

Helsinki University Hospital

Case study

Name of initiative

Milli chatbot, virtual assistant at Mentalhub.fi

Implementing organization

Helsinki University Hospital

Initiative type

Artificial intelligence (AI) system

About the initiative

Milli is an AI-powered chatbot, which uses natural language processing (NLP) to help adolescents in Finland open up and learn about mental health issues. Milli is not only the result of collective research between interdisciplinary experts and practitioners, but the chatbot has also been designed and continuously improved through an iterative and inclusive process involving adolescent end users.

Alignment with UNICEF Policy Guidance on AI for Children

The initiative has aimed to:

- Support children's development and well-being
- Ensure inclusion of and for children
- Protect children's data and privacy
- Provide transparency, explainability and accountability for children
- Ensure safety for children

Location

Finland

Launched

2019

Overview



For adolescents, opening up and seeking out timely advice to understand symptoms of depression and anxiety can mean a half-won battle. Creating a safe space for teenagers to attain mental health support has become the core mission of a multidisciplinary group at Helsinki University Hospital (HUS). Sharing expertise and learnings garnered over many years, a team of psychologists, mental health experts, nurses, artificial intelligence (AI) and design engineers created Milli, an AI-powered chatbot tailored to provide adolescents and adults in Finland with mental health information.

Existing as a chatbot on Mentalhub.fi, Milli fields 500 to 1,200 queries weekly. Launched as a pilot in 2019, the virtual assistant allows users to anonymously ask questions about the mental health issues they may be facing. Using keyword-identifying conversational AI, Milli connects users with helpful mental health information or medical providers. Critically, the chatbot has been trained to discern between adolescent and adult users and offers different responses that are tailored to these different age groups. Milli also has the capability to ascertain if a user is experiencing a health emergency, for instance, situations of self-harm, and effectively directs the user to reach out to emergency services, authority figures or trusted adults – depending upon the severity of the situation.

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Milli is not only the result of collective research by dedicated experts and practitioners, but the chatbot has been designed and continuously improved upon through an iterative and inclusive process involving adolescent end users. Milli is constantly being refined thanks to users providing binary thumbs-up or thumbs-down chat and text feedback, allowing the development team to deploy updates. This form of co-creation ensures that the AI virtual assistant provides a service that adolescents would want, could use, and would find helpful.

Context and project origins

Helsinki University Hospital is a public institution and the second-largest employer in Finland, employing over 27,000 individuals. Through a cross-disciplinary effort that started in 2009, HUS has developed and maintains [Mentalhub.fi](#) – a free but comprehensive range of mental health services accessed online by 2 million Finnish residents each year. Within this digital platform, HUS designed Milli, an AI conversational tool, to help users better recognize and find information about mental health disorders and speak about mental health issues in a safe and anonymous manner.

Mental health conditions are a serious and common occurrence around the globe, and Finland is no exception. As of 2018, approximately [18.8 per cent of the Finnish population](#) suffer from mental health conditions in a given year, slightly higher than the European Union average of 17.3 per cent. These numbers do not reflect the rise in mental health problems seen during the COVID-19 pandemic, which globally has worsened mental health cases and symptoms. For instance, in countries such as the United States, symptoms of anxiety increased from 11 per cent of the population to [over 41 per cent](#) during the pandemic.

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As of 2016, low employment and productivity loss attributed to an increase in the costs related to mental health care in Finland, an estimated [5.3 per cent of its GDP](#). Mental health conditions, therefore, significantly impact the population as well as the productivity of the nation. Combating poor mental health conditions leads to benefits for a wide swath of the population as well as an increase in GDP and productivity. Since so many Finnish citizens experience negative mental health symptoms, it is crucial to connect them with authoritative, helpful and accurate mental health information.

HUS' core values are caring, equality and pioneering leadership. Milli embodies these three virtues. The AI-powered chatbot provides care by listening to citizens and providing accurate answers in a safe, reliable and timely manner. Milli provides equality by offering care to as many citizens as possible, including younger age groups, and does so free of charge. Milli exemplifies pioneering leadership by allying the multidisciplinary expertise and learning of mental health practitioners with AI technology to provide and scale agile and tailored forms of mental health support.



About the AI system

Milli utilizes natural language processing (NLP) to converse with users and to provide them with accurate medical information about mental health. While the service targets users aged 12 and above, HUS has focused on users between the ages of 12 and 19, as the anonymous and online nature of the chatbot is geared towards adolescent users. Whenever a user goes to Mentalhub.fi, the virtual assistant pops up in the right-hand corner of the screen with a friendly greeting informing the user that (a) this assistant can help them receive mental health information and adequate support in a timely manner; and (b) that Milli is a chatbot. Milli's opening greeting is:

Hi! I am Milli, an AI dude. I know about the most common mental health issues. I am in testing and I am just learning this work. I understand most easy short sentences. P.S. I am not a psychotherapist or a doctor, but I try to support you and guide you to the right information.

