A Smart Desk: A Smart Solution for Young Students

Ahmed Shuhaiber*, Rund Hiyasat**, Amjad Abuelsamen***, Nasreen Ghanem*, Mouza Alhammadi*, Alreem Alghafri*
*College of Technological Innovation (CTI),
**College of Arts and Creative Enterprises,
***College of Interdisciplinary Studies,
Zayed University, Abu Dhabi, UAE
Emails: Ahmed.Shuhaiber@zu.ac.ae, Rund.Hiyasat@zu.ac.ae, Amjad.Abuelsamen@zu.ac.ae, 201800063@zu.ac.ae, 201505910@zu.ac.ae, 202008516@zu.ac.ae

***Abstract* - Boredom while doing homework is a common problem faced by young school students. This can affect their learning progress and achievements. On the other hand, toddlers and young children are becoming more and more experience with technology. This paper aims towards taking advantage of kids' vast experience with technology to better achieve learning outcomes; thereby, developing a smart desk that can smartly check for progress, entertain student while studying, and provide comfort to young users and their parents for daily learning activities. The methodology followed to develop this smart desk is the waterfall SDLC, where a system is developed, analyzed, designed and initially implemented. More precisely, requirements were gathered, modeled, and analyzed, the interfaces and databases were designed, coding and testing took place subsequently. The desk's features include following up with students' homework, measuring students' learning progress based on the scheduled tasks, cheering students when achieving a milestone, alerting for time breaks and more. The smart desk is also a friendly to-use system for juniors. Further, schools and academic institutions can embrace the new technology, thus benefitting from the gains of having a smart desk. The study concluded with implications and future development directions.**

Keywords - Smart Solutions, Smart Desk, Junior Assistant, Kids Tables, System Prototype

I. INTRODUCTION

The current era, also known as the digital age or information age, has brought about a rapid pace of technological advancement and change, however, the traditional methods of learning at home have remained relatively unchanged. This has resulted in a growing number of junior students feeling disengaged and uninterested in their studies. The lack of interaction, hands-on activities, and personalized experiences, combined with the overreliance on technology, has created a monotonous and repetitive learning environment [1]. This, in turn, leads to boredom, decreased motivation, and a lack of attention for many students, thereby affecting their academic progress.

The decline in children's interest in their studies has been a growing concern among parents in recent years, leading to negative impacts on their academic progress and overall learning experience. This trend has been reflected in poor grades and even warnings or dismissals from junior schools, causing alarm in the education sector [2]. The root cause of this issue is complex and multidimensional, with some students feeling bored or disinterested in their studies [3]. This disinterest leads to a lack of attention and motivation, which can have long-lasting impacts on their academic performance and future success [4]. The decline in interest in studies among young students is a worrying trend that has the potential to negatively impact the education sector, particularly for younger students who are just starting their academic journey [2]. If left unaddressed, this trend could reduce the quality of education, affecting the future of these students and the education sector as a whole [4].

The research community, parents, educators, and practitioners are putting efforts into exploring innovative solutions to make learning more enjoyable and comfortable for students. The integration of technology in the field of education has been a game-changer in recent years [5]. With the rapid advancement of technology, there has been a surge of opportunities for innovation in the way students learn and interact with information [3]. The integration of technology in the classroom has been widely recognized as an effective way to enhance the learning process for students of all ages [6]. In addition to providing a more interactive learning experience, technology has also enabled the creation of learning tools and platforms that allow students to access educational resources from anywhere and at any time [6]. One such solution is the development of smart desk systems.

The current research, proposes smart desks for young, school-age kids. It aims towards making high-quality display desks that enhance young children's learning process. It endeavors to enhance and motivate little young students to learn more efficiently by ensuring entertainment while learning. This can be achieved via the reward system proposed in the design.

For this purpose, this article is structured as follows: the following section (section 2) provides an insight to relevant papers from precedent literature. The research methodology and objectives are concisely summarized in Section 3. Next, in Section 4, the discussion and findings showcase the study's significance. While, the study concludes in section 5, limitations and future work recommendations are explained in section 6.

II. LITERATURE REVIEW

The integration of computer technology and multimedia capabilities allows students to interact with digital content in new and innovative ways. Smart Desk systems offer such capability, making the learning process more interactive, engaging, and fun. The concept of Smart Desk Systems can be traced back to the early 2000s when multi-touch technology was first introduced in consumer electronics. A Smart Desk System is a type of interactive desk that incorporates computer technology and multimedia capabilities to provide a collaborative and interactive platform for various activities such as education, meetings, and entertainment [4].

