

2024-2025: 5 Page Summary Science Fair

Can AI Replace Fruit Stickers?

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Background Research:

The fruit consumption in Canada per year in 2022 is 5,000,000 average apples, which means, 33,000,000,000 stickers, that end up going into landfills and collecting.

Artificial Intelligence is a collection of technologies that allow computers to perform tasks that normally need human intelligence to be done, such as learning, reasoning, problem solving, and interacting with others. AI systems can learn from experience and improve their performance.

Data is crucial in the programming and learning process of AI.

Artificial Intelligence image recognition:

Using machine learning to analyze images that we feed it. It compares it to data and previous images that they have successfully identified to place it. The longer AI has been trained, the more accurate it is, just like humans.

Scientific Question and Purpose:

Can Artificial Intelligence (AI) be used to identify fruit, instead of using plastic PLU codes on stickers?

We have always been interested in the planet and we would like it to remain healthy. When we learned that there were billions of plastic fruit stickers going into the environment and harming animals, we wanted to try to find a friendly way that could have the same purpose as a PLU code.

Our motivation behind using the AI was that because the world was advancing with technology, we should use technology to solve this problem, since it would fit in. It would also be easier to continue on with in the future that way.

Hypothesis:

We think that AI will be able to identify some common and obvious types of fruit, but not different varieties of the same fruit.

Experimental Design and Procedure:

Materials:

- Old Trifold (white, 2 metres)
- Small Table
- Metal Baking Pan that is large enough to hold fruit

- Phone Holder with stiff arm
- Lights (normal LED)
- Phone able to take clear pictures of the fruit
- Clear plastic bag
- Translucent plastic bag
- Fruits
- Access to an AI platform (we used a public and free one)

Variables:

Controlled variables:

- lighting
- table position
- baking pan position
- camera position,
- trifold position
- Artificial Intelligence platforms (Google Gemini, Logmeal)

Manipulated variables:

- V1: Fruit Type
- V2: fruit variety
- V3 Bag types (Clear bag vs Translucent bag vs No bag)
- V4 angle

Responding variables:

- the results from the AI softwares.

Procedure:

1. Place a baking pan in a well-lit room, with a plain background.
2. Set up your camera to take a steady picture of your fruit.
3. Take pictures of your fruit varying the following parameters:
 - a. Fruit Types
 - b. Fruit Varieties
 - c. Clear bag vs translucent bag vs no bag
 - d. Angle and position
4. Ask AI to classify fruit and record the results.
5. Log your information into an organized spreadsheet.

Results and Conclusions

Variable 1- Fruit Types:

Google Gemini successfully identified all the fruits correctly 7/7, though for the Navel orange, it only put “orange”, while Logmeal, only identified 5/7 correctly. Logmeal mixed up peaches with nectarines and we think that is because a peach and nectarine are similar, but a peach is fuzzier. We think that the pictures may not have been clear enough and the Logmeal could not see the fuzziness. Logmeal also could not identify a nectarine and responded by saying it was an apple. We think that because nectarines and apples are both fuzzy, Logmeal mixed them up, since you could not see how big they are in the picture unless put side by side. Logmeal was not very specific about the varieties of fruits.

Percentage of correct pictures: Gemini - 100% Logmeal - 71.43%

(% calculation: # of correct pictures / total pictures)

Variable 2- Fruit Variety:

Google Gemini mixed up some apples, with other varieties, except for Granny Smith, which we think because it has a distinct colour and shape. It also mixed up a plantain with a banana, since it may look like an unripe banana. Otherwise, it identified everything else, but it still said that a Navel orange is just an “orange”. Google Gemini got 8/12 correct. Logmeal mixed up the oranges, thinking that a clementine and mandarin orange are tangerines. We think that is because they have that similar small size and flatness. It also said that the plantain was a banana. We believe that it said that because Logmeal would think it looks like an unripe banana. Logmeal got 9/12. We think that with better training, Google Gemini could identify different varieties of apples.

Percentage of correct pictures: Gemini - 66.67% Logmeal - 75%

(% calculation: # of correct pictures / total pictures)

Variable 3- Clear bag vs Translucent bag vs No bag:

Google Gemini seems to not be affected by the bags, because its answers are the same vs different bags and no bags. It identified Ambrosia apples and McIntosh apples wrong, thinking they were Honeycrisp and Braeburn apples. However, we don't think it was because of the bags, since it said the same thing to the same fruit without a bag. Google Gemini also thought a nectarine was a red apple in a bag, but without a bag, it said it was a nectarine. We think that the bag might have blurred some key details in colours and patterns on the skin of the nectarine. Google Gemini got 19/26 correct. Logmeal seemed to be more affected by the bags and it thought a Granny smith was a pear and Red delicious was a strawberry. We think that the bag might have blurred some details. It also mixed up Tommy Atkins, Nectarines and kiwis, and we think because they were mostly in bags. Logmeal got 14/26 correct. Google Gemini could usually identify the fruits correctly in the clear bag, but not so much in the translucent bags. For Logmeal it seemed like it didn't really matter what type of bag it was; it mixed almost half of the fruit up.

