



Coercion Resistant Authentication Systems (CRAS) using Physiological Responses to Chill Music

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Abstract

Current text-based authentication systems cannot withstand the situation where the user is forced to release the password under hostile circumstances. Addressing such situations warrants Coercion Resistant Authentication Systems (CRAS), which do not allow authentication under significant pressure, cannot be explained to others, and are resistant to brute-force attacks. In our research, we discuss a specific implementation of CRAS utilizing physiological responses to “Chill” music as an authenticating factor. Our preliminary analysis using an existing dataset shows the potency of the musical “Chill” effect as a unique authenticating factor for CRAS.

Motivation

- Current authentication systems cannot differentiate between users who are in a normal state and those who are being coerced.
- Bank vaults, airplane cockpits, businesses’ confidential customer information, hospitals, and confidential government and military documents require enhanced protection which cannot always be guaranteed by existing authentication mechanisms.
- CRAS can be useful in such situations, which do not allow authentication under pressure, cannot be communicated to others and also can withstand brute-force attack.

“Chill” Music

- “Chills” [1] are often described as “shivers down the spine” and cause a unique physiological reaction when listening to highly pleasurable music.
- The “Chill” response is due to a physical release of Dopamine, an important neurochemical.
- Not all music creates a Dopamine release and the same music does not necessarily create a Dopamine release in two different people [3].

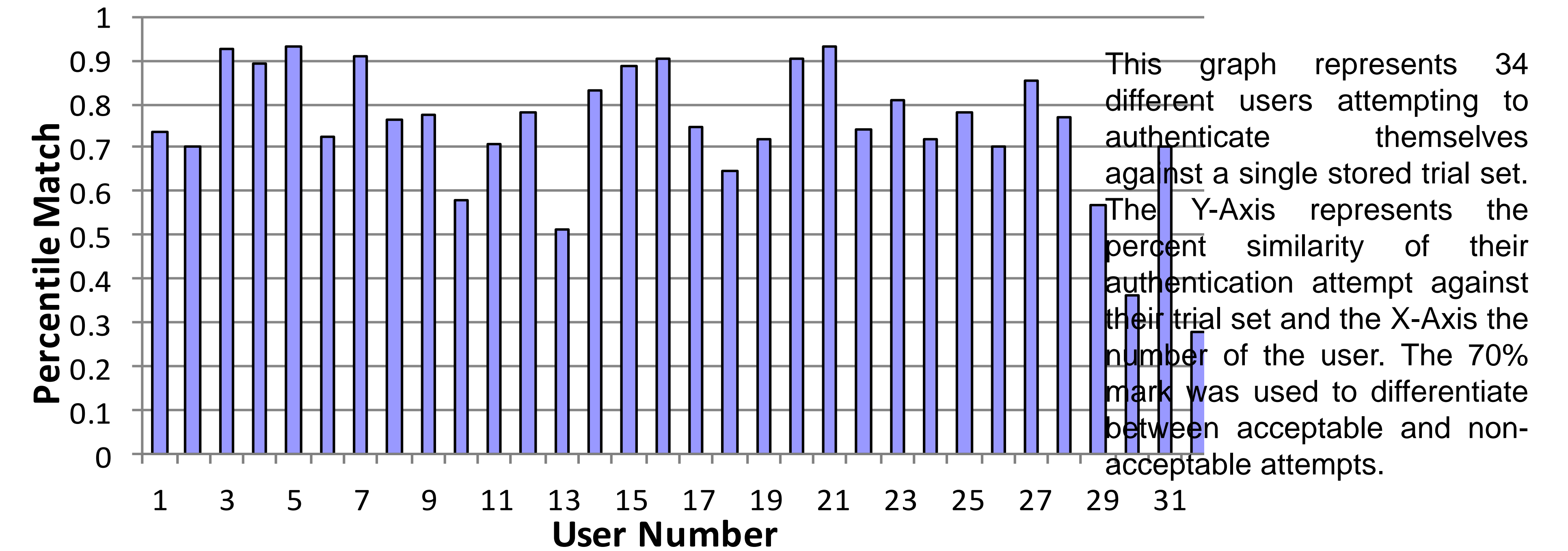
Hypothesis

- A person’s physiological responses while listening to highly pleasurable music (“Chill” music) can be used to consistently authenticate themselves under normal conditions and will fail to allow authentication if they are under significant pressure initiated by coercion.
- Since the degree in which each piece of music stimulates a Dopamine release is different depending on the person, each piece of music will affect a subject uniquely, allowing for their “Chill” music to act as a key in order to stimulate a certain physiological response.

