

**Course No. & Title:** CE-426 Real-Time  
Embedded Systems

**Instructor's Name:** Dr. Girma Tewolde

**Due Date:** 6/12/2024

Dylan Lozon

Chinyari Miles

# User Communication With a Kettering UART Chatbot

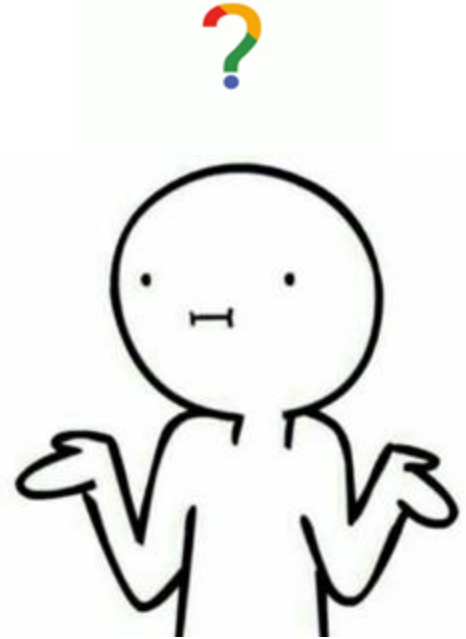
---

# What is UART ?

- “Universal asynchronous receiver-transmitters” are one of the earliest serial protocols for device-to-device communication

## Why UART?/Is UART important?

- YES! UARTs enable microcontroller and wireless module communication in devices such as IoT, GPS and computer module interface, industrial machines and smart home applications



# How does UART Work?

## UART

(Universal Asynchronous Receiver Transmitter)

Low speed  
off-board  
full duplex

### Usage :

Terminal  
Gps  
Modem ...

Peer-to-peer communication



[www.parlezvoustech.com](http://www.parlezvoustech.com)

## Benefits

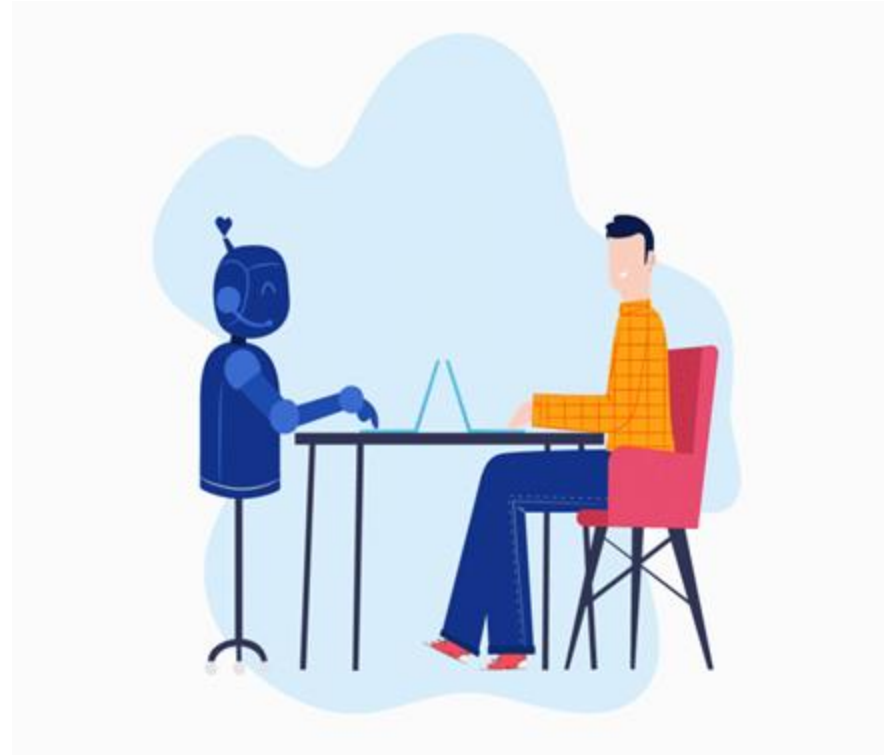
- Simplicity
- Adaptability with clock signals

## Drawbacks

- Limited data frame size
- Requires smaller baud rate for communication

# What's the Significance?

- A.I is rapidly integrating into our digital world. It's never going away
- Chatbots are like the tools inside of an A.i toolkit/toolbox.
- There's no point in having a tool box if you don't know how to use the tools!
- Best to experiment with it now while it's still young
- In general, UARs are also still widely used to this day

