Development of a Chatbot Application for Cryogenic System

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Abstract. The vacuum group of NSRRC developed a task-oriented chatbot application based on LINE message platform in 2018. LINE message is a cross-platform communication software that can be easily used on mobile phone, tablets, and PC. This interactive user interface can not only reply the real-time status of sub-systems when the user has a query but also proactively report alert. The TPS cryogenic system also introduces this application which like a virtual assistant to help cryogenic engineer management system more efficiency. In this paper we present the configuration and operation of this task-oriented chatbot application for cryogenic system.

1. Introduction
Chatbot has two main categories, one is Task-Oriented Chatbot, and the other is Chit-Chat Chatbot [1]. The first task-type Chatbot is similar to a personal digital assistant, to help users complete specific tasks. Therefore, some people call it a functional robot to interact with the latter in social interaction, gossip or no specific task. Developers often write scripts to automate certain system operations. In fact, it should be said that bot is a more extensive software robot, and Chatbot is a software robot that pays special attention to the dialogue mechanism and dialogue process. The Chatbot channel is an application that runs Chatbot on supported mobile device (such as smart phone and tablet) or a terminal (such as a desktop application). They are usually built on existing Instant Messaging (IM) platforms. Popular Chatbot interface are usually IM platforms include Facebook Messenger, Slack, Telegram, Kik, Skype and LINE are very popular and continue to steady growth. These channels are essentially Chatbot applications where the user interacts with the robot. Developers can use the IM platform’s Application Programming Interface (API) or service-oriented approach to develop Chatbot’s function. The global acceptance of chat-based interfaces makes it easy to adopt and spread new technologies built on pre-existing platforms [2]. This means that application development methods are the same as embedded devices, just like any web service that uses the Web API. The Chatbot app is a dialogue system. Unlike Graphical User Interface (GUI) systems that provide a lot of information, the dialog system is search-based. When the user requests information, the dialog system returns the answer. The vacuum group in NSRRC first applies the Chatbot function for their systems in 2018[3]. This chat bot will make it easier for engineers and scientists to get TPS front-end status and increase productivity. Because of this kind of task-oriented Chatbot is highly customize for
software should be complete development solution for the "LINE Message API". This protocol, which is well suited to E messaging, is special graphics program, SDKs interface, providing an EPICS edge. Application of PyEPICS interface function to obtain raw image data of surface detector from BASE interface module for Python, which can be read by CA protocol. Write environment PyEPICS, form however, Flask retains the flexibility of amplification, which can be added with Flask extension. Flask does not have a library or form validation tool that is preset. It is lightweight, because it uses a simple core. Add other features with extension. Flask does not have a library or form validation tool that is preset. However, Flask retains the flexibility of amplification, which can be added with Flask-extension: ORM, form validation tools, file uploads, and various open identity verification technologies. Library PyEPICS is EPICS channel access library, using Python to retrieve instrument values in EPICS environment and is EPICS and Python's channel access (CA) library interface, providing an EPICS BASE interface module for Python, which can be read by CA protocol. Write process variables (PV) value. Application of PyEPICS interface function to obtain raw image data of surface detector from EPICS. Library Line-bot-sdk-python is LINE official software development kits (SDKs) for the Messaging API. Support language Java, PHP, Go, Perl, Ruby, Python, Node.js. Line-bot-sdk-python is different industrial equipment. Cryogenics group develops its own Chatbot help its user and engineer know the statues of cryogenics system easier. The Chatbot app is based on the LINE messaging platform. LINE is a cross-platform communication software that can be easily used on mobile phones, tablets and PCs. LINE provides a complete development solution for the "LINE Message API". This Chatbot has two main functions, one function is reply system status to the user query and the other is failure alert push function.

2. Implement tools
During development period, some software should be prepared for this task-oriented Chatbot environment. Most software is open-source code and free. We don’t need speed lots budget to develop a small, task-oriented Chatbot. In this section, we introduce basic knowledge and needed software.

2.1. LabVIEW
LabVIEW is well-known commercial system engineering software designed for applications that require testing, measurement, and control to provide fast access to hardware and data for in-depth analysis. The difference between a graphical program and a traditional programming language is that the program flow breaks the traditional thinking mode with the concept of "data stream", which allows the programmer to complete the writing of the program while the flowchart is completed. Due to the easy-to-understand development interface of LabVIEW's special graphics program, it is currently widely used in the field of industrial automation. By its support communications protocol, hardware, original data format can be transfer to EPICS signal format.

2.2. EPICS
The Experimental Physics and Industrial Control System (EPICS) is a software environment used to develop and implement distributed control systems to operate devices such as particle accelerators, telescopes and other large experiments. it designed to help develop systems which often feature large numbers of networked computers providing control and feedback. EPICS uses client/server and publish/subscribe techniques to communicate between the various computers using the Channel Access (CA) network protocol. CA is a high bandwidth networking protocol, which is well suited to soft real-time applications such as scientific experiments.

2.3. Python
The Python language is used as a web application, and Python is often used for web development. Python coordinate communication between the Http server and the Python-based web application. Python is well-supported for various network protocols and is often used to write server software. Python is an object-oriented, literal-translating, cross-platform computer programming language can easily integrate with other underlying languages, so it is also known as glue language. Three necessary Python library which are Flask, PyEPICS and line-bot-sdk-python used to help develop Chatbot. Library Flask is a lightweight web application framework written in Python. The core of Flask is very simple. In fact, there is no best framework. Only the right use situation, Django is suitable for the rapid development of large applications, and Flask is relatively lightweight, because it uses a simple core. Add other features with extension. Flask does not have a library or form validation tool that is preset. However, Flask retains the flexibility of amplification, which can be added with Flask-extension: ORM, form validation tools, file uploads, and various open identity verification technologies. Library PyEPICS is EPICS channel access library, using Python to retrieve instrument values in EPICS environment and is EPICS and Python's channel access (CA) library interface, providing an EPICS BASE interface module for Python, which can be read by CA protocol. Write process variables (PV) value. Application of PyEPICS interface function to obtain raw image data of surface detector from EPICS. Library Line-bot-sdk-python is LINE official software development kits (SDKs) for the Messaging API. Support language Java, PHP, Go, Perl, Ruby, Python, Node.js. Line-bot-sdk-python is
a library provided by LINE bot SDK to Python, making it easy for developers to develop LINE Messaging API applications.

