Case study Engineering Infringement Risk Assessment: Pedestrian motion prediction for vehicle with face detection, especially for autonomous or semi-autonomous vehicle

[This document exemplifies how to interpret the search request, the preparation and gathering of keywords and patent classes and conducting a sample search including comments of how and why using search statements. This document is by no means meant to be the “best” or “perfect” search, there is no such thing. It just exemplifies a solid search that would have passed the candidate.]

0. The search request as presented to the examinee:

With autonomous and assisted driving systems, it is important to recognise in advance whether a pedestrian wants to cross the road. Pedestrian motion predicting devices help to avoid accidents by proactively controlling the speed of the vehicle.

This is typically done by recording and processing body and head movement. Your client already has licensing agreements in place covering these aspects of the pedestrian motion prediction apparatus and method and does not require them to be searched.

Your client’s new system works by examining facial features, facial expressions, eye movements, and the like, to predict the planned movement of the pedestrian across the street. Their current intention is to launch a product using this technology in Germany, the USA, Korea and Japan.

Please carry out an infringement risk search to find existing patents which may be infringed by this new technology in the territories of interest.

1. Technical Background

1.1. Preparation / Background

- Dates (priority, publication)

As this is an FTO search, patents over 20 years will generally have expired and so date limiting searching may be considered to minimize the number of documents reviewed to only those which are still in force. In some instances, however, an older document may provide some “clearance” and be of use to the attorney reviewing results. Either approach is valid, but this should be considered and discussed.

• Territories

As the client is only interested in certain territories (France, UK and USA) they might consider restricting searching to territories/offices that cover these (US; DE; KR; JP; WO; EP). Covering US, DE, KR and JP only and not EP or WO will be considered lacking and resulting in loss of marks. Some candidates may wish not to limit country coverage for searching in order to uncover any further “leads” for searching and is a valid approach but should be disclosed as intentional by the candidate.

• Registers/databases (Epoline, Inpadoc, Patbase, Espacenet)

Any databases used should give relatively easy access to patent claims.

Some searchers may consider using multiple databases to cover gaps in coverage/translations etc, should they have access to them.

1.2. Scope of search:

• technical area

The examinee should be able to recognise that the technical area covered is autonomous and assisted driving.

The client has further expressed that they are indemnified with regards to recognition and recording of body and head movements.

Therefore the search focus is the implementation of the recognition of facial features, expressions, eye movement of pedestrians and the construction of intent to cross the street from that expression.

For the scope of the present search it does not play a role how the decision is reached. Whether it is the car as a system, a separate computational entity or an artificial intelligence.

1.3. Description of concepts

As a freedom-to-operate search, candidates will need to cover autonomous or semi-autonomous driving.

Recognition of facial features or expressions or eye movements in the context of pedestrians crossing a street will have to be identified.

2. Classification

[A quick and dirty search e.g. in Espacenet will already reveal first classifications to start from. This can be complemented during the search when reviewing first possible hits.]

- **IPC / CPC**

Classification for anti-collision technology can be found by entering “collision avoidance” into the search box of the Espacenet Cooperative Patent Classification page. This returns among others the following classes:

G08G1/00 Traffic control systems for road vehicles (...)
G08G1/16 . Anti-collision systems
G08G1/166 . . G08G1/166 - for active traffic, e.g. moving vehicles, pedestrians, bikes (=> CPC)

G06V20/00 Scenes; Scene-specific elements
G06V20/50 . Context or environment of the image
G06V20/52 .. Surveillance or monitoring of activities, e.g. for recognising suspicious objects (recognising microscopic objects G06V20/69)
G06V20/53 … Recognition of crowd images, e.g. recognition of crowd congestion
G06V20/54 … of traffic, e.g. cars on the road, trains or boats
G06V20/56 .. exterior to a vehicle by using sensors mounted on the vehicle
G06V20/58 … Recognition of moving objects or obstacles, e.g. vehicles or pedestrians; Recognition of traffic objects, e.g. traffic signs, traffic lights or roads
G06V20/582 …. of traffic signs
G06V20/584 …. of vehicle lights or traffic lights
G06V20/586 …. of parking space
G06V20/588 … Recognition of the road, e.g. of lane markings; Recognition of the vehicle driving pattern in relation to the road
G06V20/59 .. inside of a vehicle, e.g. relating to seat occupancy, driver state or inner lighting conditions
G06V20/593 … Recognising seat occupancy
G06V20/597 … Recognising the driver's state or behaviour, e.g. attention or drowsiness

G06N20/00 Machine learning
G06N20/10 . using kernel methods, e.g. support vector machines [SVM]
G06N20/20 . Ensemble learning

G06N20/00; also G06N3/02/low if looking for deep learning.

