Avnet Vital Sensing Radar
User Manual

AVNET®

REVISION HISTORY

VERSION	DATE	AUTHOR	COMMENT
1.0	28/01/2022	Wanghongsheng	Initial Version

AVNET®

TABLE OF CONTENTS

LIST OF TABLES

No table of figures entries found.

LIST OF FIGURES

1 Overall introduction

Avnet vital sensing radar can detect the vital signals of the target in front of the radar. Vital signals include respiration rate and heartbeat rate. It also can detect if the target is snoring with help of microphone sensor. With the benefits of mmWave radar, all the vital signals can be detected in a contactless way and without any intrusion of privacy. So it is a perfect sensor for the baby monitoring, eldly people caring and sleep monitoring. Avnet 60GHz vital sensing radar kit is featured by IFX BGT60TR13 and NXP MCU RT1050.

The BGT60TR13C, a 60 GHz radar sensor with antenna in package, enables ultra-wide bandwidth FMCW operation in a small package. Sensor configuration and data acquisition are enabled with a digital interface and the integrated state machine enables independent data acquisition with power mode optimization for lowest power consumption.

The i.MX RT1050 is a new processor family featuring NXP's advanced implementation of the high performance Arm CortexR-M7 Core. It offers high-performance processing optimized for lowest power consumption and best real-time response.

1.2 Appearance

Figure 1 illustrate the appearance of our demo. It looks like bedside lamp but with vital sensing radar inside. We put the demo on the bedside table like a bedside lamp, also we can put the demo on the wall by a sticker.

Figure 1 the appearance of Avnet vital sensing radar

1.3 Block Diagram

Figure 2 illustrate the block diagram of Avnet 60GHz vital sensing radar.

BGT60TR13 is the microwave radar sensor with antenna in package.
The core functionality of BGT60TR13C is to transmit frequency modulated continuous wave (FMCW) signal via one of the transmitter channel (TX) and receive the echo signals from the target object on the three receiving channels (RX). Each receiver path includes a baseband filtering, a VGA, as well as an ADC. The digitized output is stored in a FIFO. The data are transferred to NXP MCU to run radar signal processing through the interface of SPI.

The microphone picks up the ambient sound and output an analog signal, then the MCU RT1050 sampled the analog signal using ADC integrated in MCU.

In MCU, the data from BGT60 and MIC will be processed to get the respiration rate, heartbeat rate and range of the target. It also can detect if the target is snoring and if the target is turning over on the bed. All the final results will be sent to ESP32 through the Uart interface. ESP32 is WIFI&BLE module, it get the data from MCU and then send the data to Baidu Cloud via MQTT protocol.

Avnet also provid an APP running on Android, the APP will download the data from Baidu Cloud and it can display the real-time vital data of the target like respiration rate and the heartbeat rate. Also we provide a simple algorithm to analyze the sleep quality of the target. It will be explained more in detail in the following chapters.
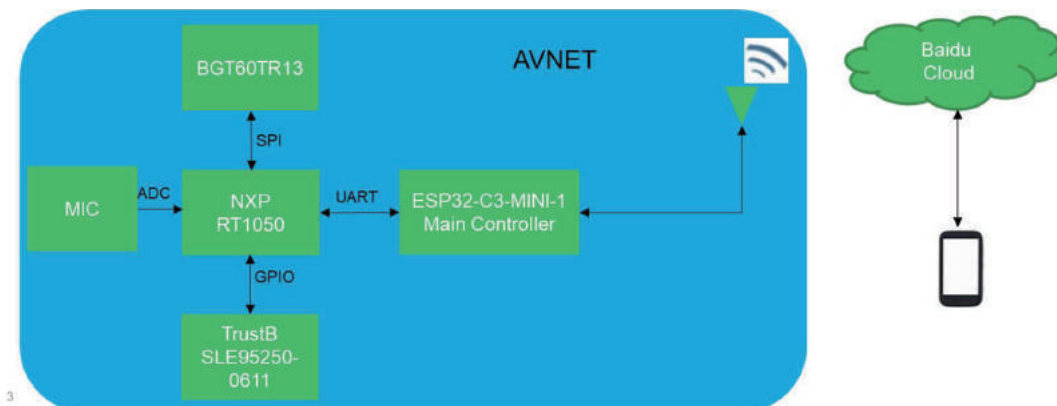