2.4. Ngorok
Using the third-party software ngrok as a forwarding server, he can forward the external request to the port you specify. The background principle is to connect to the ngrok cloud server, expose the address specified by your machine, and then use ngrok. A bunch of public URLs to access content. His strengths are quick and also provide https services that make you safer to use. Ngrok can use the external network to access the website deployed on the local server. Through ngrok, you can quickly establish an Internet-connectable web server, so that the test environment of the local computer can be directly connected to the outside for testing and debugging.

2.5. LINE
LINE app is an instant messaging (IM) platforms is most popular social network mobile APP in Taiwan. LINE is a new type of communication application. can operate at mobile phone operation system. Like Android and iOS and PC operation system. Same as other IM platform, like Facebook Messenger and Slate are cross-platform environment. LINE provide LINE Message API in 2016. Line Messange API provides Python packages for Python program designers can use the suite API to interact with LINE, eliminating write complex programs and JSON transport formats.

3. Chatbot architecture and application for cryogenic system
In 2018 the vacuum group develop a task-oriented Chatbot application by python language for monitoring Taiwan Photon Source Front-End System. The LINE app is choice as IM interface due to LINE is a most popular IM app in Taiwan, and its completely support and easy development let engineer built a useful and reliable task-oriented Chatbot in short time. The task-oriented chat is highly custom-make/private, thus cryogenic group develop a private Chatbot. Figure 1 shows the NSRRC cryogenic system data access network architecture. Three data access/storage programs develop by LabVIEW connect to three main cryogenic plants (MCP1, MCP2 and MCP3) and other related systems. These three programs provide connect-channel for other software/computer access through Ethernet in NSRRC.

![Figure 1. NSRRC Cryogenic system data access Network Architecture](image-url)
One Chatbot server developed by python is used to manage all request/response/alert function. One program collects and transfers all signals data format to EPICS data format. One fault alert program pushes the alert message to cryogenic group. The response function lets this Chatbot become a virtual assistant who knows all situation of the cryogenic system. We can request a simple question to Chatbot through LINE app and get real-time signal values response immediately. Another function is “fault alert push”. Early have an alert system is send fault alert message by short message service (SMS). It’s not free charge and needs a suitable hardware for this SMS fault alert. This alert system by LINE app can be a double security for us. This kind of Chatbot is very useful tools for the member of the cryogenics group.

3.1 Request/Response Function
The response function is written in a python’s file which can access EPICS channels and be a webhook HTTP server. To implement this service, the flask web framework is used. When a user sends a message to the Chatbot, webhook service will receive a JSON file from LINE message API, this JSON file include message information. The Chatbot architecture is shown in the Figure 2.

Figure 2. Chatbot architecture for NSRRC cryogenic system.

Figure 3. Screen shot of the Chatbot application.
After receiving the message, the EPICS channel access engine will search the correct PV name signal and callback related values filled in the formatted string of the result and use LINE message API push method returns the result to the user. The user experience of using this Chatbot application is like chatting with a virtual assistant. The developer invite relates users to add this virtual friend. Once the user acceptance the invitation, the user can enter the specific text (normally is the signal name, like “ST100” means compressor speed) to query the Chatbot. If this string matches the signal name of EPICS server, the Chatbot will return the real-time signal values to user. Figure 3 is an example the LINE screenshot of the user querying the overview status of main cryogenic plant #1. User also can type the single signal text for querying single signal value. For user who didn’t understand cryogenic system well. The Chatbot provide a function call “Rich menu” which has a six menus replace text-type for users get system status by one press. In our application six menus is used for the overview of MCP1, MCP2, MCP3, TLS related system, TPS related system and HELP menu.

3.2 Fault alert function
The currently fault alert system is used SMS through a signals collect program developed by LabVIEW. This program real-timely monitors cryogenic system status, when the system value upper/under the pre-set high/low limit, this program links a SMS hardware module and send a warning message to the responsible person. The LINE notify API provide a similar application through HTTP link function. We lightly modify the existing program. We can get the same warning message from LINE notify. Free charge is the most advantage. The LINE notify architecture is shown in figure 4. Unlike the interaction of Chatbot, this push method is a one-way data flow. Figure 5 is the screenshot of the cryogenic system signals alert.

![Figure 4. LINE notify architecture for NSRRC cryogenic system.](image1)

![Figure 5. Screen shot of the alert application of LINE notify](image2)
4. Conclusion
The task-oriented Chatbot application which likes a personal digital assistant used to query and provide real-time signal for cryogenic system relative members and user can also provide fault alert function. The prototype Chatbot for cryogenic system is completed now. The following work is extending function like history curve. The future will increase the amount of information that can be provided and enhance the user experience. Providing a service on different platforms is under considered, such as Facebook Messenger and WhatsApp, etc. The application in smart phone is more and more completer. The Chatbot integrates the Grafana dashboard to complement the continuous Monitor demand.

5. Reference
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Acknowledgments
National Taipei University of Technology and Ministry of Science and Technology, R.O.C. supported this work.