Exploration of Vibration Patterns as a means of Effective Communication

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ABSTRACT

Communicating effectively with someone who might be in the middle of another task like in a work environment has always been challenging. There is an obligation at the receptor's end to not hinder the proceedings of his surroundings through any form of interruption. Our project explores the effectiveness of different vibration patterns whenever there is a need to establish a communication in such a scenario. Also, through the use of a band, it explores the effects of variations in vibration patterns generated by different time intervals between vibrations and different surface areas (achieved through multiple points of contact with the vibrating surface). Towards the end, the result based on the user study summarizes the overall effectiveness of these vibration patterns as a non-disturbing medium of communication in different contexts.

Keywords: Effective Communication, Non-Disturbing, Vibration patterns, Discrete, Tangible User Interaction.

INTRODUCTION

Establishing a communication with someone becomes challenging especially when the receptor might be in an environment where it is not easy to respond back owing to various factors. A situation like a meeting [1] for example, wherein it is not possible for the person on the receiving end to revert back to someone trying to communicate from outside without disturbing the proceedings of the meeting or interrupting the work. A phone call or a message in the above situation for instance presents a gap in effective communication in a work environment. What makes it even more challenging is that not all incoming communications are of equal importance. As such, it becomes imperative to come up with a mechanism that could help in the effective communication in such a scenario.

There a lot of devices [2.3.4] today which keep us on the go every moment and there are various mechanisms [5] in which these devices interact with us. Vibrations as a means of feedback have been used for a long time now [6]. Explorations have been made

at imparting urgent communication and it has been established that to effectively impart the level of urgency, the design should be minimal and simple [7].

INITIAL EXPLORATIONS AND FINALIZING DOMAIN

The domain of Tangible User Interaction provides with a plethora of interesting segments that can be tapped upon to establish an interaction in an attempt to communicate. Over the years, the research on tangible bits [9,10] has seen a tremendous scope. With Internet of things [11] and newer seamless interactions that the domain of human Computer Interaction [12] is presenting, the scope has widened. However, in the context of work related environments where there is an obligation at the receptor's end to not hinder the proceedings of his surroundings, the scope narrows down and gets restricted to a select few parts of the body. Based on brainstorming, interesting domains like mild tightening or vibrations of the shoe lace, neck tie or clothes were also explored. However, when the user is already concentrating on a work, the chances of missing out on a cue like these increase a lot [13]. A thorough study of the established works reflects the high effectiveness of using vibration patterns on the wrist or the spine [8]. However, so far, the model of technology development has neglected the variations in these patterns as a means of communication.

PRELIMINARY RESEARCH

The process began with developing an understanding about work environments and the different metrics that need to be considered [1]. Since, spine related interactions might not be very ideal in a work related environment, a vibrating band attached to the wrist was chosen as the means of communicating and was further explored upon. A Collection of videos each presenting concepts related to smart wearable and seamless connectivity on the go also helped to gain insight into the experience of the users.

FIELD VISITS AND CONTEXTUAL INQUIRY

Because of ease of access to study users from work environments and also from personal experiences of most of the people for meetings being one of the work environment scenario fit for our exploration, we restricted ourselves to the same. Contextual inquiry was conducted in the form of interviews with business professionals and professors in the Indian Institute of Technology Guwahati. Diary entries and observations were made from various meetings to outline the parameters relevant to our case further and for developing a deeper understanding of the particular section of user group accustomed to meeting related situations.

COMPETITOR ANALYSIS

Past work in the field has concentrated upon the use of vibrations to establish communication. Products like Feeltact [14] allows to send messages simply by pressing buttons and to receive information playing on intensity, duration and rhythm of latest generation vibrations. Here there is even vibration throughout the wrist and increasing the intensity may cause discomfort to the user. Some of the products like Activibe [15] have vibrotactile displays, but such kind of things may create disturbance to colleagues working in the same workspace along with you. However, there has been a negligible amount of research dealing with the variations in surface area in contact with a vibrating surface and their effectiveness. Our work is an attempt at bridging the same gap.

SOLUTION

This project tries to meet the rising demand of an effective communication with the external world (outside the premises of immediate vicinity) at times of work, in order to capitalize on work productivity as well as considering the possibility of prioritizing external communication over present work. Various vibration patterns have been built upon the prior consideration of how natural human stimulus reacts to sudden external changes brought up in the working environment like emergency situations conveyed to him by his secretary in meeting (emergency context), or some dear one coming to meet him or bringing something for him (favorites context), or a random friend coming to meet or asking for help (casual context), or some business messages from other teams (business context), some salesman (subscriber context) etc.

Two important parts of the idea are the person being contacted (primary user) and his/her immediate environment of work during the proceedings (secondary users).

