Prospectus

Lonely Robo

(Technical Report)

Investigating the Relationship Between Contemplative Practices and Collaboration in Modern Workspaces

(STS Research Paper)

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Overall Introduction

Almost every student has a horror story about that one horrible groupmate that they were forced to work with on a school project. Whether they slacked off and never did work, or were far too presumptuous and judgmental of everyone else, it's an off putting experience. Often times a team member's conception of their own primacy and self importance will ultimately cause tension within and hinder productivity. However, having team members that are too focused on the collective are also problematic due to the inability to make simple, rational decisions without the group's explicit permission. The former scenario concerns a single individual, and is referred to as the "me space" in group collaboration; the latter scenario concerns the group as a whole, and is referred to as the "we space" (Byrne, 2017). Balancing how team members operate within these two spaces is a problem that must be solved if they wish to collaborate in an effective and conducive manner. One possible solution is addressed in our team's blueprint, where we investigate the interplay between contemplative practices and collaboration, and try to determine if contemplation can enhance collaboration within a group.

Kinnarps, a provider of interior workspace solutions for professional and academic spaces, has recently implemented a new system that encourages collaboration, contemplation, and concentration called "the 3Cs" (Kinnarps, 2016). The design practice recognizes contemplation and collaboration as pivotal components that a workspace must include in order to be successful, however, they do not elaborate on why that is. Ergo, this paper will explore the relationship between the two concepts and their overall synergy within the contexts of a student learning space.

Technical Topic

Word search puzzles are relativity simple games used to learn spelling, word association, or simply to pass the time. Despite this fact, word searches still take both time and mental energy to solve, and to date, the best method of solving them is by hand. "Lonely Robo" is a device that will alleviate this problem by automatically reading and solving any given word search. The user will place a word search into the mechanism, and after extracting the data from the printed page, the system will computationally solve the puzzle. Then, using that solution, a highlighter will physically mark the solution onto the word search.

Upon initialization, an Nvidia Jetson will control a camera to snap a picture of the puzzle. A computer vision algorithm will then utilize the picture to deduce a word bank and matrix of characters representing the puzzle grid by using Hough transforms and optical character recognition (OCR). The Hough transform is used to discern the word puzzle from the word bank, and OCR is used to determine what characters the camera is looking at. The algorithm will then map the matrix coordinates to their two-dimensional location on the physical platform holding the word search. This is done once at bootup of the machine, where the pen will calibrate itself by drawing through the use of fiducials and simple drawing tasks. Furthermore, the physical space between diagonal characters will also be inferred from the camera. Once the translation from camera space to physical space has been completed, the Lonely Robo may begin solving the puzzle. A separate optimized brute force solving algorithm is used to locate the target words in the image that will be highlighted later in the solution pipeline. Since the algorithm is a brute force solving implementation, it compares every possible string of letters with the dictionary, checking to see if it is an actual word. Once all valid words are found, the physical coordinates of the start and end letter of each word are stored into a solution map. Using the map, the Jetson will communicate via the Universal Asynchronous Receiver-Transmitter (UART) protocol to a Texas Instrument MSP 430 microcontroller that will control a two-dimensional drawing mechanism to physically solve the puzzle with a highlighter. For each word in the solution map, the microcontroller, by command of the Jetson, will: (1) ensure that the highlighter is off the paper, (2) move the highlighter to the starting physical coordinates of the word, (3) drop the highlighter, and (4) move the highlighter to the end coordinates of the word. The flow diagram below (figure 1) illustrates a high level conceptualization of the solution process from start to finish.

