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**Online Collaborative Learning System:
Prototype Interface Design
Usability Engineering**

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Introduction

Covid-19 caused by the new severe acute respiratory syndrome coronavirus (SARS-CoV-2), was reported in the province of Wuhan, China, in December 2020. By November 2020, over 48 million confirmed cases and 1.2 million deaths were reported by the World Health Organisation [1], leading to major disruptions in education systems and public lockdowns globally. The pandemic has delayed numerous practical learning sessions at the university. The existing e-learning technologies including, the student-teacher Moodle, are limited to support practical learning sessions, especially for science courses.

This project presents an improved prototype interface design for an online collaborative learning whiteboard that could help bridge the gap and offer virtual learning assistance for practical lessons. The existing Moodle tracker used by students and teachers in the university as shown in Figure 1 does not contain a virtual whiteboard interface to support interactive learning during the pandemic. The proposed whiteboard will support virtual and interactive learning for students physically unavailable on campus due to Covid-19 restrictions [2]

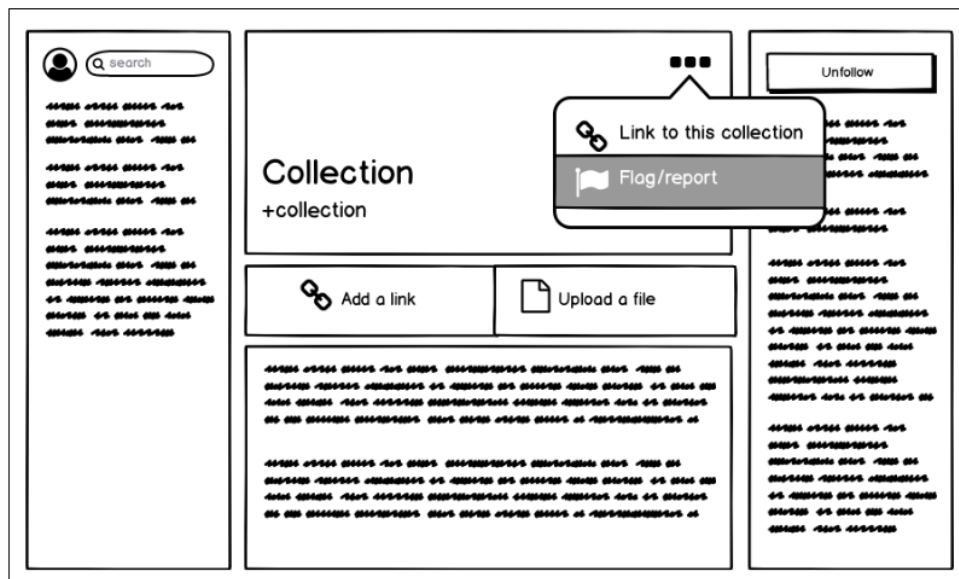


Figure 1: Existing Learning Moodle

The current Moodle tool design was subjected to simple usability to establish the need to address issues for the existing UI and IX design portfolio. As such, a heuristic evaluation was performed using a severity rating scale as shown in Table 1 [3]. A heuristic evaluation entails a usability assessment technique for a computer application to establish user interface and user experience design issues [4]. Usability tasks to be carried out and then heuristic that is violated, it identified its severity and proposed adjustments that can be conducted to solve the specific issue. As observed in Figure 2, the most significant issue is the interactiveness as the application is more of uploading and downloading learning contents.

