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Designing A Brain-Computer Interface For Paralyzed Patients

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Abstract
Facial paralysis is taken as challenge for doctor to cure the patient according to their present condition. There are numerous reports available on web which are very tiresome to identify the degree of facial paralysis. Because of lacking information regarding the number of facial paralyzed patients can be cured since the data was never updated on web. The archives can be fast, organized and semi-organized. It is known that most of such images are unstructured. While there are more reports focusing on manually entry of patients record in Civil hospitals but the records are not updated anymore about recovery of facial paralysis. Based on literature in case of facial paralysis only facial picture was employed for assessing the grade of facial paralysis, no record of patient further is maintained by which there is no mention of the follow up whether that patient got recovered or not. Voluntary control of slow cortical potentials was typically the input signal for BCI control. Seven of the individuals were unable to communicate because they were in a state of complete locked-in syndrome (CLIS). Surprisingly enough, none of the BCI-employing CLIS patients were able to communicate merely by giving a yes/no answer. Whether learned brain control methods can be used by locked-in patients with the CLIS remains to be empirically determined.
Keywords: brain-computer interfaces, brain-computer communication, locked-in state

INTRODUCTION

Among brain-computer interfaces (BCI) patients, we refer to those who are almost completely paralyzed and lack much voluntary control over only a few muscles, i.e., eye movements, blinks, or lip twitches, as "locked-in state" (LIS) patients [1]. The progressive loss of primary and secondary motoneurons in ALS results in severe motor paralysis and, eventually, respiratory failure if patients do not choose for supplemental ventilation and feeding [9]. It is possible for the degeneration to progress to the point that people are admitted to the CLIS [2]. Patients used BCIs based on delayed cortical potential self-regulation during training. To find the best system for each person and to ascertain whether one BCI type performs better than another, they were exposed to a variety of BCI kinds [3].
Repeated studies have confirmed that individuals with severe motor impairment and individuals in a complete locked-in state (CLIS) are capable of using the P300-BCI, sensorimotor rhythms (SMR), or slow cortical potentials (SCP) to communicate or control a brain-computer interface (BCI) [10]. In addition, for those patients who were totally locked in on the beginning of training, we have not been able to facilitate basic communication (yes/no). These individuals might need a BCI most desperately to enhance social interaction and communication [4].

REVIEW OF LITERATURE

The "complete locked-in state" is a situation where there is completely no social interaction or communication. In brain-computer interface (BCI) research, this state is assumed to be a result of complete motor paralysis due to neurological diseases like stroke or amyotrophic lateral sclerosis (ALS) [5]. The paralysis is caused either by degeneration of motor neurons or by trauma to the cortical motor areas and pyramidal tracts. Complete locked-in syndrome (CLIS) presented in six among seven patients that also had ALS or chronic Guillain-Barré syndrome [6]. Furthermore, a vegetative state or coma might also lead patients into the CLIS due to consciousness problems. No additional patients with consciousness issues have been assessed with a BCI as of yet [11-7].

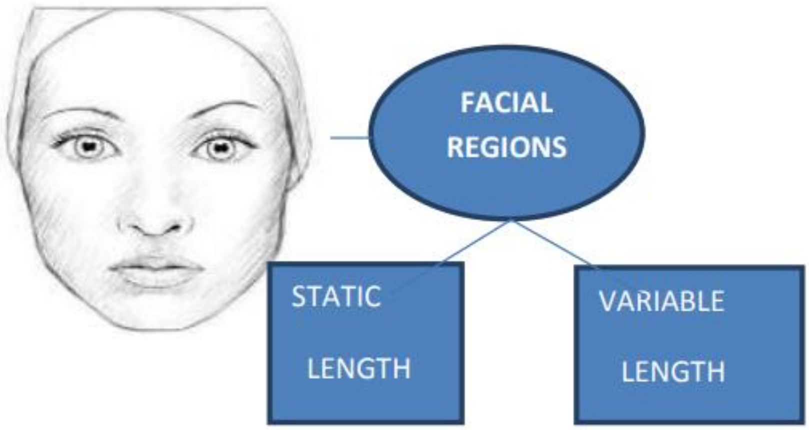


Figure 1: Face model

At the commencement of BCI training, anatomical brain scans were unavailable for any of our CLIS patients. Typically, brain scanning is not feasible for patients on artificial ventilation. Standard neuropsychological assessments cannot evaluate cognitive function in these patients, as they are inherently unable to respond [8].

MATERIALS AND METHODS

The BCI training was according to the Ethical Review Board of the Medical Faculty of the University of Tübingen, Germany. Patients were categorized as having a light degree of handicap if they had only slight impairments in their capability to move their limbs and speak normally. The moderately impaired category consists of patients with limited limb mobility who are wheelchair-bound but have normal speech or intact limb functioning but no speech (e.g., bulbar form ALS, which primarily affects speech and swallowing). Patients were considered to be greatly handicapped if they had restricted speech and were practically tetraplegic. LIS and CLIS were assigned to the fourth and fifth categories, respectively. In this investigation, every patient who used a BCI intended for communication was included. [12].