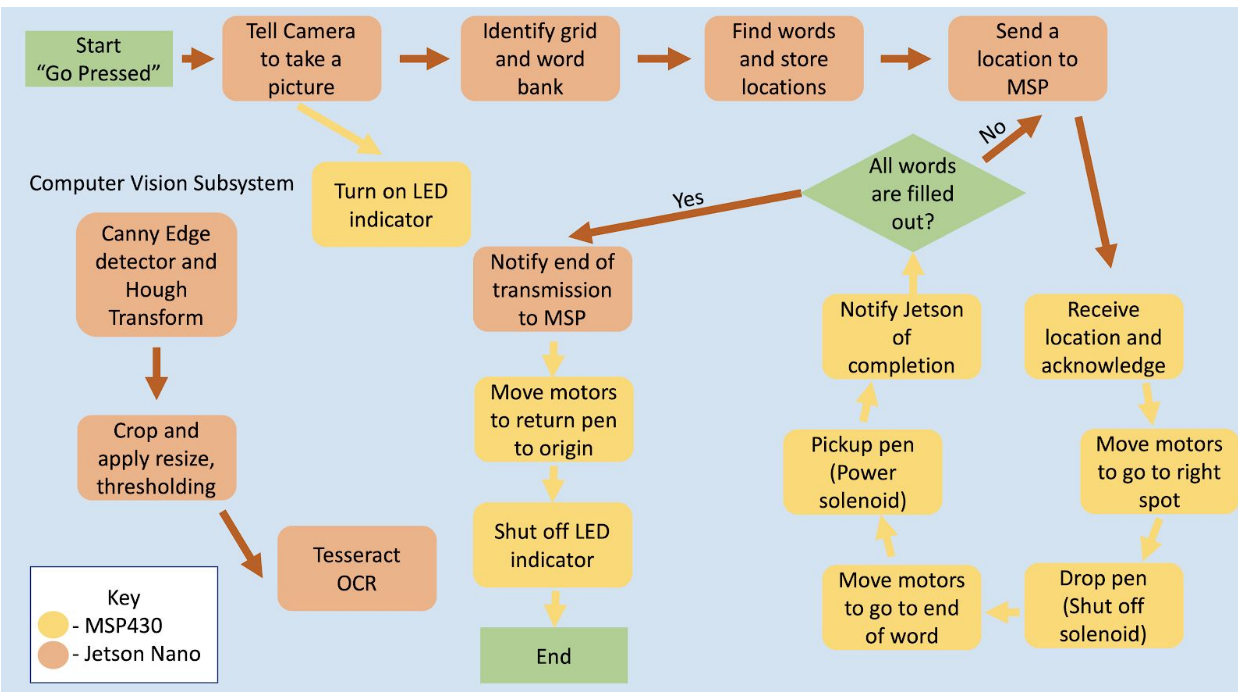

Figure 1: Solution Flow Diagram

There are many examples of word searches online that take in an image or text file containing the word puzzle and output an image with the highlighted words. Some of these solvers use computer vision to read in the puzzle, however, a large majority require the user to manually enter the grid and word bank. Both implementations are capable of solving the word puzzle, but they still require the user to manually highlight the words on the physical piece of paper. The Lonely Robo provides a unique solution that requires no work from the user other than placing the puzzle under the camera.

While the Lonely Robo may seem to be a niche robot with limited real-world applications, the reality is quite the opposite. The technology used for the machine, particularly in regards to the xy table that moves the highlighter, is directly applicable to projects like 3D printers and precision laser cutters. Two dimensional mechanical constructs play a pivotal role in modern machines, and the Lonely Robo is the result of exploration into other areas in which such devices can be implemented.

<u>STS Thesis</u>

Colleges and universities are moving towards a movement in which students are asked to work together in a collaborative manner primarily due to the increasing emphasis on teamwork in industry and the deeper understanding students achieve when partaking in collaborative learning (McWhaw, 2003; Kezar, 2005). Because of the shift from individual to collaborative learning both in and out of the classroom, universities need to ensure that their study workspaces are conducive to such group work and encourage good collaborative practices. Many collaborative workspaces have been designed to have an open layout rather than the traditional cell or cubicle structure in order to enhance group work and communication; however, the open space design has been found to have an adverse effect on collaboration and productivity due to a lack of privacy amongst its users (ncbi link). The cause of this is due in part to the decrease in face-to-face interaction that arises in open workspaces, where collaborators are more likely to converse and interact through virtual rather than physical means (Bernstein et. al, 2018). If the adoption of collaborative learning in universities is to be successful, then serious thought and effort must go into reconsidering and redefining the contemporary workspace design, bringing up the question of what is needed of a space to elicit effective collaboration while also offering individual privacy and comfortability?

