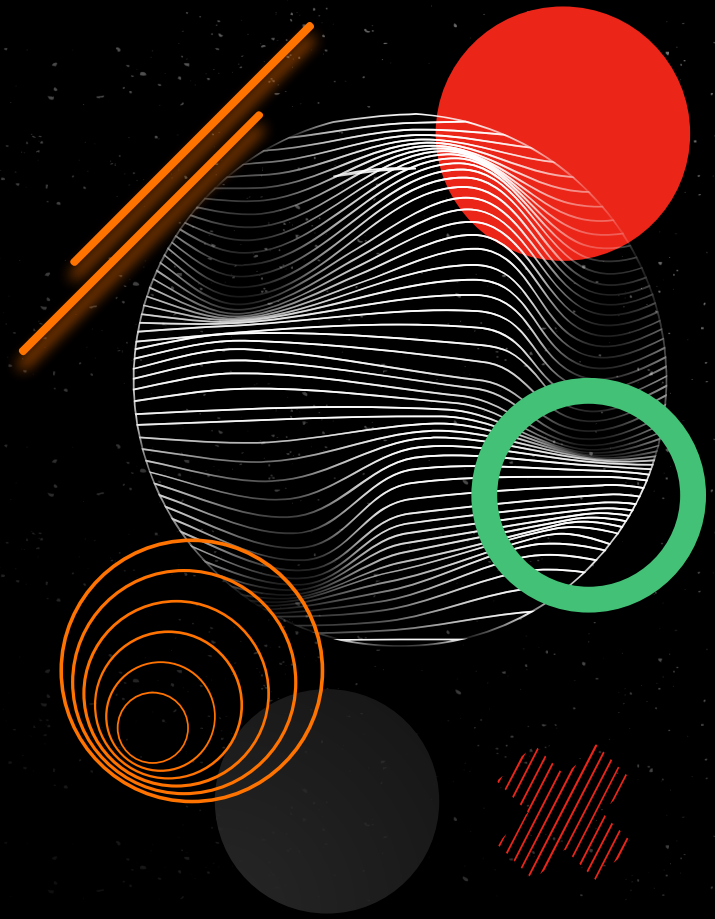


EDGE-DRIVEN REAL-TIME TEXT-TO-SPEECH READER FOR THE VISUALLY IMPAIRED

Nhan Nguyen, Pranay Thakur

WHAT WE'RE SOLVING

Many visually impaired individuals face challenges in reading printed text, limiting their access to essential information in daily life

CHALLENGES

OCR Accuracy Issues:

- OCR sometimes detects incorrect or out-of-order text.

Camera Alignment & Focus Issues

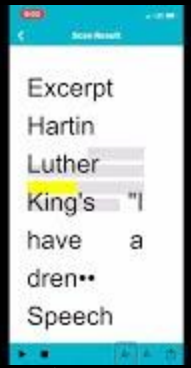
- Ensuring the camera captures clear, well-framed images of text was difficult, leading to poor OCR accuracy.

Jetson Nano integration:

- Deploying the project on the Jetson and integrate camera and speaker.

INSPIRATION

https://www.youtube.com/watch?v=cgU-8R3EpDI



OUR SOLUTION

Image Capture (Edge Device #1 - Camera Node)

- A Jetson Nano with a camera module captures an image of printed text.
- Image preprocessing techniques (grayscale conversion, noise reduction, and thresholding) enhance text clarity.

OCR Processing (Text Recognition)

- **Local Processing:** Tesseract OCR extracts text directly on the Jetson Nano for fast, offline recognition.
- **Cloud Processing (Optional):** If local OCR is insufficient (e.g., blurry or complex text), the image is sent to **AWS Textract** for higher accuracy.

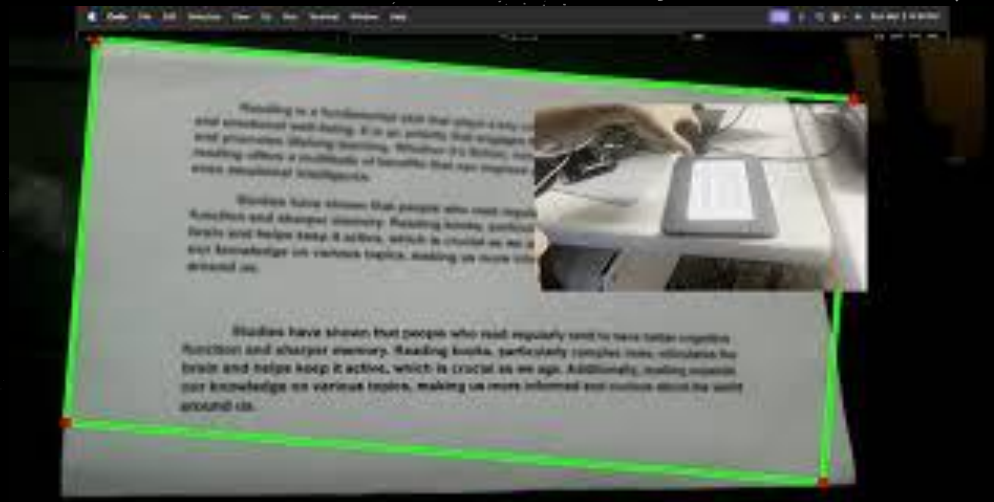
Decision Making (Fog Gateway – Jetson Nano)

