[Supplementary Content] Dataset for Cyber-Physical Anomaly Detection in Smart Homes

Yasar Majib [1,*], **Mohammed Alosaimi** [1], **Andre Asaturyan** [2], **and Charith Perera** [1]

[1] *School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom*
[2] *The Building Research Establishment, BRE Group, Bucknalls Lane, Watford, Hertfordshire, United Kingdom*

Correspondence*:
Corresponding Author
majiby@cardiff.ac.uk

1 ABOUT THIS DOCUMENT

This document is a supplement content document to Dataset for Cyber-Physical Anomaly Detection in Smart Homes, where the main information about the dataset is provided. Dataset can be accessed from (Link 1) and (Link 2). The following sections contains in depth details of all smart devices used for data collection and resulting Datasets. In Section 2, list of entities for each device can be found in tables of Section 3, Section 4 provides detailed information about datasets, and images of smart devices are provided in 5.

2 DEVICE SPECIFICATIONS

In this section, we enlisted device specification of each device used in the process of data collection. These specifications are taken from official sources e.g. manufacturer's websites. The specifications could help in determining any potential point anomalies in the device's data-stream, for example, if the temperature range for Aqara Temperature and Humidity Sensor is -20° to 50°C, an out-of-range value may reflect sensor fault or manipulation in the data streams by an adversary.

2.1 Samsung SmartThings Contact Sensor

- Material: Plastic
- Protocols: ZigBee
- Range: 15 - 40m
- Dimensions (WxHxD): 3.6 x 1.5 x 4.8 cm
- Weight: 42g (with battery)
- Power Source: Battery
- Battery Count & Type: CR-2450, 1-count
- Requirements: Samsung SmartThings Hub
- Location: Indoor use only
- Temperature: 0 to 40°C
- Battery Life: Up to 2 years

2.2 Xiaomi Motion Detector

- Connectivity Technology: Wireless
- Depth: 30
- Detection angle: 170
- Height: 32.8
- Mounting type: Ceiling/wall
- Manufacturer code: RTCGQ01LM
- Wireless connection: Zigbee

2.3 Xiaomi Contact Sensor

- Dimensions:40.8 × 20.8 × 11mm
- Wireless Connectivity: Zigbee
- Battery Type: CR1632
- Operating Temperature: -10°C to 50°C
- Operating Humidity: 0-95% RH, non-condensing
- Maximum Transmit Power: 10.5 dBm
- Working Frequency: 2405 MHz-2480 MHz

2.4 Aqara Wireless Switch

- Model: WXKG11LM
- Battery: CR2032
- Wireless Protocol: Zigbee
- Dimensions: 45 × 45 × 12 mm (1.77× 1.77 × 0.47 in.)
- Operating Temperature: -10°C +55°C (14°F 131°F)
- Operating Humidity: 0 – 95%RH, non-condensing
- System Requirements: Apple Home app (iOS 10.3 or later), Aqara Home app (Android 5.0 or later, iOS 10.3 or later)

2.5 Aqara Temperature and Humidity Sensor

- Model: WSDCGQ11LM
- Atmospheric Pressure Range and Precision: 30 kPa – 110 kPa, ±0.12 kPa
- Dimensions: 36 × 36 × 9 mm (1.42 × 1.42 × 0.35 in.)
- Wireless Protocol: Zigbee
- Battery: CR2032
- Temperature Range and Precision: -20° to 50°C, -4° to 122°F
- Humidity Range and Precision: 0 – 100% RH (non-condensing)
- System Requirements: Apple Home app (iOS 10.3 or later), Aqara Home app (Android 5.0 or later, iOS 10.3 or later)

2.6 Aqara Vibration Sensor

- Model: DJT11LM
- FCC ID: 2AKIT-DJT11LM
- Dimensions: 36 x 36 x 9 mm (1.42 x 1.42 x 0.35 in.)
- Wireless Protocol: Zigbee
- Battery: CR2032
- Operating Temperature: -10°– +45°C (14°– +113°)
- Operating Humidity: 0 - 95%RH, non-condensing
- System Requirements: Apple Home app (iOS 10.3 or later), Aqara Home app (Android 5.0 or later, iOS 10.3 or later)
- IC: 22635-DJT11LM

2.7 Aqara Motion Sensor

- Model: RTCGQ11LM
- Maximum Detection Distance: 7 m
- Dimensions: 30 × 30 × 33 mm (1.18 × 1.18 × 1.30 in.)
- Wireless Protocol: Zigbee
- Battery: CR2450
- Operating Temperature: -10°– +45°C (14°– +113°)

- Operating Humidity: 0 - 95%RH, non-condensing
- System Requirements: Apple Home app (iOS 10.3 or later), Aqara Home app (Android 5.0 or later, iOS 10.3 or later)
- Maximum Detection Angle: 170°

2.8 Aqara Water Leak Sensor

- Model: SJCGQ11LM
- Dimensions: 50 × 50 × 15 mm (1.97 × 1.97 × 0.59 in.)
- Wireless Protocol: Zigbee
- Battery: CR2032
- Operating Temperature: -10° +55^o(14° 131°)
- Operating Humidity: 0 – 100%RH
- System Requirements: Apple Home app (iOS 10.3 or later), Aqara Home app (Android 5.0 or later, iOS 10.3 or later)

2.9 Kasa Mini Smart Plug by TP-Link

- Protocol: IEEE 802.11b/g/n
- Wireless Type: 2.4 GHz
- System Requirements: iOS 10 or higher, Android 5.0 or higher
- Compatibility: Alexa, Google Assistant, Samsung SmartThings
- Certification: RoHS, CE
- Operating Temperature: 0°C 40°C (32°F 104°F)
- Operating Humidity: 5% 90%RH, Non-condensing
- Dimensions(H X W X D): 51.5 x 72.5 x 37.5 mm (without pin)
- I/O: Power Button and Status LED
- Power Input: 100-240 V , 50/60 Hz
- Maximum Load: 13 A

2.10 Philips Hue Light Bulb, B22

- Dimensions (WxHxD): 60x109
- Operational humidity: 5% ¡H¡95% (non condensing)
- Operational temperature: -20°C to 45°C
- Dimmable with Hue app and switch: Yes
- Bulb technology: LED
- Colour temperature: 2000K-6500K +16 million colours
- Diameter: 60 mm
- Fitting: B22
- Input voltage: 220V-240V
- Light output: White and colour light
- Lumen output at 4000K: 830 lm
- Max. operation power: 6.5 W
- Max. standby power: 0.5 W
- Number of switching cycles: 50,000
- Power factor: 0.5
- Rated lifetime: 25,000 hour(s)
- Software upgradable: Yes
- Start up: Instant 100% light output
- Wattage: 6.5 W
- Communication protocol: Zigbee

2.11 Philips Hue LightStrip

- Material: silicone
- Operational humidity: 5% - 95% (non-condensing)
- Operational temperature: -20 ^{o}C to 45 ^{o}C
- Colour changing (LED): Yes
- Diffused light effect: No
- Dimmable: Yes
- LED integrated: Yes
- Color temperature: 2000-6500K
- Cut-ability: Yes
- Extendibility: Yes

- Input Voltage: 220V-240V
- Max. standby power: 0.5 W
- Wattage: 20 W
- Power consumption: 19 W
- Lumen output at 4000K: 1,700 lm
- Lifetime up to: 25,000 h
- IP code: IP20
- Class of protection: II - double insulated
- Lumen output at 2,700K (out-of-the-box setting): 1,140 lm
- Compatible with Effects feature: Yes

2.12 Philips Hue Motion Sensor

- Material: Plastic
- Operational humidity: suitable for use indoors
- Operational temperature: 0°C - 40°C
- Colour: White
- Portable: Yes
- Battery type: AAA - Bar battery, pencil
- Minimal battery lifetime: 2 A
- Mounting options: Freestanding, Wall
- Sensor depth: 20 mm
- Sensor height: 55 mm
- Sensor width: 55 mm
- Software upgradeable: when connected to Hue Bridge
- IP code: IP42

2.13 Google Pixel 5

- Size: 6.0 inches
- Resolution: 2340 x 1080 pixels, 19.5:9 ratio, 430 PPI
- Technology: OLED
- Refresh rate: 90Hz
- Screen-to-body: 86.75%
- Features: HDR support, Scratch-resistant glass (Corning Gorilla Glass 6), Ambient light sensor, Proximity sensor
- System chip: Qualcomm Snapdragon 765G SM7250-AB (7 nm)
- Processor: Octa-core, 2400 MHz, Kryo 475, 64-bit
- GPU: Adreno 620
- RAM: 8GB LPDDR4
- Internal storage: 128GB (UFS 2.1), not expandable
- OS: Android (12, 11)
- Battery Capacity: 4080 mAh
- Battery Type: Not user replaceable
- Charging: USB Power Delivery, Qi wireless charging, Reverse wireless charging
- Max charge speed: Wired: 18.0W; Wireless: 18.0W
- Rear camera: Dual camera
- Rear main camera: 12.2 MP (OIS, PDAF)
- Specifications: Aperture size: F1.7; Focal length: 28 mm; Sensor size: 1/2.55”; Pixel size: 1.4 um
- Rear second camera: 16 MP (Ultra-wide)
- Specifications: Aperture size: F2.2; Pixel size: 1 um
- Video recording: 3840x2160 (4K UHD) (60 fps), 1920x1080 (Full HD) (240 fps)
- Features: Time-lapse video, EIS
- Front camera: 8 MP
- Video capture: 1920x1080 (Full HD)
- Materials: Back: Aluminum; Frame: Aluminum
- Resistance: Water, Dust; IP68
- Biometrics: Fingerprint (touch)
- Keys: Volume control, Lock/Unlock key
- Bluetooth: 5.0
- Wi-Fi: 802.11 a, b, g, n, ac, dual-band; MIMO, Wi-Fi Direct, Hotspot
- USB: Type-C (reversible), USB 3.1
- Features: Charging, Headphones port
- Location: GPS, A-GPS, Glonass, Galileo, Cell ID, Wi-Fi positioning
- Sensors: Accelerometer, Gyroscope, Compass, Barometer
- Other: NFC
- Hearing aid compatible: M4, T3

2.14 Withings Smart Scale

- Internet access required: Yes
- Connections: Wireless
- Power Source: Battery
- Batteries: Rechargeable lithium-ion
- Battery life: Up to one year
- Height: 1.9 cm/0.75 in.
- Length: 32.7 cm/12.8 in.
- Width: 32.7 cm/12.8 in
- Weight: 2.6 kg/5.7 lb.

