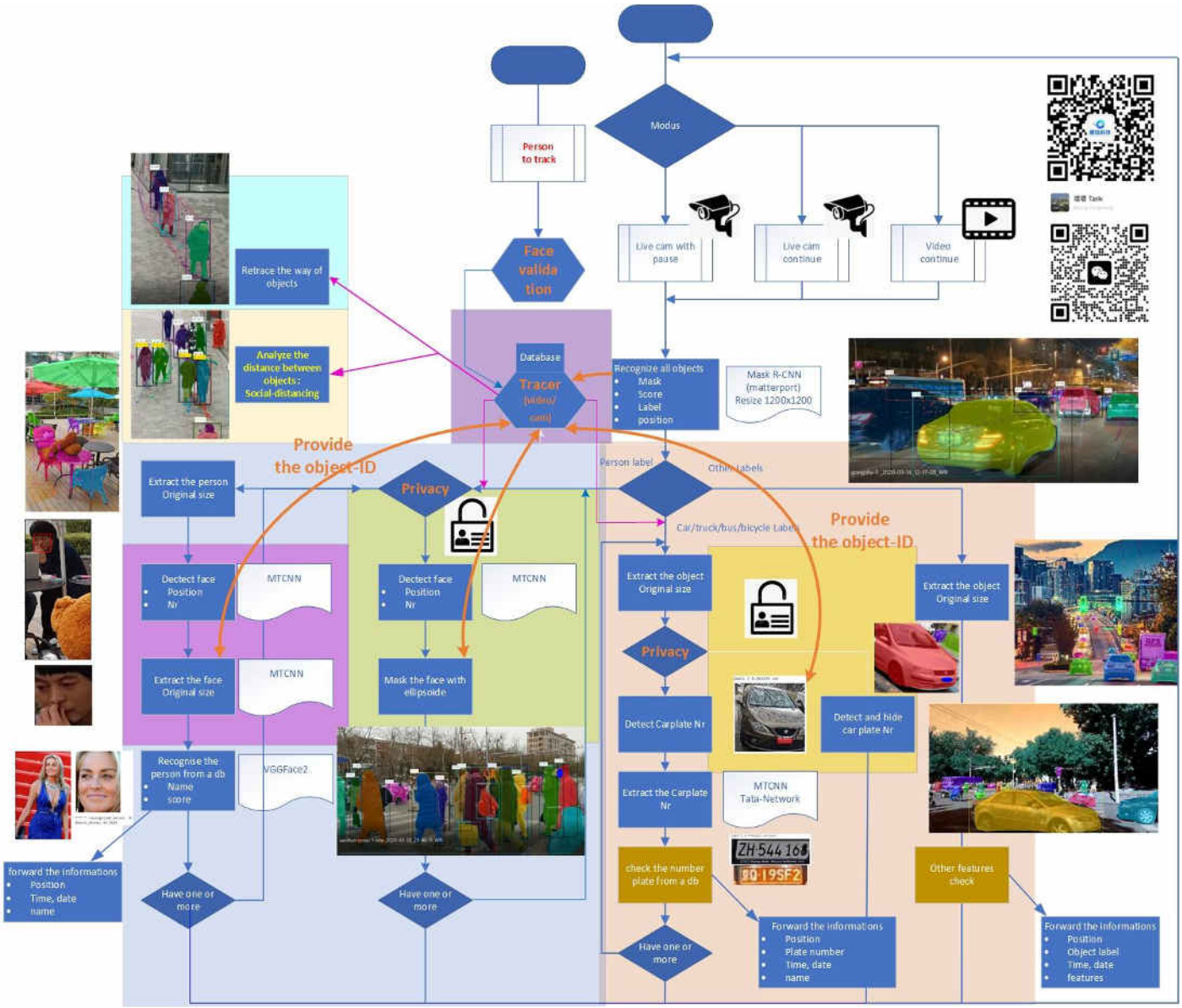
Introduction 介绍:

Object detection is one of the hottest topics in AI (such as natural language). This applies not only to autonomous driving, but also to many technologies, such as medicine, that can help doctors discover things they can't see, making it easier to identify patterns of disease. In geographic settings, it can help identify planes or ships, or astronomy can help identify stars and galaxies that you can't see with your eyes. Make sure this technology is suitable for new research code, and each code can be modified and extended to meet your new requirements. Modern technology does not need to rediscover the same 100 times If a well-rotated wheel already exists, it's best to improve it and let it fly. -)

对象检测是 AI（例如自然语言）中最热门的主题之一。这不仅适用于自动驾驶，还适用于许多技术（例如医学），这些技术可以帮助医生发现他们看不到的东西，从而更容易识别疾病模式。在地理环境中，它可以帮助识别飞机或船上的船只，或者天文学可以帮助识别您用眼睛看不到的恒星和星系。确保此技术适用于新的研究代码，并且可以修改和扩展每个代码以满足您的新要求。现代技术不需要重新发现相同的 100 次。 如果已经存在一个旋转良好的轮子，则最好对其进行改进，让它飞翔 -）

The model workflow: 模型工作流程：



Key Points: • 关键点：

- Diverse CNN are used for analyzing the picture
- The privacy is respected (s. the locks), in privacy mode will the face and car plate replaced by an ellipsoid
- 250 car plate pictures were taken and self's annotated
- With the car plate pictures was a Mask R-CNN network trained (tata-network)
- It extracts objects, the from people if available the face, if they are prominent it will be tried to recognize
- From car/truck/bus, the car plate will be extracted (tatanetwork)
- From other objects are currently not extra analyze.
- The entry can be single pictures, videos, cam.
- For every entry it gives 3 modes, complete analyze/single analyze without face /privacy with face and car plate hidden
- For every entry it is a statistic file done for later analyze.
- By face it is a statistic incoming people and outgoing people
- Frame-by-frame tracking of objects (camera / video)
- Object time position tracking from frame to frame display (point decontamination) for the last 11 frames
- 多样的 CNN 用于分析图片
- 尊重隐私（如锁），在隐私模式下，将脸部和车板替换为椭圆形
- 拍摄了 250 张车牌图片，并为自己添加了注释
- 带有车牌图片的是经过培训的 Mask R-CNN 网络（塔塔网络）
- 提取人的物体，如果有的话，从人的脸中提取，如果它们突出，将尝试识别
- 从汽车/卡车/巴士中提取车牌（tatanetwork）
- 目前不对其他对象进行额外分析。
- 条目可以是单个图片，视频，摄像头。
- 对于每个条目，它提供 3 种模式，完整分析/无需脸部的单次分析/隐藏了脸部和车板的隐私
- 对于每个条目，它都是一个统计文件，供以后分析。
- 从表面上看，这是统计传入的人和传出的人
- 逐帧跟踪对象（摄像机/视频）
- 最近 11 帧从帧到帧显示（点去污）的对象时间位置跟踪

I can imagine that one day there will be a training to get to know the green car sector. In China, green license plates describe electric cars, so they can be used to count conventional cars and electric cars. You can also identify car statistics and make statistics, such as how cheap cars are used, how expensive cars are used, etc ...
我可以想象有一天将进行一次培训，以认识绿色汽车板块领域。在中国，绿色车牌描述的是电动汽车，因此可以用于统计常规汽车和电动汽车。您还可以识别汽车徽标并进行统计，例如廉价汽车的使用方式，昂贵汽车的使用方式等...

Different accuracy tests: 不同的准确性测试：

By shooting, I took different angles to the object:
In a subway station, the camera is located 1.5 m above the ground (angle relative to the object = 0-10%)
In 28.12 shopping center, the camera is located 14m above the ground (angle relative to the object = 40--80%)
In the 29.12 shopping center, the camera is located about 6m above the ground (angle relative to the object = 30-60%)
In all 3 cases, the accuracy is very good.

