

# Chatbot Application in Laboratory Equipment Management and e-assistant

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**Abstract**—For most of school employee usually meet a difficult task about manage a lot of equipment. For instance, recording their status, malfunction and repair history. The purpose of this study was to design a small chatbot system to help these people works easily. Due to technological advances in communication and Artificial Intelligence, user not only can access the chatbot service in everywhere but for Natural Language Understanding helps, chatbot can handle complex requests through simple natural language in Chinese. Compare with the traditional management approach, that was full of paper work and reaction against with malfunction condition inefficient, Database can help to collect and track their status. By review the older equipment records, researchers found those cause of the malfunction and repair steps for those same type of equipment were similarly. It also can be found by analyzed the database of this system. Hence, the system not only shows and records the equipment usages status but also provides a quickly and flexible troubleshooting according to analyzed their malfunction and repair history. We also planned to open source this system's architecture to help those people who needs to process the objects status such as books in Library, the equipment status and products quality in manufactory processing.

**Keywords**—Chatbot, Human-Computer Interaction, Natural Language Understanding

## I. INTRODUCTION

We implemented an instant message application that helps people who manage many equipment such as the staff work in school or research institution. For them, a big problem in their daily task that is how to track efficiently equipment status. The most popular method is that records the information in local PC storage or cloud server. The advantages of these method are that is easy to view the historical record, make statistics on data related to usage or maintenance and it is beneficial for long-term storage. In a researcher's school, equipment administrators usually need to keep each one of equipment working normally, or not, they need to repair the malfunction rapidly. For current procedures in author's school, the user needs to report to administrator while malfunction occurs. It is recorded on maintenance record book. The administration staff need check the record book and upload the problem and the status to database.

LINE, a popular instant communication software in Asia. It is also a popular smartphone communication APP in Taiwan. In 2019, Taiwan's monthly active users exceeded 21 million. LINE provides many services such as chat, call, online shopping service, etc. LINE corporation provide the LINE Message API to developer. In this way, developer can build their own chatbot service easily.

Chatbot is an interface between human and device, there are so many applications in IoT [1] or Urban field [2] even in the Children concerns [3]. The other feature of chatbot is that it can accept user active with a simple sentence like user talk to a human agent.

Natural Language Processing is a language process technique in artificial intelligence subfield. Chatbot can understand the user intent while user "talk" to bot in simple sentence by using NLP techniques [4].

In this research, we built the LINE chatbot service so that user can report malfunction condition or get the troubleshooting information on their smartphone. The chatbot system is connected to a cloud Language Understanding server so that user can access the chatbot service from smartphone by input some simple dialogs and chatbot record the malfunction condition into database or responses the equipment's troubleshooting.

## II. SYSTEM ARCHITECTURE

Chatbot system consists of five parts, the system architecture is illustrated in Fig. 1.

- Client device

In this research, we provide a public LINE account so that user can "add" the account into his friend list be able to access the chatbot service. User can enter text messages, upload images or just use the LINE menu button that Fig. 2 shows on smartphone. The LINE also provides the "LIFF", LINE Front-end Framework, that makes user can open the web page without opening another external browser. In addition, LIFF also transmit the user profile like LINE user ID to chatbot server. It helps us to record who the reporter is. LINE can also be executed on a PC. However,

due to the limitation of LINE app, it can only enter text message or upload image.

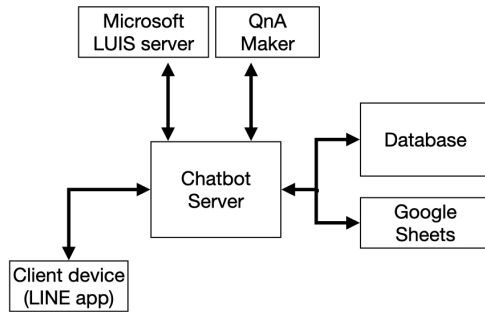


Fig. 1. Chatbot system architecture.



Fig. 2. LINE menu button.

- Chatbot server  
The chatbot implemented in this research was written by python. The server gets the user message through LINE Message API. Base on the message input by user, the program executes such as storing the fault record, answering the user question and showing the troubleshoot. Chatbot also transmits the text message to the Microsoft Language Understanding service to predict user's intentions in response.
- LUIS server  
LUIS, Language Understanding Intelligent Service, is a Microsoft cloud natural language processing service that can analyze natural language text to predict its meaning [5]. Chatbot sends the text to LUIS via endpoint API, after analysis and processing, the result is responded to chatbot server in JSON format.
- QnA Maker  
QnA Maker is a cloud service that is provided by Microsoft. QnA Maker makes the developer to construct the question-answer pairs like a dictionary. Chatbot sends a question string to QnA Maker and "answer" the question base on the "question index" in the question answer pair that shown in Fig. 3.
- Database and Google Sheets  
The system records the equipment information in database as a historical record and also synchronously update it to Google Sheets. Administrators can track the daily status of equipment by viewing the contents of Google Sheets.