The Smart Desk System is a technological solution designed to meet the needs of the younger generation. It could potentially provide features such as interactive displays, connectivity to devices, and streamlined organization and access to information. These desks have been developed to enhance the learning experience by making it more interactive and engaging for the younger generation with its advanced technology [3, 12]. Thus, The Smart Desk System is an innovative solution that aims to make the learning process for junior students at home more motivating, encouraging, and interactively engaging, while also reducing stress for parents. By using touch and gesture controls, students can interact with digital content in a natural and intuitive way, which can help increase engagement and motivation [5]. With its advanced features and capabilities, the Smart Desk System has the potential to revolutionize the way junior students learn and make remote education a more enjoyable and effective experience [7].

The concept of Smart Desk Systems has been gaining attention in recent years as a potential solution for enhancing the learning experience in both traditional and remote settings. During the COVID-19 pandemic, the shift to remote learning has highlighted the need for technology that can provide a similar experience to that of a traditional classroom's [8]. The Smart Desk System is well suited for this purpose as it can provide an interactive platform for students to engage with digital content, as well as with one another, regardless of their physical presence. consequently, various companies and research institutions have developed their versions of Smart Desk Systems, each with unique features and capabilities. The following provides an insight into some Smart Desk Systems available in the market.

The relevant literature indicated several studies of smart desks and table for educational purposes. For instance, and serving as a coffee table, Kazar tables as in [9] can bear other objects, such as glasses, plates, magazines, etc. and has a wireless charging station. Furthermore, the table also features a speaker system, which can also be linked to devices like home theatres via Wifi, or Bluetooth connections.

Thus, replacing televisions. To maintain high hygiene levels, the table's surface is treated to prevent bacterial growth and spread.

Another instance, but from the educational sector, SMART™ Table. This table can be regarded as a technological tool carrying various benefits for enhancing the students' and teachers' classroom experience [10]. The current study has focused on the key features of the SMART Table. The components of the supply chain process in the development and delivery of the device have been explained. Moreover, the benefits and limitations of the use of the SMART Table in the classroom have been covered. A few of the notable benefits are ease of remembering content, doing homework, and giving presentations. The cost of SMART Table is a key challenge that can limit the integration of the device as a learning tool. Another issue that can create a challenge in the adoption of SMART Table by students and teachers is the lack of readiness to adopt this technology in the classroom. As evident from the findings, a preference for whiteboard and concern towards the lack of surety about the usefulness of SMART Table in communication between teachers and students can limit its applicability in the University of Bridgeport. Nevertheless, the benefit of the SMART Table in the educational sector cannot be overlooked as it supports students and teachers in dealing with complex concepts and content.

Another example is Magnetic resonance wireless power transfer (MWPT) technology can potentially simplify the electrical cable layout and routing for the indoor environment due to its relatively long transmission distance and high efficiency [11]. Targeting at smart table applications, a series-series matching two-coil MWPT-powered LED system operating at 28 cm optimal operating distance is designed and characterized [11]. The effects of the varying operating distances and different blocking materials on the power transfer are studied. In addition, the system performances under different operating frequencies are also measured and analyzed.

III. METHODOLOGY

A. Planning Phase

The project's current resources, including software, hardware, and essential technologies, are analyzed and evaluated in the technical feasibility stage. This analysis provides information on whether the technology and resources needed to develop the project are indeed available to the company. A feasibility study also looks at the know-how of the technical team, the practicality of employing existing technology, the simplicity of upkeep and technological upgrades, among other things.

The smart desk project will be made initially for the little kids in the UAE due to the availability of high advanced technological infrastructure that allows us to develop and allow users to gain access to the system using existing infrastructure technology available to them at their homes for the completion of kids learning needs. Further, manufactures can easily integrate with current/available technologies in the country to the proposed functionalities such as integrating sensors with hardware to detect kid's mood.

This smart student desk must be constantly improved during the designing and implementation phases, and a final prototype must be tested in most of the potential scenarios. The system will be more dependable as a result. The new system may function independently since it will have its own storage and database and does not require integration with other databases. This new system would make learning for kids more enjoyable; as it would entertain kids and transform their lazy and boring traditional learning system to more interactive and user-friendly system. The technical team available with the company are only three staff, who alone will not be able to design and develop smart student desk. Therefore, more technical talents and talents of software development will be hired. We also have an option to outsources the hardware development team.

