Automatic Human Blood Type Detection using Digital Image Processing Techniques

Faculty of Engineering Telecommunication Engineering Department

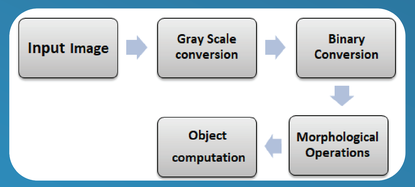
Submitted By: Aya Mousa , Farah Oshebe and Muna Shaar
Supervisors: Dr. Falah Hasan and Ms. Nuha Odeh

Objective:

- Speed up the knowledge of human blood type of causalities in emergency situations
- Implement several digital image processing algorithms such as Objects Counting, SIFT, SURF and ORB for human blood type determination.
- Compare between them to adapt the algorithm with the best results based on accuracy and time requirements.

Methodology:

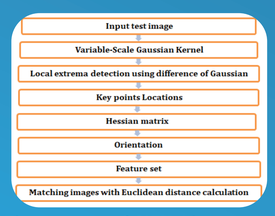
Objects Counting Algorithm:
Objects counting algorithm simply gives the number of objects in a given image. In this case, these objects represent the agglutination in blood sample image.



Flow chart for Object counting algorithm

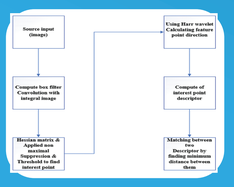
Features Detection Algorithms

1-SIFT Algorithm
The SIFT approach, for image feature generation, takes an image and transforms it into a large collection of local features vectors.



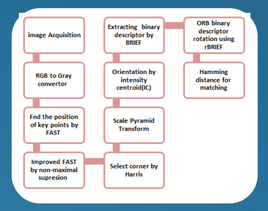
Flow chart of SIFT Algorithm

2- SURF Algorithm:
The SURF-algorithm is based on the same principles and steps that used in SIFT- algorithm, but it utilizes a different scheme and it should provide better results faster.



Flow chart of SURF Algorithm.

3- ORB Algorithm:
ORB algorithm is based on FAST (Features from Accelerated Segment Test) algorithm and BRIEF(Binary Robust Independent Elementary Features) algorithm. The greatest feature of this algorithm is fast and having rotational invariance and reducing sensitivity to noise.

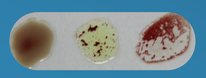


Flow chart of ORB Algorithm.

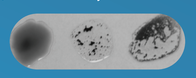
Results and Analysis:

1-Objects Counting Algorithm:

a) Input image (macro lens image):



b) RGB to Gray Conversion:

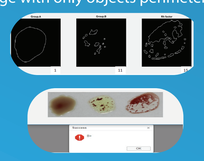


c) Multi-level thresholding result:

d) Closing operation result:

e) Opening operation result

f) Image with only objects perimeter pixels:



Final result of blood type(B+) using objects counting algorithm

Table (1) shows the number of objects of different macro lens tested samples.

Test sample	# of objects in part A	# of objects in part B	# of objects in part Rh	Result
B+	1	8	6	B+
AB+	3	4	5	AB+
A+	4	1	5	A+
O+	1	1	4	O+
B-	1	7	1	B-
O-	1	1	1	O-
A-	8	1	1	A-

2-Result of Matching Features:

- Input tested sample image (B+)and the reference one

- RGB to Gray Conversion

- Extract the features set and matching it at each section in tested image

4) GUI result for the blood sample under test using ORB

Table (2) shows ORB algorithm matching results for different cell phone tested samples.

Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
O-	0	0	0	O-
A+	4	0	4	A+
B+	0	5	5	B+
O+	0	0	5	O+
AB+	4	7	4	AB+
B-	0	4	0	B-
A-	4	0	0	A-
AB-	5	4	0	AB-

Table(3) shows ORB algorithm matching results for different Macro lens tested samples.

Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
O-	0	0	0	O-
A+	4	0	4	A+
B+	0	4	4	B+
O+	0	0	4	O+
AB+	4	4	6	AB+
B-	0	4	0	B-
A-	5	0	0	A-

Table (4) shows SURF algorithm matching results for different cell phone tested samples.

Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
O-	1	2	1	O-
A+	21	2	25	A+
B+	2	29	24	B+
AB+	34	41	30	AB+
A-	30	15	1	A-
O+	9	1	23	O+
B-	5	19	1	O-
AB-	92	6	11	A-

Table(5) shows SURF algorithm matching results for different Macro lens tested samples.

Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
A+	26	1	58	A+
A-	26	1	1	A-
AB+	56	51	57	AB+
AB-	61	51	35	AB-
O-	1	1	1	O-
O+	9	1	25	O+
B+	3	40	36	B+
B-	1	40	1	B-

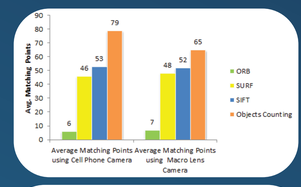
Table (6) shows SIFT algorithm matching results for different cell phone tested samples.

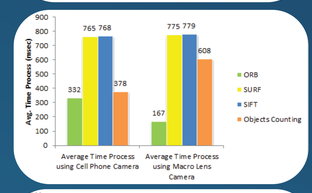
Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
AB+	28	12	1	AB+
AB-	78	48	9	AB+
A+	80	4	2	A+
A-	43	11	1	A-
B+	6	34	15	B+
B-	1	2	1	O-
O+	3	2	22	O+
O-	4	1	9	O+

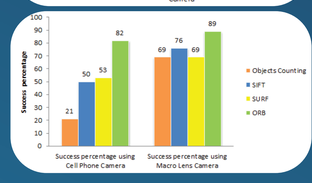
Table(7) shows SIFT algorithm matching results for different Macro lens tested samples.

Test Sample	# of Matches in Anti A	# of Matches in Anti B	# of Matches in Anti D	Result
A-	46	3	1	A-
A+	92	4	102	A+
AB-	76	7	2	A+
AB+	54	50	6	AB+
B-	4	38	1	B-
B+	13	32	7	B+
O-	1	1	1	O-
O+	1	1	146	O+

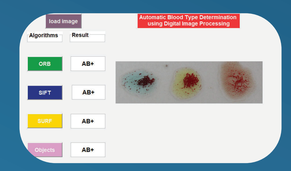
Simulation results comparison:
We compare the simulation results between Objects Counting, SIFT, SURF and ORB algorithms and displaythe matching evaluation parameters such as the number of key points in images, the execution time required and success percentage for each algorithm.







GUI result for the blood sample under test using ORB,SURF,SIFT & Object Counting algorithms



Conclusion:

- Results show that ORB is the fastest and best algorithm in determining the blood type in cases, macro lens camera and cell phone camera images.
- For macro lens camera images, objects counting algorithm show good performance due to the details in these images.
- For cell phone camera images, SIFT and SURF outperforms objects counting algorithm.

Recommendations:

1. Automatic human blood type detection system based on ORB feature detector.
2. Light editing techniques.