In this way, the user is in a better position to readily understand the capabilities and limitations of the AI system, setting expectations and reducing possibilities for miscommunication. Additionally, due to Milli's friendly trained responses and the user's understanding that Milli is a virtual assistant, HUS built on the working [hypothesis](#) that adolescents will be more likely to broach uncomfortable topics with the AI system rather than a human representative.

When a user asks Milli a question, the chatbot uses keyword-based conversational AI to guide the user to the correct information. Relying on such fundamental NLP capabilities, Milli has been trained in 46 topics and has a set of 2,224 different responses.

Milli was developed through close collaboration between clinical and AI tech experts, who took existing content from Mentalhub.fi and crafted it into shorter, simpler responses. Before Milli was launched, adolescent end users tested the service and its answers, providing HUS with critical feedback on clarity, tone and ease of use. The combination of knowledge and learning from mental health professionals and young end user testers allowed Milli to perfect a non-judgmental tone for responses, while ensuring that clear and accurate mental health information was relayed to its users.



The development team used and continues to use the PDCA process for the design of Milli. PDCA – short for plan, do, check, act – allowed HUS to focus on the end user's needs, as well as create an effective process for integrating feedback into further iterations of Milli. Initially, HUS set out to focus on anxiety and depression – the two most common mental health issues affecting Milli's target demographic of adolescents. However, through testing and collaboration with end users, the team discovered that adolescents were keenly interested in topics outside the scope of anxiety and depression. This understanding, which would not have been possible without inclusive collaboration

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with adolescents, enabled HUS to expand the topics that Milli would cover, necessitating a further commitment to NLP to provide accurate responses to users' queries.

Milli asks users for both a binary 'thumbs-up, thumbs-down' review after each answer as well as at the end of the conversation. After the interaction, users can also provide text-based feedback. The development team reviews the feedback weekly, deploying small updates every week and larger updates every six weeks, primarily in response to the comments and suggestions offered by Milli users. Most of the feedback is positive (thumbs up), which is considered rare, as users are more likely to send feedback when their experience is negative. HUS views this as a major affirmation of the effectiveness of its platform, as well as proof that it is continuing the mission of its three core values. Positive feedback allows the team to understand what portions of the platform are most useful to users, while negative feedback allows the team to refine the keyword-based conversational AI.

Importantly, Milli was developed to understand that there are situations in which the support provided by an AI virtual assistant is insufficient. In these particular situations, such as a user indicating intentions of self-harm or surpassing a threshold on a self-assessment tool for a mental health emergency, Milli will direct the user to emergency services such as 112 (the European Union emergency number) or other health providers.

Application of child-centred requirements

From its inception, Milli was conceived and designed to provide mental health support tailored to the specific needs of adolescents. While the service has been rolled out to adults as well, the original idea and framing has always been child-centred. In particular, through their multidisciplinary development process, the HUS team has focused on a set of requirements that align with the [UNICEF Policy Guidance on AI for Children](#), namely around development and well-being, inclusion, data and privacy, transparency, explainability and accountability, and safety.

Support children's development and well-being

While the HUS team made Milli accessible to both adolescents and adults, specific efforts were made to provide different text and information to its various users. This '[tailoring effort](#)' was completed in close collaboration with cognitive behavioural therapists who specialize in adolescent mental health, to produce text that is specifically crafted for emotional regulation and anxiety within adolescent populations. To segment users in the chatbot, Milli first asks users whether they wish to access information for adults or adolescents. This was decided instead of simply asking a user's age, as the team understood that adult users may wish to access mental health information for their children. While adolescents can access further knowledge about adult mental health conditions, Milli provides responses that include information related to their development and the issues that youths face. Such measures were well received and positively validated throughout the testing process, by both adults and adolescents, though the design team is still actively working on improving Milli's NLP abilities to more effectively identify adolescent users based on the text input.



Ensure inclusion of and for children

Milli had and continues to have adolescents test its conversations and responses using surveys, providing HUS' development team with constructive feedback on the effectiveness of the service, as well as on its design. During a design course at Aalto University, students played the role of 'experience specialists' and contributed critical insights to Milli's co-creation process. For instance, the visual character of Milli was originally designed as a teenager wearing a hoodie (figure 1), but upon suggestions from end users, the chatbot was redesigned to appear as a friendly, yet unmistakably virtual assistant (figure2). These changes would not have been possible without the inclusion of children in the design process.

