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Hogeschool van Amsterdam

Vincent Tuinder

Tom Vredeveld

Wii Balance Board Recorder

Weight and Center of Position Recorder

USER MANUAL
v1.0.0
[GitHub Repository](#)

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1. INTRODUCTION

The Wii Balance Board Weight and Center of Position Recorder, or called Wii Balance Board Recorder, is a system to measure and record static and dynamic movements of patients and other participants.

Originally, the Wii Balance Board in this system was developed and marketed by the Nintendo company to the public as an accessory to the Wii home video game console, released in 2008. Nintendo games involving the Balance Board were Wii Fit and the Wii Fit plus variant.

Even though the Wii system is no longer sold by the Nintendo company, new and secondhand boards can still be found on different marketplaces (e.g. Ebay). Availability to acquire such a board is still reasonable.

More information about the Wii Balance Board can be found on https://en.wikipedia.org/wiki/Wii_Balance_Board.

Before using the Wii Balance Board in combination with the recording software it is advised to read the user manual concerning use and safety of the board. This manual can be found on:

<https://www.nintendo.com/consumer/downloads/WiiBalanceBoard.pdf>.

2. OPERATION SETUP

2.1 PREREQUISITES

The Wii Balance Board recorder consists of the following parts:

1. Nintendo Wii Balance Board
2. A laptop or PC with Bluetooth facility.
3. the “WiiBalanceWalker” software
4. and the “Wii Balance Board Recorder” software .

The Nintendo Wii Balance board can be bought on (online) public marketplaces at reasonable prices. They are sold as single boards or as package with the Wii Fit or Wii Fit plus game.



The Wii balance board requires 4 AA penlite batteries to operate, these are standard NOT included in any of the above packages.

The laptop or PC preferably has an internal Bluetooth adapter. This is because the Bluetooth address of an external Bluetooth dongle is often out of range for the Wii Balance Board to connect to. The WiiBalanceWalker software will notice if this is the case and will provide an alternative solution.

The original WiiBalanceWalker software can be downloaded from the <https://github.com/lshachar/WiiBalanceWalker> repository. To do this, press the green “Code” button on Github and choose: “Download ZIP”.

Make sure to get version 0.5, since earlier release work differently. This program is used mainly to connect the Wii Balance Board to the computer using its Bluetooth connection. Since the Wii Balance Board is originally from 2008, current operating systems like Windows 10 have some issues connecting to the old Bluetooth adapter from the Balance Board. With this program and its instructions, connecting to Windows 10 will be easier than trying to make a connection manually. The program has its own interesting features and can be quite useful but its purpose lies beyond the scope of this manual. The program works without installation starting the executable “WiiBalanceWalker.exe”.

The “Wii Balance Board Recorder” software can be downloaded from [this repository](#). After downloading it can be opened as an installer which then will install the Wii Balance Board Recorder software on your computer. To install, execute the “setup.exe” file as a computer administrator and follow the instructions. The icon below will be placed on your desktop.



