Snap to Help: An Automated System for Accident Severity

Irfan Muzafar
DSI-42

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About Accidents

Accidents can happen anytime

In the last five years,

Every day

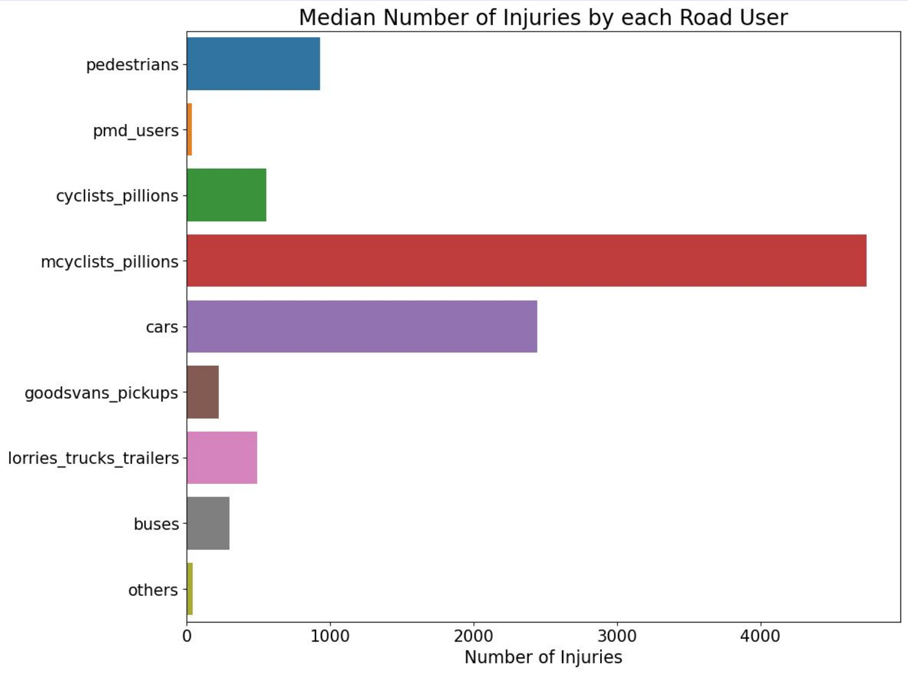
Someone gets injured in a road traffic accident in Singapore

9 deaths

Per month as a result of road traffic accidents in Singapore

Source: [SingStat]

