up incorporating those data in our model regretfully. However, we do know that there are similar products with higher accuracy available in the market that are not free, and could definitely improve our application.

3 Project management and retrospective

From the start of the project, we have been using scrum methodology in an agile style by doing bi-weekly meetings in order to define milestones for the project and individual tasks to be completed. Starting from thinking about ideas to be developed, to research of papers, possible software components and APIs to get data for the goal of lie detection, definition of questions to provoke emotional reactions, development of web interface and documentation writing.

Although we separated the development of the project in 3 main tasks, we discussed everything we did with everyone, because of two main reasons. First, it is one project. We had to communicate what we were doing so that, at the end, the connection of all parts would be done smoothly. And secondly, we all helped each other with both technical knowledge as well as ideas of how to develop each one parts.

The main tasks of this project and the members responsible of them were:

a) Brainstorming ideas: All members
b) Front end design and user interface: Diego, Jorge
c) Data cleaning and modelling: Leila, Jenny
d) Database structuring and storage: Weisi, Xing
e) Report and presentation: All members

4 References

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Reed, Lawrence Ian. Zeglenb, Katharine N. and Schmidtc Karen L. “Facial expressions as honest signals of cooperative intent in a one-shot anonymous Prisoner's Dilemma game”. *Evolution and Human Behavior*, Volume 33, Issue 3, May 2012. https://www.sciencedirect.com/science/article/pii/S1090513811001012 [Accessed on 4 Nov 2017]

Ordóñez, Francisco Javier and Roggen, Daniel. “Deep Convolutional and LSTM Recurrent Neural Networks for Multimodal Wearable Activity Recognition”. January 18, 2016. http://www.mdpi.com/1424-8220/16/1/115 [Accessed on 2 Dec 2017]

Thomas O. Meservy, Matthew L. Jensen, John Kruse, Judee K. Burgoon, and Jay F. Nunamaker Jr Meservy, Thomas O. Jensen, Matthew L. Kruse, John. Burgoon, Judee K. and Nunamaker Jr, Jay F. “Deception Detection through Automatic, Unobtrusive Analysis of Nonverbal Behavior”. https://www.researchgate.net/publication/3454301_Deception_Detection_through_Automatic_Unobtrusive_Analysis_of_Nonverbal_Behavior [Accessed on 19 Nov 2017]

Frank, Mark G. & Feeley, Thomas Hugh. “To Catch a Liar: Challenges for Research in Lie Detection Training” *Journal of Applied Communication Research*, 31:1, 58-75, 10 Jan 2011. http://www.tandfonline.com/doi/abs/10.1080/00909880305377 [Accessed on 20 Nov 2017]

Appendix A Installation guide

A.1 Download link

All the code of this project is located in the following github repository:

https://github.com/joalarcondiaz/ba_app

A.2 Pre-requisites

1. Google Chrome
    a. xLabs Head/Eye/Gaze Tracker extension for chrome. You can install it from this link: https://chrome.google.com/webstore/detail/xlabs-headeyegaze-tracker/emeeadaoegehllidjmmokeaahobondco

2. Python 3.5 with the following packages installed:
    a. flask
    b. numpy
    c. scipy
    d. pymysql
    e. scikit-learn

3. [Optional] A mysql database server with a user named "root" and the password "weisi9527sj". An example of commands you can execute under linux to initialize the database are shown below.
    a. Start the database server: `sudo service mysql start`
    b. Go to the folder "mysql" within the application folder: `cd <appfolder>/mysql`
    c. Execute the database creation query: `mysql -u root -p < create_db.sql`
    d. Load some already collected data in csv format to the database: `python3 load_first_data.py`

Note: For using the application, a mysql database is not mandatory, as the repository already comes with some data in csv format to train the model.

A.3 Starting the app

To start the application, you need to run the p4ba_app.py file with the command "`python3 <appfolder>/p4ba_app.py`" and wait for around 1 minute to initialize. When it is ready, the following message will appear: "Running on http://0.0.0.0:5000/".

After that, you just need to open google chrome, navigate to the url: http://127.0.0.1:5000/ , and start using it!