2.2 CONNECTING THE Wii BALANCE BOARD

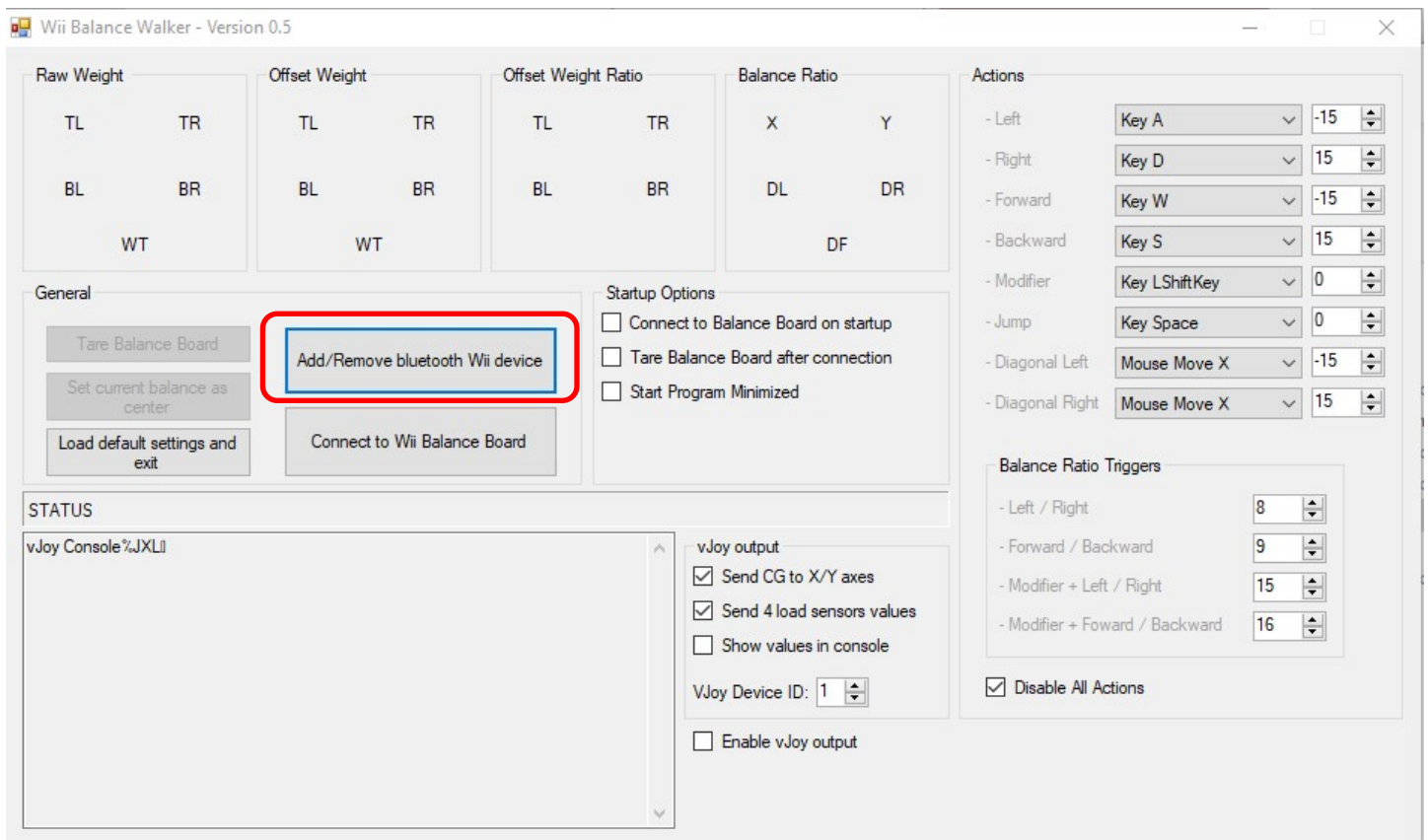
Working with the Wii Balance Board Recording software requires a stable Bluetooth connection with a laptop or PC. The Wii Balance Board is an old device, manufactured around 2009, and therefore uses old Bluetooth techniques. Connecting to a modern computer using Windows 10 is challenging but with the help of the program WiiBalanceWalker.exe this task should be easier for the user. This software performs 3 tasks:

- Remove existing (old) connections to the Wii Balance Board
- Generates a permanent Bluetooth pairing code between the Wii Balance Board and Windows 10.
- Test the connection if any data is received from the Wii Balance Board.

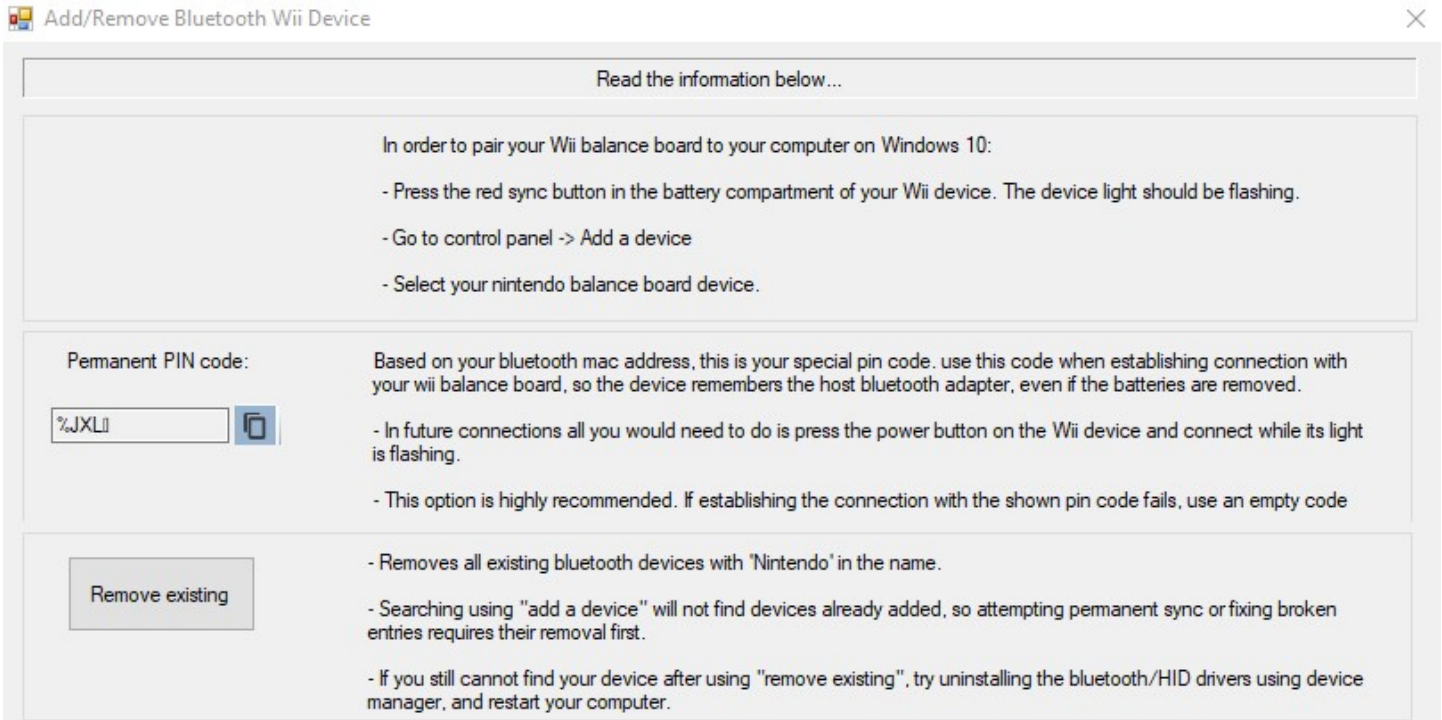
In future software updates the goal is to integrate these features in the Wii Balance Board Recording software, making this program obsolete.