From a large perspective, face recognition is more difficult, which means that the effect of 3-4m is very good. Most importantly, face information is becoming increasingly unavailable in other tasks such as face recognition.
The accuracy of the light, if you really want to read the license plate and recognize the human face with the available information, you need daylight or use a camera with other led lights. Most cars and pedestrian street lights in Beijing have additional lighting. I also conducted a night video test and the recognition rate of license plates and faces was very low.
通过拍摄，我对物体采取了不同的角度：
在地铁站中，摄像头位于地面 1.5 m 处（相对于物体的角度= 0-10％）
在 28.12 购物中心，摄像头位于地面上方 14m（相对于物体的角度= 6-70％）
在 29.12 购物中心中，摄像头位于地面上方约 6m（相对于物体的角度= 30-60％）
在所有 3 种情况下，准确性都非常好。
从大角度看，人脸识别比较困难，这意味着 3-4m 的效果非常好。最重要的是，人脸信息在诸如人脸识别等其他任务中变得越来越不可用。
灯光的准确性，如果您真的想阅读车牌并通过可用信息识别人脸，则需要日光或使用带有其他 led 灯的相机。北京的大多数汽车和行人路灯都有额外的照明。我还进行了夜间视频测试，车牌和人脸的识别率非常低。

Statistical results from R-CNN network: 来自 R-CNN 网络的统计结果:

The possibilities of statistical analysis are almost limitless, the limits are just your own imagination.
Summarize object types, combine results with time events, and get amazing results. Check out posters about shopping malls, street intersections, and subways, this is just a small example.
Let me summarize these three posters in a few words
Shopping Center: Imagine

- No security measures, only plans:
    - Monitor the flow of people at different entrances and locations in the shopping area.
    - Monitor the impact of new stores on traffic (whether attractive)
    - Monitor visitor traffic during other events.
    - Plan better capacity usage based on statistical knowledge
    - Can the event attract more people in your spare time?
    - Long-term monitoring of records and statistics for planning
    - Generate a centralized heat map of the infrastructure
- Security measures (if permitted by law)
    - People who are directly banned (blacklisted) can be found
    - Through the security threat, the root cause can be directly analyzed and recorded.

统计分析的可能性几乎是无限的，限制只是您自己的想象力。
汇总对象类型，将结果与时间事件结合在一起，并获得惊人的结果。查看有关购物中心，街道交叉口和地铁的海报，这只是一个小例子。
让我用几句话总结这三个海报
购物中心：想象

- 没有安全措施，只有计划：
    - 监控购物区不同入口和位置的人员流向。
    - 监视新商店对流量的影响（是否有吸引力）
    - 在其他事件期间监视访客的流量。
    - 根据统计知识计划更好的容量使用
    - 该活动可以在您的业余时间吸引更多人吗？
    - 长期监控记录和统计以进行计划
    - 生成基础设施的集中热图
- 安全措施（如果法律允许）
    - 可以找到被直接禁止（列入黑名单）的人
    - 通过安全威胁，可以直接分析和记录根本原因。

- 还有更多。

At the subway station 在地铁张

- No security measures, only plans:
    - Monitor the movement of people at different entrances and locations of subway stations
    - Monitor capacity based on capacity limits
    - Define actions such as (volunteers and police) during peak hours to speed up movement of people
    - Automatic signal acquisition when capacity limit is reached
    - Get automated decisions for managers (also assistants) to slow down security checks at entrances to reduce / control the number of people in subway stations
    - Long-term recording of monitoring and statistical data in preparation for next year's plans
    - Inform about possible capacity bottlenecks in some locations within the site and ask you to check what changes should be made
    - Generate a centralized heat map of your subway station (including corridors)
- Security measures (if permitted by law)
    - Can find directly banned (blacklisted) people
    - Through the security threat, the root cause can be directly analyzed and recorded.
- Proactive security measures before threats occur

地铁站的

- 没有安全措施，只有计划：
    - 监视地铁站不同入口和位置的人员流动
    - 根据容量限制监视容量
    - 在高峰时段定义诸如（志愿者和警察）之类的行动，以加快人员流动
    - 达到容量限制时自动获取信号
    - 为经理（也是助手）获得自动决策，以减慢入口处的安全检查，以减少/控制地铁站内的人员数量
    - 长期记录监控和统计数据，以为明年的计划做准备
    - 告知站点内某些位置可能存在的容量瓶颈，并要求您检查应进行哪些更改
    - 生成您的地铁站（包括走廊）的集中热图
- 安全措施（如果法律允许）
    - 可以直接找到被禁止（列入黑名单）的人
    - 通过安全威胁，可以直接分析和记录根本原因。
- 在威胁发生之前采取主动的安全措施

Cross Street

- No security measures, only plans:
    - Monitor different entrances at different entrances of a city or street, people / cars / buses / bikes / motorized traffic
    - Monitor the impact of new stores on regional turnover
    - Monitor visitor traffic in other events.
    - Plan better capacity usage based on statistical knowledge
    - How to manage capacity during peak hours
    - Record time monitoring and statistical information in preparation for the month and date of the next year
    - Change the rhythm of traffic street lights based on information (smart city)
    - Get emergency services to your destination faster by using crowded streets
    - Provide instant information on traffic flow,
    - Mapping people / cars / bikes concentration heat maps in cities
- Security measures (if permitted by law)
    - Red light jumper identification (pedestrian)
    - Quickly analyze root causes through security analysis locations
- etc

跨街

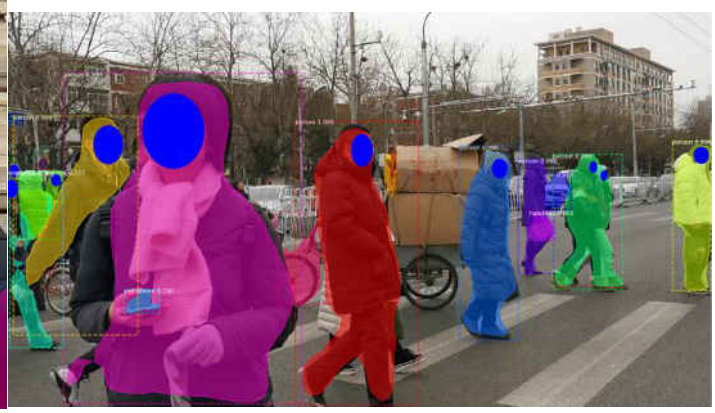
- •没有安全措施，只有计划：
  - o 监视城市或街道的不同入口处的不同入口，人/汽车/公共汽车/自行车/机动交通
  - o 监控新店对地区营业额的影响
  - o 监视访客在其他事件中的流量。
  - o 根据统计知识计划更好的容量使用
  - o 如何在高峰时段管理容量
  - o 记录时间监视和统计信息，为下一年的月份和日期做准备
  - o 根据信息更改交通路灯的节奏（智能城市）

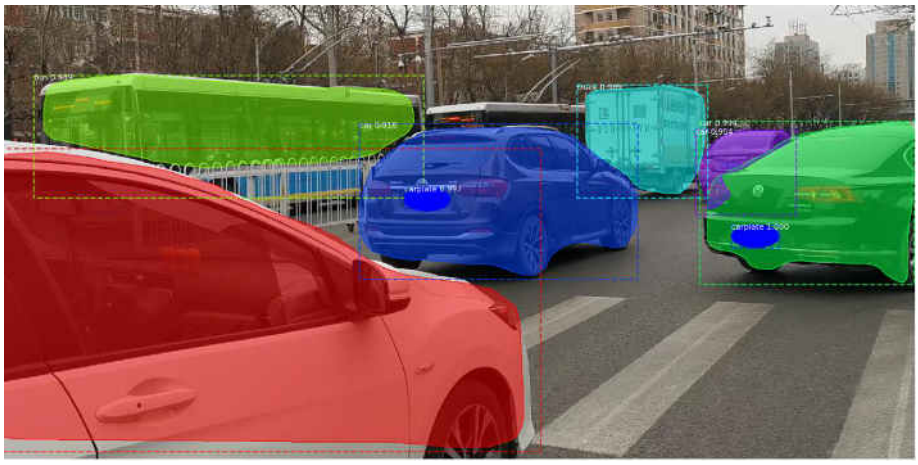
  通过使用拥挤的街道更快地获得前往目的地的紧急服务
  - o 提供有关交通流量的即时信息，
  - o 绘制城市中的人/汽车/自行车浓度热图
- •安全措施（如果法律允许）
  - o 红灯跳线识别（行人）
  - o 通过安全分析位置快速分析根本原因
  - o 等

Privacy: 隐私：

You are generally not allowed to register your face / license / identity without police authorization. That's why I implemented the privacy version through all three sources. Statistics will not be affected, but as long as there is information available on the picture or frame, you will no longer be able to see the face or license plate. You don't need to hide unreadable license plates or people.

