

# F.I.S.K. : A company's internal stress communication

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## ABSTRACT

In this paper F. I. S. K. is described. A system for registering and visualizing the average stress level of a group such as a company's employees, is described. The main purpose with this project is to keep its employees at lower stress and thereby to optimize the company's efficiency. The system consists of sensors registering relevant information for each individual, a central server making sense of the collected data and a suitable apparatus visualizing the average stress level. A GSR (Galvanic Skin Response) sensor monitors skin conductivity between two electrodes connected to a suitable part of the body. Furthermore, a motion detector is used to register the quality of sleep of every participating individual. Wireless radio communication is used between these components and the server. The visualization object consists of a cylindrical aquarium rigged with a controllable air-pump and a light bulb. Bubbles released from the pump at low-frequency intervals represent low stress levels. The colored light is static and is used to represent a specific group. Experiments, documentation and pictures show how this typical ubiquitous computing tool works and what results can be gathered from it.

## Author Keywords

Stress, ubiquitous computing, GSR, motion detector

## INTRODUCTION

Stress is a current individual and social problem and therefore an interesting issue to work with. The project outlined in this article deals with long-term stress, in an attempt to combat stress-related health problems which arise from this harmful kind of stress.

The purpose with our project is to visualize the average stress within a group, e.g. a department. The reason behind the visualization is to give an indication about staff stress level.

Our interest for the issue grew when investigating different sensors. We were fascinated by being able to measure the stress level on people, as stress is something that may be hard to detect in people who learn to hide well their stress level, and is something that can be very beneficial in measuring, in order to be able to launch pre-emptive efforts.

A short investigation within the field yielded a variety of articles, books, discussions and facts and we felt challenged to take on this very relevant and important field, in an effort to build a tool to help people in their everyday work environment. This tool is not meant to be

a replacement for conventional stress reduction therapy, rather it's a tool to help people help each other.

The tool can be understood as a system of computational devices that, in accordance with the vision of Ubiquitous Computing, aim to blend into the environment and become invisible, enriching our everyday lives without interfering with them [9].

## RELATED WORK

As stress is a very hot topic, as well as a big problem in society, there's bound to be several projects already dealing with this topic. A few projects, most directly related to stress, which we have used as references and inspiration sources during the course of our project, are mentioned here.

*Tick Tack* [1] is a critical design project aiming to show how absurd and in the long term unviable today's stressful society is. In their design, several persons, such as employees at a company, all wear a bracelet containing a GSR sensor measuring their stress level. Each of the bracelets is connected to a clock on the wall, and as the stress increases, the clock ticks on faster, to further stress the person. This in turn leads to pushing people to the limit. In essence, the point made by *Tick Tack* is, that stress is caused by social, not physical factors.

*tokOLLE* [5] is a ball-shaped object, composed of aluminum squares and triangles. *tokOLLE* reacts to stress measured by a GSR sensor, and attempts to distract the user from the stressful events by using movement, sound and flashing lights. *tokOLLE* is designed for individuals wanting to deal with their stress and use it as a meditation instrument. The premise of *tokOLLE* is that the best way to deal with stress and frustration is to not get stressed/frustrated.

*Moodicator* [2] is another bracelet, measuring moisture on the skin as well as heart rate, and from this draws conclusions about whether the user is stressed, calm, happy or depressed. This information is then transmitted to a rice paper lamp displaying the user's emotional state on an hour-by-hour basis, using tiny lamps. The daily spectrum of colors is also stored on digital paper, allowing users to reflect over their health state.

*Stressmätaren* [3] is a system for people that have been, or are in the danger zone of becoming burnt out. It operates by using a newly developed miniature sensor measuring the carbon dioxide in exhalation, something that is very relevant in stress gauging. The project also wishes to incorporate measuring heart rate (EKG),

moisture, skin temperature and the amount of oxygen in the bloodstream.

The sensors are meant to be built into a wrist watch, necklace or worn under a patch, and use Bluetooth technology to communicate with a cellular phone, which in turn can relay the information to a database via wireless internet access or a computer. The developers expect to have a foundation of something wearable within a year. Within three years they expect stress meters to be built into wrist watches, necklaces or patches.

*Atmosense* [4] aims at visualizing how well-suited the environment in a room is for concentration, mainly inside conference rooms and similar settings. To this end, the device measures room temperature, carbon dioxide in the air, and air moisture. This information is then displayed in a non-intrusive way, to give the users a choice whether to improve the conditions of the room, or ignore them and proceed anyway.

Our project takes a different approach than the others by targeting mainly a corporate environment, with the aim of visualizing stress levels in groups in order to enable application of external and professional help rather than trying to help directly via the system itself.