2.15 Alexa Dot 3rd Generation

- Virtual Assistant: Works with Alexa
- CPU: 1.3 GHz Cortex A35 Quad-Core
- RAM: 512 MB
- Storage Capacity: 4 GB
- Speaker Power Output: 1.2 W
- Drivers: 1 x 1.57” / 40 mm Full-Range
- Frequency Response: 100 Hz to 20 kHz
- Audio Port : 1 x 1/8” / 3.5 mm Output
- Ethernet: None
- USB: None
- NFC: No
- Bluetooth: 2.1
- Wi-Fi Standards: Wi-Fi 5 (802.11ac)
- Wi-Fi Bands: 2.4 GHz, 5 GHz
- DC Input Power: 12 VDC
- Microphone Mute: Yes
- Dimensions (W x H x D): 3.9 x 1.7 x 3.9” / 9.91 x 4.32 x 9.91 cm
- Weight: 10.55 oz / 299 g

2.16 Google Home

- Diameter: 96.4 mm
- Height 142.8 mm
- Power cable 1.8 m
- Device Weight 477 g
- Power Adaptor Weight 130 g
- Body Color White
- Base Color Standard base is slate fabric
- Supported Audio Format: HE-AAC, LC-AAC, MP3, Vorbis, WAV (LPCM), Opus, FLAC with support for high-resolution streams (24-bit/96 kHz)
- Sensors: Ambient light sensor, Capacitive touch controls
- Power Adaptor: 100–240V-1.1A 50–60 Hz
- Ports and connectors: DC power jack, Micro-USB port (for service only)
- Wireless network: 802.11b/g/n/ac (2.4 GHz or 5 GHz) Wi-Fi for high-performance streaming
- WPA2-Enterprise support: No
- Bluetooth: 4.1
- Supported Bluetooth profiles: AVRCP controller, AVRCP target, A2DP sink, A2DP source, GATT server, GAP
- Speaker: High excursion speaker with 2” driver + dual 2” passive radiators delivers clear highs and rich bass
- Microphones: 2 x far-field microphones with voice recognition capabilities support hands-free use

2.17 Roborock Vacuum Cleaner S5 Max

- Dimensions: 353.0 x 350.0 x 96.5 mm
- Weight: 3.5 kg
- Suction: 2000 Pa
- Dust capacity: 460 ml
- Water capacity: 290 ml
- Voltage: 14.4 V
- Battery type: Lithium battery
- Duration: 180 minutes

- Battery capacity: 5200 mAh
- Noise: 60 dB
- General functions: Planning; Real-time mapping; No-access area configuration; Intelligent area identification; Automatic return and loading; Voice assistant.
- Charging time: 4 hours

2.18 LUMIMAN Smart Bulb E27

- Colour: Multi-color
- Colour Temperature: 6500 Kelvin
- WiFi: 2.4 GHz Only
- Material: Plastic
- Switch Style: WiFi Remote
- Power Source: AC
- Voltage/Wattage: 230V, 7.5W
- Batteries: Included/Required No
- Special Features: Schedules - Dimming - Scenes - Routines
- Voice Control Support: Alexa/Google
- App/Device Support: PlusMinus & Smart Life, Android 4.0+, iOS 8.0+
- Lumen:800LM
- Weight: 70 g
- Average Life: 30000 Hours
- Type of Bulb: LED
- Wattage: 60W
- Dimensions: 6 x 6 x 12 cm

2.19 Xiaomi Air Purifier 4 Pro

- Width: 10.8 in
- Height: 26.8in
- Weight: 15.0 lbs
- Filters: HEPA, Carbon, Negative Ion
- Wifi Compatible: Yes
- Room Coverage: 646 sq. ft.
- CADR: 500 cfm

2.20 Benq GV1 Projector

- Connectivity technology: Bluetooth, USB, HDMI
- Display resolution: 480p (854 x 480 pixels)
- Item dimensions L x W x H: 15.5 x 8 x 8 centimetres
- Form factor: Portable
- Mounting type: Floor Mount, Tabletop Mount
- Wattage: 16.7 watts
- Controller type: Remote Control
- Compatible devices: USB, HDMI

2.21 Reolink E1 Pro Camera

- Image Sensor: 1/2.7” 4 Megapixel Progressive Scan CMOS
- Minimum illumination: 0 lux (with IR on)
- IR LED Range: Up to 40 feet/12 metres
- Lens type: Fixed focus
- Focal length: f=4.0mm, f 2.0
- Angle of view Horizontal: 87.5^{o}, Vertical: 47°
- Bit rate: H.264, 1024Kbps - 4096Kbps
- WDR: None
- Ethernet: None
- Wi-Fi: IEEE 802.11a/b/g/n, Dual-band 2.4GHz / 5GHz
- Standards: ONVIF
- Protocols: HTTPS, SSL, TCP/IP, HTTP, UDP, UPNP, RTSP, SMTP, NTP, DHCP, DNS, DDNS, P2P
- Storage: microSD slot
- Power supply: 5.0V/1A (no PoE)
- Main stream: 4MP (2560x1440), 3MP (2304*1296), 1080p, 720p. Max frame rate 20 fps

- Sub stream: 640x480
- Audio support: Built-in mic and dual speaker
- Dimensions: 76x106mm
- Weight: 200g
- Weather-proofing: None
- Working environment: -10 ^{o} +55 ^{o}(14°F 131°F), 20% 85% humidity

2.22 Mill WiFi Portable Heater 1200W

- Product size (W x D x H): 62,0 x 21,0 x 38,5 cm
- Model name: CO1200WIFI3
- Aluminium heating element: High efficiency and low surface temperature
- Temperature calibration function: Yes
- Tip-over switch and overheat protection: Yes
- Power: 1200W
- Material front: Steel
- Material foot: Aluminium
- Grounded connection: Yes

2.23 Samsung Smart TV

- Series: 6
- Screen Size: 65”
- Resolution: 3,840 x 2,160
- Picture Engine: UHD Up-Scaling
- Motion Rate: 120
- PQI (Picture Quality Index): 1,500
- HDR (High Dynamic Range): HDR
- Dynamic Contrast Ratio: Mega Contrast
- Micro Dimming: UHD Dimming
- Active Crystal Color: Yes
- Contrast Enhancer: Yes
- Auto Motion Plus: Yes
- Film Mode: Yes
- Dolby Digital Plus: Yes
- DTS Codec: Yes
- Sound Output (RMS): 20 W
- Speaker Type: 2 CH (Down Firing w / Bass Reflex)
- Multiroom Link: Yes
- Bluetooth Audio: Yes
- Voice Interaction: US English, Spanish, French
- Web Browser: Yes
- One App Support: Yes
- Smart View: Yes
- TV to Mobile - Mirroring: Yes
- Mobile to TV - Mirroring, DLNA: Yes
- 360 Video Player: Yes
- Bluetooth Low Energy: Yes
- WiFi Direct: Yes
- Analog Clean View: Yes
- Digital Broadcasting: ISDB-T / DVB-T / ATSC
- Analog Tuner: Yes (Trinorma)
- HDMI: 3
- USB: 2
- Component In (Y/Pb/Pr): 1
- Composite In (AV): 1 (Common Use for Component Y)
- Ethernet (LAN) : Yes
- Digital Audio Out (Optical) : 1
- RF In (Terrestrial / Cable input / Satellite input) : 1 / 1 (Common Use for Terrestrial) / 0
- HDMI A / Return Ch. Support: Yes
- HDMI Quick Switch: Yes
- Wireless LAN Built-in: Yes
- Anynet+ (HDMI-CEC) : Yes
- Design:’16 Chamfer (KU6400 reuse)
- Bezel Type: VNB
- Slim Type: Slim
- Front Color: Silver
- Stand Type: Y-Shape
- Instant On: Yes
- Processor: Quad-Core
- Accessibility: Voice Guide (US English) / Enlarge / High Contrast / Learn TV Remote (US English) / Multi-output Audio

- Ultra Clean View: Yes
- Digital Clean View: Yes
- Auto Channel Search: Yes
- Caption (Subtitle) : Yes
- Connect Share™ (HDD) : Yes
- ConnectShare™ (USB 2.0) : Yes
- Embeded POP: Yes
- EPG: Yes
- Extended PVR: Yes
- Game Mode: Yes
- OSD Language: Local Languages
- BT HID Built-in: Yes
- USB HID Support: Yes
- Time Shift: Yes
- Power Supply: AC100-240V 50/60Hz
- Power Consumption (Max): 190 W
- Eco Sensor: Yes
- Auto Power Off: Yes
- Samsung Smart Control (Included): Yes
- Mini Wall Mount Support: Yes
- Vesa Wall Mount Support: Yes

2.24 WeeKett Smart WiFi Kettle

- Dimensions: 9.06 x 9.06 x 11.02 cm; 1.25 Kilograms
- Capacity: 1.7 litres
- Power: 2200 watts
- Voltage: 240
- Material: Stainless Steel
- Auto Shutoff: Yes
- Energy Efficiency Class: A to G
- Compatible Models: Google, Alexa, Siri via Shortcuts
- Special Features: Schedule to boil anytime, Keep warm, Baby bottle programme, Share control with family members, Water gauge on both sides for left-handed people, Boil Dry Protection, Compatible with Alexa, Google & Siri via Shortcuts, 40 to 100 ^{o}C temperature range
- Weight: 1.25 kg

2.25 Mi Smart Antibacterial Humidifier

- Model: SCK0A45
- Voltage: 220 V
- Frequency: 50 Hz
- Power: 25 W
- Water tank capacity: 4.5 L
- Weight: 1.9 kg
- Noise level during operation: upto 38 dB
- Humidification capacity: 250-350 mUh
- Dimensions: 190 x 190 x 353 mm

2.26 Smarter Coffee 2nd Generation

- Compatibility: iOS & Android
- App Languages: English and German
- Wireless: 802.11 b/g/n
- Security: WPA/WPA2
- Capacity: 1.5L
- Voltage: 220-240v
- Frequency: 50/60Hz
- Power: 950-1050W
- Dimensions (WxDxH): 206 x 266 x 424 mm
- System Requirements: 2.4 GHz frequency wireless router

3 DEVICES' ENTITIES

In this section, we enlisted entities of each device in the smart device's dataset. A device can have multiple data-streams, each data-streams may have different frequency for example Kasa Smart Plug sends current_consumption and voltage data depending of the usage, in this example the average frequency of

current_consumption for Kasa Smart Plug with PID-20 is 18.657 whereas average frequency for voltage is 12.56.