Figure 2 Avnet 60GHz vital sensing radar block diagram

1.4 Power Consumption

The typical power consumption of the vital radar system is 550mW.
This power consumption doesn't include the power consumption of the lights.
However, the exact value will depend on the operating condition of the radar
sensor, especially on the duty-cycle of radar and the wifi module.
For the radar, the frame rate is 20Hz, that means BGT60 will repeat to transmit
and receive the RF signal in every 50ms. For the WIFI module, ESP32 will send the
data to Baidu cloud in every second.

1.5 APP Manual

There are five tabs in our APP as shown in Figure 3. They are Data Tab, Chart Tab,
Sleep Tab, Config Tab and the About Tab.

Real time data from the radar will be displace in the Data Tab. The top row with
Heart Icon is heartbeat rate of the target in front of the radar. The next row
following with icon of lung is the respiration rate of the target. The units of the
heartbeat rate and respiration rate is beats-per-minute.The third row indicates
if the target is snoring. The fourth row indicates if the target is turning over on the
bed. The fourth row also serves the purpose of if there is a sleep apnea.
When the target stops breathing, there will a alert on the fourth row indicates
apnea is detected.

The fifth row the range of the target. The unit is centi-meter.

There is also some information of radar device like DeviceID, IP address of the device,
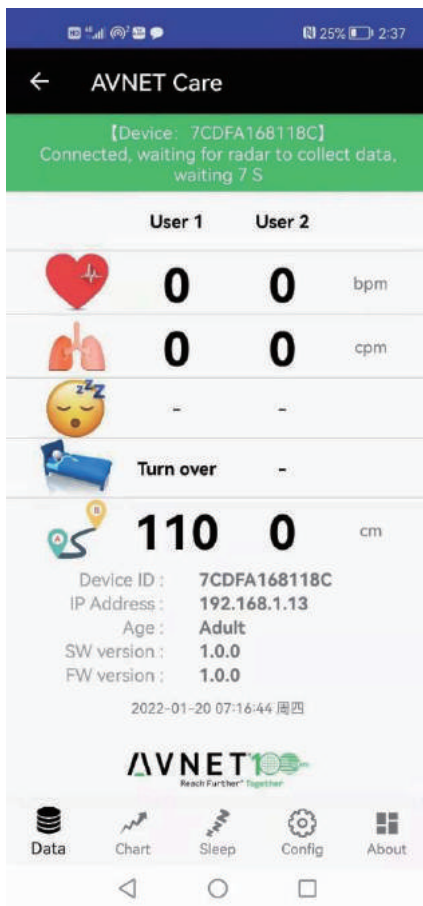software version and firmware version.

AVNET®

Figure 3 the screen shot of APP

The Chart Tab will displace the chart of heartbeat rate on the top.
The unit is beats-per-minute. It will display the latest 30 results from the target.
The Data Tab only display the real time data but in the Chart Tab you can see the latest 30 samples and displayed in a chart.

The chart in the middle is the respiration rate chart, same as the heartbeat rate chart.
The unit is beats-per-minute. The latest 30 samples will be displayed.