Though the task assignment is silent on the details of any computational specifics that would warrant primary classification in G06N so specific searching here is probably not worthwhile.

B60R21 Arrangements or fittings on vehicles for protecting or preventing injuries to occupants or pedestrians in case of accidents or other traffic risks

has long list of possible injuries and kinds of collisions in 2000 series (2021) (bonus points for mentioning orthogonal classes)

a good 99% of the group is about the safety measures for the occupants; these are the only sub-groups dealing with “non-occupants”:

B60R21/34 . Protecting non-occupants of a vehicle, e.g. pedestrians (B60R19/02 takes precedence)
B60R2021/343 .. using deformable body panel, bodywork or components
B60R2021/346 .. means outside vehicle body
B60R21/36 .. using airbags
B60R21/38 .. using means for lifting bonnets

B60W30/00 Purposes of road vehicle drive control systems not related to the control of a particular sub-unit, e.g. of systems using conjoint control of vehicle sub-units , or advanced driver assistance systems for ensuring comfort, stability and safety or drive control systems for propelling or retarding the vehicle (anti-lock brake systems [ABS] B60T8/00)
B60W30/08 . Active safety systems predicting or avoiding probable or impending collision or attempting to minimise its consequences
B60W2030/082 .. Vehicle operation after collision
B60W30/085 .. Taking automatic action to adjust vehicle attitude in preparation for collision, e.g. braking for nose dropping
B60W30/09 .. Taking automatic action to avoid collision, e.g. braking and steering
B60W30/095 .. Predicting travel path or likelihood of collision
B60W30/0953 … the prediction being responsive to vehicle dynamic parameters
B60W30/0956 … the prediction being responsive to traffic or environmental parameters

The second aspect of the invention is image recognition. Using the same approach I enter “facial expression recognition” into the CPC search box:

G06K9/62 Methods or arrangements for recognition using electronic means (machine learning

Looking for classification by entering “autonomous driving” into the search box:

B60W60/00 Drive control systems specially adapted for autonomous road vehicles
B60W60/001 . Planning or execution of driving tasks

B60W60/0011 .. involving control alternatives for a single driving scenario, e.g. planning several paths to avoid obstacles
B60W60/0015 .. specially adapted for safety
B60W60/0016 … of the vehicle or its occupants
B60W60/0017 … of other traffic participants
...
B60W60/0027 .. using trajectory prediction for other traffic participants
B60W60/00272 … relying on extrapolation of current movement
B60W60/00274 … considering possible movement changes
B60W60/00276 … for two or more other traffic participants

Bonus points for decribing additional information hidden behind Warning triangles, D (= definition), ! (= annotation) signs, using CPC toggle, optionally displaying date of coming into force, 2000 series display (and its meaning) in Espacenet classification browser! See below. This is NOT necessary to earn enough points to pass! Just an example of how to improve your chances of passing.

B60W2554/00 Input parameters relating to objects [2020-02]
Warnings
Group B60W2554/00 is incomplete pending reclassification of documents from groups B60K28/00 - B60K28/165, G05D1/0061, G05D1/0088, G05D1/021, G05D1/0214, G05D1/0221, and G05D1/0223.
Group B60W2554/00 is also impacted by reclassification into groups B60W2554/20, B60W2554/40, B60W2554/402, B60W2554/4023, B60W2554/4026, B60W2554/4029, B60W2554/404, B60W2554/4041, B60W2554/4042, B60W2554/4043, B60W2554/4044, B60W2554/4045, B60W2554/4046, B60W2554/4047, B60W2554/4048, B60W2554/4049, B60W2554/406, B60W2554/408, B60W2554/60, B60W2554/80, B60W2554/801, B60W2554/802, B60W2554/803, B60W2554/804, B60W2554/805, and B60W2554/806.
All groups listed in this Warning should be considered in order to perform a complete search.
B60W2554/40 . Dynamic objects, e.g. animals, windblown objects [2020-02]
B60W2554/402 .. Type [2020-02]
B60W2554/4029 … Pedestrians [2020-02]
B60W2554/404 .. Characteristics [2020-02]
B60W2554/4045 … Intention, e.g. lane change or imminent movement [2020-02]

