PROJECT TITLE

Uniqlo Checkout 2

STUDENT/TEAM INFORMATION

Team Name if any: **Team # on Canvas you have self-signed-up for:**	**The Outsiders**
Team member 1	*Cristobal, Kyle –* *kcristobal0254@sdsu.edu* 
Team member 2	*Hayes, Michael –* *mhayes1437@sdsu.edu* 

ABSTRACT (15 points)

(Summarize your project (motivation, goals, system design and results). Max 300 words).

Our application, Uniqlo 2 aims to streamline the checkout process by replacing barcode scanning with RFID tags. We created two pages, a live purchase page that receives streamed order data for customer viewing. Secondarily, we created a rich insights page that displays total sales to date, average order size, our fit portfolio of products, and daily sales history for the last 30 days.

INTRODUCTION (15 pts)

Motivation/Background (3 pts)

(Describe the problem you want to solve and why it is important. Max 300 words).

We first approached this project with an initial interest in creating an RFID system at the beginning of the semester. And after visiting Uniqlo around the same time we thought it would be a great idea to implement a similar system, which is their self-checkout system that uses RFID scanners, that scans the RFID tag within the price tag. A customer(user) would place their items in a designated bin at the self-checkout station, and the RFID reader will automatically scan the item, and return a number of values such as the name of the item, the price, and the total. We thought this would be extremely interesting to implement and also believed it would be advantageous for us to learn the uses of an RFID system, since many companies are now looking to implement RFID modules to ease production and organization for their businesses. The problem we wished to solve here was the tedious nature of checkout in stores. We felt that current stores' modules of checking out items through cashiers have become long outdated, and utilizing RFID solves many of the issues that fall in line with security and efficiency when checking out items. So we wished to showcase that RFID may solve these issues while still being affordable and not difficult too implement.

Project Goals (6 pts)

(Describe the project general goals. Max 200 words).

Our main goal is to build a cost-effective and scalable prototype that emulates Uniqlo's RFID self-checkout system. More specifically, we wanted to develop a wireless scanning system for RFID-tagged items, transmit scanned data to a separate server, implement basic product recognition and cost calculation, display the item total using the ESP32 TTGO build-in display, and provide a framework that supports integration with a front-end dashboard for analytics. And of course we desired that this project aimed to improve our understanding of IoT communication protocols, embedded systems, and cloud-based APIs.

Assumptions (3 pts)

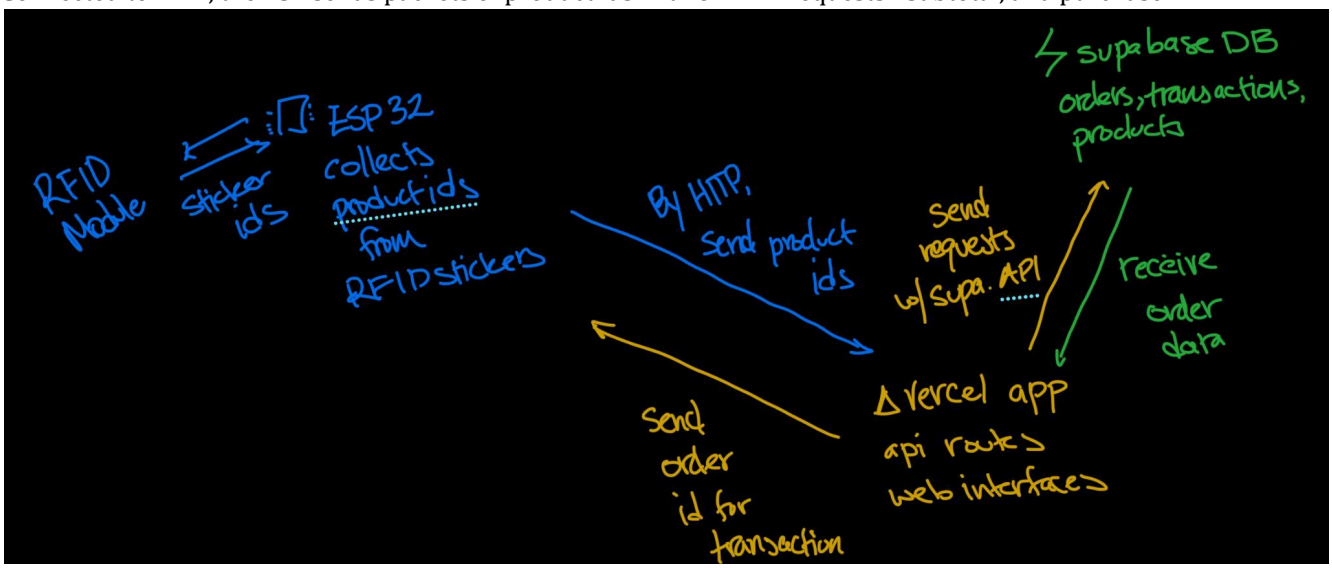
(Describe the assumptions (if any) you are making to solve the problem. Max 180 words).

