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Course: Artificial Intelligence - COMP.4200
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FINAL PROJECT PROPOSAL

1. **Title: AI Babysitter**
2. **Problem statement with literature review:**

According to a study published in the National Institutes of Health, sleep plays a key role in babies' brain and physical health and development. But parents cannot stay up all night to ensure that their loving babies are having a good sleep. Also, there're so many dangerous sleeping positions that can happens such as: accidental covering face, SIDS position, sticking leg or climbing out of the crib [4]. But there is a solution than can give them a peace in mind. A baby monitor can help anxious parents get a better night's sleep. Also, helping parents watch over sleeping babies while being busy at daytime or sleeping at night-time and alert them for emergency situations. A 24/7 babysitter is applied with AI technique can absolutely reduce the cost of sending baby to daycare and enhance working-from-home experience for parents during this Covid-19 pandemic.

Citation of published paper related:

- Choi, Soohyun, et al. "Implementation of Automated Baby Monitoring: CCBeBe." *MDPI*, Multidisciplinary Digital Publishing Institute, 23 Mar. 2020, www.mdpi.com/2071-1050/12/6/2513/html.

- Lai, Chinlun, and Lunjyh Jiang. "An Intelligent Baby Care System Based on IoT and Deep Learning Techniques." International Journal of Electronics and Communication Engineering 12.1 (2018): 81-85.

- Cheng, Lily. "Robo-Nanny: ConvNets for Intelligent Baby Monitoring." 13. Pdf, 2017, http://cs231n.stanford.edu/reports/2017/pdfs/13.pdf

3. **Problem analysis**

The need: Accidental Suffocation and Strangulation in Bed (ASSB) is a prominent cause of death for newborns. Number of baby death by ASSB increase every year according to the data and statis for SIDS and SUID by CDC [1]. Baby monitors could be helpful to react to scenarios and data, and to proactively alert the parents when a baby is at risk for ASSB.

The idea: AI agent can be taught to be able to recognize images in which babies are in dangerous situation while sleeping among a bunch of images of different babies in their cribs

The solution: We are going to implement an Image Processing AI that would help to detect the baby subject and then recognize the action of that baby (sitting down/standing up/ lying down/etc.) and from that it will define if the baby is ‘safe’ or ‘unsafe’.

The state of a baby in each image are defined by the actions of the babies. We expect these babies are sleeping, so if the AI agent sees a baby who is lying down facing up, it will mark as ‘safe’ state; otherwise, it will notify for the parents when baby is ‘unsafe’ state. There will be a **static** state for each image, so it is not necessary to have a state transition function to generate new state. The system doesn’t have a goal state. It will have a function that active the alert when the state is ‘unsafe’.

Input for this AI agent are images which stay constant most of the time. Therefore, the agent does not have to worry about uncertainty in a fully **observable and deterministic** environment. Watching babies could be considered as a complicated job that might involve multiagent which could be placed around the house to cooperate for better performances. However, with this project, we focus on analyzing the images of a baby who is sleeping inside a crib. There are not too many complicated states in this scenario so **single agent** will be a good choice. Furthermore, in this environment, the agent is said to be **episodic** because the decision will not have any impact on the future decision. Our AI agent will analyze an image at a time and define the state of the babies in these images separately. Also because of that, the environment is **static** because it doesn’t change while agent is making decision

With this problem, there will be only two final state as the result which are ‘safe’ or ‘unsafe’. The agent will active the alarm when the baby is ‘unsafe’ and won’t do anything otherwise. By saying that, this environment is said to be **discrete** because of the finite number of actions

4. Data set or other source materials

- Download about 100-200 baby sleeping images on Google and extract images from videos on Youtube of completely different babies, in different cribs, camera settings and light settings. These images will be the mix of different state (position) of babies such as sitting up, lying down and standing up.

- Resizing the images into desired pixels so the program can input and classified all the babies' states.