Connecting procedure:

Start the program WiiBalanceWalker.exe. The following window appears:



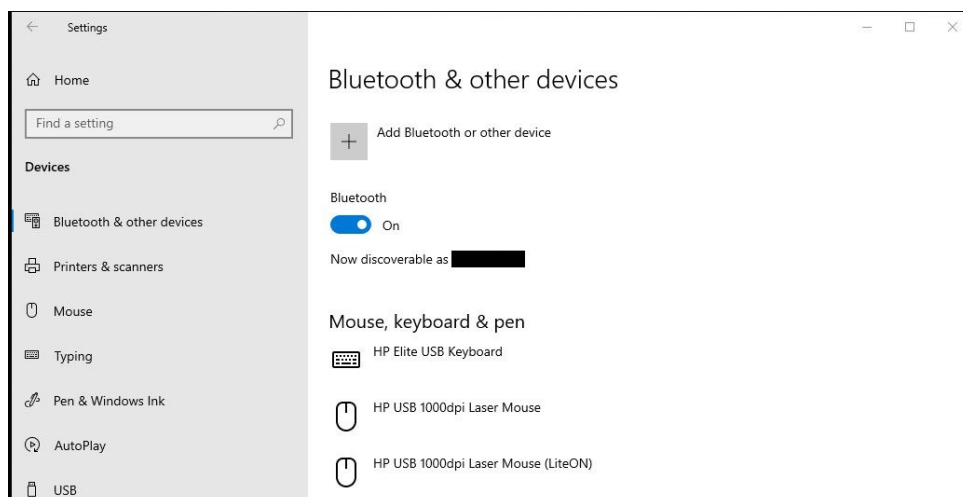
Continue by pressing the “Add/Remove bluetooth Wii device” button. A second window will appear on the screen.



Read the information in this window. If any existing Wii Balance Board has been connected before to the computer, use the “Remove Existing” button to disconnect this device from Windows 10. In the upper line of this window it will show if the device is removed.

To make the proper connection with the Wii Balance Board using Bluetooth, the permanent PIN code is needed which this window has generated. Use the “copy” button (on the right side of the PIN code) to save this code to the clipboard. If using a Bluetooth dongle, sometimes a warning is issued and no permanent Pin code is generated. In that case, read the additional information in the popup window to solve this problem. An inbuild Bluetooth adapter is therefore preferable.

Now continue to move to the “Devices” window in Windows 10:

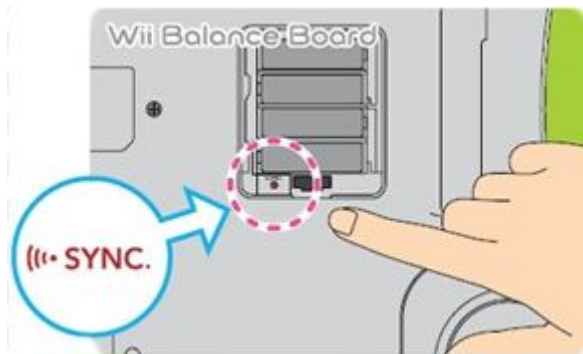


Make sure the Bluetooth setting is set to “On”.

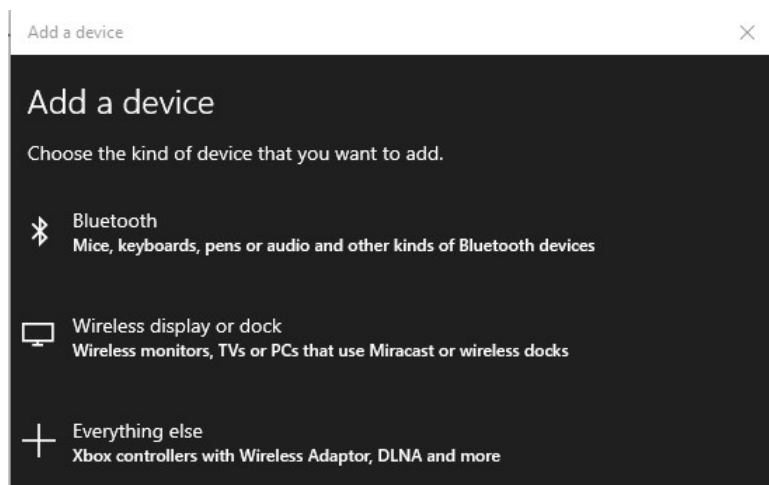
Now go to the Wii Balance Board and turn it upside down.

