A Detailed Analysis of RSIGuard's BreakTimer Functionality

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About Remedy Interactive

Remedy Interactive is the leading provider of software that streamlines ergonomic programs in large organizations, globally. The Company's flagship product, the *Office Ergonomics Suite* (OES), assesses risk, trains employees, optimizes work patterns, and collects data to enable organizations to focus their resources, automate their ergonomics programs, and ultimately reduce costs. The OES's management features are designed to allow companies to do more with less by harnessing the potential of automation.

Remedy Interactive's *Office Ergonomic Suite* is the winner of the 2002 National Ergonomics Conference Attendees' Choice Award for Product Most Likely to Improve Profitability and Productivity.

Remedy Interactive works with Fortune 1000 clients including Hewlett-Packard Company (NYSE: HPQ), ChevronTexaco (NYSE: CVX), and VISA.

For more information, please visit www.rsiguard.com or call (800) 776-5545 or (415) 332-6433.

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Introduction

Remedy Interactive's RSIGuard software is the leading ergonomic intervention application for the office environment. RSIGuard includes many components, including BreakTimer, ErgoCoach, KeyControl and AutoClick functions. This document discusses in detail the principles behind RSIGuard's BreakTimer feature and compares it to other break reminder features in other software. Documentation on how to use and setup BreakTimer can be found separately at http://www.rsiguard.com/help/helpbt.htm

For the purposes of this document, a "rest break" refers to time away from computer use. It does not necessarily indicate a work break, as employees may do non-computer-related tasks during a "rest break". The term RSI in this document refers to computer-related injuries in general. Since mechanisms of injuries vary and can result from factors other than repetition (e.g. static postures), the term RSI is used broadly, and is not intended to indicate a specific mode of injury.

Establishing the Need for BreakTimer

The U.S. Bureau of Labor Statistics reports about 520,000 cases of lost work-time due to repetitive strain injuries (RSIs) each year[1], and the National Research Council estimated the annual economic burden – including compensation costs, lost wages, and lost productivity – to be between $45 and $54 billion.[2] Although various ergonomic aids exist (e.g., alternative keyboards, chairs, adjustable desks, anti-inflammatories), research suggests that rest breaks from computer use should be a core element of any program to combat RSIs.

In some industries there is a dilemma with scheduled breaks because they are easily forgotten or ignored. But computer users have the potential advantage of using a software-assisted break reminder system (SABRS). An advantage of a SABRS is that breaks can be flexibly and intelligently timed to help prevent RSIs and minimize work disruption. Furthermore, breaks can be enforced and compliance tracked.

Although some users resist the idea of prompted breaks, regular rest from computer use supports the financial objectives of a business: a study funded by the U.S. government concluded that taking regular rest breaks can improve worker health without lowering productivity[3]. In addition, a study from Cornell University concluded that rest breaks actually increased productivity.[4]

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[1] Bureau of Labor Statistics, U.S. Department of Labor, Incidence Rate reports, 2001.
[2] *Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities*; Panel on Musculoskeletal Disorders and the Workplace, Commission on Behavioral and Social Sciences and Education, National Research Council; published by the National Academies Press, 2001.
[3] May 22, 2000, news release from the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services.
[4] Cornell Human Factors Laboratory Technical Report RP9991, Cornell University.

What does a SABRS do in general?

All SABRS make it easy to remember breaks because the computer acts as an infallible "reminder agent". Each SABRS uses some algorithm to determine when to suggest breaks to the user – and that algorithm is a significant differentiator between various systems. The mechanism a SABRS uses to indicate the need for time off the computer and how it encourages compliance with suggestions are the most important differentiator between different SABRS.

For example, if a break is given when a user feels it is inappropriate, or surprises the users, or is inflexible about when breaks are taken, it leads to rejection of the SABRS. Building trust by suggesting breaks at appropriate times and giving the user sufficient flexibility to make rest-suggestions be feasible without hampering workflow leads to greater compliance with the SABRS-suggested breaks.

