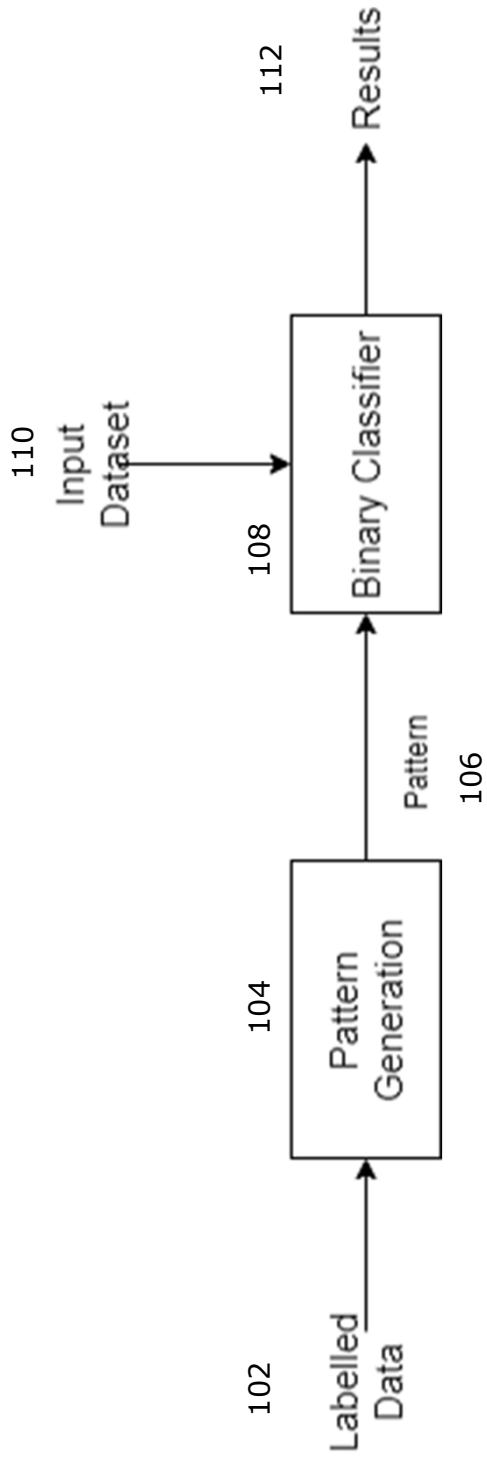
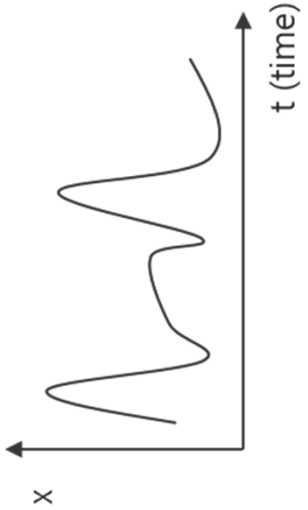

Labelled Data
102
Pattern Generation
104
Pattern
106
Binary Classifier
108
Input Dataset
110
Results
112
100

Figure 1



200

Figure 2

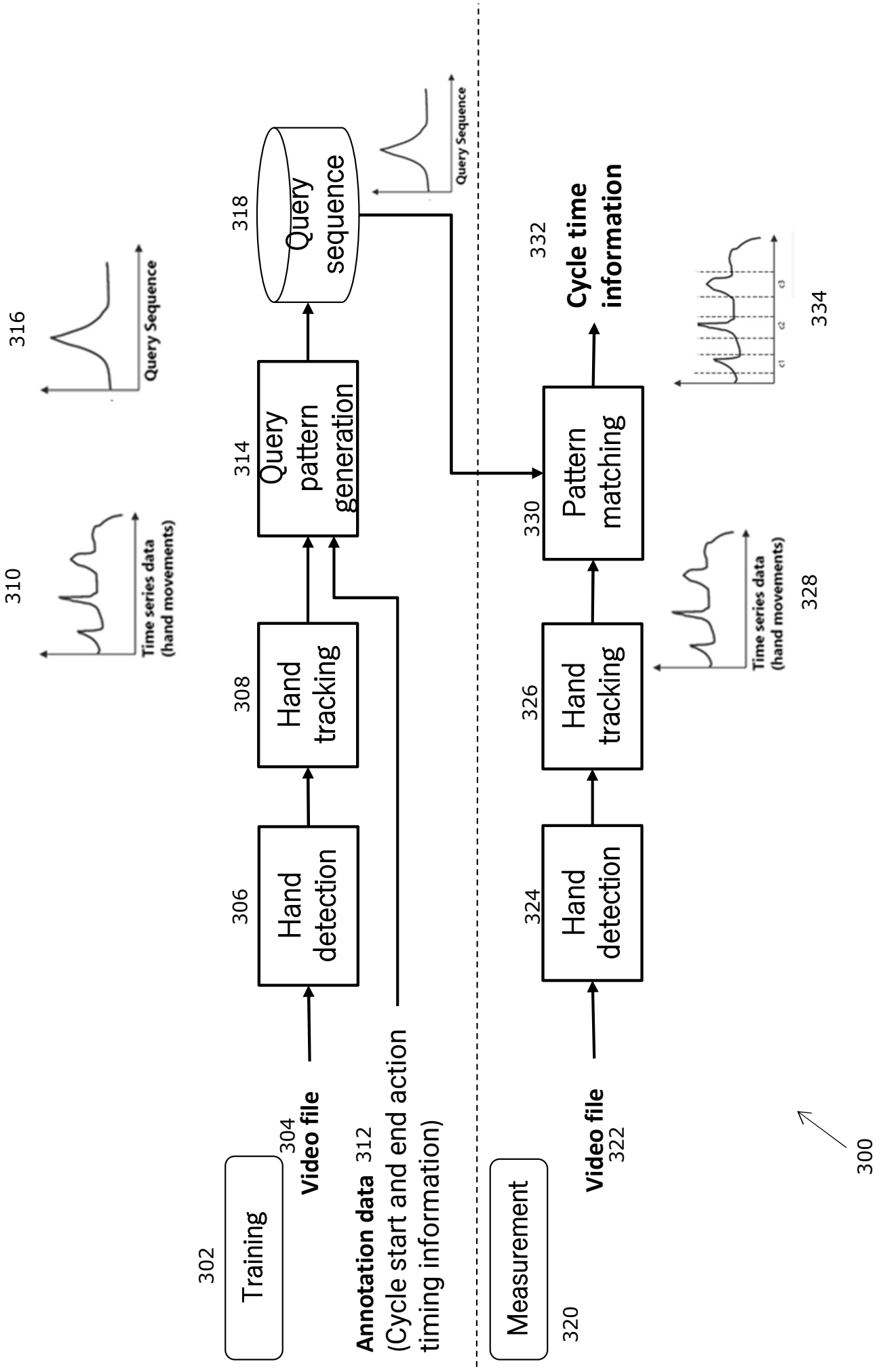

Training
302
Video file
304
Annotation data 312
(Cycle start and end action timing information)
Hand detection
306
Hand tracking
308
Query pattern generation
314
Query sequence
318
Query Sequence
316
Time series data (hand movements)
310
Measurement
320
Video file
322
Hand detection
324
Hand tracking
326
Pattern matching
330
Cycle time information
332
Time series data (hand movements)
328
334
300