Table 1. Entities of all PIDs of Aqara Temperature and Humidity Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
71	sensor.aqara_temperature_and_humidity_pid_071_pressure	Presure value	726.7805976	0.001437	655460.7109
71	sensor.aqara_temperature_and_humidity_pid_071_humidity	Humidity value	726.7805975	0.00141	655460.7109
71	sensor.aqara_temperature_and_humidity_pid_071_temperature	Temperature value	726.7806139	0.001397	655460.7108
71	sensor.aqara_temperature_and_humidity_pid_071_battery	Battery information	726.7806138	0.001392	655460.7108
71	sensor.temperature_and_humidity_pid_071_pressure	Presure value	184.4238604	0.005705	531.61046
71	sensor.temperature_and_humidity_pid_071_humidity	Humidity value	184.4234882	0.005673	531.610328
71	sensor.temperature_and_humidity_pid_071_temperature	Temperature value	184.4232374	0.005674	531.610489
71	sensor.temperature_and_humidity_pid_071_battery	Battery information	184.4229128	0.005671	531.610485
72	sensor.aqara_temperature_and_humidity_pid_072_pressure	Presure value	753.0440763	0.00147	648885.6257
72	sensor.aqara_temperature_and_humidity_pid_072_humidity	Humidity value	753.0440763	0.001396	648885.6258
72	sensor.aqara_temperature_and_humidity_pid_072_temperature	Temperature value	753.0440763	0.001385	648885.6257
72	sensor.aqara_temperature_and_humidity_pid_072_battery	Battery information	753.0440763	0.001382	648885.6257
73	sensor.aqara_temperature_and_humidity_pid_073_pressure	Presure value	702.2971547	0.001536	657005.2985
73	sensor.aqara_temperature_and_humidity_pid_073_humidity	Humidity value	702.2971548	0.001475	657005.3006
73	sensor.aqara_temperature_and_humidity_pid_073_temperature	Temperature value	702.2971548	0.001465	657005.3009
73	sensor.aqara_temperature_and_humidity_pid_073_battery	Battery information	702.2971548	0.001458	657005.301
73	sensor.temperature_and_humidity_pid_073_pressure	Presure value	174.1572554	0.00176	848.382078
73	sensor.temperature_and_humidity_pid_073_humidity	Humidity value	174.1568846	0.001623	848.382264
73	sensor.temperature_and_humidity_pid_073_temperature	Temperature value	174.1566086	0.001601	848.382286
73	sensor.temperature_and_humidity_pid_073_battery	Battery information	174.1563632	0.00235	848.381534
74	sensor.aqara_temperature_and_humidity_pid_074_pressure	Presure value	511.6072345	0.001432	311495.1856
74	sensor.aqara_temperature_and_humidity_pid_074_humidity	Humidity value	511.6072344	0.001348	311495.1855
74	sensor.aqara_temperature_and_humidity_pid_074_temperature	Temperature value	511.6072344	0.001398	311495.1855
74	sensor.aqara_temperature_and_humidity_pid_074_battery	Battery information	511.6072344	0.001393	311495.1854
74	sensor.temperature_and_humidity_pid_074_temperature	Temperature value	54.55098444	0.00932	652.007191
74	sensor.temperature_and_humidity_pid_074_battery	Battery information	54.55087783	0.009342	652.007016
74	sensor.temperature_and_humidity_pid_074_pressure	Presure value	54.549449	0.009176	652.007064
74	sensor.temperature_and_humidity_pid_074_humidity	Humidity value	54.54934822	0.009239	652.007168

Table 2. Entities of all PIDs of Samsung SmartThings Contact Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
4	binary_sensor.smartthings_contact_sensor_pid_004_moving	Door movement	1556.95692	0.00588	225548.7134
4	binary_sensor.smartthings_contact_sensor_pid_004_tamper	Temper detection	1556.95692	0.005751	225548.7134
4	binary_sensor.smartthings_contact_sensor_pid_004_battery_low	Low battery alarm	1556.95692	0.005609	225548.7131
4	binary_sensor.smartthings_contact_sensor_pid_004_contact	Door contact status	1556.956921	0.005513	225548.7132
4	sensor.smartthings_contact_sensor_pid_004_z_axis	Z-Axis	1556.956922	0.005747	225548.7131
4	sensor.smartthings_contact_sensor_pid_004_y_axis	Y-Axis	1556.956922	0.005813	225548.7132
4	sensor.smartthings_contact_sensor_pid_004_x_axis	X-Axis	1556.956922	0.005842	225548.7134
4	sensor.smartthings_contact_sensor_pid_004_battery	Battery Level	1556.956921	0.005872	225548.7135
4	sensor.smartthings_contact_sensor_pid_004_temperature	Temperature value	1556.956921	0.005898	225548.7133
4	binary_sensor.contact_sensor_pid_004_moving	Door movement	228.0395298	1.001593	3631.297504
4	binary_sensor.contact_sensor_pid_004_tamper	Temper detection	228.0394966	1.00168	3631.297641
4	binary_sensor.contact_sensor_pid_004_battery_low	Low battery alarm	228.0394604	1.001742	3631.297865
4	binary_sensor.contact_sensor_pid_004_contact	Door contact status	228.039444	1.001855	3631.298138
4	sensor.contact_sensor_pid_004_z_axis	Z-Axis	226.0392253	0.089747	3631.298411
4	sensor.contact_sensor_pid_004_y_axis	Y-Axis	226.0392147	0.088157	3631.298621
4	sensor.contact_sensor_pid_004_x_axis	X-Axis	226.0392021	0.086586	3631.298924
4	sensor.contact_sensor_pid_004_battery	Battery Level	226.0391572	0.081401	3631.299045
4	sensor.contact_sensor_pid_004_temperature	Temperature value	226.0390744	0.071905	3631.299082
6	binary_sensor.smartthings_contact_sensor_pid_006_moving	Door movement	532.6350666	0.004557	66451.12931
6	binary_sensor.smartthings_contact_sensor_pid_006_tamper	Temper detection	532.6350665	0.004464	66451.12937
6	binary_sensor.smartthings_contact_sensor_pid_006_battery_low	Low battery alarm	532.6350665	0.004168	66451.12936
6	binary_sensor.smartthings_contact_sensor_pid_006_contact	Door contact status	532.6350665	0.004145	66451.12932
6	sensor.smartthings_contact_sensor_pid_006_z_axis	Z-Axis	532.6350675	0.004152	66451.12741
6	sensor.smartthings_contact_sensor_pid_006_y_axis	Y-Axis	532.6350675	0.004177	66451.12717
6	sensor.smartthings_contact_sensor_pid_006_x_axis	X-Axis	532.6350675	0.005941	66451.12716
6	sensor.smartthings_contact_sensor_pid_006_battery	Battery Level	532.6350669	0.006079	66451.12718
6	sensor.smartthings_contact_sensor_pid_006_temperature	Temperature value	532.6350789	0.006107	66451.12718
6	binary_sensor.contact_sensor_pid_006_moving	Door movement	169.484609	0.997433	3633.579685
6	binary_sensor.contact_sensor_pid_006_tamper	Temper detection	169.4845759	0.997472	3633.579763
6	binary_sensor.contact_sensor_pid_006_battery_low	Low battery alarm	169.4845669	0.99769	3633.579761
6	binary_sensor.contact_sensor_pid_006_contact	Door contact status	169.4845582	0.997877	3633.579569
6	sensor.contact_sensor_pid_006_z_axis	Z-Axis	168.3768749	0.081858	3633.579674
6	sensor.contact_sensor_pid_006_y_axis	Y-Axis	168.376868	0.08057	3633.579803
6	sensor.contact_sensor_pid_006_x_axis	X-Axis	168.3768613	0.079426	3633.579808
6	sensor.contact_sensor_pid_006_battery	Battery Level	168.3768449	0.07681	3633.579846
6	sensor.contact_sensor_pid_006_temperature	Temperature value	168.3768017	0.070199	3633.579861
3	binary_sensor.smartthings_contact_sensor_pid_003_moving	Door movement	831.3169806	0.004295	81767.64758
3	binary_sensor.smartthings_contact_sensor_pid_003_tamper	Temper detection	831.3169806	0.004141	81767.64651
3	binary_sensor.smartthings_contact_sensor_pid_003_battery_low	Low battery alarm	831.3169943	0.004054	81767.64625
3	binary_sensor.smartthings_contact_sensor_pid_003_contact	Door contact status	831.3169942	0.004038	81767.64583
3	sensor.smartthings_contact_sensor_pid_003_z_axis	Z-Axis	831.3169813	0.003959	81767.64562
3	sensor.smartthings_contact_sensor_pid_003_y_axis	Y-Axis	831.3169813	0.003942	81767.64525
3	sensor.smartthings_contact_sensor_pid_003_x_axis	X-Axis	831.3169813	0.003948	81767.6413
3	sensor.smartthings_contact_sensor_pid_003_battery	Battery Level	831.3169812	0.004388	81767.64084
3	sensor.smartthings_contact_sensor_pid_003_temperature	Temperature value	831.3169946	0.004566	81767.64055
3	binary_sensor.contact_sensor_pid_003_moving	Door movement	239.2493491	0.995361	3628.274677
3	binary_sensor.contact_sensor_pid_003_tamper	Temper detection	239.2493046	0.995368	3628.274721
3	binary_sensor.contact_sensor_pid_003_battery_low	Low battery alarm	239.2492912	0.995387	3628.274848
3	binary_sensor.contact_sensor_pid_003_contact	Door contact status	239.2492733	0.99548	3628.27496
3	sensor.contact_sensor_pid_003_z_axis	Z-Axis	237.0939711	0.098303	3628.275085
3	sensor.contact_sensor_pid_003_y_axis	Y-Axis	237.0939625	0.097088	3628.275235
3	sensor.contact_sensor_pid_003_x_axis	X-Axis	237.093952	0.095803	3628.275308
3	sensor.contact_sensor_pid_003_battery	Battery Level	237.0939065	0.090489	3628.275344
3	sensor.contact_sensor_pid_003_temperature	Temperature value	237.0937852	0.076837	3628.275377

Table 3. Entities of all PIDs of Philips Hue Light Bulb with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
40	light.hue_light_bulb_pid_040	Bulb Status	384.6717632	0.001515	7278.464905
40	binary_sensor.philips_hue_bulb_pid_040_update_available	Update available alert	5275.466399	19.903301	73774.6491
40	light.philips_hue_bulb_pid_040	Bulb Status	5275.465099	2.209397	73774.64997