All SABRS attempt to model when the user should take a break. The simplest models use a time interval. For example, they might tell the user to take a break every 60 minutes. These systems do not consider that the user may have been on the phone or at lunch for 50 of the last 60 minutes, and can be very annoying since they often ask the user to take unnecessary breaks. Similarly, a time-based model is not optimal when a user is doing particularly intensive work and more frequent breaks may be appropriate. Organizations using this type of model will experience a high software rejection rate among employees.

Other SABRS use models that count keystrokes and/or mouse actions. This is an improvement because it ties break prompts to user activity – although this model doesn't consider work intensity (e.g., did the 1000 keystrokes occur over 30 minutes or 4 hours).

Some models go further by watching rest time as well, and count a long rest as a break taken. Thus, if the user rests on their own (natural breaks), the SABRS will suggest fewer additional breaks.

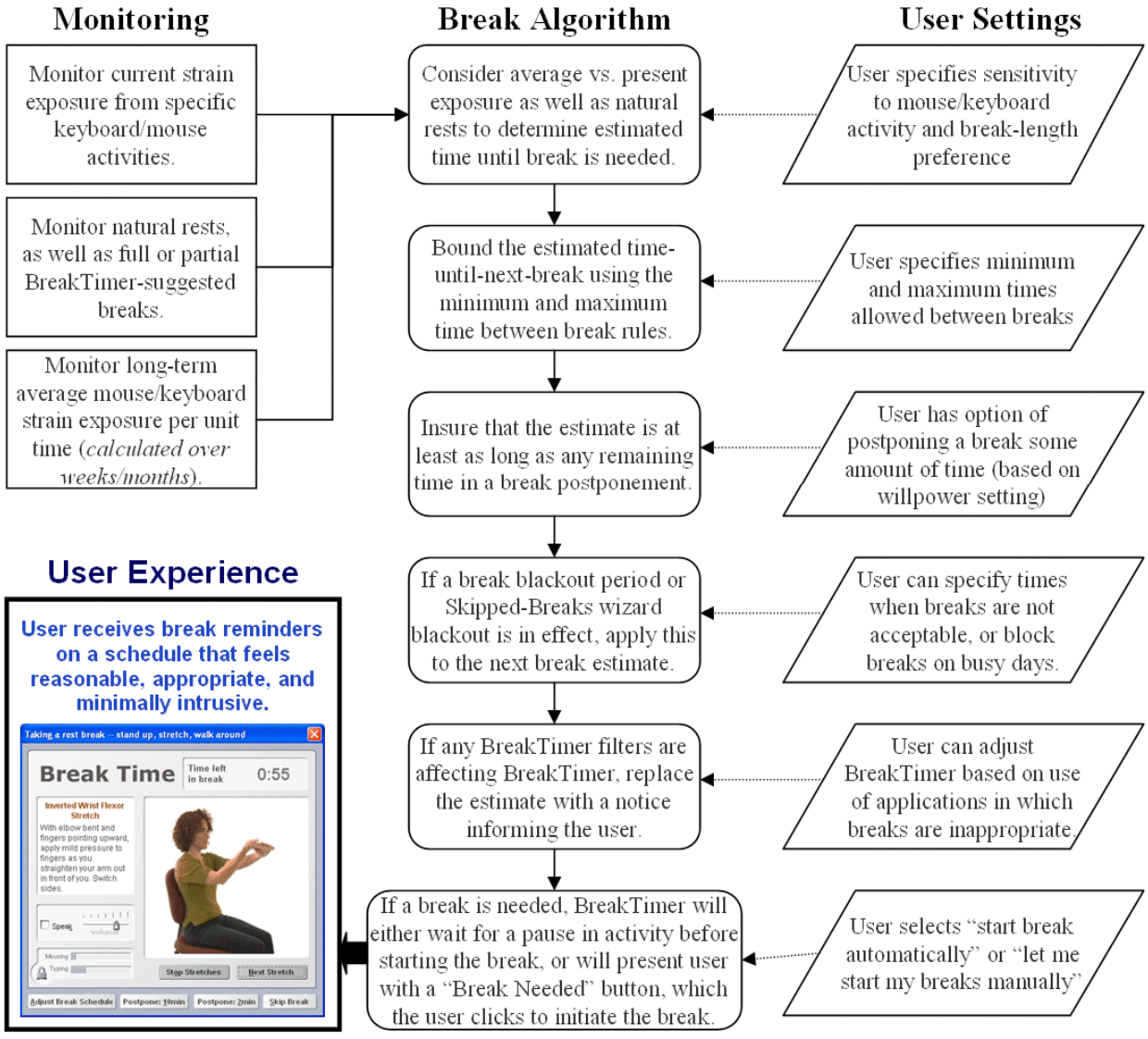
What does the RSIGuard SABRS (BreakTimer) do?

