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Review Article

Design and Implementation of Computer Activity Monitoring Software for Educational Contexts

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Abstract: The pervasive integration of computers into teaching and learning activities has generated a pressing demand for effective monitoring solutions to support the management and regulation of students' learning behaviors within educational contexts. Nevertheless, many existing monitoring systems exhibit notable limitations, including high implementation costs, limited adaptability, inadequate compatibility with mid-range hardware configurations, and reliance on users possessing advanced technical expertise. This paper presents the design and implementation of a computer activity monitoring software solution tailored for educational environments, with a particular focus on students engaged in both school-based and home-based learning settings. The proposed system facilitates the systematic collection, organization, and analysis of computer usage data, thereby assisting parents and educators in supervising, assessing, and managing students' learning processes. The solution is developed with an emphasis on system robustness, ease of deployment, interoperability with widely adopted information technology infrastructures in Vietnam, and compliance with fundamental security requirements. Preliminary experimental results demonstrate the system's practical applicability and its potential contribution to the establishment of a secure, structured, and effective learning environment.

Keywords: Computer Activity Monitoring, Educational Software Systems, Parental Supervision, Student Monitoring, Learning Management, Educational Technology.

1. INTRODUCTION

The rapid advancement of information technology in the twenty-first century has brought about profound transformations across learning, working, and communication practices. In Vietnam, the national digital transformation agenda is being actively promoted, with education identified as a priority sector for the application of information technology to enhance teaching and learning quality. The use of computers and the Internet has become an indispensable component of students' learning activities at the primary, lower secondary, and upper secondary levels, particularly in online learning, information retrieval, assignment completion, and knowledge reinforcement.

Alongside these evident benefits, the frequent use of computers by students also poses significant challenges in terms of management and supervision. Due to age-related psychological characteristics and limited self-regulation capabilities, students may misuse computers for non-educational purposes, access inappropriate content, become distracted during online learning sessions, or face potential risks such as fraud and online grooming through social networking platforms. Meanwhile, parents and teachers often encounter considerable difficulties in continuously and comprehensively monitoring students' online activities.

In this context, the research and development of a computer activity monitoring solution specifically designed for students is both necessary and timely. Such a monitoring solution is not intended to impose rigid control or punitive measures; rather, it aims to support parents and educators in observing, assessing, and guiding students' computer usage behaviors. By automatically collecting and managing computer usage data in a non-intrusive manner, the proposed solution

seeks to contribute to the creation of a safe, healthy, and effective learning environment within the contemporary digital education landscape.

The main contributions of this paper are as follows:

- Proposing a computer activity monitoring software solution tailored to educational environments, addressing the growing need for student management in increasingly digital learning contexts.
- Presenting a system design model and monitoring architecture capable of deployment on mid-range hardware configurations, making it suitable for practical application in the Vietnamese context.
- Developing and implementing a software prototype that enables the collection and management of students' computer usage data, thereby supporting parents and teachers in monitoring and guiding learning behaviors.
- Conducting a preliminary evaluation of the system's practical applicability, providing a reference foundation for future research and development in the field of digital learning activity monitoring and management.

2. Overview of Related Work

2.1. Characteristics of Existing Monitoring Solutions

At present, both the software market and the research community have produced a wide range of computer monitoring and user activity control solutions, primarily targeting environments such as households, educational institutions, and enterprises. These solutions are designed to monitor and regulate online activities, thereby contributing to the protection of users from potential risks in digital environments.

Several widely used parental control and computer monitoring software products include Qustodio [1], Net Nanny [2], Kaspersky Safe Kids [3], and Norton Family [4]. These solutions typically provide features such as website blocking, screen time limitation, content filtering, and device location tracking. However, their main drawbacks include relatively high recurring subscription costs and the lack of advanced monitoring capabilities such as keystroke logging or clipboard activity tracking. Moreover, these solutions demonstrate limited adaptability to the educational context in Vietnam, where cost efficiency and operational flexibility are critical requirements.

In enterprise environments, internal monitoring solutions such as Teramind [5], ActivTrak [6], and Hubstaff [7], enable comprehensive tracking of user activities, including keystrokes, application usage duration, website access, and even real-time screen recording. Although these systems offer extensive and sophisticated functionality, they are primarily designed for corporate management purposes, often involving high licensing costs and complex deployment requirements. Consequently, they are not well suited for individual users, households, or small-scale educational institutions.

In addition to commercial software, several open-source or free monitoring tools have been shared on online forums and platforms such as GitHub [8]. These tools typically provide basic functionalities such as keylogging and screenshot capture. However, they often suffer from limitations in system stability, weak security mechanisms, and poor usability for non-technical users. Furthermore, most of these tools lack user-friendly interfaces, do not support automated reporting, and are easily detected and disabled by antivirus software.