Appendix B AI Lie Detector sequence diagram

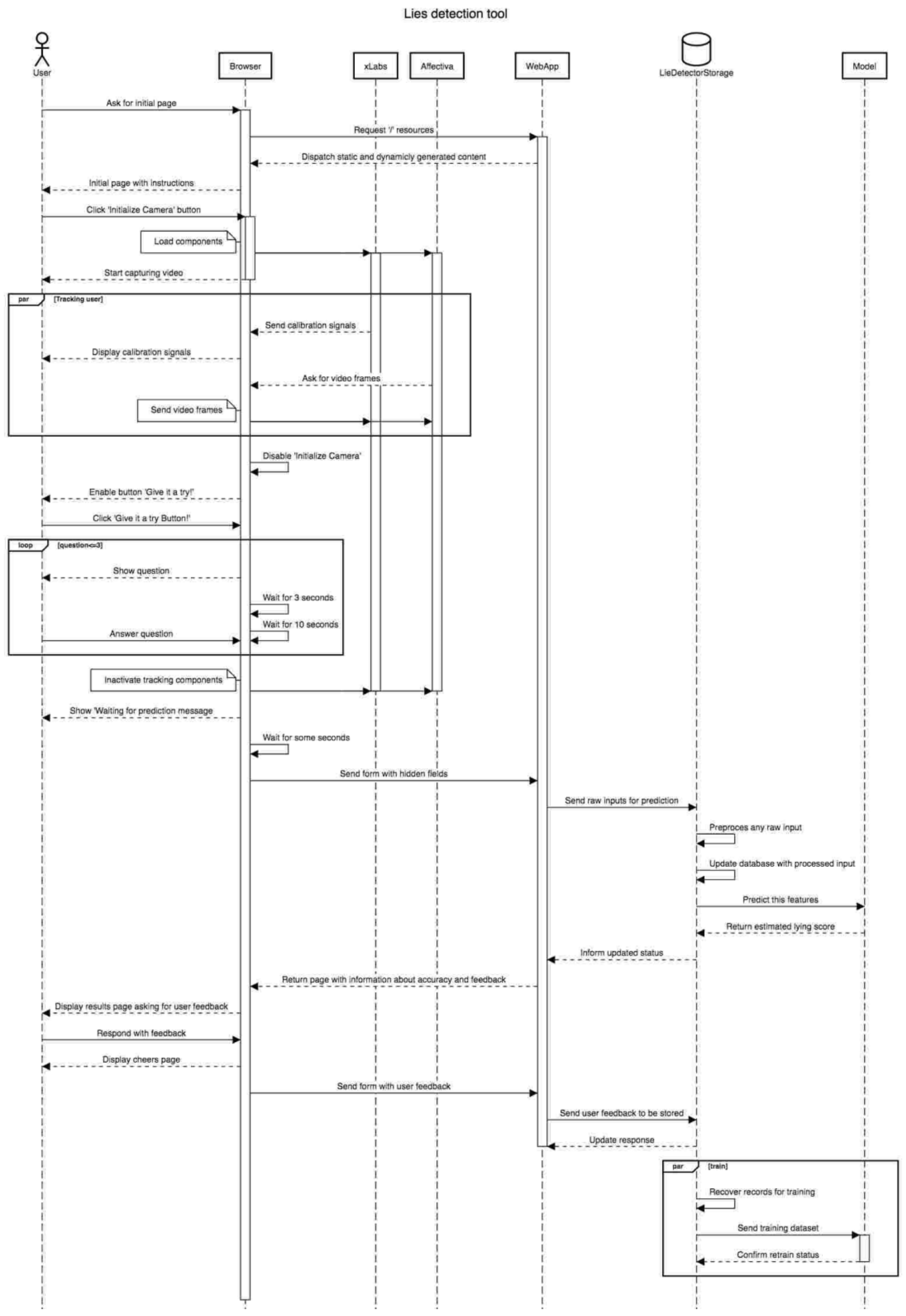

Lies detection tool
User
Browser
xLabs
Affectiva
WebApp
LieDetectorStorage
Model
Ask for initial page
Request '/' resources
Dispatch static and dynamicly generated content
Initial page with instructions
Click 'Initialize Camera' button
Load components
Start capturing video
par
[Tracking user]
Send calibration signals
Display calibration signals
Ask for video frames
Send video frames
Disable 'Initialize Camera'
Enable button 'Give it a try!'
Click 'Give it a try Button!'
loop
[question<=3]
Show question
Wait for 3 seconds
Wait for 10 seconds
Answer question
Inactivate tracking components
Show 'Waiting for prediction message
Wait for some seconds
Send form with hidden fields
Send raw inputs for prediction
Preproces any raw input
Update database with processed input
Predict this features
Return estimated lying score
Inform updated status
Return page with information about accuracy and feedback
Display results page asking for user feedback
Respond with feedback
Display cheers page
Send form with user feedback
Send user feedback to be stored
Update response
par
[train]
Recover records for training
Send training dataset
Confirm retrain status

Figure 2: AI Lie Detector sequence diagram.