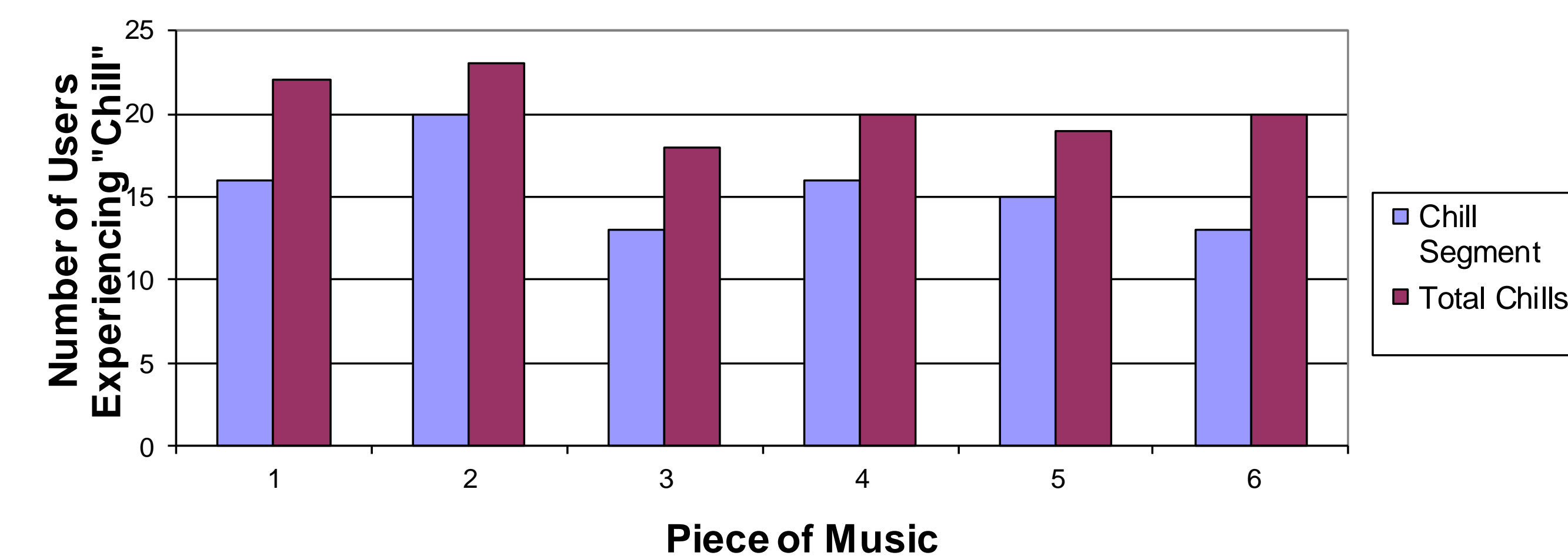
Preliminary Results

- Our preliminary analysis using the “Chill” music dataset [4] has shown that approximately 83% of users who listen to a piece of “Chill” music can positively authenticate themselves with only one stored sample of their physiological responses.
- Approximately 8% of different users exhibited similarly significant physiological responses to a piece of “Chill” music compared to a given user.
- Approximately 20% of users exhibited similarly significant physiological responses to different pieces of “Chill” music.