Figure 3

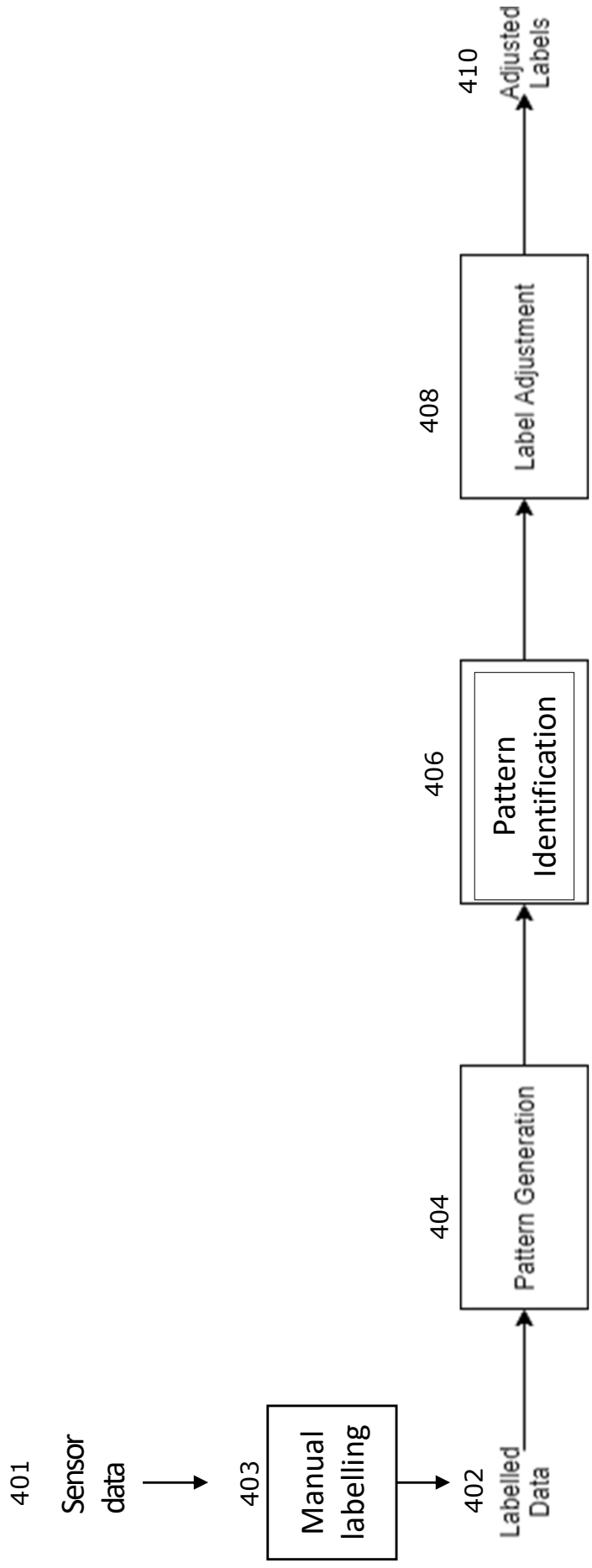

401
Sensor data
403
Manual labelling
402
Labelled Data
404
Pattern Generation
406
Pattern Identification
408
Label Adjustment
410
Adjusted Labels
400

Figure 4

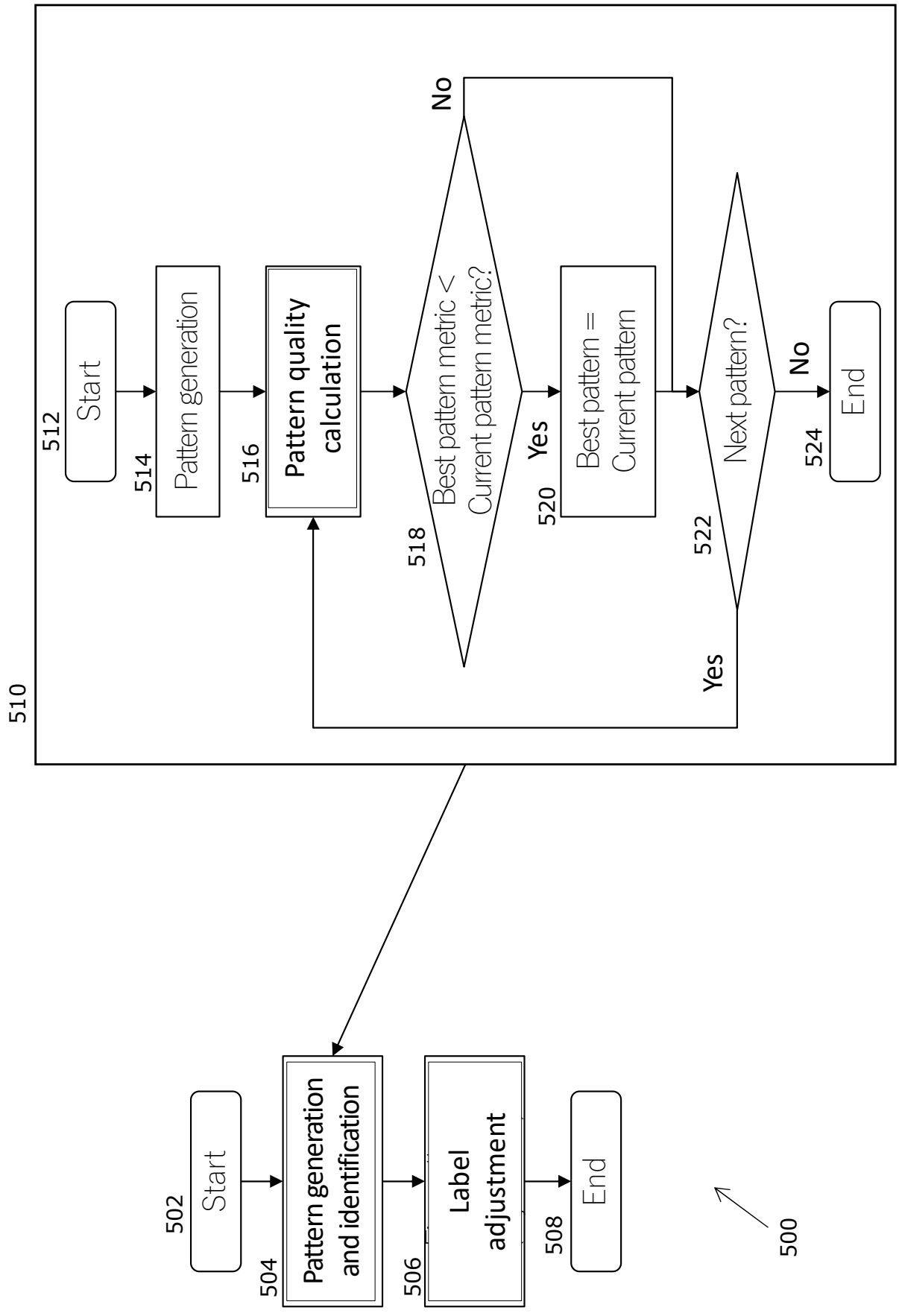

Start
502
Pattern generation and identification
504
Label adjustment
506
End
508
500
510
Start
512
Pattern generation
514
Pattern quality calculation
516
Best pattern metric < Current pattern metric?
518
No
Yes
Best pattern = Current pattern
520
Next pattern?
522
Yes
No
End
524