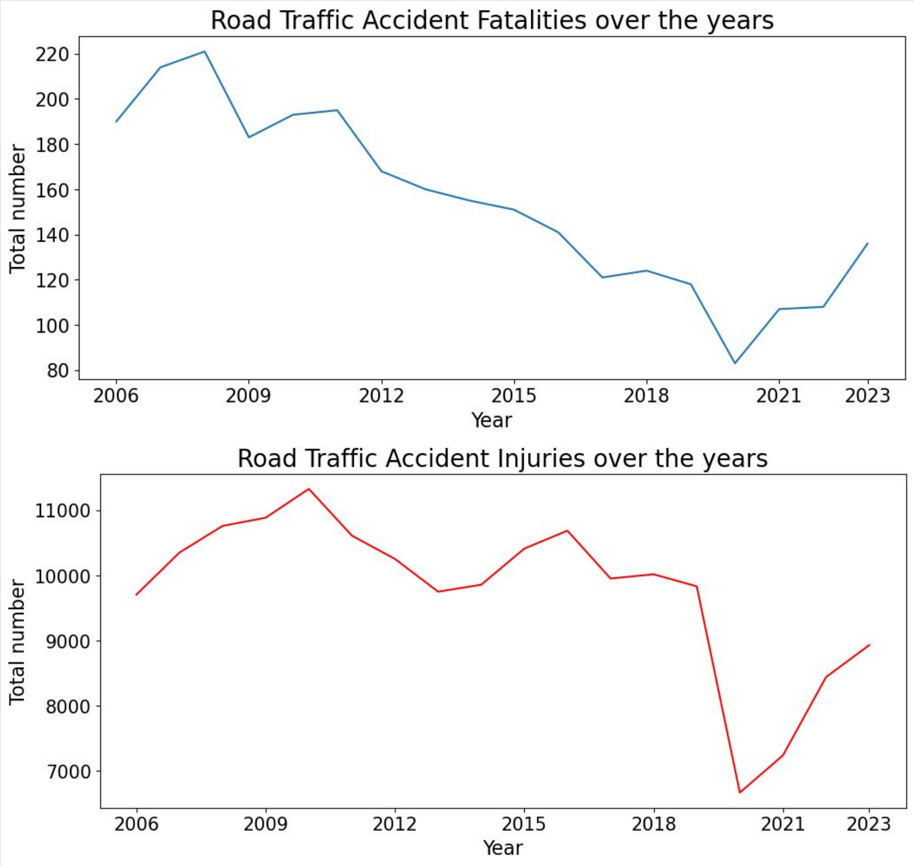
Findings on Injuries



- Motorcyclists & pillions are the **most vulnerable** to getting injured in an accident
- Car driver & passenger injuries are **very high, more than 2000**
- Pedestrians, bicycles are also **prone to injuries** due to impact and fall

Source: [SingStat]

Casualty numbers over the years



- Number of fatalities had been **decreasing from 2010**
- Number of injuries **fluctuates at around 10,000** every year
- **Sharp drop** in both numbers in 2020
- After 2020, the numbers are **going up every year**

Source: [SingStat]

What to do right after an accident

1) Check if anyone is injured. Call for an ambulance if anyone is in need of immediate medical attention.
2) Report the accident to the police. (if needed)
3) Gather evidence of the accident scene. Take photos.
4) Have your vehicle towed. (if needed)

Wheel Lift Towing

Flatbed Towing

Source: [EMAS Recovery]

Profiles

Hannah

Hannah is in charge of **deploying rescue teams in SCDF**. She receives a call when emergency help is required after an accident. There were some cases where **callers exaggerate or underestimate** the situation. When the first responder team arrives and assesses the situation at the scene, **sometimes additional resources are needed**.

Aaron is an **officer from LTA**. When there is a traffic accident, he receives a call on the LTA hotline. If the accident cannot be seen via a traffic camera, he is **unable to ascertain how severe** the accident is. Afterwhich, he deploys a recovery crew with **tow trucks** and **road marshals** to the scene, with a chance of **over deploying or under deploying**.

Aaron

Possible Solution

Hannah

They hope to have a **centralised system** where the affected driver or witnesses can **upload images** of the accident. The system should enable **quick identification** of accidents and **prompt responses** from various services.

Aaron

02

Problem Statement

Problem Statement

How can we develop an automated system capable of analysing images from traffic cameras or phone cameras to classify accidents into five severity classes accurately?

03

Dataset & Modelling

Image Dataset

Folder Directory				
Fire 120 images	Minor 100 images	Moderate 120 images	No Accident 400 images	Severe 170 images

Image dataset was split into
train, **validation** and **test** sets.

Severity Classes

Fire

Minor

Moderate

No Accident

Severe

Modelling

Classification Model	Train Accuracy	Valid Accuracy	Train Loss	Valid Loss
Self-trained CNN	0.9923	0.6626	0.0696	1.6319
MobileNetV2	0.9392	0.8098	0.2255	0.5140
VGG19	0.7710	0.6687	0.5937	0.8421
EfficientNetB4	0.2881	0.4601	3.9087	5.2880

$$\text{Accuracy} = \frac{\text{Correct Predictions}}{\text{Total Predictions}}$$

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Train and Validation Accuracy is **too low** for EfficientNetB4.

Modelling

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For CNN, it is **overfitting** to a **large extent**.
It also has the **highest validation loss**.

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Although VGG19 **overfits less** (just by a small margin), we want our chosen model to be of **high accuracy**. Thus, we pick **MobileNetV2** for further **fine tuning**.

Fine Tune MobileNetV2

Classification Model	Train Accuracy	Valid Accuracy	Difference
MobileNetV2	0.9392	0.8098	0.1294
MobileNetV2 with Regularization	0.8339	0.8221	0.0118

Fine Tune MobileNetV2

Classification Model	Train Accuracy	Valid Accuracy	Difference
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MobileNetV2 with Regularization	0.8339	0.8221	0.0118

After fine tuning, there is **less overfitting** as our model is able to **predict better** on unseen data.

Test Dataset

Fire	Minor	Moderate	No Accident	Severe
20 images	20 images	20 images	20 images	20 images

Ran our final model on the **test** dataset to get predictions.