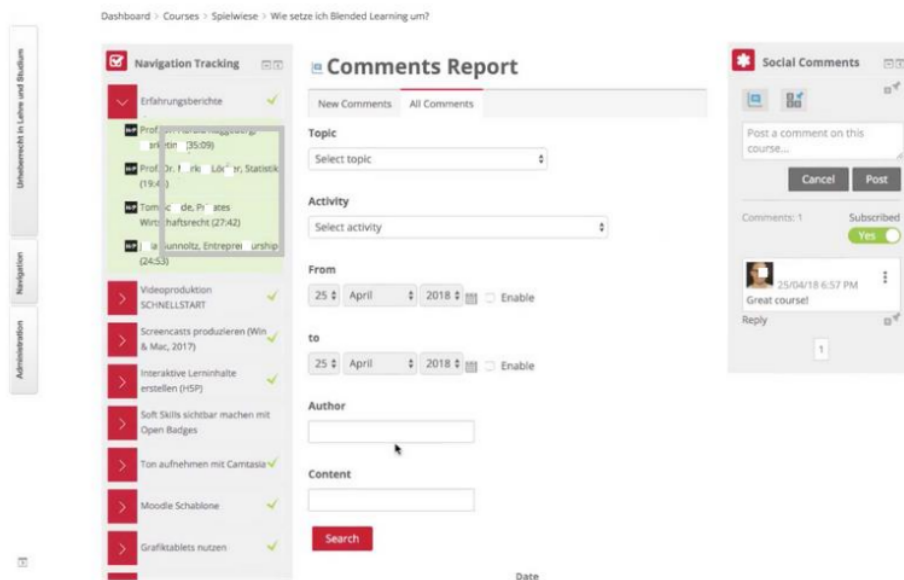


Figure 2: Existing Moodle

Across the user interface, issues from the global navigation pane to cards have different widths and heights based on the interface, which also triggers poor alignment of the cards. This aspect leads to inappropriate scan-ability since users have to adjust their viewing horizon while hovering between the global navigation and the entire website. Besides, social commenting is not adequate to facilitate human-human interactivity for practical learning sessions [5]. An example of a comment page is shown in Figure 3.

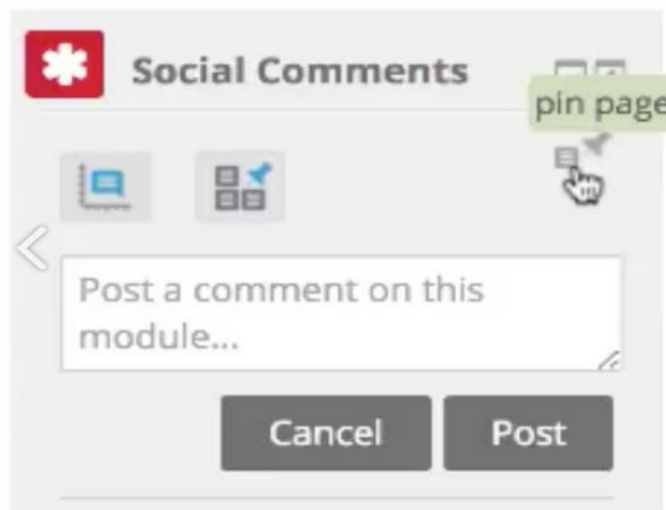


Figure 3: Low Human-Human interactivity

Students can observe videos uploaded by the professor, however, cannot make virtual video or even audio contribution or sketch ideas using tools such as whiteboard interaction among members of the class about the tutorial. The UI presents major challenge in terms of human-to-human interactivity, as shown in screenshot in Figure 4. If not erroneous, students would not even get email notification in case on other student responds to their discussion.

