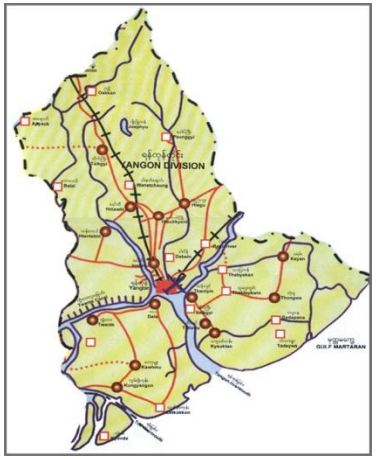
Automatic Urban Growth Detection for City Development

Presenter: Khaing Cho Moe

Outlines

- Introduction
- Objectives of the topics
- System Architecture
- Conclusion



Introduction

- The Geographic Information System is the indispensable role in the environmental changes detection and natural disaster management.
- According to 2014 Myanmar Nations' Census,
  - ✓ Total population is 51.4 millions
  - ✓ 14.9 million people living in urban areas
  - ✓ Yangon has the highest urban proportion about 70.1% (manual census result)detection.

Objectives of the topic

- To support a system that can be used for analyzing urban sprawl of Myanmar within ten years
- To implement a system that is capable of building extraction even for low resolution image
- To supply the specific information of urban increasing area with correct latitude and longitude position range
- To predict further growing rate of building areas in every place of Myanmar by testing current rate of rising percentage
- To be employed as a tool in many object-based environmental change detection application in GIS