Matching Physiological Responses to “Chill” Music

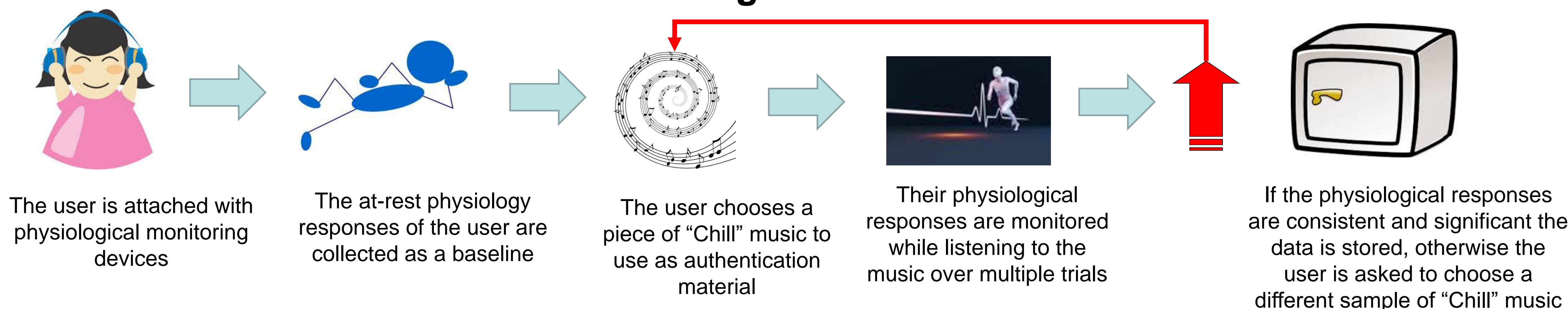


Number of “Chills” per Segment

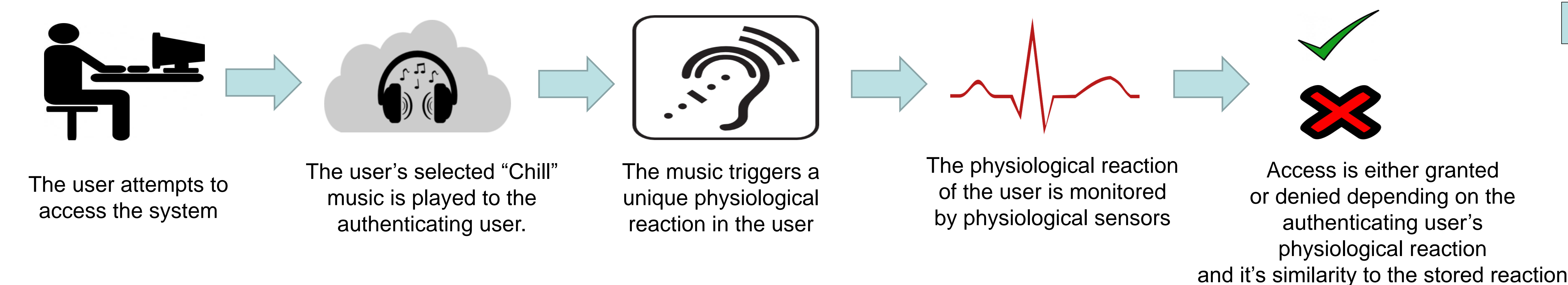


Overview of Proposed CRAS

Registration



Authentication



Conclusion & Future Work

- Our preliminary analysis shows that physiological responses to “Chill” music has unique features useful for CRAS.
- We are working on investigating the time-decay of a user’s response to a piece of “Chill” music.
- We have analyzed that approximately 76% of the “Chill” responses induced by our “Chill” music occurred during similar time intervals.
- Given this, we plan to investigate the features in these pieces of music which are more likely to induce a “Chill” response, and possibly utilize them in the future to select pieces of music which will have a high probability of inducing a significant “Chill” response for any given user.

References

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 [4] Oliver Grewe, Reinhard Kopiez, and Eckart Altenmüller, The Chill Parameter: Goose Bumps and Shivers as Promising Measures in Emotion Research, *Music Perception: An Interdisciplinary Journal*, Vol. 27, No. 1 (September 2009), pp. 61-74
 [5] K.R. Scherer. What are emotions? And how can they be measured, *Social Science Information*, vol. 44, no. 4, pp. 695-729, 2005.