IPVM

Uyghur Surveillance & Ethnicity Detection Analytics in China

Expert Report Presented to the Uyghur Tribunal

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Contents

About IPVM & Expert Background

IPVM is an independent, US-based research and media organization focused on surveillance technologies and businesses. The IPVM team publishes 3-4 reports each weekday on these topics, with particular emphasis on exposing unethical surveillance use by governments or corporations. We dedicate significant resources to covering China as the world's largest market for surveillance, and the home of the industry's most prominent companies. It is also the nation in which unethical surveillance use is arguably the most widespread, and large public projects over the last decade have significantly increased the scope and capabilities of China's national surveillance apparatus. IPVM has been following these developments for many years, particularly in Xinjiang, where advanced 'AI' surveillance technologies have been deployed specifically to target Uyghurs. Since 2018, we have published dozens of reports on these issues, with many garnering international coverage in publications such as the *New York Times*, *Washington Post*, *BBC*, and others.

As Government Director, I lead IPVM's efforts to research and communicate how surveillance technologies impact society, particularly in the context of government use. Since joining in May 2020, I have been directly involved in our investigations of surveillance technologies used on Uyghurs, and I have been responsible for communicating IPVM's

findings to the public. As such, I can offer the Tribunal insight into and answer questions about the technical capabilities of surveillance networks in Xinjiang, Uyghur face detection and its applications, and which corporate and government entities are involved in developing these technologies.

1. Overview of Uyghur Face Detection

The deployment of advanced analytic technologies ('AI', 'big data analysis') has been a signature element of China's massive state surveillance expansion. In general, these technologies empower surveillance cameras and other devices to automate, to an extent, the otherwise manual tasks of public security officials: collecting data on citizens' whereabouts, activities, associations, characteristics, etc. One such technology is Uyghur face detection (UFD), a system trained to determine if a person in an image or video is Uyghur on the basis of their facial features. In April, 2019, a New York Times investigative report found that China's authorities are "using a vast, secret system of advanced facial recognition technology to track and control the Uyghurs."[1] This facial recognition, the report said, "looks exclusively for Uyghurs based on their appearance and keeps records of their comings and goings for search and review," and it is "potentially ushering in a new era of automated racism."

Demographics classification systems such as those capable of detecting ethnicity are often marketed as extensions of face recognition products, but in fact these are distinct technologies. In terms of the development process, building ethnicity detection is not an extension of the technical work required to build a face recognition system, but a separate process and a significant investment. For UFD, manually-curated datasets containing thousands of Uyghur faces would be necessary, and creating such datasets likely involves thousands of hours of labor.

Several UFD systems have been created in China, and they are known to have been applied in many ways. Heart of City (HOC), a "smart city" software designed by Dahua Technologies integrated it into police operations systems, calling the functionality "real-time Uyghur warnings."[2] UFD has also been used in online content moderation, such as in Alibaba's "Cloud Shield" solution, which could automatically recognize Uyghur faces in online images or videos, and flag the content for review or removal.[3]

2. Uyghur Face Detection in PRC National Standards and Tenders

The proliferation of Uyghur face detection is an outcome of state policy, with UFD tacitly required in China's national standards for surveillance, and routinely specified in tenders for public surveillance projects.

In China, detailed standards are issued across all sectors of government which govern specifications in tenders for public projects and, in turn, the winning bidders for such projects. In December 2017, IPVM uncovered a draft of the Ministry of Public Security's standard for face recognition used in surveillance systems. The draft stated that "face attribute recognition" functionalities should include "Ethnicity recognition: (Uyghur/Non-Uyghur)."[4]

The draft was never published (which may, or may not, have been influenced by IPVM publishing the find). However, a similar national standard published the same year, GA/T1400.3—2017, requested face recognition systems detect "personal attributes" including "ethnicity" and "skin color," but did not specify which ethnicities should be detected. Several other national and provincial surveillance standards included the same or similar requirements, including GA/T 1756-2020, DB41/T 1514—2017, and DB4403/T 43—2020.[5] Notably, the latter is a Xinjiang provincial standard for police "technical database requirements" for "video and image" systems, which requested a statistical confidence score on a 0-100 scale

estimating whether someone belongs to a specific, unnamed ethnic group (or groups). To be sure, these standards officially list ethnicity detection features as "recommended". However, as noted by a supplier of the standards, "'Recommended' is not voluntary, it should be treated as 'mandatory'"[6].

