Leveraging Social Robots to Address Productivity Challenges in College Students with ADHD

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ABSTRACT

Attention-Deficit/Hyperactivity Disorder (ADHD) significantly impacts college students' academic performance, time management, and focus, yet existing interventions lack tailored tools for this demographic. This study introduces software applications developed on LuxAI's QTrobot platform, intended to aid students with ADHD in managing their academic responsibilities and enhancing their concentration. The system incorporates the following modules: Conversation, Task Prioritization and Schedule Generation, Pomodoro, Engagement Detection, and Emotion Recognition. A preliminary assessment involving four undergraduate students yielded encouraging outcomes in enhancing task management and concentration. The findings suggest that such robots can effectively support students with ADHD, though some technical limitations require further development.

KEYWORDS

socially-assistive robots, human-computer interaction, robot-assisted therapy, attention deficit hyperactivity disorder, cognitive behavioral therapy techniques

Reference Format:
Yeji Han and Mira Saleh. 2025. Leveraging Social Robots to Address Productivity Challenges in College Students with ADHD. In *NYUAD Capstone Project 1 Reports, Fall 2025, Abu Dhabi, UAE*. 9 pages.

1 INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder defined by a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. Up until the early 1970s, it was commonly believed that ADHD symptoms were outgrown by adolescence. However, by the mid-to-late 1990s, it was widely recognized that about half to two-thirds of individuals with ADHD continue to exhibit symptoms into adulthood [19].

In fact, research indicates that about 2 to 8% of college students exhibit clinically significant levels of ADHD symptoms, and at least 25% of college students who have disabilities are diagnosed with ADHD [9]. These students face significant challenges that impact their academic success and social interactions. They often struggle with maintaining attention in class, managing their time effectively, and dealing with increased stress and anxiety. These difficulties can lead to lower academic performance, difficulties in forming stable relationships, and increased risk of substance abuse [10]. Despite the availability of therapies and medications for ADHD, there is a noticeable lack of assistive tools specifically designed to help manage the challenges associated with ADHD in older individuals [4].

Introducing Socially Assistive Robotics (SAR) into this context offers promising avenues for support. SAR focuses on enhancing human capabilities and daily functioning through interactive and socially engaging robots. These robots can provide personalized assistance and reminders, help with time management, and offer structured routines that can significantly ease the daily struggles of individuals with ADHD [4].

Previous work by Himanshi Lalwani, Sally Kattab, and Tuqa Abdelnasir resulted in the creation of specialized software tools integrated into LuxAI's QTrobot [14]. These tools were designed to support university students aged 18 to 24 in managing and completing tasks. The system is structured into the following key modules: Conversation, Schedule Generation, Voice Note Reminder, Pomodoro, and Engagement Detection.[12].

Building on the previous project, this study incorporates various improvements and new functionalities aimed at enhancing task management and student concentration in a

This report is submitted to NYUAD's capstone repository in fulfillment of NYUAD's Computer Science major graduation requirements.

university setting. One significant upgrade is the integration of an advanced engagement detection module, which replaces the earlier rule-based system with a deep learning framework for more accurate and dynamic engagement assessment. Additionally, emotion recognition has been incorporated, enabling the robot to respond empathetically to the user's emotional state during interactions. Another key enhancement is the implementation of a website-blocking feature during Pomodoro sessions, which creates a focused work environment by restricting access to distracting websites. The task management system has also evolved from requiring pre-formatted task entries to a more sophisticated approach where users can converse with the robot to talk about their main tasks and are guided through breaking them down into subtasks. Each subtask is inquired about its deadline and importance level. The implementation of the Eisenhower Matrix aids in determining priorities between different tasks, offering a more structured approach to task management. Furthermore, the daily schedule functionality has been expanded beyond simple terminal display to include automatic CSV file storage and Google Calendar and Notion export options, making the schedule more accessible and practical for daily use. These innovations collectively strengthen the robot's role as a productivity coach, addressing a broader range of challenges faced by students with ADHD.