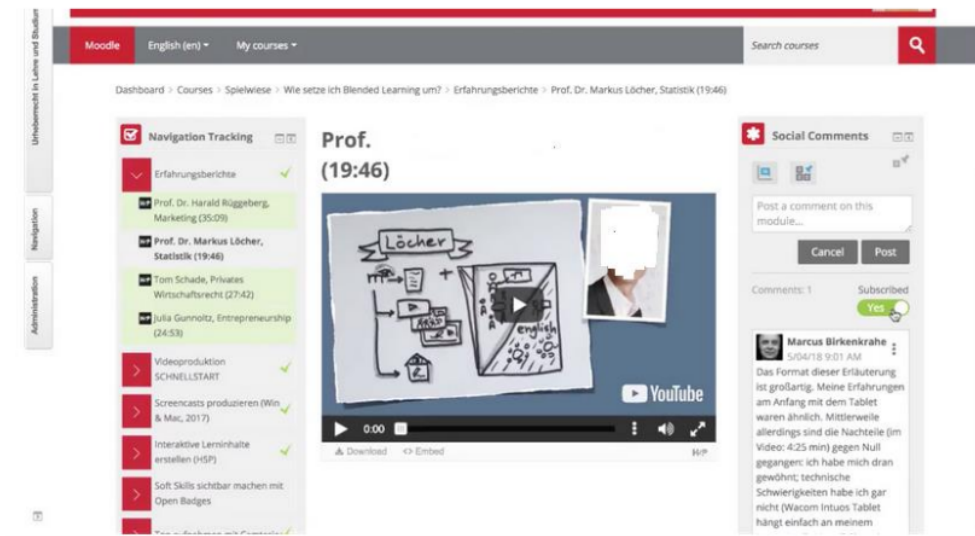


Figure 3: Favourite page

Generally, the existing Moodle have low usability to support interactive learning during Covid-19 pandemic. Introducing a visual interactive online whiteboard would help rectify the direct impact of the application interactivity and user's scanning ability [6]. Before designing whiteboard prototype, the project investigated the target user group's requirement using user personas as discussed in subsequent

The Collaborative and Interactive Virtual Whiteboard

The whiteboard becomes a privileged application to organize team activities targeting co-creation, consultation, the search for solutions, in short which allows the sharing of the intelligence of a given group. For example, in brainstorming for ideation, one can use "Post It" sticky notes, printed science articles, market research, research, visual concepts and display them on the whiteboard [7]. Thus, the brainstorming activity offers to visualise these proposals, to discuss their issues, to identify the one that will be the most relevant, the one that will be most easily achievable.

The main advantage of the smart whiteboard is that it offers a single place to organize different activities. During these activities, participants can argue both verbally and visually. Indeed, the participants can illustrate their argument using different strategies: drawing on the board, sticky note, thematic sticky, creation of logic maps. Moreover, the information that has been co-constructed can easily be accessed by students and teachers in real-time. This can be updated as the targeted process progresses in time. Finally, the virtual whiteboard can be separated into different sections to support different learning activities [8], [9].

Target User Group's Requirements (User Personas)

Based on the proactive user research performed, the project created three different user personas that capture the need goals, scenarios of my target group of users. The users were Jeremy, Whiteman, and Khan who assisted me to continuously consider and update the application portfolio based on the user and market needs. Table 2 highlight the personas obtained from the three users.

Table 2: Target Users

User persona	Scenarios	Needs	Goals	Pain-points
1. Jeremy Portfair Is 22 years and a Second year science student living in London, speak English	<i>Re-finding:</i> Jeremy is doing mathematics course at the university wants to re-find and collaborative with classmate to solve maths question using a virtual tool that he can draw figures, shapes and write solution	Need a smart whiteboard to interact with classmate	To visualise thoughts, concepts, write down ideas, explain and teach, to plan and create in the group and many other learning activities	The current Moodle is limited regarding collaborating, it's more of uploading and download contents
	<i>Re-finding::</i> Jeremy would like to video chat with classmates	Need to sketch formulas, shapes, write notes to collaborators	To integrate many learning styles into one experience. So that I can learn by seeing, hearing, and interrelating with the board using touch.	Limited functions and options to interact visually with classmates for practical assignments
2. Elizabeth Kuffman A 29 years old, Fine art student in her final year of post-graduate	<i>Exploratory seeking:</i> Elizabeth want to explore different contents good sketches an fine art shapes drawn by classmates in the log of the whiteboard	Equips the whiteboard functions to keep history of collaboration for future reference	To control the computer through touching the screen virtually. Add-on devices can be used to improve visual-interactivity between the classmates and enable us to answer quiz questions and get the data graphed in real time	The existing Moodle is more of a assignment submission tools that online virtual learning platform
	<i>Known-item Seeking:</i> Kuffman would want to bookmark virtual lessons he was attending for future use	Improve features for favourite items and notifications for updates.	To get live streaming of classes away from school.	Whiteboard displays contents and lists live stream one below the other
3. Prof Johnson A 73 mathematics lecturer at the university and wants to coach his students on geometry remotely	<i>Known-item seeking:</i> Need to log in the remotely accessed smart-whiteboard and teach a geometry class	A new system with ability to reorder the graphs to exhibit understanding.	To effective introduce and review geometry concepts, graphs or historical figures in visualised manner to students.	Using the Moodle, my students struggle to find their way around complex assignments that need interactive and collaborative support

Rationale for the Chosen target User Personas and Scenarios

The user scenarios documented based on the three main types of user needs as highlighted by Morville and Rosenfeld [10] who can comprise the exploratory Seekers, exploratory seekers, and re-find users, and roles. For instance, Elizabeth is an exploratory seekers who needs to discover diverse types of content in the app in order to keep strong ties with her practical lessons. Contrariwise, Professor Johnson is a teacher who wants an application to offers human-to-human interactivity so that he can teach his students geometry lesson more practically and a system that support interaction using visual aid. Lastly, Jeremy is a re-finder who needs to retrieve and embark on works, sketches, and graphs, figures were as well done by his classmates when logged on the virtual whiteboard.