如果没有警察授权，通常不允许您注册面部/牌照/身份。这就是为什么我通过所有三个来源实现了隐私版本。统计信息不会受到影响，但是在图片或框架上，只要有可用的信息，您将不再能够看到人脸或车牌。您不需要隐藏不可读的车牌或人员。





The Networks: 网络：

Uses three network models:

- Mask RCNN (pre-trained and self-trained) to recognize objects
- MTCNN for face recognition
- VGGFace2 for face recognition (implemented by way of example to display data processing methods)

Mask-RCNN was originally TensorFlow 1 code, and I modified it and extended it to TensorFlow 2 with many other features.

Self-trained networks are very effective, and I see that sometimes car logos are considered car signs, which gives a new idea that not only use car signs but also car logos to train the same network. Car logos can be a New category. Imagine generating statistical information about car manufacturers on Beijing's main roads, which could be an amazing statistic. But this can only be achieved with the cooperation of the city government and the police.

Another use of the self-training network is in the pattern branch, using short down jackets, long coats, white sneakers, and bags to train models.

使用三种网络模型：

-遮罩 RCNN（经过预训练和自我训练）以识别物体

-用于面部识别的 MTCNN

-用于人脸识别的 VGGFace2（以示例的方式实现，以显示数据的处理方法）

Mask-RCNN 最初是 TensorFlow 1 代码，我对其进行了修改并将其扩展为具有许多其他功能的 TensorFlow 2。

经过自我训练的网络非常有效，我看到有时汽车徽标被认为是汽车标牌，这给了一个新的想法，即不仅使用汽车标牌，而且还使用汽车徽标来训练同一个网络，汽车徽标可能是一个新类别。想象一下在北京主要道路上产生有关汽车制造商的统计信息，这可能是一个了不起的统计信息。但这只有在市政府和警察的配合下才能实现。

自我训练的网络的另一种用法是在模式分支中，使用短款羽绒服，长外套，白色运动鞋以及包等训练模型。

The tracking 目标追踪:

Tracking uses object detection results, which are displayed frame by frame in "x1, y1, x2, y2, score" format. It uses a "sort" algorithm to generate a new detection result in the format "x1, y1, x2, y2, id".

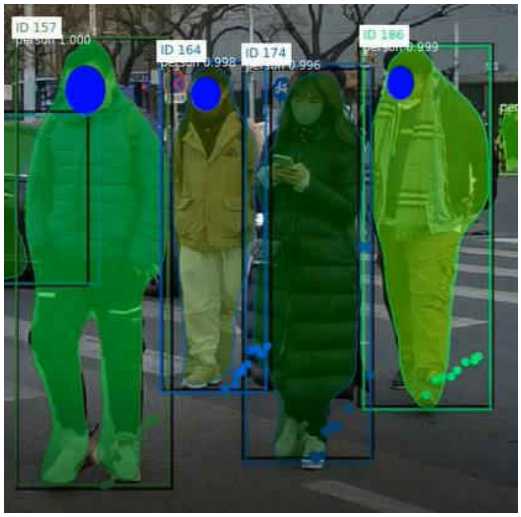
The difficulty lies in finding out from the second table which one is detected from the first table, and the size of the rectangle is different. Therefore, I use 2 complementary methods to achieve this association, and when the first fails, the second tries. The tracking rectangle is black. The object ID then generates a unique color for that ID.

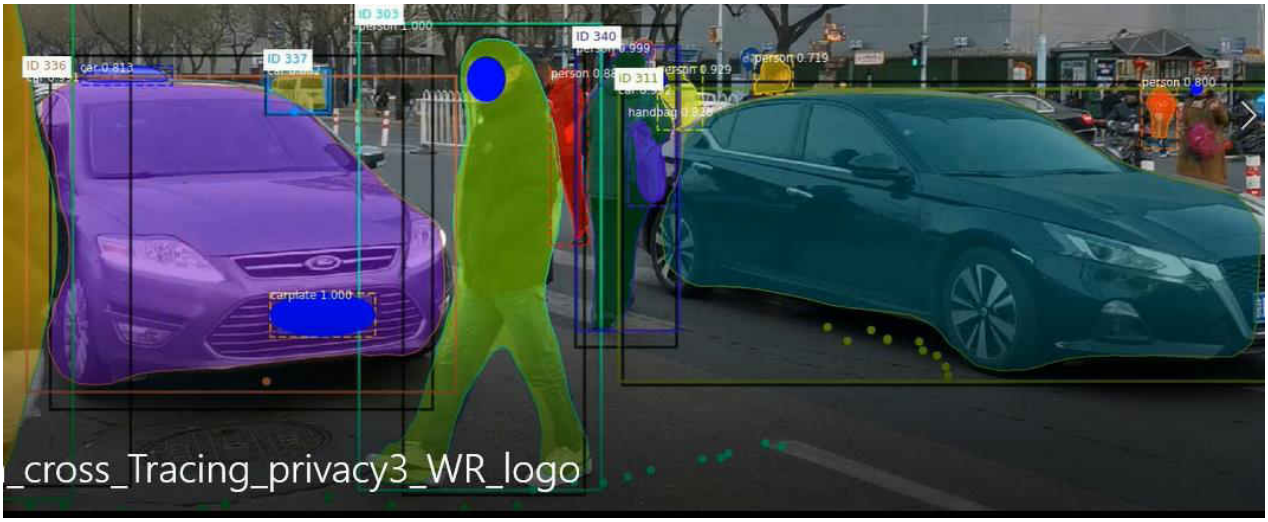
In non-tracking video, the color of the object changes with the frame. In tracking video, the color of the object is stable from frame to frame.

跟踪使用对象检测结果，这些结果以“ x1，y1，x2，y2，得分”格式逐帧显示。 它使用“排序”算法生成格式为“ x1，y1，x2，y2，id”的新检测结果。

困难在于从第二个表中找出从第一个表中检测到的一个，并且矩形的大小不同。 因此，我使用 2 种互补方法来实现这种关联，当第一种失败时，第二种尝试。 跟踪矩形为黑色。 然后，对象 ID 为该 ID 生成唯一的颜色。

