

기계종합설계 최종발표

머신러닝을 이용한 로봇 팔 고장진단

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PRESENTATION AGENDA

01 설계 목표

02 모델링 및 3D 프린팅

03 제어

04 머신러닝

05 결론



머신러닝을 이용한 로봇팔 고장진단

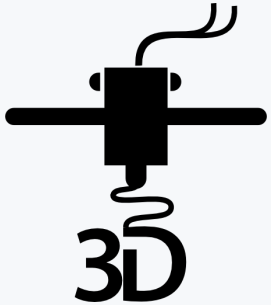
설계 목표



원가절감 및 자동화 시스템 구축을 통한 영업 이익 증대

설계 목표





3D 프린터를 이용한 원가 절감

설계 목표

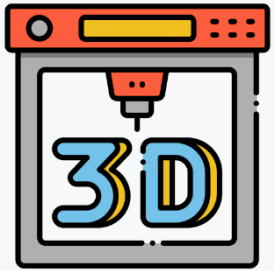




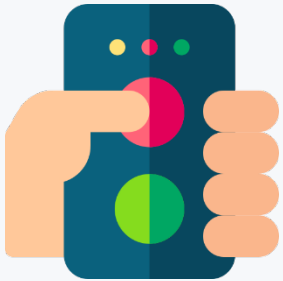
제어 및 머신러닝을 통한 자동화

설계 요약

3D 프린팅, 해석



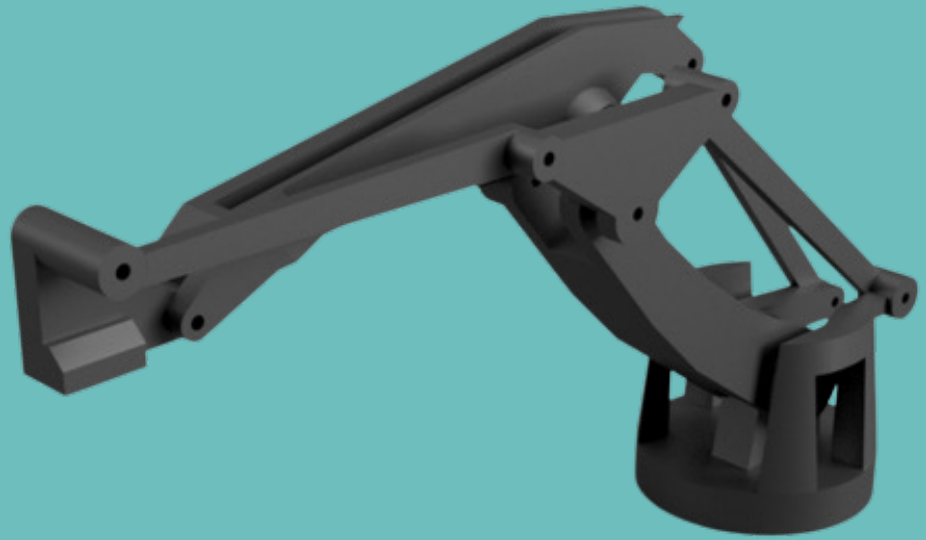
제어



머신러닝



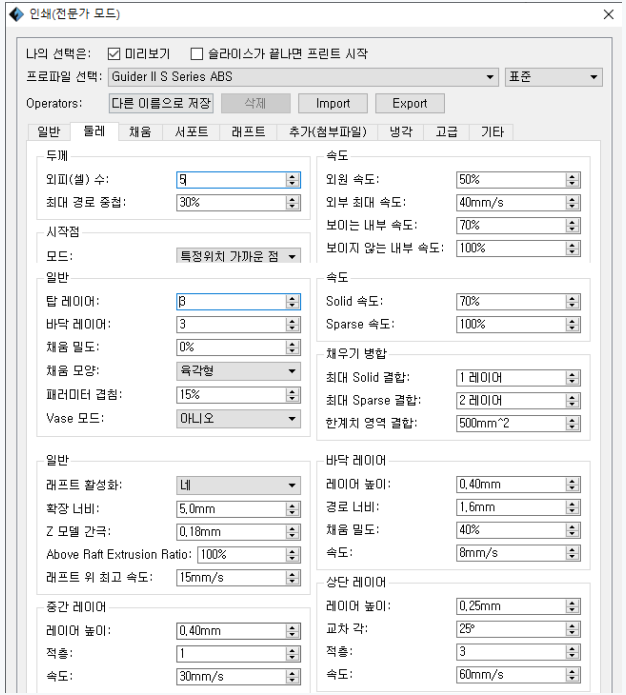
3D 프린팅

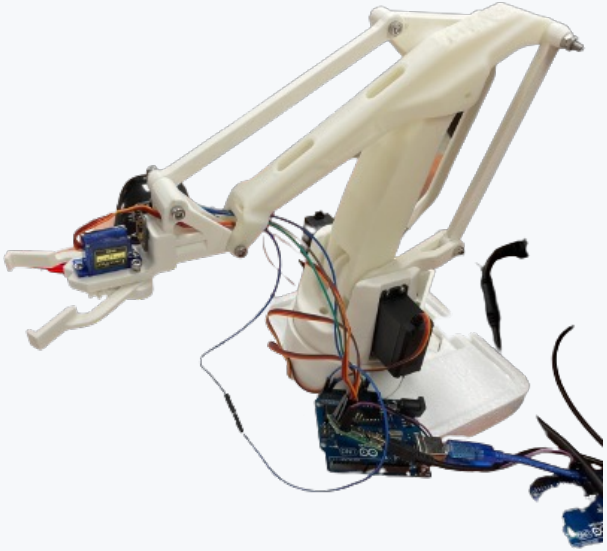


“3D 프린팅 및 해석”

