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**TCFD Sleep Study - A summary**

The goal of the study is to understand how poor sleep affects the quality of life of the residents at The Center For Discovery. For this, our first step was identifying those data modalities that give us information about the resident’s sleep but are non-invasive and privacy-preserving. Through literature survey and inputs from experts in the field we decided to capture the following data modalities during the resident’s sleep:

1. Resident’s bodily movement.
2. Ambient temperature in the resident’s room.
3. Ambient humidity in the resident’s room.
4. Ambient light intensity in the resident’s room.

Next, we worked on developing a low-cost and robust ambient data capture system to capture this data using nearable sensors (eg: Cameras). We developed a Raspberry Pi (RPi)-based ambient data capture system. In the first iteration, we captured just the resident’s bodily movement during sleep using a passive infrared sensor (PIR). In the second iteration, we added a privacy-preserving camera to the system which enabled us to capture the bodily movement at a finer resolution. In the third iteration, capturing of a new signal from the camera video feed which provides more information about the body movement was added to the system. The fourth iteration is under-development in which we have added the capabilities of capturing ambient temperature, humidity and light intensity. In the first and second iteration, data was stored in the Health Insurance Portability and Accountability Act (HIPAA) compliant cloud storage Box. In the third iteration, the data storage moved to the HIPAA compliant cloud storage - Amazon Web Services (AWS) in order to take advantage of the various functionalities in AWS. In the fourth iteration, we are implementing additional security measures to the AWS setup. The various data modalities we have collected and are planning to collect are summarized in the table below. (# of nights is the number of nights during which a certain data modality has been captured).

| **Data modality** | **Sensor** | **Iteration** | **# of nights** |
| --- | --- | --- | --- |
| PIR Binary Signal | PIR | 1 | 4806 |
| Global Difference Signal | NoIR Camera | 2 | 3985 |
| Global δ-Pixel Count | NoIR Camera | 3 | 2176 |
| Local Difference Signal | NoIR Camera | 4 | N/A |
| Local δ-Pixel Count | NoIR Camera | 4 | N/A |
| Ambient Temperature | DHT22 | 4 | N/A |
| Ambient Humidity | DHT22 | 4 | N/A |
| Ambient Light Intensity | TCS34725 | 4 | N/A |

Currently, the RPi based data capture system is installed in 14 rooms and we are collecting the different data modalities from 14 unique residents. In the 4th iteration, the data collection will be further expanded to collect data from additional 35 residents at TCFD. In parallel to the data collection from nearable sensors, we are collecting resident’s behavior data during the day. The goal is to build machine learning models to predict daily behaviors of the residents from the various data-modalities collected during previous night sleep.