



OPTIMI

Online Predictive Tools for Intervention in Mental Illness

Mental disease is one of the greatest personal, societal and economic problems of the modern world. While millions suffer, health services struggle to keep up. In the EU, mental disease is responsible for over a third of total healthcare costs; the costs in terms of lost productivity are probably higher. The most common of all mental disorders is Depression. Depression causes immense individual and family suffering, in many cases leading to suicide. The goal of **OPTIMI** is to contribute to the prevention of this devastating disease.

Objectives of the project

Currently the main treatments for depression are drugs and evidence based Cognitive Behavioural Therapy (CBT). Clinicians have few options for prevention; the only available diagnostic tools for early diagnosis or for measuring the effectiveness of interventions, are standardized inventories. **OPTIMI** aims to improve this situation.

Depression is often associated with poor coping behavior in the face of stress. Some individuals are extremely resilient but others find it difficult to cope. Based on these premises, the goals of **OPTIMI** are to:

- Develop monitoring and datamining technologies to detect early signs of stress, poor coping and depression
- Conduct calibration trials in three countries
- Analyze the results of the calibration trials with the data-mining system
- Identify measurements providing effective prediction of stress, poor coping and depression
- Design and implement a wearable sensor system to provide these measurements 24/7
- Develop a rule based engine providing automated diagnosis based on measurements from the sensor system
- Integrate this engine and the sensor system with two existing online systems for CBT therapy
- Test the integrated system in “treatment trials” in three countries
- Measure the viability, user acceptability and effectiveness of the system in the diagnosis and prevention of depression

Project Description

One of the key causes of depression is the inability to cope in the face of severe stress. Some people, it appears, can cope with stress very well; others much less so. **OPTIMI** has thus set itself two goals. First, the project is developing new tools to monitor good and bad coping behavior; second, it will develop online interventions to improve these behaviors and cut the risk of depression.

To achieve its first goal, **OPTIMI** is developing wearable sensors and other tools to monitor high-risk individuals over an extended period of time and to detect changes associated with stress, poor coping and depression. A series of “calibration trials” (in Switzerland, Spain and China) will allow the project to test a broad range of technologies. These include wearable EEG and ECG sensors to monitor participants’ physiological and cognitive state, accelerometers to characterize their physical activity, and tools to detect signs of depression in their voices. Participants will also be asked to fill in electronic diaries, reporting stressful situations to which they have been exposed and the way they behaved.

In the calibration trials, participants will be evaluated by a psychologist, who will use standardized questionnaires to assess stress, poor coping and depression. A few will also be asked to wear implanted devices to collect fluid tissue to measure levels of cortisol, an objective physiological measure of stress. The idea of the trials is to “create a rule-based system that uses sensors, electronic diaries etc to reproduce the psychologists findings automatically. The final **OPTIMI** monitoring system will consist of a set of tools that the trials show to be useful for this purpose and acceptable to users.

To achieve its second goal, **OPTIMI** will take two existing systems, already used to provide online treatment for mental disorders, and adapt them to exploit the data the project can provide. **OPTIMI** will test these systems in two “treatment trials” with unemployed people and with students preparing for important examinations. Monitoring with the **OPTIMI** sensors will make it possible to provide users with feedback, to assess the effectiveness of the treatment and to optimize the treatment cycle.

Preliminary results -18 months

Sensor devices: In the first year of its work, **OPTIMI** designed, built and tested the sensors it will use to monitor the participants in the trials. These included an easy to wear ECG sensor that measures heart rate and heart rate variability; an “actigraphic” sensor worn on the leg that detects movement; an EEG sensor for brain activity, an implantable device that continuously collects tissue fluid to measure levels of cortisol— a stress hormone -, and a voice analysis system that detects signs of depression in the voice. In each case, the project conducted extensive usability tests to ensure the design was attractive to users, easy to use and did not cause them any kind of discomfort (allergies etc.).



OPTIMI EEG sensor and microphones

CASE STUDY OF PRACTICAL EXAMPLE OR SCENARIO

Roberto is an unemployed Spanish factory worker. He is under great financial strain and is using the **OPTIMI** system to help him cope. Every week, the system gives him “homework”. Last week, it pushed him to exercise more. It has been hard, but the **OPTIMI** sensors tell him the exercises are working. He has been far more active than last week. He is also sleeping better and his EEG and ECG show less signs of stress. He sees the results improve and decides to start jogging again. Life is taking a turn for the better.