G06V40/00 Recognition of biometric, human-related or animal-related patterns in image or video data [2022-01]
Warnings
Groups G06V40/00, G06V40/10, G06V40/103, G06V40/107, G06V40/11, G06V40/113, G06V40/117, G06V40/12, G06V40/1306, G06V40/1312, G06V40/1318, G06V40/1324, G06V40/1329, G06V40/1335, G06V40/1341, G06V40/1347, G06V40/1353, G06V40/1359, G06V40/1365, G06V40/1371, G06V40/1376, G06V40/1382, G06V40/1388, G06V40/1394, G06V40/14, G06V40/15, G06V40/155, G06V40/16, G06V40/161, G06V40/162, G06V40/164, G06V40/165, G06V40/166, G06V40/167, G06V40/168, G06V40/169, G06V40/171, G06V40/172, G06V40/173, G06V40/174, G06V40/175, G06V40/176, G06V40/178, G06V40/179, G06V40/18,

G06V40/19, G06V40/193, G06V40/197, G06V40/20, G06V40/23, G06V40/25, G06V40/28, G06V40/30, G06V40/33, G06V40/37, G06V40/376, G06V40/382, G06V40/388, G06V40/394, G06V40/40, G06V40/45, G06V40/50, G06V40/53, G06V40/55, G06V40/58, G06V40/60, G06V40/63, G06V40/67 and G06V40/70 are incomplete pending reclassification of documents from group G06K9/00.
All groups listed in this Warning should be considered in order to perform a complete search.
G06V40/10 . Human or animal bodies, e.g. vehicle occupants or pedestrians; Body parts, e.g. hands [2022-01]
G06V40/16 ..Human faces, e.g. facial parts, sketches or expressions [2022-01]
G06V40/174 …Facial expression recognition [2022-01]
G06V40/175 …. Static expression [2022-01]
G06V40/176 …. Dynamic expression [2022-01]
G06V40/18 .. Eye characteristics, e.g. of the iris [2022-01]
G06V40/19 … Sensors therefor [2022-01]
G06V40/193 … Preprocessing; Feature extraction [2022-01]
G06V40/197 … Matching; Classification [2022-01]

B60W CONJOINT CONTROL OF VEHICLE SUB-UNITS OF DIFFERENT TYPE OR DIFFERENT FUNCTION; CONTROL SYSTEMS SPECIALLY ADAPTED FOR HYBRID VEHICLES; ROAD VEHICLE DRIVE...
B60W30/00 Purposes of road vehicle drive control systems not related to the control of a particular sub-unit, e.g. of systems using conjoint control of vehicle sub-units...
B60W30/08 .{Active safety systems} predicting or avoiding probable or impending collision {or attempting to minimise its consequences}
B60W30/095 ..Predicting travel path or likelihood of collision
B60W30/0956 … {the prediction being responsive to traffic or environmental parameters}

- **other classification**

Derwent Manual Codes

none found

F-terms

USCla

FI, Dekla, others

bonus points for additional classification

3. Concepts / keywords

●Keywords

One approach can be to start searching using the “finder” approach: combining as many features through keywords to either hit a lucky punch or at least quickly find interesting classification and additional keywords (e.g. in parallel filings in additional languages).

The next step could be to try out the classification found by the “finder” approach and through Espacenet’s classification search box. It turns out that only two of the 14 hits (e.g. US2020117960 by IBM) are not classified anywhere near any of the automobile classes in B60. This means the keywords for this aspect will probably have to do the job of homing in on that part of the search. On the other hand US2013201316 by May Patents has different classification but not many of the first set of keywords.

The next step can be to run several keyword searches for concepts from the same area (e.g. automobile, autonomous driving, pedestrian, facial expression recognition, etc.). These can then be combined with the classification results or each other. If there is still time, also citation searches on the most promising findings can be run.