RSIGuard's BreakTimer considers each second of computer activity and inactivity to maintain a dynamic model of work and rest patterns. In addition to time of work and rest, BreakTimer also looks at keystrokes and mouse activity. Rather than simply counting them, however, it uses a strain model that considers what keys were pressed and what mouse actions were performed and how each of these strains your body differently. Furthermore, RSIGuard's BreakTimer has various intelligent components designed to improve the timing of breaks, the palatability of breaks, as well as the ease of configuring such a sophisticated system.

Below is a flowchart that describes the overall concept of the BreakTimer.followed by a more detailed description of the many components of the BreakTimer system. While it

might seem complex, remember that the user's experience is simple – intelligently timed, less-intrusive break suggestions.

BreakTimer Overview Flowchart



- **BreakTimer setup wizard** – The setup wizard provides a simple 4 step wizard that lets most users reasonably configure User Settings without understanding the complexity of the model or the full range of possible configurations. Users who need more specific control can adjust the BreakTimer settings directly.

- **Strain compartments** – BreakTimer models strain associated with mouse and keyboard activity separately to represent the different muscle groups properly. Settings allow a user to set the BreakTimer sensitivity based on their personal physical health. Users can also specify whether they prefer more frequent shorter breaks or less frequent longer breaks.

- **Accurate strain measurement** – Different keystrokes require different levels of physical strain. RSIGuard models strain from different keystrokes based on the difficulty in pressing the key, and this model was developed from a surface electromyography (EMG) baseline study. For example, pressing Ctrl-C requires more muscular effort than Ctrl-F5, and pressing Shift-G requires more muscular effort than just pressing G. In addition, differing levels of strain from different mouse activities are accounted, e.g., single-clicking is easier than double-clicking; moving the mouse while dragging is harder than just moving the mouse. This approach is more accurate than a mouseclick counter. For example, consider a drag and drop action as compared to two single clicks: a mouse click counter would consider two single clicks as being twice the activity of a drag and drop action, while in reality a drag and drop is much more straining.

- **Average work measurement** – BreakTimer monitors the intensity of a user's typical work session. When the user works more intensely than usual (or less intensely), BreakTimer automatically adjusts the break frequency. This measurement is also used for work restrictions (more information on work restrictions follows in a later section.) This is an important distinction from keystroke/mouseclick counters, because few people know what their average keystroke or mouseclick rate is.

- **Speed of strain accumulation** – This feature measures the absolute speed of strain accumulation (average strain experienced per unit time) and accordingly adjusts frequency of breaks. This ensures that on average breaks occur on a relatively stable schedule, but they do occur more frequently as the user works more intensely than usual – and vice versa.

- **Natural break measurement** – BreakTimer analyzes each second of work and rest separately for the mouse, the keyboard, and for the two combined. For example, accumulated mouse strain can be reduced while typing, and vice-versa, even though the break model still considers that, overall, you are still at work on the computer whether your are mousing, typing, or alternating between the two. This teaches users that they can avoid break reminders by varying their activities (alternating mouse and keyboard tasks as well as switching between computer and non-computer tasks).