Hence, the core contributions of this paper can be summarized as

(1) A novel SAR system tailored to young adults with ADHD, integrating modules for conversation, task prioritization and scheduling, Pomodoro sessions, engagement detection, and emotion recognition.
(2) Evidence-based Cognitive Behavioral Therapy techniques integrated into the system to help manage distractions, structure tasks, and enhance sustained focus, transforming the robot into an empathetic productivity coach.

2 RELATED WORK

2.1 Coaching for ADHD in College Students

Cognitive Behavioral Therapy (CBT) is a widely validated psychosocial treatment for ADHD, targeting maladaptive thought patterns and behaviors to improve emotional regulation and functional outcomes [24]. It addresses core challenges like time management, task organization, and distractibility through practical strategies such as breaking tasks into subtasks, using centralized calendars, and employing the *distractibility delay* technique, which defers distractions until the current task is completed [21]. Research highlights CBT's effectiveness. Antshel et al. found significant symptom improvement and enhanced real-world functioning among adolescents with ADHD, particularly those with comorbid anxiety or depression, though benefits were limited for those with oppositional defiant disorder (ODD) [2]. Studies with adults and college students also demonstrate CBT's long-term benefits in reducing ADHD symptoms, improving executive functioning, and enhancing quality of life, especially when combined with pharmacotherapy [13, 17, 20].

Building on these findings, our study integrates CBT techniques into an assistive robotic system, Alex, designed to support young adults with ADHD. Alex helps users manage tasks by breaking them into subtasks, generating schedules integrated with Google Calendar, exporting weekly task assignment to Notion, and using the distractibility delay technique to encourage focus by documenting distractions for later review. By combining structured scheduling with real-time support during disengagement, Alex promotes sustained attention, reduces stress, and fosters personal accountability, providing an empathetic, evidence-based tool to enhance productivity and emotional well-being.

2.2 Applications of Robotic Technologies and AI in ADHD Intervention

Robotic technologies for ADHD have primarily focused on educational therapy for children. Rakhymbayeva et al. demonstrated that robot-assisted therapy (RAT) improved engagement and social behaviors, such as eye contact and task compliance, through imitation and joint attention tasks facilitated by humanoid robots [18]. Similarly, Tleubayev et al. highlighted how RAT games like "Follow Me" and "Dance with Me" stimulated attention and tactile engagement, enhancing social interaction and focus [23].

However, there remains a lack of research addressing the unique challenges faced by adolescents and young adults with ADHD, such as academic demands and stress regulation. Amato et al. bridged this gap by combining Socially Assistive Robotics (SAR) with Artificial Intelligence (AI) to monitor attention and emotional states. Their system uses real-time emotion recognition and adaptive activities to provide personalized therapeutic interventions [1]. These advancements align with our project's goal of enhancing robotic interactions tailored to young adults with ADHD. Additionally, machine learning approaches for predicting engagement through visual and social signals, such as line of sight, head pose, and facial expressions, enable robots to provide adaptive interactions [16]. Brain-Computer Interface (BCI) games have also enhanced attention and motivation in children with ADHD using neurofeedback techniques [6]. AI-assisted tools, including robots and software, also support executive functioning by adapting to users' learning patterns, while systems like LOLA2 offer real-time monitoring and tailored assistance [3]. Experimental studies further highlight the value of personalized interactions; for instance, O'Connell et al. found that passive robotic support improved ADHD college students' voluntary study engagement [15].

2.3 Prompt Engineering Techniques

To achieve optimal performance in the interaction between the user and the robot, prompt engineering played a fundamental role in shaping Large Language Model (LLM) responses. We examined multiple prompting frameworks to enhance the effectiveness of QTrobot's communication capabilities.