Though the immediate environment of work (during the proceedings) needs to be considered for not hampering the proceedings because of the vibration pattern, still our primary concern lies with the individual in consideration who needs to be effectively conveyed that an external communication effort is being made and the context it refers to.

WORKING

Considering real life situation, the flow of usage can be represented as:

1. *Individual wears the band which is in sync with his/her mobile*
2. *Mobile has been put in Silent Mode*
3. *Individual presenting his/her presentation in a meeting*
4. *Receives a call from his mother (in his/her favorites list)*

5. *The band vibrates for certain time set by the individual, with the "Clock" vibration pattern, which has been set by him/her for favorite calls.*
6. *Vibration remains invisible to other meeting members and gives a subtle clue to the individual in consideration that some dear one had called/is calling.*

Based on the above situation it becomes up to the individual whether he/she wants to pick the call/ call back later/ reply with a message or not react to it.

PROTOTYPING

Vibration motors were placed over a band in 120deg separation and different vibration patterns were generated from them by coding on Arduino platform.

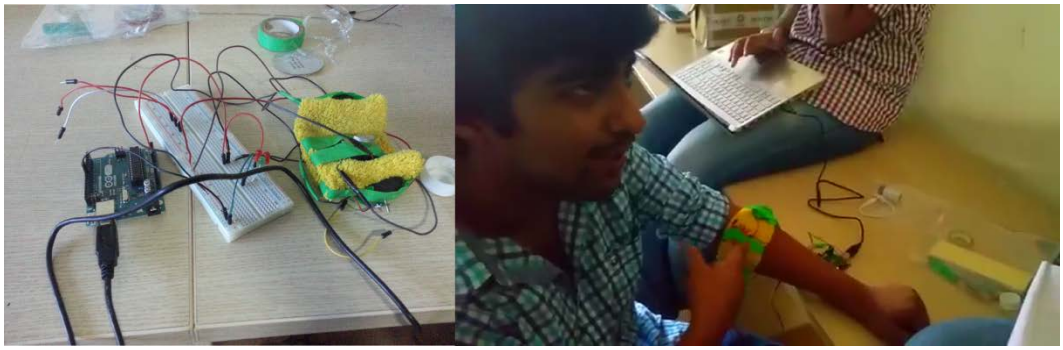

Fig. 1: Prototyping and User Testing

USER TESTING AND STATISTICAL EVALUATION

Once the prototype was created, users (sample considers only students) were tested one by one to understand several things in regard with the project:

1. *Screening the user as Novice, Intermediate and Expert based on how well versed the user was with the usage of vibration patterns (for e.g. if he/she could make out whether the vibration pattern which played in his/her pocket was a WhatsApp or a messenger notification/message.*
2. *Playing a vibration pattern sequence, which comprised of 3 vibration patterns created, being played one after the other for same intervals (4-5 times repetition) of time. Then asking them how many different vibration patterns they were able to feel.*