2.2. Context and Motivation for Developing a New Solution

In the context of Vietnam's ongoing and intensive digital transformation, particularly within the education sector [9], the application of information technology in teaching and learning has become increasingly critical. Contemporary students are progressively reliant on computers for a wide range of academic activities, including online learning, assignment completion, information retrieval, participation in virtual classrooms, and communication with peers and teachers.

When using computers, students commonly encounter several challenges, including:

- **Learning distraction:** Students are easily distracted by social media platforms, online games, and entertainment content during study time.
- **Exposure to inappropriate content:** The Internet contains a substantial amount of age-inappropriate material, including violent, pornographic, and misleading content [10].
- **Difficulties in supervision:** Parents and teachers lack effective and timely tools to monitor students' online activities in a comprehensive manner.
- **Lack of tools for learning effectiveness assessment:** It is challenging to accurately evaluate the actual amount of time students devote to academic activities when using computers.

2.3. Proposed Computer Activity Monitoring Solution

To address the aforementioned challenges, this study proposes the development of a computer activity monitoring software solution with the following key characteristics:

Comprehensive yet Unobtrusive Monitoring:

The software automatically records keystroke activities, captures clipboard content (copy and paste operations), takes periodic screenshots, and logs web browsing history. These data are automatically transmitted to parents' or teachers' email accounts or FTP servers for monitoring purposes. The system operates in the background without disrupting students' learning activities.

Ease of Use without Technical Expertise Requirements:

The solution features a simple and intuitive configuration interface and does not require advanced technical knowledge. The executable file (.exe) can be used directly without complex installation procedures.

Automation and Reduced Supervision Effort:

Parents and educators only need to periodically review emails or stored reports containing automatically generated logs, including keystroke records, clipboard data, screenshots, and web browsing histories. Continuous real-time supervision is not required.

Cost-Free and Suitable for the Vietnamese Context:

The software is entirely free of charge, lightweight, and consumes minimal system resources. It is particularly suitable for rural and mountainous areas or educational institutions with limited financial resources. The system does not require a constant Internet connection; data can be temporarily stored locally and transmitted once network connectivity becomes available.

Protection against Online Risks for Students:

By monitoring user interactions, the software enables early detection of potential online threats, such as grooming attempts, exposure to inappropriate content, and online fraud, thereby contributing to the protection of students' psychological well-being and online safety.

2.4. Công nghệ và công cụ phát triển

Python [11-18], was selected as the primary software development language due to several notable advantages, including its simple and readable syntax, which facilitates ease of development and long-term maintenance; high compatibility across multiple operating systems; extensive support for powerful libraries for system monitoring and management; and a large developer community accompanied by comprehensive documentation. As an open-source and free programming language, Python helps reduce licensing costs and enables seamless integration with other software systems.

A range of Python libraries [19-22], were employed to support key monitoring and system functionalities, including tracking and logging keyboard and mouse activities; monitoring clipboard content; capturing and processing screenshots; automating email transmission; establishing FTP connections for data transfer; and monitoring system processes and resource usage.

3. System Model

The proposed system is designed following a client-based monitoring application model, in which the monitoring software is installed directly on students' computers. The overall architecture consists of three main components:

Data Collection Module:

This module is responsible for capturing information related to students' computer usage activities, including keystroke operations, clipboard copy–paste content, web browsing history, and periodic screenshots.

Local Processing and Storage Module:

This module performs preliminary data processing, organizes and temporarily stores collected information on the local machine in the absence of network connectivity, and helps reduce system resource consumption.

Data Transmission and Reporting Module:

This module aggregates the collected data and periodically delivers reports to parents or teachers through appropriate communication channels, ensuring reliable data transfer whenever network connectivity is available.

This architectural model enables the system to operate independently, with high flexibility and ease of deployment, without reliance on complex server-side infrastructures.

The software is initially configured by parents or teachers, including parameters such as monitoring intervals and reporting mechanisms. During students' computer usage, the monitoring module automatically collects data according to

the predefined configuration. The collected data are processed and temporarily stored on the client device. At scheduled intervals or upon the availability of an Internet connection, the system aggregates the data and transmits reports to the designated supervisors. The supervisors then utilize the collected information to assess students' learning behaviors and implement appropriate guidance measures. This entire process is automated and does not require frequent user intervention.

4. System Implementation

The monitoring software system was implemented and evaluated on personal computers running the Windows operating system, which is widely used in educational environments in Vietnam. The software is packaged as a standalone executable file, allowing it to run directly on client machines without requiring complex installation procedures or advanced system configuration. This approach significantly reduces technical barriers for parents and teachers during deployment and use.