- Determines whether OCR is handled locally or sent to the cloud based on processing load and text clarity.
- Manages device coordination and logs processing activity.

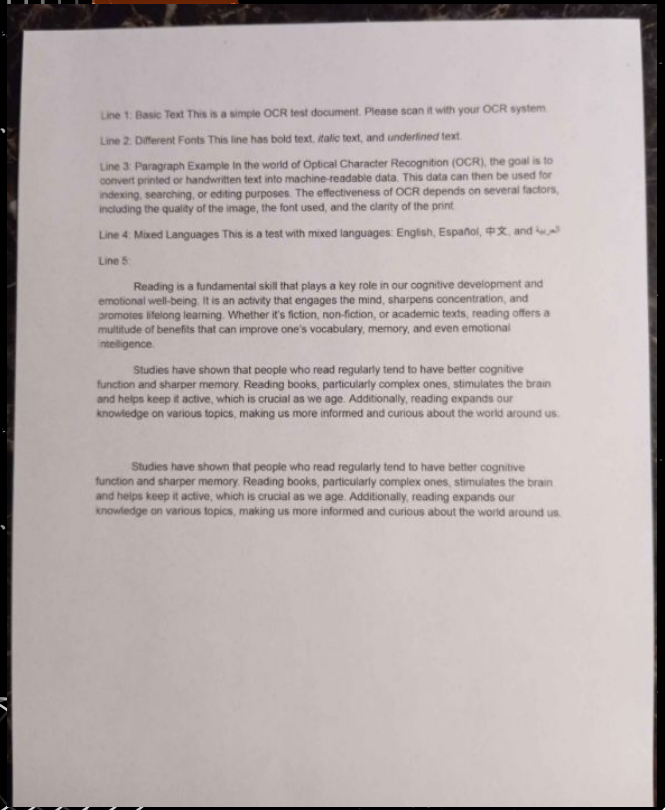
Text-to-Speech (TTS Node - Jetson Nano, AWS)

- Recognized text is processed by **Piper TTS** for natural-sounding speech.
- Audio output is played through connected headphones or a speaker, enabling the user to "hear" the text.

DEMO


Studies have shown that people who read regularly tend to have better cognitive
function and sharper memory. Reading books, particularly complex ones, stimulates the
brain and helps keep it active, which is crucial as we age. Additionally, reading expands
our knowledge on various topics, making us more informed and curious about the world
around us.

RESULTS



Line 1: Basic Text This is a simple OCR test document. Please scan it with your OCR system.

Line 2: Different Fonts This line has bold text, *italic* text, and *underlined* text.

Line 3: Paragraph Example In the world of Optical Character Recognition (OCR), the goal is to convert printed or handwritten text into machine-readable data. This data can then be used for indexing, searching, or editing purposes. The effectiveness of OCR depends on several factors, including the quality of the image, the font used, and the clarity of the print.

Line 4: Mixed Languages This is a test with mixed languages: English, Español, 中文, and العربية

Line 5:

Reading is a fundamental skill that plays a key role in our cognitive development and emotional well-being. It is an activity that engages the mind, sharpens concentration, and promotes lifelong learning. Whether it's fiction, non-fiction, or academic texts, reading offers a multitude of benefits that can improve one's vocabulary, memory, and even emotional intelligence.

Studies have shown that people who read regularly tend to have better cognitive function and sharper memory. Reading books, particularly complex ones, stimulates the brain and helps keep it active, which is crucial as we age. Additionally, reading expands our knowledge on various topics, making us more informed and curious about the world around us.