Appendix C Full list of features captured from affdex API

Feature	Measurement descriptions
gender	Supported classes: Male/ Female/ Unknown
glasses	Used probability to calculate confidence level of the existence of glasses in the image.
age	Supported ranges: Under 18, from 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 Plus.
ethnicity	Supported classes: Caucasian, Black African, South Asian, East Asian and Hispanic, Unknown
joy	Score ranged from 0 (no expression) to 100 (expression fully present)
sadness	Score ranged from 0 (no expression) to 100 (expression fully present)
disgust	Score ranged from 0 (no expression) to 100 (expression fully present)
contempt	Score ranged from 0 (no expression) to 100 (expression fully present)
anger	Score ranged from 0 (no expression) to 100 (expression fully present)
fear	Score ranged from 0 (no expression) to 100 (expression fully present)
surprise	Score ranged from 0 (no expression) to 100 (expression fully present)
valence	Score ranged from 0 (no expression) to 100 (expression fully present)
engagement	Score ranged from 0 (no expression) to 100 (expression fully present)
smile	Score ranged from 0 (no expression) to 100 (expression fully present)
innerBrowRaise	Score ranged from 0 (no expression) to 100 (expression fully present)
browRaise	Score ranged from 0 (no expression) to 100 (expression fully present)
browFurrow	Score ranged from 0 (no expression) to 100 (expression fully present)
noseWrinkle	Score ranged from 0 (no expression) to 100 (expression fully present)
upperLipRaise	Score ranged from 0 (no expression) to 100 (expression fully present)
lipCornerDepressor	Score ranged from 0 (no expression) to 100 (expression fully present)
chinRaise	Score ranged from 0 (no expression) to 100 (expression fully present)
lipPucker	Score ranged from 0 (no expression) to 100 (expression fully present)

Feature	Measurement descriptions
lipPress	Score ranged from 0 (no expression) to 100 (expression fully present)
lipSuck	Score ranged from 0 (no expression) to 100 (expression fully present)
mouthOpen	Score ranged from 0 (no expression) to 100 (expression fully present)
smirk	Score ranged from 0 (no expression) to 100 (expression fully present)
eyeClosure	Score ranged from 0 (no expression) to 100 (expression fully present)
attention	Score ranged from 0 (no expression) to 100 (expression fully present)
lidTighten	Score ranged from 0 (no expression) to 100 (expression fully present)
jawDrop	Score ranged from 0 (no expression) to 100 (expression fully present)
dimpler	Score ranged from 0 (no expression) to 100 (expression fully present)
eyeWiden	Score ranged from 0 (no expression) to 100 (expression fully present)
cheekRaise	Score ranged from 0 (no expression) to 100 (expression fully present)
lipStretch	Score ranged from 0 (no expression) to 100 (expression fully present)

Appendix D List of questions currently in the database

ID	Question
1	Have you ever peed when you are in a shower/pool?
2	Do you pick your nose?
3	Do you have a secret crash?
4	Have you watched a porn within the last week?
5	Have you ever shoplifted?
6	How would you rate your looks on a scale of 1 to 10?
7	How many guys have you dated so far?
8	Have you cheated on your boyfriend/girlfriend before?
9	Have you ever done drunk driving?
10	Have you ever farted in an elevator?
11	Have you ever practiced kissing in a mirror?
12	Do you snore?
13	Do you think you'll marry your current girlfriend/boyfriend?
14	If you were allowed to marry more than one person, would you?
15	If someone offered you 1 million dollars to break up with your girlfriend/boyfriend, would you do it?
16	Have you ever thought about cheating on your partner?
17	If you ran out of toilet paper, would you consider wiping with the empty roll?
18	Have you ever had a crush on a friend's girlfriend/boyfriend?
19	Is there a person that you are always jealous of?
20	If you had to choose between dating someone ugly who was good in bed or dating someone hot who was bad in bed, which would you choose?
21	If you had to choose between being poor and smart or being rich and dumb, what would you choose?