Table 4. Entities of all PIDs of Kasa Smart Plug with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
20	sensor.kasa_020_current_consumption	Current consumption value	18.65772309	9.077039	3860.410499
20	sensor.kasa_020_voltage	Voltage value	12.56641473	9.077166	3860.413345
20	sensor.kasa_020_today_s_consumption	Today's consumption value	134.6945317	9.129699	3860.412773
20	sensor.kasa_020_total_consumption	Total consumption value	360.8909118	11.232551	3860.411628
20	sensor.kasa_020_current	Current status	191.7672294	9.130074	29754.00382
20	switch.kasa_020	Physical button status	66627.85416	11.234033	736941.7659
20	switch.kasa_020_led	Physical LED status	66627.85416	11.234174	736941.7658
21	sensor.kasa_021_current_consumption	Current consumption value	17.51419368	9.071926	3860.459771
21	sensor.kasa_021_voltage	Voltage value	12.65461994	9.034834	3860.462757
21	sensor.kasa_021_today_s_consumption	Today's consumption value	1413.930425	9.353912	3860.462053
21	sensor.kasa_021_total_consumption	Total consumption value	1436.381922	9.351542	3860.46092
21	sensor.kasa_021_current	Current status	2379.479556	9.354178	688413.605
21	switch.kasa_021	Physical button status	3172.729397	9.354183	1029330.592
21	switch.kasa_021_led	Physical LED status	3172.729396	9.35413	1029330.592
22	sensor.kasa_022_voltage	Voltage value	23.99623368	9.05126	587468.3471
22	sensor.kasa_022_current	Current status	63.70359738	9.079148	587468.3468
22	sensor.kasa_022_today_s_consumption	Today's consumption value	2208.166982	9.284276	587468.3471
22	sensor.kasa_022_total_consumption	Total consumption value	2346.66413	9.283454	587468.3474
22	sensor.kasa_022_current_consumption	Current consumption value	46.03561854	9.051926	587468.3478
22	switch.kasa_022	Physical button status	6615.618597	9.284946	587468.3466
22	switch.kasa_022_led	Physical LED status	6615.618595	9.285048	587468.3463
23	sensor.kasa_023_current_consumption	Current consumption value	21.42532346	9.06213	239239.7806
23	sensor.kasa_023_voltage	Voltage value	13.53864906	9.053014	239239.7827
23	sensor.kasa_023_today_s_consumption	Today's consumption value	866.121075	9.330378	239239.7822
23	sensor.kasa_023_total_consumption	Total consumption value	1032.434548	9.330139	239239.7816
23	sensor.kasa_023_current	Current status	409.93026	9.328125	313690.5134
23	switch.kasa_023	Physical button status	47275.14654	9.328189	1352359.949
23	switch.kasa_023_led	Physical LED status	47275.14654	9.326138	1352359.949
18	sensor.kasa_018_current_consumption	Current consumption value	94.30790393	9.096032	940700.3718
18	sensor.kasa_018_total_consumption	Voltage value	14861.74676	10.038558	940700.3714
18	sensor.kasa_018_today_s_consumption	Today's consumption value	14324.57517	10.039209	940700.3712
18	sensor.kasa_018_voltage	Total consumption value	60.15683758	9.081045	940700.3712
18	sensor.kasa_018_current	Current status	396.0492128	9.304629	940700.3711
18	switch.kasa_018	Physical button status	56616.17774	10.039851	940700.3709
18	switch.kasa_018_led	Physical LED status	59446.98656	10.039993	940700.3708
19	sensor.kasa_019_voltage	Voltage value	12.50957619	9.13095	3860.417382
19	sensor.kasa_019_current_consumption	Current consumption value	18.39588875	9.109018	3860.414814
19	sensor.kasa_019_current	Current status	18.81186779	9.148908	4970.00381
19	sensor.kasa_019_today_s_consumption	Today's consumption value	2099.641654	9.999318	3860.416643
19	sensor.kasa_019_total_consumption	Total consumption value	2154.109346	10.016978	3860.415571
19	switch.kasa_019	Physical button status	59864.20145	10.016841	1291301.009
19	switch.kasa_019_led	Physical LED status	59864.20142	10.016806	1291301.009
17	sensor.kasa_017_current_consumption	Current consumption value	55.63390764	9.069961	35552.89109
17	sensor.kasa_017_voltage	Voltage value	17.45416714	9.043001	7394.029505
17	sensor.kasa_017_today_s_consumption	Today's consumption value	3031.806705	9.288565	27872.9948
17	sensor.kasa_017_total_consumption	Total consumption value	3133.326554	9.288313	35962.88402
17	sensor.kasa_017_current	Current status	2676.711947	9.288798	127938.2656
17	switch.kasa_017	Physical button status	3707.007491	9.288706	408133.3179
17	switch.kasa_017_led	Physical LED status	3712.303216	9.288777	408133.318
24	sensor.kasa_024_current_consumption	Current consumption value	26.77250674	1.206296	582639.057
24	sensor.kasa_024_voltage	Voltage value	17.14517429	1.211279	582639.0575
24	sensor.kasa_024_today_s_consumption	Today's consumption value	1324.70162	1.208125	582639.0573
24	sensor.kasa_024_total_consumption	Total consumption value	1341.106595	1.207315	582639.0571
24	sensor.kasa_024_current	Current status	2800.716138	1.212424	582639.0575
24	switch.kasa_024	Physical button status	5448.772694	1.213386	582639.0574
24	switch.kasa_024_led	Physical LED status	5448.772692	1.214648	582639.0574

Table 5. Entities of all PIDs of Google Pixel 5 with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
125	sensor.pixel_5_battery_temperature	Battery temperature	1661.83648	0.011303	227563.089
125	sensor.pixel_5_battery_level	Battery level	4881.508274	3.186935	227613.8156
125	sensor.pixel_5_battery_power	Battery lower	1367.633854	0.003843	227563.39
125	sensor.pixel_5_app_memory	Application memory	1067.070628	0.001792	227563.6547
125	sensor.pixel_5_app_importance	Application importance level	5256.479442	0.008934	227563.9261
125	sensor.pixel_5_geocoded_location	GeoCoded location	19184.4668	0.00678	603629.4634
125	binary_sensor.pixel_5_device_locked	Device locked status	34098.53707	8.037938	330288.0384
125	binary_sensor.pixel_5_keyguard_locked	Device keyguard Locked status	34098.52927	8.037819	330288.0387
125	sensor.pixel_5_last_update_trigger	Last update trigger event	4279.589591	0.012889	227564.9718
125	sensor.pixel_5_light_sensor	Illumination level	2713.769137	0.011744	227616.0177
125	sensor.pixel_5_wifi_link_speed	Wifi connection speed	8252.442609	0.074621	334715.3757
125	sensor.pixel_5_wifi_signal_strength	Wifi signal strength	13028.80825	3.423046	230454.0779
125	sensor.pixel_5_pressure_sensor	Pressure sensor	1497.184768	0.006717	227568.3188
125	sensor.pixel_5_app_rx_gb	App data receiving status	4236.058302	0.012161	227620.3084
125	sensor.pixel_5_total_rx_gb	App data total receive status	5361.310663	0.360711	228652.9991
125	sensor.pixel_5_total_tx_gb	App data total transmit status	8090.313803	3.581722	230456.5032
125	sensor.pixel_5_app_tx_gb	App data transmit status	11149.26244	0.018653	235518.4029
125	sensor.pixel_5_proximity_sensor	Proximity sensor	24903.46468	0.00752	521409.6814
125	binary_sensor.pixel_5_interactive	Interaction status	10634.68943	1.224771	332466.7737
125	device_tracker.pixel_5	Device tracker	1440.559568	0.388672	229859.4676
125	sensor.pixel_5_volume_level_music	Volume level for music	217084.1076	112.424125	941251.2661
125	sensor.pixel_5_volume_level_accessibility	Volume level for accessibility	217083.8725	110.071767	941251.2675
125	binary_sensor.pixel_5_doze_mode	Doze mode status	39973.46369	5.28735	628208.6369
125	sensor.pixel_5_battery_state	Battery state	40720.10561	3.219571	285958.0666
125	binary_sensor.pixel_5_is_charging	Charding state	52228.50739	3.214394	343883.339
125	sensor.pixel_5_charger_type	Connected charger type	52228.48107	3.212491	343883.8067
125	sensor.pixel_5_internal_storage	Internal storage	118110.9686	381.41295	850378.8955
125	sensor.pixel_5_network_type	Current network type	68345.84922	0.054279	596922.7696
125	sensor.pixel_5_battery_health	Bettery health level	269778.7672	381.411944	959075.8706
125	sensor.pixel_5_wifi_ip_address	Wifi IP address	118706.1853	0.281147	1039119.485
125	sensor.pixel_5_current_version	Current OS version	172793.7218	381.418486	941251.2616
125	binary_sensor.pixel_5_app_inactive	Inactive applications	172793.425	381.412076	941251.2701
125	sensor.pixel_5_app_standby_bucket	Standby bucket	172793.3061	381.418555	941251.2625
125	sensor.pixel_5_ringer_mode	Ringer mode status	172793.2001	381.418939	941251.2651
125	sensor.pixel_5_audio_mode	Audio mode status	172793.1602	381.419095	941251.2654
125	binary_sensor.pixel_5_headphones	Headphones status	172793.1256	381.411929	941251.2709
125	binary_sensor.pixel_5_mic_muted	Microphones status	172793.0802	381.411915	941251.2717
125	binary_sensor.pixel_5_speakerphone	Speakerphone status	172793.039	381.411901	941251.2722
125	binary_sensor.pixel_5_music_active	Music status	172792.9995	381.411869	941251.2728
125	sensor.pixel_5_volume_level_alarm	Alarm volume level	172792.9574	381.419219	941251.2655
125	sensor.pixel_5_volume_level_call	Call volume level	172792.9025	381.419324	941251.2658
125	sensor.pixel_5_volume_level_ringer	Ringer volume level	172792.8292	381.418528	941251.2663
125	sensor.pixel_5_volume_level_notification	Notifications volume level	172792.7789	381.41188	941251.2666
125	sensor.pixel_5_volume_level_system	System volume level	172792.7387	381.411752	941251.2668
125	sensor.pixel_5_volume_level_dtmf	DTML volume level	172792.7014	381.411824	941251.2674
125	sensor.pixel_5_bluetooth_connection	Bluetooth connection status	172791.6617	381.412041	941251.2676
125	binary_sensor.pixel_5_bluetooth_state	Blootooth state	172791.6079	381.411842	941251.2739
125	sensor.pixel_5_do_not_disturb_sensor	DND sensor	172791.402	381.412111	941251.2676
125	binary_sensor.pixel_5_work_profile	Current work profile	172791.3295	381.41175	941251.2743
125	binary_sensor.pixel_5_device_secure	Device security state	172791.2009	381.412367	941251.275
125	binary_sensor.pixel_5_keyguard_secure	Keyguage security state	172791.1188	381.412869	941251.2757
125	sensor.pixel_5_last_reboot	Last reboot time	172791.036	381.412182	941251.2677
125	binary_sensor.pixel_5_high_accuracy_mode	High accuracy model status	172790.9146	381.412868	941251.2759
125	sensor.pixel_5_high_accuracy_update_interval	High accuracy update internal	172790.8708	381.412383	941251.2696
125	binary_sensor.pixel_5_mobile_data	Model data status	172790.8296	381.412925	941251.2763
125	binary_sensor.pixel_5_mobile_data_roaming	Model data on roaming status	172790.6219	381.412992	941251.2765
125	sensor.pixel_5_wifi_connection	Wifi connection status	172790.5684	381.412281	941251.2698
125	sensor.pixel_5_wifi_bssid	Wifi access point BSSID	103674.3171	381.412244	529060.8937
125	binary_sensor.pixel_5_wifi_state	Wifi state	172790.0828	381.41305	941251.2706
125	sensor.pixel_5_wifi_frequency	Wifi connected frequency	219814.9119	381.412278	1381224.979
125	sensor.pixel_5_public_ip_address	Public IP address	94248.93142	381.412331	529064.7357
125	sensor.pixel_5_next_alarm	Next alarm	172789.5812	381.412667	941251.2704
125	binary_sensor.pixel_5_power_save	Power save mode status	172788.8199	381.413247	941251.2705
125	sensor.pixel_5_external_storage	External storage information	172788.5566	381.413062	941251.2711
125	sensor.pixel_5_current_time_zone	Current time zone	148104.4433	381.413214	767296.198
125	sensor.pixel_5_mobile_rx_gb	Mobile's total data receiving value	86394.20013	3.180436	940510.973
125	sensor.pixel_5_mobile_tx_gb	Mobile's total data transmis value	86394.1729	3.181165	940510.7449