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OCR Confidence Score: 93.15 %
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RESULTS W/O PREPROC

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OCR Confidence Score: 92.13 %
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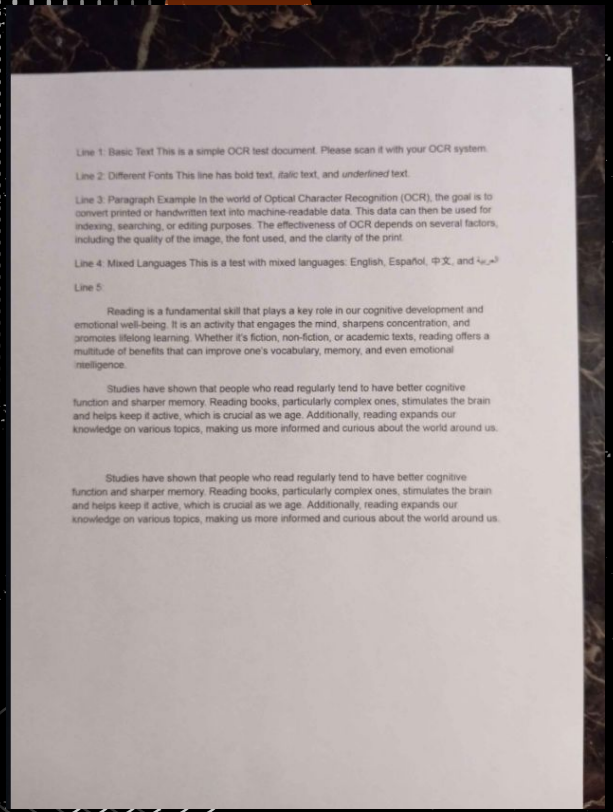
RESULTS



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Line 4: Mixed Languages This is a test with mixed languages: English, Español, 中文, and العربية

Line 5:

Reading is a fundamental skill that plays a key role in our cognitive development and emotional well-being. It is an activity that engages the mind, sharpens concentration, and promotes lifelong learning. Whether it's fiction, non-fiction, or academic texts, reading offers a multitude of benefits that can improve one's vocabulary, memory, and even emotional intelligence.

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he world around us

OCR Confidence Score: 91.07 %
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RESULTS W/O PREPROC

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our knowledge on various topics, making us more informed and curious about t
he world around us

OCR Confidence Score: 90.4 %
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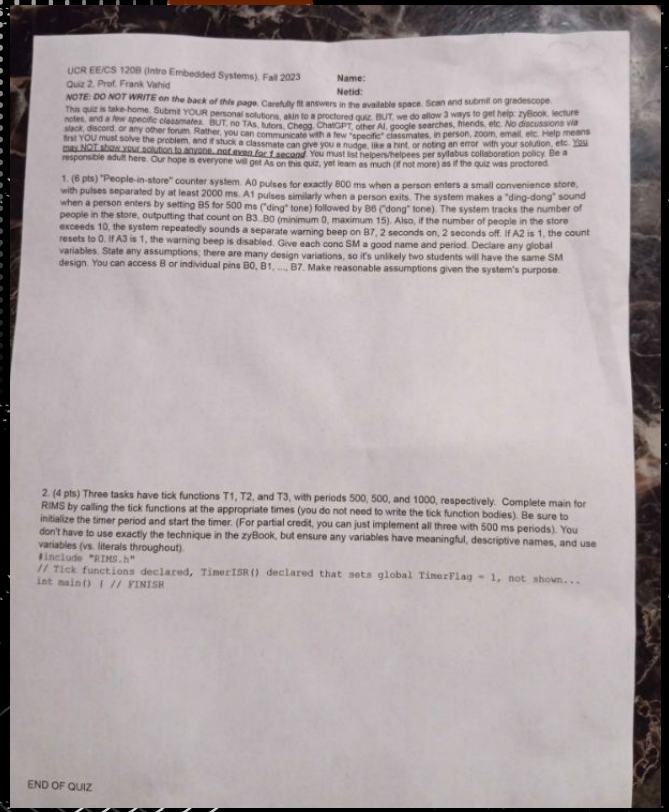
RESULTS



UCR EE/CS 120B (Intro Embedded Systems). Fall 2023 Name:
Quiz 2, Prof. Frank Vahid Netid:
NOTE: DO NOT WRITE on the back of this page. Carefully fit answers in the available space. Scan and submit on gradescope.
This quiz is take-home. Submit YOUR personal solutions, akin to a proctored quiz. BUT, we do allow 3 ways to get help: zyBook, lecture notes, and a few specific classmates. BUT, no TAs, tutors, Chegg, ChatGPT, other AI, google searches, friends, etc. *No discussions via slack, discord, or any other forum.* Rather, you can communicate with a few "specific" classmates, in person, zoom, email, etc. Help means first YOU must solve the problem, and if stuck a classmate can give you a nudge, like a hint, or noting an error with your solution, etc. You may NOT show your solution to anyone, *not even for 1 second*. You must list helpers/helpees per syllabus collaboration policy. Be a responsible adult here. Our hope is everyone will get As on this quiz, yet learn as much (if not more) as if the quiz was proctored.

