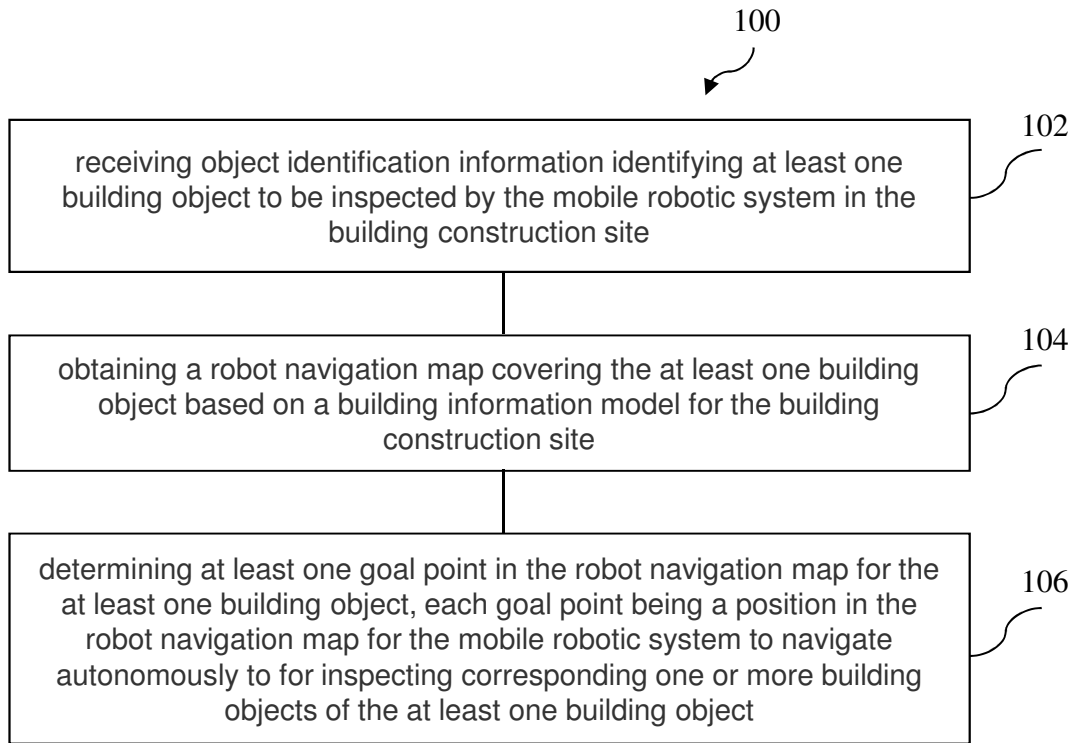
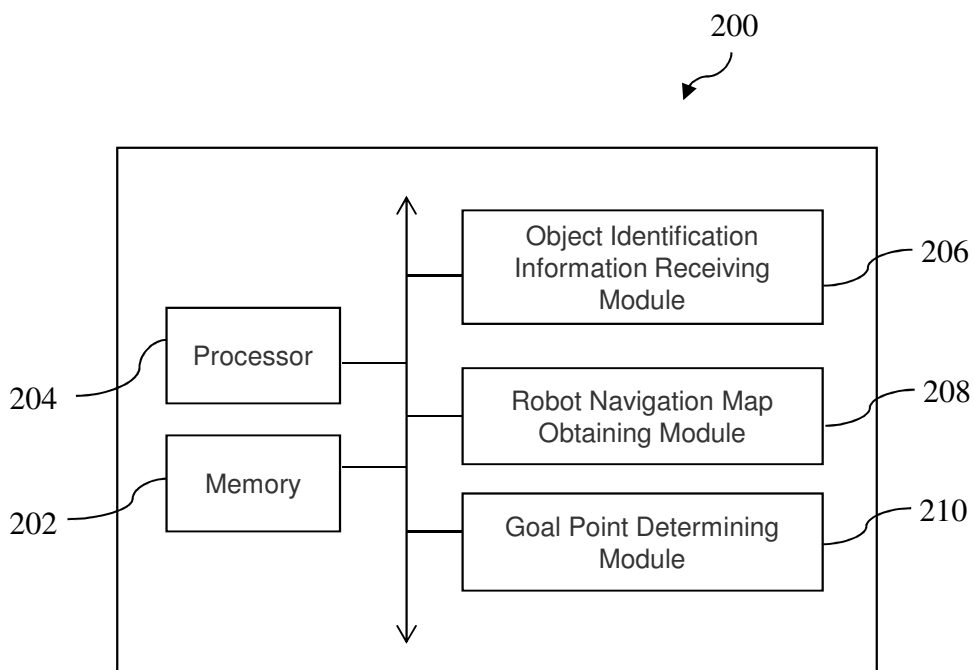