Insert the 4 penlite batteries in the battery compartment if not done already, watch the polarity.

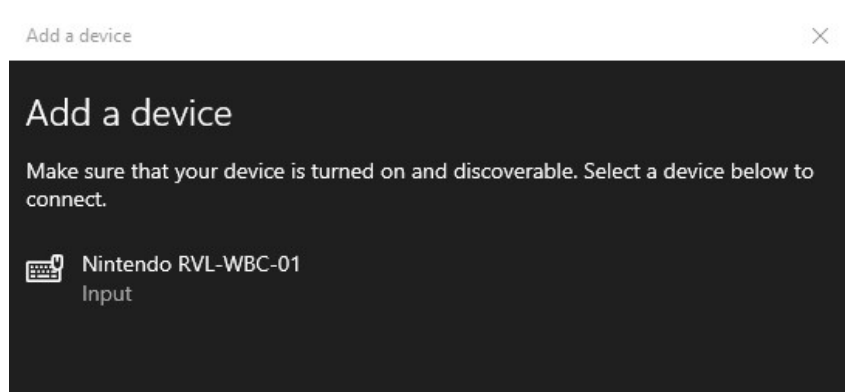
Press the red button inside the battery compartment and hold, the Wii balance Board will try to make connection to any device nearby. A blue light on the front button of the board will start to blink and remains blinking while pressing the red button.



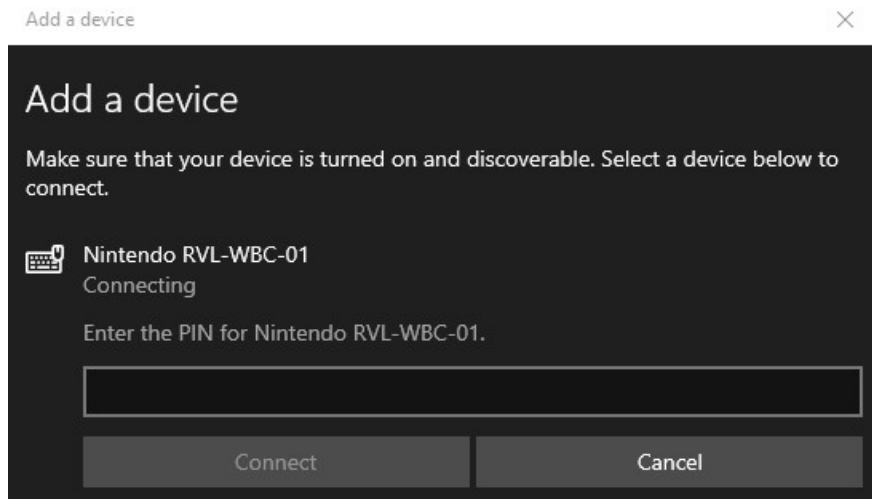
While holding the red button, press the “Add Bluetooth or other device” button on the “Device” window of Windows 10. Continue by selecting the “Bluetooth” option.



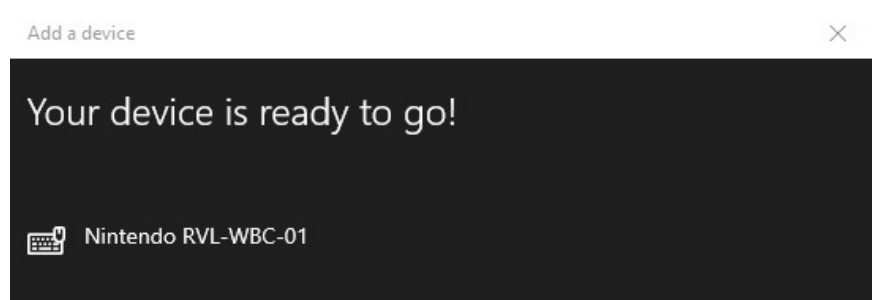
Windows 10 will now start searching for any new Bluetooth devices and will try to connect to the Wii Balance Board.