## HYPOTHESIS

We believe that creating a tool which can measure and monitor stress levels during longer periods will help companies, both the administration and the employees, to reduce stress levels, thus decreasing the risk of stress-related health issues, which benefits both the company itself and the persons involved.

Displaying a more accurate long-term history over stress levels to people in positions of responsibility we believe will help by allowing stress-reducing efforts to be made before it has gone too far and the stress starts affecting the health of the employees.

Displaying a more short-term, ambient overview of stress levels to everyone, we think will help people show consideration and respect to each other, by not further burdening already stressed departments, and by emotional support.

## METHOD

We started from a basic idea about a bracelet that would show you how stressed you are, and started developing this idea using design methods. The first one we used is known as *Five Whys* [6], and helps you in questioning things and in drawing conclusions. From this, we realized that stress is caused by people being dependent on each other, and that showing the stress level to oneself only is pretty uninteresting.

From this we started working with a concept of showing the stress level to others. We also continued our methodical design process by finding out more about stress, by conducting interviews with a school welfare officer, a professional therapist and people who have been burnt out. Additionally we began reading about stress in general, what it is, how it manifests and how it can be measured.

From this we found several factors that mattered, and could be measured; heart rate, GSR, blood pressure, respire trace and quality of sleep. We also got feedback on our ideas about how to display the stress, and to whom, and drew conclusions about our design.

## RESULTS

Our results are two-fold, both a design for a system we envision, and a basic prototype of our system.

### Concept

Our concept, which evolved from the design process, consists of multiple parts working together to form a coherent system. The aim is to measure stress in individuals in groups, such as departments at a company, compile the information, and display averages for the whole groups. We chose not to show individual data out of personal integrity concerns, since showing this kind of sensitive information about individuals invites to abuse.

The first part is a bracelet, which we thought would be a suitable and non-disturbing item to put sensors on, and is already worn by many people anyway. The bracelet measures stress levels using sensors in contact with the wrist, such as GSR and heart rate sensors, and then weighs this information in relation to how indicative the values of stress are, computes a stress index, and adds this to a daily average, which is then sent along with the bracelet's ID over wireless radio communication to receiver modules in the workplace.

The receiver module picks up the data and the IDs, and is in turn linked to a server where a daily average for the whole group of users is stored (see figure 1).

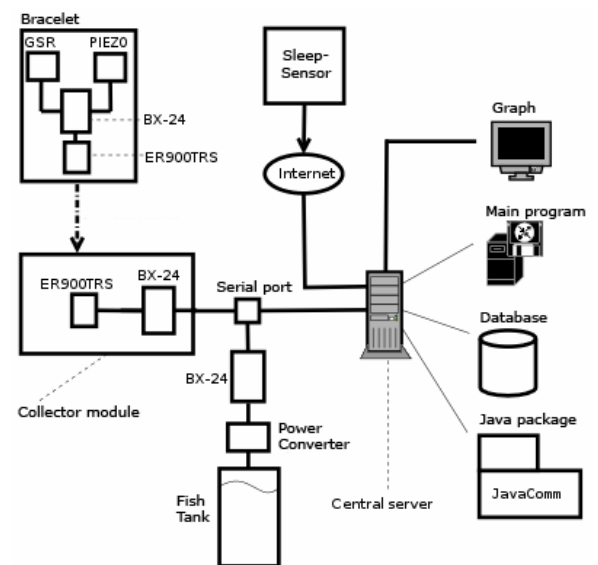


Figure 1: Overview of system architecture

Another stress sensor used by our system is a motion sensor. It monitors the amount and the quality of sleep, whereby the amount is measured in time and the quality can be measured by registering the amount of body-movement while sleeping. The quality of sleep is very indicative of stress levels, especially the dangerous long term stress. The sleep monitor communicates with the

server at work, and the sleep quality is included in the stress measurement average.

The compiled data is sent to a graph plotting a history view of a group's average over the 30 most recent days. Access to the graph is restricted to people in positions of responsibility that it grants them the right to see the information. These persons can access the graph over the company's internal network or over the Internet.

Information is also shown publicly in a more abstract fashion, via an ambient feedback display integrated into the surroundings at a place where many employees pass, such as an employee entrance or front desk. The visualization objects take an average of the five most recent days for each group monitored, and show this for each group using different tubes filled with water. The stress level is indicated by controlling the amount of bubbles, a high stress level will generate many bubbles. For differentiating between different tubes and relating them to the groups for which stress levels are monitored, each tube has a unique color.

### Prototype

Our prototype implements a basic system based on our concept. It has a single "bracelet" using a GSR sensor, a microcomputer chip and is equipped with a wireless communication module to measure, calculate an average and send the information to a receiver module. The "bracelet" is of considerable size as of yet, due to being a simple prototype, but one of manageable size and using multiple sensors for more accurate measurements could be constructed.