2.3.1 Least-to-Most Processing Methodology. Least-to-most prompting represents an innovative approach to complex problem-solving that breaks down challenging tasks into progressively more sophisticated components. This methodology leverages a hierarchical decomposition strategy where simpler subtasks build towards more complex solutions, enabling more accurate and manageable problem-solving processes [7].

2.3.2 One-Shot Processing Methodology. One-shot prompting represents a sophisticated approach to AI interaction that leverages a single, well-crafted example to guide model behavior. This methodology combines advanced language model capabilities with strategic input design to generate coherent and contextually appropriate responses. The technique enables rapid deployment and efficient task execution while maintaining high accuracy through careful template structuring [7].

The above two frameworks were integrated into the Task Prioritization and Schedule Generation modules, facilitating the decomposition of complex task prioritization processes into discrete, manageable steps. Through the implementation of these methodologies, we established a structured approach for output standardization, incorporating exemplar templates that ensure consistent formatting and presentation of task lists and schedules. This integration enhanced the robot's capability to generate systematic, reproducible outputs while maintaining operational efficiency and user comprehension. The empirical implementation demonstrated the frameworks' efficacy in streamlining complex decision-making processes while preserving output consistency across multiple user interactions.

2.4 Eisenhower Matrix

As illustrated by figure 1, the Eisenhower Matrix is a powerful decision-making framework that categorizes tasks based on their urgency and importance, helping individuals make more informed choices about time allocation and task prioritization [5]. For college students with ADHD, who often

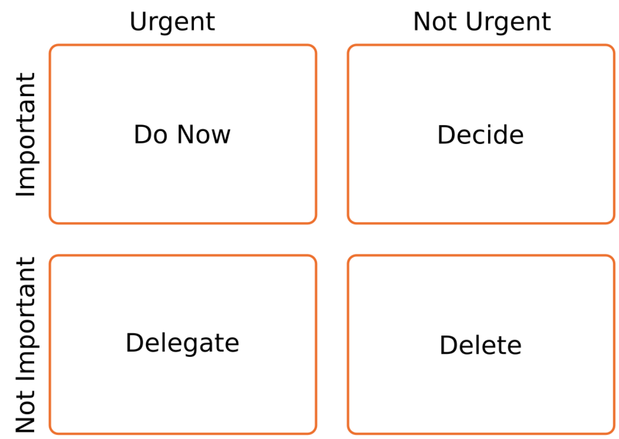

Figure 1: Eisenhower Matrix

experience challenges with academic performance and time management, this matrix can be particularly beneficial as it provides a clear, structured approach to organizing responsibilities.

Our solution implements the Eisenhower Matrix through interactive conversations with students during the Task Prioritization phase, guiding them to evaluate and categorize their tasks. This approach aligns with the matrix's four-quadrant structure (Do, Schedule, Delegate, Delete), while empowering students to develop their own decision-making skills. The conversational aspect is crucial as it helps students with ADHD make the abstract concrete and transform task awareness into task completion [11]. By engaging students in active dialogue about task prioritization, the system supports the development of executive functioning skills while maintaining user autonomy in the decision-making process.

3 METHODOLOGY

3.1 Scenario

Our use case focuses on the robot assisting students in organizing and completing their tasks. The robot creates a weekly schedule based on tasks entered through a text-based interface while gathering details such as deadlines and priorities. The tasks are assigned for the next 7 days, and the user can also choose to create a daily schedule. These items are also exported to Notion and Google Calendar. When the student starts a focused work session, the robot activates a Pomodoro timer. Throughout the session, it monitors the student's engagement and emotional state, providing supportive interventions if signs of distraction or negative emotions arise to help the student regain focus.

