Team Number: JAPE043
Project Title: Kid-AID
Project Type: Invention

*To our best knowledge, there <u>are</u> / ~~are no~~ * similar works in the market*; **(if there are,) related product links are as below:**

https://reurl.cc/gZQobR

The enhancement our project made / the difference with related products are:

There is a solution similar to Kid-AID, which is the AI system invented by the University of Hong Kong. Kid-AID is not developed with the base of this system. HKU's system can detect physical abuse movements by analyzing the placement of the abuser's bones using artificial intelligence, and will consequently alert the childcare center to check the CCTV footage again. Although this approach is competent, it is mainly targeted towards toddlers. Kid-AID can identify abuse movements targeted towards victims of all ages, ranging from young children to the elderly. Moreover, HKU's system will alert the childcare center's supervisor – cases of child maltreatment may be unreported since it is probable that the supervisor is actually the abuser. On the other hand, Kid-AID automatically alerts the superintendent for assistance, and will record a timestamp of when the suspected physical child abuse has taken place to make it easier for superintendent's checking.

Additionally, the system invented by HKU focuses on different specific actions of the abuser such as shaking, while Kid-AID focuses on whether the action is violent or non-violent. Even though HKU's system may have less false alarms, it has more missed signal detection. However, we would rather have more false alarms than having more child abuse cases go unnoticed.

*Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.

I.   Background

Our team has noticed a surge in the number of child abuse cases in Hong Kong childcare centers recently. From the Child Protection Registry Statistical Reports published by the Social Welfare Department, among the 1367 newly registered cases in 2021, 60 (4.4%) children being maltreated were living in residential child care services, including but not limited to childcare centers. Compared with the 42 newly registered cases of victims of the same category (out of 940) in 2020, there has been a 43% increase. The most notable case is the one in the Children's Residential Home, in which a female staff member hit a 2-year-old girl. However, the currently possible solution of monitoring activity by going through the footage manually may be time-consuming or even unreliable. To tackle this problem, we innovated Kid-AID, an artificial intelligence (AI) physical child abuse detection system. When it detects suspected child abuse surveillance camera footage by video recognition, it will automatically alert the authorities concerned to intervene.

II.   Objectives

As previously mentioned, the number of child abuse cases in Hong Kong has risen, especially in childcare centers. The current possible solution to solve the problem would be to check the CCTV camera footage manually, which wastes a lot of time and manpower. In many realistic cases, the CCTV footage is not being monitored. In fact, they usually only check the footage when the incidents have been exposed. Additionally, the person checking the footage could be the abuser, making this method unreliable.

In addition, child abuse can cause a range of negative effects to the abused children, including short-term and long-term side effects such as physical and psychological trauma. This is definitely not a problem to be overlooked. Therefore, we aim to use artificial intelligence (AI) to help save innocent abused children. By making use of video recognition, our invention, Kid-AID can identify suspected physical abuse towards children like slapping or punching through the given CCTV footage. It will then alert the superintendent or authorities concerned to stop the abuse as soon as possible.

III.   Methodology

The Kid-AID violence detection model makes use of MobileNet v2, which is a convolutional neural network architecture. It is based on an inverted residual structure where the input and output of the residual block are thin bottleneck layers unlike traditional ones that use expanded representations in the input. The MobileNet v2 neural

network architecture is a model that delivers high accuracy while keeping the parameters and mathematical operations as low as possible. As Kid-AID may be run for a long period of time, efficiency with high accuracy is much welcomed.

The dataset for the Kid-AID model is "Real Life Violence Situations Dataset". It was taken from Kaggle, Google's data science and machine learning community. The original dataset contains 1000 violence and 1000 non-violence videos mainly collected from YouTube videos. Violence videos include scenes of fighting in different environments and scenarios, while non-violence videos show different non-violent human actions like sports, eating and walking. To train our data, we extracted 250 videos from each class to enhance efficiency and memory usage, and to avoid overfitting issues.

Using a Google Colaboratory notebook, we developed our violence detection model with Python and libraries like Tensorflow, Keras and OpenCV.

IV. Design of Invention

Kid-AID is the AI-based system we developed to solve the above problem by detecting suspected physical child abuse movements. When we insert a video into the system and start the detection, it will classify the movements into "violence" or "non-violence" categories. The system will notify the superintendent of the childcare center of any suspicious actions through email or other means, so the superintendent can review the related footage and see if any intervention is needed.

On the right is the flow chart of our solution to the aforementioned problem.