After having exhausted the most logical combinations the results will have to be narrowed to publications from Germany, the US, Japan and Korea. Also EP and PCT will have to be checked, restricted to the last 18 months for applications not having been nationalised yet, but still in the pipeline.

pedestrian; walker; fussgaenger; fussgänger

absicht; intention;

vorhersag; predict; prognos; forecast; detect; erkenn; estimat; einschaetz; einschätz; detekt

road; strasse; street

face; facial; gesicht; ausdruck; expression; auge; eye; mund; mouth; alter; age; gender; geschlecht; mimik; mimic

camera; kamera; optic; optisch; video

autonom; semiautonom; automated; selbstfahr; selfpropell; selfdriv; propell; themselve; driverless; assist

fahr; drive; driving; vehicle; car; cars

An alternate approach:

Run a quick and dirty search and sample some of the results to get a first estimate of whether that approach will work (from PatBase, with comments):

1) sc=G08G1/16* (50499)
2) // I use "*" to capture the hierarchy of groups indented below "16" (0)
3) sc=B60W60 (9606)
4) // I use generic B60W60 to capture all of "Drive control systems for autonomous road vehicles (0)
5) 1 and 3 (3077)
6) tac=(facial expression*) (7973)
7) 5 and 6 (10)

I notice that most documents describe watching the driver's (not pedestrian's) facial expression (e.g. US2019283771 or US2020216095). These are not covered by the desired product. Search needs more focus.

Quick Search to find relevant IPC / CPC:

	PatBase Search History - January 25, 2022 9:43	
#	Search query	Results
1	(autonom* or selbstfahr* or Selfpropell* or Selfdriv* or Propell* or Themselve* or Drive	112.759
2	pedestrian* or walker* or Fussgaenger* or Fussgänger*	84.934
3	1 and 2	1.582

=> Class Analyse IPC + CPC

and then:

IPC and Keywords

4	sc=b60w30/08* (Predict collision)	16.732
5	3 and 4	327
6	camera* or kamera* or optic* or optisch* or video*	3.394.504
7	5 and 6	128
8	face* or facial* or gesicht* or ausdruck* or expression* or auge* or eye* or mund* or mouth* or alter* or age* or gender* or geschlecht* or mimik*	11.862.523

	or mimic*	
9	7 and 8	32
10	7 not 8	96
	IPC and Keyword/Titel	
11	ti=(pedestrian* or walker* or Fussgaenger* or Fussgänger*)	20.354
12	11 and 4	203
13	12 and 1	48
14	13 not 7	30
	other IPC and Keywords	
15	sc=g08g1/16* (Anti-Collision)	50.499
16	15 and 1	7.874
17	16 and 2	553
18	17 and 8	137
19	18 not (7 or 14)	110
	IPC/CPC and IPC/CPC	
20	15 and 4	8.672
21	20 and sc=g06t7	489
22	21 and 2	78
23	21 and 1	150
24	22 and 23	25
25	24 not (7 or 14 or 19)	8
26	22 or 23	203
27	26 not (7 or 14 or 19 or 25)	178
	other IPC and Keywords	
28	vorhersag* or predict* or prognos* or forecast* or Detect* or Erkenn* or Estimat* or Einschaetz* or Einschätz* or detekt*	6.369.462
29	28 and 15 and 11	514

30 29 and 8 61

31 pn=DE102017124904 and 30 1

Cc=(de or ep or wo or us or jp or kr) for the Limitation of countries

prdf=>200201 for the Limitation of the first Priority date (FtO)

Excerpt from another history:

106 105 not (93, 95, 96, 98, 100, 102) 31
105 sc=b60W2554/4029 and sc=B60W2554/4045 32
104 sc=60W2554/4029 and sc=B60W2554/4045 0
103 102 not (93, 95, 96, 98, 100) 5
102 FN=(73498635 OR 74782419 OR 89916842 OR 16055544 OR 41978633 OR 44012785) 6 - citations
101 100 not (93, 95, 96, 98) 5
100 FN=(53124515 OR 55169670 OR 64524196 OR 69572666 OR 72870283 OR 75837360) 6 - citations
99 98 not (93, 95, 96) 24
98 FN=(73504707 OR 77224176 OR 77586215 OR 81095980 OR 82715225 OR 82715597 OR 84749961 OR 89916842 OR 11606937 OR 42654043 OR 47096172 OR 47809399 OR 47850820 OR 49051241 OR 49610804 OR 53328875 OR 54380771 OR 54909959 OR 57491272 OR 58342572 OR 58447172 OR 59778798 OR 60349346 OR 62063810) 24 - citations
97 96 not (93, 95) 171
96 sc=G06V40/174 and sc=(b60*, b62*) 178
95 atac=((((face%, facial%)w5(expression%))w10(detect*, recognition*))w20(pedestrian%)) 15
94 sc=(b60*, b62*) and atac=((((face%, facial%)w5(expression%))w10(detect*, recognition*))w20(pedestrian%)) 0
93 sc=(b60*, b62*) and ata=(((face%, facial%)w5(expression%))w10(detect*, recognition*)) 63