1. (6 pts) "People-in-store" counter system. A0 pulses for exactly 800 ms when a person enters a small convenience store, with pulses separated by at least 2000 ms. A1 pulses similarly when a person exits. The system makes a "ding-dong" sound when a person enters by setting B5 for 500 ms ("ding" tone) followed by B6 ("dong" tone). The system tracks the number of people in the store, outputting that count on B3..B0 (minimum 0, maximum 15). Also, if the number of people in the store exceeds 10, the system repeatedly sounds a separate warning beep on B7, 2 seconds on, 2 seconds off. If A2 is 1, the count resets to 0. If A3 is 1, the warning beep is disabled. Give each conc SM a good name and period. Declare any global variables. State any assumptions; there are many design variations, so it's unlikely two students will have the same SM design. You can access B or individual pins B0, B1, ..., B7. Make reasonable assumptions given the system's purpose.

2. (4 pts) Three tasks have tick functions T1, T2, and T3, with periods 500, 500, and 1000, respectively. Complete main for RIMS by calling the tick functions at the appropriate times (you do not need to write the tick function bodies). Be sure to initialize the timer period and start the timer. (For partial credit, you can just implement all three with 500 ms periods). You don't have to use exactly the technique in the zyBook, but ensure any variables have meaningful, descriptive names, and use variables (vs. literals throughout).

```
#include "RIMS_h"
// Tick functions declared, TimerISR() declared that sets global TimerFlag = 1, not shown...
int main() { // FINISH
```

END OF QUIZ

Extracted Text:
UCR EE/CS 1208 (Intro Embedded Systems). Fall 2023 Name: Quiz 2, Prof. Fran k Vahid Netid: , it on gradesco NOTE: DO NOT WRITE on the back of this page. Carefully fit answers in the available space. Scan and submit on g pe - zyB ook., lecture This quiz ts take-home. Submit YOUR personal solutions, akin t o a proctored quiz. BUT, we do allow 3 ways to get help: zy , ISCUSSIONS VI8 notes, and & few specific classmates. BUT. no TAs. tutors, Chegg, ChatGPT, other A1, google searches. mend. etc No aise Help means Slack, discord, or a ny other forum. Rather, you can communicate with a few *specific* classmates , in person, . : scration etc YOu smate can give YOU a nudge, like a hint. o r noting an error with you first YOU must solve the problem, and if stuck a Clas) i . You must list helpers/helpees per syllabus collaboration poly. Be a quiz, yet learn as much (if not more) as if the quiz was proctored. respon sible adult here. Our hope is everyone will get As on this 1. (6 pts) "Peopl e-in-store" counter system. AO pulses for exactly 800 ms when a person enter s a small convenience store, ; with pulses separated by at least 2000 ms. A1 pulses similarly when a person exits. The system makes a “ding-dong soun wh en a person enters by setting BS for 500 ms (“ding" tone) followed by B6 (“d ong” tone). The system tracks the number o people in the store, outputting t hat count on B3..B0 (minimum 0, maximum 15). Also, if the number of people i n the store exceeds 10, the system repeatedly sounds a Separate warning beep on B7, 2 seconds on, 2 seconds off. If A2 is 1, the count resets to 0. If A 3 is 1, the warning beep is disabled. Give each conc SMa good name and perio d. Declare any global variables. State any assumptions; there are many desig n variations, so it's unlikely two students will have the same SM design. Yo u can access B or individual pins BO, B1, ... B7. Make reasonable assumptio ns given the system's purpose. periods 500, 500, and 1000, respectively. Com plete main for u do not need to write the tick function bodies). Be sure to you can just implement all three with 500 ms periods). You ure any variables have meaningful, descriptive names, and use 2. (4 pts) Three tasks have tic k functions T1, T2, and T3, with RIMS by calling the tick functions at the a ppropriate times (yo initialize the timer period and start the timer. (For p artial credit, don't have to use exactly the technique in the zyBook, but en s vaniables (vs. literals throughout). finclude "RIMS.h" . // Tick functions declared, TimerISR() declared that sets global TimerFlag = 1, not shown... int main() { // FINISH END OF Quiz

OCR Confidence Score: 90.81 %

RESULTS W/O PREPROC

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Extracted Text:
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you a nudge, like a hint, or noting an error with your so pee i You must ist
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declared t int main() { // FINISH hat sets global TimerFlag = 1, not shown..
. END OF Quiz

OCR Confidence Score: 91.67 %
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OCR ACCURACY

Local: 84% on average
Cloud: 99% on average

On average cloud has a greater OCR accuracy however local edge is good enough for most purposes

REFLECTIONS

Edge computing benefits: Reduces latency and enhances privacy.

Hybrid approach: Combining local and cloud OCR improves flexibility.

Optimizing OCR: Preprocessing significantly improves accuracy.

Future improvements: Adding NLP to enhance text clarity and meaning, document detection and live feedback when taking photo.