Low resolution Google Earth Satellite Images

North Dagon

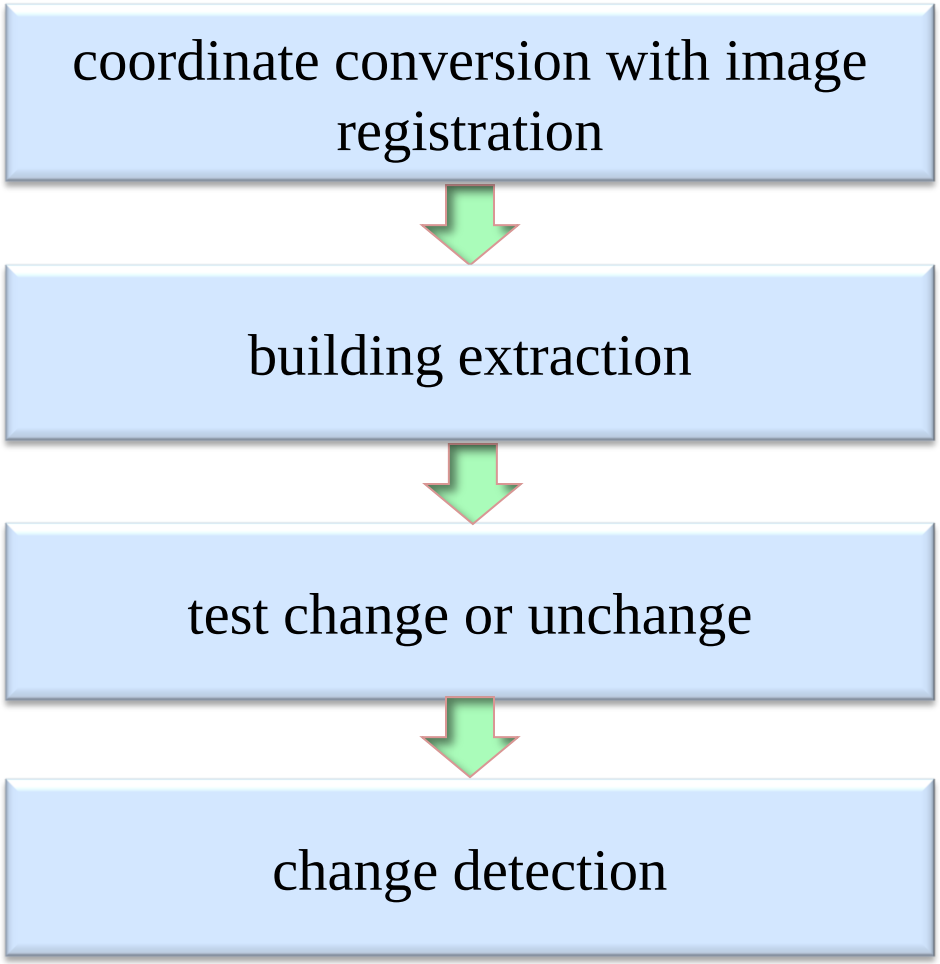
Tamwe

downtown

High resolution Arial Image of Yangon Downtown region

Downtown areas

System Architecture



Stage: 1 *(coordinate conversion with image registration)*

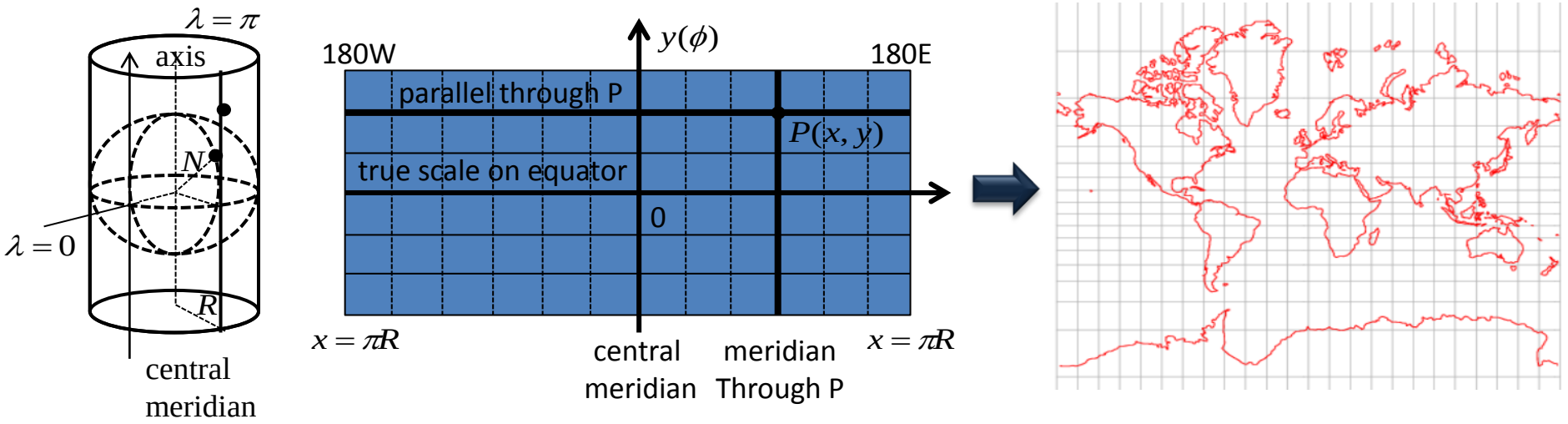


Figure: A cylindrical map projection

- A cylindrical map projection
- Linking the geographic coordinates of latitude φ and longitude λ to Cartesian coordinates on the map with the origin on the equator and x-axis along the equator.

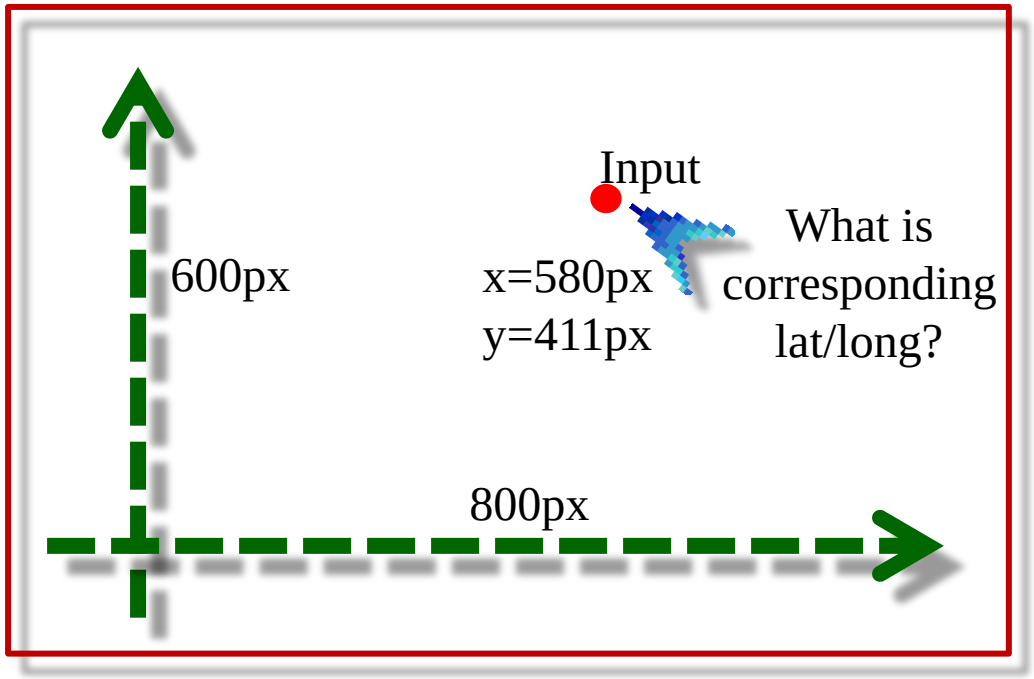
Input

- Minimum latitude / longitude
- Maximum latitude / longitude
- Desired 4 control points with lat/long value

