

# Datasheets for datasets.

## UDC-VIX: A Real-World Video Dataset for Under-Display Cameras

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### Motivation

**For what purpose was the dataset created?** Was there a specific task in mind? Was there a specific gap that needed to be filled? Please provide a description.

Under Display Camera (UDC) significantly degrades captured images or videos, introducing low transmittance, blur, noise, and flare issues. Tackling such issues is challenging because of the complex degradation of UDCs. Despite their importance, studies on real-world video datasets have yet to be significantly explored in the UDC domain. Currently, available datasets consist solely of synthetic videos, failing to depict real-world degradation accurately. As far as we know, this is the first real-world UDC video dataset addressing the limitations of existing ones.

**Who created this dataset (e.g., which team, research group) and on behalf of which entity (e.g., company, institution, organization)?**

The dataset is crafted by the authors of the paper affiliated with our research group.

**Who funded the creation of the dataset?** If there is an associated grant, please provide the name of the grantor and the grant name and number.

The answer to this question will be provided in the camera-ready version to ensure the author's anonymity.

### Any other comments?

N/A.

### Composition

**What do the instances that comprise the dataset represent (e.g., documents, photos, people, countries)?** Are there multiple types of instances (e.g., movies, users, and ratings; people and interactions between them; nodes and edges)? Please provide a description.

The dataset comprises pairs of undistorted and UDC-distorted videos for the same scene. Each pair includes annotations detailing the video-capturing conditions, such as indoor or outdoor settings, presence of flare and light sources, human presence, and types of human motion.

**How many instances are there in total (of each type, if appropriate)?**

There are a total of 647 pairs of undistorted and UDC-distorted videos.

**Does the dataset contain all possible instances or is it a sample (not necessarily random) of instances from a larger set?** If the dataset is a sample, then what is the larger set? Is the sample representative of the larger set (e.g., geographic coverage)? If so, please describe how this representativeness was validated/verified. If it is not representative of the larger set, please describe why not (e.g., to cover a more diverse range of instances, because instances were withheld or unavailable).

The dataset was meticulously gathered, considering crucial factors such as indoor and outdoor settings, flare presence, various light sources, and diverse human motions from varying angles. However, videos were deliberately recorded without fast-moving objects such as speeding cars. It is important to note that the dataset does not aim to represent all distortions caused by every UDC product comprehensively. Instead, it provides sample videos captured explicitly by the Samsung Galaxy Z-Fold 5 [Samsung Electronics Co., Ltd.(2023)] UDC, representing just one of many UDC products available.

**What data does each instance consist of? “Raw” data (e.g., unprocessed text or images) or features?** In either case, please provide a description.

Every instance (i.e., video pair) contains the following components:

- An undistorted video and a UDC-distorted video for the same scene in low dynamic range (.PNG file) along with conversion code from PNG to NPY.
- Annotations that tell the video-capturing conditions, such as flare presence, light sources, indoor/outdoor, human presence, and types of human motion (.CSV file).

**Is there a label or target associated with each instance?** If so, please provide a description.

We offer annotations for each video pair. Table 1 provides a detailed overview of the total count and distribution of instances of different annotation labels. Note that an instance can have multiple annotation labels. The parenthesized number beside a label is the encoding of the label. The instances are categorized as indoor/outdoor, flare presence and light sources, and human presence and type of motion. Detailed information can be found at: [our project site](#).

Table 1: Annotation distribution and the number of instances.

Label	# of videos
Indoor (0)	468
Outdoor (1)	179
No flare (0)	195
Flare: Natural light (1)	70
Flare: Artificial light (2)	299
Flare: Both (3)	83
No human (0)	222
Human: Hand waving (1)	126
Human: Thumbs-up (2)	114
Human: Body-swaying (3)	151
Human: Walking (4)	34
<b>Total</b>	<b>647</b>

**Is any information missing from individual instances?** If so, please provide a description, explaining why this information is missing (e.g., because it was unavailable). This does not include intentionally removed information, but might include, e.g., redacted text.

There is no missing information.

**Are relationships between individual instances made explicit (e.g., users’ movie ratings, social network links)?** If so, please describe how these relationships are made explicit.