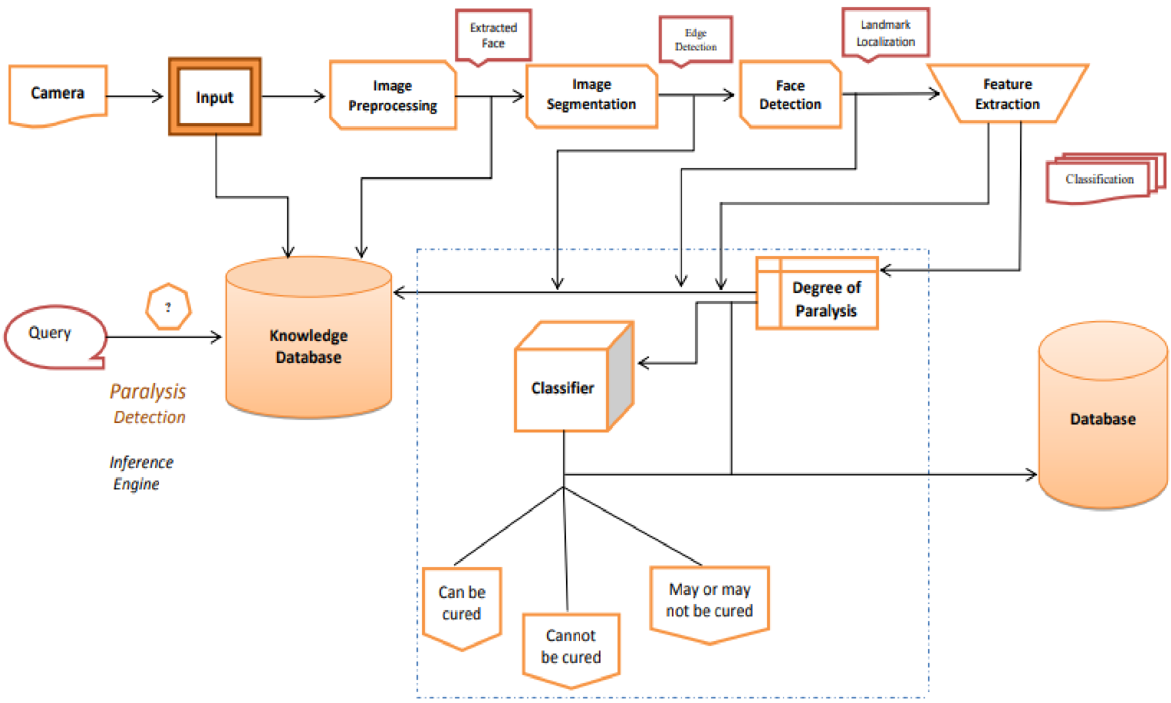


Figure 2: System flow

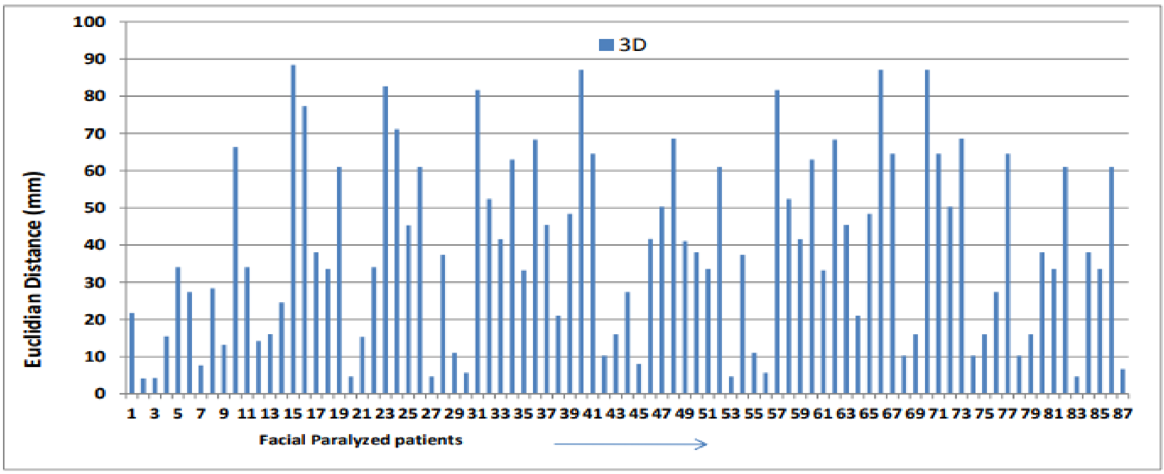
Polarity that is negative Prolonged intracortical or thalamocortical stimulation of cortical layers results in sluggish cortical potentials, which show that large groups of apical dendrites in pyramidal neurons are depolarizing at the same time. In areas related to motor or cognitive tasks, such depolarization enables neuronal firing by reducing the threshold of cortical cell assemblies to excitation. To enable SCP amplitude regulation, patients are presented with two targets on a screen, one at the top and one at the bottom. Continuous feedback is provided through cursor movement on a computer display during discrete trials. The cursor moves toward the upper target when the SCP amplitude is negative, and toward the lower target when the SCP amplitude is positive, relative to a baseline set at the beginning of each trial. Patients are urged to mimic successful techniques and see how the cursor moves in connection to their thoughts. Over the course of weeks, months, or even years, a total of 25 patients used a SCP-based brain-computer interface (BCI) and participated in training sessions that ranged from two to several hundred.