Some results (e.g. for a citation search, time permitting):

(JP2014059841 A2)

(DE102020122023 B3)

(DE102012009703 A1) (status)

(US10082796B2) Pedestrian face detection

(patent family: DE102017124904A1, US10082796B2, US20180120858A1, GB2557438A, CN108001389A, MX2017013608A, RU2017134590A)

US in force, DE not in force

A controller for a vehicle is programmed to detect a pedestrian in an image received from a camera, determine whether a face of the pedestrian is present in the image, and cause the vehicle to change lanes based on the absence of the face.

1. DE102017010513A1 Verfahren zur Ermittlung einer Aufmerksamkeit einer in einer Umgebung eines Fahrzeuges erfassten Person / not in force
2. US2019259284A1 PEDESTRIAN DETECTION FOR VEHICLE DRIVING ASSISTANCE / in force
3. KR20170052713A VEHICLE AUTONOMOUS EMERGENCY BRAKING SYSTEM AND METHOD CONSIDERING PEDESTRIAN'S EYE / in force

others:

4. JP2014059841 A DRIVING SUPPORT DEVICE (but not autonomous driving) / in force
5. JP2014006700A PEDESTRIAN DETECTION DEVICE (but not autonomous driving) / not in force
6. JP2011170663A VEHICLE PERIPHERY MONITORING DEVICE (but not autonomous driving) / in force

Yet another PatBase History, complete with comments:

1) // finder / searcher approach: (0)
2) tac=(((anti_collision) or (collision near avoid*)) and (autonomous*) and ((face or facial) w2 recogni*)) (14)
3) // S2 = will need additional (and non-English) keywords for anti collision, autonomous, and face recognition later (0)
4) sc=G08G1/166 (8708)
5) sc=G06V20/58 (7293)
6) sc=B60R21/34 (9941)
7) sc=B60W30/09* (7296)
8) // S4 to S7 = first rough classifications found via Espacenet, take short samples to establish value of classes for search (0)
9) // seems S4 to S7 are too general, mostly traffic control, can only be used together with keywords (0)
10) sc=(G06N20 or G06N3/02) (80361)
11) // S10 = machine learning (0)
12) sc=(G06T7 or G06K9/62) (433385)
13) // S12 = image analysis (0)
14) sc=B60W60 (10853)
15) // S14 = autonomous driving (0)
16) sc=(B60W2554/4029 or B60W2554/4045) (737)
17) // S16 = input parameters for automotive control (0)
18) sc=G06V40/16* (43119)
19) sc=(G06V40/16 or G06V40/174 or G06V40/175 or G06V40/176 or G04V40/18) (15092)
20) // S18 = biometric recognition; searching with "*" to include hierarchically lower entries as well: same as S19 (0)
21) tac=(pedestrian* or walker* or (jay_walker*) or fussgaenger* or fussganger* or fussgänger* or pieton*) (87920)

22) tac=(car or cars or automobil* or auto or autos or vehicle* or vehicule* or voiture*) (5120484)
23) tac=(intent* or purpose* or tendenc* or absicht*) (7840838)
24) tac=(predict* or forecast* or foretell* or expect* or anticipat* or vorhersag* or prognost* or voraussag* or pronost* or predir*) (760574)
25) tac=((intent* or purpose* or tendenc* or absicht*) near (predict* or forecast* or foretell* or expect* or anticipat* or vorhersag* or prognost* or voraussag* or pronost* or predir*)) (7151)
26) tac=(face* or facial* or eye* or mouth* or mimic* or gesicht* or auge* or mund* or mimik* or visage* or oeil* or bouche* or mimique*) (6771709)
27) tac=(autonom* or semiautonom* or automated or (driver_less) or (self_driving) or unmanned or (robo* car*) or selbstfahr* or halbautomat*) (530691)
28) // truncation with "_" finds words either adjacent, with hyphens or in one word; some truncations chosen to find both English, German and / or French words (0)
29) // combining search statements after some samples: (0)