There are no explicit relationships between individual instances in the dataset, with each instance comprising a pair of undistorted and UDC-distorted videos.

**Are there recommended data splits (e.g., training, development/validation, testing)?** If so, please provide a description of these splits, explaining the rationale behind them.

We plan to release the dataset with predetermined divisions into training, validation, and test sets. The dataset is randomly partitioned into three sets with the following counts: 510 for training, 69 for validation, and 68 for testing. This random allocation ensures that the different annotation types are adequately represented in each set.

**Are there any errors, sources of noise, or redundancies in the dataset?** If so, please provide a description.

Stringent quality assessments were conducted to guarantee the dataset's coherence, alignment accuracy, and annotation precision across video pairs. We have devised a dedicated maintenance strategy to promptly address and resolve any issues reported by users after the dataset's public release, thereby ensuring continuous data integrity and usability.

**Is the dataset self-contained, or does it link to or otherwise rely on external resources (e.g., websites, tweets, other datasets)?** If it links to or relies on external resources, a) are there guarantees that they will exist, and remain constant, over time; b) are there official archival versions of the complete dataset (i.e., including the external resources as they existed at the time the dataset was created); c) are there any restrictions (e.g., licenses, fees) associated with any of the external resources that might apply to a future user? Please provide descriptions of all external resources and any restrictions associated with them, as well as links or other access points, as appropriate.

The dataset is self-contained and created without relying on external resources. There are no dependencies on the existence, stability, or licensing of external resources, eliminating the need for any associated guarantees or restrictions.

**Does the dataset contain data that might be considered confidential (e.g., data that is protected by legal privilege or by doctor-patient confidentiality, data that includes the content of individuals non-public communications)?** If so, please provide a description.

The dataset includes 64.6% of videos that capture individuals' faces and actions. We obtained approval from the Institutional Review Board (IRB) and recruited 22 participants with the understanding that the dataset would be made publicly available. The informed consent indicated that the dataset would consist of videos featuring individuals' faces and motions without collecting additional personal information. Therefore, no data elements are confidential, as all participants agreed to release their facial and behavioral data publicly.

**Does the dataset contain data that, if viewed directly, might be offensive, insult-**

**ing, threatening, or might otherwise cause anxiety?** If so, please describe why.

No. The dataset contains no content that is offensive, insulting, threatening, or likely to cause anxiety.

**Does the dataset relate to people?** If not, you may skip the remaining questions in this section.

Yes.

**Does the dataset identify any subpopulations (e.g., by age, gender)?** If so, please describe how these subpopulations are identified and provide a description of their respective distributions within the dataset.

The dataset consists of videos depicting human actions, allowing for the identification of gender and approximate age. These subpopulations are visually identified within the video dataset. The 22 research participants include twenty males and two females, all healthy adults in their twenties to thirties.

**Is it possible to identify individuals (i.e., one or more natural persons), either directly or indirectly (i.e., in combination with other data) from the dataset?** If so, please describe how.

Yes. Given that human faces are discernible in the video dataset, individuals can potentially be identified through visual inspection of the videos.

**Does the dataset contain data that might be considered sensitive in any way (e.g., data that reveals racial or ethnic origins, sexual orientations, religious beliefs, political opinions or union memberships, or locations; financial or health data; biometric or genetic data; forms of government identification, such as social security numbers; criminal history)?** If so, please provide a description.

No. The dataset does not contain any data that might be considered sensitive.

**Any other comments?**

N/A.

Collection Process
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**How was the data associated with each instance acquired?** Was the data directly observable (e.g., raw text, movie ratings), reported by subjects (e.g., survey responses), or indirectly inferred/derived from other data (e.g., part-of-speech tags, model-based guesses for age or language)? If data was reported by subjects or indirectly inferred/derived from other data, was the data validated/verified? If so, please describe how.

The data associated with each instance in our dataset is directly observable, gathered via smartphone cameras, and does not depend on reported information or indirect inference.

**What mechanisms or procedures were used to collect the data (e.g., hardware apparatus or sensor, manual human curation, software program, software API)?** How were these mechanisms or procedures validated?

