TECHNICAL SOLUTION PROPOSAL **INTERNAL FILE NO.: A2020-016**

Title: **„Haptic feedback for UIs based on actuator build from flexible PCB “**

Company Unit: **Diehl AKO Stiftung & Co. KG**

Description:

Haptic feedback for UIs based on actuator build from flexible PCB

A flexible PCB is able to bend and twist (in limited range). An actuator is designed as a coil (build in the flexible PCB) which can move in a magnetic field. A magnetic field can be induced with a strong magnet or another coil built-in the same or another PCB. A movement of the flexible PCB is utilized to create a knocking effect by hitting the flexile part on rigid one.

This invention simplifies getting a haptic feedback from the device by using less additional actuators known as ERM (Eccentric Rotating Mass) or LRA (Linear Resonant Actuators). This invention describes the implementation of an actuator inside the PCB by using a flexible PCB.

Up to now actuators are built in different ways. To get a haptic feedback additional components have to be located in the appliance. Physical elements (actuators, motors) to be assembled to the PCB or inside the device.

Examples of devices with haptic feedback are disclosed at:
- D. Parisi, 2018, Tactile temporalities: The impossible promise of increasing efficiency and eliminating delay through haptic media
- https://www.precisionmicrodrives.com/vibration-motors/linear-resonant-actuators-lras/
- https://www.precisionmicrodrives.com/vibration-motors/
- There is a channel on YouTube presenting similar actuators but they are not used in an appliance nor a market solution
https://www.youtube.com/channel/UCdxTCCRnQgfi2vr2fZupYIQ

Using magnetic field induced in in-flex-PCB coil a part of the flex PCB is moving. Using that move creates a knocking effect by hitting one part of flexible PCB to another. An alternative solution is the usage of a piece of metal ball/magnet, which moves in the magnetic field created by the print on the PCB coil. Moving the metal/magnet hits the surface of the PCB or a part of the housing in which it is enclosed.

No additional elements on the PCB nor an additional device is needed (except metal ball/magnet as moving part in one variant of the solution).

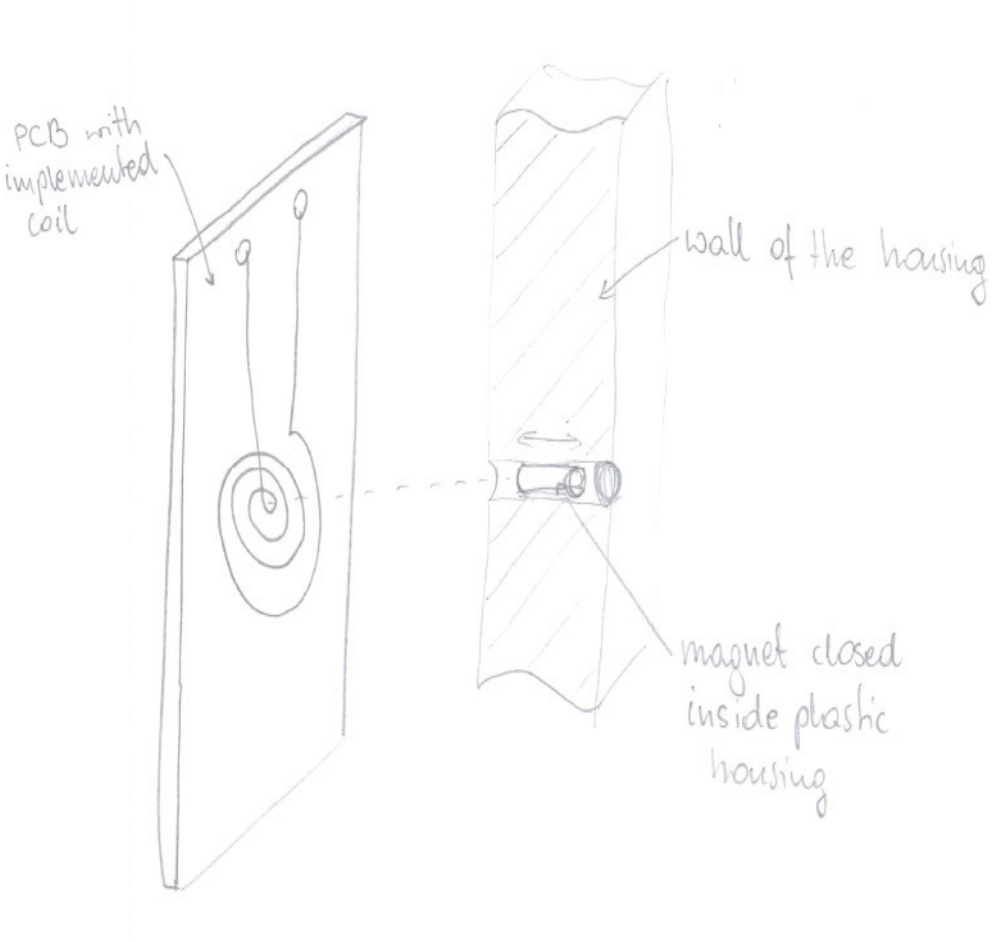
Using a (flexible) PCB with an included coil is easier to achieve haptic feedback with less external elements. Moving parts (like metal ball/magnet) are enclosed directly in the device housing.