**FIG. 1****FIG. 2**

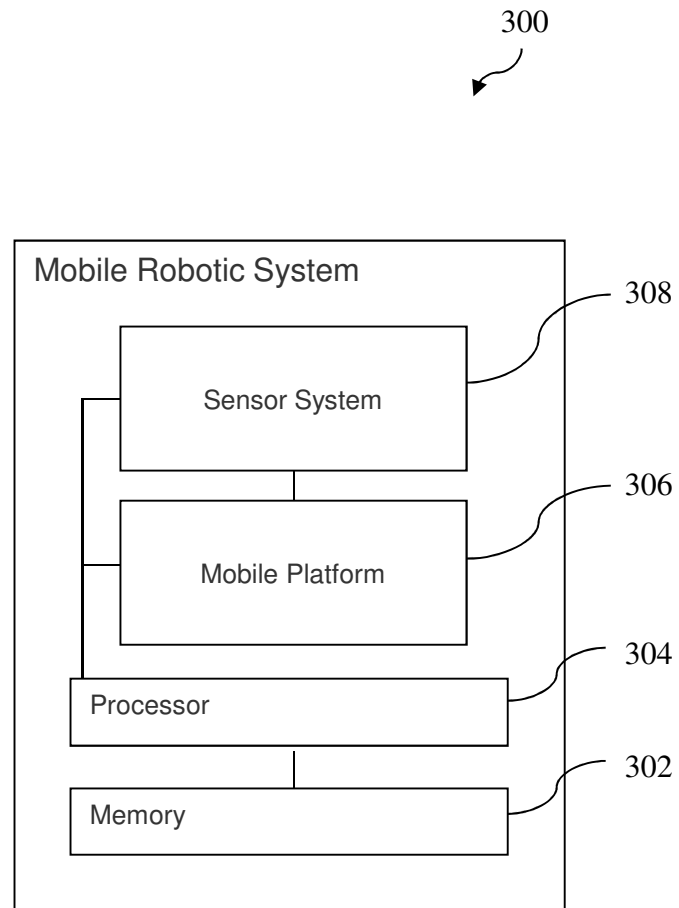


FIG. 3

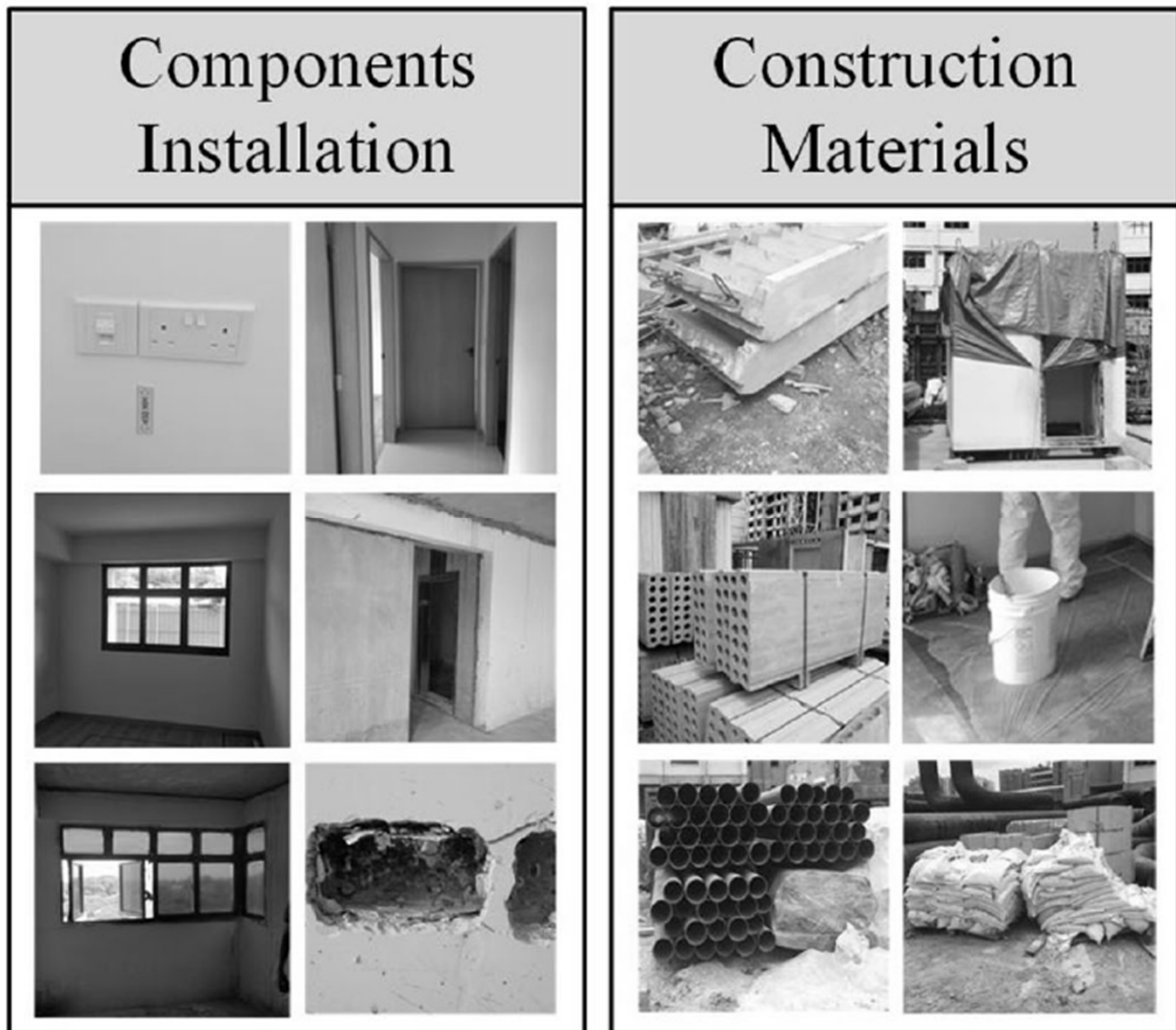


FIG. 4A

FIG. 4B

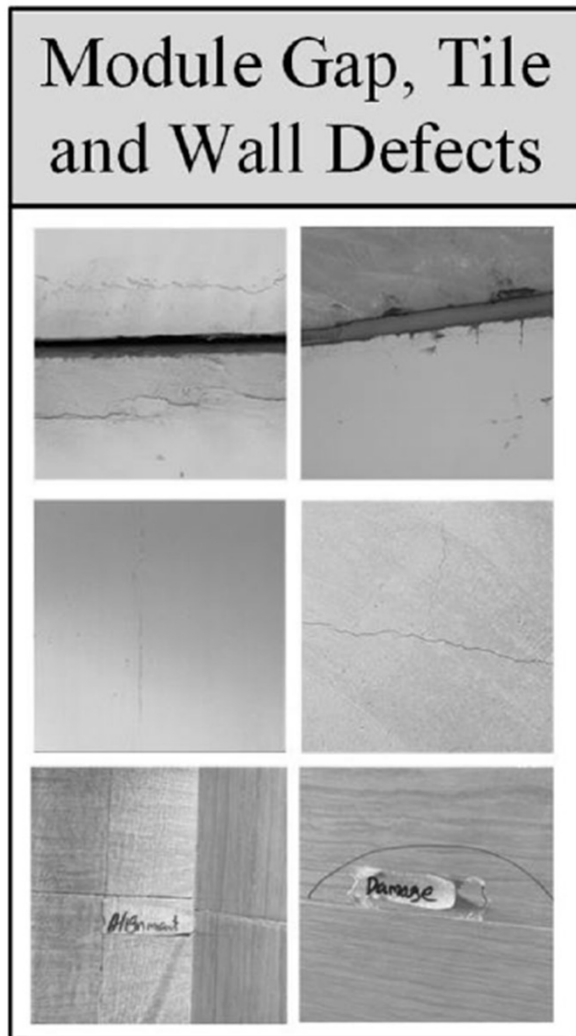


FIG. 4C



FIG. 4D

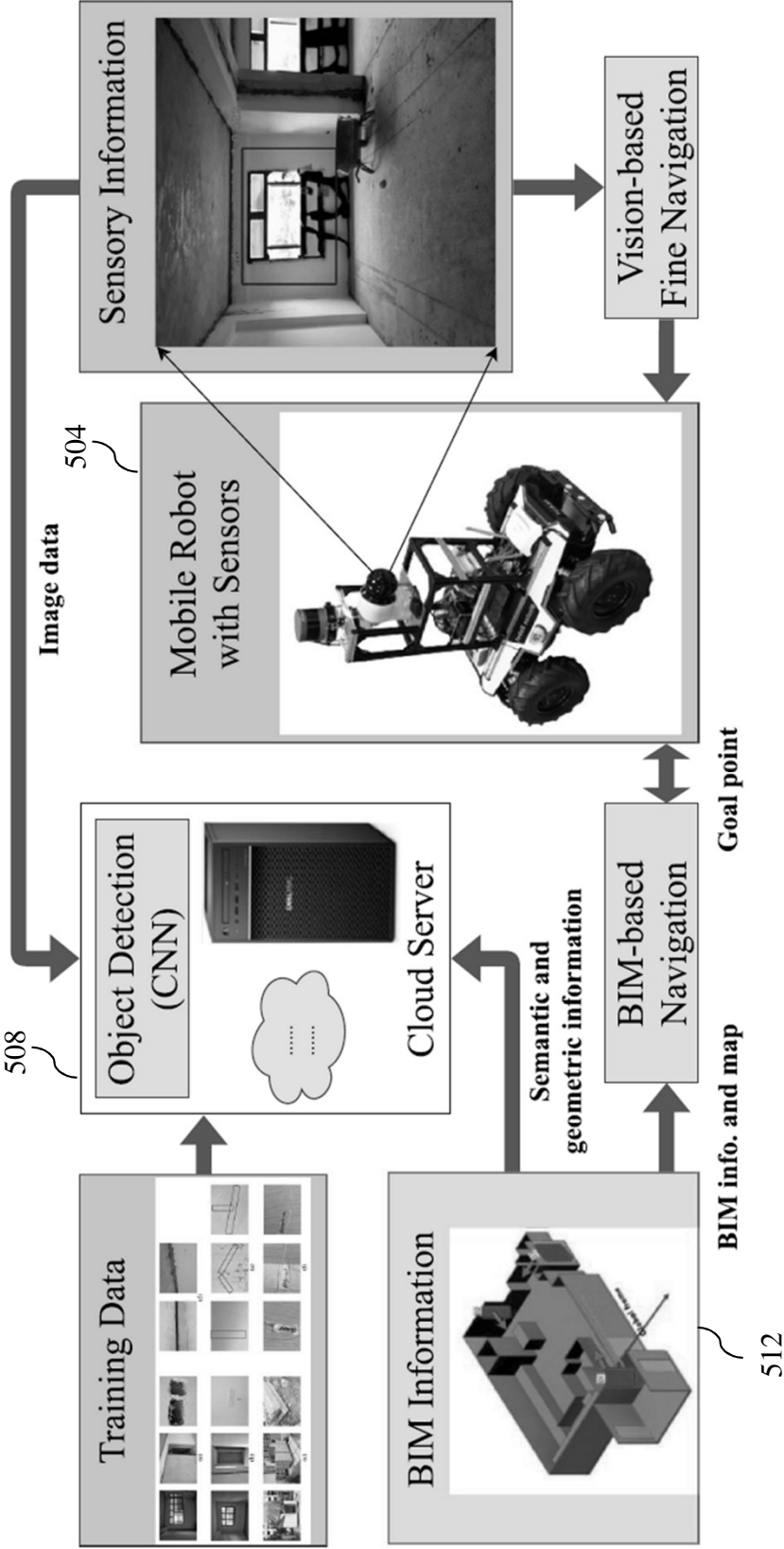


FIG. 5

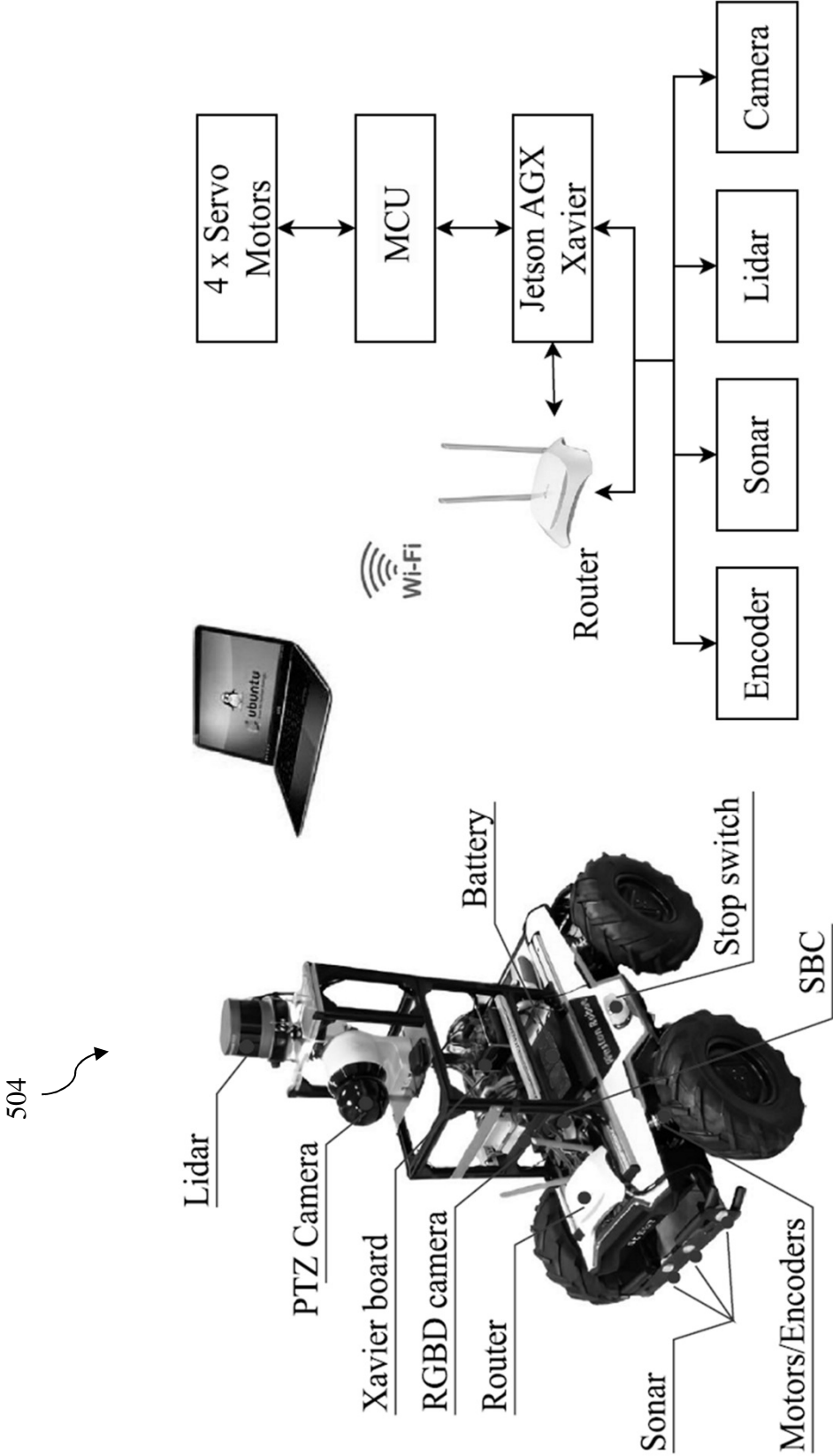


FIG. 6

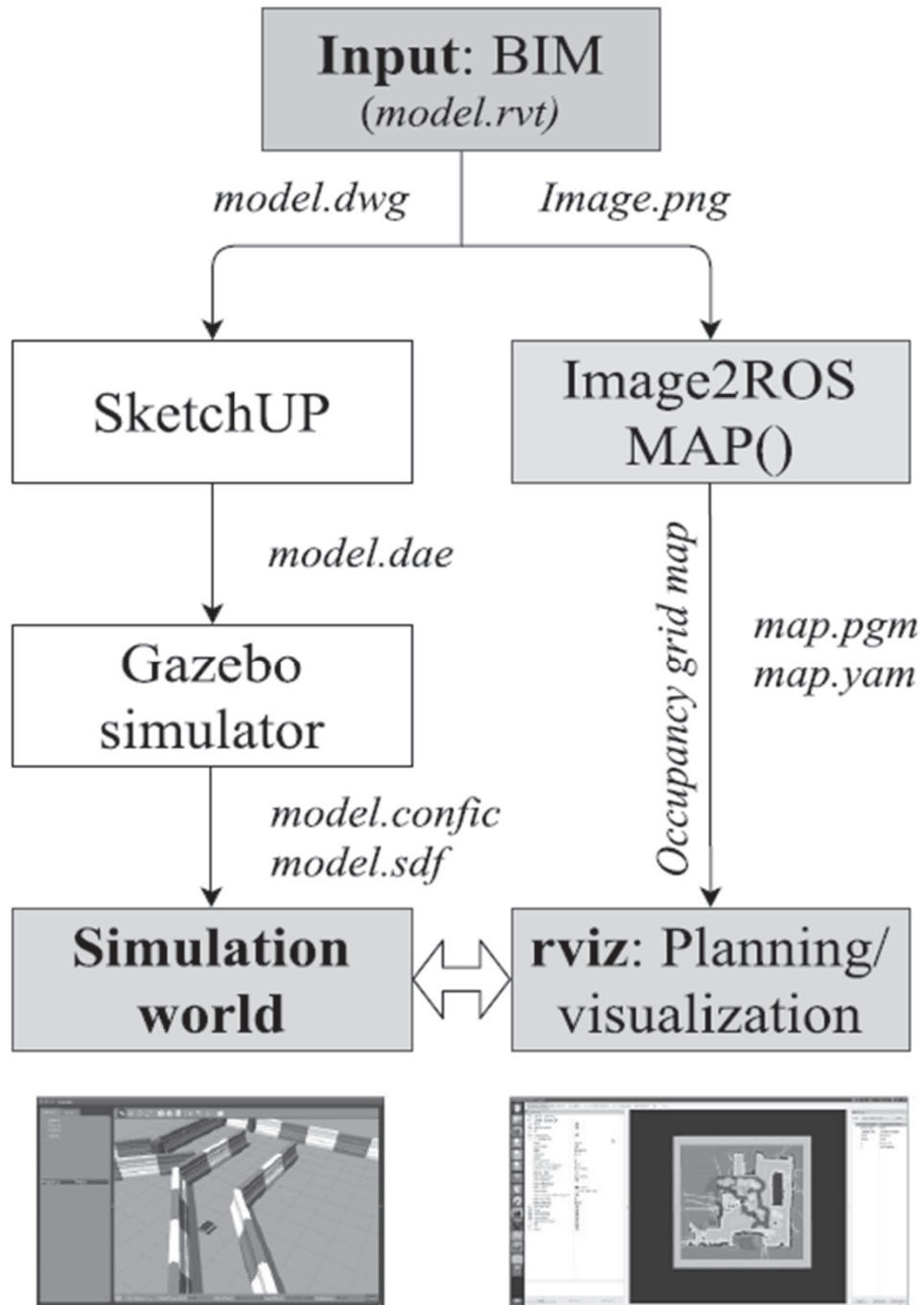


FIG. 7A

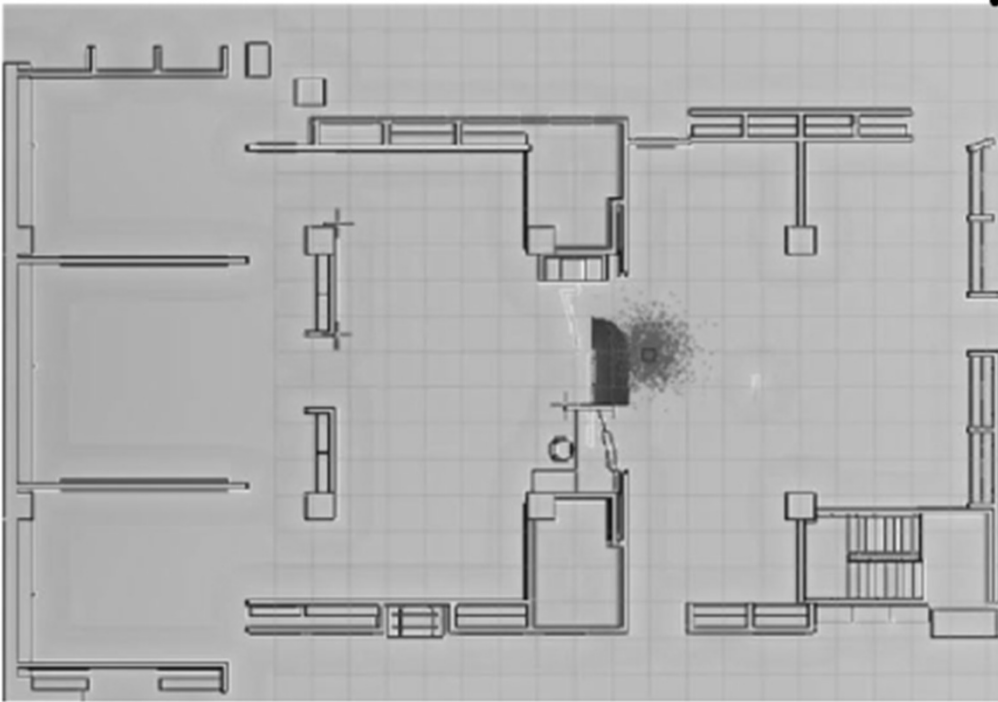


FIG. 7B

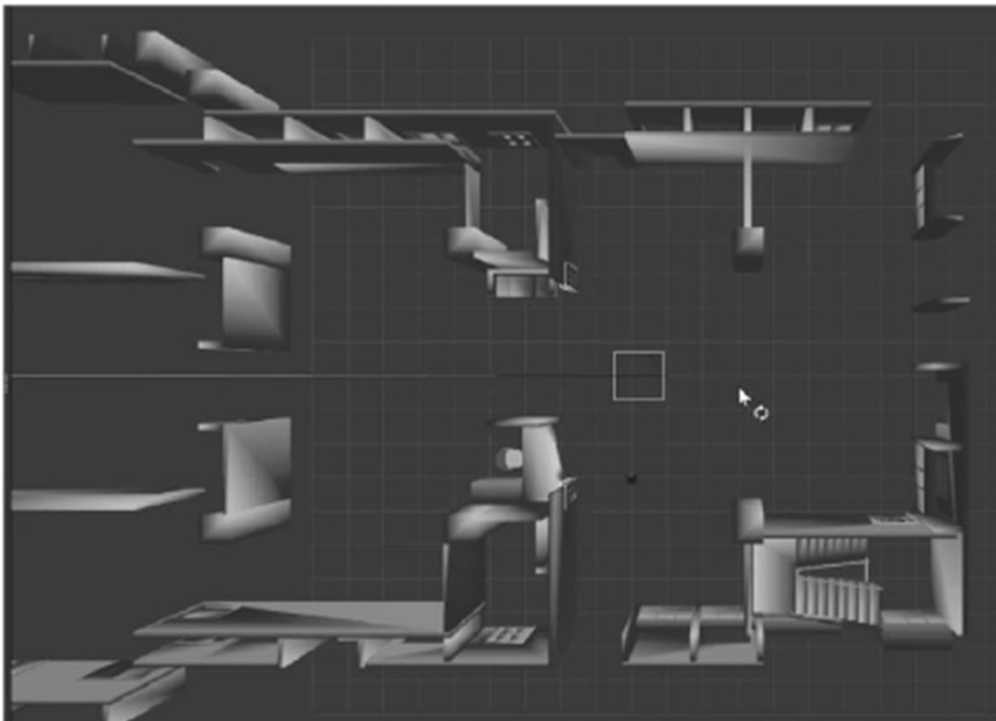


FIG. 7C

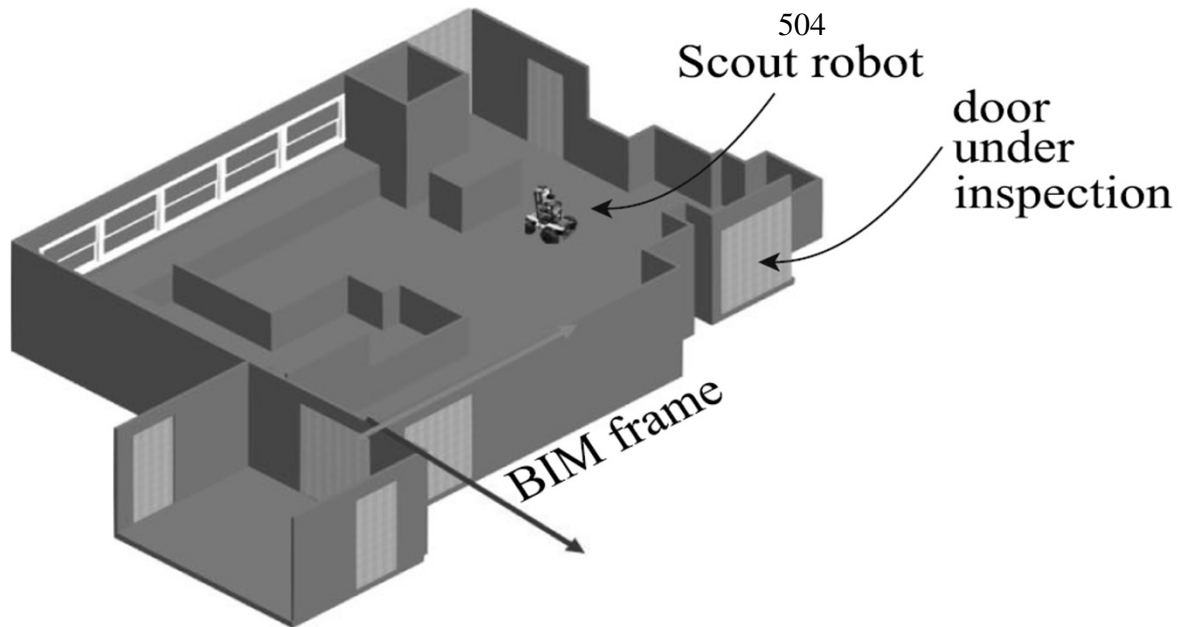


FIG. 8A

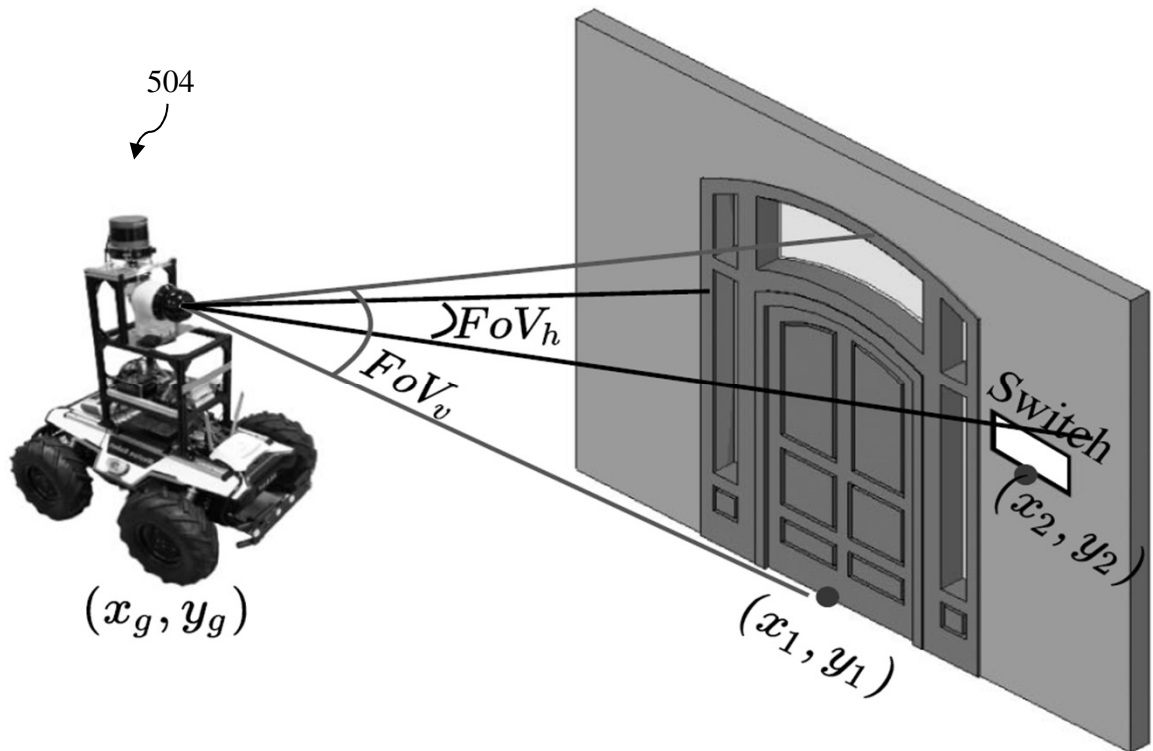


FIG. 8B