Since obtaining well-synchronized and precisely aligned paired videos for the same scene is challenging, we meticulously designed both hardware and software components for video capture. Our proposed UDC video-capturing system comprises two camera modules (e.g., the Arducam Hawk-Eye (IMX686) [Arducam(2022)]), a display panel for the UDC area (e.g., Samsung Galaxy Z-Fold 5 [Samsung Electronics Co., Ltd.(2023)]), a beam splitter (e.g., Thorlabs CCM1-BS013 [Thorlabs(2015)]), two 6-axis stages [Thorlabs(2013)], and a single-board computer (e.g., Raspberry Pi 5 [Arducam(2023)]). Software programs were utilized for video recording (e.g., rpicamapps [Foundation(2023)]) and alignment of paired images, following the image alignment method proposed by Ahn et al., which employs the discrete Fourier transform. The alignment accuracies of the instances were validated using the Percentage of Correct Keypoints (PCK) metric [Ahn et al.(2024)Ahn, Ko, Lee, Park, and Lee, Feng et al.(2023)Feng, Li, Chen, Li, Gu, and Loy] as detailed in the main body of the paper.

**If the dataset is a sample from a larger set, what was the sampling strategy (e.g., deterministic, probabilistic with specific sampling probabilities)?**

No. It is not a sample from a larger set.

**Who was involved in the data collection process (e.g., students, crowdworkers, contractors) and how were they compensated (e.g., how much were crowdworkers paid)?**

The authors created the dataset. The answer to this question regarding the crowd workers will be included in the camera-ready version to ensure the author’s anonymity.

After obtaining IRB approval and recruiting 22 participants, we provided each individual with a Starbucks gift card valued at 50,000 Korean won (approximately 40 USD), as specified in the recruitment document and participant information sheet.

**Over what timeframe was the data collected? Does this timeframe match the creation timeframe of the data associated with the instances (e.g., recent crawl of old news articles)?** If not, please describe the timeframe in which the data associated with the instances was created.

We developed the video-capturing system, consisting of hardware and software, for dataset capture between January and April 2024. The video shooting using the video-capturing system was conducted from April to May 2024, which aligns with the timeframe for creating the data associated with the instances.

**Were any ethical review processes conducted (e.g., by an institutional review board)?** If so, please provide a description of these review processes, including the outcomes, as well as a link or other access point to any supporting documentation.

We have conducted an ethical review process by an Institutional Review Board (IRB) at Anonymous University. We obtained IRB approval by preparing a research proposal, participant information sheet and consent forms, a dataset collection management sheet, a bioethics compliance pledge, and participant recruitment documents. Through the participant recruitment documents, we recruited 22 participants. On the day of shooting, we explained the contents outlined in the participant information sheet to the participants and proceeded with the actual shooting. The information included in the participant information sheet covers the purpose and scope of the research, the number of participants to be recruited, the participation period,

the process participants will undergo, potential side effects, benefits, disadvantages, withdrawal options, the scope of personal data protection, and compensation.

**Does the dataset relate to people?** If not, you may skip the remaining questions in this section.

Yes. It contains videos featuring humans and their motions.

**Did you collect the data from the individuals in question directly, or obtain it via third parties or other sources (e.g., websites)?**

We directly collected the data by meeting the individuals and filming the videos.

**Were the individuals in question notified about the data collection?** If so, please describe (or show with screenshots or other information) how notice was provided, and provide a link or other access point to, or otherwise reproduce, the exact language of the notification itself.

Yes. We informed the research participants about the filming using the participant recruitment documents that underwent IRB review, which specified the duration and specific motions (e.g., hand waving, thumbs-up, body-swaying, and walking) of the filming. On the shooting day, we explained this based on the participant information and consent forms.

**Did the individuals in question consent to the collection and use of their data?** If so, please describe (or show with screenshots or other information) how consent was requested and provided, and provide a link or other access point to, or otherwise reproduce, the exact language to which the individuals consented.

Through the participant information document and in-person explanation on the shooting day, we detailed the research’s objective (i.e., UDC dataset collection and restoration model development). Following this, participants signed consent forms after understanding that the captured video dataset would be publicly available for research on the deep-learning model for UDC video restoration. Filming proceeded with the consent of the 22 individuals who signed the consent forms. Unfortunately, we cannot share the individuals’ signed consent forms due to privacy concerns. However, one can access the Korean

consent form approved by IRB in the supplementary materials.