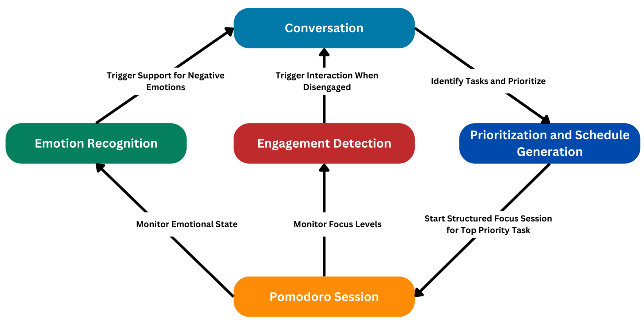

Figure 2: Overall Architecture Displaying Different Nodes of the System

The system's architecture, as illustrated in figure 2, demonstrates how its various components interact to enable seamless task management, focused work sessions, and real-time monitoring. Through interactive conversations, the system identifies and prioritizes tasks using techniques like the Eisenhower Matrix before initiating a focus session via the Pomodoro module. During the session, the Engagement Detection module continuously monitors user focus and triggers a re-engagement conversation when low engagement levels are detected. Simultaneously, the Emotion Recognition module analyzes the user's emotional state, detecting negative emotions such as sadness or frustration. When identified, it prompts a supportive interaction to address the user's concerns and help them refocus effectively.

3.2 Conversation

The conversational abilities of QTrobot were significantly improved through the integration of the OpenAI API. By employing prompt engineering techniques with GPT-4o, the robot was programmed to act as a study assistant named *Alex*. This assistant was tailored to support individuals with ADHD by facilitating task prioritization, generating schedules, and initiating focus sessions. The design of this role aimed to ensure interactions were both meaningful and supportive. This module effectively transformed QTrobot into an interactive and engaging study companion, enhancing its functionality and user experience.

3.3 Task Prioritization and Schedule Generation

The system implements a comprehensive task management and scheduling solution through multiple interconnected modules as demonstrated in figure 3. The architecture follows a user-centric design, emphasizing accessibility and automated assistance in academic planning.

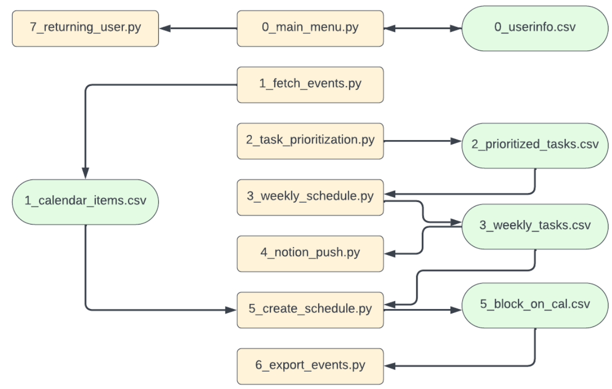

Figure 3: Task Prioritization and Schedule Generation Flowchart

```
Please enter the number to select the task that you want to execute:
1. Import your current schedule from Google Calendar
2. Converse with me to prioritize tasks
3. Converse with me to assign tasks for the next 7 days
4. Export the weekly task breakdown to Notion
5. Converse with me to schedule the tasks assigned to today
6. Export the generated daily schedule to Google Calendar
7. Start a focus session
Enter 'exit' to quit
Enter 'menu' to see the options again
Enter your choice:
```

Figure 4: Main Menu Display

3.3.1 *Authentication.*

The system's entry point is established through an authentication interface that serves as the initial landing page for all users. This interface presents a dual-functionality approach, accommodating both existing users through a login mechanism and new users via a registration process, ensuring secure access to the features.

3.3.2 *Main Menu.*

Following successful authentication, users are presented with an interactive menu interface, shown in figure 4, that serves as the central hub for all system functionalities. The menu employs a numerical selection system, allowing users to efficiently navigate and execute their desired operations through simple numerical inputs.

3.3.3 *Google Calendar Import.*

The system implements Google Calendar integration functionality by establishing a connection with Google Calendar's API. This integration is crucial for schedule optimization as it retrieves existing events and appointments, which are subsequently factored into the scheduling algorithm. The system interprets these time slots as unavailable periods, ensuring that task assignments do not conflict with pre-existing commitments.