The desk adopted a flexible design that can best suit the student's individual needs. As children grow taller, the desk's height can be adjusted for a healthier posture. Further, to optimize storage, the desk is equipped with a deep drawer, pencil and stationary storage compartments, and a pull-up tablet and cable storage compartment. The tablet can be placed either horizontally or vertically, thus displaying in landscape, or portrait format, respectively. Additionally, the tablet's angle can also be rotated to fit the user's height and comfort.

Similarly, the desk's surface can be adjusted with a 10° angle. This allows for various kinds of activities to be conducted on the tabletop. An art project, a painting, or a reading assignment, for instance, can be performed on the inclined surface. If the students are copying or writing a piece of text, the desk can be adjusted to a 0° angle to better fit the task. The bottom of the table's top has a grove that prevents pencils and pens from sliding down as the table's inclination is adjusted.

On right-hand-side of the user, lies the control panel, where all buttons can be placed in a closed compartment. From this control panel, users can adjust the desk's height, angle of inclination of the tabletop, and pull the tablet compartment up or down. That side also hosts a set of other compartments that feature pen and stationary storage. Finally, the upper compartment features electric sockets that can be connected to the wall's electricity source. All cables can pass through the desk's wide and hollow legs, to avoid tripping danger. Finally, the tablet's pullup compartment also features shelves with clips to organize cables and avoid messes. The figures below (Figure 1 – 4) show a set of conceptual illustrations of the proposed Smart Table System.

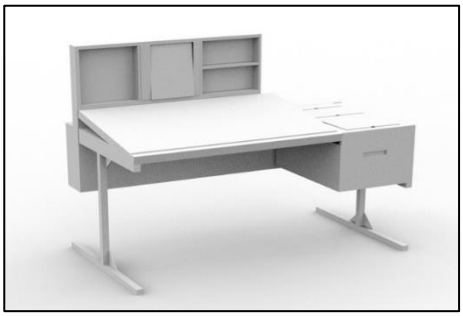

Figure 1 Conceptual model of the proposed table. Source: Authors

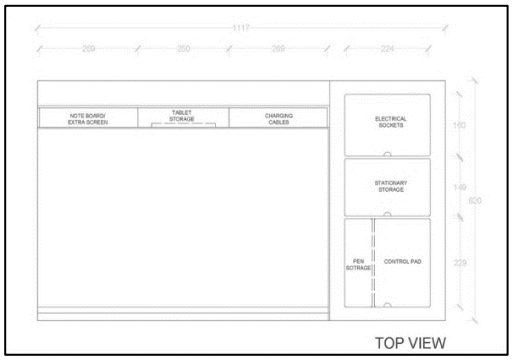

Figure 2. Smart Desk - Top view. Source: Authors

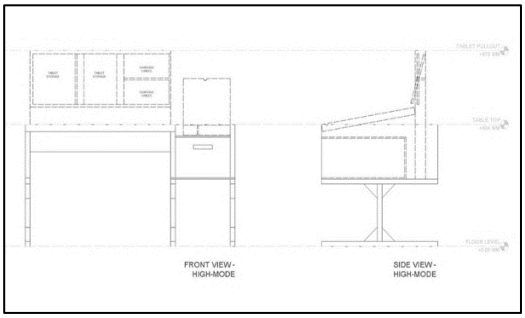

Figure 3. (Left) Desk's Front View (Right) Side View. In Highest mode.

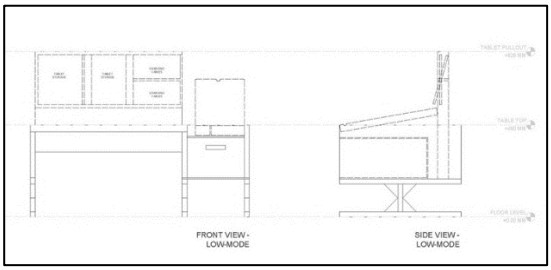

Figure 4. (Left) Desk's Front View (Right) Side View. Both in the lowest mode.

B. Analysis Phase:

1) Requirements gathering

To ensure our product is successful and useful We have explained below the main system requirements to reach our goals. There are two types of system requirements: functional and non-functional system requirements.

Each user mentioned below has an important role in completing the system well and completely because they use the system

regularly and rely on it to improve the relationship between the student child at home and his studies.