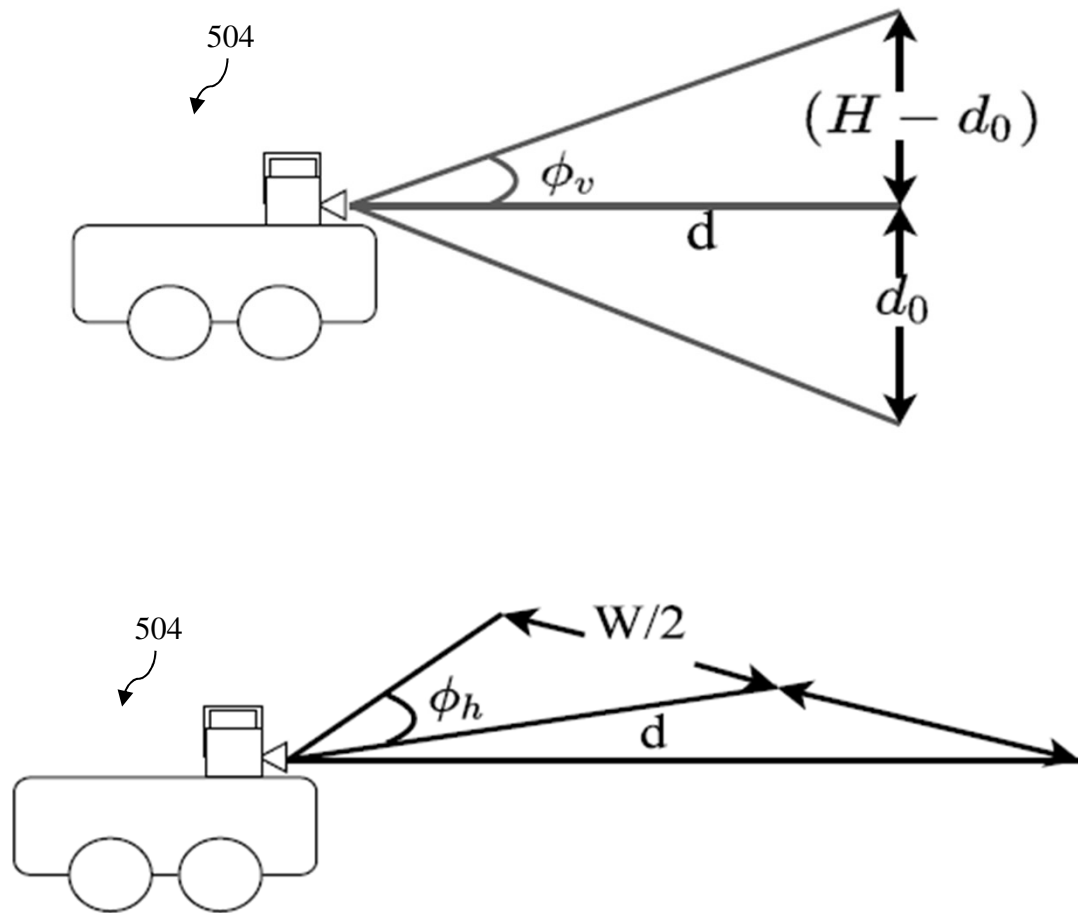


FIG. 8C

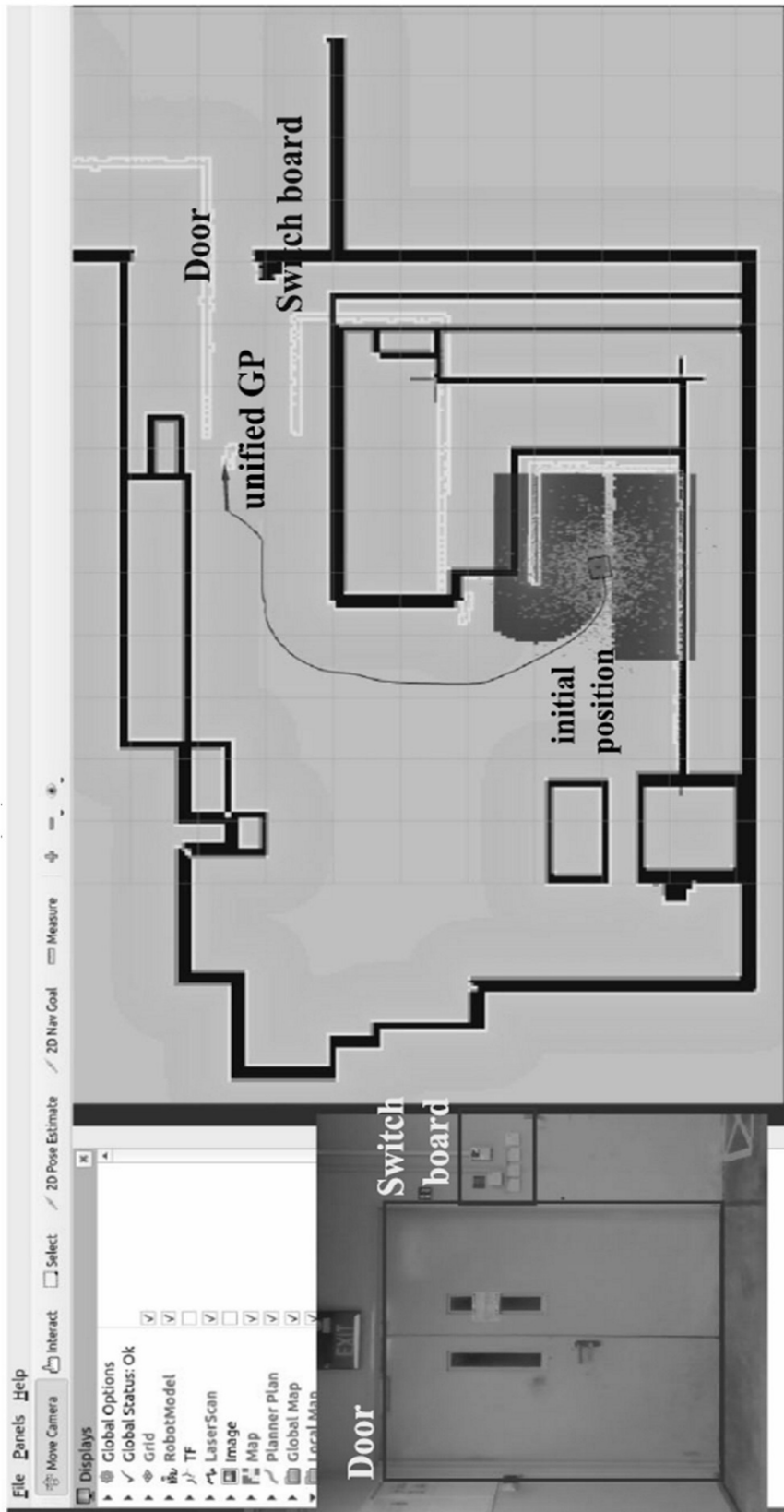


FIG. 8D

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FIG. 8E



FIG. 8F

Input:BIM information (Semantic and geometric info)

Output: $Flag_2$

```

1:  initialization;
2:   $Flag_1 = 0, Flag_2 = 0$ ;
3:   $N \leftarrow BIMchecklist$ ;
4:  while  $i \leq (N - 1)$  do
5:    Check distance ( $B$ ) between objects  $(x_i, y_i)$  and
       $(x_{i+1}, y_{i+1})$ , and corresponding surface angles,  $\alpha_i$  and
       $\alpha_{i+1}$ ;
6:    if  $H_{o_i} \leq 2d_o$  then
7:       $H_{o_i} = 2d_o$ 
8:    end
9:    if  $(B < T_r \text{ and } \alpha_i = \alpha_{i+1})$  then
10:   (2)–(5);
11:  else
12:    Exclude  $(i + 1)$ th object for GP calculation;
13:   (2)–(4);
14:  end
15:  ROS Move Base Package  $\leftarrow GoalPoint_i$ ;
16:  if  $(GP \text{ reached})$  then
17:     $Flag_1 = 1$ ;
18:    Send  $Flag_1 = 1$  to vision system to start detection
      task.
19:  end
20:  if  $(Check\ Flag_2 = 1)$  then
21:    if  $Flag_2 = 1$ , then choose next two objects in the BIM
      checklist for GP calculation.
22:  end
23: end