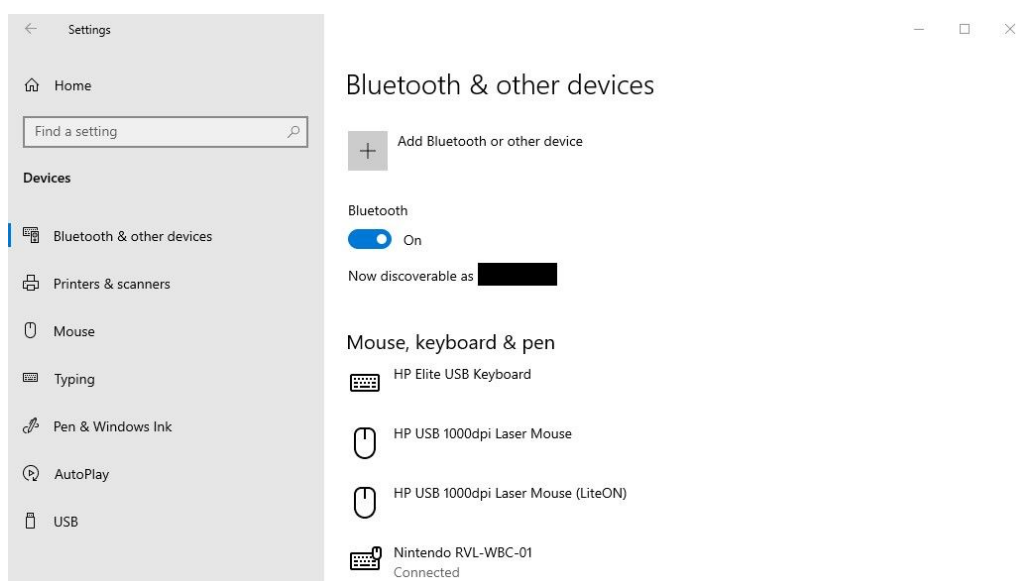
“RVL-WBC-01” is the identification of the Wii Balance Board. Select this device, while still holding the red button.



Now enter the Pin code previously copied from the WiiBalanceWalker software: Click inside the Pin code area and use the key CTRL-V to insert the pin code. Press the “Connect” button. Wait for the connection to establish.



Presse “Done”. It is only now that the red button of the Wii Balance Board can be released. If the Balance Board remains connected, the blue light on the front of the board remains on or will be blinking. If not, repeat the above procedure. The “Device” menu of Windows 10 will show the connected Wii Balance Board as a new Bluetooth device.



Close the “Device” window. The Wii Balance Board is now connected. Close the battery lid and set the board upright.

Close the “Add/Remove Bluetooth Wii Device” window of the Wii Balance Walker software. In the main window press the “Connect to Wii Balance Board” button to check if any Balance Board data is transferred to the program. In the “Raw Weight” part of the window the figures will start changing, “Offset Weight”, “Offset Weight Ratio” and “Balance Ratio” figures will follow as soon as a weight is put on the Balance Board.