Appendix E Database entity relationship diagram

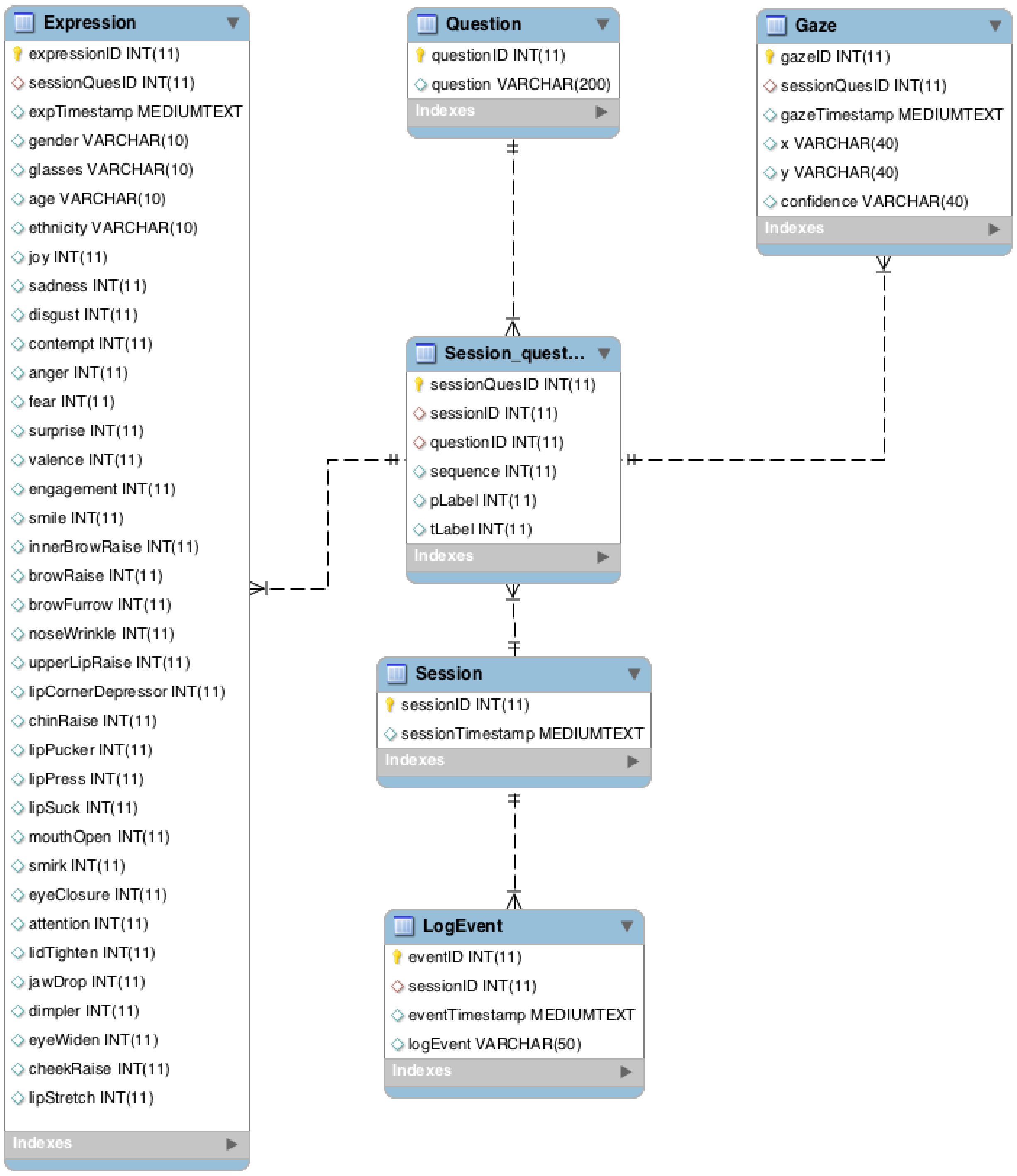
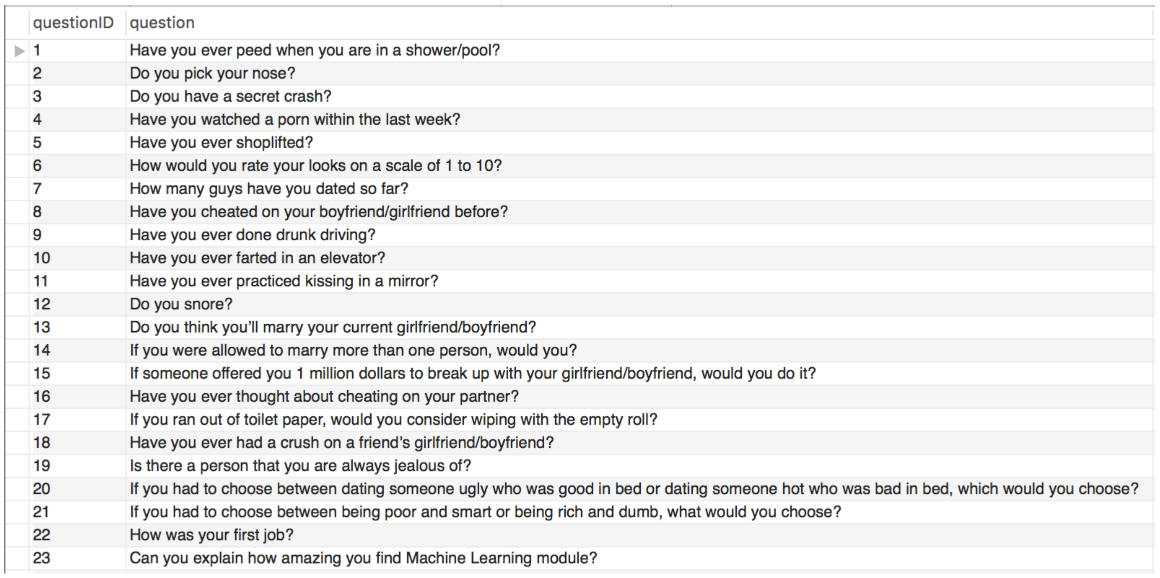