Figure 5

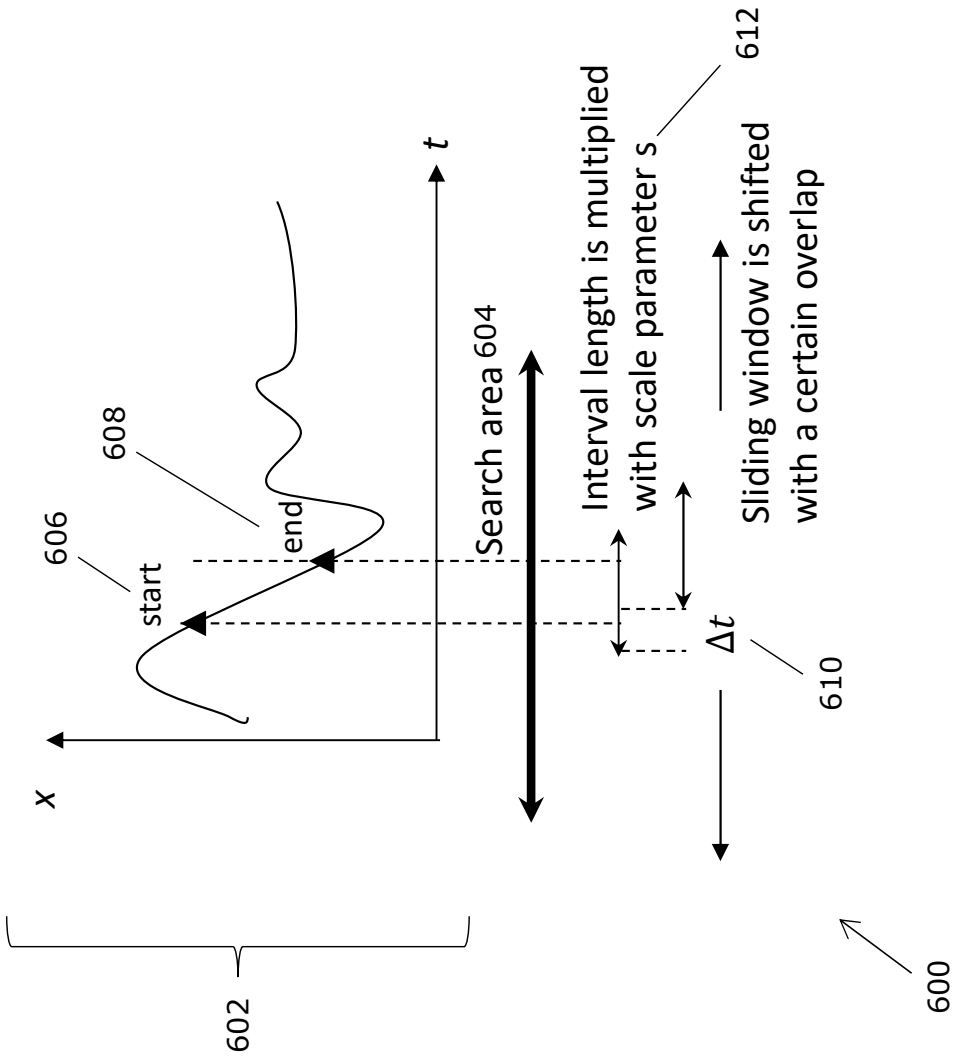

600
602
x
t
606
start
608
end
Search area 604
Interval length is multiplied
with scale parameter s
612
Sliding window is shifted
with a certain overlap
Δt
610