In the standards, "ethnicity" is thought to be shorthand for "Uyghur." In addition to the draft standards uncovered in 2017, this is reinforced by the fact that Chinese authorities have explicitly requested UFD capabilities in tenders for public security camera networks. One example is a project to install "face recognition and analysis systems" in Yulin City, Guangxi, which required the systems to "support the facial attributes of the analyst's objectives (Uyghur, Han)." A similar project in Suqian City, Jiangsu, required face recognition to "Analyze the age, ethnicity, gender, whether you wear glasses, or Uyghurs" for "captured passerby pictures." Yet another project in Gangsu Province required "automatic labeling of captured faces or portrait images, including age, gender, ethnicity (Han and Uyghur)."[7] Even excluding projects in Xinjiang, tenders for PRC government surveillance projects which specifically require Uyghur face detection are commonplace.

3. PRC Corporations Offering Uyghur Face Detection

Several of China's technology companies have developed UFD systems. This section discusses them with the exceptions of Dahua and Hikvision which are addressed in their own, separate sections to account for a discussion of their broader involvement in Xinjiang.

3.1 Huawei

3.1.1 Huawei/Megvii "Uyghur Alarms"

Huawei is a well-known Chinese technology multinational, while Megvii is one of China's largest face recognition companies. A confidential Huawei report titled "Huawei Video Cloud Solution and Megvii Dynamic Face Recognition Interoperability Test Report" and dated January 8th, 2018, showed the two companies worked together to test and validate "Uyghur alarms". It was listed among the "basic functions of Megvii's facial recognition system" that Huawei "verified" could operate with Huawei technology, including a "Uyghur alarm" feature which was noted as having "passed" inspection (Figure 1). Despite being marked

Figure 1 - Huawei/Megvii Interoperability Report

confidential, the report was uncovered by IPVM via Google search and downloaded from Huawei's own website.[8][9]

3.1.2 Huawei Patent

In a July 2018 patent application, Huawei described a face recognition system capable of using surveillance to identify the race of passersby, and returning two possible results: Han or Uyghur. The patent application was submitted jointly with the Chinese Academy of Sciences, the PRC government's top research arm.[10]

3.2 Megvii Patent

In a June 2019 patent application, Megvii described a face recognition system with an "ethnicity classification" feature capable of analyzing if a person is "Han, Uyghur, non-Han, non-Uyghur, and unknown." The patent notes it "can also directly connect to the facial recognition that has been built by the public security organ."[11]

Several other Megvii patents mention "minority" or "ethnicity" detection, but without explicit mention of Uyghurs. These are searchable in any public patent database.

3.3 Alibaba

3.3.1 Alibaba Cloud Uyghur Content Moderation

Among Alibaba's divisions is Alibaba Cloud, China's largest cloud services provider. An Alibaba Cloud API guide, downloaded from the company's own website, lists "Is [the face] Uyghur?" as one of several 'face attributes' it can detect. The API guide mentions Uyghurs a second time, describing its ability to detect "Whether [the face] is a minority (Uyghur)", with the brackets specifying that "minority" is equivalent to "Uyghur."[12]

The API guide stated this technology was part of Alibaba's "Cloud Shield" solution. Alibaba describes Cloud Shield as "a pioneer in the field of Content Security," and states it "detects and recognizes text, pictures, videos, and voices containing pornography, politics, violent terrorism, advertisements, and spam, and provides verification, marking, custom configuration and other capabilities." Although most applications of Uyghur face detection are intended for video surveillance, this suggest's Alibaba intended it for internet content moderation. It is well-known that the PRC government strictly censors its internet, an effort increasingly driven by AI moderation and censorship solutions created by private firms. However, Alibaba's "minority" detection can be used for surveillance as well. Two other Alibaba API

guides for "sensitive video facial recognition" include a feature for detecting "whether [the face] is an ethnic minority."[13]

3.3.2 Alibaba Patent for Ethnicity Detection

In 2018, Alibaba was granted a patent filed in 2016 for an "image set generation method, device, and image recognition module." The patent lists "race" and "ethnicity" detection capabilities in illustrating a use case, "For example, if a company wants to use face recognition technology to check attendance, then each employee of the company can be regarded as a category, so that after classifying the image, you can identify which person it is. Of course, in other applications, categories can be divided according to race, ethnicity, or region." Uyghurs are not mentioned explicitly in the patent.[14]

3.4 Tiandy

Tiandy is one of China's largest surveillance companies, with 2019 sales of $620 million and branches in ~60 countries.