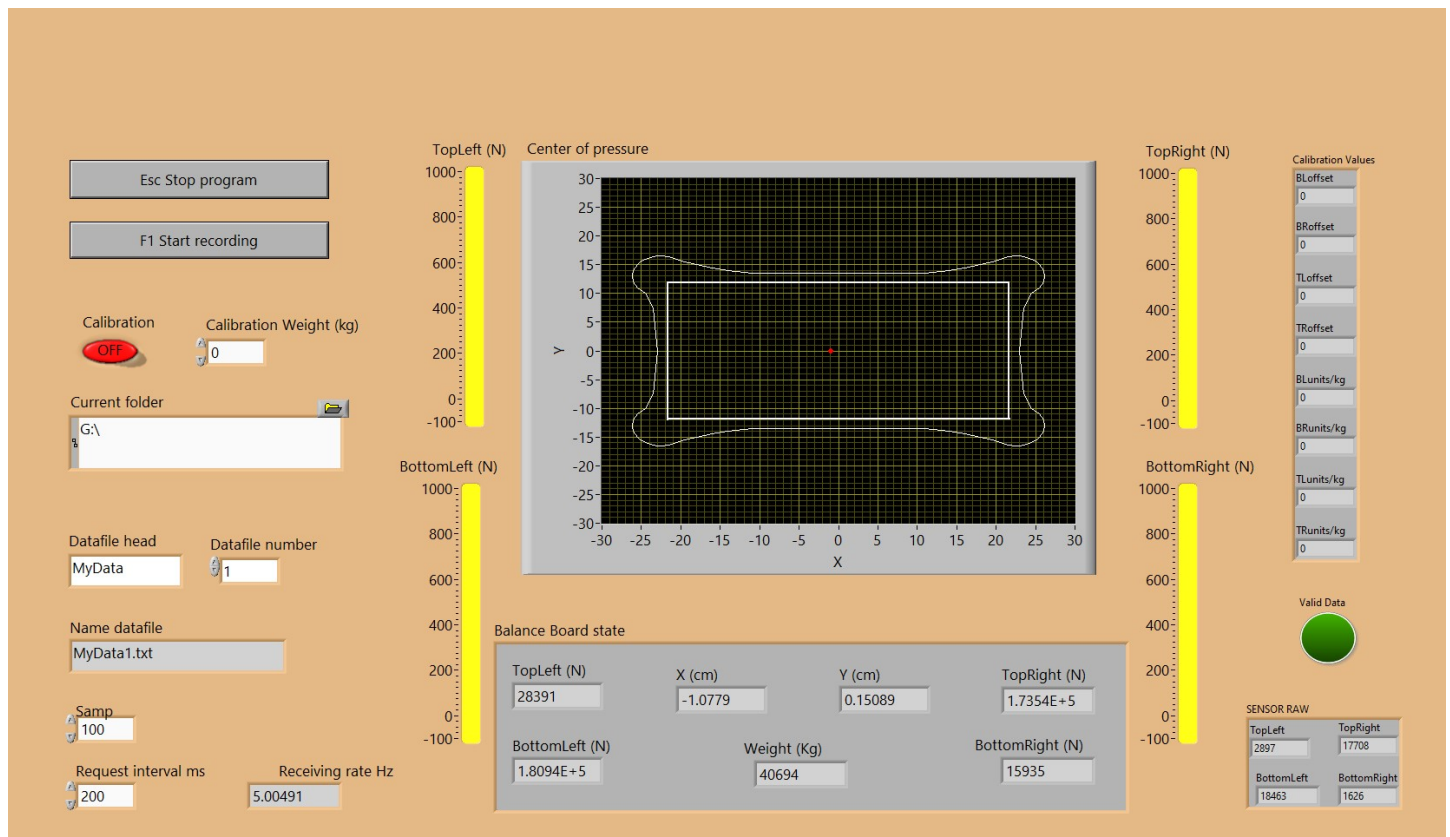
3. Wii BALANCE BOARD RECORDER SOFTWARE

3.1 INTRODUCTION

The Wii Balance Board Recorder software can be started using the Wii Balance Board Recorder shortcut on the desktop.



The initial screen will have this look:



At this point, the Wii Balance Board is not calibrated and therefore will return “random” numbers without much meaning. The changing numbers can be found at the “Receiving rate Hz”, “Balance Board state” and “SENSOR RAW” indicating the software is indeed reading data from the Wii Balance Board.

3.2 MEASUREMENT PANEL

To understand the working of this software the main screen can be divided into three sections:

3.2.1 LEFT PANEL:

Esc Stop program

This button is used to stop the program, the Esc button on the keyboard will have the same result.

F1 Start recording

Record raw values from the Balance Board as well as calculated data. These include: interval sampling time, all the values from the “Balance Board state” indication panel and the 4 values from the “SENSOR RAW” panel. Recording is starting automatically when pressing the “Calibration” button.

Calibration

Used for the calibration of the Wii Balance Board. A standard calibration procedure is done in 2 sessions. A zero weight calibration and calibration with a known weight placed (preferably measured on a calibrated weighing scale) on the Wii Balance Board. The calibration procedure is described later.

Calibration Weight (kg)

The values which can be filled in here for executing the standard calibration procedure.

Current Folder

Present folder where all recorded data is stored. The folder can be put in manually or with the use of the windows explorer browser, opened by the icon on the top right side of this input field.

Datafile head and Datafile number fields

Primary or prefix name for the file where recorded data is stored can be filled in the left field. This filename is followed by a session number from the “Datafile number” field on the right side. The “Datafile number” field is automatically updated after every recording. However, recorded datafiles can be overwritten if the same file has been used more than once.

Name datafile

The entire recording file name as the combination of the “Datafile head” and “Datafile number” fields.

Samp

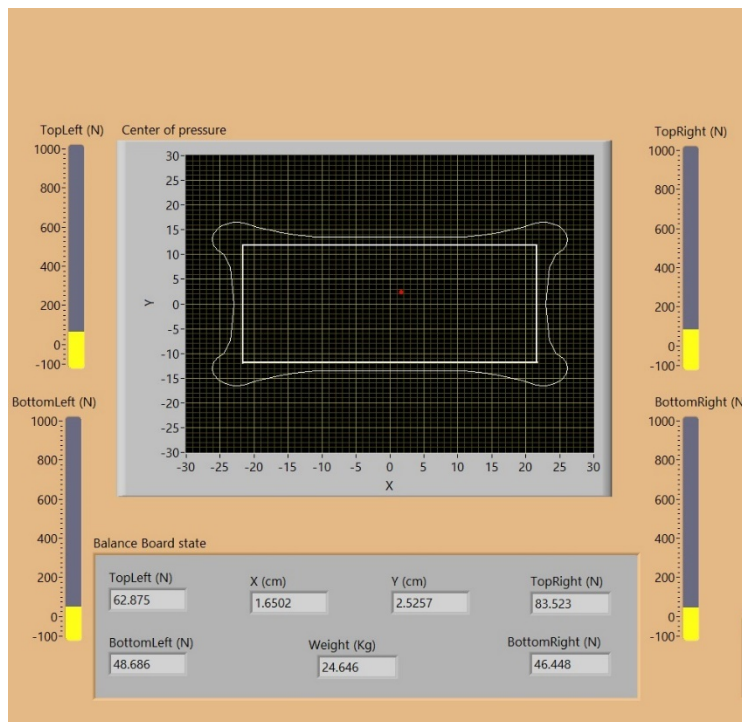
Number of samples taken when executing a calibration. This figure can be manually adjusted.

Request interval ms and Receiving rate Hz fields

The left field determines the requested update rate for the Wii Balance Board to send data to the recording software. An interval of e.g. 200 ms will result in an update of $1/200\text{ms} = 5$ samples per second. The indicator on the right will show the actual number of samples per second possible. It is advised not to push the sample interval below 50 ms to prevent double recorded results because the Balance Board can not keep up with the requested speed rate.