Question	Answer
<ul style="list-style-type: none"> <li>* 三用電錶量不到電流</li> <li>* 三用電錶故障</li> <li>* 三用電錶電壓不正常</li> </ul>	<ol style="list-style-type: none"> <li>1. 請檢查三用電錶保險絲是否正常？</li> <li>2. 如燒斷，請至器材室索取相應型號的保險絲。</li> <li>3. 如保險絲外觀正常，請回報“三用電錶故障”</li> </ol>
<ul style="list-style-type: none"> <li>* 電腦無法上網</li> <li>* 教室沒有網路</li> </ul>	<ol style="list-style-type: none"> <li>1. 請檢查其他組別電腦是否有相同狀況</li> <li>2. 若教室電腦皆無法上網，請重開教室牆上的switch開關，並等待五分鐘等候網路交換器重新開機。</li> <li>3. 若其他電腦皆為正常，請查看電腦網路線是否正確接上。</li> <li>4. 若問題仍然存在，請回報“網路問題”</li> </ol>

Fig. 3. QnA Maker question-answer pair.

### III. IMPLEMENTATION

Fig. 4 shows the block diagram of the chatbot processing algorithm.

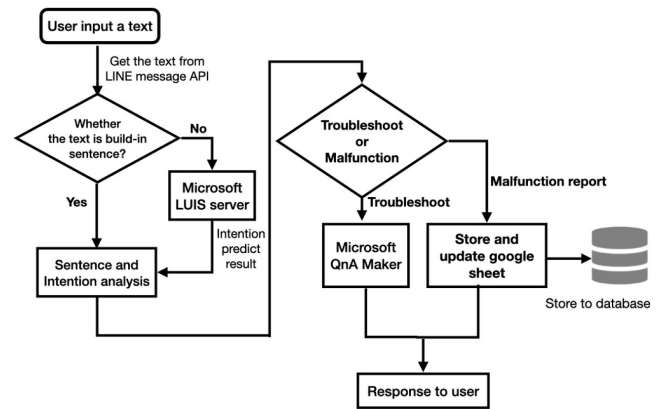


Fig. 4. Data Processing Flowchat.

Chatbot system is built on Django framework. Django is an open source python-based web framework that follows MVC architecture pattern. Developers can build a web application quickly based-on Django framework. LINE also provides a python-based SDK, while Django allow developer import any python modules into its framework.

- 1) Receive message from LINE:  
Chatbot receives the messages that user input from LINE server through the LINE Message API. The message that chatbot get is formatted in JSON.
- 2) Send the message to LUIS:  
At first, system recognizes whether the message is build-in message. Non-build-in message will be sent to LUIS server in order to predict intention. The LUIS return the intention probability will be formatted in JSON that is shown in Fig. 5. For those build-in messages, chatbot executes its default processing on the next step.
- 3) Troubleshooting or Malfunction condition report:  
According to the build-in message or the probability of intent, the system will display the troubleshooting or report the equipment failure information.

```

query: "示波器動作不正常"
prediction:
  topIntent: "assistant_show_troubleshooting"
  intents:
    assistant_show_troubleshooting:
      score: 0.7625587
      None: {}
      assistant_report: {}
  entities:
    equipment.name: []
    $instance:
      equipment.name:
        0:
          type: "equipment.name"
          text: "示波器"
          startIndex: 0
          length: 3
          modelTypeId: 5
          modelType: "List Entity Extractor"
          recognitionSources: []

```

Fig. 5. JSON that is Response from LUIS service.

- Store the malfunction status:  
System will store the equipment failure status in the database, and update the content of the equipment status list stored in Google Spreadsheet via the Google Sheet API. Equipment administrators can track those abnormal machines by viewing worksheet. Google Spreadsheet provide the e-mail notification, that setting is shown in Fig. 6. Owner of the worksheets will receive notification mail when the content of Spreadsheet be changed.

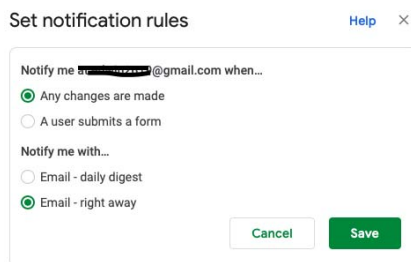


Fig. 6. Google Sheet notification rule setting.

- Show the troubleshooting:  
When the user asks the chatbot show the equipment troubleshooting, the question that user asked will be sent to QnA Maker service server. Developer have built the "question-answer pairs" as a "Knowledge Base" on QnA Maker. The question sent by user is an index of question-answer pair. The response from QnA Maker is formatted in JSON.
- 4) Response message to User:  
LINE Message API provides a "Reply" method and a "Push message" method in order to chatbot server can

send the message to users. The "Reply" method can only "reply" message to the user who sent the request. While "Push message" method can send a message to anyone who has added the chatbot account as a LINE friend.