  The longer and more frequently a user takes natural breaks, the more "credit" BreakTimer gives – providing users the positive feedback of fewer interruptions as encouragement towards developing good break-taking habits. Although the credit BreakTimer gives for natural rests is non-linear (i.e. longer breaks get more than proportionally greater credit), a rough guide is that a natural pause of about 1.5 times the user-selected average break length will be treated similarly to a full BreakTimer-suggested break.

- **Maximum time between breaks** – Because fatigue from extended sitting and eyestrain (and other static exposure) is more a function of time at the computer

than of keystrokes and mouse activity, BreakTimer allows the user to set a "maximum time without a break." If a user works longer than this time, a break is triggered. This is not the same as triggering a break every X number of minutes, because these breaks will not be triggered if natural breaks are taken or if breaks are triggered earlier as a result of keyboard or mouse strain.

- **Minimum time between breaks** – BreakTimer lets a user specify a minimum amount of time between breaks. This time lets a user specify that even if they have accumulated high levels of strain, no breaks will be given. Ideally a user won't use this to avoid breaks, but it can help users avoid the frustration of too frequent breaks.

- **BreakTimer filters** – There are situations where interruption is unacceptable and can lead to rejection of a SABRS. While the situations may be rare, they can have significant negative impact on software acceptance. BreakTimer filters let you specify conditions in which the BreakTimer should either not interrupt the user, or should use "polite mode" (see below). For example, during a PowerPoint presentation, it is not appropriate to ask a presenter to take a break. The filter for this is one of the defaults built into BreakTimer, but you can add others as appropriate.

- **Predefined break times** – Users can define certain times during the day when they want RSIGuard to suggest breaks (e.g. standard employee break times) and RSIGuard will suggest breaks at these times independent of other factors.

- **Preparing users for breaks** – An important part of making breaks less intrusive is to let users prepare for upcoming breaks. RSIGuard addresses this in several ways to avoid surprise interruptions. The RSIGuard window shows an *estimate* of how long it will be before the next break is triggered (as well as how long it has been since the last break). This estimate updates dynamically as the user takes natural rests or adjusts work intensity. It also accounts for minimum and maximum time between breaks and break postponements. The RSIGuard icon (in the system tray) blinks and an optional tone sounds shortly before RSIGuard estimates a break will occur. RSIGuard will also delay starting a break by a short time to try to look for a natural pause in the users work. This prevents a break from interrupting a user in the middle of writing a sentence or in the middle of a mouse operation.

- **Polite mode** / **Break suggestion intrusiveness level** – Ideally, breaks should be taken as BreakTimer suggests them. Although ideal, this method can be too intrusive to be practical for some employees or for certain job descriptions. For example, a 911 operator cannot simply take a 4 minute break whenever BreakTimer suggests it. Also, some employees will simply not tolerate break interruptions well, but they still need the benefit of break timing. During the initial setup wizard, BreakTimer will allow the user to determine if breaks should begin as soon as BreakTimer deems it is break time (greatest benefit but more

intrusive), or if at break time BreakTimer simply displays a “Break Needed” button (non-intrusive). When the “Break Needed” button is clicked, the break begins – but the user will not be interrupted until the button is clicked. Users can also select a “compromise mode” in which the break will eventually occur if the button is ignored for several minutes. Several other adjustments in the BreakTimer settings screen can be configured to reduce break intrusiveness.

- **Adjustable break enforcement** – Because the enforcement of breaks can be a source of frustration to users, RSIGuard allows a user to specify their “willpower to respect breaks.” If a user has good willpower, RSIGuard makes it easier to bypass breaks. If a user specifies that they want more enforcement, RSIGuard will make it more difficult to bypass breaks.

- **Managing poorly timed breaks** – When a break is triggered, the user may simply not be able to stop at that moment. The user has the option of postponing breaks. The amount of total time a break can be postponed is dependent on the willpower setting. When a break is postponed, BreakTimer continues to measure strain. If the user incurs more strain, the postponed break will be appropriately longer. If the user spends enough of the postponement resting, the break will properly not occur. In addition, the “End Break Early” feature allows a user to completely skip a break and artificially lower the measure of accumulated strain.