Figure 3: Database entity-relationship diagram.

Appendix F Database tables

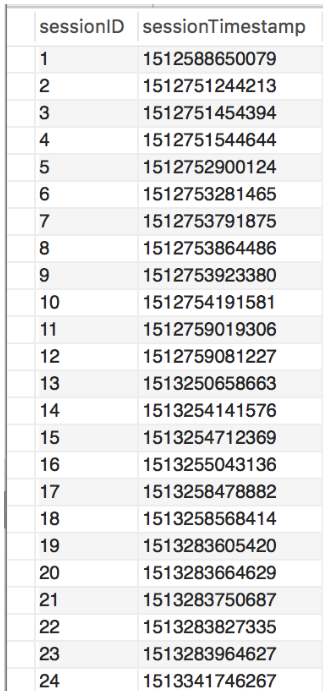
F.1 Question



questionID	question
1	Have you ever peed when you are in a shower/pool?
2	Do you pick your nose?
3	Do you have a secret crash?
4	Have you watched a porn within the last week?
5	Have you ever shoplifted?
6	How would you rate your looks on a scale of 1 to 10?
7	How many guys have you dated so far?
8	Have you cheated on your boyfriend/girlfriend before?
9	Have you ever done drunk driving?
10	Have you ever farted in an elevator?
11	Have you ever practiced kissing in a mirror?
12	Do you snore?
13	Do you think you'll marry your current girlfriend/boyfriend?
14	If you were allowed to marry more than one person, would you?
15	If someone offered you 1 million dollars to break up with your girlfriend/boyfriend, would you do it?
16	Have you ever thought about cheating on your partner?
17	If you ran out of toilet paper, would you consider wiping with the empty roll?
18	Have you ever had a crush on a friend's girlfriend/boyfriend?
19	Is there a person that you are always jealous of?
20	If you had to choose between dating someone ugly who was good in bed or dating someone hot who was bad in bed, which would you choose?
21	If you had to choose between being poor and smart or being rich and dumb, what would you choose?
22	How was your first job?
23	Can you explain how amazing you find Machine Learning module?

Figure 4: Question table.