3.4.1 Tiandy Ethnicity Detection

A publicly available Tiandy SDK dated July 2020 has "race" analytics, with possible results as "yellow", "black", "white", and "the Uyghurs," and Tiandy's own website touts the ethnicity detection capabilities of their cameras.[15]

3.4.2 Tiandy "Smart Interrogation Table"

Tiandy also offers a 'one stop shop' police solution called the "Tiandy Law Enforcement and Case Handling Management Center" which includes a "Smart Interrogation Table" (Figure 2) that uses tiger chairs.[16]

Figure 2 - Tiandy Smart Interrogation Table
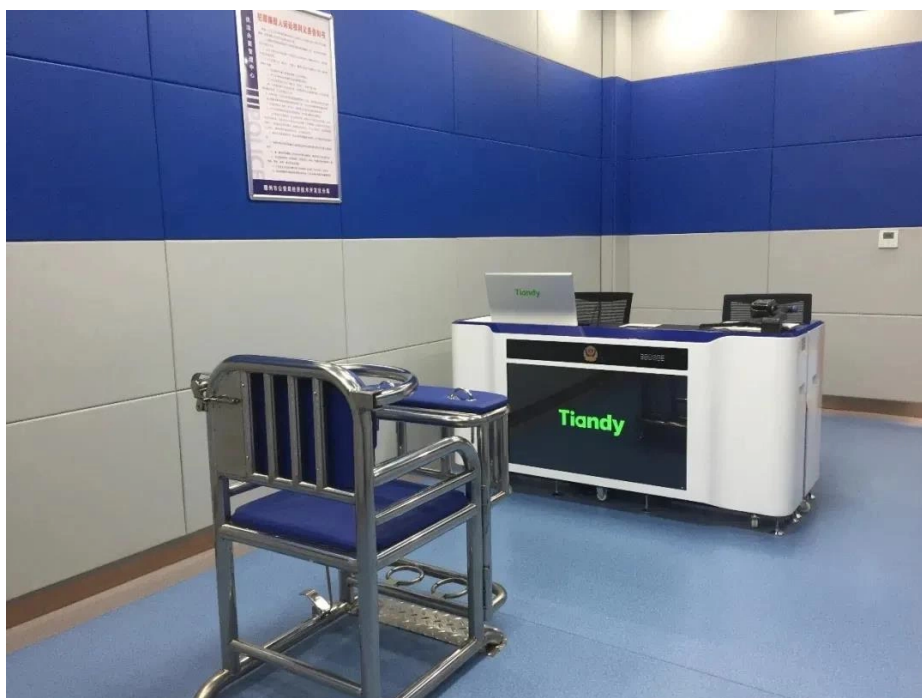
Human Rights Watch has reported that tiger chairs are used for torture by police, who "strap [detainees] into these metal chairs for hours and even days, depriving detainees of sleep, and immobilizing them until their legs and buttocks were swollen."[17]

3.4.3 Tiandy Xinjiang Presence

Tiandy has publicized selling and installing integrated police security solutions for numerous PRC police authorities and court systems. The company has a Xinjiang office in Urumqi that has promoted its work helping Xinjiang's "safety and stability maintenance" and projects in "safe cities, roads, hotels, courts, [and] mosques." Tiandy's Xinjiang office promoted an interrogation solution that has been they said is

being used by police and courts in Xinjiang, and in recent months, Tiandy has posted numerous job listings for police, military, and court-related staff in Xinjiang.[18]

3.5 Kingsoft API Guide

Kingsoft is a PRC cloud services provider worth ~$10 billion USD that went public on the NASDAQ stock exchange in May, 2020. An API guide downloaded from Kingsoft's website included "Uyghur, non-Uyghur" face detection claiming to detect with 48.7% confidence if a sample face is Uyghur.

3.6 SenseTime Patent

Sensetime is the PRC's largest face recognition/AI startup, with a reported $750m USD in 2019 sales. A patent filed in July 2019 describes the ability to classify individuals with "structured attribute tags such as age group and ethnicity…it can be divided according to Han, non-Han and unknown, or according to Han, Uyghur, non-Han, non-Uyghur, and unknown." The patent gives the example of using the system to search for "a middle-aged Uyghur man with sunglasses and a beard" by inputting those variables to find matching individuals.

3.7 Intellifusion Patent

Intellifusion is a PRC AI/face recognition startup which raised nearly $141 m USD in a pre-IPO funding round last year. An Intellifusion patent filed in 2018, for an "image retrieval method and device", described Uyghur face detection.

3.8 SensingTech Patent

SensingTech, another China face recognition/AI startup, filed a patent in 2019 for an "aggregation method of pedestrian [image] library based on face recognition" which picks out Uyghurs as one of "two categories".

