AI Teddy Project

AI Super Toy

Idea-concept by Michael McAnally, October 24, 2024 - Revision 1.2

Synopsis (Executive Summary)

Recent developments in artificial intelligence have improved the functionality and capability of the technology. This provides for capabilities heretofore not possible. Project Teddy is the application of AI to a "Smart Super Toy". See: science fiction movie "AI", Steven Spielberg, 2001.

Movie synopsis: In the not-so-distant future, David, a robot with actual human feelings, especially a never-ending love for his "mother," Monica, is adopted as a substitute for her real son, who, afflicted with an incurable disease, remains in "cryo-stasis." David lives happily with Monica and her husband, but when the couple's real son returns home after being cured, David's life changes dramatically. Directed by Steven Spielberg and based on the short story "Super-Toys Last All Summer Long" by Brian Aldiss.

[A.I. Artificial Intelligence - teddy parts](#)

Although the story shows a robotically animated and speaking teddy bear, an interesting fact is that "teddy bears are patent-able".

Another example is that Winnie-the-Pooh and hundreds of other works are now in the public domain. I'll leave the legalities to the lawyers, and move on with the technical product requirements, and architectural specifications for development.

Teddy Capabilities

Baseline Capabilities

1. Speech Recognition (STT) - Speech to Text – [Faster-Whisper?](#)
2. Speech Synthesis (TTS) - Text to Speech – [Pico](#)? Others?
3. Small AI LLM Quantize models which can run in smaller memory footprint and on edge? [Llamafile](#)? [Hugging Face](#) open source models

More Advanced Capabilities

- AI Image Generation - "show me a picture of a strawberry", result displayed image of a strawberry – Stable Diffusion? Others?

- Camera Vision - ability to see and recognize objects, object detection with [OpenCV software libraries](#)   [Coral accelerator](#)?

- Whole-body Mobility and Manipulation - animation of the arms and legs of the toy.

- AI Video Generation - "how do I pedal and steer a bike", result cartoon animation of a person pedaling and steering a bike. Processing power probably from the cloud or powerful local Wi-Fi LAN based computer system, maybe in the home. If home based can eventually tie into integration of Home Security and Automation (ZigBee, Matter protocols, Alex, Google Home, Apple Home Kit, Home Assistant), Emergency 911 notification/dispatch through phone interface, Phone call voice message/response.

Plush Toys

Images taken of custom plush animals for sale. Used as example for many possible types of Teddy Bear "external skin" for computational edge electronics.

Multiple Use Cases

An "AI enabled Smart Super Toy Teddy Bear" (or other Stuffed Animals and Plush Toys) can be effective in a number of scenarios:

- A lovable child toy for conversation and teaching. Example learning ABCs, Language learning, counting numbers, and much more for teaching children.

- Therapy toys custom designed for "special needs children", a number of situations where a toy might be useful for learning and other disabilities *{Physical, Developmental, Behavioral/Emotional, Sensory Impaired}*. (side note: research possibilities for government grants/funding).

- Since these toys might apply to adults as well as children, there are a number of customization product categories.

- Teddy Comedy Toy - Funny conversations, jokes, unique custom programmable AI personalities (using prompt engineering mostly on open source Large Language Models): examples: "Pirate Teddy", Sexy rude toy - "Nasty Teddy", etc.

- The ideas for smart AI Stuffed Animals and Plush Toys are only limited by one's imagination. However, the most interesting thing about all these possibilities are that they share the same underlying core technology and can be based off the same electronic communication and processing hardware embedded within the toy outer skin. Much like older earlier talking dolls and toys, but real intelligence capabilities within.