In combination with the **Samp** field it determines the total time a calibration will take place. With 100 samples and an interval time of 200 ms, the total calibration time per session will take $100 \times 200\text{ms} = 20$ seconds.

3.2.2.CENTER PANEL:



Center of pressure panel

This central panel will show the operator the actual dynamic behavior of the participant on the Wii Balance Board. Within the outline of the board, the red dot shows the central point of pressure of balance of the participant at any position in time. Scales run from +/- 30 cm on either side of the central cross point of the Balance Board.

It has to be noted that the orientation of the board is with the blinking on/off switch towards the participant when stepping on to the Balance Board and therefore behind when the participant has stepped on the board.

TopLeft (N)

Force meter in Newtons showing the amount of pressure measured on the sensor on the top left side corner of the Balance Board outline in the Center Panel. If for the participant the blinking on/off switch is on the front side, this will be the back-left side corner of the board.

TopRight (N)

Force meter in Newtons showing the amount of pressure measured on the sensor on the top right side corner of the Balance Board, the back-right corner of the board.

BottomLeft (N)

Force meter in Newtons showing the amount of pressure measured on the sensor on the bottom left side corner of the Balance Board, the front-left corner of the board.

BottomRight (N)

Force meter in Newtons showing the amount of pressure measured on the sensor on the bottom right side corner of the Balance Board, the front-right corner of the board.

The above force meters above will dynamically change when the participant is moving on the Wii Balance Board.

Balance Board state panel

On this panel, the readings from the above force meters are shown as well as the (combined) measured weight of the participant. Also the center point of pressure (red dot) is expressed in a deviation from the central cross point on the board in cm.

As can be seen on the panel there is some fluctuation on the readings, the “noise” of reading the values of individual and combined signals from the four sensors. With more pressure applied on the Balance Board, this noise will reduce compared to the overall weight.

With 0 N of pressure the center of pressure red dot will run randomly on the sensor noise.

When the Wii Balance Board is not calibrated, all figures on this center panel will give random results, the force meters will run to or almost to maximum level. Only AFTER calibration figures on the Center Panel will present valid values.

3.2.3 RIGHT PANEL:



From the operators point of view this is the least interesting panel, but it will still show some significant information.

Starting from the bottom:

SENSOR RAW

Values in this panel show the raw data from the four sensors of the Wii Balance Board. On its own, these numbers mean nothing when a calibration of the board is not done. From the program point of view it needs 2 sets of information:

- 1) the “zero” number of a sensor when no pressure is applied to the board, this is the offset value of the sensor at 0 kg..
- 2) The “gain” value of each sensor, this is the value the sensor reading will change per kg (or N) or multitude of these numbers. Gain is referred to as units(reading value) per kg.

Calibration to the board is done to obtain the above values “zero” and “gain”.

Calibration Values

This panel will show the result of the Wii Balance Board calibrations. When still uncalibrated, all values will be “0”.

Once the Balance Board is calibrated, the top four numbers will present the “zero” numbers or offset of any of the four sensors. The four numbers below will present the “gain” value of each

sensor in units/kg.

Values of “zero” and “gain” are sensor dependent, and no sensor equals another sensor. “Zero” ranges therefore can differ a lot from each other. From experience “gain” values will be around the range of 70-130 units/kg, any value outside this range should be regarded suspicious. Recalibrating may fix this issue. The higher this last value, the better the sensor resolution.

Valid Data

This indicator will flash from green to red when the update reading rate becomes too high. This will happen when two consecutive readings will give the same result. Update rate can be adjusted with the “Request interval ms” from the left panel.

4. MEASUREMENTS

4.1 CALIBRATION PROCEDURE

Prior to take any measurements with the Wii Balance Board, this system has to be calibrated.

Calibration is done in two measurements sessions:

- Session 1: “Zero” level calibration
- Session 2: “Gain” level calibration

Always start with the “zero” calibration first, since the “Gain” level calibration depends on the “zero” calibration.

Session 1: “Zero” level calibration

1. Choose in the left panel the “Current folder” where the calibration datafiles will be stored.
2. Next, choose in “Datafile head” your preferred filename for the calibration file.
3. Make sure the Datafile number start with 1. The resulting filename is displayed in “Name datafile”.
4. Choose in “Samp” the amount of samples you want take for your calibration. Standard value is 100.
5. Choose an interval rate in “Request interval ms” . Standard value is 200 ms, the overall calibration time will be $100 \times 200 \text{ms} = 20 \text{ sec}$.
6. Remove any weight from the Balance Board or any other obstacles which might influence the measurement.
7. Press the “Calibration” button, which will turn green while measuring. Also the “F1 Start recording” button will turn yellow, indicating that calibration data is stored in the predefined file. During the “zero” calibration measurement all numbers in the center part of the panel will freeze to 0 until completed.
8. After the “Calibration” button is switched back to red, the “zero” calibration is completed. Notice on the right panel the first 4 offset indicators of the “Calibration Values” panel are now determined.