Design Prototypes

Prototyping entails procedures for designing application architecture or skeleton. The process includes low-fidelity, medium-fidelity, and high fidelity. User feedback is obtained from designing a physical application and they can experience an improved interface when using the application and. A major benefit to prototypes is the ability to determine what users consider to be the product's purpose and reduced development time [11], [12] For this application, low-fidelity and medium-fidelity prototypes are used. Low-fidelity (lo-fi) entail fast and simple technique to translate a high-level system design concepts into tangible and testable artifacts. It essential to check and test functionality rather than the visual appearance of the system [13]. Having the hand-drawn screens, a low-fidelity prototype was designed by integrating multiple design aspects to represent the user flow as shown in Figure 4 shows the wireframe.



Figure 4: Lo-fi Paper-based design

Human Factor and Ergonomic Issues with the Lo-fi Design

The above hand-drawn shows user flows on the main application UI for the online collaborative whiteboard. Also, comprise onboarding flow for efficiency and ease navigation on the web page, especially for first-time users. The design was based on user feedback for crucial UI. However, this prototype seems not compatible with some aspects of target user needs. Some global navigation and buttons; for instance, adding image at the left-bottom corner and chatbot button might cause some ergonomic issues from stylus pen, reflection problems, and interruption on drawing, which is a key human factor while using the online whiteboard [14]. Therefore, the medium-fidelity will increase the size and navigation space of the chat bot, and other option buttons in the whiteboard design.

Medium-fidelity Prototype

A medium-fidelity prototype entails limited functionality but with a clickable area, which shows the interaction and navigation possibilities of the application [13]. This prototype provides adequate user experience before designing the final application. The prototype needs

to be tested for usability to ensure ergonomic and other human factor issues are resolved. Performing usability tests with prototypes ensures that valuable user feedback is implemented by designers from the early application design process [15]. The only actual weakness (that was not a major issue at moment) of the medium-fidelity design prototype is that; whereas the wireframe is capable of creating an imitation of the application environment, users were not able to experience an environment that is more practical and addressed their need; perhaps giving the design benefit of doubts [16].

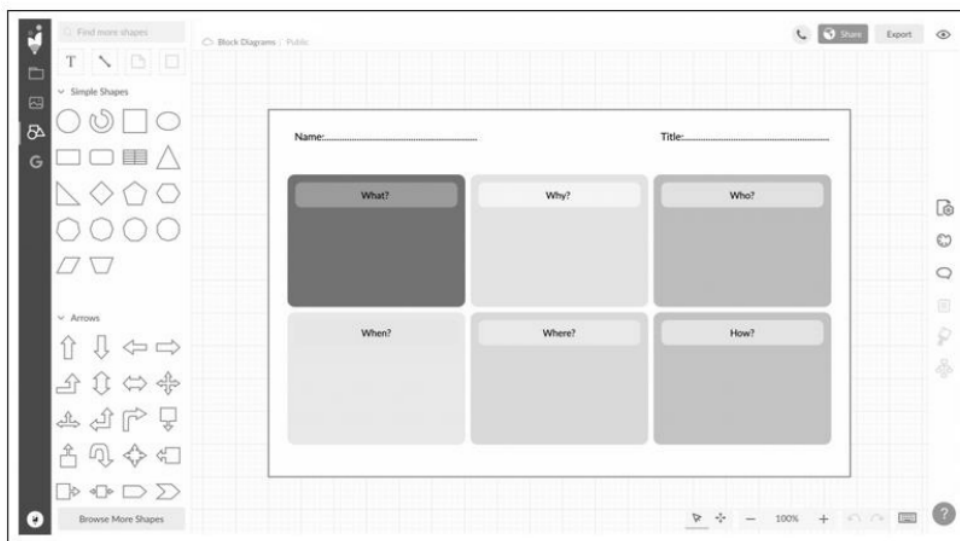


Figure 5: Medium - fidelity Landing page UI

The medium-fidelity prototype is designed to solve ergonomic issues of application links and buttons as well as other global navigation issues emanating from the use of classical IR pen and Splint stylus designs, which are fairly bigger in circumference as shown in Figure-set 6 below [14]. The settings and tools panels have been adjusted in size to allow easier navigation between shaping and drawing tools using Sprint stylus. Similarly, the chat button both for video and text has been collapsed with a pop-up link on the right side of the whiteboard to eliminate reflection problems, and interruption while drawing or writing.