원가 절감

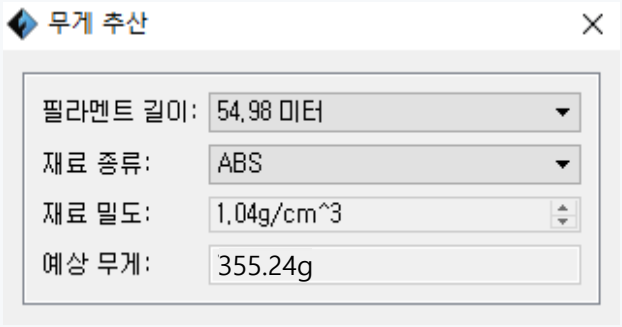
3D 프린팅, 해석

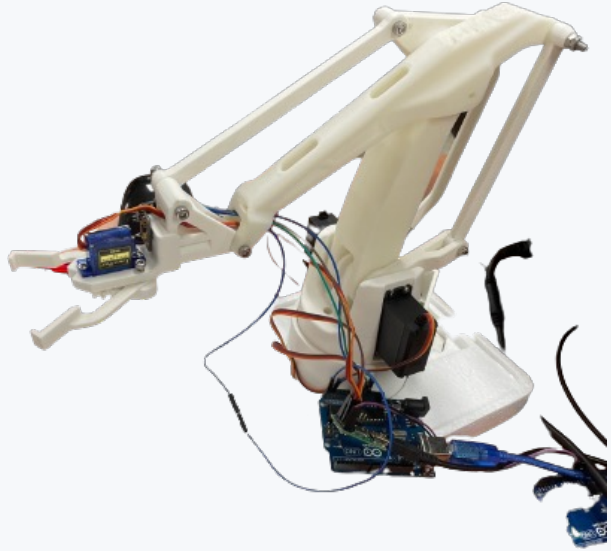


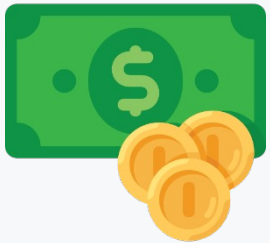


3D 모델링, 프린팅, 조립

3D 프린팅, 해석





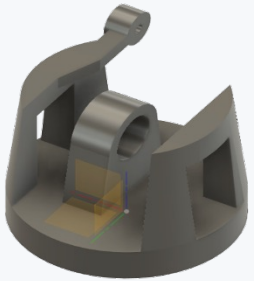


프레임 제작 6349원
(ESUN ABS 기준)