Figure 6

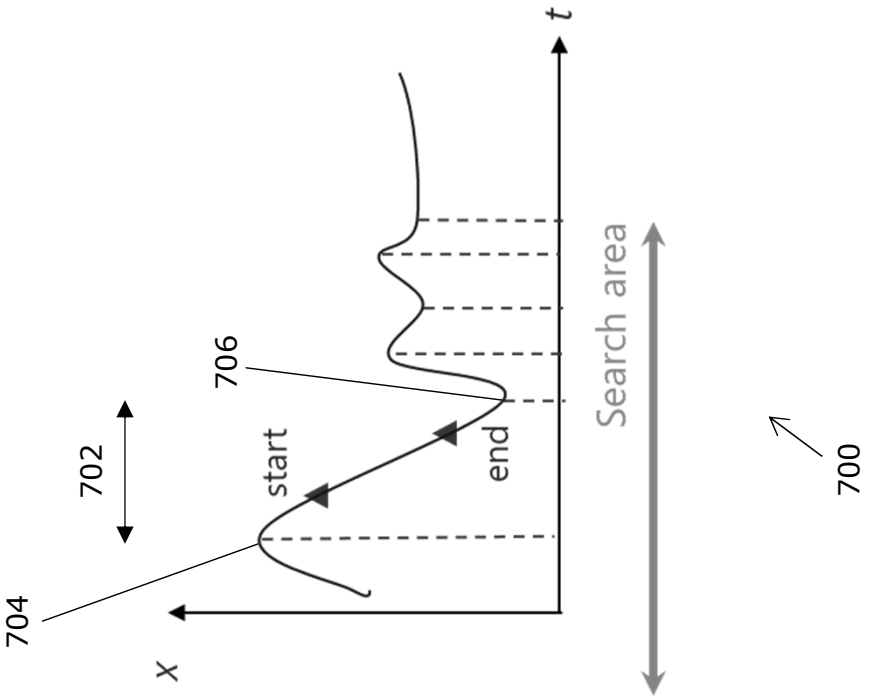


Figure 7

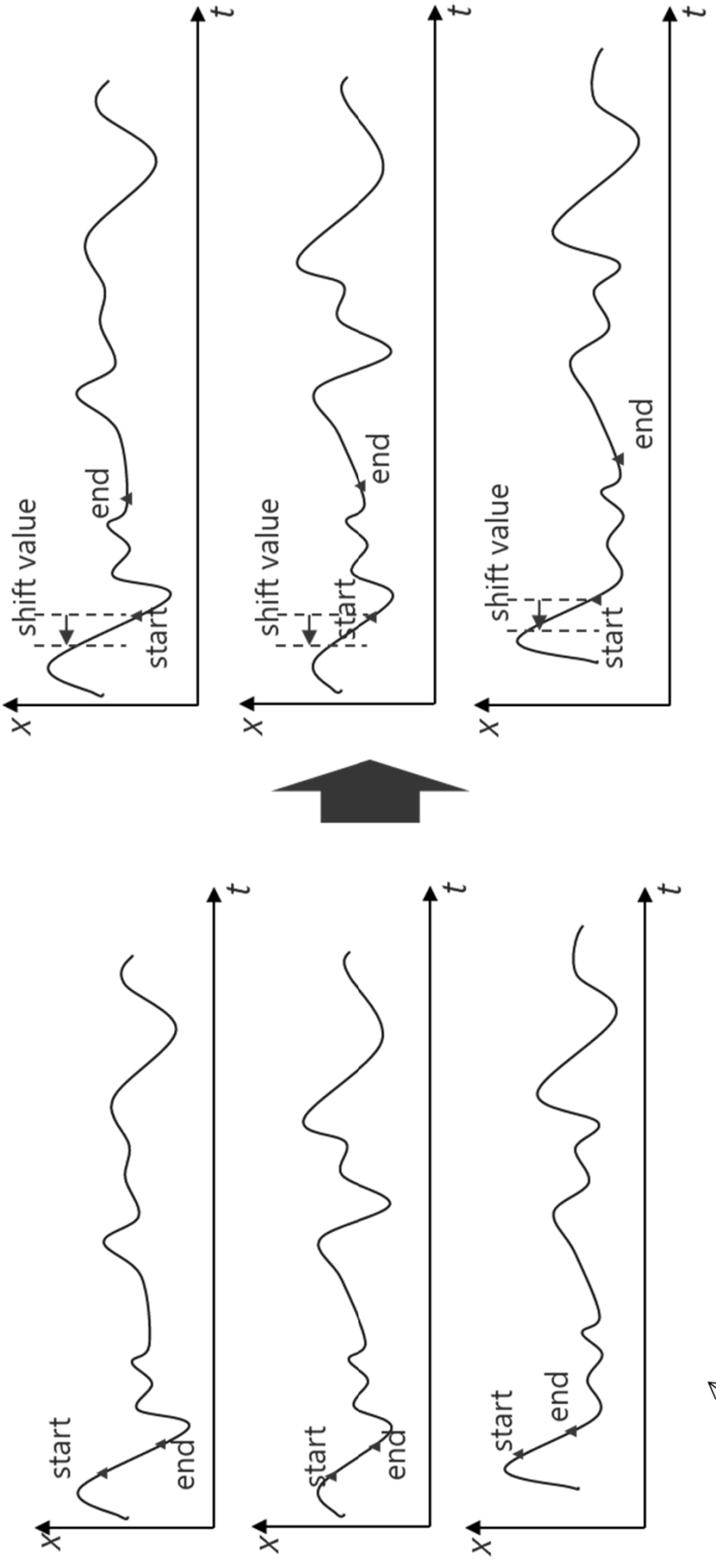


Figure 8

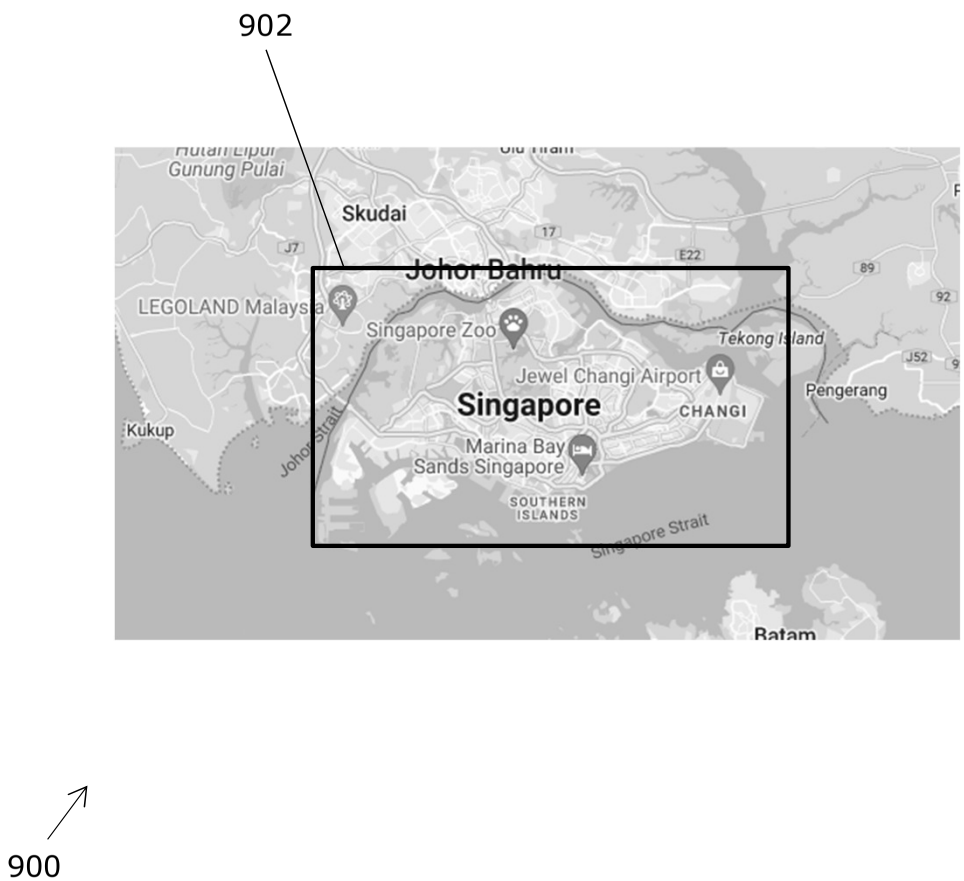

902
Gunung Pulai
Skudai
Johor Bahru
LEGOLAND Malaysia
Singapore Zoo
Tekong Island
Jewel Changi Airport
Singapore
CHANGI
Pengerang
Kukup
Johor Strait
Marina Bay
Sands Singapore
SOUTHERN
ISLANDS
Singapore Strait
Batam
900

Figure 9

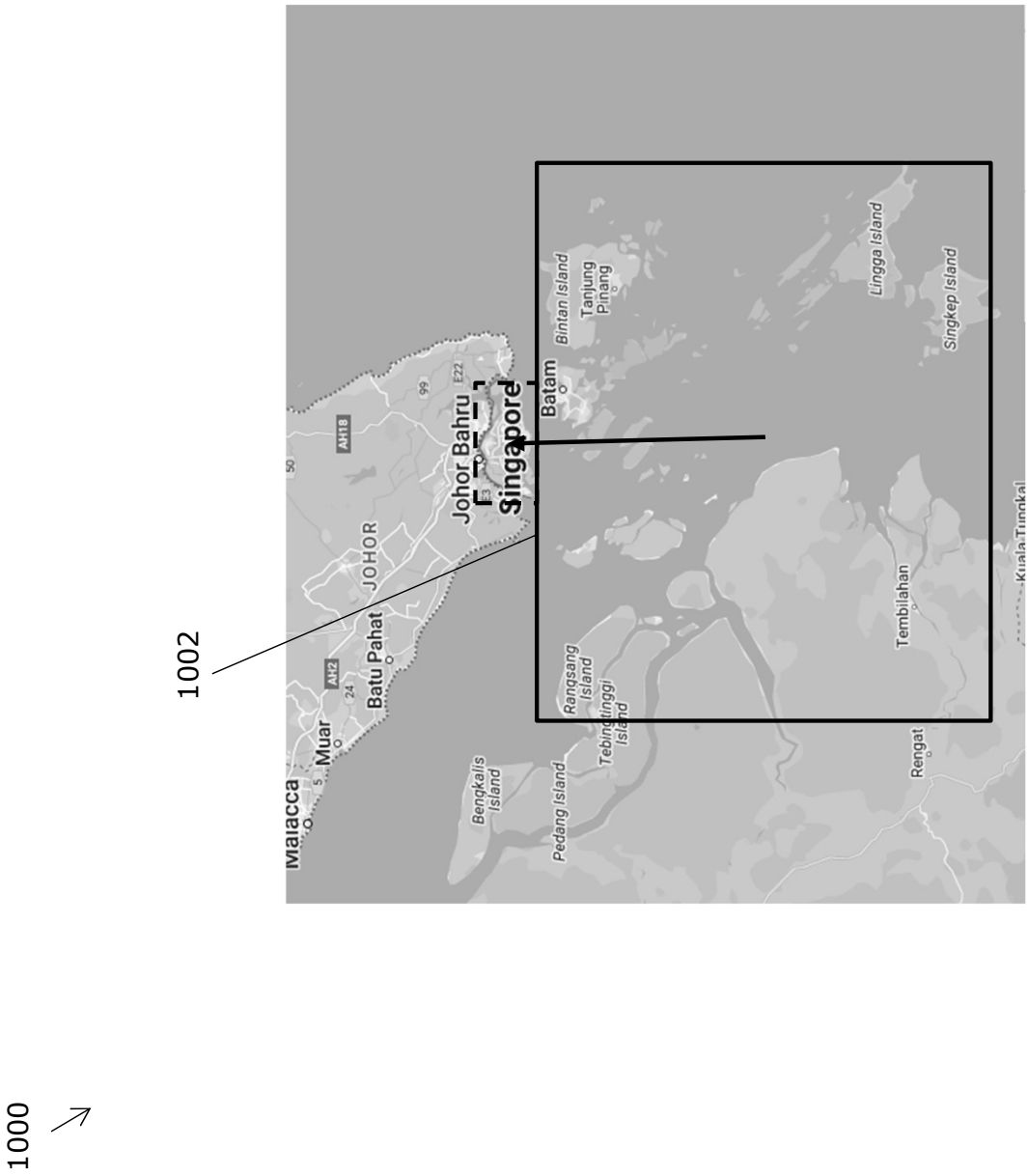
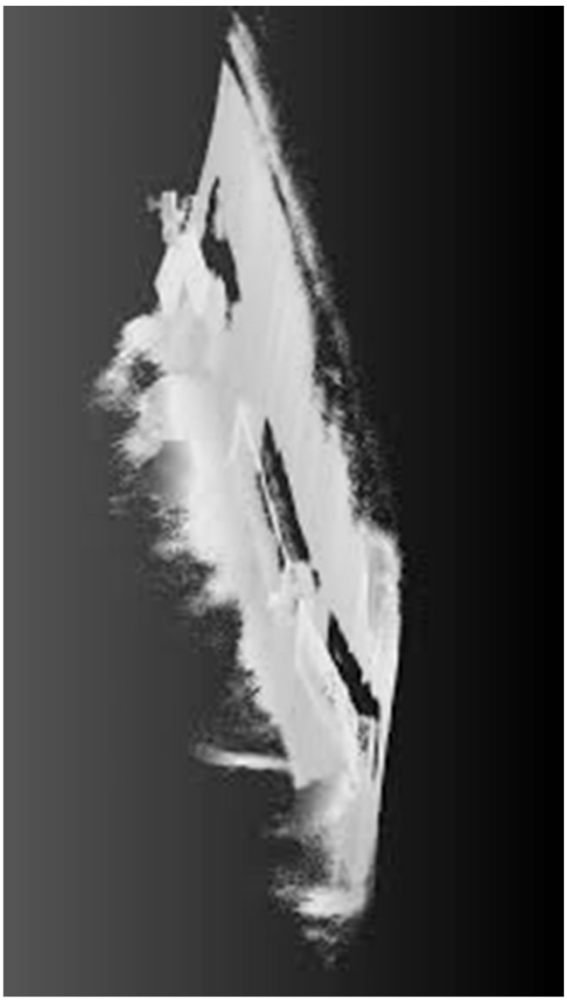

1000
1002
Malacca
Muar
Batu Pahat
JOHOR
Johor Bahru
Singapore
Batam
Bintan Island
Tanjung Pinang
Lingga Island
Singkep Island
Tembilahan
Rengat
Rangsang Island
Tebingtinggi Island
Bengkalis Island
Pedang Island
AH18
AH2
E22