3.9 Baidu Patent

Baidu is known as the 'Google of China'. In 2019, Baidu filed a patent which includes "ethnicity" in its "attribution recognition" AI model. The patent does not explicitly mention Uyghurs, or any other ethnicities in particular.

4. Hikvision

4.1 Hikvision Overview, Origins & Ownership

Hangzhou Hikvision Digital Technology Co. is the world's largest surveillance manufacturer, with greater than 40,000 employees, operations in 150+ countries, and 2020 revenue of RMB 63.5 Billion (~$10B USD).

Hikvision originated from the No. 52 Research Institute of the China Electronics Technology Group Corporation (CETC), a PRC state-owned entity. CETC remains Hikvision's controlling shareholder to this day through a wholly-owned subsidiary, CETHIK. The Director of the No. 52 Research Institute, Chen Zongnian, is a member of the National People's Congress; he is also Hikvision's Chairman.[19]

Hikvision has touted its "substantial fiscal subsidies", having received several billion USD in investment from the PRC government. The company's financial filings have stated that the PRC government could "exert significant influence over our business and other matters of significance to us."[20]

4.2 Hikvision in Xinjiang

Hikvision has a substantial presence in Xinjiang, where the government has contracted them to directly build and operate multiple large surveillance projects.

One contract is a $46M USD "Social Defense System" in Xinjiang's Moyu county. The project included surveillance cameras for both re-education centers and

mosques; specifically, it required "facial recognition cameras to be placed at the entrance of each of the 967 mosques in Moyu County." Mosques were also to be set up with video conference systems allowing sermons to be centrally delivered from a studio run by the Moyu County Ethnic Affairs Commission.[21]

Another is a $53 M USD contract in Xinjiang's Pishan County for a mass facial recognition system. Contract documents described the installation of a surveillance system for the Justice Bureau's "Transformation Through Education Center" or "司法局教育转化基地监控系统" in Chinese. This term is used by Chinese authorities to refer to Uyghur re-education camps. The project also included a mosque surveillance and video conferencing system.[22]

Hikvision has received several other contracts for surveillance in Xinjiang. It should be noted that these projects are 'Private-Public Partnerships' between Xinjiang authorities and Hikvision, meaning Hikvision constructs, finances, and operates the installations for several years with government support under the "DBFOT" or Design-Build-Finance-Operate-Transfer model. The Pishan County project, for example, expires in 2040 according to Hikvision's own financial disclosures. Despite evidence of direct operational involvement, Hikvision has claimed it has no control or knowledge of how its technology is used in Xinjiang.

On its China website, Hikvision published a map of its "R&D Centers" showing a location in Xinjiang. Job postings described it as the "Hikvision Xinjiang Research Institute", stating that staff would live and work at an "Armed Police Forces camp" in Urumqi located "500 meters behind the Fuqian Road Chinese Medicine Hospital." This location corresponded to a PAP camp visible in satellite imagery. The workers would be "mainly responsible for labeling image or video samples in an

office working environment with computers." Applicants were required to be of "Han nationality".[23]

Prior to discovering the job postings, IPVM researchers asked Hikvision about the map. It was promptly removed and the company stated, "Hikvision does not have a research institute in Xinjiang." Later, when asked about the job postings for the "Hikvision Xinjiang Research Institute", the company deleted the postings, stated they were intended "to service commercial enterprises and not work on government projects," and reiterated that the Hikvision Xinjiang Research Institute does not exist.[24]

The manual labelling of images/videos is a key part of training deep learning-based analytics, such as Uyghur face detection. But it is unclear which projects the job postings were meant to serve.

4.3 Hikvision Uyghur Detection Cameras

In 2018, Hikvision inadvertently showcased an "ethnic minority" detection feature in a demonstration at the AI Cloud World Summit. (Figure 3) The demonstration did not specify which ethnic minority was being detected.

Figure 3 - Hikvision Minority Detection at AI World Cloud Summit

In November, 2019, it was discovered that Hikvision developed software that would specifically identify ethnic Uyghurs, according to the product description of a "smart" camera on Hikvision's own China website.

Figure 4 - Hikvision Uyghur Face Detection Camera

DS-2CD7A2XYZ-JM/RX
2 million star class 1/1.8"   CMOS Hikvision AI pan smart capture camera network camera

- Support the gender attributes of the analyst's target (male, female), support the racial attributes of the analyst's target (such as Uighur, Han) and ethnic color attributes (such as white, yellow, black); support analysts whether to wear glasses, whether Wear a mask, wear a hat, or have a beard, and the recognition accuracy is not less than 90%.