- The AI agent will detect its primary subject (the baby) and the position of the subject by analyzing the pixel/color of an images. After subject’s found, the agent will process to categorized it into the right class (positions/state) and conclude if these positions are safe or unsafe for the subject to stay in.

a)

b)

Example a: With this set of data, the agent should output:
(1) Lying & FacingUp- Awake – Safe/No Alert
(2) Lying & FacingUp- Awake – Safe/No Alert
(3) Lying & Facingdown – Sleeping – Unsafe/Alert
(4) Lying & FacingUp – Sleeping – Safe/ No Alert

Example b: With this set of data, the agent should output:
(1) Standing - Awake – Unsafe/Alert
(2) Lying & Facingdown – Awake– Unsafe/ Alert
(3) Lying & Facingdown – (unknown) – Unsafe /Alert
(4) Lying & FacingUp – Sleeping – Safe/ No Alert

- The purpose of creating this dataset is to test the adaptability of the agent to changes from different camera viewpoints, lightings, environments and various subjects. The higher percentage of agent's success comes with the more diverse dataset would make the agent's decisions more precise.

5. Deliverable and Demonstration.

At the end of the project, we expect to come up with an AI Agent that can determine the actions of the baby in each image (lying down/sitting down/standing up/etc.) and define if the baby is safe or not safe by analyzing these images
There will be a piece of software for some main purposes such as:

- Visualization: Represent processed data in an understandable way
- Object measurement: Measure objects in an image
- Object/Pattern recognition: Distinguish and classify objects in an image, identify their positions, and understand the scene.

In this project, we decided to go with mini-batch mode in which input is a subset of all training data during one iteration for some reasons: easily fits in the memory and it is computationally efficient compare to batch mode or stochastic.

The AI agent will be taught to recognize images of different babies in different position in their cribs. For examples before being able to recognize a baby who is sleeping facing up in a safe state, AI agents needs to be trained by looking at a bunch of images of different babies who are sleeping in this position under different angles/views. From that, the agent will learn the common points among these images to understand how a baby is supposed to look like when he/she is lying down facing up. This will help the agent make prediction in the future when it sees similar images from different source data.

6. Evaluation of results.

Our successful in this project would be similar to Lily Cheng's project at Standford University [2]. In her project the AI agent model was Squeezenet which yield 98.4% success rate. Thus, our successful rate using the same model should be 90% and above. In Cheng's project, the publisher using Convolutional Neural Network to implement his/her AI agent. Our model AI agent has not yet been determined but the output will be used to compare the accuracy and the loss with Cheng's model.

7. Major components and schedule.

	To do list	**Due Date**
1	Collect data (images) Manually classify data	10/10
2	Writing code - Detect subject(baby) within the image - Classify subject position/state - Define if subject is safe/not safe to send notification to parent	 10/25 11/5 11/15
3	Testing Gather data from AI agent Make report	11/20
4	Prepare for presentation the complete project	11/30

Base on the schedule above, we have decided that our first step would be rather the data from YouTube and Google, and we will classify the data base on the image that we have collected. Doing so will allow us to determine the performance of our AI agents. After data have been collected, we will come up with a pseudocode of how we want to implement our project. There will be 3 important components in the pseudocode: detect subject, classify the subject's position/state and determine the safety of the subject to report to the parents. The language has not been set in stone, but the implementation of the code will be in either python, TensorFlow or jupyternotebook. Tests will also be run thoroughly during development. After we are done implementing the software and make sure the software running properly then we will get the data from our AI agent to determine the success rate, accuracy and loss, and turn it into a complete report. The project expects to be done by November 30th.

8. References

[1] Data and Statistics for SIDS and SUID.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 18 Sept. 2020, www.cdc.gov/sids/data.htm.

[2] Cheng, Lily. “Robo-Nanny: ConvNets for Intelligent Baby Monitoring.” 13. Pdf, 2017, http://cs231n.stanford.edu/reports/2017/pdfs/13.pdf

[3] Choi, Soohyun, et al. “Implementation of Automated Baby Monitoring: CCBeBe.” *MDPI*, Multidisciplinary Digital Publishing Institute, 23 Mar. 2020, www.mdpi.com/2071-1050/12/6/2513/htm.

[4] Task Force on Sudden Infant Death Syndrome. “SIDS and Other Sleep-Related Infant Deaths: Updated 2016 Recommendations for a Safe Infant Sleeping Environment.” American Academy of Pediatrics, American Academy of Pediatrics, 1 Nov. 2016, https://pediatrics.aappublications.org/content/138/5/e20162938?fbclid=IwAR0rwA47ad357F2FOn87pHctLjZA24Wb-n9hhqqYAKemRVjaXPqgWaKkO60

[5] Lai, Chinlun, and Lunjyh Jiang. "An Intelligent Baby Care System Based on IoT and Deep Learning Techniques." International Journal of Electronics and Communication Engineering 12.1 (2018): 81-85.