DigiEduHack Solution
Lappeenranta - Digital Twins & Raw material sustainability - Global better future for next generations
Challenge: Lappeenranta - Digital Twins & Raw material sustainability - Global better future for next generations Challenge 2020

Solution of Developing the Algorithm from Given Data and Modelling the Collisions to Digital Twins.

Form algorithm aiding data and modelling digital twins solution

We get to know this digital education hackathon from our university professor, Dr. Mulari. We were aiming for Sandvik as our challenge themeas we want to find a solution that can help to decrease the damage on the machine. We had gained a lot of knowledge through this digital education hackathon.

Team: Hackathonnzz

Team members

SANTHIA A/P KASEWANI @ KESAVAN, YEOH KEAN TEONG, SUSHANOR A/L SIHANOR, UNG SHUH CHIEN, CHIN SE MUN

Members roles and background

We are currently student who are studying at University Malaysia Sabah (UMS) in Sabah, Malaysia. We are doing our degree there and the course that Santhia A/P Kasewani @ Kesavan, Yeoh Kean Teong, Sushanor A/L Sihanor and Ung Shuh Chien taking is mechanical engineering. On the other hand, Chin Se Mun is taking industrial physics for her degree course. Our age range

are basically around 20-21 years old. Santhia A/P Kasewani @ Kesavan are one of the open-minded persons when it comes hearing out answer from every member and communicating welly among us. Besides that, Yeoh Kean Teong is one of the wise one when it comes to figuring out the answer. He will diligently find a way to get the answer to the solution. Furthermore, Ung Shuh Chien who is the graceful one detecting any clumsiness and mistake done by the group member to alert us and inform us our mistake. Moreover, Sushanor A/L Sihanor who is the diligent one where he will help the team in the most possible way he can meanwhile making sure that the work will keep on going. Lastly, Chin Se Mun who is the most alert person that will always give us the information that is going on from the company. She is also sharp in data as she can find out the odd data. Therefore, each and every one of us have a role that contribute a lot to find out the solution given to us. Teamwork is the word that is strongly sense from every one of us.

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Solution Details

Solution description

In the first part of the challenge, we have developed an algorithm that can recognize and classify the collisions from the data given. We were given a set of data about the sensors, signals and joints. Using these data, we have to find the correlation between them. With the correlation, we have to develop a suitable algorithm that can give an output (collision flag 0, 1 and 2). If these data match the algorithm we have created then our algorithm will be considered as a correct solution. This algorithm is a very vital part of digital twin as it helps us to come up with possible simulation or digital replicas whereby we can test it virtually rather than executing tasks physically(risky).

For the second challenge, we need to model the collisions. The solution for modelling the collision that happens in Digital Twins conducting with two simple concepts which are visual effect and auditory effect. The visual effect means by looking at the screen of the simulation, the users can know the collision has happened while the auditory effect will announce the user by sound. The solution will be considered as successful if the idea or concept of modelling is reachable and workable by the company and the team. Our solutions will contribute a different mindset of thinking from the perspective of solving this problem. These solution suggestions can be accepted by the challenger owner and applied in the system or enhanced.

Solution context

In this challenge by Sandvik there were mainly two parts of the challenge of which for the first, we were given a task to develop an algorithm to recognize and classify the collision from the given data. The data included boom control signals, joint position, a gyroscope, an accelerometer and a pressure sensor and the collision classification. Our first step was to find the correlation, the second step was to develop an algorithm and classify the collision. The major problem that we faced during this first part would be observing and discovering the correlation in the large data given. Data observing was time-consuming. We were lacking time and couldn’t keep up our progress according to the plan we

set as the analysing procedure took too much time. It was also extremely difficult to find the correlation with just eyeballing technique.

For the second part of challenge, we were required to present a concept for modelling the collisions to the digital twin. When simulating a drilling machine in a tunnel, the user would be observing from the back of the machine and would be unable to check any movement of the front area. According to the problem, we are to notify or inform the user easily in any obvious ways regarding the misuse collision or unwanted collision from happening through our algorithm system incorporated in digital twins. Since user unable to move itself to the front area, if a collision happens, users are unable to notice it and may cause a dangerous situation towards users, machines and the fellow workers working in the area. Our challenge is to solve the problem of the observation of the tunnel by modelling the collision. With the time constraint and limited skills it was very difficult for us to come up with a model or a simulation. However we managed to come up with a possible solution that can help avoid such collisions.

Solution target group

This solution is tailored for the SANDVIK company. A different company owned a different solution to its problem to minimize the damage it may cause and maximize its profit at the same time. Besides, any target group that owns a Digital Twins for drilling simulation and prediction can apply this solution too to avoid any harm because for other drilling solution providers, the company will encounter the same problem which is to identify and simulate the collisions.