Figure 10



1100

Figure 11

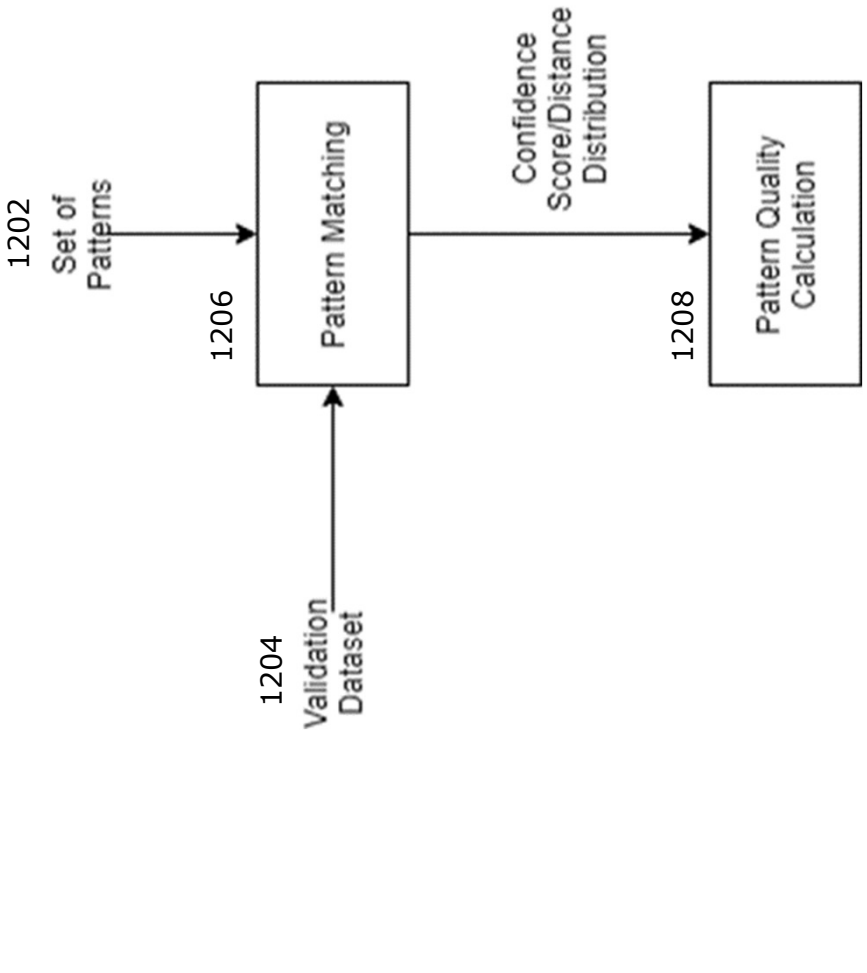
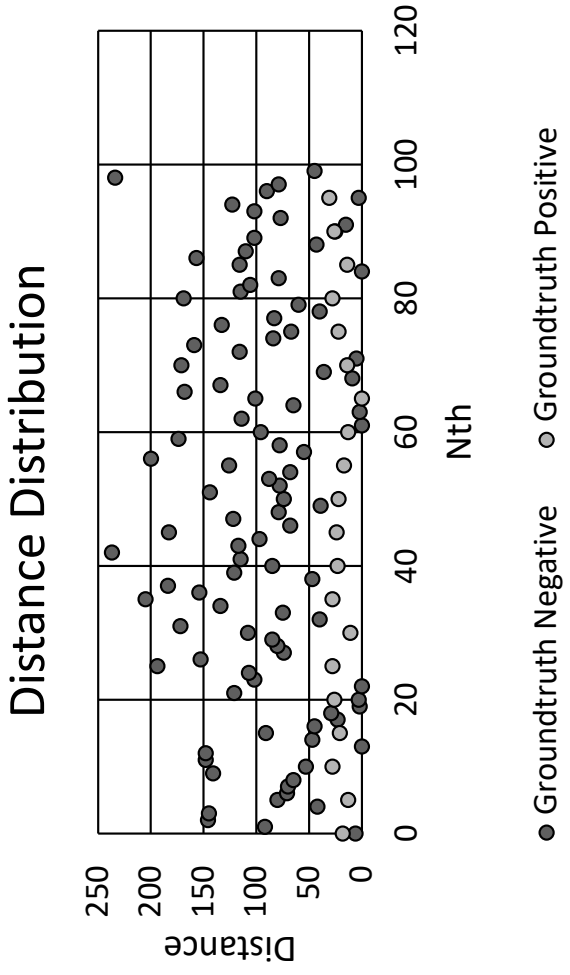

1202
Set of Patterns
1206
Pattern Matching
1204
Validation Dataset
Confidence Score/Distance Distribution
1208
Pattern Quality Calculation
1200

Figure 12



1300

Figure 13

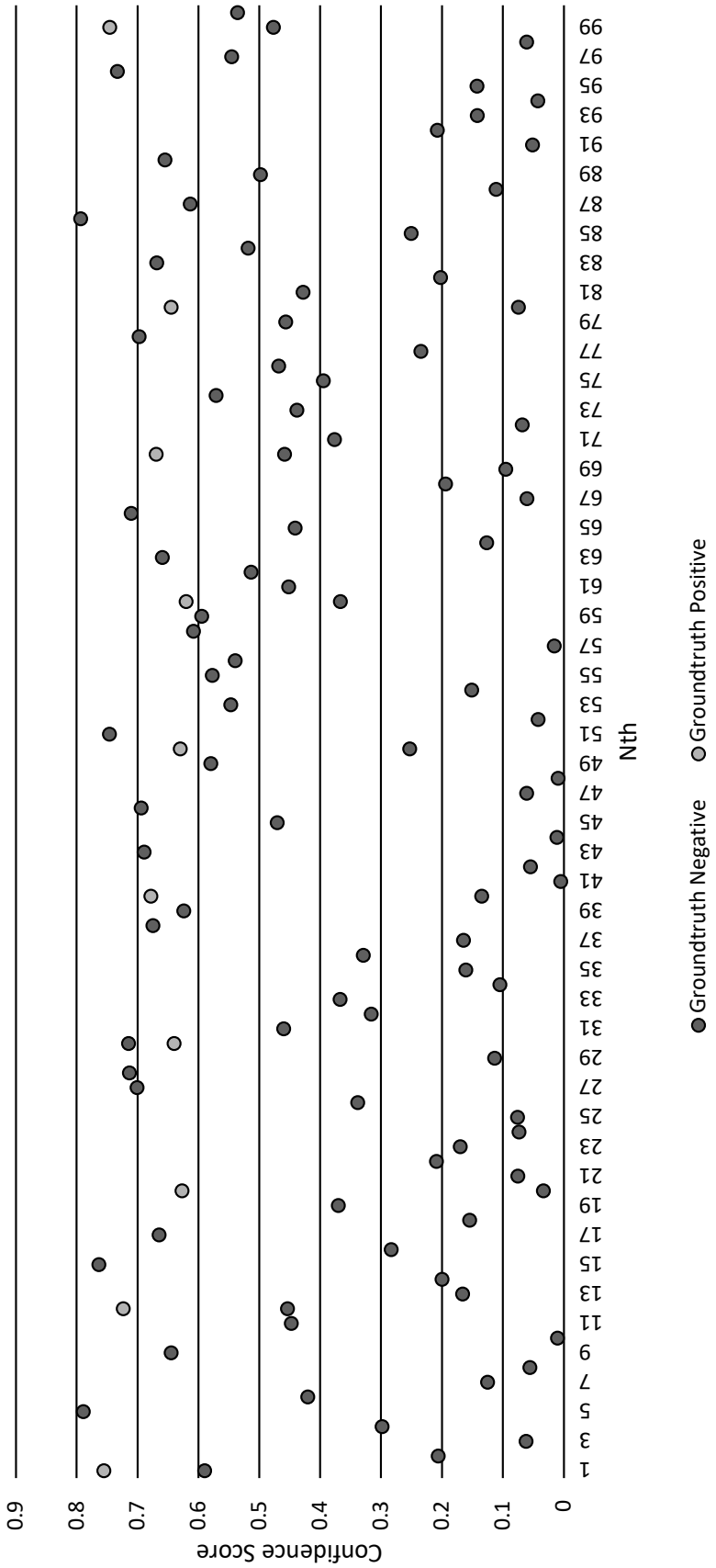

Confidence Score
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Confidence Score
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
97
99
Nth
Groundtruth Negative
Groundtruth Positive
1400