Confusion Matrix

- Does well on fire, no_acc and severe classes
- Many wrong predictions for minor and moderate classes

Accuracy = 0.65

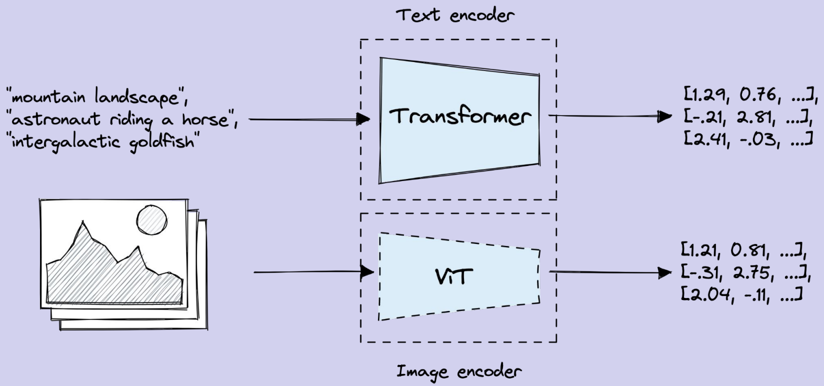
04

Zero-Shot Classification

Zero-Shot Image Classification

Zero-shot image classification uses a model that was **not explicitly trained** on data containing **labeled examples** from those specific categories. It is typically a model that has been trained on a **large dataset of images** and **associated descriptions**.

Contrastive Language-Image Pretraining (CLIP) by OpenAI



Source: [Hugging Face](), [Pinecone]()

Candidate Labels

candidate_labels =
[“fire accident", "minor accident",
"moderate accident", "no accident",
"severe accident"]

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Source: [Stomp]

Candidate Labels

candidate_labels =
["fire accident", "minor accident",
"moderate accident", "no accident",
"severe accident"]


```
[{'score': 0.6180193424224854, 'label': 'minor accident'},
 {'score': 0.1664766692733765, 'label': 'no accident'},
 {'score': 0.1589252797493744, 'label': 'moderate accident'},
 {'score': 0.05580728128552437, 'label': 'severe accident'},
 {'score': 0.0007714481325820088, 'label': 'fire accident'}]
```

Source: Stomp

05

Streamlit Demo

Hannah & Aaron

Hannah

Now, Hannah has a **clearer idea** on the severity of the accident. Thus, she can decide the **type of resources / emergency vehicles** to deploy to the scene, whether there is a fire or someone stuck in the car. If there is an **overturned vehicle**, it is **very likely** that someone is **severely injured** and require immediate assistance.

Aaron is now able to make a **definite decision** on which **kind of tow truck** to deploy to the scene. He can also clearly decide on **how many road marshals** are required depending on the severity of the accident.

Aaron

06

Learnings

Limitations

Inaccuracy in some classes

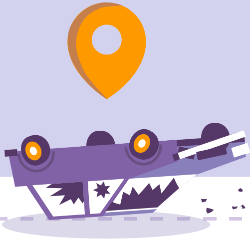
Difficult to predict **minor** and **moderate** accidents. Some images **look similar**, thus unable to be predicted correctly by our model.

Unclear Definitions

While ‘fire’ and ‘no_acc’ are classes with clear identities, there are **no clear definitions** for a minor, moderate or severe accident. It was also **not mentioned** by the **author** of the dataset.

Data Formats

Deeper analysis cannot be done on severity of an accident without other details such as **number of people injured** and **estimated speed before collision**.



Recommendations

Data Augmentation

More transformations (saturating / cropping) can further help to **generalize** and **expand** our accident dataset. There may be **clearer distinctions** between **minor** and **moderate** accidents.

Relate severity of accident to injuries suffered

An **injury** can be classified into **different tiers** based on **Injury Severity Score** (ISS). Relating this to accident severity can be done as **future research**.

Using dashcam for severity analysis

Severity of an accident can also **depend on the speed** of the vehicles involved. Using a **dashcam** can potentially **estimate the speed** of the vehicle.

07

Conclusion

Conclusion

We conducted **exploratory data analysis** on road traffic accidents in Singapore and **classified images** of accidents into **five severity classes**.

Other agencies or authorities may **benefit** from our severity classifier. Vehicle insurance companies can use this to **calculate insurance claims**, while the Traffic Police can use this for **further enhancements of road safety**.

THANK YOU

Do you have any questions?

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