비용 계산

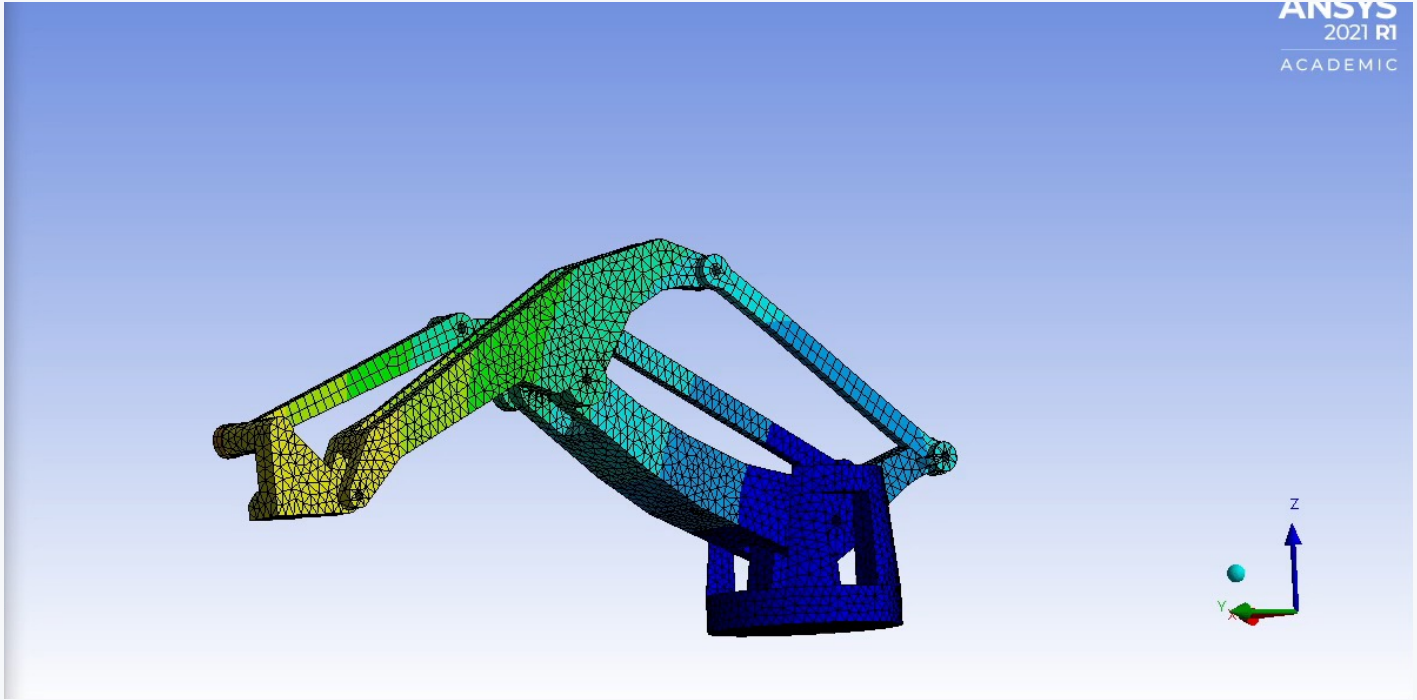
3D 프린팅, 해석





해석을 위한 모델링 간략화

동적 해석 영상



“ANSYS 해석을 활용한 ABS 소재의 로봇 활용 가 능 성 ”

3D 모델링 및 프린팅 목표

모터 제어

모터 제어



Pololu

Pololu를 이용한 모터제어

모터 제어

```
# Sequence 0
begin
  500 0 7550 4667 7750 5784 3968 frame_0..5 # Frame 0
  500 5367 frame_2 # Frame 1
  500 5917 frame_4 # Frame 2
  500 5984 frame_1 # Frame 3
  500 6600 frame_4 # Frame 4
  900 4484 frame_3 # Frame 5
  500 4767 5084 frame_2_4 # Frame 7
  500 6250 frame_2 # Frame 8
  500 5017 frame_4 # Frame 9
  500 7883 6267 4767 frame_1_2_4 # Frame 10
  500 4567 frame_2 # Frame 11
  500 6517 frame_2 # Frame 12
  500 6067 5100 frame_2_4 # Frame 13
  500 6033 frame_1 # Frame 14
  500 5917 frame_4 # Frame 15
  500 3968 frame_2 # Frame 16
  500 7783 frame_3 # Frame 17
  500 6467 frame_4 # Frame 18
  500 5984 5367 7750 5917 frame_1..4 # Frame 19
  500 8000 frame_1 # Frame 20
  500 5750 frame_4 # Frame 21
  500 4217 frame_2 # Frame 22
repeat
```

```
sub frame_0..5
  5 servo
  4 servo
  3 servo
  2 servo
  1 servo
  0 servo
  delay
  return

sub frame_2
  2 servo
  delay
  return

sub frame_4
  4 servo
  delay
  return

sub frame_1
  1 servo
  delay
  return
```

```
sub frame_3
  3 servo
  delay
  return

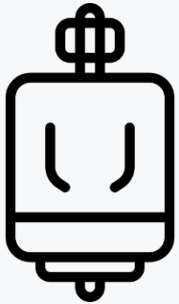
sub frame_2_4
  4 servo
  2 servo
  delay
  return

sub frame_1_2_4
  4 servo
  2 servo
  1 servo
  delay
  return

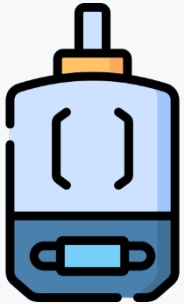
sub frame_1..4
  4 servo
  3 servo
  2 servo
  1 servo
  delay
  return
```