FIGURE 1: ORIGINAL MILLI CHARACTER



FIGURE 2: REDESIGNED MILLI CHARACTER



Additionally, child and adolescent psychiatrists and medical professionals who specialize in childhood care were brought into the development and learning journey from the beginning. These specialists even attended a 3-day training by the AI developer (boost.ai) to understand the platform, in order to provide accurate and helpful design suggestions. This cross-field and cross-sectoral approach ensured that the design had adolescents and children in mind and that they were part of the co-creation process, so that Milli would be uniquely helpful and practical for this target demographic.

Protect children's data and privacy

Milli extends privacy and data-protection to all users. Individuals can access the virtual assistant without providing any identifying information or having to sign up for an account. In this way, all questions put to Milli are completely anonymous, a critical feature which [has shown](#) in similar virtual support tools to help reduce barriers to information and care. Storing and building on user responses will help improve the chatbot's conversational and analytical capacities, but users can request that their responses be deleted at any time, and Milli will comply. Furthermore, if users enter any identifying information, such as a telephone number, Milli will automatically delete it. This two-pronged approach (by not requiring identifying information and deleting sensitive information proactively) ensures that children's data and privacy are secure.



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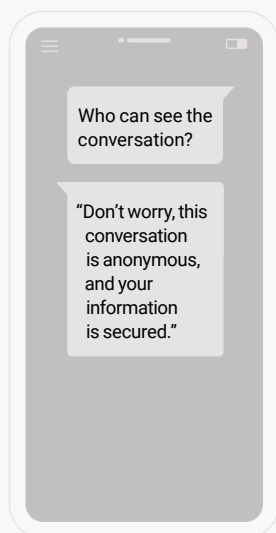
Provide transparency, explainability and accountability for children

HUS is committed to transparency and accountability with its users regarding chatbot interactions. While Milli has always allowed users to delete messages and has provided responses that emphatically state that messages are private and that Milli is an AI-bot, not a human, the HUS team has worked to create more detailed and nuanced responses taking into account adolescent comprehension about chatbot limits and mental health.

Milli's new iteration provides detailed and thoughtful responses if a user enquires about how their data is used, while explaining how their messages may be stored anonymously to support the development of the app.

FIGURE 3: EXPLAINING HOW MILLI PROTECTS INFORMATION SHARED BY USERS

Before feedback



After feedback: new design provides more comprehensive explanation

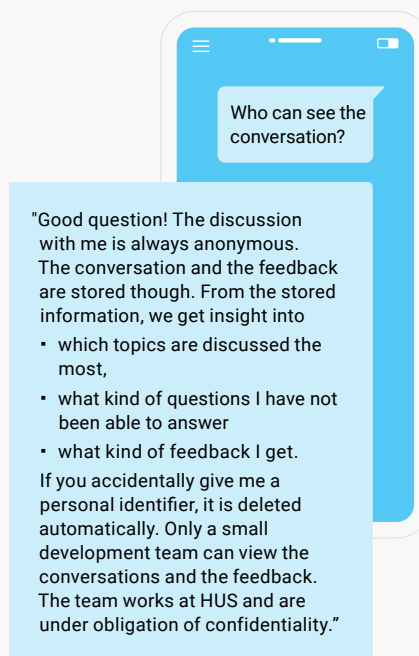
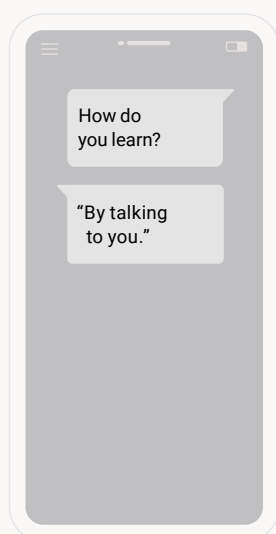
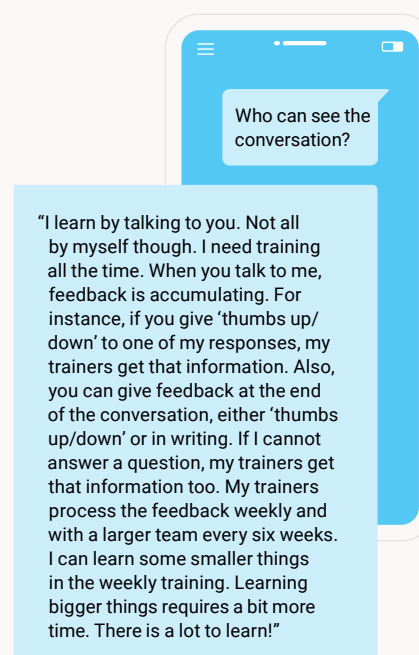


