

Person Detection – Application Note

Intrusion Detection, the automated sensing of a new person or animal into a surveilled area, is one of the main applications of low-resolution thermopile arrays like Heimann Sensor's 32x32 or 80x64 array. It is used for safety and security as well as for making life easier and more comfortable. Examples are smart buildings with functions like smart HVAC control and smart lighting for energy savings. The same system can be used as a security alarm. Other functions include wellness checks of invalids and older people living alone, fire prevention and elevated body temperature detection.

The advantages of low-resolution thermopile arrays for these applications are:

- No privacy issues
- Independent illumination (day/night)
- Not affected by smoke in case of fire or while cooking
- Detection of stationary people (e.g., while sitting/sleeping)
- Low-cost

So let us have a closer look into some specific applications of person and presence detection. We will give a brief overview of some possible applications and discuss the potential benefits of using infrared thermopile arrays.

Intelligent HVAC Control

Intelligent or smart HVAC control is one important application for low-cost infrared arrays like our 32x32 thermopile array. The sensor can detect the occupancy of a room. The number of people can be obtained from the thermal sensor. This data is then used to calculate the required heating and cooling with respect to the number of people, desired room temperature and outside temperature. If there are many people in a room, extra heating in the winter might not be necessary. On the other hand, on a hot summer day, the cooling level should probably be increased. In contrast to normal room thermostats, an intelligent system can anticipate the required heating and cooling. This will result in less overshoot in contrast to a conventional room thermometer which reacts more slowly to room temperature variations resulting in longer time constants. The usage of thermopile arrays for smart HVAC control can drastically reduce the energy consumption of a building.

In addition to energy savings, the level of comfort can also be increased. As the location of all people in a room can be obtained from the infrared array, the direction of the air conditioner ventilation can be controlled in such a way that no one is in the draught. The further increase the comfort, the intelligent HVAC can be combined with an air quality monitoring system for CO₂, which can be realized with single or dual thermopile sensors and sensor modules.

To have an overview of the room, choose a sensor with large field of view of 90 degree or more. The required spatial resolution of the sensor depends on the room's size and height. For most rooms, the 32x32 thermopile array is sufficient, while in large rooms with high ceilings as they can be found in many public buildings, the higher resolution 80x64 array is the better choice.

People Counting

People counting is an important task as knowing the exact number of people in a location can be of great benefit. This applies to shopping malls or shopping centers. Counting people at the entrance and exit to determine the times with high and low demand allows staff level allocation. Mounting of several sensors to

overview a complete store allows tracking individual people. In combination with data analysis, this can give valuable insights in customer behavior and how to run a store effectively. The same is true for public transportation like trains. Counting the entering and exiting people will help to optimize the capacity needed. This can have significant impact and can save cost on personnel and fuel.

Another application is people counting at the entrance of office buildings to know how many people are inside. In case of a fire, this could help to check whether everyone got out, which helps the firefighters to save lives. If mounted on the ceilings of offices, the sensors may also help to prevent fires and detect them at a very early stage. This is discussed in more detail on our page about hot spot detection.

Elderly People Monitoring

People all around the world are living longer. Especially in western societies, many people prefer to live in their own home as long as possible instead of a nursing home or assisted living. This creates a dilemma for the caregivers and relatives. On one hand the caregivers and relatives want to be sure that everything is fine and on the other hand they cannot be present at all times.

One emerging solution are elderly monitoring systems. There is a large choice now available in the market. Most require the elderly person to push a button in case of need.

The use of a low spatial resolution infrared thermopile array can solve many challenges induced by elders living on their own. It can be used to keep track of their location inside their home. At the same time their privacy is respected due to the low spatial resolution of the thermal sensor. Additionally, the sensor can be used to detect a fallen person and notify caregivers and relatives or release an alarm. Unusual situations can be monitored, for example if the person stays for unusual time at the same location. Further capabilities are fire detection and intrusion alarm, which can also be implemented with the same sensor. In case of dementia or Alzheimer's, a notification can be released if the person leaves an area. This enables the person to stay maximally independent, while easing their caregiver's and relative's stress.

Burglar Alarms

Burglar or intrusion alarming is an important application of thermal imaging. This can protect people, locations and assets and can reduce psychological damage by lowering stress.

Independent of external illumination, as it only depends on temperature sensing. It is also not affected by smoke, dust and light fog. Humans have a common temperature signature. This can be detected and classified even with a low number of pixels. This allows systematic distinguishing between humans and animals. Risk of false alarms is minimized through accurate intrusion classification.

The intrusion/burglar alarm function can be integrated via software in the same system which is used for the previously mentioned applications such as intelligent HVAC control, people counting and elderly people monitoring just by adding software functionality. If a building, office, or home is empty and the alarm function is activated, the sensor can be used to detect unauthorized persons and notify the owner and triggers an alarm sound.

For indoor alarms, the 32x32 thermopile array is normally sufficient, for outdoor perimeter intrusion detection systems a higher resolution like 80x64 or 120x84 is usually the better option depending on the area to be covered.

Smart Lighting

The ability to detect humans with Heimann thermopile array sensors can also be used to switch lights depending on presence. This is not only possible in smart homes and buildings, but also street lighting can be made smart by detect the presence of people and cars and adapt the lighting situation accordingly. This can save up to 70% of energy costs while still maintain safe streets.

With advanced analytical methods the intention of a person to enter the next room can be anticipated in software and the light will be switched on in advance.

Together with further smart home functionality like voice control and routines for changing light color and intensity based on the biorhythm (also referred to as "human-centric lighting"), the smart lighting is not only cost and energy efficient but provides also a comforting home environment. Combined with the burglar alarm the detection of an unwanted intruder can be used to turn on the lights, which could scare him out without leaving much damage.

Driver Assistance

Thermal imaging is an option to improve the driving experience in advanced driver assistance systems. While driver presence in many cases is not detected directly, but over secondary signals like fastened seat belt, closed door and seat occupancy sensor, thermal imaging allows direct detection of the presence of the driver and other passengers. This gives more reliable information about the presence of a driver, which may be important for (semi-)autonomous driving. For this kind of application thermopile arrays with a very large field of view of 90° and more can be used. It is also possible to detect if a person is sitting properly or out of position, or to detect a baby in a baby seat. This can be used to deactivate airbags automatically to reduce the risk of unwanted airbag induced injuries.

One single sensor can be utilized for a number of different tasks in a vehicle. If a person is detected on a specific seat, it can provide an information to fasten the corresponding seat belt. And with the ability to sense facial temperature, a drowsiness warning system can be implemented. Intelligent control of the car's air conditioning is possible. This improves the level of comfort and saves a lot of energy, which is especially important in electric vehicles as their available energy is limited. Other options are control of the electric parking brake or gesture control of the infotainment and navigation system.