3.3.4 *Task Prioritization.*

The system harnesses natural language processing capabilities through OpenAI integration to facilitate intelligent task management and decomposition, enabling a sophisticated approach to academic workflow optimization. It systematically breaks down complex assignments into manageable components through structured interactive dialogue, implementing established cognitive behavioral therapy (CBT) principle of breaking tasks into subtasks and offering contextual suggestions when users encounter difficulties in task breakdown. The framework incorporates a comprehensive deadline management system and employs the Eisenhower Matrix methodology for priority classification while maintaining user autonomy through customizable priority assignments and manual override capabilities. The human-robot interaction interface implements a hybrid communication model: utilizing text-to-speech synthesis for general interactions and terminal-based output for comprehensive task listings, with user input currently constrained to terminal-based text entry due to inherent limitations in contemporary speech recognition capabilities. This architectural design demonstrates a thoughtful balance between automated assistance and user control while acknowledging and adapting to current technological constraints in natural language processing and speech recognition systems.

3.3.5 Weekly Task Assignment and Notion Export. The task assignment algorithm operates on a seven-day framework, allocating 3-4 tasks per day while accommodating recurring subtasks across multiple days as needed for comprehensive task completion. The system generates detailed weekly task assignments, which users can review and modify. Integration with Notion's platform provides users with a dedicated external repository for weekly task documentation, enhancing accessibility and record-keeping capabilities.

3.3.6 Daily Schedule Generation and Google Calendar Export. The system synthesizes daily task assignments with imported Google Calendar events to create comprehensive daily schedules. This detailed temporal planning ensures optimal task completion while respecting existing commitments. Users maintain the flexibility to adjust these generated schedules, and the system supports direct export to Google Calendar, providing visual representation and easy access to daily planning structures. This again is one of the strategies employed by CBT, of using centralized calendars to structure time and obligations.

3.3.7 Returning Users. For returning users, the system implements a tracking mechanism that monitors task completion from previous sessions. Through interactive dialogue, it assesses task completion status and, in cases of incomplete tasks, analyzes underlying challenges. The system provides tailored feedback and strategies to address identified obstacles, supporting continuous improvement in task management efficiency.

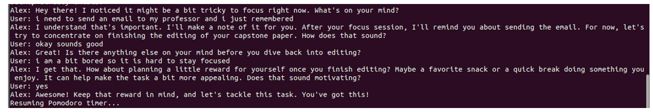

Figure 5: Sample Disengagement Detection Output

3.4 Pomodoro Session

The functionality of QTrobot is further enhanced with the integration of a Pomodoro timer, specifically designed to address the time management challenges faced by students with ADHD. The timer operates on a structured schedule of 25-minute focused work intervals followed by 5-minute breaks, repeating for two cycles before a longer 15-minute break. If disengagement or negative emotions are detected during a Pomodoro session, the timer pauses for the conversation and resumes afterward, ensuring the user can seamlessly return to work without losing time.

To further promote focused work during Pomodoro sessions, a website blocking mechanism is implemented to restrict access to distracting websites, such as social media platforms and streaming services. This mechanism modifies the system's hosts file to redirect specified URLs to a local address, effectively blocking access during active work intervals. The process is dynamically managed, with websites automatically unblocked during break periods by restoring the original hosts file. This functionality creates a distraction-free environment during work intervals while ensuring users can access these websites during designated breaks, supporting a balanced approach to productivity and relaxation.

3.5 Engagement Detection

The engagement detection module implemented builds on the work by Del Duchetto et al., which introduces a sophisticated deep learning framework for continuously assessing engagement during human-robot interactions. This module goes beyond traditional gaze or facial feature analysis, incorporating advanced temporal and spatial modeling to produce accurate engagement scores in dynamic scenarios [8].