Session 2: “Gain” level calibration

Continue now with the “gain” calibration. For this calibration a piece of dead weight is needed as a calibration weight with a well-known value in kg. This dead weight is to be placed in the exact center of the Wii Balance Board, at the center crossing lines. This is of most importance and it is advised to use a ruler to make sure the distance from the weight to the side of the board is the same to the opposite side.

PLEASE BE ADVISED: A PARTICIPANT CANNOT BE USED AS A CALIBRATION WEIGHT!!

Even with an accurate knowledge of a participants weight, putting the central point of weight of a participant in the exact center of the Balance Board during an entire calibration measurement is almost impossible, making the calibration unreliable to use in measurements to follow.

A lifting weight can be used as a reliable dead weight, as long it is first weighted on a scale with a resolution of at least 100 gr. Using multiple weights, each measured with a reliable weight value, is advised: The more calibration weight is used, the more accurate the calibration will be. The maximum weight which can be used is 150 kg.

1. Place the calibration weight in the exact center of the Wii Balance Board, use the central cross lines as reference and use a ruler to put the calibration weight in the exact position.
2. Fill in the used calibration weight in “Calibration Weight (kg)” in the left panel.
3. Check the “Name datafile”, the name should have an updated session number, 2.
4. Leave the “Samp” and “Request interval ms” at the values which were used before in the “zero” calibration.
5. Press the “Calibration” button, which will turn green while measuring. Also the “F1 Start recording” button will turn yellow, indicating that calibration data is stored in the predefined file. During the “gain” calibration measurement all numbers in the center part of the panel will freeze to 0 until completed.
6. After the “Calibration” button is switched back to red, the “gain” calibration is completed. Notice on the right panel the last 4 offset indicators (units/kg) of the “Calibration Values” panel are now determined. Check if these values are within the range of 70-130. If this is not the case, you may solve this issue by any of the following: Repeating the calibration procedure, reconnect the Wii Balance Board, change batteries or replace the

Wii Balance Board unit completely if this problem persists.

4.2 MEASUREMENT PROCEDURE

After completing the calibration procedure the Wii Balance Board is ready for use in the collection of data. To make sure if the Wii Balance Board is working properly:

- Ask a participant to step on the Wii Balance Board and check if the bodyweight (Wii Balance Board state panel) matches the bodyweight from a weighing scale, there will be some noise on the values.
- Let the participant lean forward, to the left, backwards and to the right and follow the movements of the red dot in the “Center of pressure” panel in the same directions.

Apart from the specific research methodology all measurements will start similar within the software.

Starting the first measurement:

1. Check if the “Current Folder” is correct for storing the recording data.
2. (Re)define the “Datafile head” filename to a recognizable measurement file and put the “Datafile number” to 1
3. Choose which sample frequency is used for the recordings. In human movement, it would be advised to take a sample frequency of at least 20 Hz, but preferably higher. Please refer to recommendations by the ISGPR before deciding which sample frequency to use.

Then for all measurements:

1. Let the participant take position for the exercise
2. Press “F1” or the “F1 Start recording” button to start the measurement and the exercise.
3. Monitor the results in the “Balance Board state” and continue until the exercise is completed.
4. Press “F1” or the “F1 Stop recording” button to stop the recording.

After the first measurement taken, check your data file for valid results. The recorded file is a Tab delimited datafile which can be easily imported in programs like Microsoft Excell.

The results of a recorded file will have the following format:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Time	CpX	CpY	BottomLeft	BottomRight	TopLeft	TopRight	Weight	RAWBottomLeft	RAWBottomRight	RAWTopLeft	RAWTopRight		
2	0.004	-3.245	-2.14	57.334	53.25	50.446	26.43	19.129	19005	2213	3427	17983		
3	0.193	-3.341	-2.022	57.025	52.408	50.945	26.694	19.089	19002	2204	3432	17986		
4	0.392	-3.215	-2.062	56.921	52.969	50.646	26.782	19.114	19001	2210	3429	17987		
5	0.591	-3.311	-2.055	57.747	52.501	50.646	27.135	19.187	19009	2205	3429	17991		
6	0.793	-3.268	-2.045	56.715	52.595	50.646	26.606	19.037	18999	2206	3429	17985		
7	0.992	-3.304	-2.084	57.541	53.063	50.945	26.694	19.208	19007	2211	3432	17986		
8	1.191	-3.32	-2.04	58.264	53.063	51.344	27.4	19.395	19014	2211	3436	17994		
9														
10														

Time

Time interval (starting from 0) when a measurement was taken. Between A3 and A2 the interval is approximately 200 ms according to the standard value of “Request interval ms”.

CpX and CpY

Deviation in cm in X and Y direction from the Center Point of pressure. These are the X (cm) and Y (cm) values of the “Balance Board state” panel.

BottomLeft, BottomRight, TopLeft and TopRight

Values in Newton of the similar indicators of the “Balance Board state” panel.

Weight

Values of the recorded Weight in kilograms (kg).

RAWBottomLeft, RAWBottomRight, RAWTopLeft, RAWTopRight

Recorded values of the SENSOR RAW panel.

Continue recording all exercises until completed, then use the “Esc Stop program” to exit the recording program.