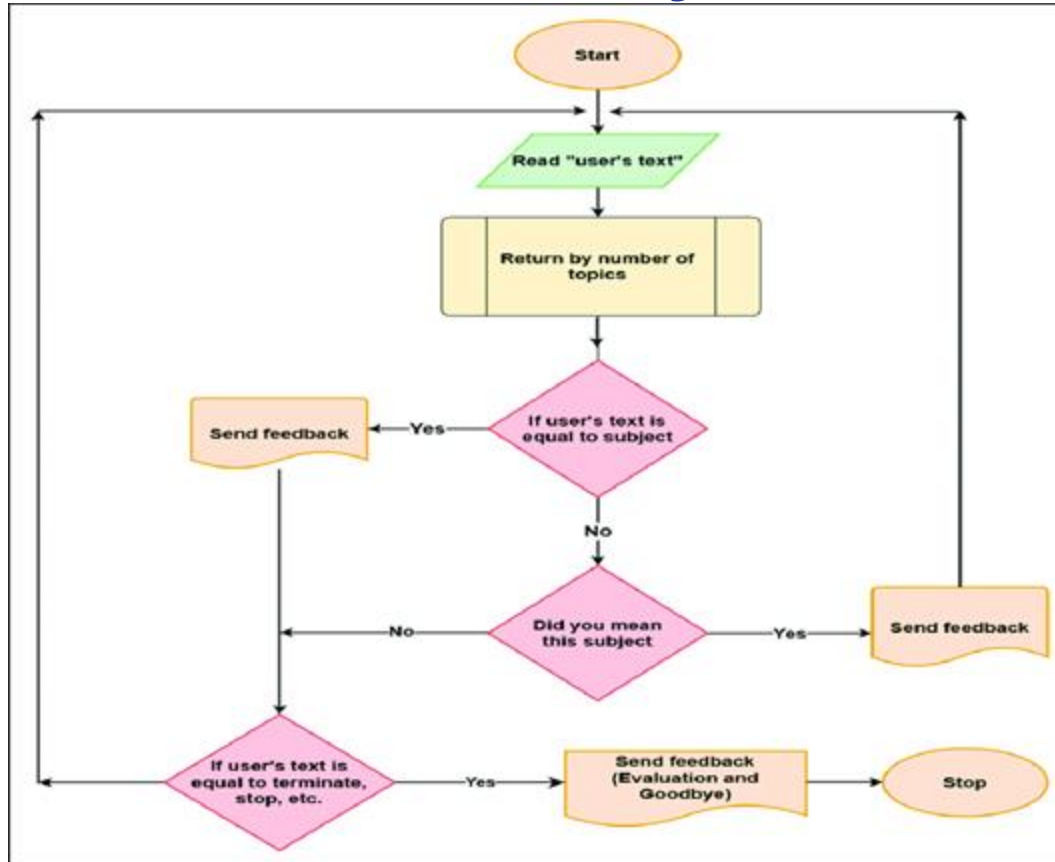


# Our Project

- A user-to-chatbot implementation with predetermined questions/responses specifically about Kettering.
- Utilizes a UART terminal in Keil Uvision that can communicate by sending messages to a chatbot that will generate and send a response.
- Main idea is to imitate the likes of commonly known website chat assistant bots that can answer general questions about their realm/domain.



# Our Project: Flow



# Our Project: Utilizations

- Thread management
  - Handles individual UART communication
- System check logic
  - SysTick timer for user/bot activity
- Inter-thread communication
  - UART interrupt handler
- UART initialization
  - UART 1 and 2 interface
- Semaphore synchronization
  - Manages access to shared resources and UART synchronization
- Chatbot Logic
  - “Get\_response” based on user input



# Specific Methodology

- There are two main threads
  - Keepalive sends a message every 30 seconds to let the user know the system is working.
  - Input handler reads input from UART and decides whether to respond and how.
- When a character is typed, it is received by an interrupt, placed in a message queue, echoed to the terminal, and consumed by the UART reader thread.
- A semaphore is used to ensure that only one thread has write access to the UART terminal at any time.



# Response Generation

- Responses are stored in an array of key-value pairs where the keys are potential user inputs and the values are the response associated with the key.
- When a key is found in a message sent to the chatbot, the corresponding response is returned to the input handler for sending.
- Before checking the input against the response array, the input is sanitized.
- There are two steps to sanitization:
  - Convert the message to lowercase.
  - Remove non-letters.
- This makes the input much more likely to match a key.

# Example Output

UART #1

Received: hello

Response: Hello there user! What can I assist you with Kettering University today?

still alive

Received: what is the cost of tuition at kettering

Response: The tuition fee varies by program, year and other factors. For the most accurate count, please refer to the official Kettering Website <https://www.kettering.edu>

Received: what kind of degree programs are there

Response: Kettering University offers programs in engineering, computer science, business, Pre-med and more

still alive

Received: who founded kettering

Response: Kettering University was founded by Albert Sobey.

still alive

Received: can you tell me about the history of the clock tower

Response: Long story short, Kettering faculty asked students if they wanted a pool or a clock tower. Most students voted pool, but Kettering still put in the clock tower

Received: how can i apply

Response: You can apply to Kettering University through this official site -> <https://www.kettering.edu/apply> Go Bulldogs!

still alive

Received: nice

Response: I'm sorry, I don't have a response for that.

Demo



<https://www.youtube.com/watch?v=J39D2-P5Sj8>

# Our Project: Limitations

- Limited responses and limited knowledge
- It works, but there are better environments out there to initialize hatbot assistants
- Has the potential to give the wrong response due to keywords
- C programming. Most chatbots are using python, java/javascript, C#, Ruby and PHP.



# Our Project: Conclusion

- In the future, it would probably be best to use a different environment for chatbot implementation with instances like Active.A.i and programs specifically made for A.i and NLP (Natural language processing).
- It does what it's suppose to do with what we have
- Can always be upgraded with better programming styles to improve functionalities that would include more possibilities.

# Reference Material

Rohde & Schwarz, Understanding UART

[https://www.rohde-schwarz.com/us/products/test-and-measurement/essentials-test-equipment/digital-oscilloscopes/understanding-uart\\_254524.html](https://www.rohde-schwarz.com/us/products/test-and-measurement/essentials-test-equipment/digital-oscilloscopes/understanding-uart_254524.html)

Parlez-vous Tech, 12C, UART and SPI

<https://www.parlezvoustech.com/en/com-paraison-protocoles-communication-i2c-spi-uart/>

# Additional Help

Darek Konopka UART 3 enabling

[Click here](#)

UART 2 enabling from previous students

[Click here](#)

Our Previous Lab Partner, Nathan Lee :)

# THANKS!