모터 제어 코드

모터 제어

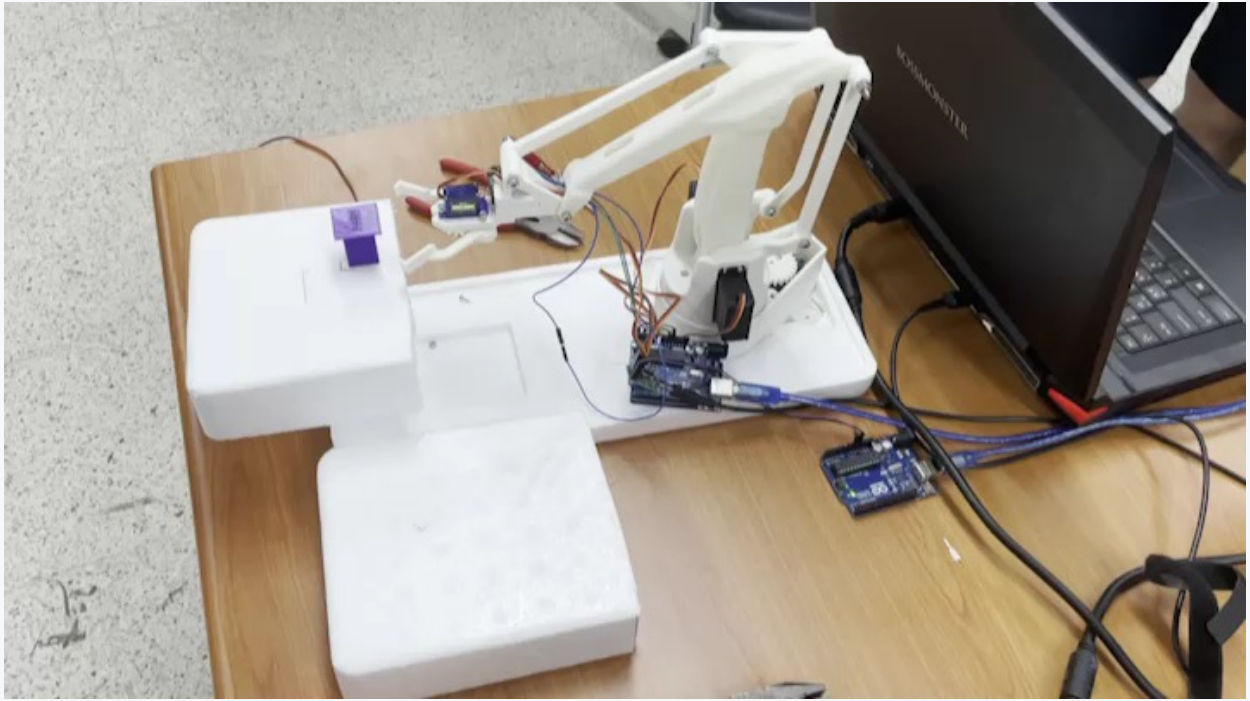


SG90 SERVO x1

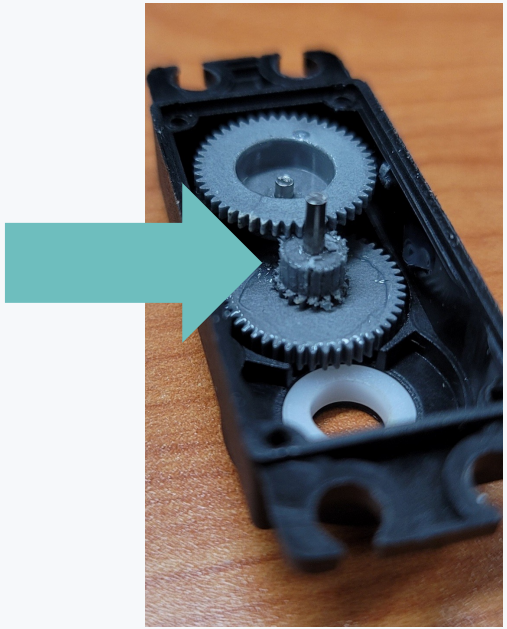


995 SERVO x3

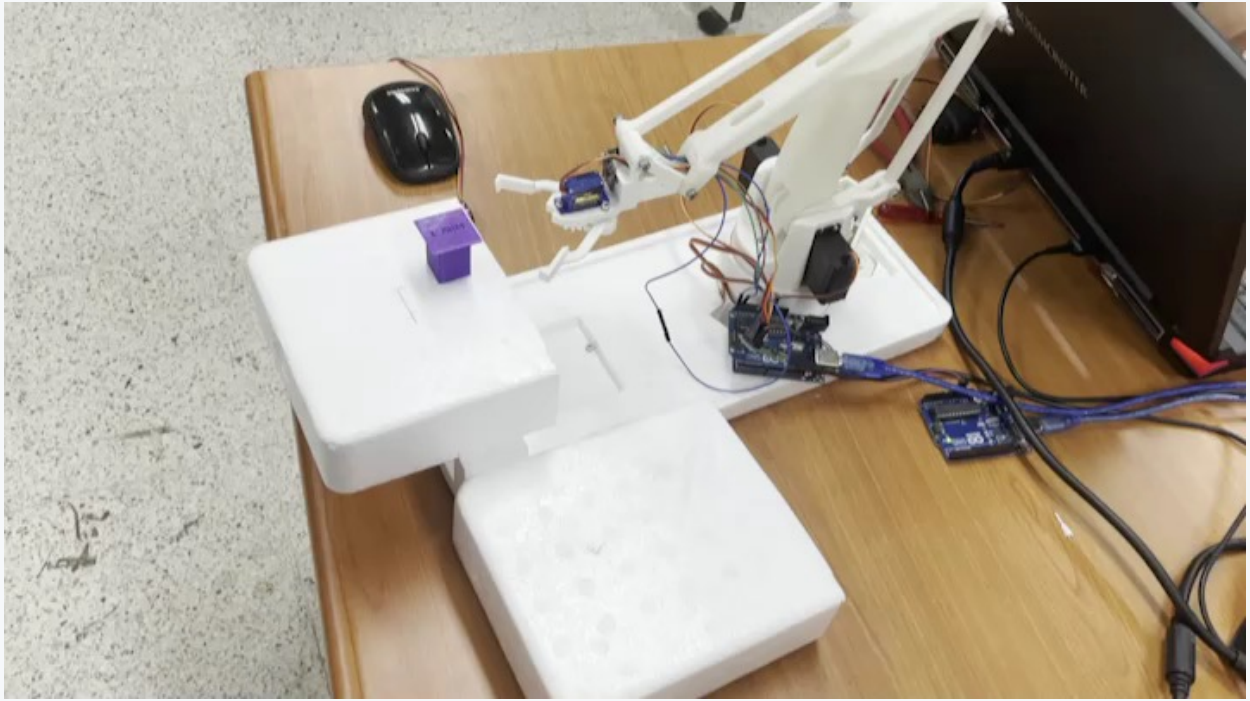
정상작동 영상



모터 고장



고장작동 영상



데이터 수집

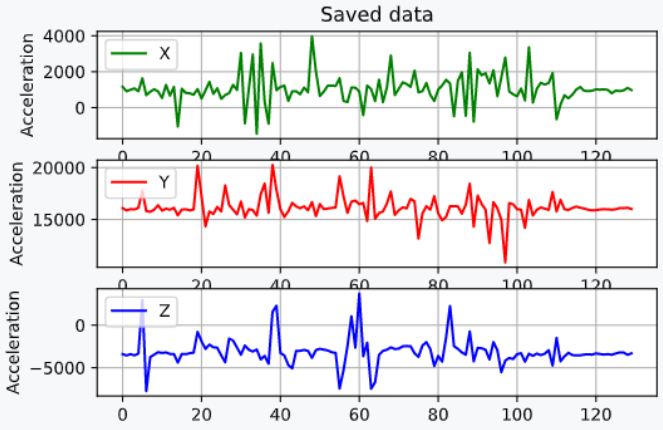


SENSOR

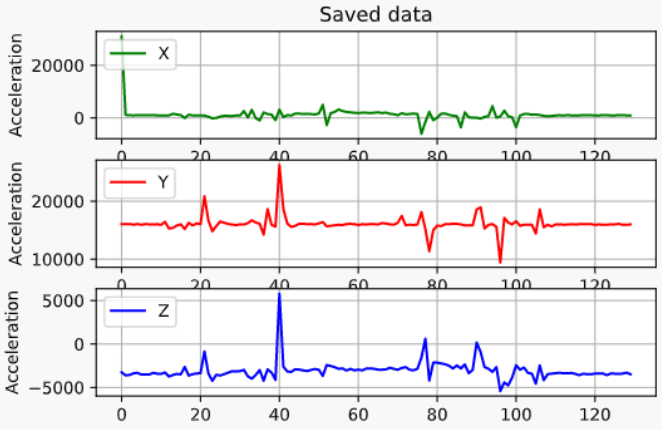


MPU 6050

데이터 수집



정상 가속도
그래프



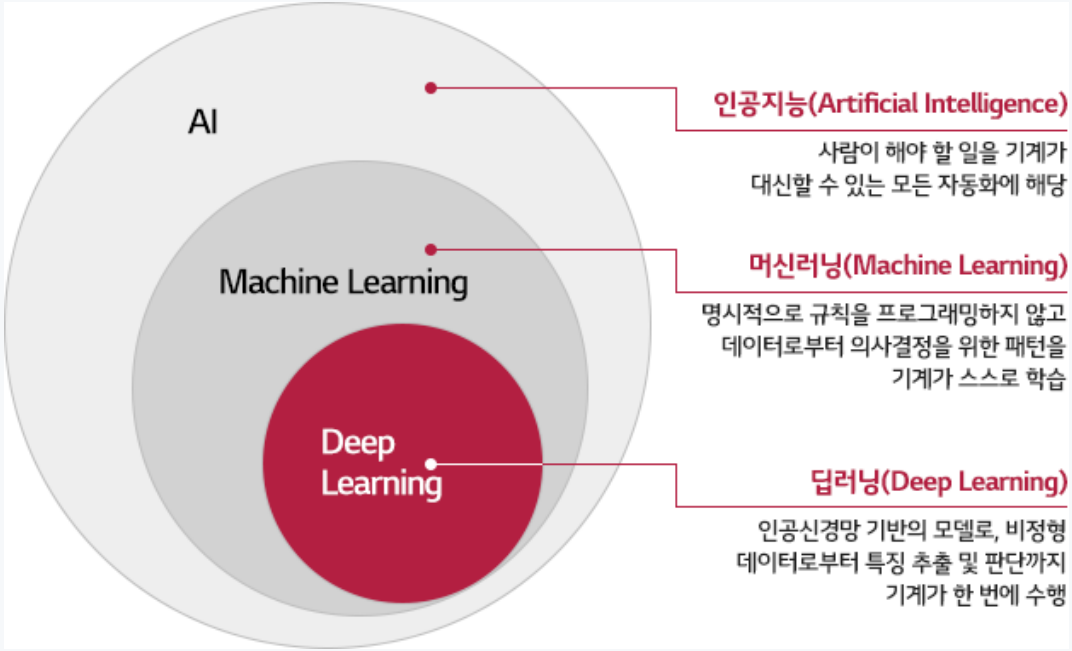
고장 가속도
그래프

“POLOLU를 이용한 모터 제어 및 가속도 데이터 수집 ”

모터 제어

머신 러닝

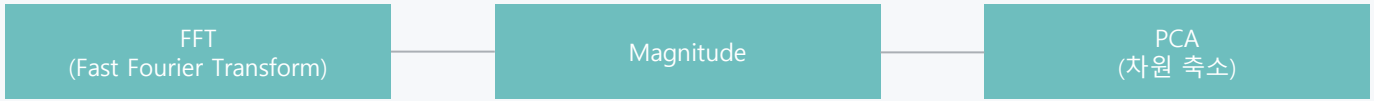
머신 러닝


AI
Machine Learning
Deep
Learning
인공지능(Artificial Intelligence)
사람이 해야 할 일을 기계가
대신할 수 있는 모든 자동화에 해당
머신러닝(Machine Learning)
명시적으로 규칙을 프로그래밍하지 않고
데이터로부터 의사결정을 위한 패턴을
기계가 스스로 학습
딥러닝(Deep Learning)
인공신경망 기반의 모델로, 비정형
데이터로부터 특징 추출 및 판단까지
기계가 한 번에 수행

