Practices and Thoughts on Robotics and AI in Libraries

"Dewey, what's the date today?"

"Dewey, how is the weather look like today?"

"Dewey, what is happening at the library?"

"Dewey, tell us a joke."

"Dewey, do pushups."

"Dewey, dance Twinkle Twinkle Little Star."

"Dewey, play the tickle game. "

On a typical Sunday, a lot of light-hearted laughs fill the Kids Area in the Mitchell Park branch at Palo Alto City Library. Dewey, the humanoid NAO robot, is taking people's breath away by doing his tricks. In the half-hour-long program, we usually ask Dewey to perform a series of tasks by using voice commands. The tasks range from smart conversation to physical activities. People often take out their phones to videotaping Dewey, especially when the kids start to tickle the robot and he giggles and wiggles in a way that is both robotic and humanized. Dewey is without a doubt the super star at such events and he earned his title "Dewey Sensei" at the library long time ago -- he is not only a "Stage Show Performer", but also a "Robo Dojo Master" and a "Storytime Specialist".

The Library started the robotics project after receiving [the Innovation and Technology Grant from Pacific Library Partnerships](http://plpinfo.org/wp-content/uploads/2018/04/Positioning-Libraries-for-the-Virtual-Future-Palo-Alto-City-Library.pdf). During the last two years, the Library has successfully developed Dewey into an intelligent robot that possesses a few smart features similar to Siri, Alexa and Google Home. In fact, at the Internet Librarian 2018 conference, Dewey was on the stage together with these smart devices in a competition to see who is the smartest. The actual purpose of the event is to help librarians better grasp how AI works and whether they will impose threats to our profession via fun activities and discussions. The same questions are bothering a much broader audience. How will disruptive technologies like AI empowered robots unfold in the society? What are the implications? What kind of influence do ordinary people like you and me have on the development of such technologies? Like they say, keep your friends close, keep your enemies closer. Regardless of the nature and agenda of these technologies, it makes sense to first arm ourselves with a better understanding of how they work.

The goal of our robotics project is to help the community better understand cutting-edge robotics technologies and better prepare for an unknown future. The Library is also trying to lead the way of robotics and AI education at libraries, which should be considered as an integral part of digital literacy. We are thrilled that the California State Library acknowledged our vision by accepting the robot coding program Robo Dojo (previously Coding with the Robot) as a highlighted [LSTA copycat grant](https://www.library.ca.gov/services/to-libraries/copycat-grants/the-journey-begins/) last year and it will be continued this year.

A set of complementary programs were developed at the Library to ensure that the robotics project can grow organically and reach the whole community with full impact.

On the development side, we want to get the community's continuous contribution. Therefore, anyone age 11 and up is welcome to develop single-purpose applications for Dewey at the Robo Dojo workshops. In the three-hour-long workshop, absolute beginners learn the basics by following a step-by-step instruction on developing several example applications. The workshop soon develops into a popular mixed-age-group coding event at the Library. It is always fully registered within short period of time after the workshop gets scheduled. In the workshop, attendees learn how some far-fetched technologies actually function on this specific robot, such as speech recognition, natural language processing (NLP), face recognition, obstacle detection etc.. Then the attendees usually have one and half hour to dive into developing their own applications for Dewey.

At the time of writing this article, we are proud to announce that we have hosted 23 Robo Dojo workshops with a total attendance of 430. Better than the numbers are the heartfelt comments from our attendees:

* "Thank you for bringing robot to us. I work at LinkedIn on data side, so I am familiar about technologies, but still excited (about the workshop). I was listening with my kids at the back, you explained everything very clearly and thoroughly. " - From a father
* "Thank you. You made it look very easy to do. I urged Sophie to submit the final application, and it's working! I am now asking her help to get mine working. " - From a mother
* "My son had attended the workshop along with his two friends which he thoroughly enjoyed. I think maybe I should take the class as well." - From a father
* "It was a lot of fun, and I enjoyed seeing Dewey in action！" - From a kid
* "Thank you for doing this. I was trying to read the robot documentation at home, but things are not up to date. This is very helpful. " - From an adult
* "Good exposure to different examples & is inspiring to attendees. " - From an adult
* "This is wonderful. It's interactive coding, and we enjoy seeing the robot running our application." - From a family