```

FIG. 9

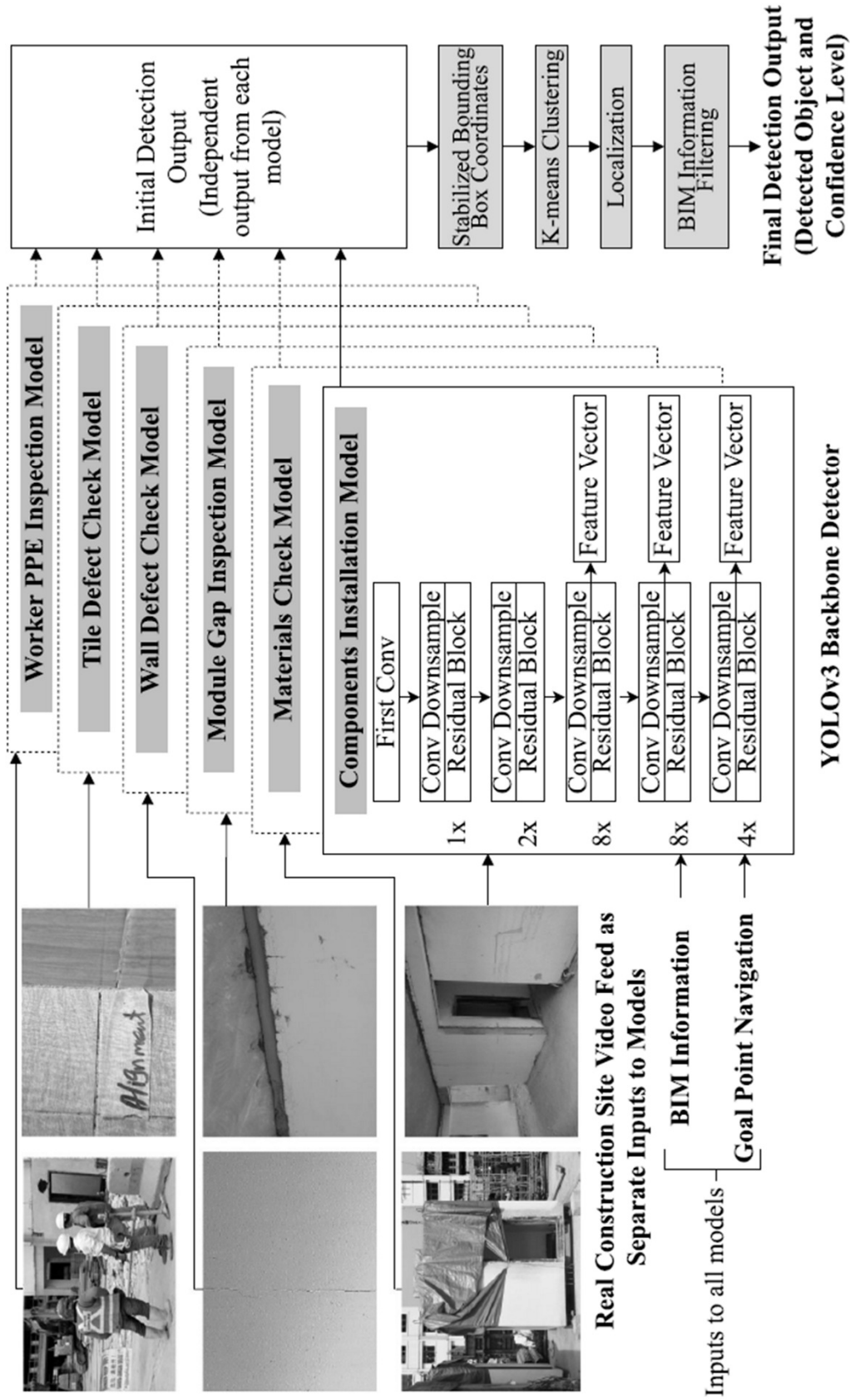


FIG. 10

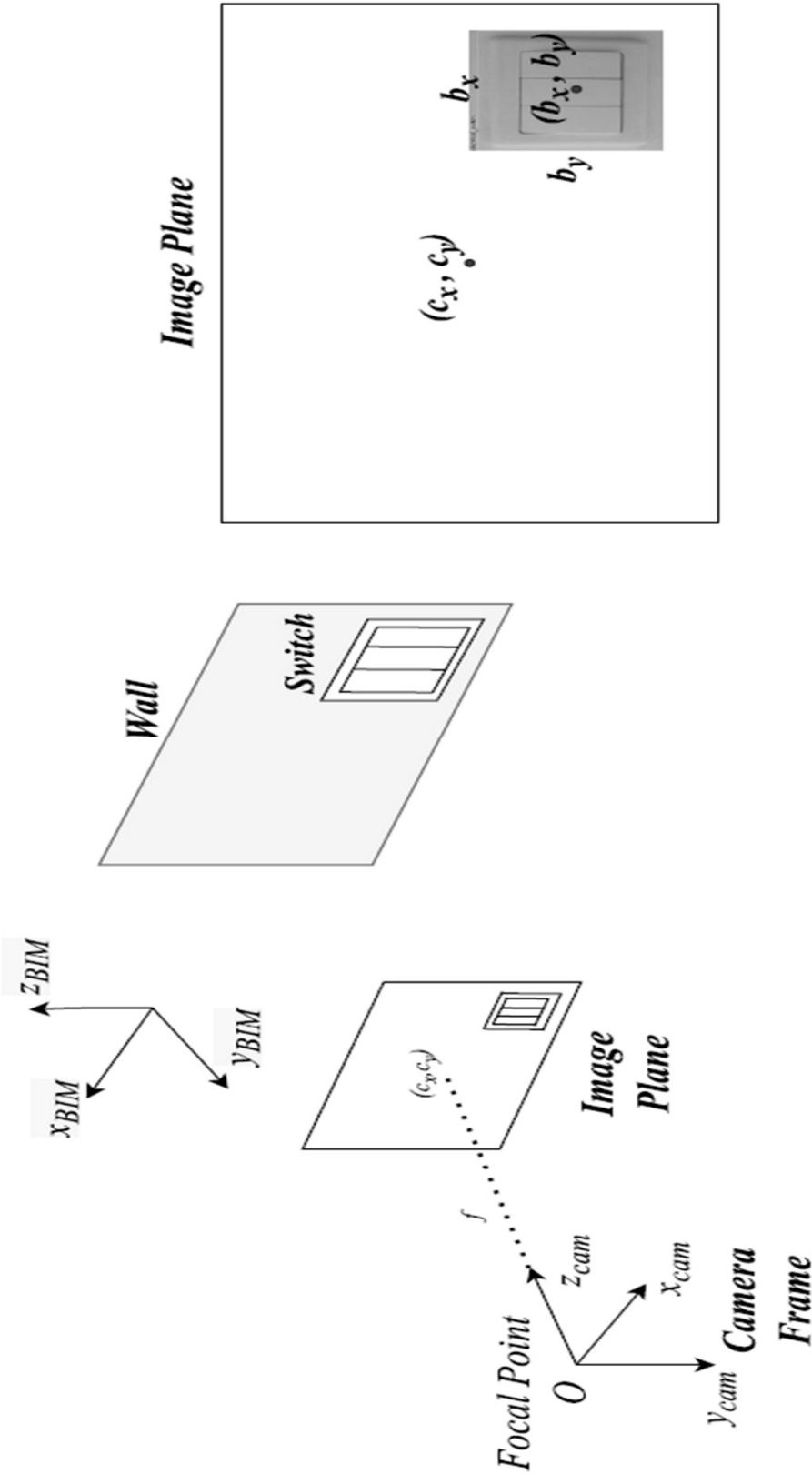


FIG. 11B

FIG. 11A

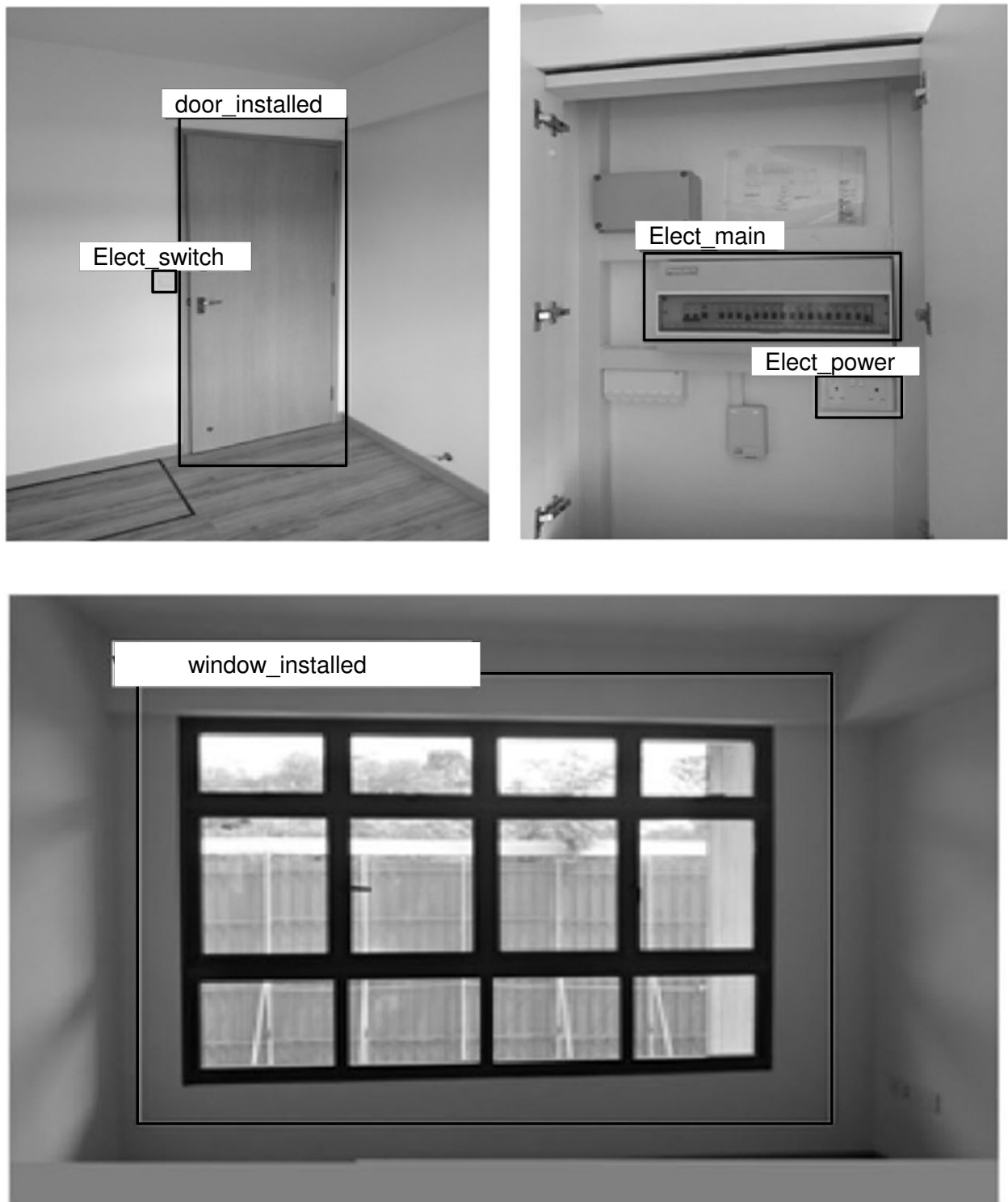


FIG. 12A

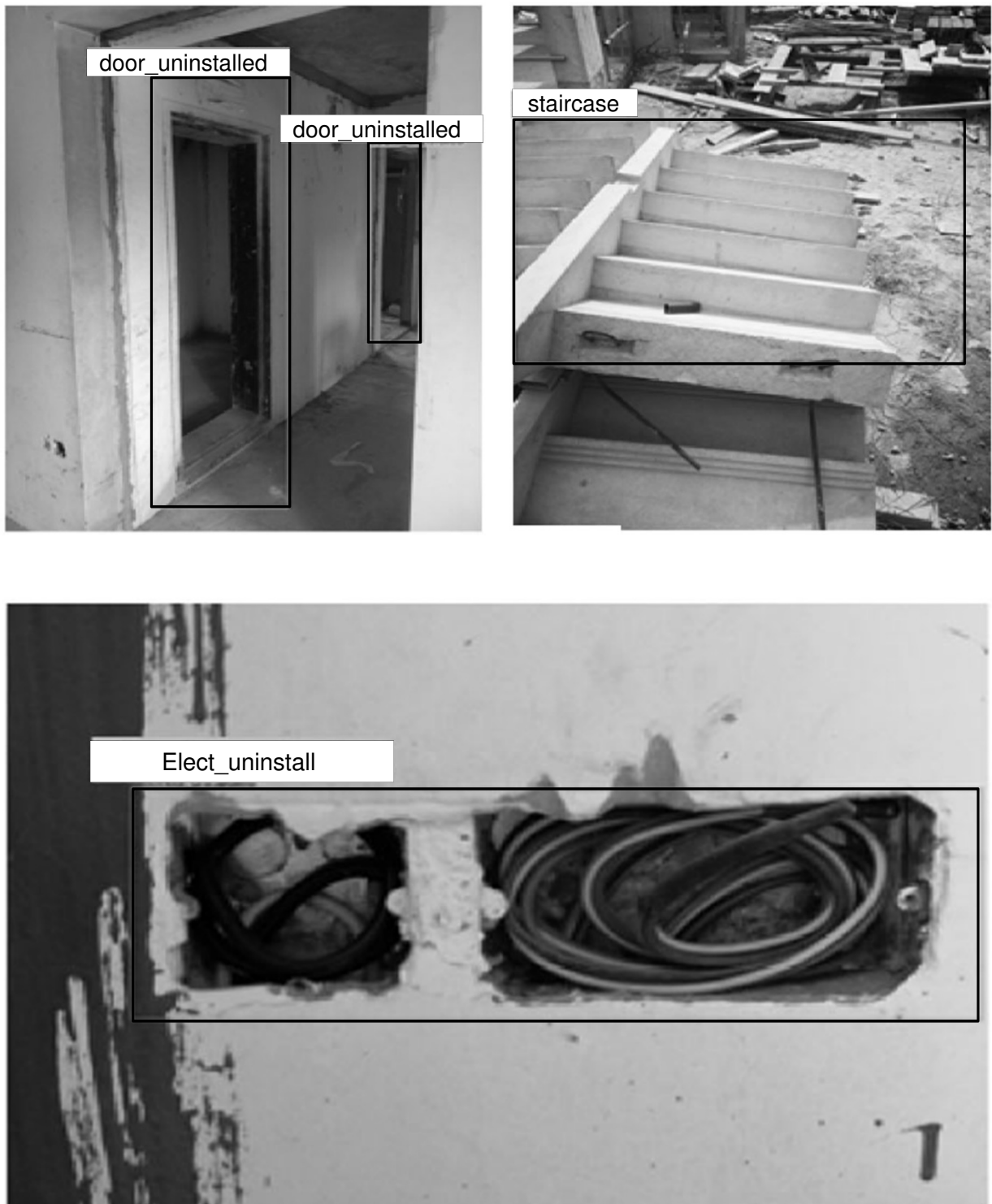


FIG. 12B

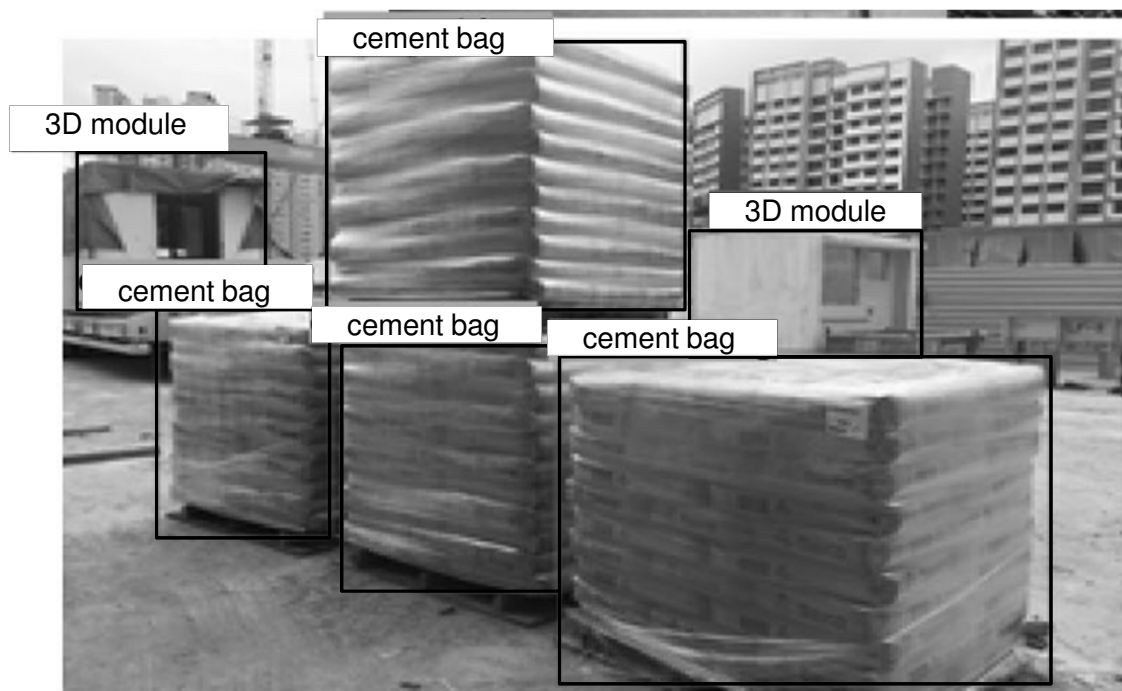


FIG. 12C

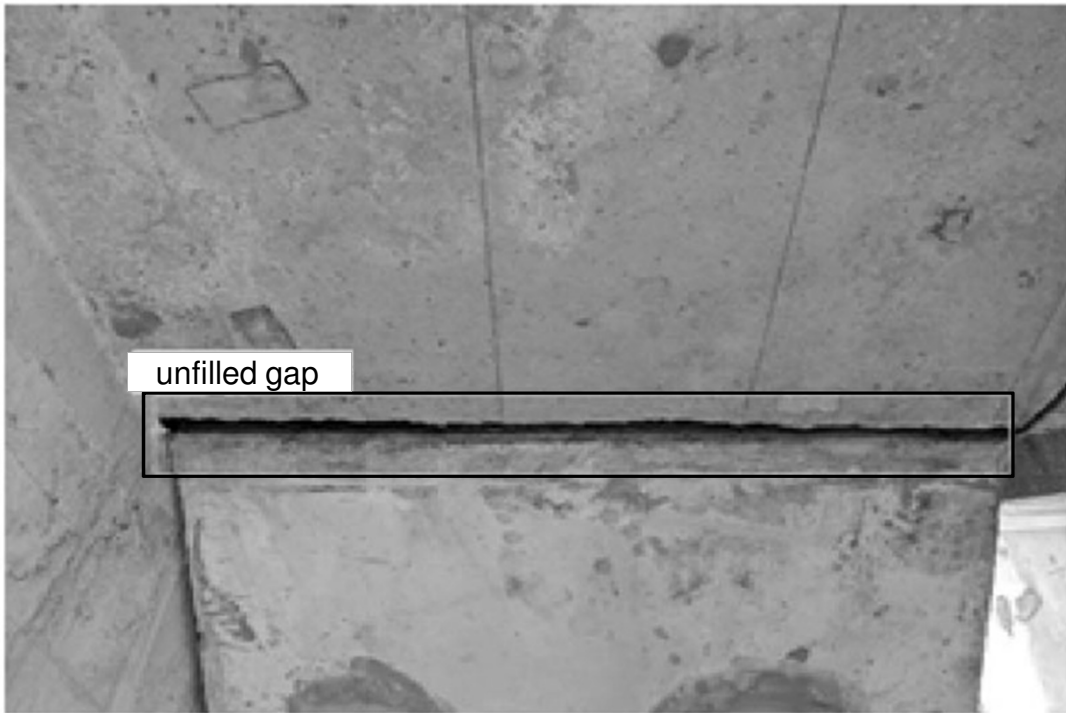


FIG. 13A

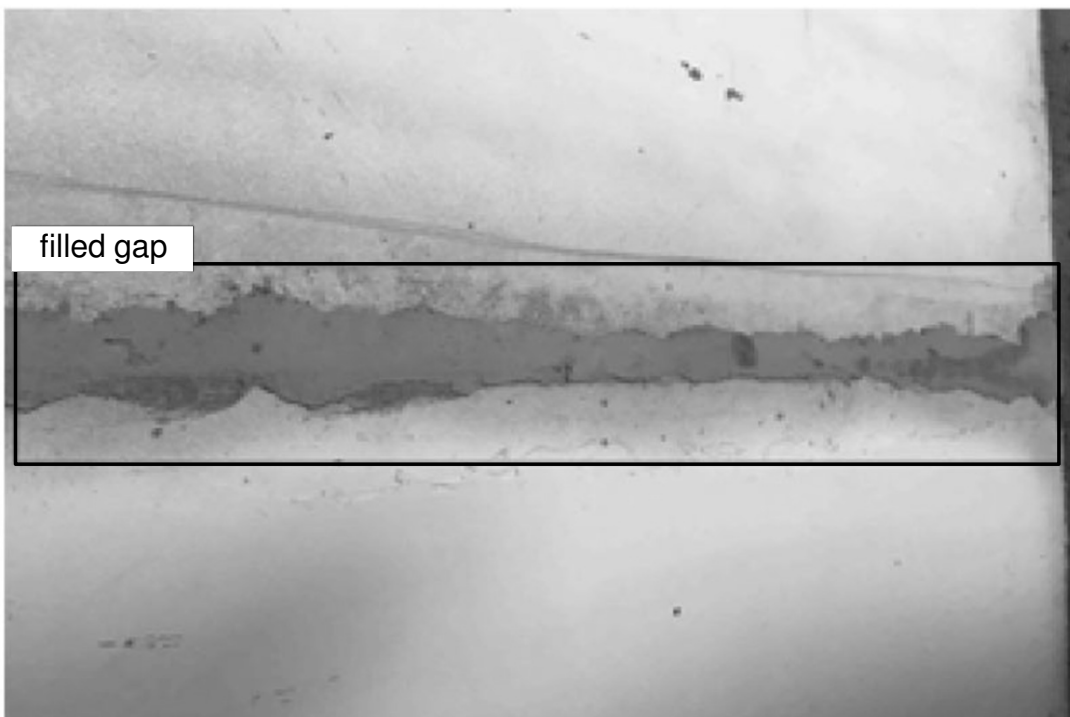


FIG. 13B

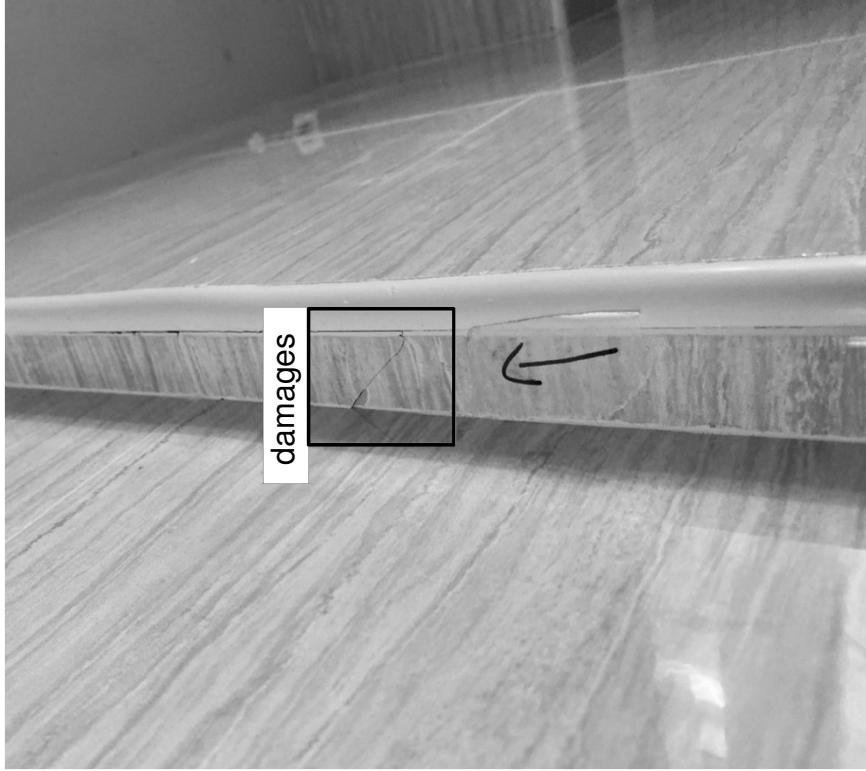