The receiver module receives the data sent from the sensor over wireless radio, and relays it to a PC over serial port communication. It is then read by a Java program, which stores the data for the appropriate day, and draws up a graph of the daily averages, as well as it sends a five day average, again over a serial port, to another microcomputer chip. The chip which controls the amount of bubbles in a tank containing plastic fish in a certain color, and is also lit by a light in the same color as the fish, this to indicate group (see figure 2).

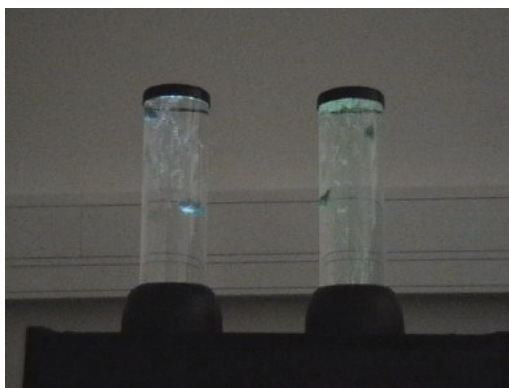


Figure 2: Ambient visualization – color coded bubble tanks

The sleep sensor uses a motion sensor to detect if a person is moving or not. The user can turn it on when it's time to go to bed, and turn it off when getting up. The data collected in between, during sleep, is a sum of the

movement done during the night. If the user has had an uneasy sleep and tossed and turned a lot, the value will be much higher than for someone who has had a peaceful sleep.

With some additional calibration, the prototype could be used to monitor a person's stress levels within a certain area, such as the workplace or home. However, if this concept should be put in use, it would be advisable to develop the prototype further, as well as make multiple prototypes, to allow for measuring of groups.

### DISCUSSION

Overall, our feedback on our concept has been positive, both by the interviewed professionals, who seemed to think it would be a great help for reducing stress, and individuals we demonstrated the project to.

We see some issues with the concept, one being the potential for abuse, something that also came up during our presentation of the project as a concern expressed by many of the onlookers. Langheinrich [7] writes about WW II<sup>1</sup> where public records made it possible to point out the Jewish population which led to mass murder. Even though we don't display individual data, one could imagine eavesdropping on the radio communication and eventually linking a person to an ID, but this could be solved using encrypted transmissions.

There's also the possibility that groups with low stress levels are given more work, as the people in charge may see low stress levels as the group not having enough work to do. This could mean the system is used to increase stress, and not as intended to reduce it. However, since this is designed as a bracelet you wear, the users always knows they are being monitored, and can take it off to avoid it.

Drug screening on job applicants have been debated a lot in the media, and are in use in some countries already. Does the employer have a right to that information? Can they force someone to take a drug test or be fired? One can picture our system in a similar situation, where employees are forced to wear it if they want to keep their job, combined with abuse of the data collected.

The GSR sensor itself is easy to cheat; this could either be used to cheat an above mentioned abusive leadership trying to increase production by pushing the limits, but also to give false readings in an attempt to lower the workload and get out of work.

Overall, it is important that people are always kept in the loop. Serious evaluations by professional therapists are made to assess the involved personnel, laws that outline what information companies have the right to know, and unions that make sure abuse does not occur. The system is by no means intended to replace help from other people; it only aims to inform that people may need to act.

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<sup>1</sup> WW II = World War II

The prototype has, of course, due to time restraints and limited technical knowledge, many issues, but these are not worth discussing to any great extent.

## CONCLUSION

We conclude that it is possible to measure stress with reasonable accuracy, as well as to build a mobile non-intrusive device for this purpose. An obstacle in measuring is to separate stress from physical activity, but using multiple sensors, especially sleep monitoring, simplifies distinguishing between the two.

We do not see an issue with the production cost or complexity of such a device, rather the critical issue being whether it is in fact desirable at all, which is a question of security and personal integrity above all. We think that in a near future, stress monitoring will be applied to much of our everyday life, and it will be up to designers of such systems as well as legislators to make sure the goal of these monitors is to help people feel better, and safeguard against abusive applications of the technology.

## FUTURE WORK

There is plenty of work to be done along this line of research. One of these would be to build a much-improved prototype in multiple copies, and perform a large-scale user test during a time period of half a year or more, as this concept tries to combat long-term stress. This would mean a much needed test of the concept which in turn can lead to further evolution of the design.

Design improvements that can be imagined already at this stage are for example to measure more than just stress, turning it into a mobile health monitor. Of course there is the question about who we want to have access to such information.

Another possible route to take in future work is integrating it with devices such as the active badges [8], and using thus combining identification with health monitoring and using biometrics as a means of authentication.

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