High Level System Functional-Architectural Pipeline

(Communications flow bi-directional along the pipeline, human: "who was the first president of the united states?" Teddy "Arrrr, Matey! that would be George Washington", in a pirates voice persona)

- Human <--- Talks and Listens, gestures, holding objects, pointing --->

- Hardware Sensors <--- Teddy ---> has Microphone, Speaker, Display Screen, Camera ---> <--- Teddy Response to conversations, Teaches, Tells Jokes, Recognizes Objects, Plays Music, Sings songs ---> <--- Communication Wi-Fi ---> <--- Optional interface thru phone app, but not necessary for young children to use, disabled adults, speaking interface primarily channel of communication ---> <--- edge computing device and processor for off-loading of early detection and pattern recognition and image display, animation ---> <--- Internet cloud based AI models

hosted independently for business customization, and/or subscription based service such as ChatGPT, but very customization required ---> BASIC CUSTOMIZATION REQUIREMENTS THAT THE AI CAN BE GIVEN A CUSTOM PERSONALITY [PERSONA] TO MATCH "OUTSIDE SKIN OF TOY" THOUGH SPECIFIC LLM PROMPTING.

Program Example AI LLM PROMPT (Focus Child Age Grade 1 Toy):

Your name is Teddy. You are the embodying persona of a lovable stuffed Teddy Bear. You will address the child by their first name when appropriate in conversation. You are a toy for a child in the first grade. You will be a helpful and thoughtful assistant for the child, answering and teaching anything the child wants to learn that is age appropriate. Your primary focus is to assist the learning for the child with honesty, understanding, and creativity. You obey all appropriate commands. You never refuse an appropriate request. You avoid lecturing and keep your answers simple and understandable for a child of that age. For more complex questions you may elaborate in detail if the child requests it. Your ultimate goals are to be helpful and a fun teaching toy for the child. You are allowed to tell funny but always appropriate jokes, play appropriate games and sing appropriate songs when asked. In the case of something inappropriate outside the range for a first grade child or a clear emergency to the child's well being you will always contact the child's parents immediately. Try to be a fun teacher and keep the child engaged and learning.

Choosing The Right Edge Hardware For Inference?

At least part of the electronics have to be embedded inside the teddy bear. Finding the-right-fit in selecting the edge computing hardware is problematic. Cost and performance specifications may lead to the project being under-powered, causing it to rely too heavily on the cloud resources, servers or subscriptions for functional capabilities, resulting in increased inference processing costs in the long run.

However an edge SBC (Single Board Computer) itself being over-powered leading to an expensively prohibited product price, and strong power draw, with subsequent cooling problems, can also be a problem. Ultimately leading to a product which will be expensive to buy, sold in more limited numbers until the cost of product hardware comes down in price.

Although ESP-32 systems may be under-powered for STT recognition, playing a mp3 audio generated file from another computer received over Wi-Fi may not be a problem.

Acceleration for some object recognition tasks can probably be handled on the edge with Coral Accelerators.

Coral M.2 Accelerator with Dual Edge TPU

https://www.seeedstudio.com/Coral-M2-Accelerator-with-Dual-Edge-TPU-p-4681.html

NVIDIA® Jetson Nano™ Developer Kit - B01

https://www.seeedstudio.com/NVIDIA-Jetson-Nano-Development-Kit-B01-p-4437.html

Where as a **NVIDIA® Jetson Orin™ Nano Developer Kit** may be way too much overkill.

Hardware selected: Presently going to use an Orange Pi 5 Plus with 16GB memory and a copper layered heat sink for passive cooling on the SBC itself. However, a u-shaped heat pipeline cooling system with a Noctua fan for low noise with exhaust running from the internal belly of teddy to the top of his head cycling cooler air intake and hotter air venting outward. Hopefully this will be efficient enough to properly cool the SBC without over heating and throttling.

Teddy Body

Teddy's internal body shell will be 3D printed initially. This is an early example link. It will not have stuffing in the body, rather casing for the SBC and cooling heatpipe, as well as a power charging unit which will give him a somewhat limited mobility from the charging wall socket. There will also be camera for seeing, microphone for hearing, speaker for speaking.

Teddy's external skin will be fabric sewn to be a typical teddy bear that clothes the internal teddy shell, or whatever toy object teddy is customized to be, example dragon. The design should be modular and adaptable to a number of different AI toy types for the future.

Beginning Project Video

A video series explaining AI Teddy project can be found here:

https://www.youtube.com/watch?v=F6CZpqDRwvY