머신러닝 고장 분류 과정

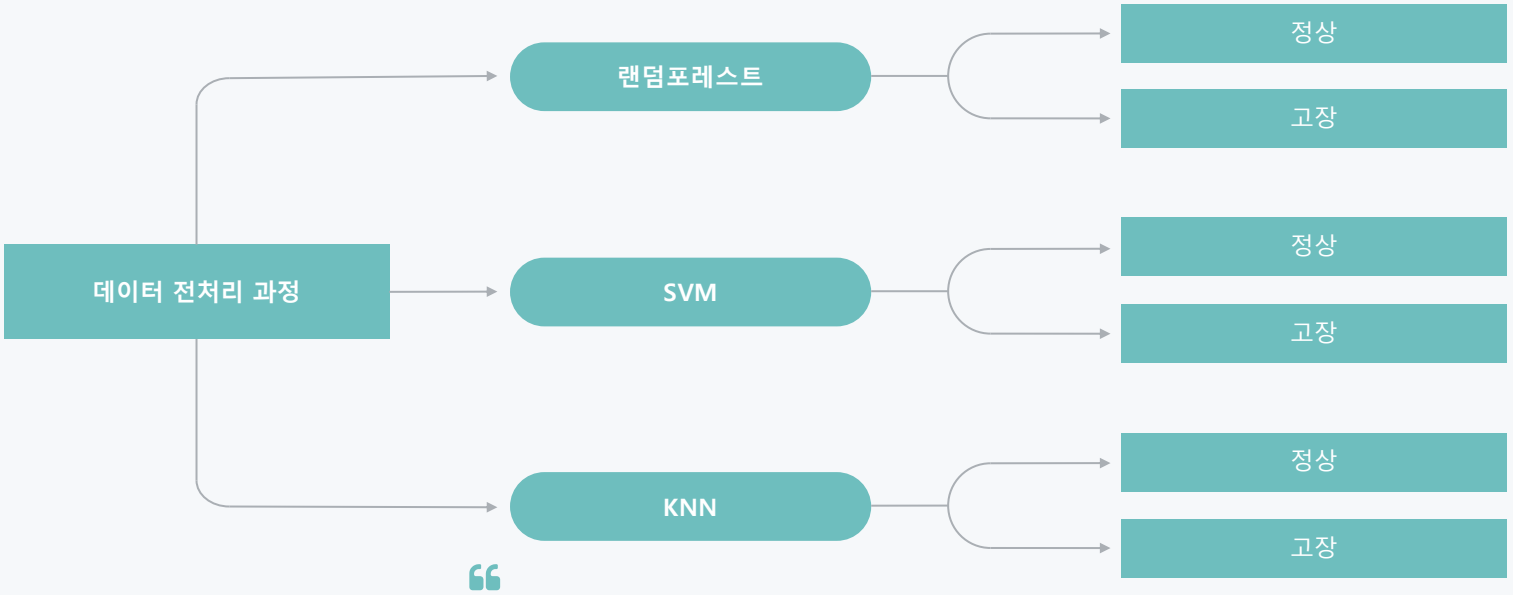


머신러닝 고장 분류 과정



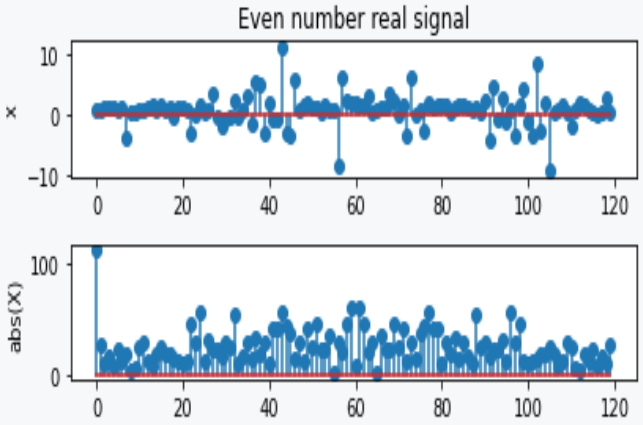
데이터 전처리 과정

머신러닝 고장 분류 과정

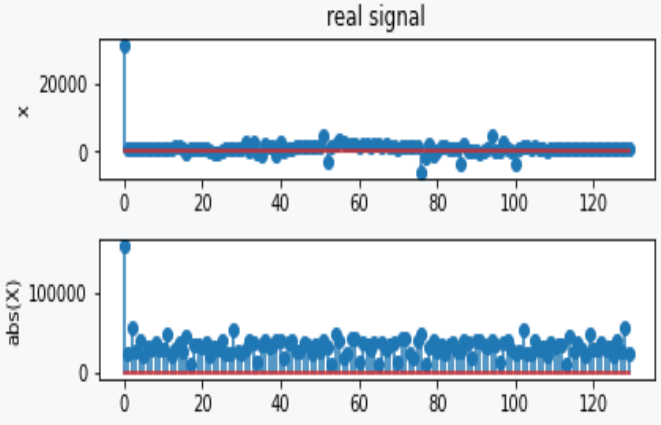


머신러닝 알고리즘

머신러닝 데이터 전처리 (FFT)

