BGT60TR13C Radar Based Vital Sensing

About this document

# Scope and purpose

# To build a vital sensing system using Infineon’s BGT60TR13C radar chip

# Intended audience

The vital sensing system is intended to be used in the Health Sector and Medical Industry for Mass screening and detection of vital parameters.

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# Algorithm Innovation

There were 23 different experiments designed and implemented to collect data. Duration of each experiment was for 10 seconds, corresponding to 10000 frames.

The criterion for each experiment is described below

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| **Data Index** | **Summary** |
| 1 | Subject 1 moving |
| 2 | Subject 1 normal breathing |
| 3 | Subject 1 idle with rapid Breathing |
| 4 | Subject 1 moving at a different range |
| 5 | Subject 2 moving |
| 6 | Subject 2 idle |
| 7 | Subject 2 moving at different range |
| 8 | Subject 3 moving in a different direction |
| 9 | Subject 3 idle with minimal breathing |
| 10 | Subject 3 idle |
| 11 | Subject 1 idle with zero torso displacement |
| 12 | Subject 1 idle with normal breathing |
| 13 | Subject 1 idle with rapid breathing |
| 14 | Subject 1 with gesture movements |
| 15 | Subject 1 with rapid movements |
| 16 | Subject 1 moving |
| 17 | Subject 2 idle with zero torso displacement |
| 18 | Subject 2 idle with normal breathing |
| 19 | Subject 2 idle with rapid breathing |
| 20 | Subject 2 with gesture movements |
| 21 | Subject 2 with rapid movements |
| 22 | Subject 2 moving |

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| Code please refer to the Jupiter notebook mentioned at the end of the document |

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## Heading 2

The raw data from the sensor was converted into range data by taking FFT across a single chirp. The FFT was performed using the getrange subroutine in the processing file. The range FFT file is used to train the convolutional neural network

The data from three receivers were split into three different points and thus the data was augmented, and the no. of frames were down sampled to 1000 frames in order to reduce computational time. Each data point is an array of 1000 x 32 with one channel.

The CNN consisted of four layers with 32 filters in each layer followed by four fully connected layers with 400 neurons each. The output layer consists of 1 neuron with an activation of sigmoid. An output value of 1 signifies moving target and zero signifies still target. The model was trained with an Adam optimizer with learning rate of 10e-4 and loss function of binary cross entropy.

During the testing each experiment would give three data points corresponding to the three receivers. And the final output is the majority of the three points.

2. Normal or anxious state

The normal or the anxious state of the quasi state subject is determined by analyzing the heartbeat of the subject which was detected using the radar based sensor. The patient was classified as anxious if the heartbeat of the subject was exceeding 100 beats per min. The resting range was considered to be 48 – 100 beats per min.

The heartbeat was detected from the displacement plot derived from the do\_processing file. The displacement data was filtered using bandpass filter followed by peak detection. The no of peaks per min in the plot was calculated and defined as the heartbeat.

**RESULT**

The CNN was trained and has an accuracy of 87.94 %. The live detection of quasi-static subject’s heartrate accurately measured and was compared with other standard measurement techniques for determining the accuracy.