Solution impact

The main purpose of this challenge is to create a digital twin that can provide a safer environment to the workers and also reduce failure or loss. With the creation of the algorithm and the correlation between various sensors and joints, we can certainly create a digital twin. A digital twin can be defined as the exact replica of a real life object or living thing. With a digital twin, we can estimate and have a pre vision of what a machine would function like in a specific condition. It is also much more reliable, tech savvy and cost efficient. It also helps us to avoid any mishaps that could possibly happen and cause damage to the machine. In this case, we were given the simulation of a real life underground drilling and bolting machine. Using the data we found the correlation between sensors and joints, and created an algorithm chart that shows the flow of the machine. With this useful algorithm, we can create a digital twin, a replica of the machine on software and calculate any misuse collision that may happen beforehand. We can also make sure it is much safer for the workers as well as for the longevity of the machine. This is the future of underground drilling and bolting because it is incredibly difficult to control actions underground nor to repair heavyweight machines faster. However, with the replica on digital twin would certainly meet the demands of future technology that is fast and precise. The error margin would also be less and the normal collision=1 would be accurate. It is known that our industry has used CAD for more than 30 years in rendering 3D models and simulations. The companies would no longer have to depend on this as the concept of digital twin is taking over. The digital twin certainly drives the impact of the Internet of Things (IoT) by providing a powerful way to track and control assets and processes. However, to continuously impact and improve, we need to update the analytics as well as the algorithm.

Solution tweet text

From the algorithm, Collision flag 2 recorded as the Feed Swing exceeds the range data provided. Collision flag 0 occur as data recorded within data range. Normal collision occur as pressure bar recorded too high data. Then, the collisions modelled by vision and auditory sense.

Solution innovativeness

The algorithm build was based on team members understanding, and the data was interpreted and analysed by own understandings. The solution also was given based on our understanding.

Solution transferability

The algorithm to identify the types of collision and the modelling for collisions can apply in other industries too. For example, our solution can be applied in a driving simulation class. In the first challenge, we need to find the correlation between each part and joint movement with the collision by observing its movements such as sudden stop or acceleration, the direction changed without instruction by users and the joint reached its maximum extension or angle movement. The purpose to find the correlation is to identify and classify the types of collisions. For a driving simulation, we can identify the collision by observing this correlation too. If a car has a sudden stop it might encounter a collision or avoid a collision and give an emergency break instruction. We can collect the data for any movement before and after collisions between a car, people and building. The correlation of the movement of the car with collisions will be analyzed and an algorithm will be created. For the collisions, we can classify it as scratch or collision. While for the collision simulation, we can use the same concept in the drilling simulation. When a scratch happens can "pop-out" a window and escalation mark at the place where it scratched. While a collision with people, building or car happens, an escalation mark will pop out at the position where it happens and an alarm sound will be activated to inform the driver a collision has happened. This solution is suitable to apply in driver improvement courses for seniors. As we know that as a person gets older, his/her reaction towards dangers will become slower and lack of awareness. In 2017, almost 7,700 older adults (aged 65+) were killed in motor vehicle crashes, and more than 257,000 were treated in emergency departments for motor vehicle crash injuries. This means that each day, approximately 20 older adults are killed, and an additional 700 are injured in motor vehicle crashes according to a statistic from the Centers for Disease Control and Prevention in the USA. According to these numbers, driving simulation class is necessary for the senior citizens to prevent the rise of fatal numbers. Our solution is possible as one of the solutions to reduce the case happens.

Solution sustainability

As in mid and long terms, the data given should be analysed using programming software as the data is able to be analyzed more correctly and able to visualise the reading. The analysis result obtained using the software should be able to construct more accurate algorithms.

Solution team work

No matter what, the teamwork and the team bond stayed strong ever throughout this hackathon.

With such a difficult task, and reduced opportunities to communicate our ideas, we still managed to pull the best of the challenge. Each and every team member was extremely excellent in creative thinking, analysing and critical thinking. The mutual connection among the like-minded people was the key to our success in task completion. Every member of the team has their significance and played their role well to keep the team going. The cooperation, motivation and understanding between us also pushed us further up till the final step of the competition. Although there were differences in opinion, we are proud to say that we openly welcomed each other's opinion and considered them as a possible solution. As this is the first time for all of our teammates, it certainly became an experience that was filled with ups and downs but most importantly as a memory to be cherished. We are definitely looking forward to working as a team in the future in tasks that are more challenging and require intense group brainstorming efforts.