FIG. 13D

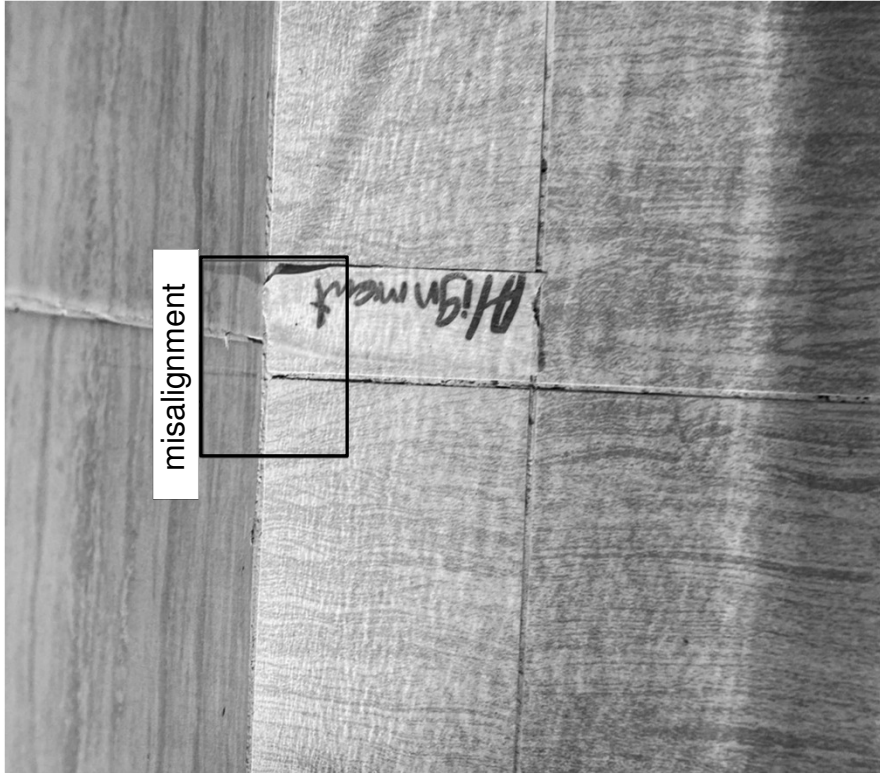


FIG. 13C

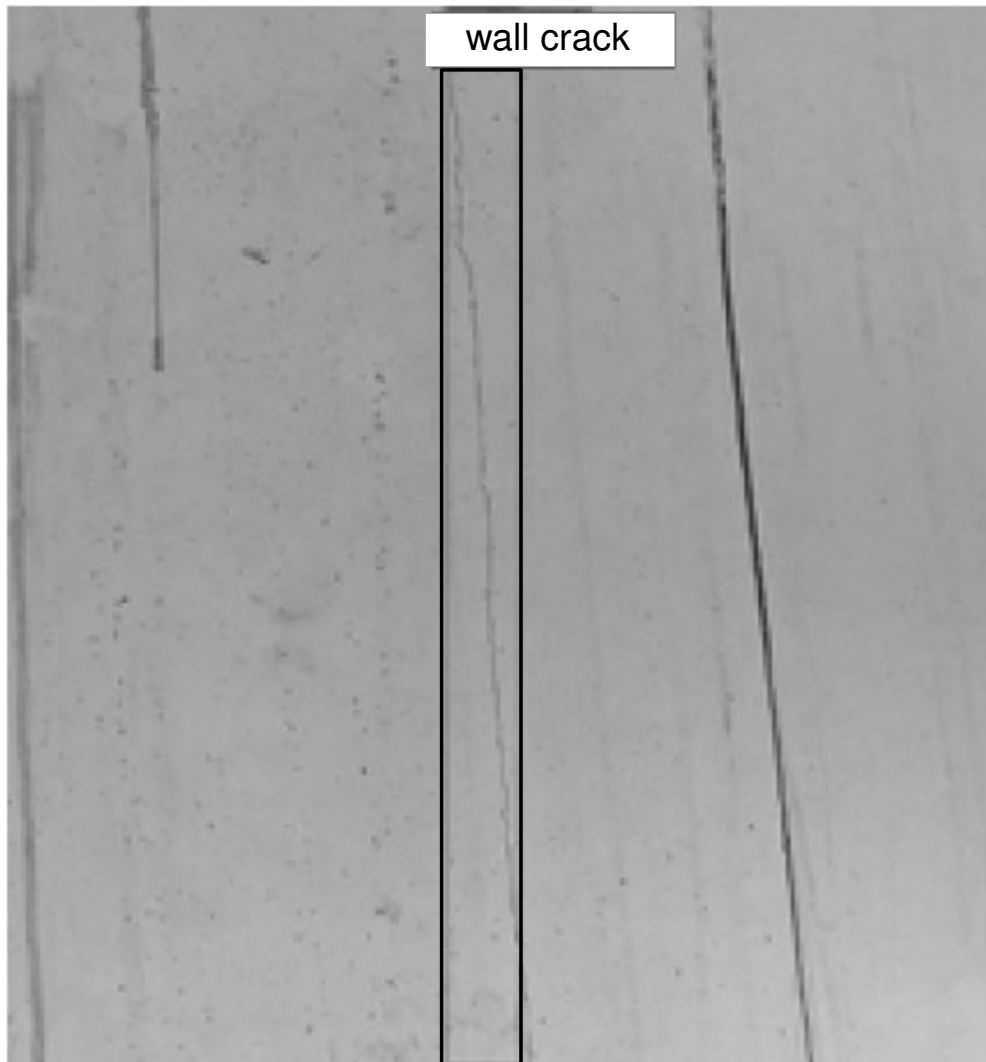


FIG. 13E

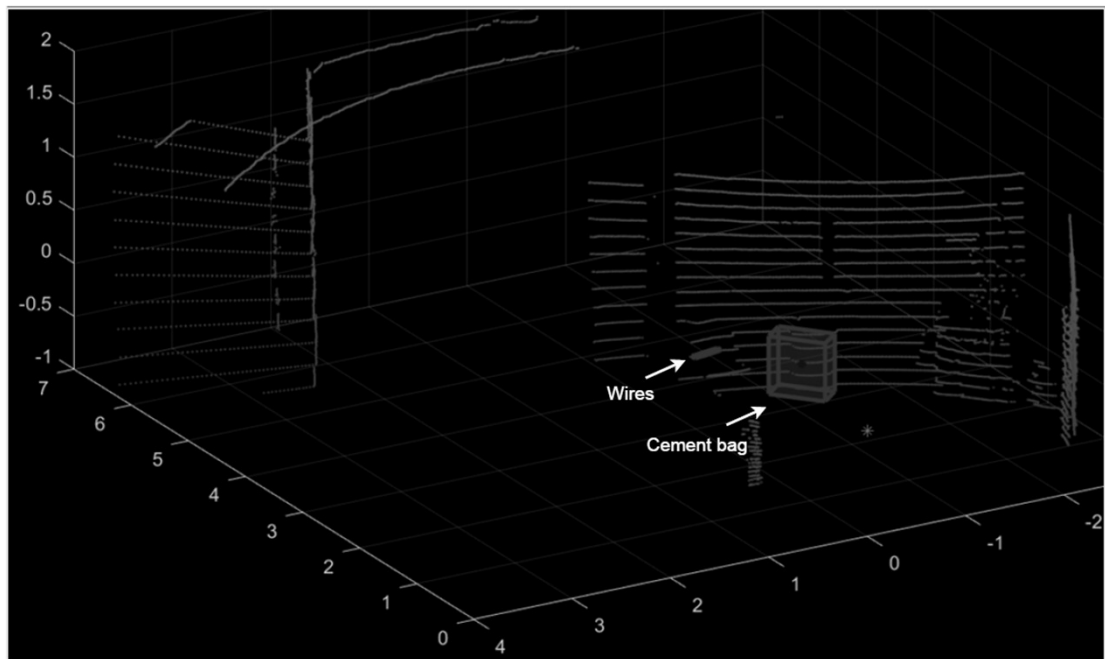


FIG. 14A

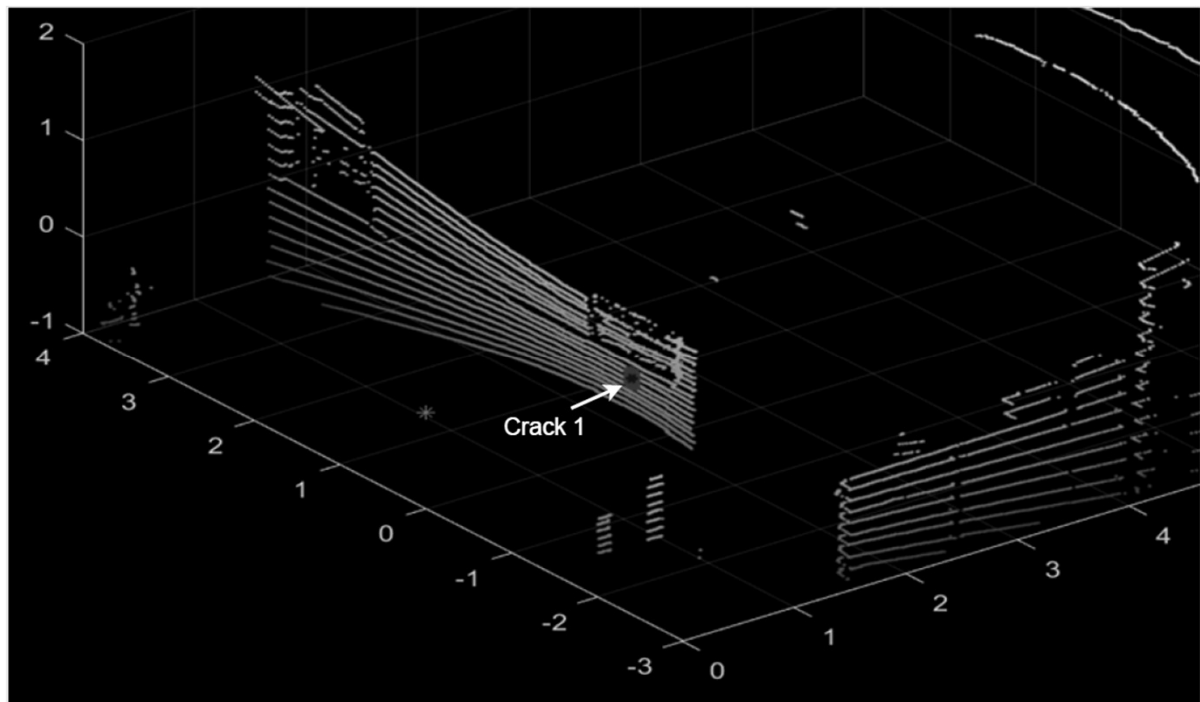
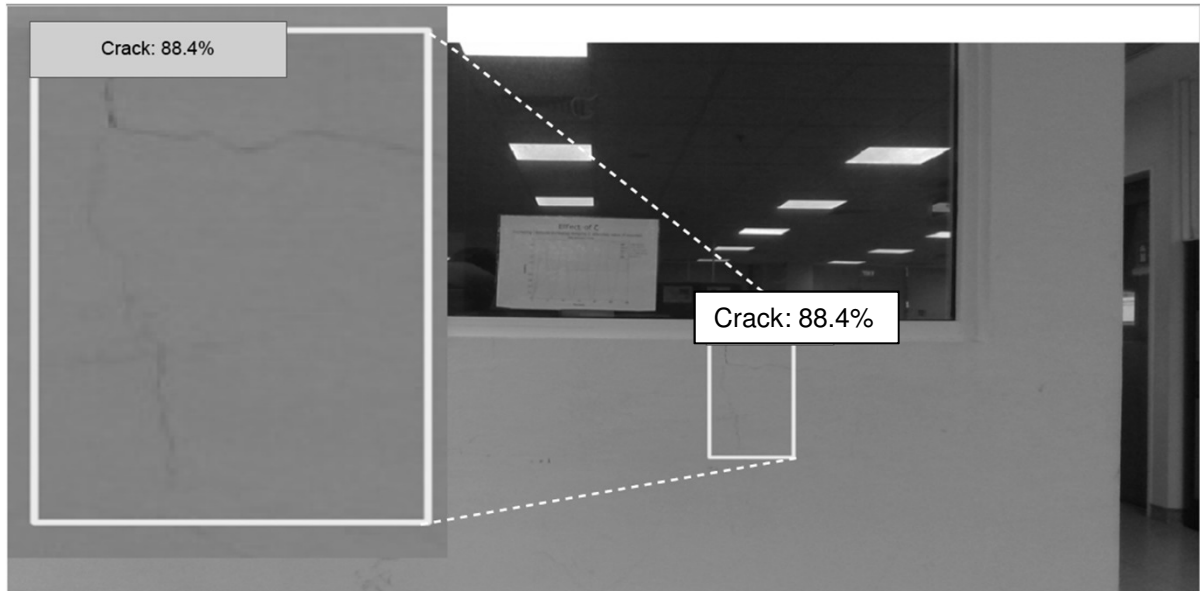


FIG. 14B

TABLE I
CONSTRUCTION MATERIAL AND WALL CRACK LOCALIZATION

Name	—	x (cm)	y (cm)	z (cm)	Date/Time
<i>Cement bag</i>	G.Truth	-305.0	-220	45	24.12.20
	RAOD	-307.3	-229.0	40.5	16 : 29 : 30
Error(cm)	—	2.3	9.0	4.5	Av.E=5.3
<i>Elect. wires</i>	G.Truth	-305.0	-305.0	60	24.12.20
	RAOD	-303.1	-312.9	54	16 : 29 : 30
Error(cm)	—	1.9	7.9	6	Av.E=5.2
<i>Crack1</i>	G.Truth	65	460	80	24.12.20
	RAOD	60.9	455.1	83.5	17 : 35 : 50
Error(cm)	—	4.1	4.9	3.5	Av.E=4.1
<i>Crack2</i>	G.Truth	155	460	80	24.12.20
	RAOD	159	458.3	84.1	17 : 55 : 10
Error(cm)	— —	4.0	1.7	4.1	Av.E=3.3

