STMicroelectronics UM3330 MotionSM Aleep Monitoring Library User Manual

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Contents

Introduction

The Motion SM is a middleware library part of X-CUBE-MEMS1 software and runs on STM32. It provides real-time sleep monitoring of the user based on data from a device.

It provides real-time information if the user sleeps or not. The library is intended for wrist worn devices. This library is intended to work with ST MEMS only.

The algorithm is provided in static library format and is designed to be used on STM32 microcontrollers based on the Arm Cortex®-M3, Arm Cortex®-M4, Arm Cortex®-M33 or Arm Cortex®-M7 architecture.

It is built on top of STM32Cube software technology that eases portability across different STM32 microcontrollers.

Acronyms and abbreviations

Table 1. List of acronyms

Acronym	Description
API	Application programming interface
BSP	Board support package
GUI	Graphical user interface
HAL	Hardware abstraction layer
IDE	Integrated development environment

MotionSM middleware library in X-CUBE-MEMS1 software expansion for STM32Cube

MotionSM overview

The Motion SM library expands the functionality of the X-CUBE-MEMS1 software.
The library acquires data from the accelerometer and provides real-time information if the user sleeps or not. The library is intended for wrist-worn devices.

The library is designed for ST MEMS only. Functionality and performance when using other MEMS sensors are not analyzed and can be significantly different from what described in the document.

MotionSM library

Technical information fully describing the functions and parameters of the Motion SM APIs can be found in the MotionMC_Package.chm compiled HTML file located in the documentation folder.

Motion SM library description

- The Motion SM sleep monitoring library manages the data acquired from the accelerometer; it features:
- Possibility to distinguish if the user sleeps or not
- Intended for wrist-based devices
- Recognition based only on accelerometer data
- Required accelerometer data sampling frequency of 16 Hz
- Resources requirements:
  - Cortex®-M3: 1.7 KB of code and 2.2 KB of data memory
  - Cortex®-M33: 1.6 KB of code and 2.2 KB of data memory
  - Cortex®-M4: 1.6 KB of code and 2.2 KB of data memory
  - Cortex®-M7: 1.6 KB of code and 2.2 KB of data memory
- Available for Arm Cortex®-M3, Arm Cortex®-M33, Arm Cortex®-M4 and Arm Cortex® M7 architectures
- Known limitations: sleep state might be also detected if the device is in a stable position, for example: stored on

a shelf. It is recommended to combine the sleep monitoring algorithm with the activity recognition for wrist algorithm (Motion AW library) and run it only if the lying position is detected

Motion SM APIs

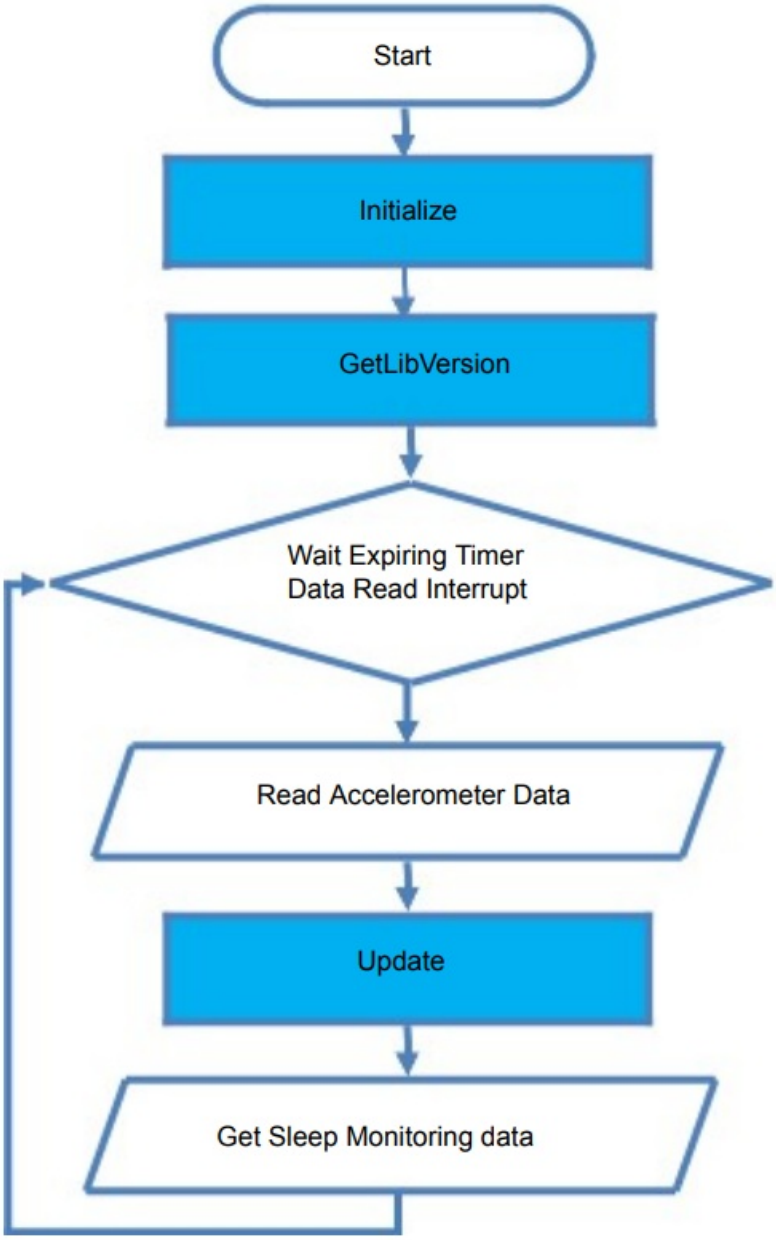
The Motion SM library APIs are:

- uint8_t Motion SM_ GetLib Version(char *version)
  - Retrieves the library version
  - *version is a pointer to an array of 35 characters
  - Returns the number of characters in the version string
- void Motion SM_ Initialize(void)
  - Performs Motion SM library initialization and setup of the internal mechanism
  - The CRC module in the STM32 microcontroller (in RCC peripheral clock enable register) has to be enabled before using the library

    Note: This function must be called before using the sleep monitoring library
- void Motion SM_ Reset(void)
  - Resets the sleep monitoring algorithm
- void Motion SM_ Update(MSM_ input_t *data_ in, MSM_ output_t *data_ out)
  - Runs the sleep monitoring algorithm
  - *data_ in parameter is a pointer to a structure with input data
  - The parameters for the structure type MSD_ input_t are:
    - AccX is the accelerometer value in the X axis in g
    - AccY is the accelerometer sensor value in the Y axis in g
    - AccZ is the accelerometer sensor value in the Z axis in g
  - *data_ out parameter is a pointer to a structure with output data
  - The parameters for the structure type MSD_ output_t are:
    - Sleep Flag is the sleep flag
    - Total Sleep Time is the total sleep time
- void Motion SM_ Set Orientation_ Acc(const char *acc_ orientation)
  - Sets the accelerometer orientation
  - *acc_ orientation is a pointer to a string containing reference system of the accelerometer raw data (for instance: south-west-up became “swu”, north-east-up became “ned”)

API flow chart

Figure 1. Motion SM API logic sequence



Demo code

The following demonstration code reads data from the accelerometer sensor and gets the motion intensity code.

```
[…]
#define VERSION_STR_LENG 35
[…]
/*** Initialization ***/
char lib_version[VERSION_STR_LENG];
/* Sleep Monitoring API initialization function */
MotionSM_Initialize();
/* Set accelerometer sensor real orientation */
MotionSM_SetOrientation_Acc(“ned”);
/* Optional: Get version */
MotionSM_GetLibVersion(lib_version);
[…]
/*** Using Sleep Monitoring algorithm ***/
Timer_OR_DataRate_Interrupt_Handler()
{
MSM_input_t data_in;
MSM_output_t data_out;
/* Get acceleration X/Y/Z in g */
MEMS_Read_AccValue(&data_in.AccX, &data_in.AccY, &data_in.AccZ);
/* Intensity Detection algorithm update */
MotionSM_ Update(&data_ in, &data_ out);
}
```

References

The following resources are freely available on **www.st.com**:

- UM1859: Getting started with the X-CUBE-MEMS1 motion MEMS and environmental sensor software expansion for STM32Cube
- UM1724: STM32 Nucleo-64 board
- UM2128: Getting started with Unicleo-GUI for motion MEMS and environmental sensor software expansion for STM32Cube

Revision history

Table 2. Document revision history

Date	Revision	Changes
02-Apr-2024	1	Initial release.

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Documents / Resources

	STMicroelectronics UM3330 MotionSM Aleep Monitoring Library [pdf] User Manual UM3330 MotionSM Aleep Monitoring Library, UM3330, MotionSM Aleep Monitoring Library, Aleep Monitoring Library, Monitoring Library, Library

References

- User Manual