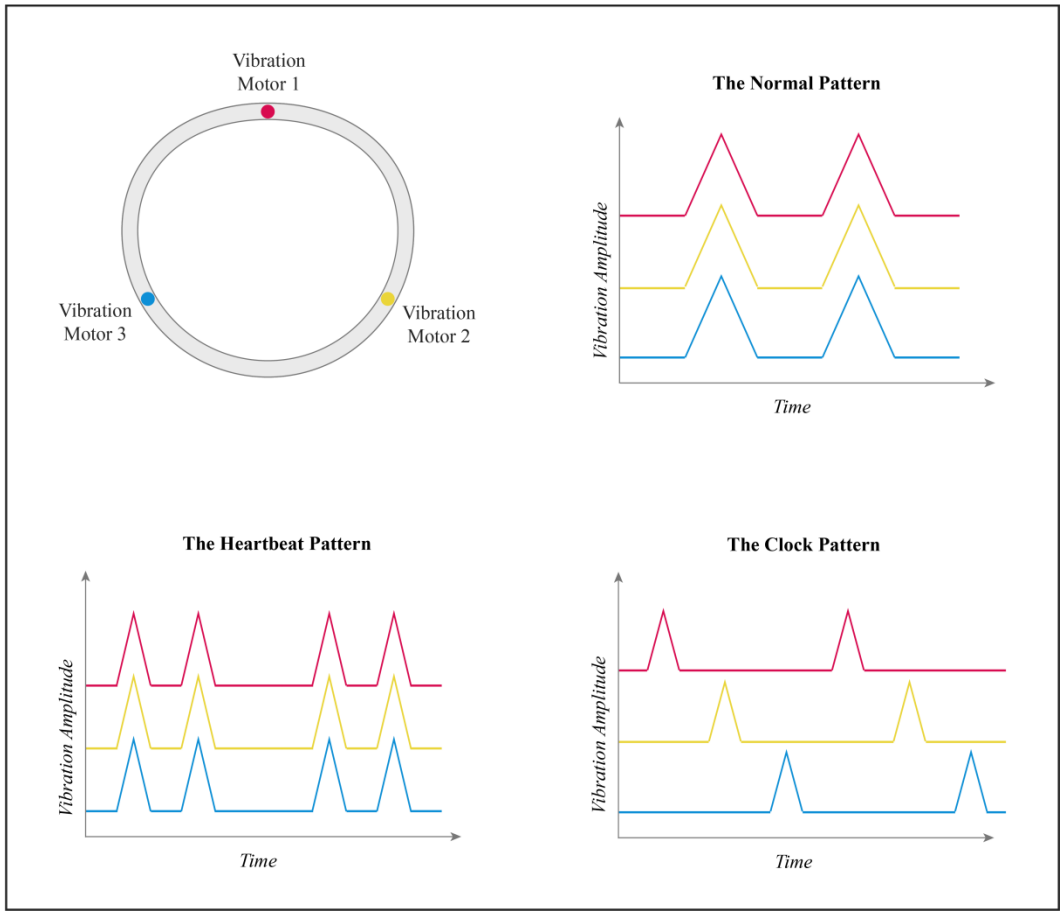

Fig. 2: Different Vibration Patterns Generated

3. *Once made familiar with different vibration patterns, the user was told to imagine the context where he/she is in a meeting and their phone is in sync with this band which plays a different vibration pattern corresponding to particular type of call (Could be a casual call, a business call, emergency call, favorites call and subscriber calls.).*
4. *Then a particular vibration pattern was played for long interval(6-7 times), after which the user had to assign what typical call did the information system*
5. *Once they set the context for a particular vibration pattern (after one hour) they are tested on how much they remember the context for a particular vibration pattern when vibration patterns are stimulated randomly.*
6. *They are again tested on how much they remember their set context a day later.*

INFERENCES

A set of 15 users was tested for statistical evaluation taken and it was found that over 75% people believed heartbeat vibration pattern to be the apt one for casual calls context, while 75% believed that favourite and emergency context is best represented by clock vibration pattern.

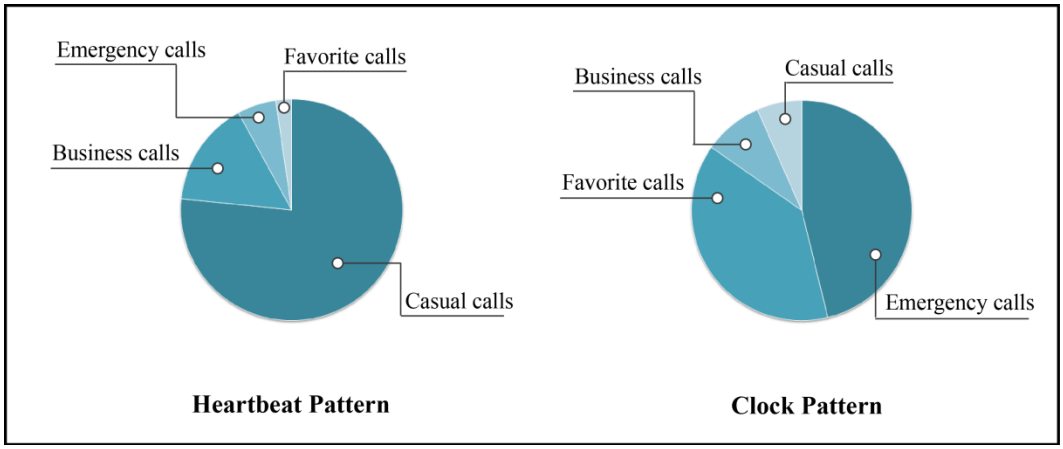

Fig. 3: Inferences from Statistical Evaluation

One more thing which marked variable surface area vibrations (Clock vibration pattern) over time interval vibrations (Heartbeat vibration pattern) was the learnability involved (Heartbeat vs Clock), where it was seen from user testing that "variable surface area vibrations" were significantly ($p<0.05$) better to indicate the learnability of a vibration pattern. This was proven on the basis that how many times mistake to remember the context for both these patterns was committed (over a roughly same count of vibration pattern being played for each) by a user.

DISCUSSION

There is a rise in situations demanding subtle, non-disturbing feedback so as to increase the work productivity. Amidst the wide plethora of feedbacks, which can be used for building such clues, the users agree upon vibrations as the most acceptable choice, however the effectiveness of vibrations as compared to other feedback systems like thermal, actuators etc. still needs to be verified. As of now the testing has been confined

to only three patterns which don't give that clear a picture of what is the scope of vibration patterns based on surface area manipulation.

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