FIGURE 4: EXPLAINING HOW MILLI LEARNS FROM INFORMATION SHARED BY USERS

Before feedback



After feedback: new design provides more comprehensive explanation



Milli now also offers detailed explanations for young users on how AI works, who developed the chatbot, and how it learns through each discussion. In this way, adolescents can feel confident in how their interactions with Milli work to increase the accuracy and predictive value of the platform, without compromising their sensitive data.

Ensure safety for children

As a priority, HUS has focused on ensuring children's safety through several avenues. First, HUS has relied on medical experts and child psychologists to ensure that the advice given to adolescents is accurate and understandable. Second, the development team reviews analytics weekly to better improve how the chatbot is responding to frequently asked questions, as well as improve upon negative feedback. Third, Milli itself is trained to recognize emergency situations and guide children to speak to an adult, an authority figure, or an emergency responder, depending upon the severity of the issue at hand.

Although Milli is not considered to be a medical device, HUS chose to rely on symptom assessment questionnaires that are recognized standards in the medical field (specifically for anxiety, depression and alcohol use). The chatbot provides feedback about the user's situation based on the self-assessment, while stressing that Milli itself cannot provide a diagnosis. If a user expresses that these symptoms are causing harm, the virtual assistant will provide ways for a user to contact a doctor or a medical professional.

When it comes to recognizing intentions of self-harm, Milli is continually working to improve its NLP through contextual understanding. Many expressions of self-harm in Finnish are not explicit but are instead ambiguous and best understood in the context of the conversation. HUS is improving Milli's analytical capabilities so that these ambiguities are readily understood and treated as medical emergencies, connecting users to ad hoc services without delay. In the future, the team behind Milli hopes to focus on prioritizing fairness and non-discrimination by ensuring the virtual assistant meets European Union accessibility requirements (for which they are currently being evaluated), as well as rolling out gender-sensitive content and vocabulary.

Lessons learned and future challenges

During evaluation with end users, the Milli team discovered some important actionable items. First, adolescents were interested in many more topics than anxiety and depression, which led to widening their scope to include additional topics and responses. Second, testers questioned the design of Milli, the chatbot avatar. Originally, Milli was designed as a 14-year-old child – with the idea that it would make Milli relatable (see figures 1 and 2, page 8). However, users questioned the logic of a 14-year-old providing authoritative (and friendly) mental health guidance. As a result, Milli's avatar was changed to be an unmistakably virtual character, which increased the users' believability and trust.

During the pandemic, professionals tested a live mental health chat to augment their mental health outreach. Interestingly, this service had relatively low demand, and was discontinued. Demand for Milli, however, has been consistent and strong. This is possibly attributed to the anonymous nature of the virtual assistant, where users understand that humans do not read and respond to their answers, so they open up more easily about issues they are facing. Milli's benefits are numerous: it provides accurate and tailored responses at all hours of the day (Milli is never out of office or off the clock), meaning that users always have a resource they can depend upon.

One area of concern that the team is hoping to address in the future are users aged 8 to 11. Milli was designed for users aged 12 and over, and the design team has spent considerable time making sure Milli can speak effectively to youths and adults. Children aged from 8 to 11 who consistently read proficiently are a group that Milli hasn't specifically crafted responses for. Modifications are still needed to make this service available for younger users.

As a priority, HUS' multidisciplinary experts seek to constantly improve the ability of NLP systems to decode nuanced and ambiguous messages signifying self-harm. As of April 2021, the team is also working to implement content on sexual abuse, parental abuse, parental substance abuse and parental mental health problems. These challenges reflect how refining the chatbot's NLP capabilities remains critical to expanding Milli's capabilities and scope of care.

About this case study

This case study is part of [UNICEF's Artificial Intelligence for Children project](#), which aims to better understand how AI-powered technologies can protect, provide for and empower children. Through a partnership with the Government of Finland, the project developed a draft [Policy Guidance on AI for Children](#), which contains practical recommendations and principles for governments and industry to create child-centred AI policies and systems. In order to inform and improve future versions of the guidance and inspire others, organizations were selected to pilot the guidance and share their diverse experiences to illustrate how AI-based initiatives could be designed to be more child-centred. The approaches taken, lessons learned and insights gathered will be one contribution to the global effort towards AI policies and systems that support children's development. View all of the case studies on our [website](#).

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