**If consent was obtained, were the consenting individuals provided with a mechanism to revoke their consent in the future or for certain uses?** If so, please provide a description, as well as a link or other access point to the mechanism (if appropriate).

The participant information document informed consenting individuals that they have the option to revoke their consent. In case of withdrawal, we provide them with the email and mobile phone number of the paper’s first author for contacting purposes.

**Has an analysis of the potential impact of the dataset and its use on data subjects (e.g., a data protection impact analysis) been conducted?** If so, please provide a description of this analysis, including the outcomes, as well as a link or other access point to any supporting documentation.

We discussed potential adverse societal impacts and provided user guidelines and authors’ responsibilities in the Appendix. The discussion encompasses the permissibility of utilizing the dataset within the scope of UDC research while explicitly prohibiting unintended uses like deep fakes. Users must adhere to their respective countries’ laws and ethical standards, undergo IRB review, and conduct research using the UDC-VIX dataset.

**Any other comments?**

N/A.

#### Preprocessing/cleaning/labeling

**Was any preprocessing/cleaning/ labeling of the data done (e.g., discretization or bucketing, tokenization, part-of-speech tagging, SIFT feature extraction, removal of instances, processing of missing values)?** If so, please provide a description. If not, you may skip the remainder of the questions in this section.

The alignment of video pairs utilizes the discrete Fourier transform. Proper annotations are assigned to the instances, as described in Table 1.

**Was the “raw” data saved in addition to the preprocessed/cleaned/labeled data (e.g., to support unanticipated future uses)?** If so, please provide a link or other access point to the “raw” data.

Upon request, individuals can access the unaligned “raw” video.

**Is the software used to preprocess/clean/label the instances available?** If so, please provide a link or other access point.

We will publicly release the image alignment software through our [our project site](#). However, the authors conduct the cleaning and labeling processes manually, not through software.

**Any other comments?**

N/A.

### Uses

**Has the dataset been used for any tasks already?** If so, please provide a description.

No. The dataset has yet to be used for any tasks.

**Is there a repository that links to any or all papers or systems that use the dataset?** If so, please provide a link or other access point.

No. There have yet to be papers or systems that use the dataset.

**What (other) tasks could the dataset be used for?**

The dataset can be applied to tasks concerning UDC video restoration. Participants’ consent was obtained to acquire the UDC video datasets and develop restoration models for UDC video datasets. Consequently, users of the UDC-VIX dataset can utilize it for UDC research purposes under usage restrictions following IRB review.

**Is there anything about the composition of the dataset or the way it was collected and preprocessed/cleaned/labeled that might impact future uses?** For example, is there anything that a future user might need to know to avoid uses that could result in unfair treatment of individuals or groups (e.g., stereotyping, quality of service issues) or other undesirable harms (e.g., financial harms, legal risks)

If so, please provide a description. Is there anything a future user could do to mitigate these undesirable harms?

Since the misuse of technologies like deep fakes can lead to undesirable consequences, such as financial losses or legal risks, it is essential to utilize the dataset solely for UDC research purposes following IRB review. Moreover, it is recommended that the dataset not be shared or distributed arbitrarily. Instead, all users should access it through official links (e.g., our research group’s homepage) after receiving proper guidance and consent.

**Are there tasks for which the dataset should not be used?** If so, please provide a description.

The dataset aims to facilitate the research on UDC video restoration tasks. Participants’ consent was obtained to acquire the UDC video datasets and develop restoration models for UDC video datasets. Consequently, users of the UDC-VIX dataset can utilize it for research purposes under usage restrictions. In particular, since the dataset contains videos of people’s faces and actions, it cannot be used for research involving deepfakes, generative models, and similar applications.

**Any other comments?**

N/A

### Distribution

**Will the dataset be distributed to third parties outside of the entity (e.g., company, institution, organization) on behalf of which the dataset was created?** If so, please provide a description.

The dataset will be publicly available via our research group’s homepage, which is currently unavailable during the review period. In the camera-ready, we will include the address of our research group’s homepage on our [our project site](#).

**How will the dataset be distributed? (e.g., tarball on website, API, GitHub)** Does the dataset have a digital object identifier (DOI)?