Parents

- Faster and easier because they only have to enter their e-mail to receive the child progress reports.
- Able to check the tasks of their children.
- Able to see the child's selection of the weekly reward and put it in the box.

children:

- Able to always use the desk.
- Able to solve tasks using the hologram system
- Able to open the fund every weekend

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Functional Requirements

The functional aspect describes what the system is requires in three fronts: input. Output, and process.

Input

- The system will require creating a special account for each child of the family.
- The system will ask to sign in for the child.
- The system will activate the hologram screen.
- The system will ask to choose characters for each child.
- The system will choose the tasks of the day.
- The system will show you options to finish incomplete tasks or start new tasks.
- The system asks the child to scan the book or page that the system is required to help the child with.
- Sometimes the system will scan the child's mood through sensors.
- At the end of all assignments, the system will allow the student to choose his end-of-day rewards.

Output

- The system grants access to students with active account
- The system will welcome the child using the hologram system through different characters.
- If the child adds new tasks, it will be added to the existing tasks that must be completed.
- Alert that there are incomplete tasks.
- The page that was scanned appears in a high-quality display that the child can touch and interact with
- The system sends the end of all tasks to report what the child has achieved in the day.
- Change the display system according to the mood of the child.
- Opening a special box in the desk to place the reward of the child by his parents. The system does not open this box until all the tasks required at the end of each week are completed.

Process

- A student must be logged onto his account before using the desk.
- The hologram system will be turned on and a character speaking to the child will appear.
- The child's choice of today's tasks (completing previous tasks or new tasks).
- Scan the page to view it by hologram.
- Scan the child's mood every half an hour (if he is happy to complete the presentation, but if he is not satisfied, the system will change the character who is talking to the child).

Non-Functional Requirements

This part of the system describe how it operates during performance and control.

A. Performance

- The system will check all tasks.
- The system operates 24 hours a day and seven days a week.
- Charge the desk for a full night after you finish it.
- No system lags.
- The system does not delete tasks on its own.
- It will only take 30 seconds to scan a child's mood.
- The system should send reports to parents at the end of each day.
- The system must save all the tasks of each child in a special file.
- The system tolerates multiple inputs or multitouch’s.

B. Control

- The use of the desk is limited to the student child and school assignments only.
- Only the child himself or one of his parents can access the accounts of the child.
- A child is not allowed to cancel an assignment**.**

As for the system modelling, we developed the Context Diagram, and the Entity Relations diagram for demonstrating data, as in Figure 5 and 6

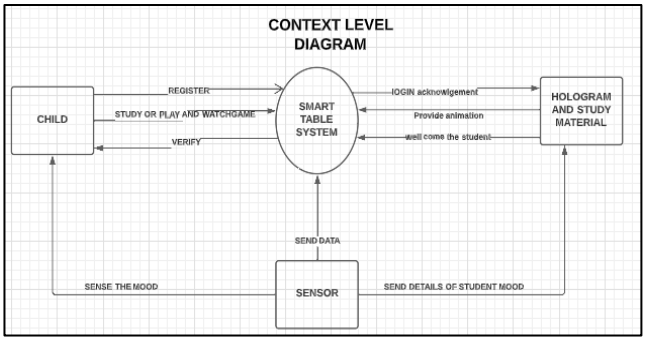

Figure 5. Data Flow Diagram

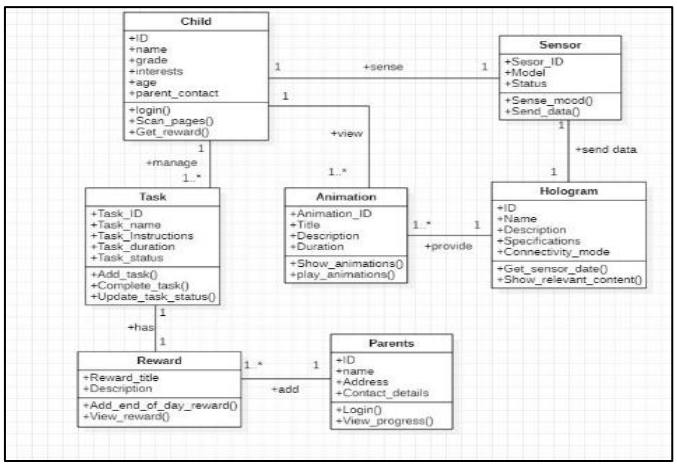

Figure 6. Entity Relationship Diagram

The researchers also considered modelling the decisions and conditions associated with the system, as shown in Figure 7.