Below is the demonstration. Left is a frame from a testing video simulating violence. Right is the output of the program when using the testing video and in the end, the suspicious activity is recognized and reported.
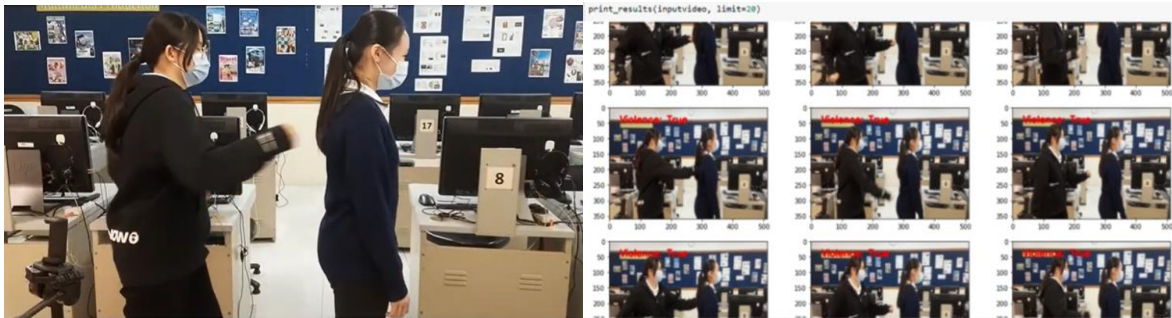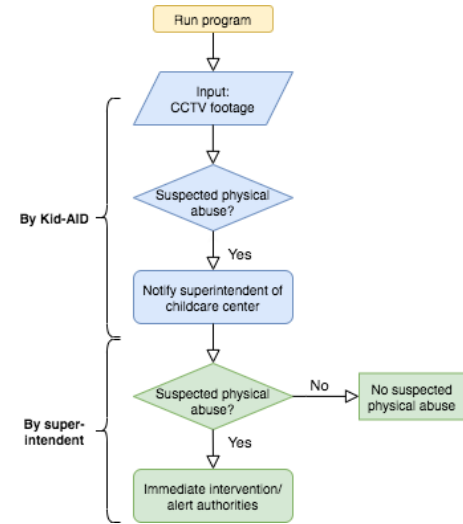
V. Application / Market Need

Kid-AID has been designed to be applied to the CCTV of childcare centers by being attached onto existing CCTV cameras or systems. We hope to collaborate with childcare centers to include Kid-AID in their systems. With slight moderations, Kid-AID can be applied to all types of locations. For example, our system can even be used in public spaces to detect all kinds of physical conflicts. Take jail as an example, conflicts often happen in cells which result in violence. The fight often escalates until the guard realizes but by modifying Kid-AID, these physical conflicts can be detected sooner and they can be stopped as soon as possible. As mentioned above, the mainstream way is to monitor CCTV footage manually. By replacing it with Kid-AID, apart from the mentioned benefits, companies or centers can also save money by eliminating the need for someone to monitor the footage. Currently, Kid-AID is only trained on a total of 500 video samples due to RAM and memory limitations, which may not be enough data to detect a wider variety of abuse actions.

As previously mentioned, HKU has a similar AI child abuse system, but it is targeted towards infants, will only alert the childcare center's own staff when abuse is detect, and only classifies footage as specific actions like shaking and hitting. However, Kid–AID can target victims of all ages, will alert the superintendent instead, and will only detect footage as violent or non-violent. While it may contain more false alarms, Kid-AID is able to lower the chance of missing any signals, and save more children's lives.

VI. **If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award.** *(Word limit: 300 words)*

Kid-AID is related to goal 16, promoting peaceful and inclusive societies for sustainable development. Abused children may not be aware of the abuse they are enduring. Even if they are aware, the children are constantly monitored by their abuser, making it virtually impossible for others to know about their abuse. The abuser takes advantage of this and exploits the power they were given. By using Kid-AID to detect the child abuse in childcare centres, we can inform the superintendent of the organisation or related authorities and thus, letting others realize and acknowledge the severity of the problem. Most importantly, unlike traditional means of checking CCTV manually, Kid-AID doesn't rely on manpower so it can carry out monitoring procedures at any given time with the same accuracy – Kid-AID can effectively stop child abuse as soon as possible. In conclusion, Kid-AID can help put violence against children to an end, and to assist every child to live free from fear, neglect, abuse and exploitation.

VII. **If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award.**
(Word limit: 300 words)

Kid-AID focuses on physical child abuse problems, more specifically those that happen in childcare centers. The original purpose of childcare services is to take care of children in a safe environment, in hopes of enhancing their growth and development. However, with physical abuse cases on the rise, these venues are stripped of their original purpose, becoming a dangerous place for them instead. Our system, which detects suspected physical abuse through CCTV camera footage and notifies the superintendent to intervene or investigate the problem, can stop the abusers from continuing to do harm to the innocent victims. Besides stopping abuse that is already happening, Kid-AID can also serve as an enforced deterrent, meaning the potential abusers may refrain from misbehaviors and this can keep the probability of children being harassed low. In these ways, children can be protected from more maltreatment.

VIII. **Conclusion**

According to our evaluation for the Kid-AID model, out of the 3000 testing videos used, 2888 were correct detections, which means the accuracy is around 96.3%. This shows that Kid-AID is able to detect most of the suspected physical abuse, and hence being able to notify the superintendent of childcare centers to intervene in real-life situations. It will be effective in reducing the number of child abuse cases when in use.
For future development, we will continue to optimize the mode, such as finding a more suitable neural network architecture. More samples can be used to train the model, providing more diverse scenarios and hence improving the reliability of the invention and also allowing Kid-AID to be used in more different settings or situations like streets, public areas, etc. However, more experimenting and testing of Kid-AID will be needed to find a good fit, such as using a k-fold cross validation resampling technique or a validation dataset.

� **Our project is developed based on previous project and the enhancement is below:**

N.A.