Table 6. Entities of all PIDs of Xiaomi Motion Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
138	binary_sensor.xiaomi_motion_sensor_kitchen_occupancy	Occupancy in the covered area	983.2982616	0.076033	66451.1293
138	sensor.xiaomi_motion_sensor_kitchen_power_outage_count	Power outage count	983.2982619	0.075919	66451.1274
138	sensor.xiaomi_motion_sensor_kitchen_battery	Battery information	983.2982618	0.075855	66451.12742
139	binary_sensor.xiaomi_motion_sensor_workarea_occupancy	Occupancy in the covered area	941.8845828	0.336644	66451.12939
139	sensor.xiaomi_motion_sensor_workarea_power_outage_count	Power outage count	941.8845834	0.33646	66451.12736
139	sensor.xiaomi_motion_sensor_workarea_battery	Battery information	941.884583	0.3362	66451.12737

Table 7. Entities of all PIDs of Aqara Vibration Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
77	select.aqara_vibration_sensor_pid_077_sensitivity	Senstivity Configuration	723.9387801	0.003686	316342.6011
77	binary_sensor.aqara_vibration_sensor_pid_077_vibration	Vibration Event	723.9388129	0.003503	316342.601
77	sensor.aqara_vibration_sensor_pid_077_power_outage_count	Power outage count	723.9387806	0.003462	316342.601
77	sensor.aqara_vibration_sensor_pid_077_angle_z	Sensor placement angle z-axis	723.9387805	0.00352	316342.6009
77	sensor.aqara_vibration_sensor_pid_077_angle_y	Sensor placement angle y-axis	723.9387805	0.003515	316342.6009
77	sensor.aqara_vibration_sensor_pid_077_angle_x	Sensor placement angle x-axis	723.9387805	0.003546	316342.6009
77	sensor.aqara_vibration_sensor_pid_077_strength	Strength of vibration	723.9387877	0.003551	316342.6008
77	sensor.aqara_vibration_sensor_pid_077_action	Action information	723.9388133	0.00354	316342.6009
77	sensor.aqara_vibration_sensor_pid_077_device_temperature	Temperature of the device	723.9388132	0.003513	316342.6008
77	sensor.aqara_vibration_sensor_pid_077_battery	Battery information	723.9388132	0.003505	316342.6007
78	select.vibration_sensor_pid_078_sensitivity	Senstivity Configuration	3539.725765	0.003889	919112.0423
78	binary_sensor.vibration_sensor_pid_078_vibration	Vibration Event	3539.725762	0.003725	919112.0446
78	sensor.vibration_sensor_pid_078_power_outage_count	Power outage count	3539.72565	0.003696	919112.0802
78	sensor.vibration_sensor_pid_078_angle_z	Sensor placement angle z-axis	3539.725673	0.003685	919112.0801
78	sensor.vibration_sensor_pid_078_angle_y	Sensor placement angle y-axis	3539.725716	0.003678	919112.08
78	sensor.vibration_sensor_pid_078_angle_x	Sensor placement angle x-axis	3539.725716	0.003682	919112.0776
78	sensor.vibration_sensor_pid_078_strength	Strength of vibration	3539.725764	0.003767	919112.0773
78	sensor.vibration_sensor_pid_078_action	Action information	3539.725764	0.005675	919112.0771
78	sensor.vibration_sensor_pid_078_device_temperature	Temperature of the device	3539.725763	0.005864	919112.0769
78	sensor.vibration_sensor_pid_078_battery	Battery information	3539.725763	0.005977	919112.0768
79	select.aqara_vibration_sensor_pid_079_sensitivity	Senstivity Configuration	2783.219845	0.004068	66451.12855
79	binary_sensor.aqara_vibration_sensor_pid_079_vibration	Vibration Event	2783.219845	0.003886	66451.12934
79	sensor.aqara_vibration_sensor_pid_079_power_outage_count	Power outage count	2783.21985	0.003839	66451.12894
79	sensor.aqara_vibration_sensor_pid_079_angle_z	Sensor placement angle z-axis	2783.219847	0.003881	66451.12886
79	sensor.aqara_vibration_sensor_pid_079_angle_y	Sensor placement angle y-axis	2783.219847	0.00387	66451.12889
79	sensor.aqara_vibration_sensor_pid_079_angle_x	Sensor placement angle x-axis	2783.219847	0.003859	66451.12888
79	sensor.aqara_vibration_sensor_pid_079_strength	Strength of vibration	2783.219846	0.003866	66451.12813
79	sensor.aqara_vibration_sensor_pid_079_action	Action information	2783.219846	0.004764	66451.128
79	sensor.aqara_vibration_sensor_pid_079_device_temperature	Temperature of the device	2783.219846	0.004752	66451.12798
79	sensor.aqara_vibration_sensor_pid_079_battery	Battery information	2783.219846	0.004747	66451.12817
79	sensor.vibration_sensor_pid_079_power_outage_count	Senstivity Configuration	208.9946007	0.091603	328.78635
79	sensor.vibration_sensor_pid_079_angle_z	Vibration Event	208.9940863	0.090087	328.786454
79	sensor.vibration_sensor_pid_079_angle_y	Power outage count	208.9936477	0.088875	328.786317
79	sensor.vibration_sensor_pid_079_angle_x	Sensor placement angle z-axis	208.9932167	0.087607	328.786261
79	select.vibration_sensor_pid_079_sensitivity	Sensor placement angle y-axis	313.4890695	298.191917	328.786222
79	sensor.vibration_sensor_pid_079_strength	Sensor placement angle x-axis	208.9914507	0.082612	328.786127
79	sensor.vibration_sensor_pid_079_action	Strength of vibration	208.9908533	0.080721	328.786087
79	binary_sensor.vibration_sensor_pid_079_vibration	Action information	313.4856325	298.185226	328.786039
79	sensor.vibration_sensor_pid_079_device_temperature	Temperature of the device	208.989937	0.078206	328.785996
79	sensor.vibration_sensor_pid_079_battery	Battery information	208.9894357	0.076717	328.785964

Table 8. Entities of all PIDs of Xiaomi Contact Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
136	binary_sensor.xiaomi_contact_sensor_pid_136_contact	Contact event	4028.313933	0.020153	66451.12944
136	sensor.xiaomi_contact_sensor_pid_136_power_outage_count	Power outage information	4028.313934	0.019988	66451.12716
136	sensor.xiaomi_contact_sensor_pid_136_battery	Battery information	4028.313931	0.020071	66451.12732
136	sensor.contact_sensor_pid_136_power_outage_count	Power outage information	613.2605495	0.08213	3562.710204
136	sensor.contact_sensor_pid_136_battery	Battery information	613.258687	0.070949	3562.709764
136	binary_sensor.contact_sensor_pid_136_contact	Contact event	735.8946148	0.131098	3562.783325

Table 9. Entities of all PIDs of Aqara Wireless Switch with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
81	sensor.wireless_switch_pid_081_click	Click Event	2048.579306	0.048397	3008.897301
81	sensor.wireless_switch_pid_081_power_outage_count	Power Outage count	2048.579211	0.047157	3008.897387
81	sensor.wireless_switch_pid_081_device_temperature	Temperature of device	2048.579113	0.04594	3008.897789
81	sensor.wireless_switch_pid_081_action	Action	2048.57903	0.044857	3008.897975
81	sensor.wireless_switch_pid_081_battery	Battery information	2048.578929	0.043609	3008.89804
81	sensor.aqara_wireless_switch_pid_081_click	Click Event	2638.87049	0.029901	66451.12719
81	sensor.aqara_wireless_switch_pid_081_power_outage_count	Power Outage count	2638.870444	0.025273	66451.12721
81	sensor.aqara_wireless_switch_pid_081_device_temperature	Temperature of device	2664.741662	2.368223	66451.12727
81	sensor.aqara_wireless_switch_pid_081_action	Action	2664.741626	2.369603	66451.12718
81	sensor.aqara_wireless_switch_pid_081_battery	Battery information	2664.740422	2.371005	66451.12713
82	sensor.wireless_switch_pid_082_click	Click Event	2050.460206	0.041735	3009.84002
82	sensor.wireless_switch_pid_082_power_outage_count	Power Outage count	2050.460128	0.040755	3009.840026
82	sensor.wireless_switch_pid_082_device_temperature	Temperature of device	2050.460053	0.039877	3009.839922
82	sensor.wireless_switch_pid_082_action	Action	2050.459981	0.039036	3009.839905
82	sensor.wireless_switch_pid_082_battery	Battery information	2050.4599	0.037975	3009.83989
82	sensor.aqara_wireless_switch_pid_082_action	Click Event	4516.045565	0.007223	247716.1423
82	sensor.aqara_wireless_switch_pid_082_battery	Power Outage count	4553.994766	0.007219	247716.0789
82	sensor.aqara_wireless_switch_pid_082_click	Temperature of device	4516.045439	0.007494	247716.1433
82	sensor.aqara_wireless_switch_pid_082_power_outage_count	Action	4516.045387	0.007271	247716.1431
82	sensor.aqara_wireless_switch_pid_082_device_temperature	Battery information	4516.045313	0.007237	247716.143

Table 10. Entities of all PIDs of Aqara Motion Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
75	binary_sensor.aqara_motion_sensor_pid_075_occupancy	Motion event	1061.501175	0.002882	227839.5381
75	sensor.aqara_motion_sensor_pid_075_power_outage_count	Power outage information	1061.50116	0.002383	227839.538
75	sensor.aqara_motion_sensor_pid_075_illuminance_lux	Illumination Level (Lux)	1061.50116	0.002333	227839.5379
75	sensor.aqara_motion_sensor_pid_075_device_temperature	Temperature information	1061.501176	0.002642	227839.5378
75	sensor.aqara_motion_sensor_pid_075_battery	Battery informaiton	1061.501175	0.002608	227839.5378