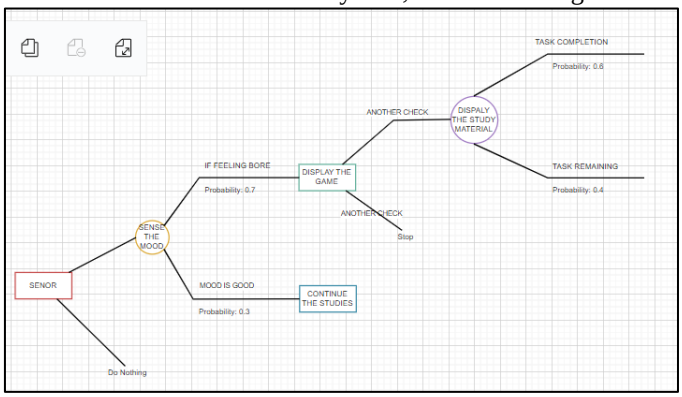

Figure 7. Decision Tree

C. *Design & Implementation Phase*

Also, the figure below (8, 9 and 10) shows samples of the system interfaces, in form of the log-in screen, student's profile and the animation display to all users.

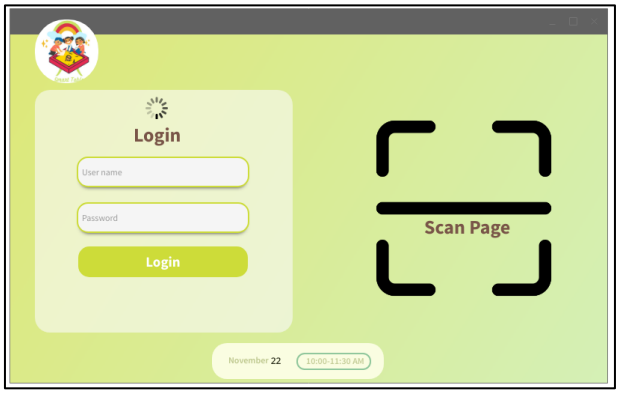

Figure 8. Profile Log-In

Figure 9. User Profile

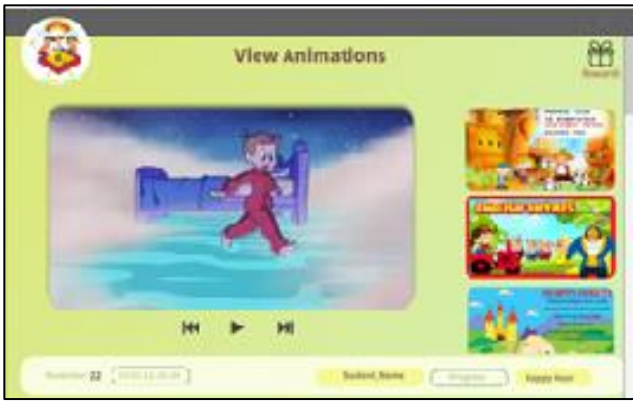

Figure 10. Animation page

D. *Testing Phase*

Alpha testing is the first step in in which developers test the product on their own end. In this stage, we didn't face any structural or functional issues related to the desk. The software was also tested, where users were given system' inputs to try out and observed system' responses according to the requirements. In short, the Alpha testing was successful. In the second phase which was Beta testing, we invited a group of parents along with their kids to test the system, children created

their accounts in the supervision of their parents and fortunately here too our system performed very well. So, the beta test was also successful and fulfilled the user needs.

IV. Discussion

The smart desk has noticeable impact on the studies of the children. The main purpose of smart desk is to engage children in their studies and minimize boredom they feel while studying and lose their interest during studies. Children would feel curious about the smart desk and its Holographic display, which is an innovative idea and kids just think in dreams about these kinds of gadgets. We were also curious about the smart desk that if we are making any mistake because if we talk about the tablets, laptops and smart phones then they gave many advantages but side by side they also distracted kids from their studies and provided them with games and other fun opportunities which is ethically wrong and it also cause of bad performance of students.

Smart desk resolved all these issues and assist children to focus during their educational activities. Smart desk also completes all the objectives and goals which we were expecting from this project and allowed us to explore such a great and innovative idea successfully.

V. Conclusion

In summary, our developed smart desk for kids is designed to make learning and doing homework more fun and interactive than SMART™ and MWPT desks, and more oriented to education than Kazar's table. Our smart desk integrated various technologies that cater to student's needs and interests. Our desk has Adjustable height feature, interactive touch screen, integrated speakers, wireless charging and integrated storage which make the learning process personalized and convenient to students at homes.

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