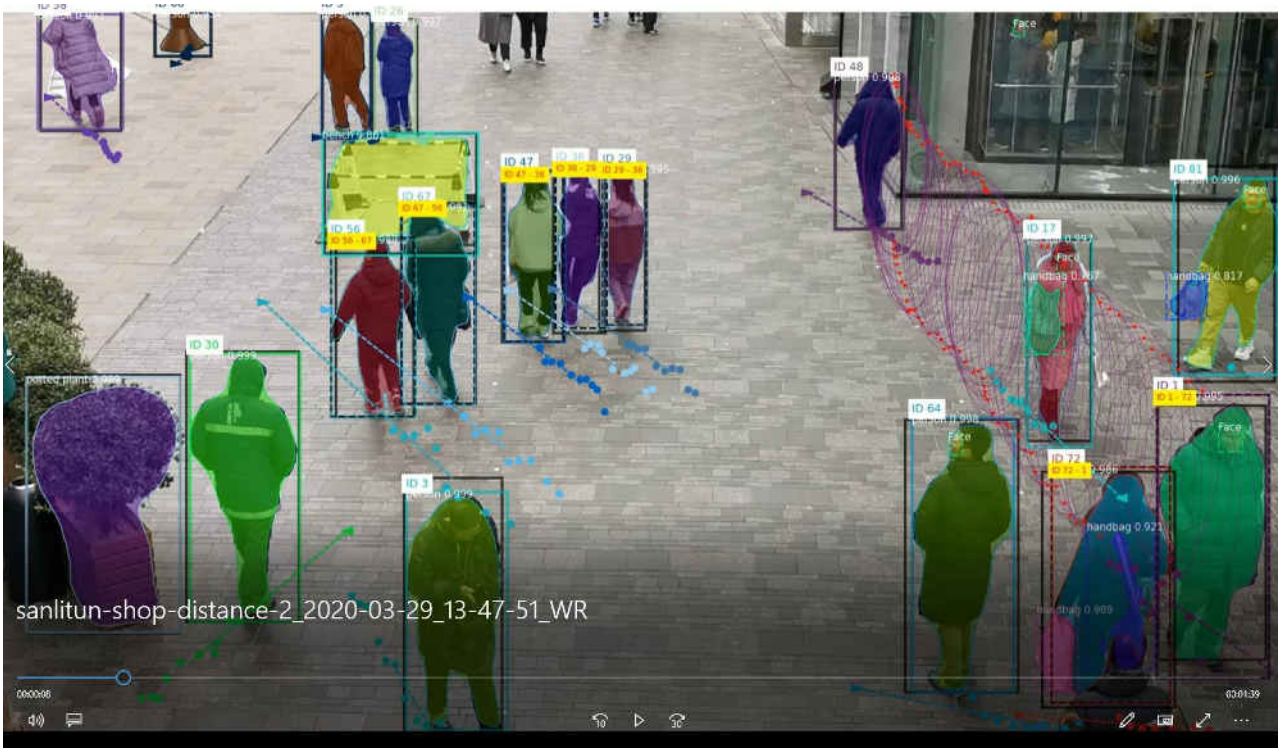
在非跟踪视频中，对象的颜色随帧而变化。 在跟踪视频时，对象的颜色在帧与帧之间是稳定的。





Tracking objects work for any object. The time tracking point is the lower center position of the tracking rectangle in the last 11 frames. I implemented a circular buffer. If the location is unknown or not detected, the value is -1.
This way you can not only see the method, but also (read the tracking poster) to evaluate the speed of the object.
跟踪对象适用于任何对象。时间跟踪点是最近 11 帧中跟踪矩形的下中心位置。我实现了环形缓冲区。如果位置未知或未检测到，则值为-1。
这样，您不仅可以看到方法，而且还可以（阅读标语）评估对象的速度

Privacy can also be active in tracking. Face and car plate extraction can also be provided as needed, and the results will be stored with the object ID for subsequent analysis.
隐私也可以在跟踪中处于活动状态。还可以根据需要提供面部和汽车板块提取，结果将与对象 ID 一起存储，以方便后续分析



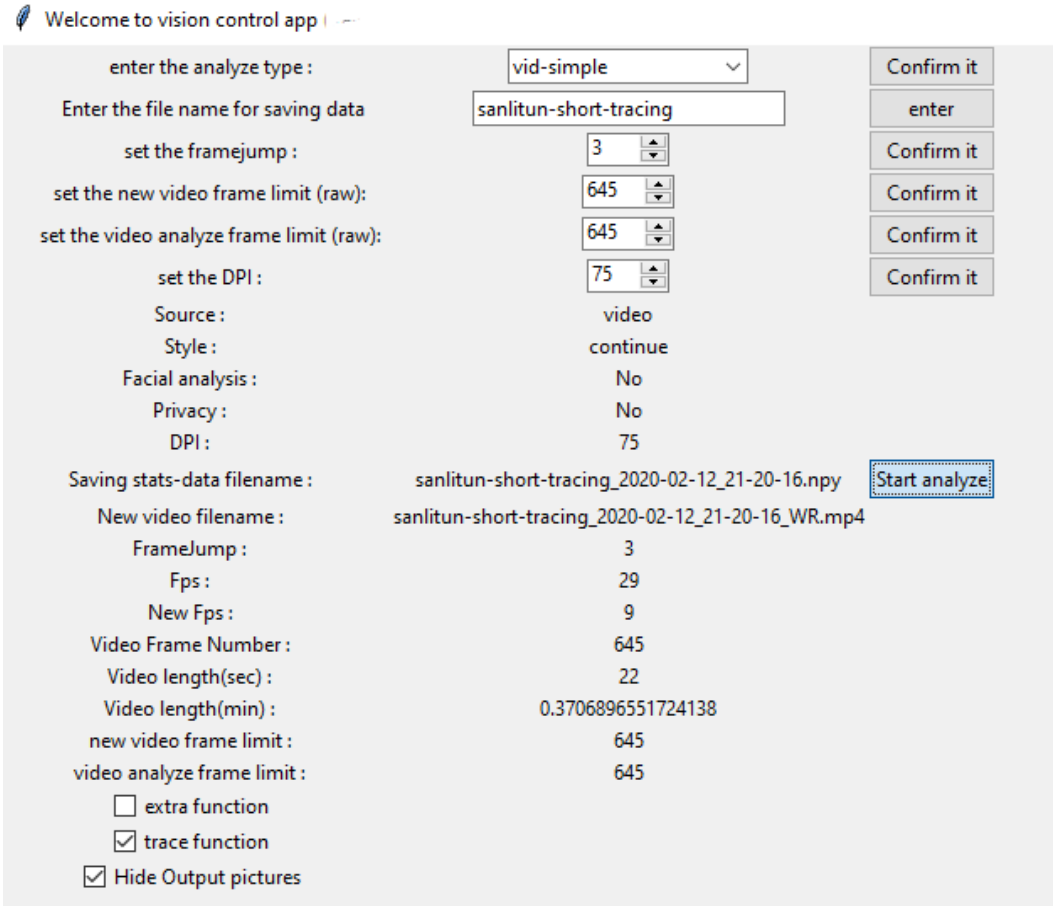
。videos are available on google drive

https://drive.google.com/file/d/1n0NZ87QyBiM6XJ4uoIfwmEbH9Hb5idaO/view?usp=sharing

and Baidu-share

链接: https://pan.baidu.com/s/1mnyrX5wGFwhOFeBEm1HLCg 提取码: 5kf5

The application:

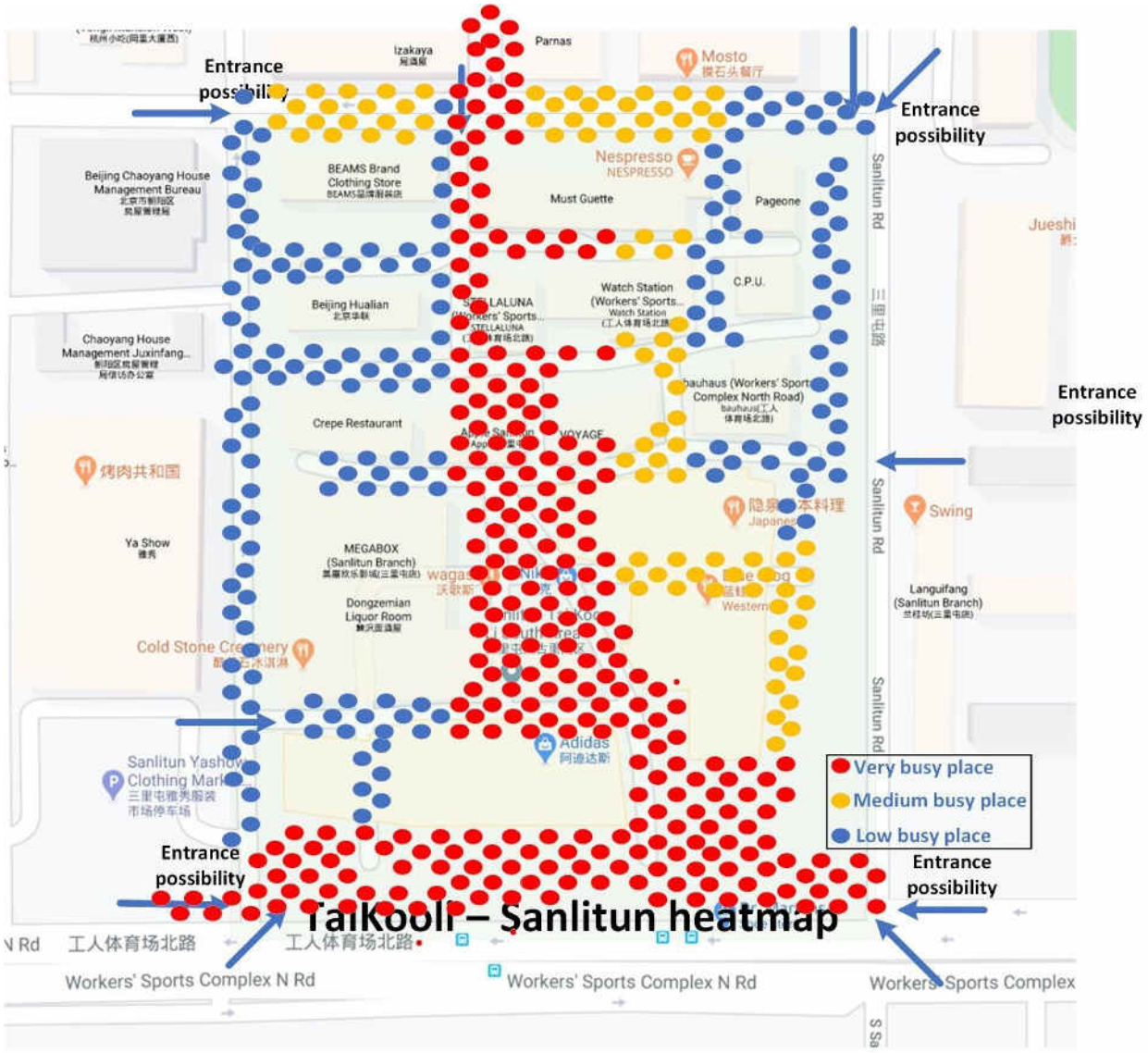


1. Select the method (picture / video / video / statistics) (normal / simple / privacy), then select the source 选择方式（图片/视频/视频/统计信息）（正常/简单/隐私），然后选择来源
2. Enter the basic file name of the result 输入结果的基本文件名
3. Set frame jump (if you take the video as the end, please choose 3-5 frame jump) 设置跳帧（如果您将视频作为结尾，请选择 3-5 跳帧
4. Select the new video frame limit in the original frame (check down the video frame number) 在原始帧中选择新的视频帧限制（向下检查视频帧号）
5. Set video analysis limits 设置视频分析限制
6. Set the dpi (best 75) 设置 dpi（最佳 75）
7. Set hidden output pictures (Jupyter Lab rests by a lot of pictures, so select this option if the video is longer) 设置隐藏输出图片（Jupyter 实验室按大量图片休息，因此如果视频较长，请选择此选项
8. Tracing function: select this function to get the position of the last 11 frames 跟踪功能：选择该功能可获取最后 11 帧的位置
9. Additional function: Allows to save the face / object / license plate professional object ID in the file name 附加功能：允许将人脸/物体/车牌专业物体 ID 保存在文件名中

At the end of the video, the app inserts the user logo as the video owner 在视频末尾，应用程序将用户徽标插入为视频所有者

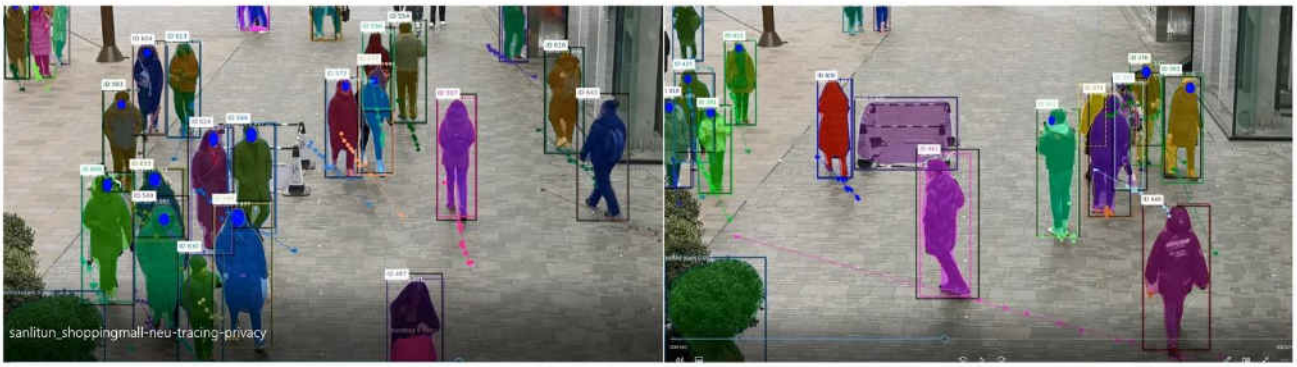
The posters and user cases: 海报：

该系统还用于分析商场的人流，识别热点区域，并优化店铺位置、类型和吸引力。



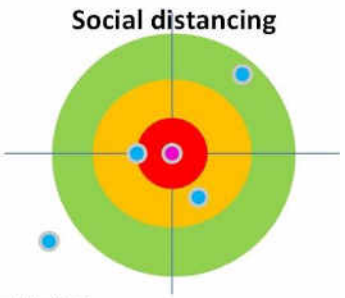
Tracking objects2 : Monitor motion / speed and distance between objects (social distance)
Mask R-CNN:追踪对象2：监视物体的移动/速度和距离（社交距离）

The goal of object tracking is to provide a constant ID assignment with the same object as long as he/it is visible, as well as a tracking option (where he / it comes from), a prediction of the direction of movement (where he/it is going) and an estimate the speed (how fast).
The first version backend was based on circular buffers, but had some disadvantages such as the limited depth of historical information, performance problems with a high number of object IDs to be tracked (4000) and no information storage for offline analysis.
The second version is now based on a back-end database and offers unlimited object ID capacity, enormous performance improvements and information storage for offline analysis.
对象跟踪的目的是为同一对象提供恒定的ID分配（只要它可见），并提供跟踪选项（他/它来自何处），运动方向的预测（他/它要去往何处）），以及估算的速度。
后端的第一个版本基于循环缓冲区，但是存在一些缺点，例如历史信息的深度有限，具有大量要跟踪的对象ID（4,000）的性能问题以及无法离线存储信息的情况分析。
现在，第二个版本基于后端数据库，并提供了无限的对象ID容量，巨大的性能改进以及用于离线分析的信息存储。