The software is designed to operate reliably on computers with mid-range hardware configurations, ensuring low system resource consumption and minimal impact on overall system performance during learning activities.

4.1. Implementation of Functional Modules

The software adopts a multi-module, multi-threaded architecture, in which each module is responsible for a specific function, such as keystroke logging, screenshot capture, clipboard monitoring, and web browsing history extraction. The design prioritizes lightweight operation, simplicity, and the ability to run in the background without degrading system performance, particularly on low-specification devices. The software is configured to automatically start with the operating system, ensuring continuous and stable operation from system boot.

4.1.1. Data Collection Module

The software records all keyboard activities performed by students, including special keys such as Enter, Shift, and Ctrl, and stores the captured data in text-based log files. This functionality enables parents and teachers to monitor students' activities, ranging from academic tasks to the use of potentially inappropriate applications. The data collection process operates silently, without displaying windows or notifications, thereby avoiding distractions during learning sessions.

4.1.2. Local Processing and Storage Module

The software captures and records all clipboard activities, including copied and pasted content from web pages, word processing documents, and source code. This feature supports the detection of academic dishonesty during online assessments as well as the identification of access to inappropriate content. The collected clipboard data are stored locally and subsequently transmitted to the designated supervisors.

In addition, the software automatically captures full-screen screenshots at configurable time intervals (default interval: 5 minutes). These screenshots allow parents and teachers to observe students' on-screen activities, such as studying, watching videos, playing games, or accessing social media platforms. The captured images are temporarily stored on the local machine and transmitted to supervisors via email or FTP.

The software also retrieves and stores web browsing history from the browser's SQLite database, including page titles and URLs of visited websites. This functionality enables supervisors to examine students' browsing patterns and promptly detect access to inappropriate or harmful websites.

4.1.3. Data Transmission and Reporting Module

The system utilizes the Zoho Mail service (SMTP over SSL) to transmit collected data to supervisors' email accounts. Additionally, the data are uploaded to an FTP server for long-term storage. To improve efficiency and reduce detection risks, large files are automatically segmented during transmission, and local copies are deleted after successful delivery. This mechanism helps conserve disk space and ensures unobtrusive system operation.

4.2. Configuration and Operational Mechanism

The software is configured to run automatically at system startup and does not require user intervention during operation. Installation packages can be customized for different user groups (e.g., parents or teachers), enabling straightforward deployment across multiple computers without requiring advanced technical skills.

The software operates entirely in the background, without displaying windows or appearing in the taskbar, thereby minimizing the likelihood of detection or manual termination. The monitoring process has a negligible impact on system performance, with individual data transmissions limited to file sizes below 25 MB, ensuring that network bandwidth and system responsiveness remain unaffected.

The software provides a simple and user-friendly configuration interface that does not require users to possess advanced technological knowledge. Depending on their needs, users can selectively enable or disable specific modules, such as screenshot capture or web history monitoring. The configuration process is performed only once, after which the software operates automatically in subsequent sessions.

5. Experimental Evaluation

The experimental study was conducted to evaluate the operational performance of the proposed monitoring software in real-world conditions, with a focus on system stability, system resource consumption, data collection and reporting capabilities, as well as its suitability for deployment in educational environments.

The software was experimentally deployed on several personal computers running the Windows operating system with hardware configurations commonly found in households and educational institutions. The experimental scenarios simulated students' typical daily learning activities, including online learning sessions, document editing, information retrieval via the Internet, and the use of commonly adopted educational software.

During the experiments, the software was configured to collect monitoring data at predefined intervals and to periodically transmit reports to designated supervisors. The evaluation was conducted over multiple consecutive working sessions to assess the system's long-term stability and reliability.

5.1. Evaluation Criteria

The effectiveness of the system was assessed based on the following criteria:

- Stability: The ability of the software to operate continuously over extended periods without errors, crashes, or interruptions.
- Resource consumption: The impact of the software on overall system performance, including CPU utilization and memory usage.
- Completeness of monitoring data: The capability of the system to collect and store data that accurately reflect computer usage activities.
- Data reporting and synchronization: The timeliness and completeness of reports delivered to parents or teachers.
- Usability: The level of convenience and ease of configuration and operation for users without specialized technical expertise.

5.2. Experimental Results

The experimental results indicate that the software operated stably throughout the entire evaluation period, without causing interruptions to regular learning activities. System resource consumption remained at a low level and did not significantly affect overall computer performance during use.

The monitoring data were collected in a complete and consistent manner, accurately reflecting students' learning behaviors and computer usage patterns. The local storage mechanism combined with data synchronization upon network availability enabled continuous system operation under unstable network conditions. Periodic reports were delivered in accordance with the predefined schedule, effectively supporting supervisors in monitoring and assessing students' learning activities.