Table 11. Entities of all PIDs of Philips Hue Light Strip with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
145	light.hue_lightstrip_plus_pid_145	Light status	216.512879	72.777438	360.24832
146	light.philips_hue_lightstrip_pid_146	Light status	18155.04068	1.449103	581322.9596
146	binary_sensor.philips_hue_lightstrip_pid_146_update_available	Update available notification	20156.38337	1.572395	581322.9595
146	light.hue_lightstrip_plus_pid_146	Light status	222.07688	72.774466	360.249226
146	light.hue_lightstrip_plus_1_pid_146	Light status	588.0073029	0.0009	7698.938305
147	light.hue_lightstrip_plus_pid_147	Light status	216.5119445	72.774456	360.249433

Table 12. Entities of all PIDs of Philips Hue Motion Sensor with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
62	sensor.hue_motion_sensor_1_temperature	Temperature value	785.7119291	0.25838	16770.62812
62	sensor.hue_motion_sensor_1_illuminance	Illuminance level	682.371701	0.002873	52702.86315
62	binary_sensor.hue_motion_sensor_1_motion	Motion event	3964.914413	0.257092	343664.3781
62	sensor.hue_motion_sensor_1_battery	Battery information	33822.88915	0.258958	919380.865
62	switch.hue_motion_sensor_1_motion	Motion Swtich	33822.88921	0.26422	919380.862
62	switch.hue_motion_sensor_1_illuminance	Illuminance switch	33822.88923	0.265526	919380.8612

Table 13. Entities of all PIDs of Aqara Water Leak with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
83	binary_sensor.aqara_water_leak_sensor_pid_083_battery_low	Low battery alarm	3480.159916	0.116307	66451.12882
83	binary_sensor.aqara_water_leak_sensor_pid_083_water_leak	Water leakage alarm	3480.159915	0.116315	66451.12889
83	sensor.aqara_water_leak_sensor_pid_083_power_outage_count	Power outage information	3480.159917	0.116287	66451.12916
83	sensor.aqara_water_leak_sensor_pid_083_device_temperature	Device temperature value	3480.159917	0.116135	66451.12919
83	sensor.aqara_water_leak_sensor_pid_083_battery	Battery information	3480.159916	0.116137	66451.12905
83	binary_sensor.water_leak_sensor_pid_083_water_leak	Water leakage alarm	449.316637	449.316637	449.316637
83	sensor.water_leak_sensor_pid_083_battery	Battery information	449.312783	449.312783	449.312783
83	sensor.water_leak_sensor_pid_083_power_outage_count	Power outage information	449.283615	449.283615	449.283615
83	sensor.water_leak_sensor_pid_083_device_temperature	Device temperature value	449.281665	449.281665	449.281665
83	binary_sensor.water_leak_sensor_pid_083_battery_low	Low battery alarm	449.280237	449.280237	449.280237
84	binary_sensor.aqara_water_leak_sensor_pid_084_battery_low	Low battery alarm	3553.513164	0.111905	66451.12862
84	binary_sensor.aqara_water_leak_sensor_pid_084_water_leak	Water leakage alarm	3553.513164	0.112306	66451.12873
84	sensor.aqara_water_leak_sensor_pid_084_power_outage_count	Power outage information	3553.513168	0.112451	66451.12946
84	sensor.aqara_water_leak_sensor_pid_084_device_temperature	Device temperature value	3553.513166	0.115235	66451.12909
84	sensor.aqara_water_leak_sensor_pid_084_battery	Battery information	3553.513165	0.115407	66451.12911
84	binary_sensor.water_leak_sensor_pid_084_water_leak	Water leakage alarm	368.751235	368.751235	368.751235
84	sensor.water_leak_sensor_pid_084_battery	Battery information	368.7489	368.7489	368.7489
84	binary_sensor.water_leak_sensor_pid_084_battery_low	Low battery alarm	368.70506	368.70506	368.70506
84	sensor.water_leak_sensor_pid_084_power_outage_count	Power outage information	368.671729	368.671729	368.671729
84	sensor.water_leak_sensor_pid_084_device_temperature	Device temperature value	368.670234	368.670234	368.670234

Table 14. Entities of all PIDs of Alexa Dot 3rd Generation with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
13	media_player.echo_dot_013	Media player information	1736.998927	0.000296	611399.8221
13	switch.echo_dot_013_do_not_disturb_switch	DnD switch status	4233.273509	3.574507	611388.13
13	switch.echo_dot_013_shuffle_switch	Shuffle switch status	43195.93266	3.574946	941251.6038
13	switch.echo_dot_013_repeat_switch	Repeat switch status	17278.37305	3.575359	941251.6039
13	sensor.echo_dot_013_next_alarm	Next alarm information	40316.20336	3.576566	941251.6055
13	sensor.echo_dot_013_next_timer	Next time information	40316.20334	3.577767	941251.6053
13	sensor.echo_dot_013_next_reminder	Next reminder information	40316.20332	3.581646	941251.6053

Table 15. Entities of all PIDs of Roborock Vacuum Cleaner S5 Max with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
91	binary_sensor.roborock_s5_max_mop_attached	Mop attached with base status	13600.06827	15.065279	538245.5056
91	binary_sensor.roborock_s5_max_water_box_attached	Water box attached status	13600.06827	15.065102	538245.5057
91	sensor.roborock_s5_max_last_clean_start	Last clearning start time	13390.83644	15.065008	538245.506
91	sensor.roborock_s5_max_last_clean_end	Last cleaning end time	13390.83644	15.065009	538245.5062
91	sensor.roborock_s5_max_last_clean_duration	Last cleaning duration	13390.83644	15.065156	538245.5063
91	sensor.roborock_s5_max_last_clean_area	Last clearning area	13459.86137	15.065049	538245.5064
91	sensor.roborock_s5_max_current_clean_duration	Current cleaning duration	11869.15048	8.119141	538245.5064
91	sensor.roborock_s5_max_current_clean_area	Current cleaning area	12088.94956	8.11943	538245.5064
91	sensor.roborock_s5_max_main_brush_left	Brush life	13390.83644	15.064754	538245.5066
91	sensor.roborock_s5_max_side_brush_left	Side brush life	13390.83644	15.064691	538245.5015
91	sensor.roborock_s5_max_filter_left	Filter life	13390.83644	15.064621	538245.5018
91	sensor.roborock_s5_max_sensor_dirty_left	Sensor life	13390.83643	15.064575	538245.5022
91	vacuum.roborock_s5_max	Device information	7811.083713	14.160011	538245.5026

Table 16. Entities of all PIDs of LUMIMAN Smart Bulb E27 with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
53	light.053_lumiman_smart_bulb_2	Bulb status	1187.550704	0.30731	5011.586838

Table 17. Entities of all PIDs of Xiaomi Air Purifier 4 Pro with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
108	sensor.mi_air_purifier_3_3h_pm2_5	Air quality PM2.5	139.1425574	1.931263	7219.453165
108	sensor.mi_air_purifier_3_3h_humidity	Humidity level	254.1640241	1.930028	4962.049214
108	fan.mi_air_purifier_3_3h	Fan level	587.113752	1.924469	4541.245169
108	number.mi_air_purifier_3_3h_favorite_level	Favorite level	570.5587399	1.925659	10327.52622
108	number.mi_air_purifier_3_3h_fan_level	Fan level	646.3153492	1.926258	21012.83209
108	select.mi_air_purifier_3_3h_led_brightness	LED brighness level	650.7606455	1.9269	7219.452588
108	sensor.mi_air_purifier_3_3h_temperature	Temperature level	641.9164208	1.92756	8996.021188
108	sensor.mi_air_purifier_3_3h_motor_speed	Motor speed	353.7390647	1.930641	4541.24449
108	sensor.mi_air_purifier_3_3h_filter_life_remaining	Filter life remaining	637.6655852	1.931569	7219.452962
108	sensor.mi_air_purifier_3_3h_filter_use	Filter usage status	650.2151529	1.931903	4541.244202
108	switch.mi_air_purifier_3_3h_buzzer	Buzzer switch	650.7606473	1.932857	7219.451847
108	switch.mi_air_purifier_3_3h_child_lock	Child lock switch	639.164951	1.935451	22072.01339

Table 18. Entities of all PIDs of Mill WiFi Portable Heater 1200W with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
113	climate.millheat_113	Climate information	924.082581	10.110761	62710.39362
113	sensor.millheat_113_year_consumption	Current year energy consumption	3655.085826	29.266673	188042.3198
113	sensor.millheat_113_day_consumption	Current day energy consumption	4018.352327	29.266957	188042.3195

Table 19. Entities of all PIDs of Samsung Smart TV with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
-1	media_player.samsung_6_series_50	Media player information	7204.796727	0.344254	430494.8691
-1	media_player.tv_samsung_6_series_50	Media player information	3923.399165	0.007812	430084.3201

Table 20. Entities of all PIDs of WeeKett Smart WiFi Kettle with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
109	sensor.kettle_current_temperature_2	Current temperature	42.68051811	0.004583	191769.3492
109	sensor.kettle_current_temperature	Current temperature	43.87585847	0.003988	245628.6857
109	switch.kettle_start	Start switch	22977.44761	0.010787	501492.7279
109	sensor.kettle_status	Kettle status	22770.44372	0.010927	501492.7082
109	switch.kettle_heat_preservation	Heat preservation switch	36434.54281	0.010654	849261.7842
109	number.kettle_temperature	Temperature	44546.3331	0.011326	849261.7861
109	number.kettle_temperature_2	Temperature	44546.2875	0.011241	849261.7862

Table 21. Entities of all PIDs of Mi Smart Antibacterial Humidifier with data frequency. All the entities and associated information was extracted from the dataset after complete capturing.

	Devices' Details			**Frequency**	
PID	entity_id	Data	Average	Minimum	Maximum
107	binary_sensor.mi_smart_antibacterial_humidifier_water_tank_empty	Water tank empty alert	21300.33646	2.513243	776315.8288
107	binary_sensor.mi_smart_antibacterial_humidifier_water_tank	Water tank level	21476.3723	2.513945	776315.8298
107	humidifier.mi_smart_antibacterial_humidifier	Humidifier status	21127.163	2.514815	776315.8313
107	sensor.mi_smart_antibacterial_humidifier_temperature	Temperature level	17324.27366	2.516135	776315.8326
107	sensor.mi_smart_antibacterial_humidifier_humidity	Humidity level	6122.17995	2.516859	776315.833
107	switch.mi_smart_antibacterial_humidifier_buzzer	Buzzer switch	21476.37237	2.517553	776315.836
107	switch.mi_smart_antibacterial_humidifier_led	Humidity LED switch	21476.37237	2.518043	776315.8367

4 DATASETS' DETAILS

In this section, we have provided in-depth details of each dataset e.g. names of data streams, columns in the RAW dataset of smart devices, hostnames, IP and MAC addresses of devices, etc. Location of root directory of dataset is /Datasets/ZB-BRE, details of further directory structure can be found in Table 26 where Type and Stage also means directories and sub-directories in root directory.