Figure 14

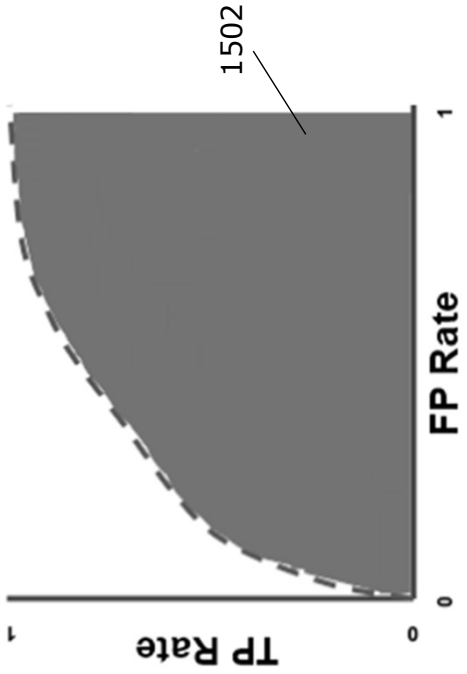
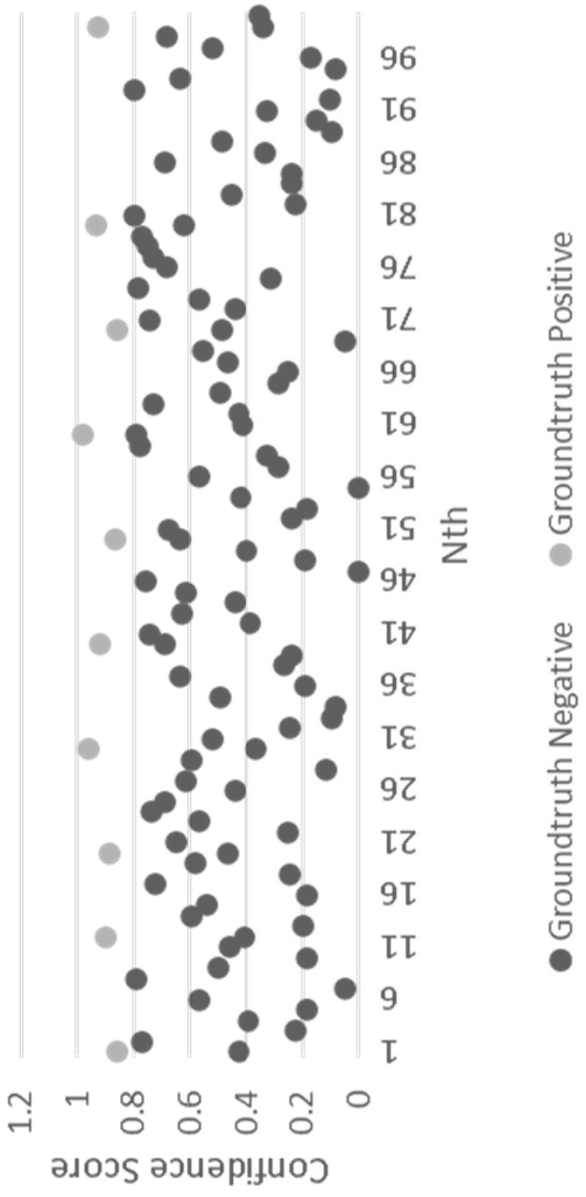


Figure 15



1600

Figure 16

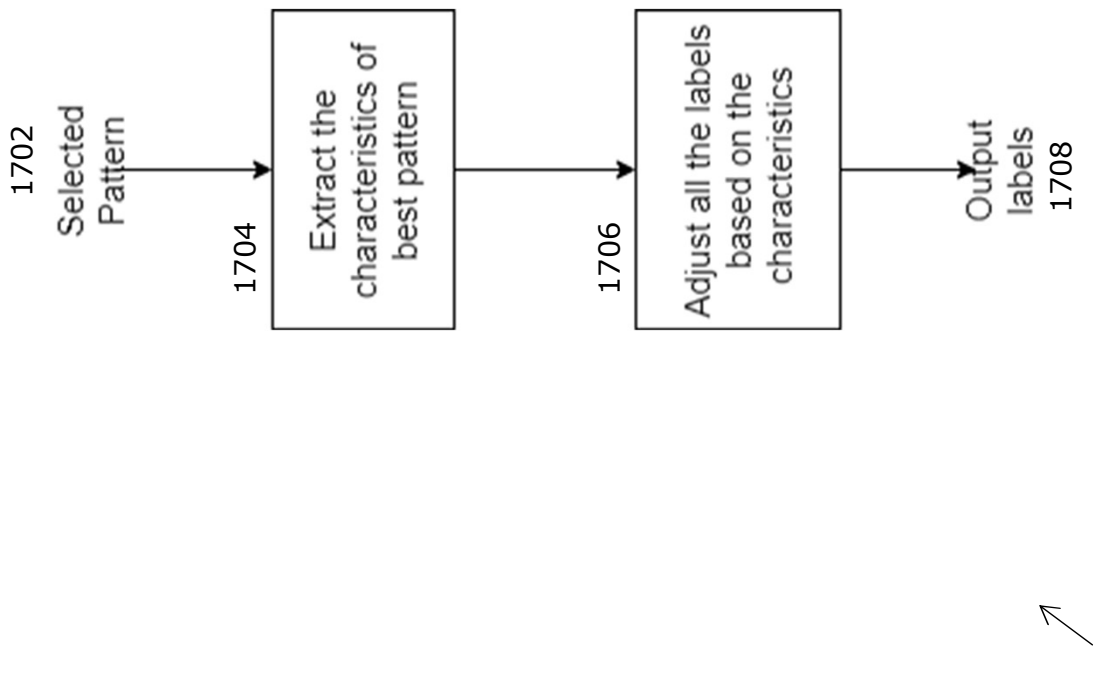

1702
Selected Pattern
1704
Extract the characteristics of best pattern
1706
Adjust all the labels based on the characteristics
Output labels
1708
1700