- **Work restrictions** – A frequent prescription issued by physicians for injured workers is to restrict their use of the computer to a certain amount of time per day. BreakTimer not only allows a user to monitor a basic hourly restriction, but also allows the user to adjust the restriction based on either the day of the week (i.e., Monday, Tuesday, etc.) or whether preceding days were spent working or resting. In addition, instead of a time exposure limit, work restrictions can limit a user to a particular level of strain exposure. More detail about the work restriction feature appears below.

- **AutoClick and KeyControl integration** – The AutoClick and KeyControl feature of RSIGuard are integrated with BreakTimer, so that as users depend more on these features, they can work longer without a break. (For a detailed analysis of AutoClick, see http://www.rsiguard.com/documents/help/AutoClickAnalysis.pdf).

- **Self-timed breaks** – When a user wants to take a break, he or she can request the “Take a break now” feature of BreakTimer, either by selecting it from the main menu or by pressing the take-a-break-now hotkey. This forces a break to occur immediately. Although BreakTimer would already treat time away from the computer as a break, this lets users tell BreakTimer that it can lock out the computer – and show stretches in RSIGuard Stretch Edition.

- **Break logging** – BreakTimer logs the number of breaks taken per day via the DataLogger feature. It also logs the number of breaks that are ended early, the amount of time that breaks are postponed, and the amount of time spent taking

breaks. (For a detailed analysis of the DataLogger feature, see http://www.rsiguard.com/documents/help/DataLoggerAnalysis.pdf).

- **Multi-user support –** BreakTimer can handle an arbitrary number of users simultaneously on one computer without any additional strain on the processor. As one user switches to another and switches back later he or she will notice that the computer has continued to monitor his or her strain level even while someone else was using the computer. If a user turns off the computer for a while and restarts it later, the model will properly account for "off-time" as time away, just as it would if the user had left the computer on.

- **Multi-computer support –** If DataLogger stores its data on a network, BreakTimer can be configured to calculate break timing based on a user's activity on multiple computers. Thus, if a user's breaks normally occur on average every 40 minutes, and they spend 20 minutes (working at an average pace) on one computer followed by 20 on another, BreakTimer will detect this and tell him or her to take a break.

How Does BreakTimer Measure Strain?

BreakTimer works by modeling a user's "strain." Strain is a measure of the absolute quantity of exposure to straining activity. Because there is no standard unit for defining strain, RSIGuard defines its own standard.

There are two types of strain that are modeled – strain from using a keyboard and strain from using the mouse. The basic keyboard strain unit equals the amount of strain from pressing the letter 'f' with the left-hand's pointer finger. The basic mouse strain unit is defined as the amount of strain incurred from moving the mouse (without clicking) for a time of $1/10^{th}$ of a second.

The values for various activities were derived with a baseline surface-EMG study of several computer users. Although the defined strain units do have a theoretical absolute value, each person is different – both physiologically and in the way they work – so the values RSIGuard uses are only approximations. However, the relative measure of a user's strain from day to day can be compared meaningfully. This allows BreakTimer to know whether a user is working more or less throughout the course of the day and whether their long-term intensity of work (strain per unit-time) is changing.

BreakTimer's Work Restriction Feature

Doctors frequently prescribe work restrictions for injured workers in order to reduce strain exposure. Although the typical prescription is to require users to reduce their workload from their current "hours of work per day" to a "reduced hours of work per

day," or to "no more than X minutes per hour", most doctors agree there are problems with this solution.

First, most workers don't know how many hours they spend on the computer per day, especially since it is often different every day. This makes it difficult for a doctor to prescribe an intelligent reduced number of hours. RSIGuard's DataLogger accurately measures how much a user works per day, the intensity of that work, and also separately monitors the length and intensity of mouse and keyboard use.

Secondly, without DataLogger, this lack of awareness of how long they work prevents most people from reducing their number of hours to follow prescribed reductions. BreakTimer's basic work restriction feature alerts the users when they have reached their prescribed limits.