#### IV. RESULT AND DISCUSS

In this research, we have successfully implemented a chatbot service that provide the equipment users to report abnormal condition or try to fix the problem by reading the troubleshooting that chatbot response. User can act with chatbot by using simple sentences, as shown in Fig. 7. User can send their questions to chatbot, which will predict user's intentions and try to give them the best answer. According to the analysis of equipment failure records, the information that most user really need is a simple troubleshooting to repair abnormal condition. We summarize the equipment maintenance history and generate the useful troubleshooting. User can follow the check steps to solve the most problems. For those complex situations that cannot be recovered in a short time, users can report through the report form that built on LIFF, as shown in Fig. 8.

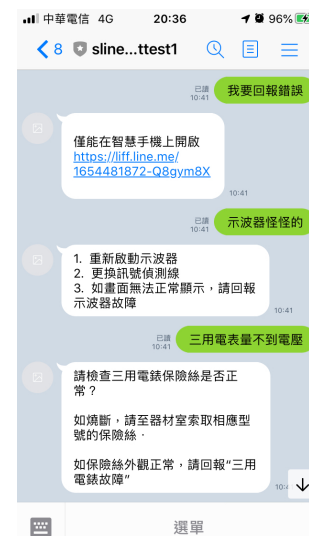


Fig. 7. The dialog between user and chatbot.

When the chatbot receives the report, the system will store the report data in the database and Google Sheets. Fig. 9 shows the contents of worksheet. The administrator will receive the email notification, which is shown in Fig. 10 when worksheet's content has been changed. We choose Google Sheet to record the malfunction condition because Google Sheet has good build-in functions, such as data sorting, visualizing data as a chart. For example, the Fig. 11 shows the history records that be sorted by the equipment name. It can also help administrators to track and summarize the common failure cause of each type of equipment. The troubleshooting can be flexibly modified in order to adapt to those abnormal conditions occurred frequently.

Fig. 8. Problem report using LIFF.

	A	B	C	D	E	F
1	回報時間	Reporter id	地點	設備名稱	設備桌次	問題簡述
2	2020-09-06T1	U643f290529987236cd21c B2_305	電腦		13	軟體打不開
3	2020-09-06T2	U643f290529987236cd21c B2_305	訊號產生器		11	訊號輸出有雜訊
4	2020-09-07T0	U643f290529987236cd21c B2_210	教室網路		0	教室網路不通
5	2020-09-07T1	U643f290529987236cd21c B2_305	電腦		0	自動開機

Fig. 9. Equipment condition report in Google Sheets.



Fig. 10. Google Sheet notification mail.

	A	B	C	D	E	F	G	H
1	Date	Room	status	equipment	locate	condition	root cause	fix action
2	2018-03-06	B2_305	OK	三用電表	6	量不到電流	保險絲燒斷	更換保險絲
3	2018-03-13	B2_305	OK	三用電表	11	量不到電流	保險絲燒斷	更換保險絲
4	2018-05-30	B2_305	OK	三用電表	9	量不到電流	保險絲燒斷	更換保險絲
5	2020-04-02	B2_305	OK	三用電表	10	量不到電流	保險絲燒斷	更換保險絲
6	2020-04-02	B2_305	OK	三用電表	18	量不到電流	保險絲燒斷	更換保險絲
7	2020-06-03	B2_305	OK	三用電表	4	量不到電流	保險絲燒斷	更換保險絲
8	2018-04-09	B2_305	OK	示波器	2	量測有雜訊	操作不正確	
9	2018-04-09	B2_305	OK	示波器	24	量測有雜訊	操作不正確	
10	2019-05-01	B2_305	OK	示波器	11	量測有雜訊	量測線不良	更換量測線後正常
11	2020-04-02	B2_305	OK	示波器	17	量測有雜訊	操作不正確	
12	2020-04-09	B2_305	OK	示波器	24	沒有畫面	儀器故障需送修	送修
13	2020-06-03	B2_305	OK	示波器	25	量測有雜訊	操作不正確	
14	2018-06-20	B2_305	OK	信號產生器	2	無法開機	電源線鬆脫	重新接上電源
15	2018-11-05	B2_305	OK	信號產生器	12	信號不正常	操作不正確	
16	2018-11-5	B2_305	OK	信號產生器	25	信號不正常	操作不正確	
17	2020-04-24	B2_305	OK	信號產生器	18	信號不正常	操作不正確	

Fig. 11. Equipment repair history worksheet.

## V. CONCLUSION

People can access the chatbot service everywhere since the interface of chatbot is built on a smartphone app. In this research, the user of chatbot service, is more concerned whether the equipment working normally instead of found the root cause. Troubleshooting that chatbot provide helps them remove the problem quickly and for those complex condition that rarely happens also provide a report form to report to administrator. Collecting these conditions in the database helps equipment administrators understand equipment status, and the notification mechanism can help administrators react rapidly. For the next develop plan for chatbot is to implement an automatically generate troubleshooting procedures based on the maintenance history. Visit <https://hackmd.io/@shawnlintw/rJ095LiSU> can get the source code of this research's chatbot and the basic step about chatbot building.

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