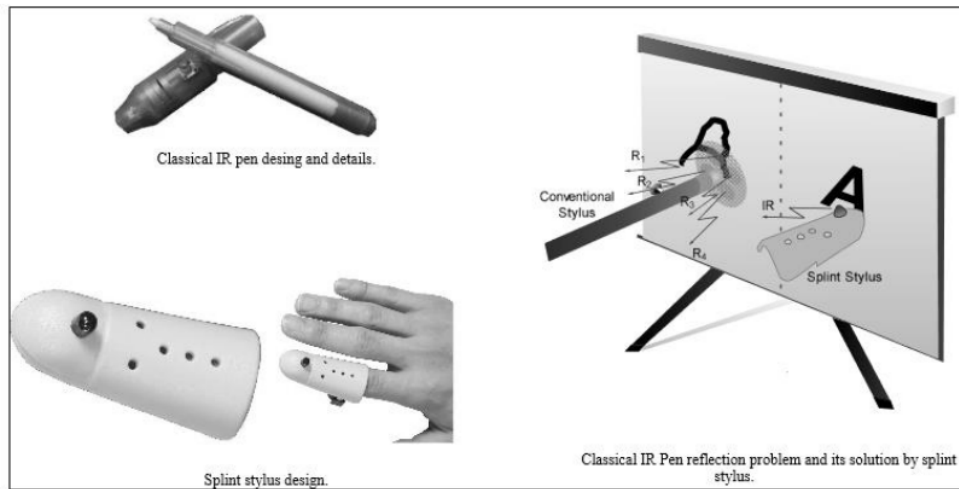


Figure 6: Human Factor and Ergonomic Assessment

The medium-fidelity prototype was designed using Terrastruct to incorporate the icons and glyph-icon into the wireframe. Using Terrastruct, the high-fidelity prototype was also designed to make the design more interactive and ensure that the whiteboard application conforms to other human reasoning issues and pleasures that the medium-fidelity is unable to meet. The proposed online collaborative system would obtain a high-fidelity as shown in Figure 7.