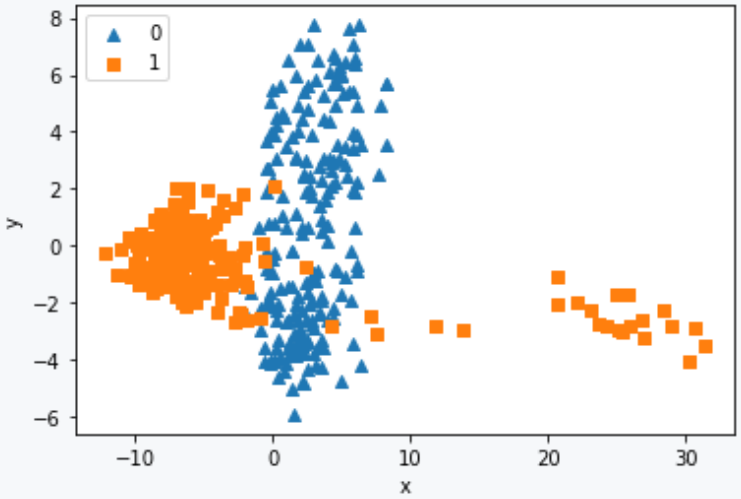


정상 FFT 그래프



고장 FFT 그래프

머신러닝 PCA 산점도

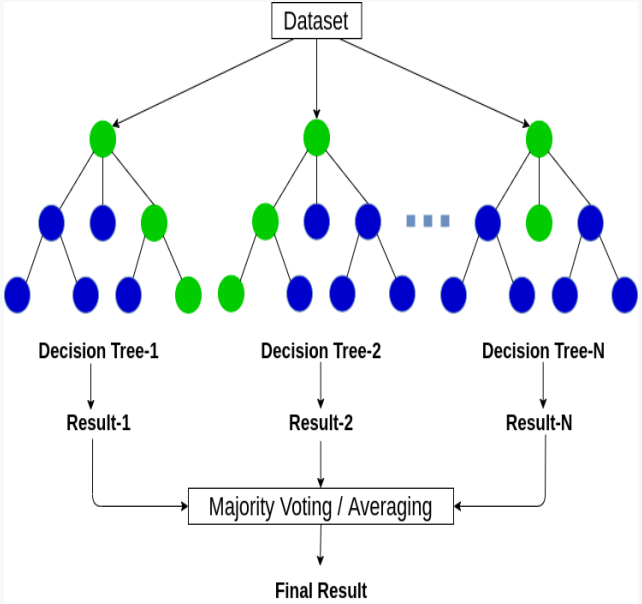


PCA 산점도

머신러닝 랜덤포레스트

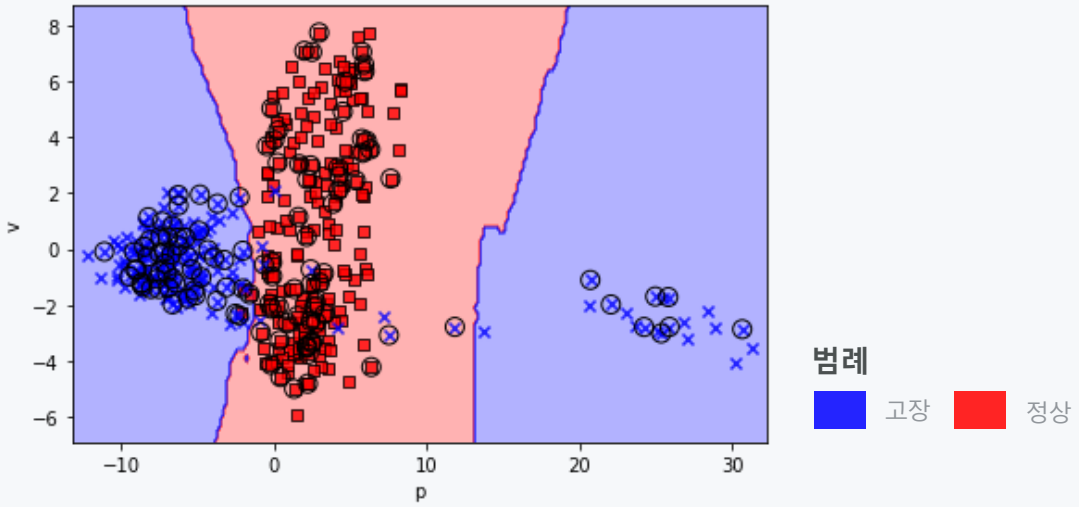


머신러닝 랜덤포레스트



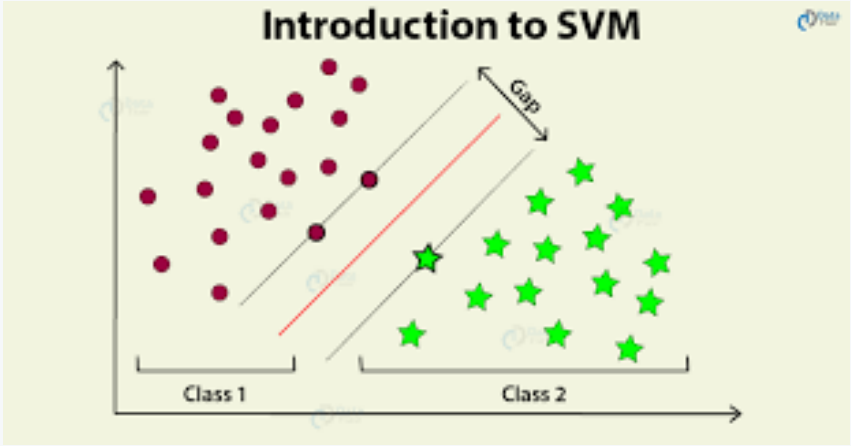
분류기 생성 후 최종 결정

머신러닝 랜덤포레스트



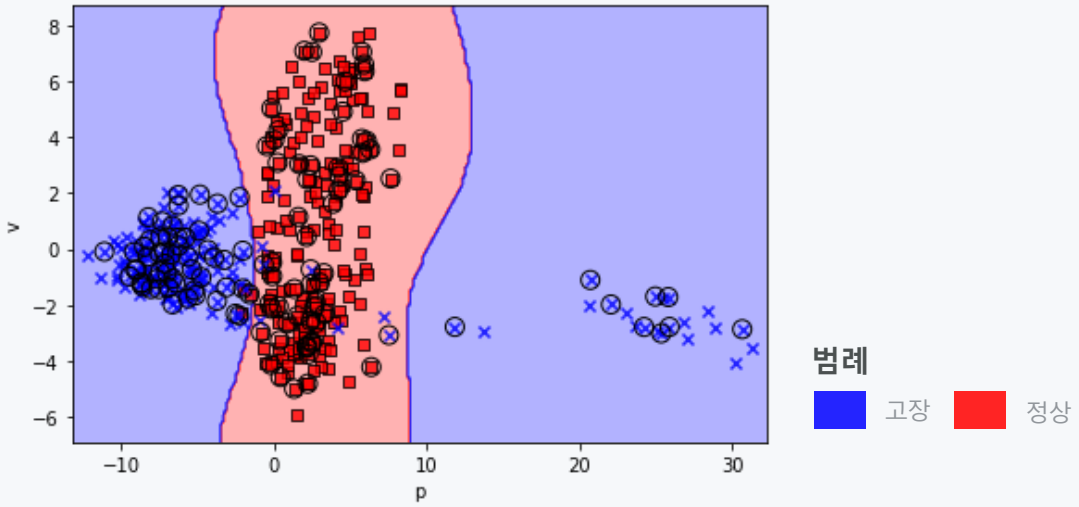
정확도 : 96.74%

머신러닝 서포트 벡터 머신 (SVM)