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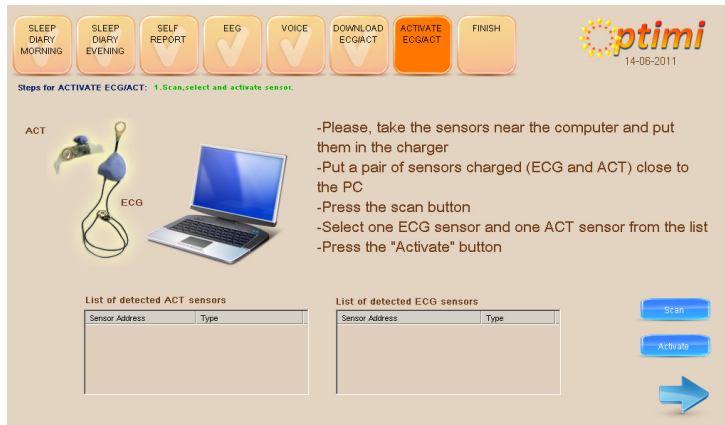
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Signs of poor coping and depression: When people are coping badly and beginning to feel depressed their body no longer functions as previously and their behavior changes. For instance they may become less active, sleep badly, and change the way they talk. So OPTIMI has conducted laboratory tests to find out whether it can detect specific behaviors, which might be of interest – and whether it can catch advanced signs of stress or depression. To make the comparison possible, we also conducted several “normative trials” investigating the range of value we can find in people who are not coping badly and who do not suffer from depression. The final test will come with the “calibration trials”. However, the preliminary data is extremely promising.



OPTIMI Home PC application: uploading sensor data

Home PC application: To make the sensors usable, we designed a “Home PC application” – a program that runs on PCs in participants’ homes, collects the data generated by the sensors and transmits it to a central database where it can be analyzed. The application also provides users with electronic diaries where they can record their daily activities and sleep patterns, and questionnaires to assess their general psychological state. As with the sensors, the project conducted extensive usability testing, to make sure the software was easy to use. At the end of the process, the Home PC application sends the information to the server. The files received are parsed and the information stored in the database for later analysis.

Analyzing the data: OPTIMI is now working on a “rule-based engine” that takes information from sensors, diaries and questionnaires and uses the data to automatically assess users’ behavior and physiological state and to detect users’ showing poor coping. Data from the new system will provide valuable feedback, to users themselves and to healthcare professionals.

Expected Results & Impacts

Wearable sensor systems that can continuously and reliably monitor states of the body and behaviors associated with poor coping and depression: e.g. Heart Rate, Heart Rate Variability, brain activity, levels and kinds of physical activity (including sleep). Compared to alternative methods (such as questionnaires) sensor measurements will provide a far more accurate picture of the user’s behavior and mental health. And of course they can also be used for other purposes – for instance to measure physical activity in patients trying to lose weight.

Voice analysis systems that can reliably detect signs of stress and depression in recordings of users’ voices. Mental health professionals will be able to use these systems on their own, or with other OPTIMI sensors, to monitor patients recovering from severe depression and to detect signs of a relapse.

Systems for the continuous measurement of changes in fluid tissue cortisol levels. Cortisol levels are another sign of the way people react to stress. Today the best we can do is to take a fluid tissue sample and measure the cortisol in the sample. The OPTIMI system will measure how cortisol levels change on a 10 minutes basis as users face the stresses of everyday life. Such measurements could provide invaluable information for healthcare professionals and could also be useful to monitor levels of cortisol in patients undergoing intensive care.

Integrated monitoring systems providing continuous measurements and assessment of body states and behaviors associated with coping and depression. Once the systems have been tested in Randomized Clinical Trials, individuals could use them for personal stress management and doctors could apply them to monitor patients at high risk of depression.

Online programs for the prevention and treatment of stress and poor coping that use OPTIMI monitoring systems to provide better feedback to users than is possible with current systems. Such programs could make treatment far more accessible than it is at present while simultaneously relieving the burden on psychologists and psychiatrists and reducing the cost of treatment for national health services and insurance companies.