FIG. 15



FIG. 16A

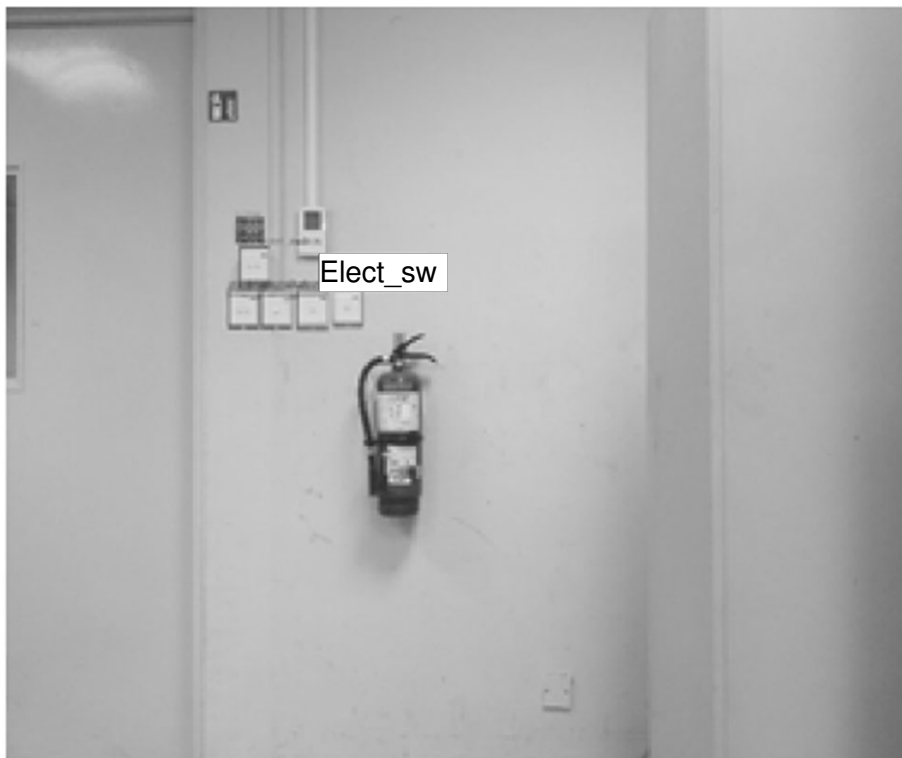


FIG. 16B

TABLE II
BIM INFORMATION-BASED FILTERING BY USING OBJECT LOCATION IN THE
BIM AND CALCULATING IOU TO FILTER OUT FALSE DETECTIONS

Objects in Checklist	-	Location (x, y, z (cm))			IoU	Status
Switch1	G.Truth	-200.25	0	142	0.53	Installed
	ROAD	-198.89	0	143.10		
Switch2	G.Truth	-196.25	0	130	0.55	Installed
	ROAD	-195.59	0	131.99		
Switch3	G.Truth	-206.75	0	130	0.56	Installed
	ROAD	-205.68	0	131.99		
Switch4	G.Truth	-218.25	0	130	0.60	Installed
	ROAD	-216.94	0	131.97		
Switch5	G.Truth	-228.75	0	130	0.62	Installed
	ROAD	-227.81	0	132.38		
Switch6	G.Truth	-	-	-	0	False Detection
	ROAD	-216.94	0	147.39		

FIG. 17



FIG. 18A

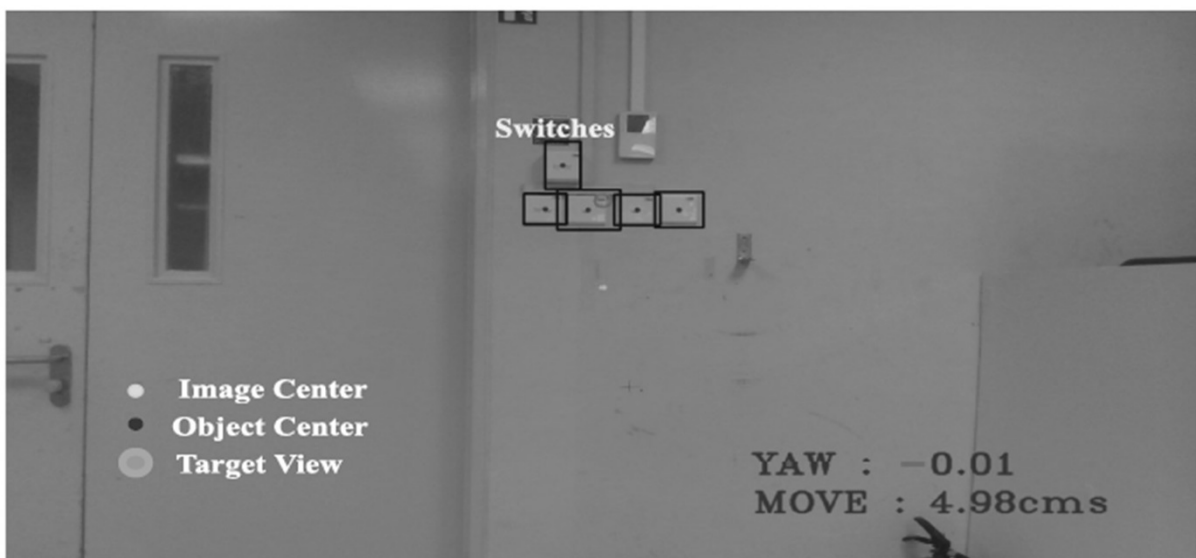


FIG. 18B



FIG. 19A

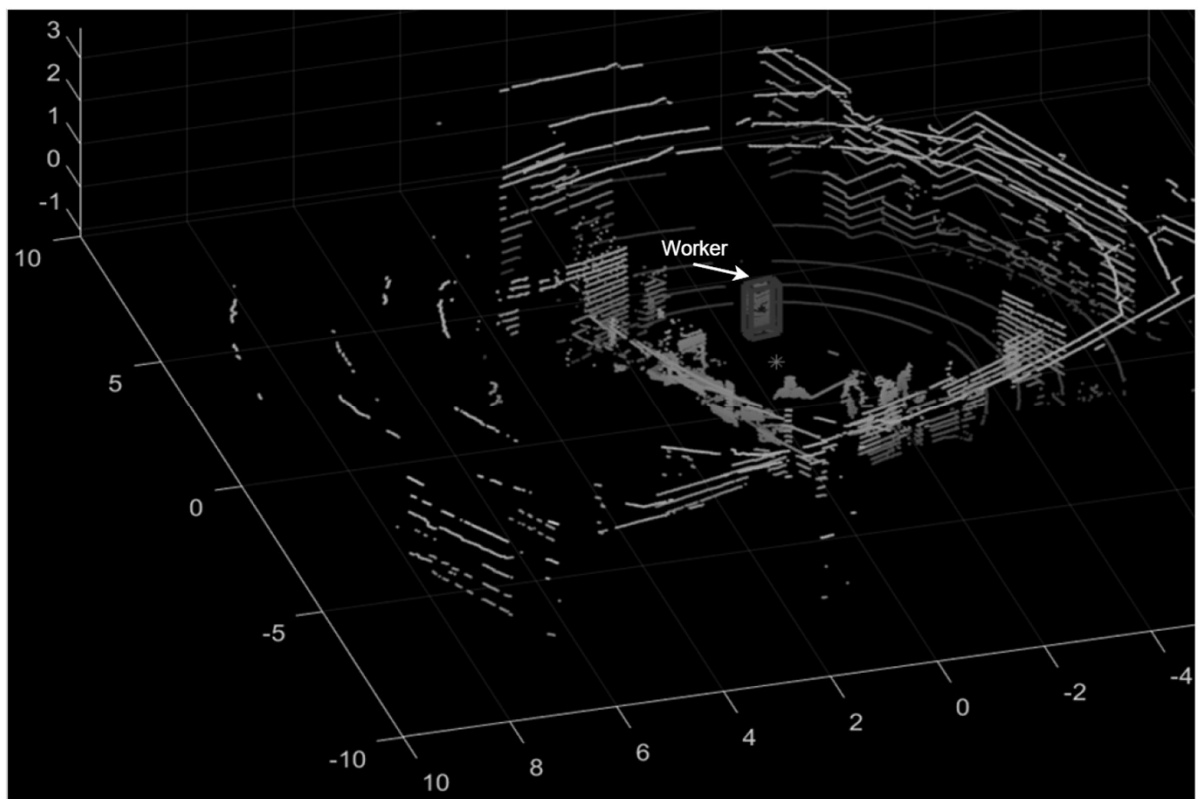


FIG. 19B

TABLE III
COMPARISON OF THE RAOD DETECTOR WITH CONVENTIONAL YOLOV3
FOR BUILDING COMPONENT DETECTION

Obj	Metric	YOLOv3				RAOD	
		Conf. (%)	F.D	Cov. (%)	M.D.	Conf. (%)	Cov. (%)
Main Door	Mean	72.6	7	28.2	0	98.9	48.8
	Std. Dev	21.2	-	19.4	-	2.8	5.4
Back Door	Mean	91.6	3	32.2	0	98.9	47.4
	Std. Dev	12.6	-	14.1	-	1.2	5.1
Switch Board	Mean	90.1	3	6.2	3	97.3	8.3
	Std. Dev	5.3	-	4.1	-	2.1	0.8

FIG. 20

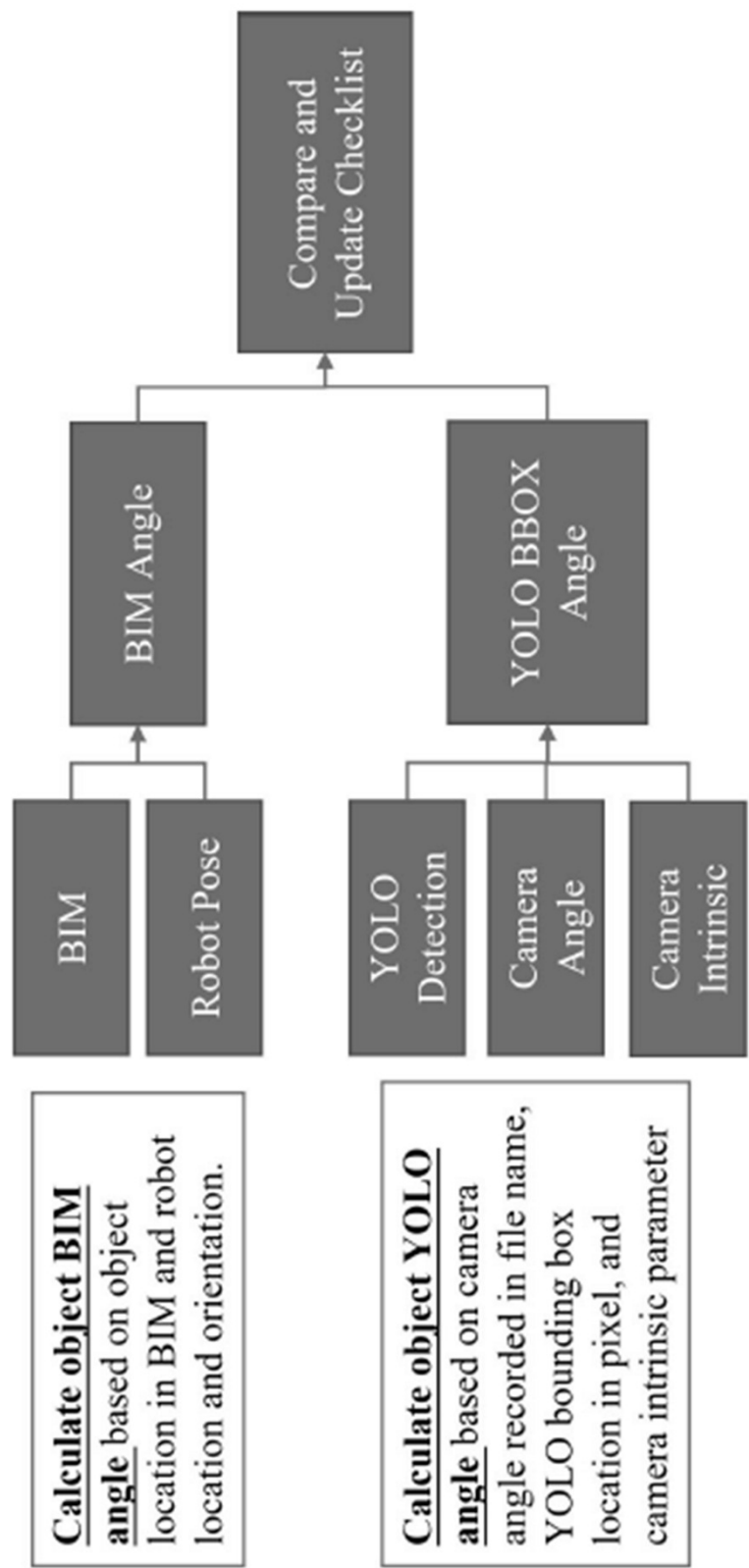


FIG. 21