The module utilizes a hybrid architecture designed for real-time engagement assessment, combining a Convolutional Neural Network (CNN) and a Long Short-Term Memory (LSTM) network. Video frames are first preprocessed through resizing and normalization, then passed to the CNN, specifically a ResNetXt-50 pre-trained on the ImageNet dataset, which extracts high-level spatial features. These features capture details such as body posture, facial orientation, and the presence of individuals in the robot's field of view. The extracted features are then processed by the LSTM over a sequence of 10 frames, corresponding to a 1-second window. This temporal modeling captures dynamics such as sustained attention, movement patterns, and transitions in engagement. The LSTM aggregates the features and produces a scalar engagement score ranging from 0 (disengaged) to 1 (fully engaged) [8].

The module effectively captures both static features and temporal patterns, allowing it to distinguish between sustained attention and brief glances. It accounts for momentary lapses in focus without significantly lowering engagement scores, maintaining recognition of continued interest. Additionally, the system handles scenarios where traditional facial or gaze analysis may fail, using temporal cues like body orientation and interactions with objects to accurately assess engagement, even when facial features are ambiguous or occluded [8].

This engagement detection module operates during Pomodoro sessions, monitoring user engagement in real-time. The module processes video frames captured by the webcam for a duration of 30 seconds, after which the average engagement score is computed. A threshold of 0.93 was established through internal testing to differentiate between engaged and disengaged states effectively. When the average engagement score falls below the threshold, several conditions are checked before initiating a response. An active conversation must not be underway, and a cooldown period of 60 seconds since the last conversation must have elapsed. The cooldown period is implemented to prevent overly frequent interactions that could disrupt the user's workflow. If these criteria are met, the Pomodoro timer is paused and Alex addresses the user, stating that it has detected disengagement and inquiring about the user's thoughts.

If the user mentions being distracted by unrelated tasks, Alex uses the CBT-based "distractibility delay" technique to prompt them to acknowledge the distractions. GPT-4o is used to extract the distracting tasks from the conversation and record them in an array, so that the user can be reminded of them after the session. Once the user indicates there is nothing else on their mind, the conversation ends and Pomodoro timer resumes, allowing the user to continue working at the task on hand. At the conclusion of the entire Pomodoro cycle, Alex revisits the tasks documented during the session and reminds the user of these pending items.

Figure 5 presents a sample conversation between the user and Alex, where Alex empathetically acknowledges the user's struggle to maintain focus and gently asks, "What's on your mind?" The user responds by sharing that they remembered the need to send an email to their professor. Alex validates this concern and reassures the user that it will be noted for follow-up after the current focus session. When Alex probes further, the user admits to feeling "a bit bored," which makes it difficult to concentrate. In response, Alex suggests a motivating strategy: planning a small reward, such as enjoying a favorite snack or taking a brief break, after completing the task. The user agrees to this approach, and Alex provides encouraging words to help the user refocus. The conversation concludes, and the Pomodoro timer resumes.

3.6 Emotion Recognition

The emotion recognition module implemented leverages the DeepFace library, a state-of-the-art facial recognition and emotion analysis framework. DeepFace identifies seven primary emotional states—angry, disgusted, fear, happy, sad, surprise, and neutral—enabling the system to monitor and respond to the user's emotional state during interactions.

The module processes video frames from the webcam every 5 seconds using DeepFace's analyze method to identify the dominant emotion among seven categories. Negative emotions—defined as angry, disgusted, fear, and sad—are recorded, and the system initially calculated their percentage every 30 seconds. A response was triggered if the percentage exceeded a 40% threshold, provided there was no ongoing conversation and a cooldown period of 60 seconds had elapsed since the last interaction to avoid frequent interruptions. Under these conditions, Alex initiates a tailored and empathetic dialogue to support the user. Alex encourages the user to express their feelings and offers practical coping mechanisms, such as guided breathing exercises, grounding techniques like the 5-4-3-2-1 method, or recommendations for mindfulness practices, creative outlets, or study tips based on the situation.