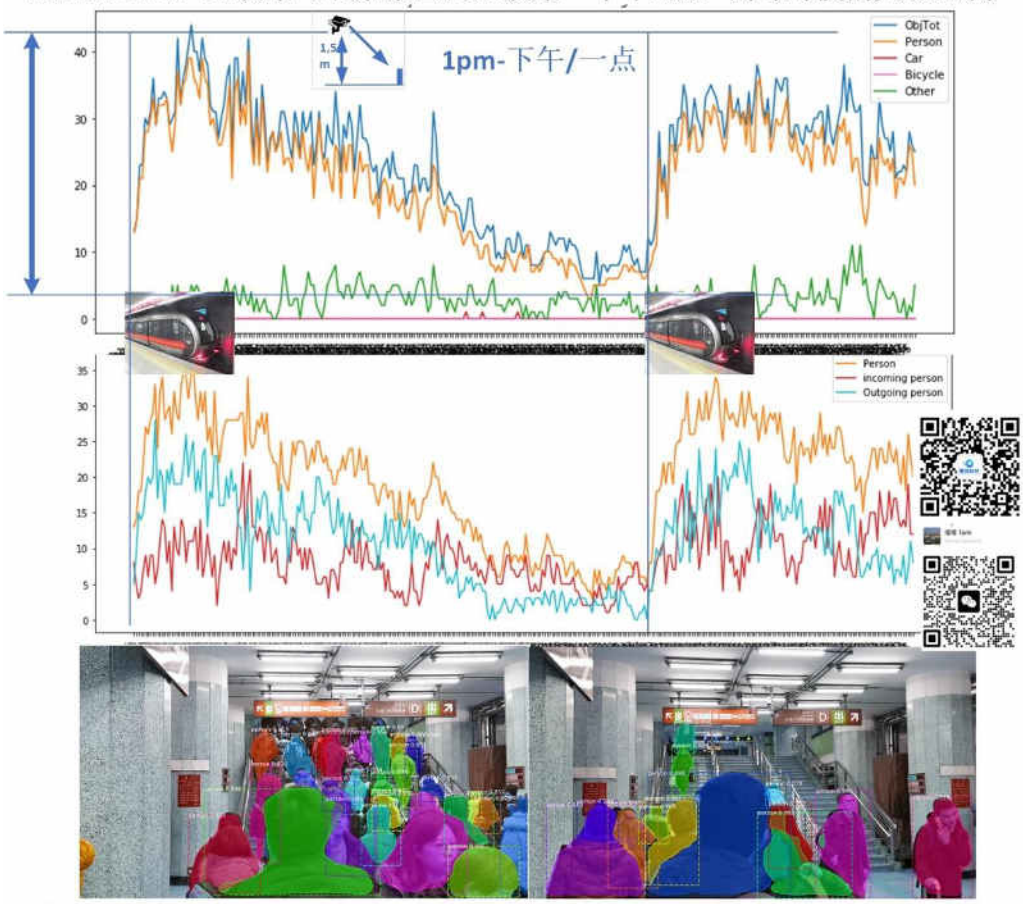
Based on the advantage of the database, we introduced facial validation. If you provide a picture of a person, it will try to recognize the person on one of the objects (embedded face validation) (face is a Match (0.119 <= 0.500)) once he has checked the person, it will track the movement until the person disappears.
基于数据库的优势，我介绍了面部认证。 如果提供人的照片，则在提取脸部之后，他将尝试在物体上识别该人（嵌入式面部认证），并且他将跟踪运动直到该人消失。
The new database backend also allows information to be shared and managed between multiple cameras. The idea is that the database has "embedded vector" information for each object ID, so the face of each camera can be verified on the same data set and unique ID. This also allows monitoring and tracking of objects in large regions / cities / countries
新的数据库后端还允许在多个摄像机之间共享和管理信息。 这个想法是数据库具有每个对象ID的“嵌入矢量”信息，因此可以在相同数据集和唯一ID上验证每个摄像机的面部。 这也允许监视和跟踪大区域/城市/国家中的对象

Social distance is the term "2020" related to the Corona / codiv-19 epidemic. Now, the new data concept and database data structure allow to check (online or offline) the minimum distance between two people. The yellow mark indicates that the distance between the two object IDs is too small. The distance is required to be set on the application menu and is also independent of the distance from the object to the camera.
社交距离是与Corona / codiv-19流行病相关的术语“ 2020”。 现在，新数据概念和数据库数据结构使可以（在线或离线）检查两个人之间的最小距离。 黄色标记表示两个对象ID之间的距离太小。 该距离需要在应用程序菜单上设置，并且还与物体到相机的距离无关。

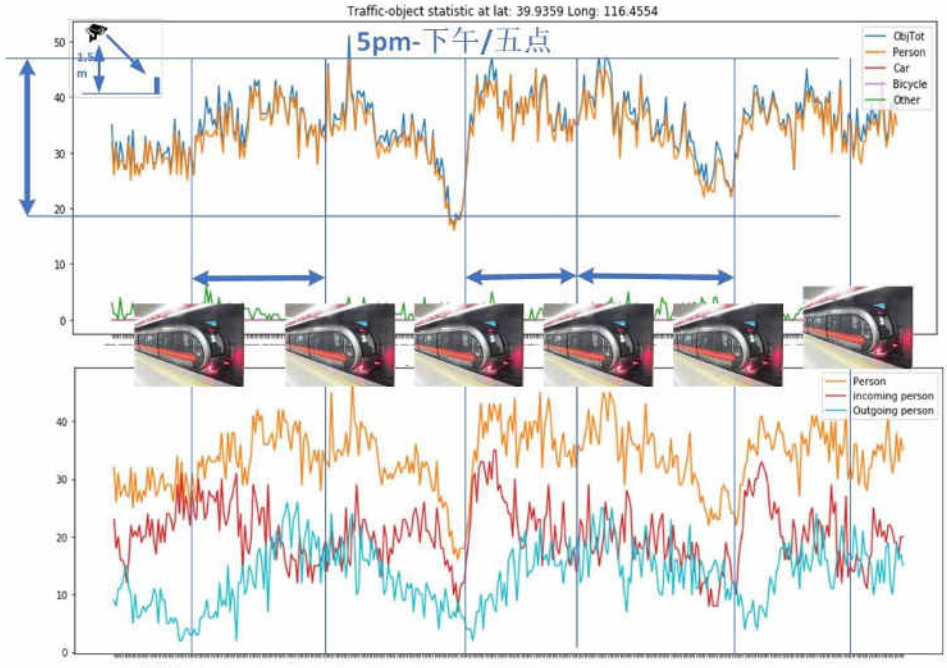


Mask R-CNN : Person flow monitoring at subway Station

Mask R-CNN：地铁站（北京东直门地铁站—下午1点）高峰时段的人流监测



The accuracy of the enumeration can only be achieved by better placement of the cameras (height and angle) and the precise definition (surface) of the array to be monitored.
枚举的准确性只能通过更好地放置摄像机（高度和角度）以及要监视的阵列的精确定义（表面）来实现。



During the rush hour在高峰时段

- Increased number of subway trains地铁列车数量增加
- Increased number of passengers entering subway stations进入地铁站的乘客数量增加
- Increased number of passengers arriving from subway trains从地铁列车到达的乘客数量增加

Finding发现:

- The available time window for evacuating passengers from and to the train is decreasing从和向火车上撤离乘客的可用时间窗口正在减少
- Variations in subway arrival intervals also reduce the available time window地铁到达间隔的变化也减少了可用的时间窗口

Preventive measures for Beijing subway 北京地铁的预防措施

- They use security personnel and volunteers to increase the speed of passenger flow他们使用安全人员和志愿者来提高客流的速度
- Optimize passenger walking and reduce bottlenecks caused by fluctuations in subway arrival times优化乘客的步行方式并减少地铁到达时间波动引起的瓶颈

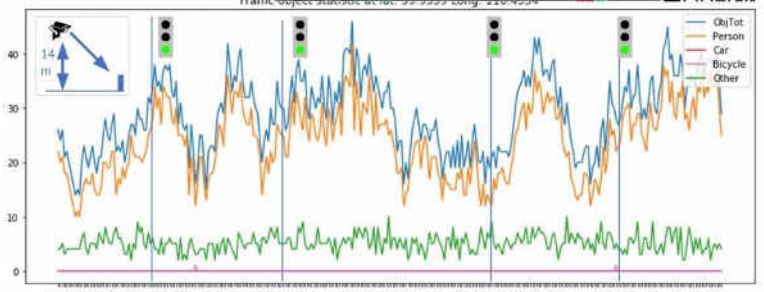
When the "vertical wave" disappeared, the subway station was already saturated. In this case, during the National Day, the Beijing Metro began to close some subway stations.当“垂直波动”消失时，地铁站已经饱和。在这种情况下，即国庆节期间，北京地铁开始关闭部分地铁站

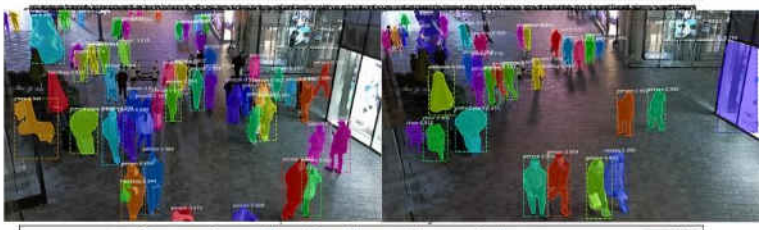
Mask R-CNN : Person flow monitoring in Shopping area