Figure 17

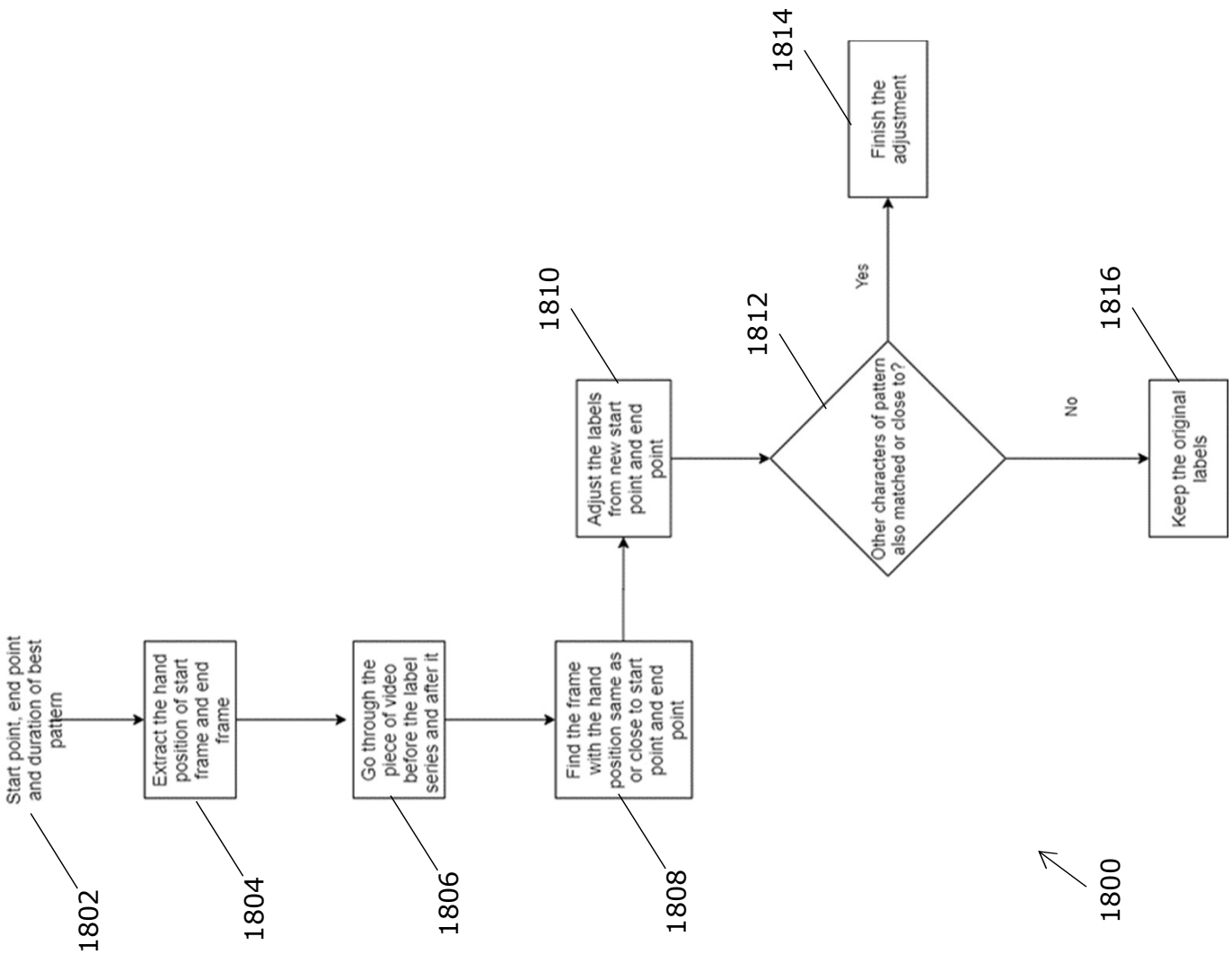

Start point, end point and duration of best pattern
Extract the hand position of start frame and end frame
Go through the piece of video before the label series and after it
Find the frame with the hand position same as or close to start point and end point
Adjust the labels from new start point and end point
Other characters of pattern also matched or close to?
Yes
No
Finish the adjustment
Keep the original labels
1802
1804
1806
1808
1810
1812
1814
1816
1800

Figure 18

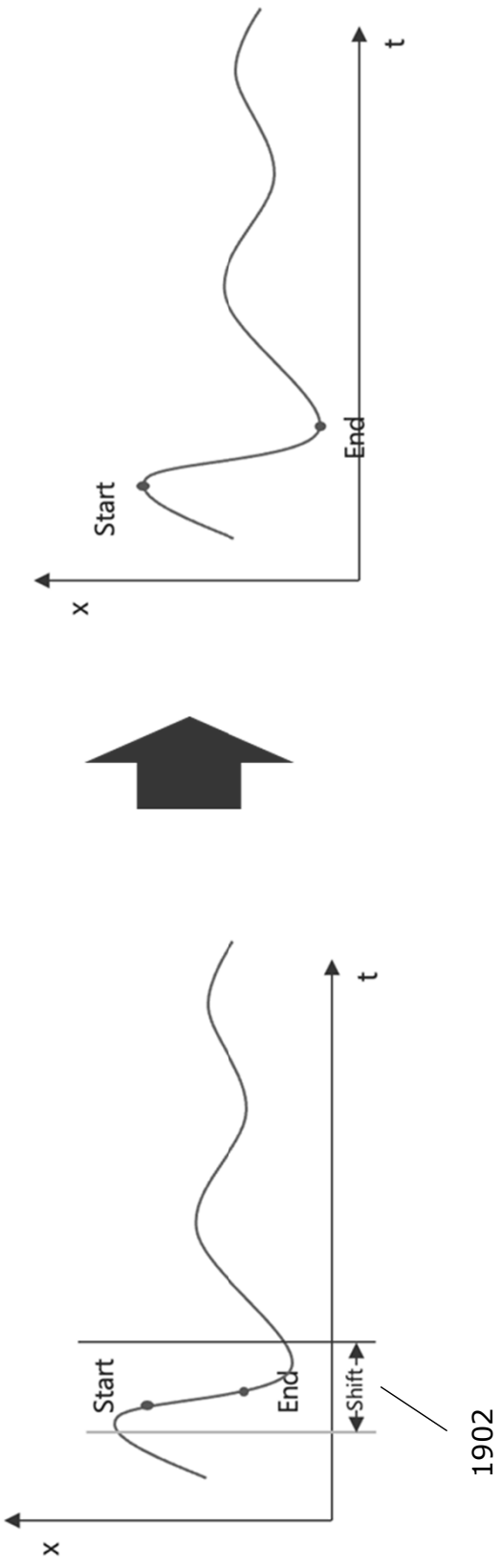


Figure 19

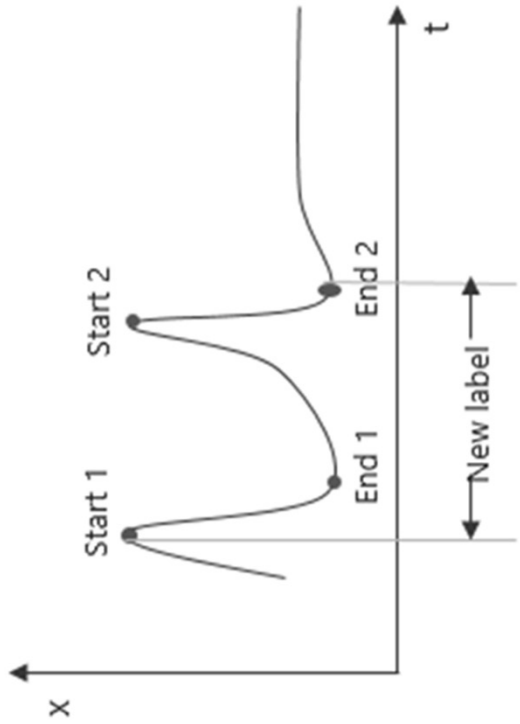


Figure 20

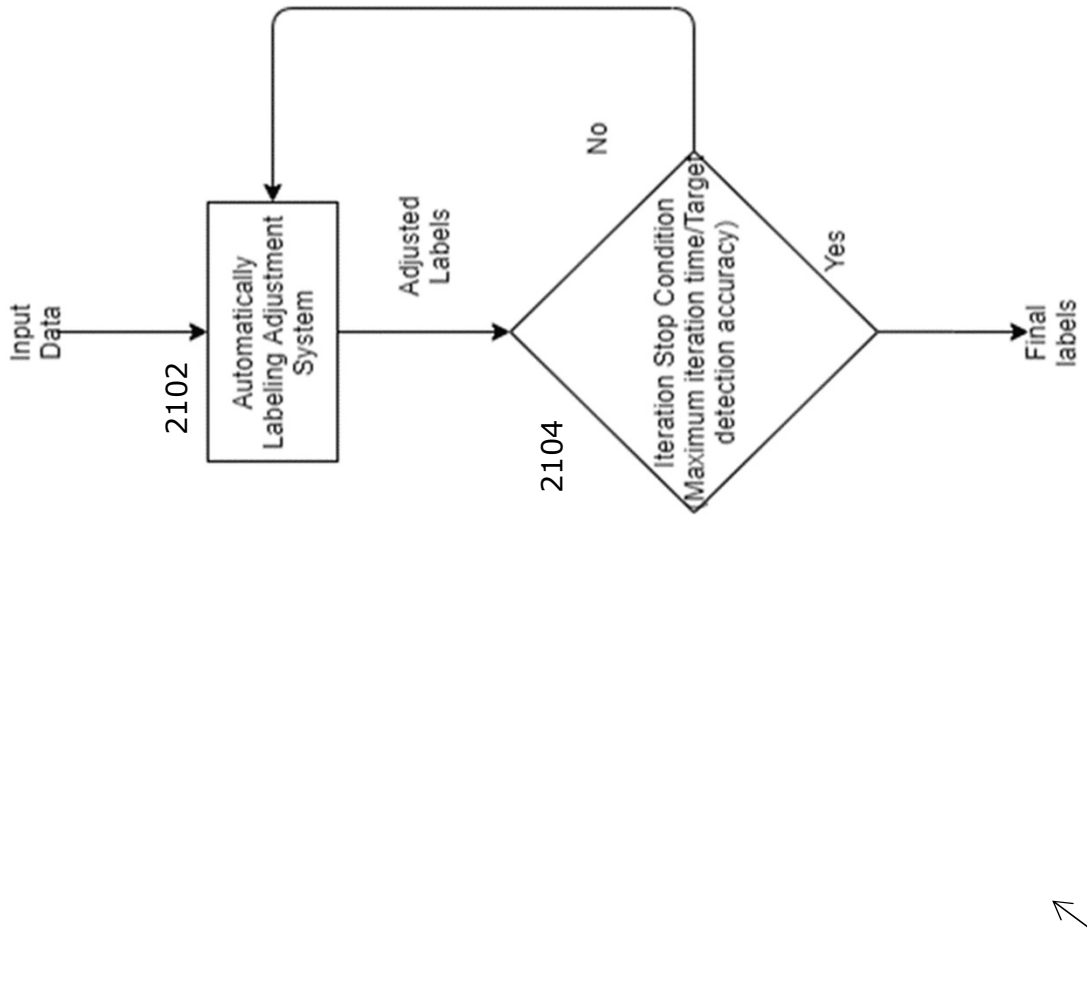

Input Data
2102
Automatically Labeling Adjustment System
Adjusted Labels
2104
Iteration Stop Condition (Maximum iteration time/Target detection accuracy)
No
Yes
Final labels
2100