However, frequent triggering was observed, disrupting the user's workflow. To address this, the analysis interval was increased to 60 seconds, the threshold was raised to 80%, and the cooldown period was extended to 5 minutes. Despite these adjustments, the system still initiated conversations more often than desired. Due to time constraints, we were unable to fully resolve this issue, but a potential solution would be to limit the number of times a conversation can be triggered within a session to avoid overwhelming the user.

4 EVALUATION

Prior to the initiation of this study, approval was obtained from the University Institutional Review Board. This study utilized a structured experimental design to evaluate the effectiveness of the QT Robot in supporting task management and focus among college students. Participants completed pre- and post-experiment surveys to assess their executive functioning, attitudes toward robots, and system usability. The experiment focused on task prioritization and completion within a single session, where participants interacted with the robot to create schedules and engage in focus sessions.

4.1 Participants

The study included four full-time undergraduate students, aged 21 to 23, with an equal gender distribution of 2 females and 2 males. Participants were recruited through a sign-up form that gathered relevant background details and assessed their ADHD symptoms using the Adult ADHD Self-Report Scale (ASRS). The four participants had ASRS scores of 0.833, 2.44, 3, and 4, which showed a good range of participants with low to high frequency of reported ADHD symptoms.

4.2 Study Design

Each session was conducted with the guidance of an experimenter. Participants were asked to complete a pre-experiment questionnaire upon their arrival. Once the questionnaire was completed, participants either logged into the system or created a new account if they were first-time users. The interaction with the robot began with the participant being prompted to grant access to their Google Calendar. This access enabled the robot to retrieve the participant's scheduled events for the day. Following this, the participant had a conversation with the robot, with the participant interacting on the terminal and the robot interacting through its speech output. The purpose of this interaction was to help the participant organize their tasks, prioritize them effectively, and generate a structured to-do list and schedule. Once the schedule was finalized, it was exported to their Google Calendar and Notion.

Once participants had organized and prioritized their tasks and finalized their schedules, they began a focus session dedicated to working on their top-priority task. The robot facilitated this session using the Pomodoro technique, initiating with a 25-minute focused work session followed by a 5-minute break. To minimize distractions, the robot temporarily blocked access to distracting websites during the work interval and restored access during the break.

Throughout the session, the robot monitored the participant using a webcam to detect signs of disengagement or stress. If these were observed, the robot initiated a supportive conversation designed to help the participant regain focus and continue working effectively.

At the conclusion of the 30-minute session, the robot thanked the participant for their involvement, marking the end of the session. This structured approach aimed to evaluate the robot's ability to assist with task prioritization, productivity enhancement, and focus maintenance.

4.2.1 Pre-experiment survey. Before beginning the experiment, participants completed a pre-experiment survey designed to capture their existing approaches to task tracking and scheduling. It also included the Executive Skills Questionnaire-Revised (ESQ-R) [22], which assessed their executive functioning skills.

4.2.2 Post-experiment survey. Following their interaction with the system, participants completed a post-experiment survey. The survey collected participant feedback on various aspects of the study, including the robot's effectiveness in assisting with task prioritization and scheduling, comparisons between self-scheduling and robot-assisted scheduling, and reflections on the focus session tasks. Participants were also asked to evaluate how effectively the robot supported them during the Pomodoro session, particularly in helping them refocus.

4.3 Results

4.3.1 Pre-experiment. The qualitative data collected prior to the experiment revealed diverse patterns in task management and personal traits among the users. For task tracking, they employ various methods ranging from digital solutions like Akiflow and OneNote to traditional approaches like lists and checklists. Schedule management predominantly centers around Google Calendar, with some participants using it for time blocking and task organization. Regarding organizational challenges, users frequently reported difficulties with task completion and attention maintenance, as well as maintaining focus during repetitive work. Personal trait assessments showed that users generally agreed they get upset when plans go awry and have difficulty estimating task completion times. The data also indicates varying levels of organizational skills, with some users consistently reporting high frequencies of organizational challenges while others showed more moderate patterns.