4.1 Physical Dataset

In this section, in-depth details about physical dataset are given. Details of all Raspberry Pis in Physical dataset is provided in Table 22. Followed by the list of columns in RAW data of each RPi.

Table 22. List of all RPis with associated MAC addresses, IP addresses, Device IDs and Location.

Device ID	Device IP	MAC Address	Name	Location
1	10.11.12.16	dc:a6:32:58:fe:12	RPi-1	Entrance
2	10.11.12.17	e4:5f:01:20:76:ea	RPi-2	Workarea
3	10.11.12.19	dc:a6:32:51:73:cb	RPi-3	Kitchen
4	10.11.12.50	dc:a6:32:51:78:36	RPi-4	Bathroom
5	10.11.12.51	dc:a6:32:51:78:03	RPi-5	Bedroom

1. Timestamp (RPi-C)
2. DevID (RPi-C)
3. DevIP (Server)
4. Temp (Enviro)
5. Humidity (Enviro)
6. PIR (x)
7. NoiseL (Enviro)
8. NoiseM (Enviro)
9. NoiseH (Enviro)
10. NoiseA (Enviro)
11. AirQuality (x)
12. Accelero (x)
13. Gyro (x)
14. Pressure (Enviro)
15. Lux (Enviro)
16. Prox (Enviro)
17. Motion (x)
18. MassPM1.0 (SRS-30)
19. MassPM2.5 (SRS-30)
20. MassPM4.0 (SRS-30)
21. MassPM10 (SRS-30)
22. NumPM0.5 (SRS-30)
23. NumPM1.0 (SRS-30)
24. NumPM2.5 (SRS-30)
25. NumPM4.0 (SRS-30)
26. NumPM10 (SRS-30)
27. TPM (SRS-30)

4.2 Cyber Dataset

In this section, we have provided in-depth details about Cyber dataset. Table 23 provides IP addresses with associated MAC addresses and Device names (host-name) in Cyber dataset. It is pertinent to mention that the RPis are listed in cyber dataset as a DHCP client because all RPis were connected via same Internal WiFi connection to send sensor data to HTTP service install on GW. It is also important to note that there are multiple Kasa Smart Plugs with same host-name (KP115), this host-name is default for this device. These devices provides energy consumption information used by associated smart devices. There are two IP addresses leased by homeassistant for both interfaces i.e. first for WiFi interface (10.11.12.22) and later for Ethernet interface (10.11.12.54).

Table 23. DHCP IP Lease List

IP Address	MAC Address	Host-name
10.11.12.10	48:e1:e9:3f:d2:13	Meross_Smart_Plug
10.11.12.11	d2:46:71:06:7f:d0	Yasar-s-Note20-Ultra
10.11.12.12	ac:74:b1:3f:2a:e6	DESKTOP-0LMVMT9
10.11.12.13	00:1a:13:b9:78:f5	android-fc7ede3b2397dbf1
10.11.12.16	dc:a6:32:58:fe:12	raspberrypi
10.11.12.17	e4:5f:01:20:76:ea	raspberrypi
10.11.12.18	68:54:5a:80:3c:02	WR68545A803C02
10.11.12.19	dc:a6:32:51:73:cb	raspberrypi
10.11.12.20	32:1f:dd:50:2a:0a	Pixel-5
10.11.12.21	2c:6e:85:01:b0:4e	YM-Win
10.11.12.22	e4:5f:01:0e:4c:25	homeassistant
10.11.12.23	4c:17:44:c2:67:09	Alexa Echo Dot
10.11.12.24	00:31:92:e1:a6:e8	KP115
10.11.12.25	00:31:92:e1:a4:55	KP115
10.11.12.26	00:31:92:e1:a6:7d	KP115
10.11.12.27	00:31:92:e1:a4:f8	KP115
10.11.12.28	54:48:e6:dc:b8:2b	zhimi-airpurifier-mb3_mibtB82B
10.11.12.29	00:31:92:e1:a7:2c	KP115
10.11.12.30	0c:2a:69:1e:d7:23	Smarter Coffee maker
10.11.12.31	10:d5:61:fd:ae:46	TY_WR
10.11.12.32	58:b6:23:80:9f:27	deerma-humidifier-jsq_miap9F27
10.11.12.33	b0:4a:39:12:93:96	Roborock Vacuum Cleaner
10.11.12.34	98:d8:63:6a:ec:e7	Mill Device G2
10.11.12.35	54:ef:44:12:f6:94	Aqara-Hub-M2-52AC
10.11.12.36	ec:b5:fa:84:f8:f1	ecb5fa84f8f1
10.11.12.37	dc:a6:32:58:fe:12	raspberrypi
10.11.12.38	84:e3:42:d3:64:25	Lumiman Bulb
10.11.12.39	00:31:92:e1:a9:1f	KP115
10.11.12.40	70:89:76:39:87:94	Lumiman Bulb
10.11.12.41	00:17:7a:13:ca:43	YALE security system
10.11.12.42	d8:6c:63:47:02:52	Google-Home
10.11.12.44	00:31:92:e1:a9:4f	KP115
10.11.12.45	00:31:92:e1:a4:29	KP115
10.11.12.50	dc:a6:32:51:78:36	raspberrypi
10.11.12.51	dc:a6:32:51:78:03	raspberrypi
10.11.12.54	e4:5f:01:0e:4c:24	homeassistant
10.11.12.65	04:39:26:36:65:ca	ReoLink IP Camera
10.11.12.82	00:c0:ca:b0:15:78	kali-raspberry-pi
10.11.12.95	06:86:fd:84:06:4c	unknown
10.11.12.96	9c:b6:d0:b7:5f:51	DESKTOP-A90G6BS
10.11.12.97	dc:a6:32:51:78:c3	kali-raspberry-pi
10.11.12.98	dc:a9:04:97:f5:a4	ians-MBP

4.3 Smart Devices (CU) Dataset

In this section, we provided details about CU smart devices RAW dataset. Following is the list of columns in RAW format of CU smart devices dataset, these columns are only available in RAW CU smart devices dataset.

1. **state_id**: Unique ID (number) for each entry.

2. **entity_id**: Name of the device's particular function (entity), each device contains one or more functions reflected by entity_id. List of entity_id[s] for each devices is mentioned in sub-sections of **??** e.g. Section **??** for Samsung SmartThings Contact Sensor.
3. **state**: State of device, this can be a Boolean, string, number, float or other data type depending on the device's function.
4. **attributes**: Attributes of the current state (if any).
5. **event_id**: Event ID associated with current state.
6. **last_changed**: Last change in the state, this is a timestamp.
7. **last_updated**: Timestamp of the current event.
8. **old_state_id**: Previous State ID of current state.
9. **attributes_id**: Attributes ID of the current state.
10. **context_id**: Context ID of the current state.
11. **context_user_id**: User ID (in case of multiple users configured in HA).
12. **context_parent_id**: Parent context ID of current state if configured in HA.
13. **origin_idx**: Origin of the state.

4.4 Smart Devices (BRE) Dataset

In this section, we provided details about BRE smart devices RAW dataset. The location column has details of location, device and type of data streams in Table 25, and Table 24 hosts the code names of each sensor type mentioned in Sensors column in Table 25.

Table 24. Sensor Code and Names: Code mentioned in Sensors column of Table 24 can be mapped with name from this table.

Code	Sensor Name
T	temperature
C	contact
Tp	tamper
H	humidity
M	motion
I	illuminance
PM1	MassConcentrationPM1.0
PM2	MassConcentrationPM2.5
PM4	MassConcentrationPM4.0
PM10	MassConcentrationPM10.0
NC.5	NumberConcentrationNC0.5
NC1	NumberConcentrationNC1.0
NC2.5	NumberConcentrationNC2.5
NC4	NumberConcentrationNC4.0
NC10	NumberConcentrationNC10.0
TPS	TypicalParticleSize

Table 25. BRE Dataset Details: Location column contains location, type and name of data stream, each devices has multiple data steams listed in Sensors column. Other than first four fixed parts (separated by a -) and fifth part (for internal use), the later parts of the Location column are explained in columns Code, Floor, and Area. Code column is explained in Type column, Area column is explained in Area Name column. Sensors column contains different sensors in each devices. Refer to Table 24 for name of each sensor code.

Location	Code	Type	Floor	Area	Area Name	Sensors
UK-WAT-ZB_MTS-19_OC-02-S1	OC	Contact	SF	S1	Solar Loft	T,C,Tp
UK-WAT-ZB_MTS-15_OC-00-H1	OC	Contact	GF	H1	Hallway	T,C,Tp
UK-WAT-ZB_MTS-03_A6-02-SL	A6	Multi	SF	SL	Solar Loft	H,T,I,M
UK-WAT-ZB_MTS-09_A6-01-B3	A6	Multi	FF	B3	Bedroom	H,T,I,M
UK-WAT-ZB_MTS-01_A6-00-K1	A6	Multi	GF	K1	Kitchen	H,T,I,M,Tp
UK-WAT-ZB_MTS-07_A6-01-B2	A6	Multi	FF	B2	Bedroom	H,T,I,M,Tp
UK-WAT-ZB_MTS-17_OC-01-B3	OC	Contact	FF	B3	Bedroom	T,C,Tp
UK-WAT-ZB_MTS-16_OC-00-L1	OC	Contact	GF	L1	Living Room	T,C,Tp
UK-WAT-ZB_MTS-10_A6-02-H3	A6	Multi	SF	H3	Hallway	H,T,I,M,Tp
UK-WAT-WB_MTS-10_OC-00-H1	OC	Contact	GF	H1	Hallway	C
UK-WAT-WB_MTS-15_OC-01-W1	OC	Contact	FF	W1	Water Closet	C
UK-WAT-WB_MTS-03_A6-01-B1	A6	Multi	FF	B1	Bedroom	H,T,I,M
UK-WAT-WB_MTS-24_OC-01-HB	OC	Contact	FF	HB	Hallway	C
UK-WAT-ZB_MTS-18_OC-01-HWA	OC	Contact	FF	HWA	Hallway	T,C,Tp
UK-WAT-ZB_MTS-05_A6-00-HW	A6	Multi	GF	HW	Hallway	H,T,I,M,Tp
UK-WAT-ZB_MTS-02_A6-02-B4	A6	Multi	SF	B4	Bedroom	H,T,I,M
UK-WAT-ZB_MTS-06_A6-01-B1	A6	Multi	FF	B1	Bedroom	H,T,I,M
UK-WAT-ZB_MTS-04_A6-00-L1	A6	Multi	GF	L1	Living Room	H,T,I,M,Uv
UK-WAT-ZB_MTS-45_S3-00-L1	S3	AirQuality	GF	L1	Living Room	PM1, PM2, PM4, PM10, NC.5, NC1, NC2.5, NC4, NC10, TPS
UK-WAT-ZB_MTS-20_OC-01-B3A	OC	Contact	FF	B3A	Bedroom	T,C,Tp
UK-WAT-ZB_MTS-08_A6-01-H2	A6	Multi	FF	H2	Hallway	H,T,I,M

Table 26. Datasets' Details: Location of file can be generated using Type (as directory name in the root directory), Stage (sub-directory in Type directory), and Filename for each dataset.