Figure 21

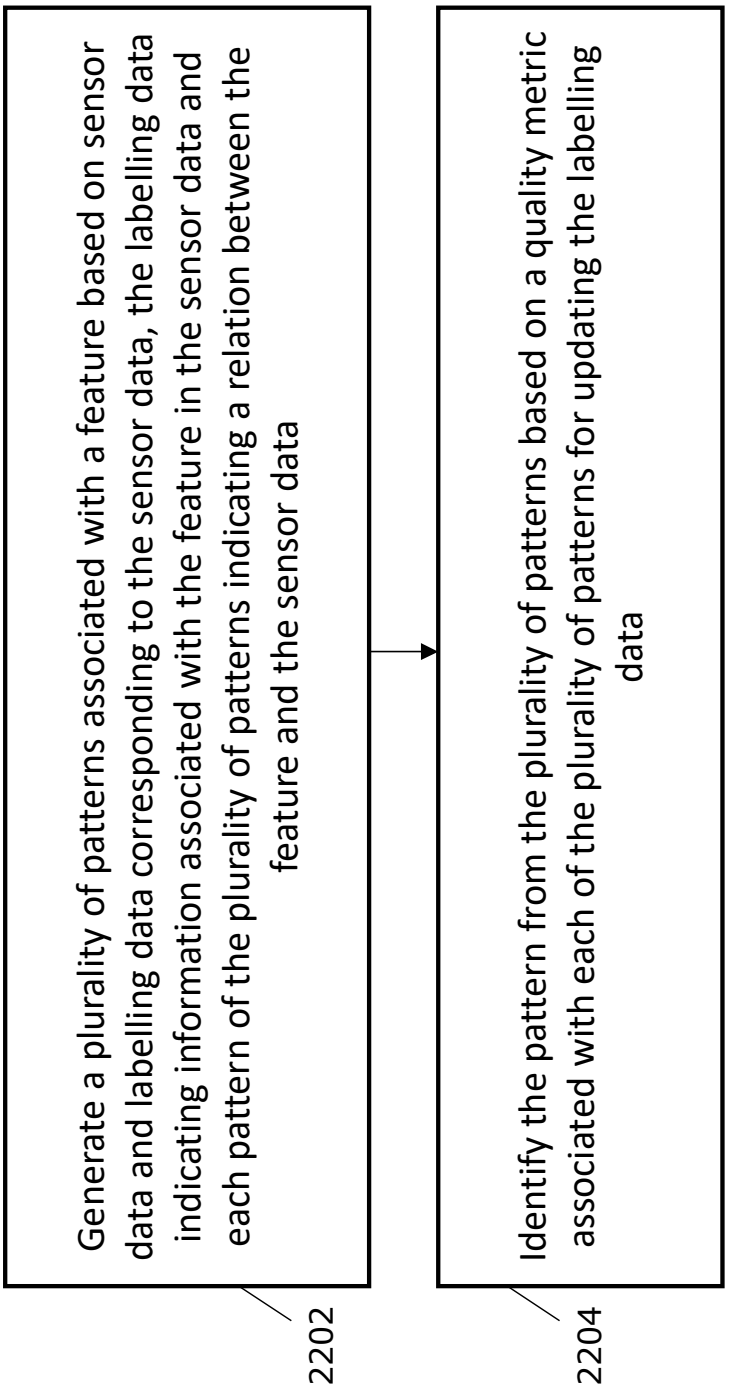

Generate a plurality of patterns associated with a feature based on sensor data and labelling data corresponding to the sensor data, the labelling data indicating information associated with the feature in the sensor data and each pattern of the plurality of patterns indicating a relation between the feature and the sensor data
2202
Identify the pattern from the plurality of patterns based on a quality metric associated with each of the plurality of patterns for updating the labelling data
2204
2200

Figure 22

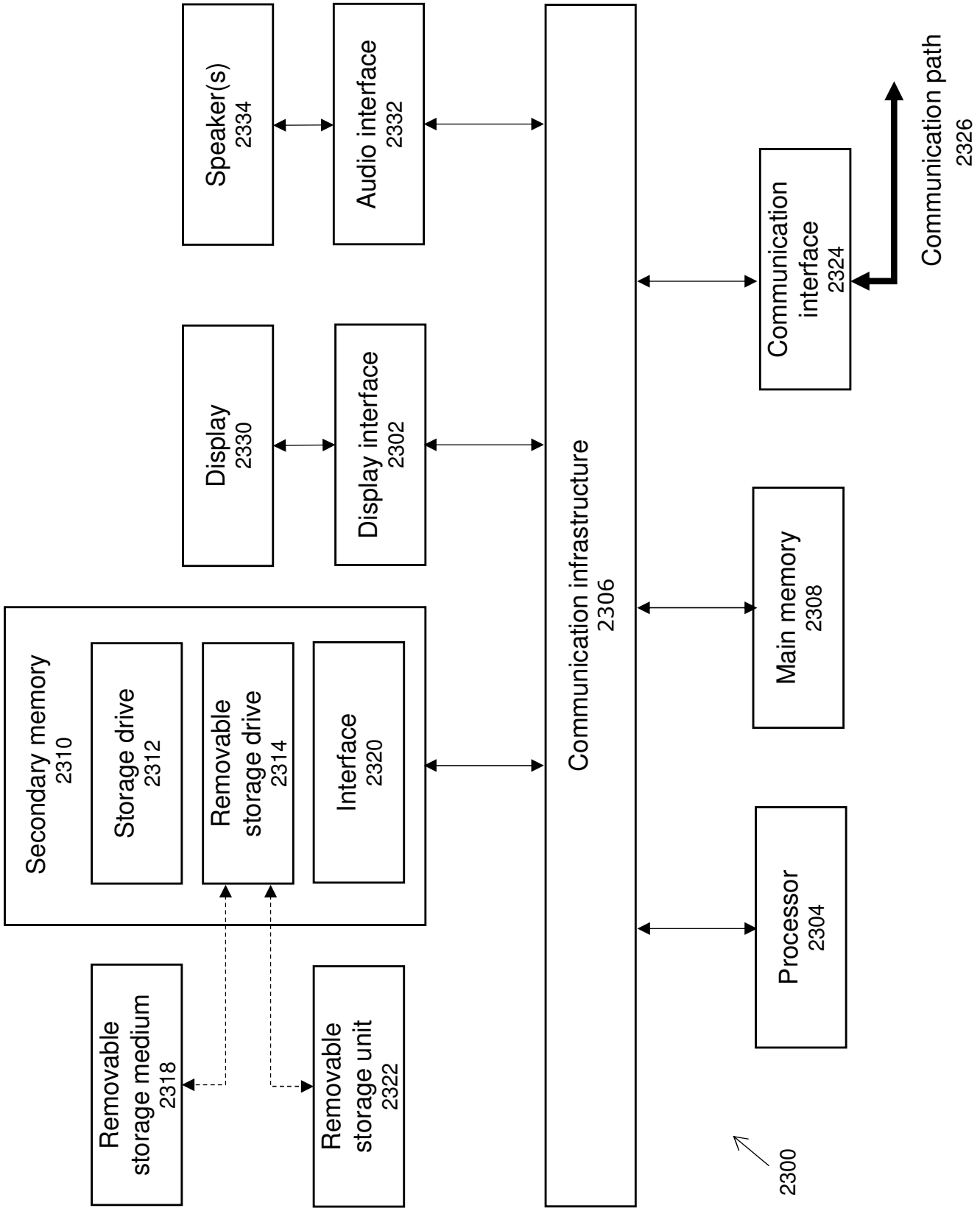

Speaker(s)
2334
Audio interface
2332
Display
2330
Display interface
2302
Secondary memory
2310
Storage drive
2312
Removable
storage drive
2314
Interface
2320
Communication infrastructure
2306
Main memory
2308
Communication
interface
2324
Communication path
2326
Removable
storage medium
2318
Removable
storage unit
2322
Processor
2304
2300

Figure 23