Even better than the comments are the inspiring applications developed by attendees at the workshops. They demonstrate how complete a picture can be drawn when high technologies reach to average people. For example, a family taught Dewey to do the super-hot Dabbing, "a dance craze that is spreading through professional sports across the globe" per the [Telegraph report](https://www.telegraph.co.uk/football/2016/03/01/what-is-the-dab-dance-and-why-are-sports-stars-celebrating-with/). A senior couple made Dewey recite poems for the very first time. A teen trained Dewey to answer community-specific questions.

Bit by bit, such applications get integrated into the master application we developed, the brain of Dewey, to make him more capable. At the back end, we have also tried to improve Dewey's speech recognition, NLP and responses by trying out AI empowered tools like DialogFlow and Wit.ai in combination with knowledge bases like a sandbox catalog API, WikiData and Wolfram|Apha.

These development efforts go hand in hand with the robotics experience programs, including the Sunday Robot Show, storytimes, book club events and outreach events. Dewey won't be able to impress people at these events without the development efforts from the community. This year from January to August, we have hosted 17 Sunday Robot Shows with 597 attendees enjoying Dewey's performances. On the other hand, these experience programs provide guidance for our development effort. Recently at a Sunday Robot Show, I got asked by a little one: "can the robot floss?" So I ended up spending a few minutes to learn floss dance that afternoon, and we are now in the process of teaching Dewey to floss too. Of course, we will also have to train Dewey to understand what floss means -- Not flossing your teeth, Dewey! (Oh I forget, Dewey does not have teeth.)

But not all of our experience with Dewey is pleasant.

The other day on the radio, an author in San Francisco shared her experience of trying to fix her five-year-old computer. She was told the computer is considered as an antique in the tech world and cannot be fixed any more by a technician. Same story with Dewey -- he is aging fast, and soon he will become an antique. Last summer, Softbank Robotics released a new version of NAO robot, NAO V6. Dewey as a NAO V5 became outdated instantly. The software working with Dewey was sadly marked as "Former version" although not much significant changes take place if one compares the new version to the old one. This is just yet another reminder of how fast the world around us is changing these days. Technologies, including that of hardware and software, seem to have a lifespan of a fly.

Libraries are playing a dangerous catch-up game here. We have to be better prepared when entering the treacherous water called emerging technologies. We need good insights and visions, sustainable grant and budget, carefully carved out contract terms, as well as flexible project management on the ground level to repurpose "outdated" technologies.

The current grant and budget plans in libraries are not that sustainable for new technology projects. For an AI project, we probably need budget to cover the long-term subscription cost for cloud servers, cloud storage, cloud computing, API calls, as well as the cost of hardware upgrades. This is very hard to achieve with the current system.

We also have to be creative in managing new technology projects. For example, our hard work with Dewey, a soon-to-be "antique", could go in vain without a plan B. That is why starting last year, we began to generalize some of the solutions we had for Dewey. Palo Alto City Library, along with Roanoke County Library, is working on a prototype chatbot platform. The hope here is that this platform will become as platform-neutral as possible, and it can be extended to future hardware.

From our experience developing Dewey, we discovered that it is pretty much an uncharted map even in peripheral areas in terms of AI in libraries. Are your library's website and other public information machine readable and machine friendly? Does your library's website have an API? Does your catalog have an API? Does your library's calendar have an API, or at least, an RSS feed? While these might not be linked directly to machine learning, they are an equally important part in an overall AI solution. For example, the human robot interaction platform for Dewey is built with four components: human inputs, voice to text conversion, NLP and response retrieval. One time we were trying to train Dewey to fetch answers for questions like "is the library open today?". It sounded like a simple task that could be realized in a few lines of code, but the solution turned out to be quite intertwined at the last step. Our main library website does not have an API yet, so the machine needs to take the slow process to check multiple places. First it has to read the regular schedule page. Then it has to read the events RSS feed to see if there is any planned or unexpected closures for a specific branch on a specific day. Finally, it consolidates both findings for the output -- this is too much.