## Henderson Panelboard Panelboard Extraction

Detecting the panelboard is going through three steps:

- 1. Panelboard detection
- 2. Template Matching
- 3. Information Extraction

Model can also detect some drawings or images similar to tables by detecting them as tables. Therefore, before trying to extract the information we should be sure that we are dealing with an image that contains a panelboard. For this reason we do an extra step where we check once again if the image contains a table while we are doing template matching. If the image contains a table and we have found the right template, then we can extract the information. This three step model has an accuracy of 90%.

## Panelboard Checking

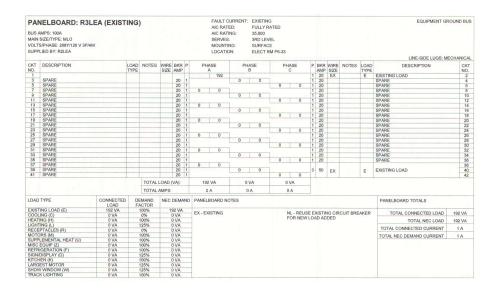
- There are three rules used for detecting if there is a table in image
  - The template matching score should be above 0.4
  - The header template should be positioned above end template

The threshold for the first rule was decided based on some experiments with a corpus that has images of drawings, unknown tables (tables that are not defined with template) and known tables (tables for which we have template to use for template matching). Based on this corpus, drawings have a score under 0.4 and unknown tables have a score under 0.5, while known tables have a score above it, with average 0.66. The above two rules give us an accuracy of 80% on checking if the image contains a table.

```
Average score for drwaings for hader 0.4
Average score for drwaings for footer 0.37
Average score for unknown tables for hader 0.49
Average score for unknown tables forfooter 0.48
Average score for tables for hader 0.68
Average score for tables for footer 0.63
```

	Header Score	Footer Score	Image Name	Image Layout	Template Layout	ls Table	Header Distance	Header Position	Footer Distance	Footer Position
8	0.336998	0.539122	layout5_23- cropped.png	5	5	False	15	0	30	1
40	0.295547	0.473847	layout5_20- cropped.png	5	5	False	120	0	15	1
70	0.553338	0.538887	layout3_15- cropped.png	3	4	False	72	0	97	1
83	0.336543	0.486283	layout5_21- cropped.png	5	5	False	15	0	30	0
94	0.552811	0.533906	layout3_13- cropped.png	3	4	False	67	0	67	1

Table1. Information about images that are detected wrong.



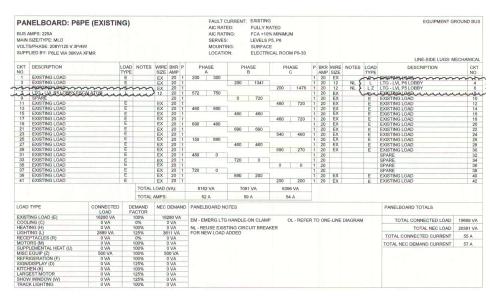


Fig.1 Example images detected as drawing.

Three of the images are detected wrong because of a very low score, while the other two are because of template position within the panelboard.

## **Template Matching**

All layouts perform well in total we have an accuracy of 96%. The only low performing layout is the layout 3, which has an accuracy of 85%. It is interesting that these layouts match always with the same template, which is template 4. While the matching score of these panelbords are around 0.55.

DESCRIPTION	IRE BRKR PL	KVA A	KVA B	KVA C	PL BRKR WIRE	DESCRIPTION	
	TOTAL	22.40	24.05	18.67	KVA		

Fig.2 Template 4 from layout 4 a) header, b) bottom.

BI M. V(	PANELBOARD: FS1N-2NW7  JUS AMPS: 100A  JAIN SIZE/TYPE: MLO  JOINTS/PHASE: 208Y/120V, 3PH, 4W  JECTION: 1				AIC R SERV MOUN		: ONC RE	CES	A +10% SION/I SSED	6 MINII PANTR		LY RATED		EQUIPMENT GROUN	D BUS
1 -	DESCRIPTION NO.	VOLT	AMPS/PI B	HASE C	WIRE NO.	BKR AMP	Р	Р	BKR AMP	WIRE NO.	VOL.	FAMPS/PH B	ASE C	DESCRIPTION	CKT NO.
⊨	1 PWR-5012 1.	.269			8	40	2	1	20	12	360			RCPT-5027 (2) A	2
J	*	$\overline{}$	1260	8	L			1	20	12		780		RCPT-5025 A	4
٠	5 SPARE	$\neg$		$\overline{}$	דכו	20	1	1	20	12			540	RCPT-5027 (3) B	6
┖	7. SPARE				17	20	1	1	20	12	780			RCPT-5025 B	8
_	ZASPARE	$\sim$	$\sim$	$\overline{}$		20	1	1	20	12		1,800		RCPT-5042 (2) A	10
	11 RCPT-5006			1,092	12	20	1	1	20	12			1,800	RCPT-5042 (2) B	12
1	13 RCPT-5003 (2) 1,	,920			12	20	1	1	20	12	360			RCPT - 02.27E.02 GEN	14
1	15 RCPT-5004		180		12	20	1	1	20	$\neg$				SPARE	16
1	17 RCPT-5046 A			1,400	12	20	1	1	20					SPARE	18
1	19 RCPT-5046 C 1,	,400			12	20	1	1	20					SPARE	20
7	21 RCPT-5046 A		1,400		12	20	1	1	20	$\Box$				SPARE	22
-4	23 EQUIPPED SPACE						1	1	20					SPARE	24
7	25 EQUIPPED SPACE						1	1						EQUIPPED SPACE	26
7	27 EQUIPPED SPACE						1	1						EQUIPPED SPACE	28
ľ	29 EQUIPPED SPACE						1	1						EQUIPPED SPACE	30
	SUBTOTAL 4	,589	2,849	2,492	1						1,500	2,580	2,340	SUBTOTAL	
Г	TOTAL PHASE A - VA 6,089 LO	AD		CONN. V	Ά	DF		LO	AD		C	ONN. VA	DF		
г	AMPS 51 CO	OLING				1.00		RE	FRIG	$\neg$			1.00	1	
	TOTAL PHASE B - VA 5,429 HE	ATING				0		SIG	N/DIS	P			1.25	1	
Г	AMPS 45 LIG	HTING	i			1.25		KIT	CHEN			5,190	0.80	1	
г	TOTAL PHASE C - VA 4,832 RE	CEPTA	CLES	9,060		1.0/.5		EXI	STING	;			1.00	1	
	AMPS 40 MO	TORS				1.00		LR	G MOT	OR			1.25	TOTAL DEMAND	
Г	TOTAL PNLBD - VA 16,350 SUI	PP HE	AT			1.00		SH	OW W	NDW			1.25	15,312 V	A
Г	AMPS 45 MIS	SC EQI	JIP	2,100		1.00		LTO	3 TRA	CK			1.00	43	A
P	ANELBOARD NOTES														