RESULT AND DISCUSSION

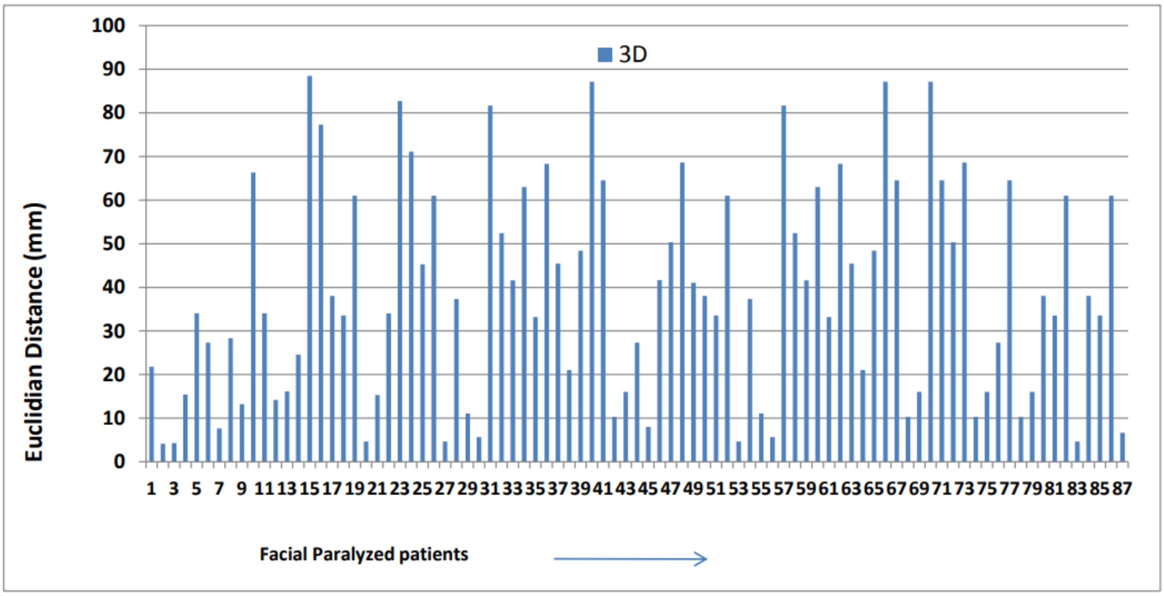
Averaged EEG analyses from several trials are shown on the right, while three different types of Brain-Computer Interface (BCI) are depicted on the left. Targets are placed in the upper or lower right corner of the screen, while the SMR-BCI is displayed at the top [13]. The objective for patients is to move the pointer toward the target.

Figure 3: Input data

Movement of the cursor is depicted by squares; a single square is displayed when the amplitude of the SMR is being feedbacked [14]. The P300-BCI is shown in the middle, with a 6x6 letter matrix of randomly flashing rows and columns highlighted by an illuminated row. The EEG target and non-target letter signals during the copy spelling mode are quite different.



(a)



(b)

Figure 4: Graphical representation of evaluation

. The gray bar is the baseline that is recorded before each trial. The job is presented at -2 seconds, a baseline recording is made at 500ms, and cursor movement starts at 0 seconds. The patient has learnt to manage the SCP amplitude, as seen by the distinct shifts in the positive and negative SCP amplitude [15].

CONCLUSION

Patients varied in how often they attended training sessions and how long they participated. One theory is that, especially in the early stages of training, performance can be correlated with the number of sessions attended. In line with previous research, there was a persistent performance level amongst the patients up to the initial 10-20 sessions and the implication that there was acquisition in the beginning stages of the training. Yet considering the small number of participants involved, it cannot be concluded confidently whether such carry-over effects actually existed.

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