Thirdly, many doctors recognize that a fixed number of hours is not an ideal prescription, but that to make a more complex restriction is useless since it is difficult to follow even the most basic restriction. BreakTimer's advanced work restriction feature has two features that make work restrictions much more meaningful and useful:

- **Variable restrictions** – Users can select either to specify a different work restriction for every day of the week (normally restricted to fewer hours towards the end of the week) or to have a dynamic restriction that goes up after each day of rest and down after each day of work. The upper and lower limits, as well as how much the restriction changes each work day and each rest day, can be defined by the user.

- **True time or Strain time** – A normal work restriction measures the restricted work in terms of actual time. That means that if a user is restricted to four hours of work, he or she can spend no more than four hours at the computer per day, although it can be spread out over the whole day with time away from the computer in-between. BreakTimer reveals that four hours of work one day could involve a lot more strain than four hours of work another day. Therefore, RSIGuard's BreakTimer gives the user the option of limiting work in terms of the amount of average strain accumulated in a certain number of hours. For example, if the user is limited to four hours, BreakTimer will stop the user after he or she has accumulated as much strain as he or she typically experiences in four hours. Thus, if the user is working less intensely than usual, he or she will be allowed to work longer than four hours, and if working more intensely than usual, the user will be allowed to work fewer than four hours.

The main RSIGuard display normally shows how long a user has been working (if the Time Statistics option is enabled, as it is by default.) If a user has activated the work restriction feature, however, the main display will instead show how much time the user has left to work that day.

Another common type of work restriction is to limit computer activity to a certain number of minutes per hour (or other length of time). RSIGuard has a feature called “Minute by minute” work restrictions that lets you set a limit of no more than X minutes of mousing/keying activity per Y minutes (e.g. no more than 30 minutes of keying/mousing per hour).

Stretches During Breaks

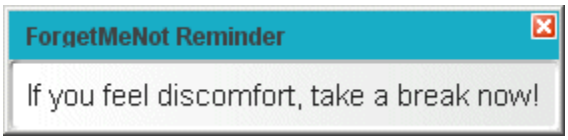
BreakTimer includes high-quality stretches which are shown during breaks. The stretches are accompanied by a text description of the stretch and an optional audio track that guides the user through the stretches. The audio track can be heard through audio headphones or speakers attached to the user’s computer. An option for showing organization-specified video content during breaks is also available.

ForgetMeNots

In addition to activity-based BreakTimer-suggested breaks, RSIGuard also offers the ForgetMeNots system – a time based microbreak reminder and self-awareness reminder. The purpose of this system is to specifically address static postures by frequently suggesting brief (e.g. 10-15 second) rests and to enhance self-awareness of how a user is using their workstation.

ForgetMeNots offer users frequent (e.g. once per 15 minutes) time-based reminder messages that help maintain awareness of work patterns by showing messages. Messages might ask the user to notice something about their posture or ask them to notice about how they feel.

In addition, ForgetMeNots can also ask the user to take a brief (e.g. 12 second) rest from typing and mousing.



Sample ForgetMeNot Reminder

Since the fundamental purpose of ForgetMeNots is to enhance awareness and address static postures, popups are time-based rather than activity-based. However, the ForgetMeNots system is aware of activity and of the BreakTimer break schedule. As a result, ForgetMeNots will not appear right before or after a full break, and may occur less often or not at all if the user is idle for an extended period of time.

Additional information about ForgetMeNots is available at http://www.rsiguard.com/help/helpfmn.htm.

Conclusion

RSIGuard software's rich feature set – including the BreakTimer functionality – makes it the industry's leading ergonomic intervention software application. BreakTimer helps reduce or eliminate strain that can lead to injury. RSIGuard's BreakTimer feature uses a unique and powerful algorithm to calculate strain, and it offers more flexibility and intelligence that any other alternative application. BreakTimer can also be set to manage prescribed work restrictions.