Overall, the results demonstrate that the proposed solution satisfactorily meets the essential requirements of a monitoring software system for educational environments, particularly in terms of stability, usability, and suitability for the information technology infrastructure commonly available in Vietnam. Nevertheless, the experimental scope was limited in terms of the number of devices and the duration of deployment. Therefore, future work should involve larger-scale and longer-term evaluations to provide a more comprehensive assessment of the system's effectiveness and practical applicability.

6. CONCLUSION AND FUTURE WORK

This paper has presented the design and implementation of a computer activity monitoring software for educational environments, aimed at supporting parents and teachers in monitoring, managing, and guiding students' computer usage behaviors. Based on an analysis of existing monitoring solutions, the study proposed a system architecture tailored to the information technology infrastructure commonly available in Vietnam, emphasizing stability, ease of deployment, and cost efficiency.

Preliminary experimental results indicate that the system operates reliably, consumes minimal system resources, and is capable of collecting and reporting data to facilitate the assessment of students' learning activities. The proposed solution meets the fundamental requirements of a monitoring tool for educational settings, contributing to the creation of a safe, healthy, and effective learning environment.

Future research directions include: (i) enhancing the system's capability to analyze monitoring data in order to automatically detect abnormal behaviors or signs of distraction during learning; (ii) expanding the experimental scope to include a broader range of participants and educational settings to comprehensively evaluate system effectiveness; (iii) integrating the software with learning management systems to further support teaching and student management within the context of digital education. These developments are expected to increase the practical value and overall maturity of the proposed solution.

REFERENCES

- Qustodio LLC. (2024). Qustodio Parental Control Software. Retrieved from https://www.qustodio.com/, https://help.qustodio.com/hc/en-us
- Content Watch Holdings, Inc. (2024). Net Nanny - Parental Control Software. Retrieved from https://www.netnanny.com/
- Kaspersky Lab. (2024). Kaspersky Safe Kids - Free Parental Control App. Retrieved from https://www.kaspersky.com/safe-kids, https://support.kaspersky.com/KSK/Win1.3/en-US/134464.htm
- Norton Life Lock Inc. (2024). Norton Family - Parental Control Software. Retrieved from https://family.norton.com/
- Teramind Inc. (2024). Teramind - Employee Monitoring & Insider Threat Prevention. Retrieved from https://www.teramind.co/solutions/employee-monitoring/, https://www.teramind.co/images/cms/Teramind-User-Guide-2019-07-24.pdf
- Birch Grove Software, Inc. (2024). Activ Trak - Workforce Analytics. Retrieved from https://www.activtrak.com/, https://support.activtrak.com/hc/en-us/articles/360034996271-Guide-to-Getting-Started-with-ActivTrak
- Hubstaff. (2024). Time Tracking & Productivity Monitoring Software. Retrieved from https://hubstaff.com/, https://support.hubstaff.com/hubstaff-quick-start-guide-for-owners-and-managers/
- GitHub, Inc. (2024). GitHub Repository Collection - Keylogger Projects. Retrieved from https://github.com/topics/keylogger
- Prime Minister of Vietnam. Decision No. 749/QD-TTg: Approval of the "National Digital Transformation Program until 2025, with Orientation toward 2030". Hanoi, Vietnam: Government of Vietnam, 2020.
- UNICEF. (2020). Children's online safety in Vietnam. Retrieved from https://www.unicef.org/vietnam/
- Al Sweigart (2015), Automate the Boring Stuff with Python, No Starch Press.
- Bill Lubanovic (2015), Introducing Python, O'Reilly Media.
- Đoàn Minh Phụng (2022), Python Programming, Hanoi, Vietnam: Science and Technology Publishing House.
- Eric Matthes (2019), Python crash course, 2nd Edition, No Starch Press.
- Gowrishankar S., Veena A. (2019), Introduction to Python programming, CRC Press.
- Michael Dawson (2010), Python Programming for the Absolute Beginner- 3rd Edition, Publisher and General Manager, Course Technology PTR.
- Y. Daniel Liang (2013), Introduction to Programming using Python, Pearson.
- Lutz, M. (2009). Learning Python: Powerful Object-Oriented Programming (4th ed.). O'Reilly Media.
- Python Software Foundation. (2024). Python Documentation. Retrieved from https://docs.python.org/3/
- PyPI. (2024). pynput 1.7.6 - Monitor and control user input devices. Retrieved from https://pypi.org/project/pynput/
- Sweigart, A. (2020). Automate the Boring Stuff with Python (2nd ed.). No Starch Press.
- PyPI. (2024). Pillow - Python Imaging Library. Retrieved from https://pypi.org/project/Pillow/