The bottom chart is the range of the target. Also 30 latest samples will be displayed.
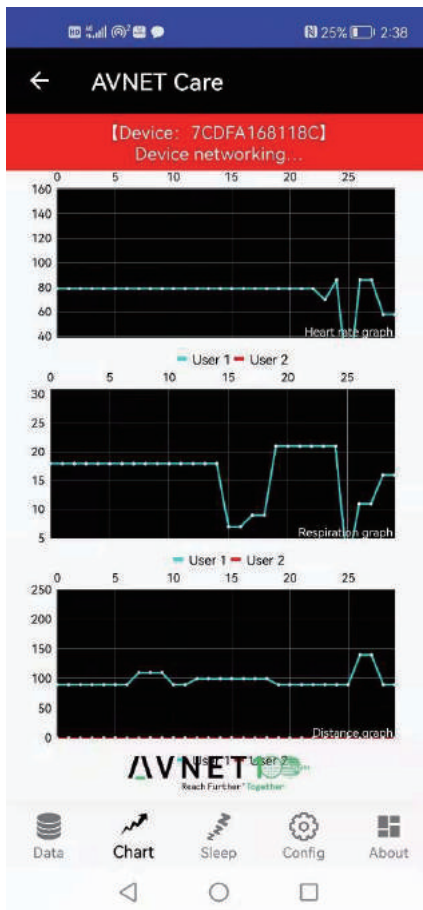
Figure 4 Chart Tab in the APP

In the Sleep Tab, there is a sleep summary report of the target, like the time to fall asleep ,the time to wake up, and how long is the sleep, deep sleep percentage of the sleep, the average of the respiration rate, the average heartbeat rate, how many times of the turning over on the bed, and how long that the snoring lasts. If there is an apnea, it also display how many times of the apnea.

Also there is a button that can display the sleep quality curve of the target.
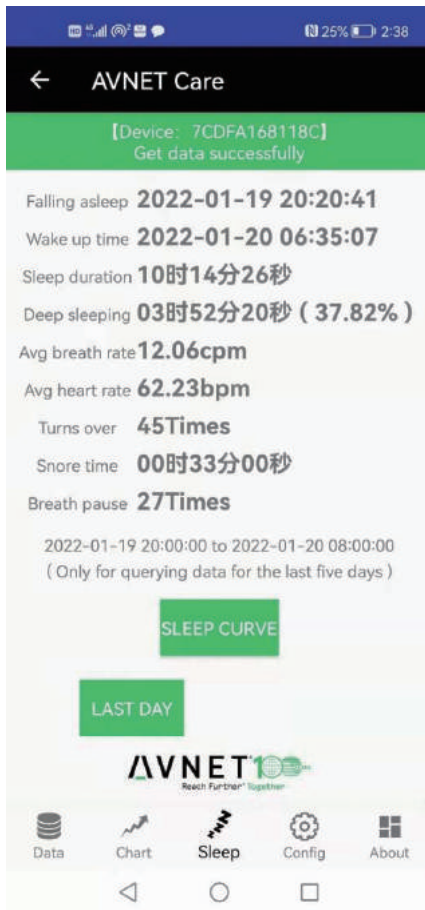
Figure 5 Sleep Tab in the APP

The Config Tab will be used to configure the radar device.
Please input the SSID of WIFI Access Point also with password of this AP.
APP will broadcast the SSID of the AP with the password, and the radar device will get the SSID and Password from the broadcasting. And then the radar device will connect to Baidu Cloud using the SSID and Password.
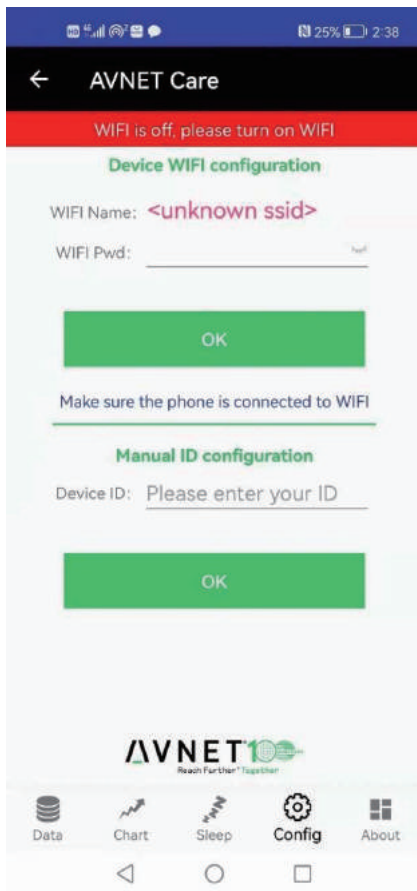
Figure 6 Config Tab in the APP