4.5 CETC and the Integrated Joint Operations Platform

Hikvision's parent company CETC, which was created to supply technology to the People's Liberation Army[25], is reported to have been an architect of the Integrated Joint Operations Platform (IJOP), a system used by Xinjiang authorities to monitor Uyghurs.[26] According to Human Rights Watch, "The Program aggregates data about people - often without their knowledge - and flags those it deems potentially threatening to officials". IJOP takes data from multiple sources, with face recognition-enabled surveillance representing a critical part of the system. IJOP also uses surveillance in combination with "wifi sniffers", which collect the unique identifiers of networked devices (smartphones, etc.) in their vicinity, to associate devices to individuals captured by cameras. Although Hikvision is not known to

have worked directly with CETC to design IJOP, it should be noted that its surveillance devices form a critical component of the system.

5. Dahua

5.1 Dahua Overview, Origins, and Ownership

The Hangzhou-based Zhejiang Dahua Technology Co., Ltd. is the world's second-largest surveillance manufacturer. With 16,000 employees, Dahua's operations span more than 180 countries.

Although Dahua's operations are comparable in many ways with its crosstown rival Hikvision, the company's origins and ownership are private. Dahua's controlling shareholders are founder and Chairman, Fu Liquan, and his wife Chen Ailing. State-owned enterprises hold 13.3% of Dahua shares.[27]

5.2 Dahua Contracts in Xinjiang

With nearly $1 B USD in contracts, Dahua is the PRC's largest Xinjiang surveillance supplier on record.

Among these is a $686 M surveillance project in Xinjiang's Yarkant County. Dahua was contracted to build and operate, for a period of 9 years, a mass surveillance network, and multiple 'convenience police stations'. Construction of thousands of new police stations has been a signature move by Xinjiang's top official Chen Quanguo; Reuters has reported these can be found at "almost every corner" of major cities.[28] This project is notable for its massive size, an $807 USD expense for each of the 850,000 residents of Yarkant County.

In 2017, Dahua and local firm Leon Technology won a surveillance project for Xinjiang's Qiemo County worth $61 M. It included "a system that captures the features of wireless MAC addresses," technology also known as 'WiFi sniffers'. As

discussed in 4.5, WiFi sniffers combined with surveillance cameras are used to track Xinjiang residents in IJOP.

5.3 Dahua Xinjiang Industry Park

Dahua built a large-scale facility in Changji City, Xinjiang, the "Dahua Security Science and Technology Information Industry Park," which includes an R&D center, a manufacturing center, a logistics center, a management center, and a monitoring center. Local Changji media reported that the park will "support and meet the demand for various security technologies that are required for ensuring stability in Xinjiang" and "carry out customized research and development." Dahua's Chairman Fu Liquan was pictured attending the groundbreaking ceremony. During a separate visit to Xinjiang, Mr. Fu said "with the strong support of all parties in Xinjiang, Dahua has become one of the most important security products and solutions providers in the Xinjiang market."[29]

5.4 Dahua Uyghur Face Detection, "Real-time Uyghur Warnings"

A Dahua SDK shows the company has developed Uyghur face detection. The SDK listed "Ethnicity Recognition: (Uyghur/Non-Uyghur" under "Face Attribute Recognition" capabilities. This SDK was downloaded from Dahua's own website, but deleted after the Uyghur detection references were discovered. The same SDK also showed Dahua offered beard analysis.[30]

Dahua Technologies build UFD into Heart of City (HOC), a "smart city" software integrated into mass surveillance which Dahua describes as "tapping the potential of big data resources to build a new AI-driven 'Smart Policing' model, driving front-line teams to operate accurately, efficiently and intelligently." In a December 2019 company document, Dahua described this system as providing police with "Real-time Uyghur warnings". This means if a Dahua surveillance camera sees what it

believes is a Uyghur, HOC's functionality allows a report to be automatically sent to the police.[31]

Figure 5 - Dahua HOC "Real Time Uyghur Warnings"

A separate March 2020 Dahua document said that Heart of City supports "real time Uyghur warnings." The document mentions various subcategories of individuals that can be tracked by HOC, including "Uyghurs with hidden terrorist inclinations." It is unknown what the assessment criteria are for "hidden terrorist inclinations", but reports have stated that mundane characteristics such as having a full beard, owning knives, or going to mosques can land an individual in this category.

6. Publications

Listed below are publications produced by our team which are relevant to the Tribunal. All have been made available for public access via the included links, and PDF copies are available upon request.

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