In order to solve the question of eliciting collaboration, an effective framework that can be applied to help solve the problem must first be realized. When broken down, collaboration is simply an encapsulating system made up of subsystems which represent the individual team members who contribute progress towards some shared goal. Thinking in such a way, collaboration can be seen as a bottom-up design starting with the team members present in the group. Dr. Ken Blanchard, an expert in management training and collaboration, supports this methodology of thinking in his book, *Collaboration Begins with You*. Blanchard argues that collaboration begins at the individual level by stating that each member of the team must place themselves within a “collaborative mindset,” where each team member is willing and ready to work closely with others (Stoner, 2016). Using a bottom-up framework where each member must put themselves into a collaborative mindset to be successful will allow the above question to be answered by shifting the focus from group dynamics to individual mentality.

Approaching collaboration at the individual level shows that each member of a team must be in a mindset conducive to collaboration. But how is this mindset defined and by what methods do members step into it? A proposed solution to these questions may be found in the progressive workplace designed by Professor Jeremy Myerson, Director of the Helen Hamlyn Centre for Design, called Shard. Professor Myerson noted the aforementioned trend towards open workspaces as opposed to the cubicle space, and discusses how such a space can cause distraction and remove privacy, ultimately lowering productivity and hindering collaboration. As a solution, he proposes the implementation of a “contemplative space,” in which team members may “think freely, reflect on ideas and plan in a relaxed environment” (Jeremy, 2014). He acknowledges that sometimes members need a break from the group work in order to recalibrate by reflecting on their self and be mindful of their current emotions and thoughts. Furthermore, Professor Myerson suggests that these contemplation spaces should be "quiet and enclosed with a comfortable domestic feel and a degree of privacy… You may even use blocking technology so that it's a Wi-Fi free zone" (Bartlett, 2015). In essence, these contemplation spaces should be a place where team members can get away from the collective, be completely free of all distractions, and most importantly, be able to reflect internally and recharge in order to get back to a productive level.

Contemplative practice seems to be an increasingly popular facet of collaborative workspaces; the question now becomes how to implement these ideas into such a space. In the case of Dr. David Germano, the director of the Contemplative Sciences Center (CSC), he argues that a key component to a contemplative space is a design which is biophilic. Dr. Germano has worked with students and stakeholders to design a new contemplative, collaborative center at the University of Virginia that utilizes nature-like design choices, including: gardens, tree-filled atriums, waterways, and a ceiling-less design. In the CSC's workspace design justification, they state that "the mind, body, and nature are deeply interconnected… exposure to natural environments is key to productivity" (Contemplative, 2019). Dr. Germano and the CSC use the fact that biophilic designs are a key way in which individual contemplation can be elicited. The nature focused design of the workspace is shown below in figure 1.

Figure 1: Courtyard Design of Student Space

Another key principle in contemplative practice is mindfulness thinking, in which an individual is keenly focused on the present moment and their current emotions. Mindfulness has been found to greatly reduce stress and burnout while also increasing productivity and mental well-being (Wendy, 2018). Due to the promising results of mindfulness and its direct relation with ideas of reflection in contemplation, it is paramount that a space is able to catalyze such practices, but how can a workspace become the catalyst? One way to determine an answer to this question is to look at what hinders individuals from being able to practice mindfulness, and the primary inhibitor is technology. Constantly checking smartphones, watching youtube, and spending time on social media all serve to pull people out of the current moment, making mindfulness practices impossible (Sears, 2017). By utilizing the concept of blocking Wi-Fi in mindfulness zones, an idea proposed previously by Dr. Myerson, the use of smartphones and other internet-based technologies becomes restricted, and can allow individuals to reflect on the present moment and be more mindful.

The literature paints a picture that contemplative practices are an exemplary method of enhancing collaboration within groups, however, they all lack experimental justification. In order to remedy this, I will be conducting interviews with students who have been using contemplative practices in their group work and asking them to discuss its overall effectiveness. Furthermore, I will be discussing with experts at the CSC in order to further understand how contemplative practices boost collaboration.

To summarize, collaboration is becoming increasingly more important in contemporary university classes, and workspaces must provide an effective medium through which students may work together. Through a bottom up framework focused on the individuals in collaborative groups, the encouragement of contemplation and mindfulness may be the key to an effective collaborative workspace.

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