File Name	Storage Location		Dataset Details	Size		Dimensions			Time Range	
Dataset	Type	Stage	Description	Disk	RAM	Rows	Cols	Freq	Start Time	End Time
SensorData.csv	Physical	RAW	Physical sensors dataset with all EnvS, including Device IDs, Device IPs and static columns	2.99	1.3	8003600	27	1s	2022-10-19 13:27:15.86	2022-11-17 11:27:03.07
SensorDataClean_DevID{X}.csv	Physical	Clean	Physical sensors dataset for each EnvS, excluding Device IDs, Device IPs and static columns	2.64	0.25	1601000	20	1s	2022-10-19 13:27:15.86	2022-11-17 11:27:03.07
SensorDataRepaired_DevID{X}.csv	Physical	Repaired	Physical sensors dataset for each EnvS, excluding Device IDs, Device IPs and static columns. Without sensor reading errors.	2.64	0.25	1601000	20	1s	2022-10-19 13:27:15.86	2022-11-17 11:27:03.07
SensorDataMasterTransposed.csv	Physical	Master	Physical sensors dataset for all EnvS in transposed structure, excluding static information and sensor reading errors. Time range adjusted with other datasets.	3.93	1.8	2671186	96	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
temp_XXXXX_{YYYYmmddHHMMSS}.pcap	Cyber	PCAPFiles	Network activity packet captures in PCAP format, each file contains one hour of network packets.	119		NA	NA	≤1s	2022-10-19 14:04:48.00	2022-11-17 11:22:40.98
temp_XXXXX_{YYYYmmddHHMMSS}.csv	Cyber	CSVFiles	Network activity packet captures in CSV format, each file contains one hour of network packets.	32		NA	NA	≤1s	2022-10-19 14:04:48.00	2022-11-17 11:22:40.98
CyberMaster.csv	Cyber	Master	Network activity dataset in CSV format from start to end time in one file.	21.3	10.9	182197719	7	≤1s	2022-10-19 14:04:48.00	2022-11-17 11:22:40.98
CyberMasterNormalised.csv	Cyber	Master	Network activity dataset in CSV format from start to end time in one file with normalisation and sort by timestamp (_ws.col.Time). Length (_ws.col.Length) and Protocol (_ws.col.Protocol) columns are converted to int for normalisation. Source and Destination has multiple type of addresses e.g. Private IPs, Public IPs and MAC addresses. ProtocolMap.json is stored in Misc directory which holds the map of Protocol and Protocol IDs.	20.8	9.5	182197719	7	≤1s	2022-10-19 14:04:48	2022-11-17 11:22:40
CyberMasterNormalised_NoInfo.csv	Cyber	Master	Same as CyberMasterNormalised with all columns except the Info (_ws.col.Info) column to reduce memory requirement. Time (_ws.col.Time) is change to Timestamp.	12.1	8.1	182197719	6	≤1s	2022-10-19 14:04:48	2022-11-17 11:22:40
CU_CyPhy_*.csv	CyPhy	RAW	HomeAssistant's states table dump from MySQL in csv format. Multiple files were downloaded from time to time.	1.229	0.09	8057208	13	≥1s	NA	NA
BRE_CyPhy_W*.csv	CyPhy	RAW	BRE dataset received via email in csv format, multiple files received on weekly basis.	0.006	0.003	16571	5	≥1s	2022-10-13 00:01:45	2022-11-17 23:56:52
CU_{PID}.csv	CyPhy	IndDevs	Separate dataset for each physical smart device in HomeAssistant. Filename is based of PID. Each dataset has columns based on the number of entities on the device.	7.2	NA	NA	NA	≥1s	NA	NA
BRE_{Location}.csv	CyPhy	IndDevs	Separate dataset for each physical smart device in BRE Network. Filename is based of location and type of device. Each dataset has columns based on the number of sensors on the device.	2.3	NA	NA	NA	≥1s	NA	NA
CUMaster.csv	CyPhy	Master	All PIDs' entities in columns with timestamp from start time till end of dataset collection period.	5.75	7.4	2671186	370	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
BREMaster.csv	CyPhy	Master	All Locations' sensors in columns with timestamp from start time till end of dataset collection (total 5 weeks).	1.15	1.9	2671186	95	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
CU_BRE_Master.csv	Master		Both Smart Devices' datasets in one dataset.	9.2	6.85	2671186	464	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
Phy_CU_Master.csv	Master		Physical dataset synchronised with CU dataset. Entity states' value inflated with 1s frequency.	9.66	8.7	2671186	465	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
Phy_BRE_Master.csv	Master		Physical dataset synchronised with BRE dataset. Sensors' value inflated with 1s frequency.	5.05	3.6	2671186	189	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
Phy_CU_BRE_Master.csv	Master		Physical dataset synchronised with both CU and BRE dataset. Entity states' and Sensors' value inflated with 1s frequency.	10.8	11.1	2671186	559	1s	2022-10-18 00:00:00	2022-11-17 21:59:46
Cyber_Phy_Master_{YYYY-MM-DD}.csv	Master	CyberPhy	Cyber dataset frequency is less then 14 ms on average which increases the number of rows in all left joined datasets. This one is Cyber excluding Info columns with inclusive of Physical sensors' values.	259	NA	NA	101	≤1s	2022-10-18 00:00:00	2022-11-15 23:59:59
Cyber_Phy_CU_Master_{YYYY-MM-DD}_{HH}.csv	Master	CyberPhyCU	Cyber dataset frequency is less then 14 ms on average which increases the number of rows in all left joined datasets. This one is Cyber excluding Info columns with inclusive of Physical sensors' and CU entity states' values.	363	NA	NA	471	≤1s	2022-10-18 00:00:00	2022-11-15 23:59:59
Cyber_Phy_BRE_Master_{YYYY-MM-DD}_{HH}.csv	Master	CyberPhyBRE	Cyber dataset frequency is less then 14 ms on average which increases the number of rows in all left joined datasets. This one is Cyber excluding Info columns with inclusive of Physical sensors' and BRE location's sensors' values.	310	NA	NA	195	≤1s	2022-10-18 00:00:00	2022-11-15 23:59:59
Cyber_CU_BRE_Master_{YYYY-MM-DD}_{HH}.csv	Master	CyberCUBRE	Cyber dataset frequency is less then 14 ms on average which increases the number of rows in all left joined datasets. This one is Cyber excluding Info columns with CU entity states' and BRE location's sensors' values.	303	NA	NA	470	≤1s	2022-10-18 00:00:00	2022-11-15 23:59:59
Cyber_Phy_CU_BRE_Master_{YYYY-MM-DD}_{HH}.csv	Master	CyberPhyCUBRE	Cyber dataset frequency is less then 14 ms on average which increases the number of rows in all left joined datasets. This one is Cyber excluding Info columns with inclusive of Physical sensors', CU entity states' and BRE location's sensors' values.	549	NA	NA	565	≤1s	2022-10-18 00:00:00	2022-11-15 23:59:59

Table 27. Miscellaneous Files: contains information about important files required to explore datasets.

FileName	Details
headers_BRE-ZB.csv	Headers (columns) file for Physical Dataset (SensorData.csv).
ActivityLabels.json	Data columns for each type of activity (ActID). Each activity has different data points which are linked via separate Cyber, Physical, CUCP, and BRECP datasets. The file also name of the activity as shown in Figure **??**.
ActivityLogR1.csv	Each activity was noted while being performed by actor 1. This file contains StartTime, EndTime and ActID for each activity.
ActivityLog2.csv	Each activity was noted while being performed by actor 2. This file contains StartTime, EndTime and ActDetails (Description of activity rather than Activity ID of pre determined activities from Activities list) for each activity.
CUStatesMap.json	There are different strings in the dataset from various columns. This file was generated before normalising CUCP dataset. This includes string with its alternative floating number (-9.x) in the resulting dataset e.g. "charging": -9.57. This mapping is central for all entities in the dataset.
BRE_Devices_Location_Sensors.json	BRE dataset contains location for each device which provides different sensors' readings. This file contains list of sensors in each location/device in BRECP dataset as seen in 25.
CyberDevices.json	This file contains IP addresses and names of devices in the network, it was taken from DHCP server's log.
ProtocolMap.json	Map of protocols with protocol ID used to normalise Protocol (_ws.col.Protocol) column in CyberMaster Dataset.
SmartDevices_Data_and_Frequency.xlsx	List of Devices' PIDs and associated entities in HomeAssistant.

5 SMART DEVICES' IMAGES

Figure 1. Samsung SmartThings Contact Sensor

Figure 2. Xiaomi Motion Detector

Figure 3. Xiaomi Contact Sensor

Figure 4. Aqara Wireless Switch

Figure 5. Aqara Temperature and Humidity

Figure 6. Aqara Vibration Sensor

Figure 7. Aqara Motion Sensor

Figure 8. Aqara Water Leak Sensor

Figure 9. Kasa Mini Smart Plug

Figure 10. Philips Hue Light Bulb, B22

Figure 11. Philips Hue LightStrip

Figure 12. Philips Hue Motion Sensor

Figure 13. Google Pixel 5

Figure 14. WiThings Smart Scale

Figure 15. Alexa Dot 3rd Generation

Figure 16. Google Home

Figure 17. Roborock Vacuum Cleaner S5 Max

Figure 18. LUMIMAN Smart Bulb E27

Figure 19. Xiaomi Air Purifier 4 Pro

Figure 20. Benq GV1 Projector

Figure 21. Reolink E1 Pro Camera

Figure 22. Mill WiFi Portable Heater 1200W

Figure 23. Samsung Smart TV

Figure 24. WeeKett Smart WiFi Kettle

Figure 25. Mi Smart Antibacterial Humidifier

Figure 26. Smarter Coffee 2nd Generation