Percentage of correct pictures: Gemini - 73.08% Logmeal - 53.85%

(% calculation: # of correct pictures / total pictures)

Variable 4- Angle and Position:

Google Gemini tried to identify the fruits, but it seems the angle of the fruits affected the results. It just got apples wrong. It was able to identify Granny Smith apples and Red Delicious apples, as well as peach, red mango, and bananas and plantains. We think that because of the colour and shape of the apples- how they are so similar- it made Google Gemini mix them up, but other fruits and Granny Smith and Red Delicious apples have a distinct colour and shape. It didn't matter what angle the fruit was at, it still mixed up the apples. Google Gemini got 16/25 correct. Logmeal, since it doesn't identify variety, just said that all angles and types of apples were apples. Since it doesn't identify variety, we couldn't tell if the angle affected it. The only ones it got truly wrong were the mangos (thinking it was a mango, then pomegranate), peaches (thinking they were nectarines), and the plantain (thinking it was a banana- though Logmeal has never identified it correctly). It doesn't seem like the angle affected Logmeal, as it still identified certain fruits. Logmeal got 19/25 correct.

Percentage of correct pictures: Gemini - 64% Logmeal - 76%

(% calculation: # of correct pictures / total pictures)

Variable 5- AI software:

Comparing Google Gemini and Logmeal, in short, Google Gemini is much better than Logmeal. Google Gemini tries to identify the type and variety of fruit, while Logmeal just identifies the type of fruit- though that is what it was made for (it said on the website). Google Gemini generally identifies all the fruits correctly, and usually mixes up certain varieties of apples, such as Ambrosia, Cosmic Crisp, and McIntosh. It sometimes gets oranges wrong, as well as plantains, but can identify all the other things (besides apples). Logmeal can usually identify mangos right, and bananas, and in addition, can also identify that an "apple is an apple", though it only says "apple". It also mixes up oranges, peaches, plantains, kiwis. So taking all this into consideration, Google Gemini would probably work best if this was in real life.

Percentage of correct pictures: Gemini - 75.94% Logmeal - 69.07%

(% calculation: average # of correct pictures for each variable)

Conclusion:

Answering our hypothesis, our two AI softwares could identify fruit, but some different varieties and/or fruit types messed them up. Our data partially supports our hypothesis.

As for the variables, Google Gemini was most affected by the bags, but the angle did not affect it. Logmeal didn't seem to really be affected by our variables. Overall Google Gemini has a percentage of 75.94% accuracy. Logmeal has a 69.07% accuracy. (% calculation: average # of correct pictures for each variable)

In the end, we think with programming and training, programmers could use this information to update the AI, and with time, there might be an AI programmed just for this purpose: Recognizing fruits at the grocery checkout.

Sources of Error

1. Due to money, we could not buy more fruits and varieties, which could have provided a larger dataset to perform the experiment and possibly provide more information
2. Unable to access certain AI platforms, or paid ones, which could have been better at identifying types and varieties of fruit
3. It was not possible to setup an environment at home that is exactly the same as a grocery store check-out scanner, and we cannot perform the experiment in an actual store
4. If we used a higher quality and better resolution camera than the one from a smartphone, the images might be better and the AI might have a higher chance of identifying fruits

Applications, Improvements, and Future Questions

Application:

The results that we collect can be useful for identifying fruits with AI, and also Artificial Intelligence image recognition could be used in stores soon, and that would help with inventory check and just make people's lives easier, cheaper, and more efficient.

Improvements:

We think that we could have thought and started this project sooner, which would increase our time, and we would not feel as rushed. We think that we could have started thinking about our topic in the summer, leaving us more time to work on the project, which we will take into mind for next time. Learning from our past mistakes last year, we filled out our hypothesis sooner, before our actual project, which we had done in the past.

Future Question(s):

Could we have made a program to identify fruits that would work better than the ones we had? If we were to take this further, we would definitely try to maybe conduct more tests, and maybe program our own AI. We might also try having a tiny fruit sticker that the AI can map to a fruit.

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