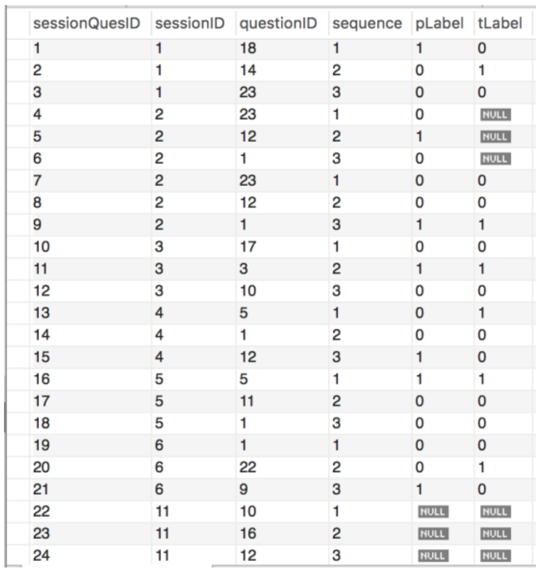
F.2 Session



sessionID	sessionTimestamp
1	1512588650079
2	1512751244213
3	1512751454394
4	1512751544644
5	1512752900124
6	1512753281465
7	1512753791875
8	1512753864486
9	1512753923380
10	1512754191581
11	1512759019306
12	1512759081227
13	1513250658663
14	1513254141576
15	1513254712369
16	1513255043136
17	1513258478882
18	1513258568414
19	1513283605420
20	1513283664629
21	1513283750687
22	1513283827335
23	1513283964627
24	1513341746267

Figure 5: Session table.

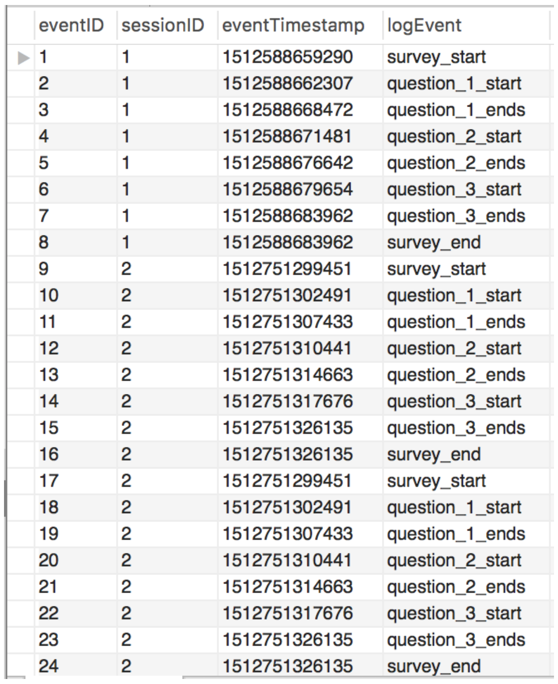
F.3 Session_question



sessionQuesID	sessionID	questionID	sequence	pLabel	tLabel
1	1	18	1	1	0
2	1	14	2	0	1
3	1	23	3	0	0
4	2	23	1	0	NULL
5	2	12	2	1	NULL
6	2	1	3	0	NULL
7	2	23	1	0	0
8	2	12	2	0	0
9	2	1	3	1	1
10	3	17	1	0	0
11	3	3	2	1	1
12	3	10	3	0	0
13	4	5	1	0	1
14	4	1	2	0	0
15	4	12	3	1	0
16	5	5	1	1	1
17	5	11	2	0	0
18	5	1	3	0	0
19	6	1	1	0	0
20	6	22	2	0	1
21	6	9	3	1	0
22	11	10	1	NULL	NULL
23	11	16	2	NULL	NULL
24	11	12	3	NULL	NULL

Figure 6: Session_question table.