We also provide a unbox manual of radar device in the About Tab.
Before using the radar device, please read it carefully.
In the tab, we will guide how to install the radar, where to install and
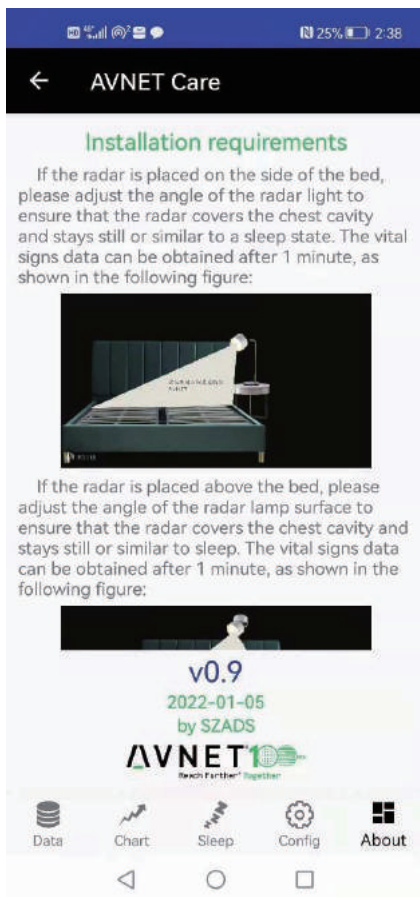make sure that radar can detect the chest displacement of the target.

Figure 7 About Tab in the APP

1.6 OTA

Over-The-Air (OTA) is a procedure to update the firmware without the use of physical wires.When a product is ready and released in the field, OTA can be used to upload new firmware that brings new features. From the point view of a customer, OTA is convenient because the Headset does not need to be connected to a PC. We have finished this function and customer can use this function directly.

1.7 Order Information

The P/N of this demo is AVT60VSR, AVT means Avnet, 60 means 60GHz, VSR means Vital Sensing Radar.

1.8 Contact information

Contact your local Avnet sales for demo application. If you have no idea who to contact, you can contact me via hongsheng.wang@avnet.com

2 Test Report

2.1 Heartbeat Rate Accuracy

Before get the accurate test result of the heartbeat, people should stay still before the radar for about one or two minutes. Waiting for the radar to get enough data and then get more accurate result.
We have compared the radar result with the result from the fingertip pulse oximeter. Pulse oximetry uses light to work out oxygen saturation. Light is emitted from light sources which goes across the pulse oximeter probe and reaches the light detector. And the oximeter we used is from a famous medical instrument supplier, we take the result from the oximeter as the reference result.

The largest error of our radar is about 6 Beats-per-minute compared with the result from oximeter.

And most time the result is the same if people keep still for enough long time. But since the physical difference of people, maybe there is some difference in the final test result. So please contact your local Avnet Sales for field testing by yourself.

2.2 Respiration Rate Accuracy

Since the displacement of chest caused by respiration is very large.
From Figure 8, the top chart is chest displacement caused by respiration, it is very large and very clear, so for the respiration rate, the result will be very accurate.

Figure 8 Chest displacement caused by respiration

ABOUT AVNET

Avnet is a global technology solutions provider with an extensive ecosystem delivering design, product, marketing and supply chain expertise for customers at every stage of the product lifecycle. We transform ideas into intelligent solutions, reducing the time, cost and complexities of bringing products to market. For nearly a century, Avnet has helped its customers and suppliers around the world realize the transformative possibilities of technology.

Learn more about Avnet at **www.avnet.com/apac**