A flexible PCB is able to bend and twist (in limited range). An actuator is designed as a coil (build in the flexible PCB) which can move in a magnetic field. A magnetic field can be induced with a strong magnet or another coil built-in the same or another PCB. A movement of the flexible PCB is utilized to create a knocking effect by hitting the flexile part on rigid one. (see the idea https://www.youtube.com/watch?v=c0Wh9mZckWY).

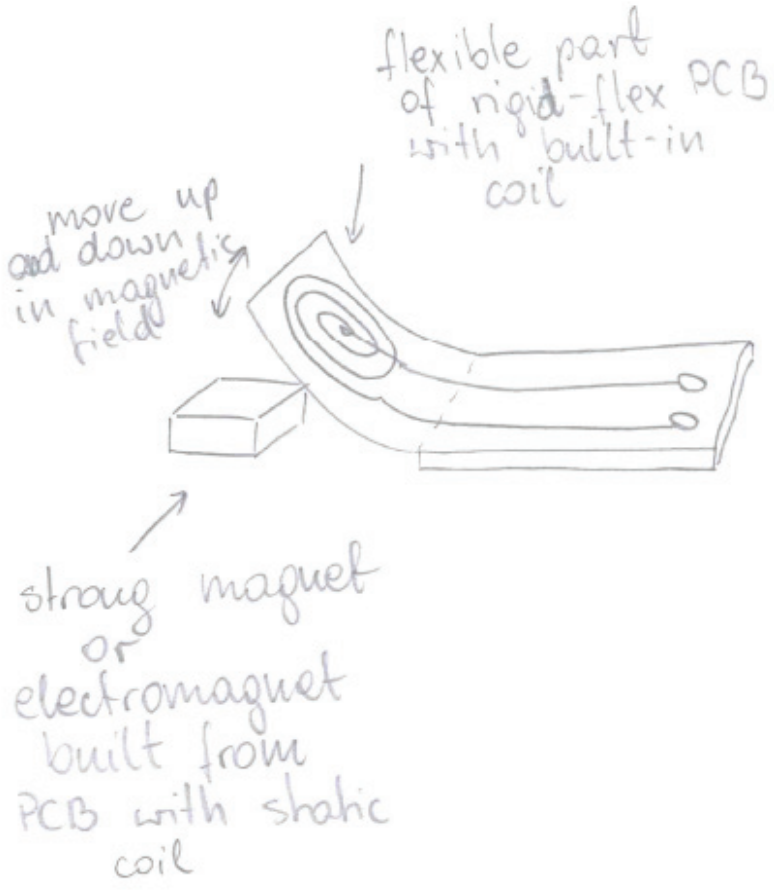
Another possibility is to enclose a little magnet in a plastic housing. The plastic housing can be assembled to the PCB on which a coil is implemented. The supplied coil generates a magnetic field, which can move the little magnet. A knocking effect is created by hitting the magnet on the plastic or the PCB. As plastic housing the housing of whole electronics can be used. (see https://www.youtube.com/watch?v=EHN8Wx2BKkM).

An appropriate design of coils have to be developed. Calculations of current flow in the coil and the strength of the magnetic field has to be done.

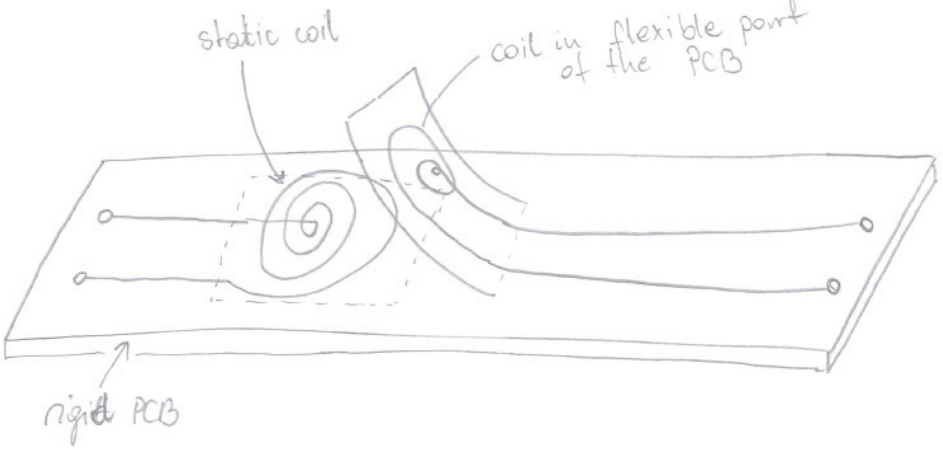
Drawing:


PCB with implemented coil
wall of the housing
magnet closed inside plastic housing

Sketch 1


flexible part of rigid-flex PCB with built-in coil
move up and down in magnetic field
strong magnet or electromagnet built from PCB with static coil

Sketch 2



Teaser-Text/Abstract

This invention simplifies getting a haptic feedback from the device by using less additional actuators known as ERM (Eccentric Rotating Mass) or LRA (Linear Resonant Actuators). As an actuator a coil integrated in a flexible PCB is used. In said coil a magnetic field is induced being created by a magnet or another coil. Due to a magnetic force the flexible PCB is bend and the flexible part moves towards a rigid component until the flexile part pounces on the rigid component. At the same moment the flexile part pounces on the rigid component a knocking effect is created and a haptic feedback occurs in the end.