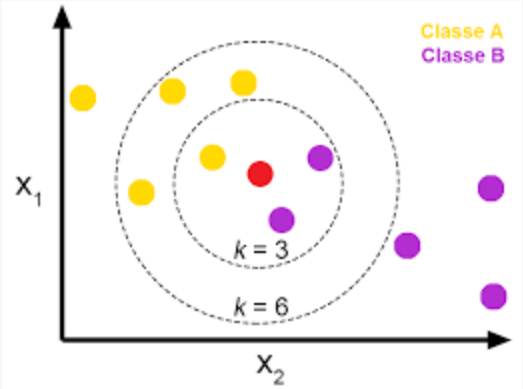
GAP을 최대화 하는 결정 경계 탐색

머신러닝 서포트 벡터 머신 (SVM)



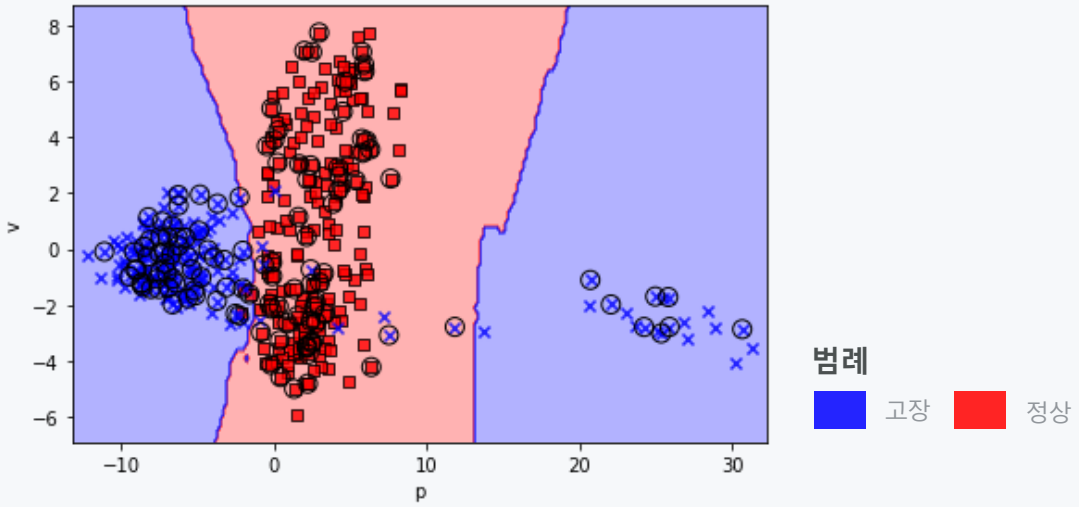
정확도 : 95.93%

머신러닝 K-최근접 알고리즘 (KNN)



최근접 이웃탐색을 통한 데이터 분류

머신러닝 K-최근접 알고리즘 (KNN)



정확도 : 95.12%

결론

결론







3D 프린터를 활용한 원가 절감
비용 : 6429원

랜덤포레스트 활용
고장진단률 : 96.74%

시청해주셔서,
감사합니다.

Contact us:

https://github.com/leehyeongjin1/MechanicalSystemDesign

F-ARM