BUS MAIN VOLT	NELBOARD: FS1N-6NW AMPS: 1000A SIZE/TYPE: 1000A MCB 'S/PHASE: 208Y/120V, 3PH, 4W IION: 1	/1			AIC R SERV MOUN		: W F : SU	OO JRF	D POF ACE	% MINI RTABLE	MUM FUL	TX-FSN-6 LY RATED		EQUIPMENT GROUND BUS	
CKT NO.	DESCRIPTION	VOL'	TAMPS/PI B	HASE C	WIRE NO.	BKR AMP	Р	Р	BKR AMP	WIRE NO.	VOL A	TAMPS/PI B	IASE C	DESCRIPTION	CK
	6NW F&B CART SPONSORED CONCOURSE A	5,764	5,764	5.764	6	60	3	3	30	10	2,882	2,882	2.882	6NW F&B CART SPONSORED CONCOURSE H	4 6
	6NW F&B CART SPONSORED CONCOURSE B	2,882	2,882	2,882	10	30	3	3	30	10	2,882	2,882	2,882	6NW F&B CART SPONSORED CONCOURSE I	8 10
13	6NW F&B CART SPONSORED CONCOURSE C	2,882	2,882	2.882	10	30	3	3	30	10	2,882	2,882	2.882	6NW F&B CART SPONSORED CONCOURSE J	14 16
19	6NW F&B CART SPONSORED CONCOURSE D	2,882	2,882	2.882	10	30	3	3	30	10	2,882	2,882	2.882	6NW F&B CART SPONSORED CONCOURSE K	20 22 24
	6NW F&B CART SPONSORED CONCOURSE E	2,882	2,882	2.882	10	30	3	3	30	10	2,882	2,882	2.882	6NW F&B CART SPONSORED CONCOURSE L	26 28 30
31	6NW F&B CART SPONSORED CONCOURSE F	2,882	2,882	2,882	10	30	3	3	30	10	2,882	2,882	2,882	6NW F&B CART SPONSORED CONCOURSE M	32 34 36
37	6NW F&B CART SPONSORED CONCOURSE G	2,882	2,882	2,882	10	30	3	3	30	10	2,882	2,882	2,882	6NW F&B CART SPONSORED CONCOURSE N	38 40 42
	FION: 2 6NW F&B CART SPONSORED CONCOURSE O	2,882	2,882	2,882	10	30	3	3	30	10	2,882	2,882	2,882	6NW F&B CART SPONSORED CONCOURSE P	46
53	SPARE				-	100	3	3	30	-				SPARE	50 52 54
55 57 59	SPARE				-	60	3	3	30	-				SPARE	56 58 60
63 65	SPARE SPARE SPARE				-	20 20 20	1	1	20 20 20	-				SPARE SPARE SPARE	62 64 66
69 71	EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE						1	1						EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE	68 70 72
77	EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE						1	1 1						EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE	74 76 78
79 81 83	EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE						1	1 1						EQUIPPED SPACE EQUIPPED SPACE EQUIPPED SPACE	80 82 84
	SUBTOTAL TOTAL PHASE A - VA 48,994	25,938 LOAD	25,938	25,938 CONN. V	/A	DF		LO	AD			23,056 CONN. VA	23,056 DF	SUBTOTAL	
	AMPS 408 TOTAL PHASE B - VA 48,994 AMPS 408	COOLING HEATING LIGHTING	3 3			1.00 0 1.25		SIC	FRIG SN/DIS CHEN			146,982	1.00 1.25 0.65		
	TOTAL PHASE C - VA 48,994  AMPS 408  TOTAL PNLBD - VA 146,982  AMPS 408	MOTORS SUPP HE MISC EQ	EAT			1.0/.5 1.00 1.00		LR SH	G MO OW W	TOR /NDW			1.00 1.25 1.25 1.00	TOTAL DEMAND 95,538 V 265 /	_
PANE	ELBOARD NOTES												FEED T	HRU CONNECTION: (3) Sets of 40	i0kcm

Fig.3 Test images matched with template in fig1.