4.3.2 Post-experiment. Users expressed satisfaction with several aspects of the robotic system, particularly highlighting its supportive features and scheduling capabilities. The robot effectively provided accountability and positive reinforcement to help users maintain focus on their tasks during the focus session. The structured schedules it generated were highly valued, featuring realistic time allocations, focus blocks, and well-planned breaks, which users found superior to self-made schedules. The system demonstrated strong capabilities in re-engagement support by identifying disengagement and offering motivational suggestions. Users also appreciated the robot's ability to consider deadlines and the importance in task prioritization while providing emotional support during focus sessions.

Several suggestions and areas for improvement emerged from the user feedback. The system's technical aspects received some criticism, with users noting slow speech and response times as significant drawbacks. A strong desire for a graphical user interface (GUI) was expressed to enhance user-friendliness. The emotional support module's frequent interventions in response to detected negative emotions were sometimes perceived as disruptive, indicating a need for better calibration. Users also suggested implementing the ability to initiate conversations with the robot rather than having the robot control the interaction flow. The likelihood of future use or recommendation of the system varied among participants.

5 LIMITATIONS AND FUTURE WORK

Preliminary evaluations of the system demonstrate its potential to enhance productivity and focus among users. However, some limitations observed include the inability to pause custom video playback on the QTrobot's display via ROS commands. This issue, attributed to system-level calls on the robot that fail to execute as intended, was confirmed to be a constraint on LuxAI's end. As a result of this limitation, custom videos were not displayed during this study. To address this, we plan to explore alternative methods or implement updates from LuxAI to ensure smoother functionality for custom video integration in the future.

Additionally, the emotion detection model frequently triggered responses, disrupting the user's workflow. To mitigate this, we increased the analysis interval to 60 seconds, raised the threshold to 80%, and extended the cooldown period to 5 minutes. Although these adjustments reduced interruptions, they did not fully resolve the issue. A potential solution is to limit the number of triggers per session to prevent overwhelming the user.

Furthermore, the system currently relies on a Command-Line Interface (CLI) which, while efficient, poses usability challenges for non-technical users due to its text-based nature and lack of visual elements like buttons and interactive windows. This limitation impacts user engagement and requires more extensive training.

Lastly, while speech capabilities were tested using NVIDIA's Riva and Google's Speech-to-Text API, significant technical issues arose including poor voice detection, premature session termination, and inaccurate transcriptions. As a result, while the robot retains speech output functionality, user input remains CLI-based to maintain reliable interaction, with the potential for future exploration of alternative speech recognition solutions.

6 CONCLUSION

Our system provides an innovative and comprehensive solution tailored to support students with ADHD in managing their academic responsibilities. Acting as a productivity coach, the robot offers a range of integrated features that include task prioritization, daily schedule creation, and Pomodoro session facilitation. It supports multiple users through a login and authentication mechanism. The system also integrates with Google Calendar for seamless import and export of events, ensuring schedules are synchronized with users' commitments. Additionally, engagement and emotion detection modules monitor the user's focus and emotional state in real time, enabling the robot to provide timely and empathetic interventions when signs of disengagement or stress are detected. Furthermore, the robot blocks distracting websites during Pomodoro sessions to create a focused work environment. These features are complemented by the ability to conduct meaningful, task-oriented conversations and the use of behavioral strategies inspired by Cognitive Behavioral Therapy (CBT) to address productivity challenges. Overall, we believe that this project can meaningfully impact college students with ADHD by offering a practical and innovative tool designed to support their academic achievements.

7 CODE AVAILABILITY

The source code for our project is available on GitHub at the following link https://github.com/H2YL/fall2024qtrobot.git

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