We must assume that the RFID reader will scan one or a few tags at a time within a close proximity. This is largely due to the limitations of the hardware we bought and the device that scans multiple tags at a time or at a customizable distance is over $300, so of course by budgetary restraints we are limited there. We can also assume that the number of uses interacting with the system simultaneously is minimal (about 5). And of course we assume that reliable Wi-Fi access is available at the point of deployment.

SYSTEM ARCHITECTURE (20 pts)

(Describe the final architecture you have implemented listing sensors, communication protocols (Wi-Fi, BLE, ...), cloud services and user interfaces. Include a block diagram of the system. Max 300 words).

Connected to WiFi, the ESP sends packets of product ids in two HTTP requests - subtotal, and purchase



FINAL LIST OF HARDWARE COMPONENTS (5 pts)

(Write the final list and quantity of the components you have included in your system)

Component/part	**Quantity**
NFC tag stickers	10
TTGO	1
Breadboard	1
RFID Reader Module (MFRC522)	1
Cap 188	1
4 digital 7 panel display	1

PROJECT IMPLEMENTATION (30 PTS)

Tasks/Milestones Completed (15 pts)

(Describe the main tasks that you have completed in this project. Max 250 words).

Task Completed	**Team Member**

Created a skeleton code for our program in integrating RFID reader with ESP32 microcontroller.	Michael
Successfully wired and tested RFID reader to detect and print card UIDs on the serial monitor.	Kyle
Set up an AWS EC2 instance to act as a web server using flask for receiving HTTP requests.	Kyle
Created architecture plan for Next Js web interface to display Uniqlo checkout statistics	Michael
Integrate RFID tag scanning with HTTP GET requests to AWS server.	Kyle
Develop and test basic Flask route on AWS server to receive and log RFID UIDs.	Kyle
Integrate product and purchase data with a database (e.g. SQLite, PostgreSQL) to support real-time lookup and logging.	Michael
Interface the CAP touch sensor with the ESP32 to trigger subtotal and confirm purchase actions.	Michael
Display the returned total cost on a 4-digit display module connected to the TTGO board.	Michael
Test anti-collision functionality of the MFRC522 to ensure multiple RFID tags can be read and processed correctly.	Kyle

Challenges/Roadblocks (5 pts)

(Describe the challenges that you have faced and how you solved them if that is the case. Max 300 words).

Some technical issues we ran into was the MFRC522 having trouble detecting multiple tags at once due to interference and timing issues. We somewhat resolved this by adjusting delay intervals and implementing UID filtering logic; but as stated before the hardware limitations make it difficult for us to scan multiple tags at once, so we have to make the assumption that a user would only be scanning one item at a time and could only solve the interference

Tasks Not Completed (5 pts)

(Describe the tasks that you originally planned to complete but were not completed. If all tasks were completed, state so. Max 250 words).

Task	Reason
Scanning multiple items at once.	Hardware limitation(MFRC522).
Including a buzzer similar to that of a checkout area to indicate purchase or scanning of items.	Scrapped mainly due to using light bulbs as our required sensors, plus bulbs are a lot more customizable and easier to implement.

WEAK POINTS / FUTURE WORK (15 pts)

(Mention at least two points of your project that have room for improvement. These points can be additions to the existing project setup (components) or improvement of the current implementation. Max 200 words).

Add manage inventory page: We did not implement a way to onboard products from the web interface. Currently we had to create rows using the Supabase GUI to add products to the DB

Refine purchase display webhook: Currently the “webhook” publishes the most recent order to a database table with one a single row. Upon a new purchase, the row in the webhook database table is replaced. To retrieve the data, on the purchase page, we poll an endpoint which does a lookup on the first row every 2 seconds. To optimize, we could use a traditional webhook to limit the unnecessary network calls.

SOURCE CODE (25 pts)

Please include a link to the source code of your project. A link to a repository (like GitHub) is preferred.

https://github.com/kcristobal07/rfid-project (ESP 32 source code)

https://github.com/mhayescs19/uniqlo2 (website source code