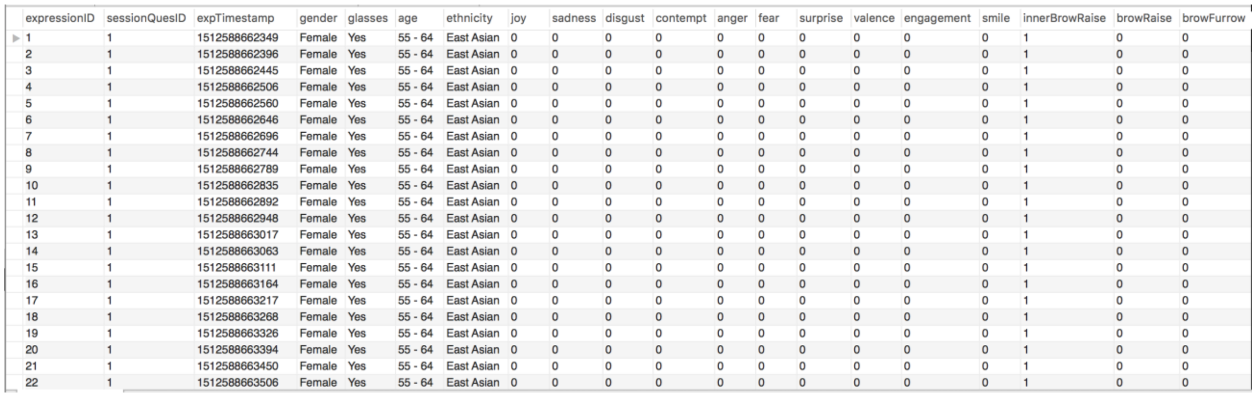
F.4 LogEvent



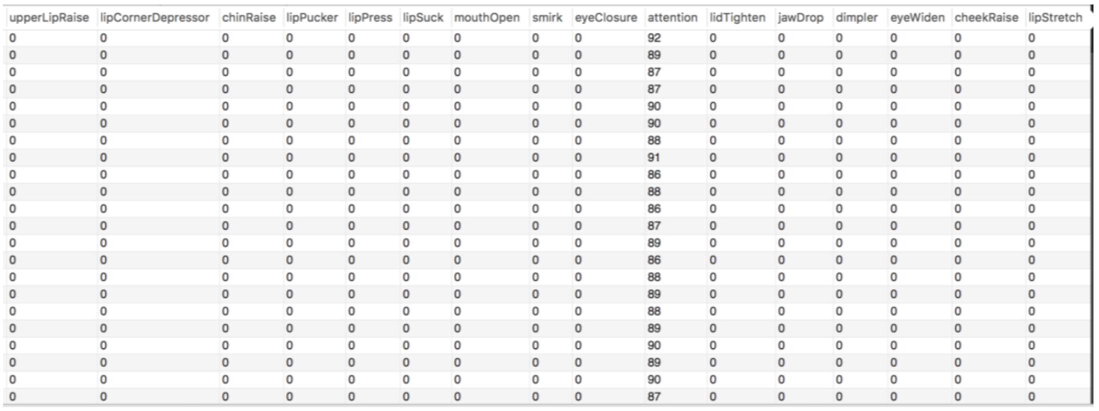
eventID	sessionID	eventTimestamp	logEvent
1	1	1512588659290	survey_start
2	1	1512588662307	question_1_start
3	1	1512588668472	question_1_ends
4	1	1512588671481	question_2_start
5	1	1512588676642	question_2_ends
6	1	1512588679654	question_3_start
7	1	1512588683962	question_3_ends
8	1	1512588683962	survey_end
9	2	1512751299451	survey_start
10	2	1512751302491	question_1_start
11	2	1512751307433	question_1_ends
12	2	1512751310441	question_2_start
13	2	1512751314663	question_2_ends
14	2	1512751317676	question_3_start
15	2	1512751326135	question_3_ends
16	2	1512751326135	survey_end
17	2	1512751299451	survey_start
18	2	1512751302491	question_1_start
19	2	1512751307433	question_1_ends
20	2	1512751310441	question_2_start
21	2	1512751314663	question_2_ends
22	2	1512751317676	question_3_start
23	2	1512751326135	question_3_ends
24	2	1512751326135	survey_end

Figure 7: LogEvent table.