- The dataset will be available at our research group’s homepage.



- Dataset DOI:  
<https://doi.org/10.5281/zenodo.11447554>.

### When will the dataset be distributed?

The dataset will be distributed and made publicly available before the start of the International Conference on Learning Representations (ICLR) 2025 conference.

**Will the dataset be distributed under a copyright or other intellectual property (IP) license, and/or under applicable terms of use (ToU)?** If so, please describe this license and/or ToU, and provide a link or other access point to, or otherwise reproduce, any relevant licensing terms or ToU, as well as any fees associated with these restrictions.

The UDC-VIX dataset is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0). Under this license, the users of the UDC-VIX dataset can freely utilize, share, and modify this work by adequately attributing the original author, distributing any derived works under the same license, and utilizing it exclusively for non-commercial purposes. Detailed information about this license can be found in [the official Creative Commons website](#).

**Have any third parties imposed IP-based or other restrictions on the data associated with the instances?** If so, please describe these restrictions, and provide a link or other access point to, or otherwise reproduce, any relevant licensing terms, as well as any fees associated with these restrictions.

No, there are no IP-based or other restrictions on the data associated with the instances imposed by third parties. The dataset was independently created without utilizing any external datasets or sources. Therefore, no relevant licensing terms, access points, or fees are associated with any restrictions.

**Do any export controls or other regulatory restrictions apply to the dataset or to individual instances?** If so, please describe these restrictions, and provide a link or other access point to, or otherwise reproduce, any supporting documentation.

Participants' consent was obtained to acquire the UDC video datasets and develop restoration models for UDC video datasets. Consequently, users of the UDC-VIX dataset can utilize it for research purposes under usage restrictions. In particular, since the dataset contains videos of people's faces and actions, it cannot be used for research involving deepfakes, generative models, and similar applications. Users must secure IRB approval before initiating any research with the UDC-VIX dataset. Any commercial or unethical use of the dataset, its use in violation of applicable laws, or any use unrelated to UDC restoration will hold the user solely responsible for any legal consequences.

### Any other comments?

N/A.

## Maintenance

### Who will be supporting/hosting/ maintaining the dataset?

The dataset will be supported/hosted/maintained by the authors and the members of our research group.

### How can the owner/curator/manager of the dataset be contacted (e.g., email address)?

Users can contact the authors using the email addresses provided in the paper or through the our [our project site](#). In addition, they can contact our research group.

### Is there an erratum? If so, please provide a link or other access point.

There are currently no reported errata for the dataset.

### Will the dataset be updated (e.g., to correct labeling errors, add new instances, delete instances)? If so, please describe how often, by whom, and how updates will be communicated to users (e.g., mailing list, GitHub)?

If users report any labeling errors, the dataset will be promptly updated, and the revisions will be communicated through our [our project site](#). The users can report any illegal or unethical use of the dataset.

### If the dataset relates to people, are there applicable limits on the retention of the data

**associated with the instances (e.g., were individuals in question told that their data would be retained for a fixed period of time and then deleted)?** If so, please describe these limits and explain how they will be enforced.

There are no explicit regulations concerning the duration required to retain the dataset. However, users must have IRB approval and are restricted to utilizing it solely for UDC research.

**Will older versions of the dataset continue to be supported/hosted/maintained?** If so, please describe how. If not, please describe how its obsolescence will be communicated to users.

If errors have been reported and corrected, older versions of the dataset with those errors will no longer be maintained. However, older versions will still be supported if new instances are added to the dataset.

**If others want to extend/augment/ build**

**on/contribute to the dataset, is there a mechanism for them to do so?** If so, please provide a description. Will these contributions be validated/verified? If so, please describe how. If not, why not? Is there a process for communicating/distributing these contributions to other users? If so, please provide a description.

If individuals wish to contribute additional annotations, they can provide annotations for each instance and contact us for validation. Approved annotations will be added to the official [our project site](#) for distribution to other users. Adding paired video instances that do not include individuals is permissible. However, suppose someone intends to add videos containing individuals to the official UDC-VIX dataset. In that case, we will review the addition by IRB regulations and relevant laws before considering its inclusion.

**Any other comments?**

N/A.



## References

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