

# Nx10 BrainCharge

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June 28, 2024

## Abstract

The following is an information document presenting the basis and methodology behind Nx10's BrainCharge (BC). The document outlines the the specific Touchscreen, Accelerometer, and Gyroscope (TAG) data Nx10 intends to retrieve for inputs, and proposes methods of analysis supported by precedent in the pre-existing literature in order to correlate observable physical data to the user's affective state and extract real-time insight. The process of testing and validation of the BC is discussed as well as potential applications of BC technology in both the short-term and long-term. This document builds on the previous information document for Nx10's Game Behaviour Index (G.B.I.) and expands on how G.B.I. is adapted for BC, recommended as a supplementary reading for understanding the following document.

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## 1 Introduction

Touchscreen, Accelerometer, and Gyroscope collectively referred to as (TAG) data recorded by sensors in modern mobile phones have been shown to be indicative, through extraction by various statistical and Machine Learning (ML) methods, of a user's *affective state* [2, 3, 12]. For this document, an affective state is an emotional state which results in an externally exhibited response, such as an individual tapping their touchscreen faster when they are experiencing heightened frustration. An accelerometer measures linear acceleration along the axis of the phone's internal coordinate system which allows detection of the phone's direction and speed of movement through space [?]. Hence, an accelerometer can record tremors or shaking which can be particularly insightful into emotional states such as anxiety or frustration. A gyroscope measures rotation by recording the orientation and angular velocity of the phone around the  $X$ ,  $Y$ , and  $Z$  axes. Touchscreen sensors can record how thick and straight a stroke is, as well as the speed and patterns of tapping keys which is classed under *Keyboard Dynamics*, which similarly can reveal a user's level of frustration or anxiety.

Nx10's Game Behaviour Index (G.B.I.) is a measure which infers the temporaneous affective state of a user in real-time from their TAG data. The relevant TAG data is bucketed into 3 levels of intensity or *arousal*, and aligned to the relevant axes of the *Affect Cube*, discussed in Section 4. Nx10's document on G.B.I. is strongly recommended as background reading for the following content.