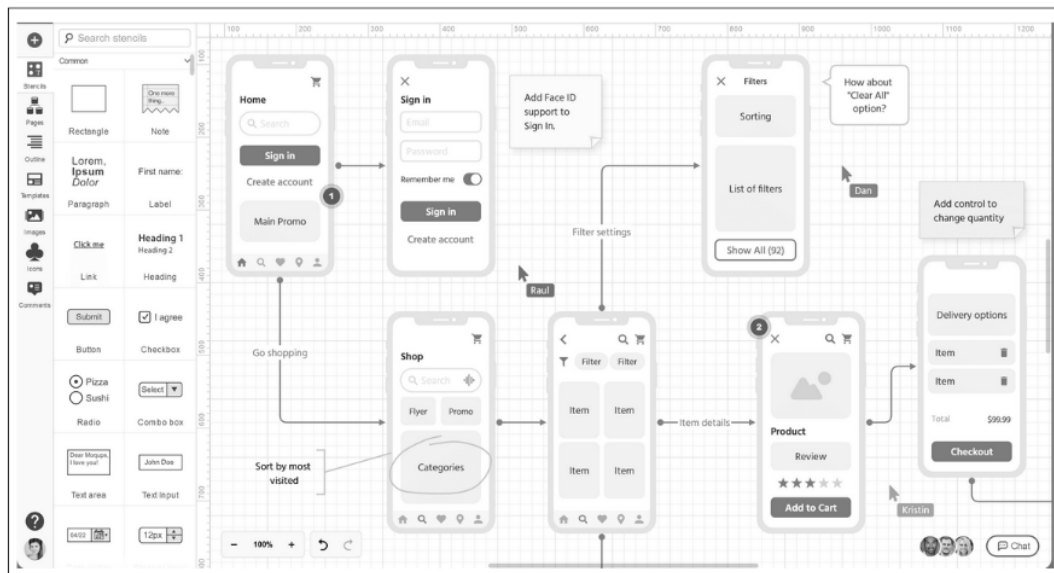


Figure 7: High-fidelity Online Collaborative Whiteboard

The high-end prototype will ensure that the three target user needs are incorporated in the final application. For instance, exploratory seeking will ensure users can edit their profile once logged in, change their preferences, track historical learning so that the application can customise their user experience and update. Equally, the high-fidelity design fully eliminates the drawing interruption problem in comparison with medium-fidelity. In a situation that the user uses twin NWRC. Further, the high-fidelity ensures that the application detects the IR light on the surface as shown in Figure 8 [14].

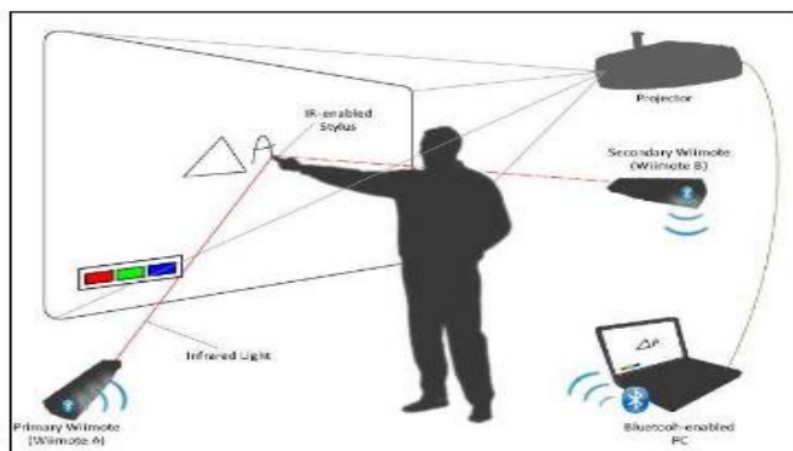


Figure 8: Uninterrupted drawing

The high-fidelity ensures that IR light is detected using border alignments on each interface button and links as well as navigation as shown in Figure 7. Moreover, the 4 Pleasures of socio, Psycho-pleasure, Physio-pleasure, and Ideo-pleasure are complied with in the high-fidelity. For instance, the final prototype design strongly considered the social aspects of diverse users, social plugins for chat and sharing functions to expand user's social capabilities within the system [17]. Students can get help when they click on the question mark button on the left-side corner of Figure 7. For physio-pleasure, the last whiteboard design is eye-catching, the texture and quality of effect and arrangement of interface layout will catch user taste, colours used throughout the application's pages are not shouting, while font style is acceptable across different user groups. For psycho-pleasure, the design has a variety of contents that are informative to the user, from sports, education, celebrity news that are derived based on cognition, discovery, and knowledge that can satisfy an application's user intellect. Last for

ideo-pleasure, the design merges several ideo-pleasures in a unified platform to sweeten users aesthetically and culturally.

Conclusion

The proposed virtual whiteboard application is capable to fully support interactive learning during the covid-19 pandemic. The existing learning tool (Moodle) is limited in many reasons regarding improved usability that allows more practical and interactive learning experience. Using medium and high-fidelity prototype design, the project has been able to ensure that the proposed online collaborative whiteboard solves numerous ergonomic issues and human reasoning to improve overall usability. In particular, the proposed application and its designs ensure the lecturer can lead collaborative audio and visual lessons. Similarly, at the same time support the use of classical IR pen and Splint stylus designs by users, which help to eliminate reflection problems, and interruption while drawing or writing.

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FINAL GRADE

58/100

GENERAL COMMENTS

Instructor

Introduction: A good outline of the chosen resource, Moodle, and some usability issues faced with reference to the literature.

Personas were not asked for how - careful with spending time on material not requested. This does provide some evidence towards the Task Analysis requested.

Paper Prototype should be hand drawn! Some useful features were included however.

Human Factors briefly discussed with references.

Rather than create a software prototype you have included a review of methods, at least this partly answers the question.

A brief conclusion is included.

Please carefully read the assignment spec and include what is asked for. Ask if not sure! Some good work included in places.

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