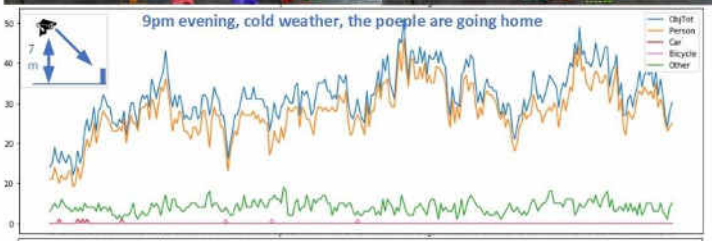
Mask R-CNN：物体检测与识别

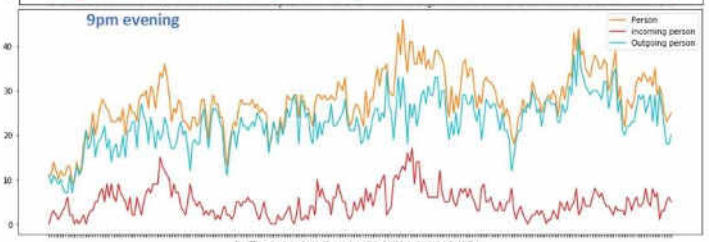
Long-term analysis of visitor traffic, useful for planning or impact analysis by opening a store

对访客流量的长期分析，对于通过开设店铺进行计划或影响分析很有用

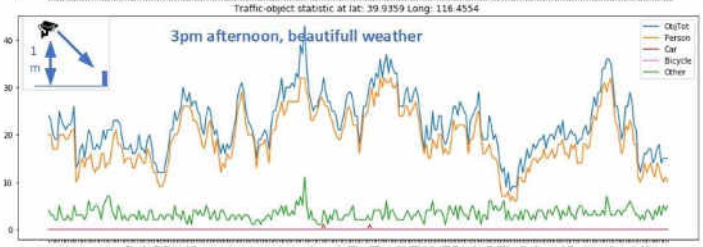


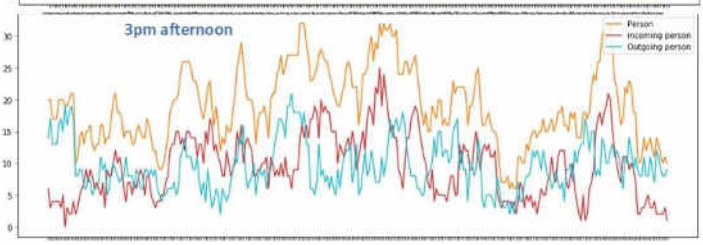




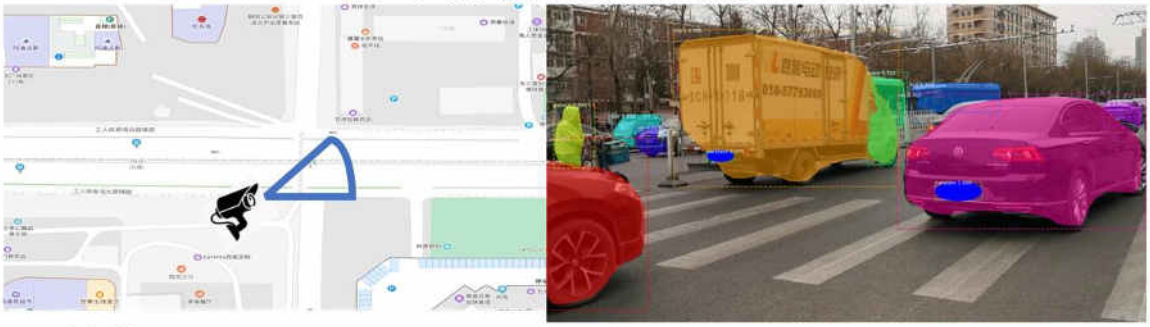


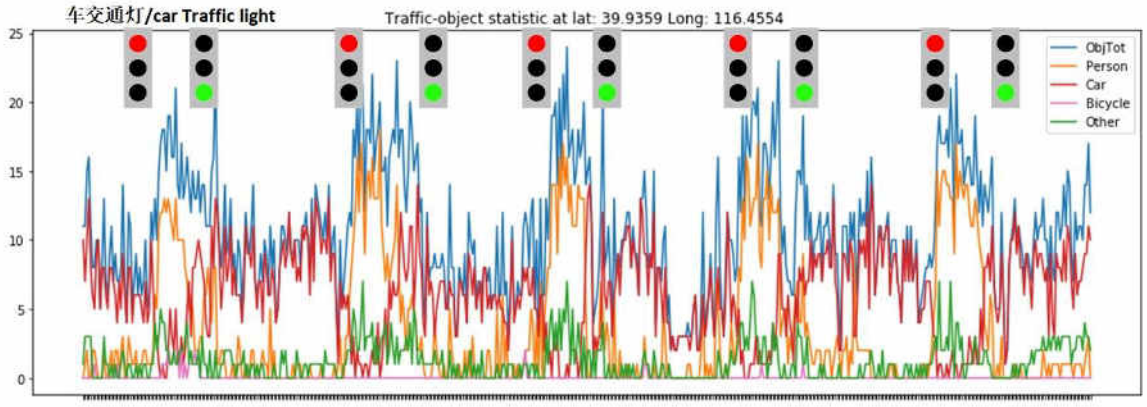
Traffic-object statistic at lat: 39.9359 Long: 116.4554

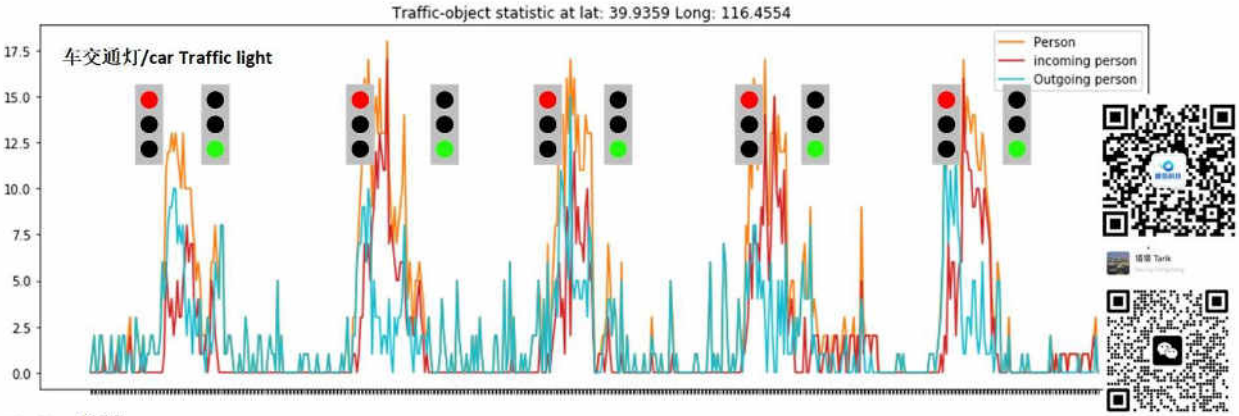




Mask R-CNN : Person flow monitoring at a crosswalk
Mask R-CNN：人行横道人流量监控（三里屯）



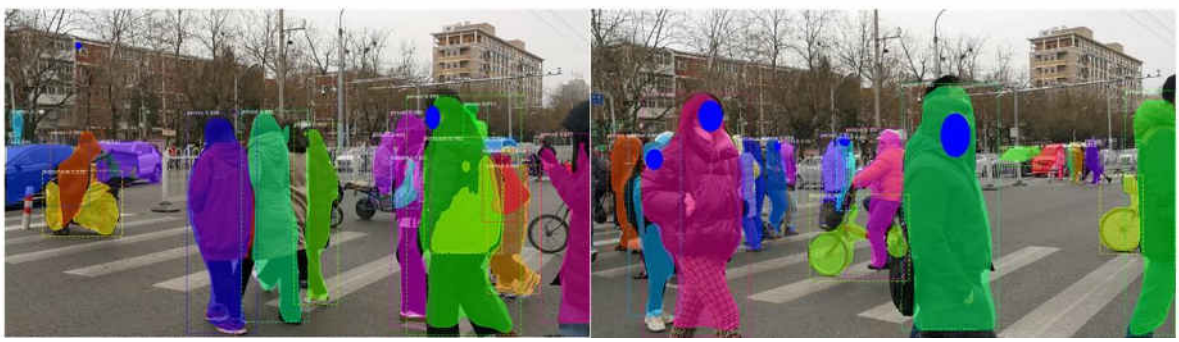




Finding发现:

- We can clearly see that when the lights turn green, the number of people leaving the camera increases significantly, and later the number of people entering the camera increases (they pop out from the other side of the street)
-Passing red lights, car numbers are also decreasing
-During the red light, the number of other objects such as bicycles is also increasing
-The number of cars during the red light period will remain the same during traffic jams. You will see the difference between the determined number of plates / minute. If the number is small, it means that we are in a traffic jam.
The nr cars here also include integrated buses and trucks

我们可以清楚地看到，当灯变成绿色时，离开摄像机的人数显着增加，后来进入摄像机的人数增加（他们从街道的另一侧弹出）
-通过红灯，车号也在减少
-在红灯期间，自行车等其他物体的数量也在增加
-在交通拥堵期间，红灯期间的汽车数量将保持不变。您将看到确定的板数/分钟之间的差异。如果数量少，则表示我们处于交通拥堵中。
这里的nr车还包括集成的公共汽车和卡车

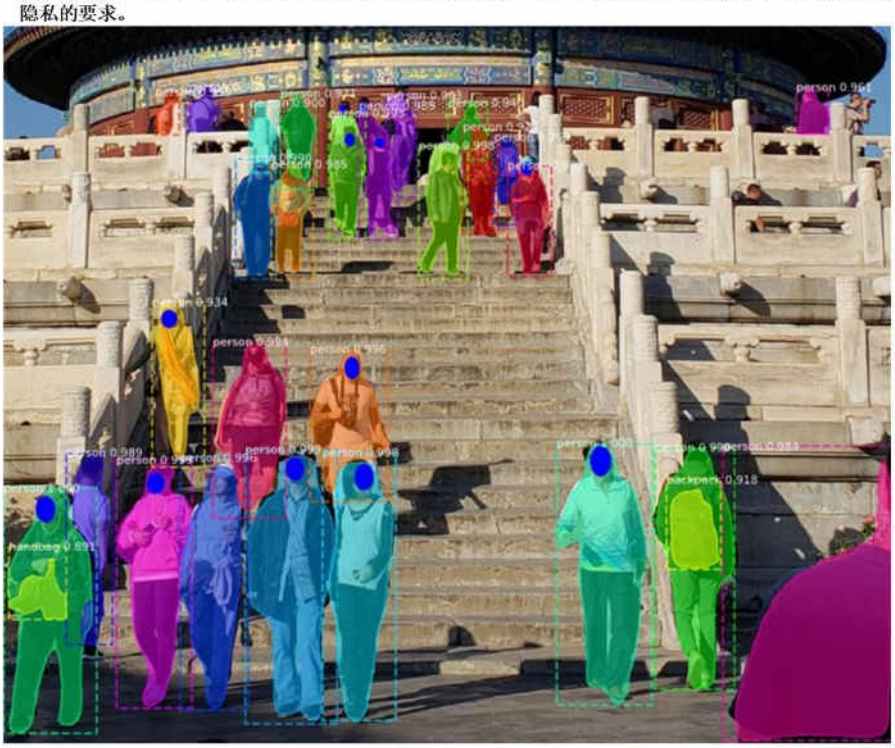


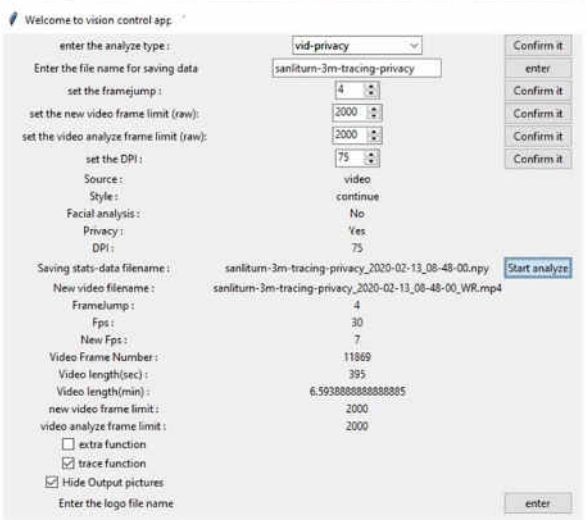
Mask R-CNN : The privacy
Mask R-CNN： 隐私权

without privacy - 没有隐私

with privacy - 有隐私

Privacy mode is a mode where every available face is hidden with an ellipse and each license plate is also hidden with a rectangle. This way I can meet my privacy requirements.
隐私模式是一种模式，其中每个可用的面孔都用椭圆隐藏，每个车牌也都用矩形隐藏。这样我就可以满足有关隐私的要求。

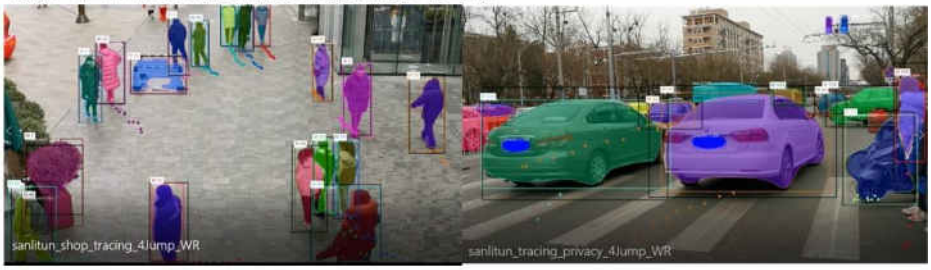




Mask R-CNN : Tracking objects
Mask R-CNN:追踪对象

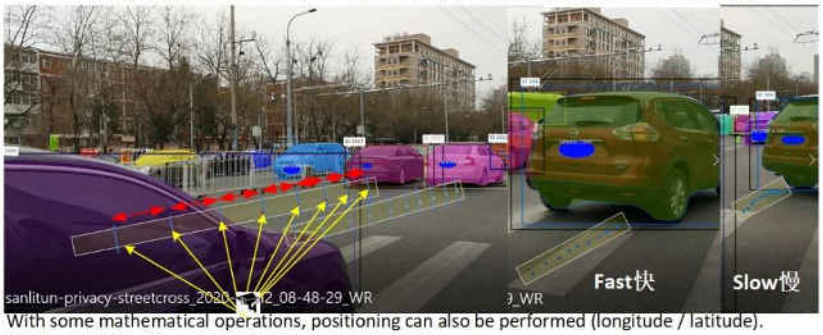
Tracking an object means identifying the same object frame by frame, even if the object is moving. This is done through a "sort" algorithm. It gives the object a unique identity, which gives him a constant color. The logo is also used for face and license plate extraction assignments. This tracking can also pass the object position of the last x frames. It uses a circular buffer to track the object position of the last x frames
跟踪对象意味着即使对象正在移动，也要逐帧标识相同的对象。这是通过“排序”算法完成的。它赋予物体独特的身份，从而赋予他恒定的颜色。该徽标还用于面部和车牌提取分配。该跟踪还可以传递最后x帧的对象位置。它使用循环缓冲区跟踪最后x帧的对象位置

Privacy mode is a mode where every available face is hidden with an ellipse and each license plate is also hidden with a rectangle. Also available in tracking mode.隐私模式是一种模式，其中每个可用脸部都用椭圆隐藏，每个车牌也都用矩形隐藏。在跟踪模式下也可用。



The position of the object can be tracked in the past x frames (see point)可以在过去的x帧中跟踪对象的位置（请参见点）

The tracking point is the position of the object in the last frames. The time distance between 2 frames is constant and is defined in the setting: x frames / second, which means that the distance between two points multiplied by a factor that depends on the angle and distance to the camera can provide the speed of the object.跟踪点是对象在最后一帧中的位置。 2帧之间的时间距离是恒定的，并在以下设置中定义：x帧/秒，这意味着两点之间的距离乘以取决于与摄像机的角度和距离的因数可以提供物体的速度。



With some mathematical operations, positioning can also be performed (longitude / latitude).
通过一些数学运算，也可以执行定位（经度/纬度）

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