F.5 Expressions



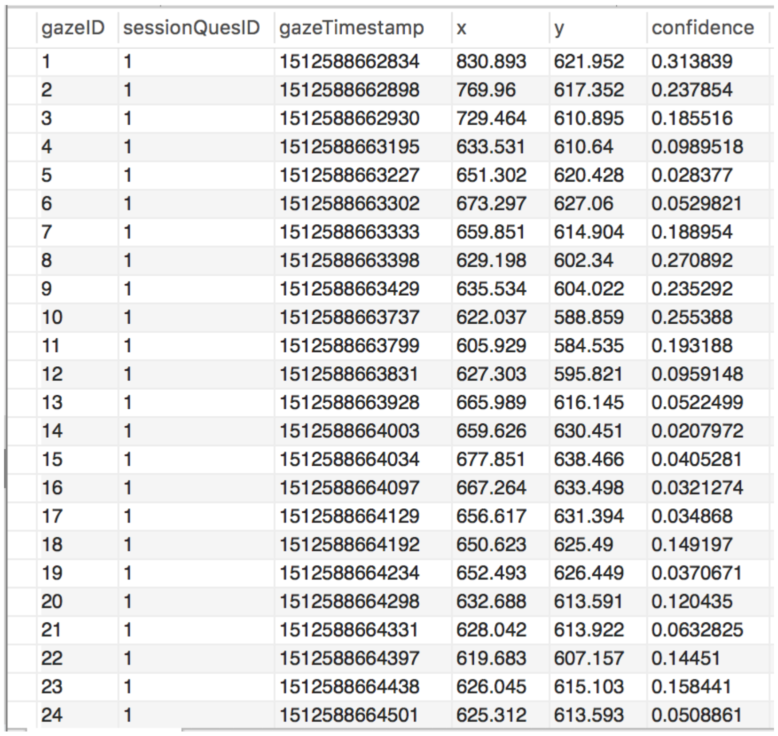
expressionID	sessionQuesID	expTimestamp	gender	glasses	age	ethnicity	joy	sadness	disgust	contempt	anger	fear	surprise	valence	engagement	smile	innerBrowRaise	browRaise	browFurrow
1	1	1512588662349	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
2	1	1512588662396	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
3	1	1512588662445	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
4	1	1512588662506	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
5	1	1512588662560	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
6	1	1512588662646	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
7	1	1512588662696	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
8	1	1512588662744	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
9	1	1512588662789	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
10	1	1512588662835	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
11	1	1512588662892	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
12	1	1512588662948	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
13	1	1512588663017	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
14	1	1512588663063	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
15	1	1512588663111	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
16	1	1512588663164	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
17	1	1512588663217	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
18	1	1512588663268	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
19	1	1512588663326	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
20	1	1512588663394	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
21	1	1512588663450	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0
22	1	1512588663506	Female	Yes	55 - 64	East Asian	0	0	0	0	0	0	0	0	0	0	1	0	0



upperLipRaise	lipCornerDepressor	chinRaise	lipPucker	lipPress	lipSuck	mouthOpen	smirk	eyeClosure	attention	lidTighten	jawDrop	dimpler	eyeWiden	cheekRaise	lipStretch
0	0	0	0	0	0	0	0	0	92	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	87	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	87	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	91	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	86	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	86	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	87	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	86	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	87	0	0	0	0	0	0

Figure 8: Expressions table, part b.

F.6 Gaze



gazeID	sessionQuesID	gazeTimestamp	x	y	confidence
1	1	1512588662834	830.893	621.952	0.313839
2	1	1512588662898	769.96	617.352	0.237854
3	1	1512588662930	729.464	610.895	0.185516
4	1	1512588663195	633.531	610.64	0.0989518
5	1	1512588663227	651.302	620.428	0.028377
6	1	1512588663302	673.297	627.06	0.0529821
7	1	1512588663333	659.851	614.904	0.188954
8	1	1512588663398	629.198	602.34	0.270892
9	1	1512588663429	635.534	604.022	0.235292
10	1	1512588663737	622.037	588.859	0.255388
11	1	1512588663799	605.929	584.535	0.193188
12	1	1512588663831	627.303	595.821	0.0959148
13	1	1512588663928	665.989	616.145	0.0522499
14	1	1512588664003	659.626	630.451	0.0207972
15	1	1512588664034	677.851	638.466	0.0405281
16	1	1512588664097	667.264	633.498	0.0321274
17	1	1512588664129	656.617	631.394	0.034868
18	1	1512588664192	650.623	625.49	0.149197
19	1	1512588664234	652.493	626.449	0.0370671
20	1	1512588664298	632.688	613.591	0.120435
21	1	1512588664331	628.042	613.922	0.0632825
22	1	1512588664397	619.683	607.157	0.14451
23	1	1512588664438	626.045	615.103	0.158441
24	1	1512588664501	625.312	613.593	0.0508861

Figure 9: Gaze table.