Output

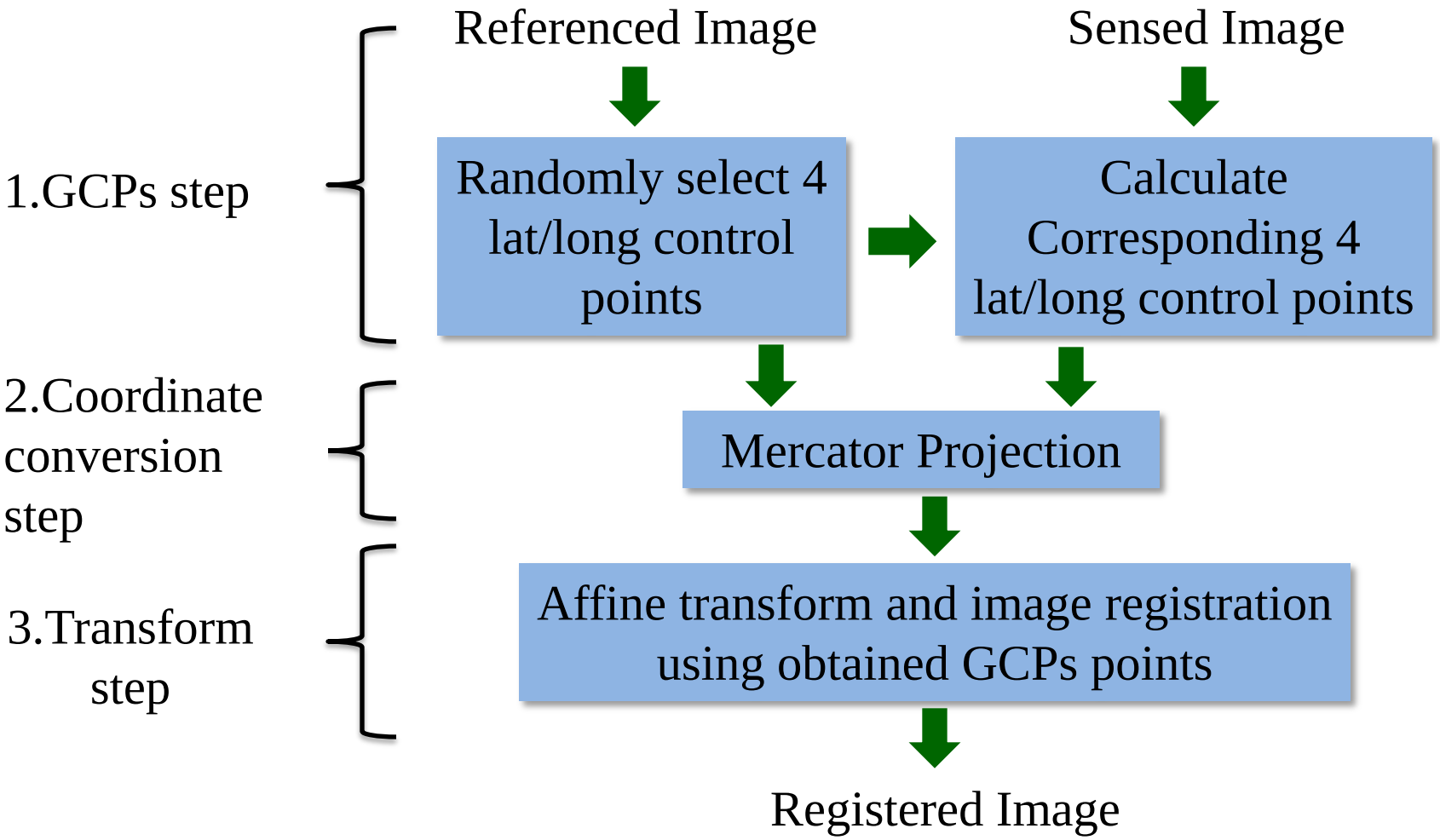
- 4 control points with x,y coordinates within defined pixel range

16°51′ 34.92“
96°12′ 3.93“



16°51′ 24.92“
96°12′ 13.93“

Steps of Image Registration



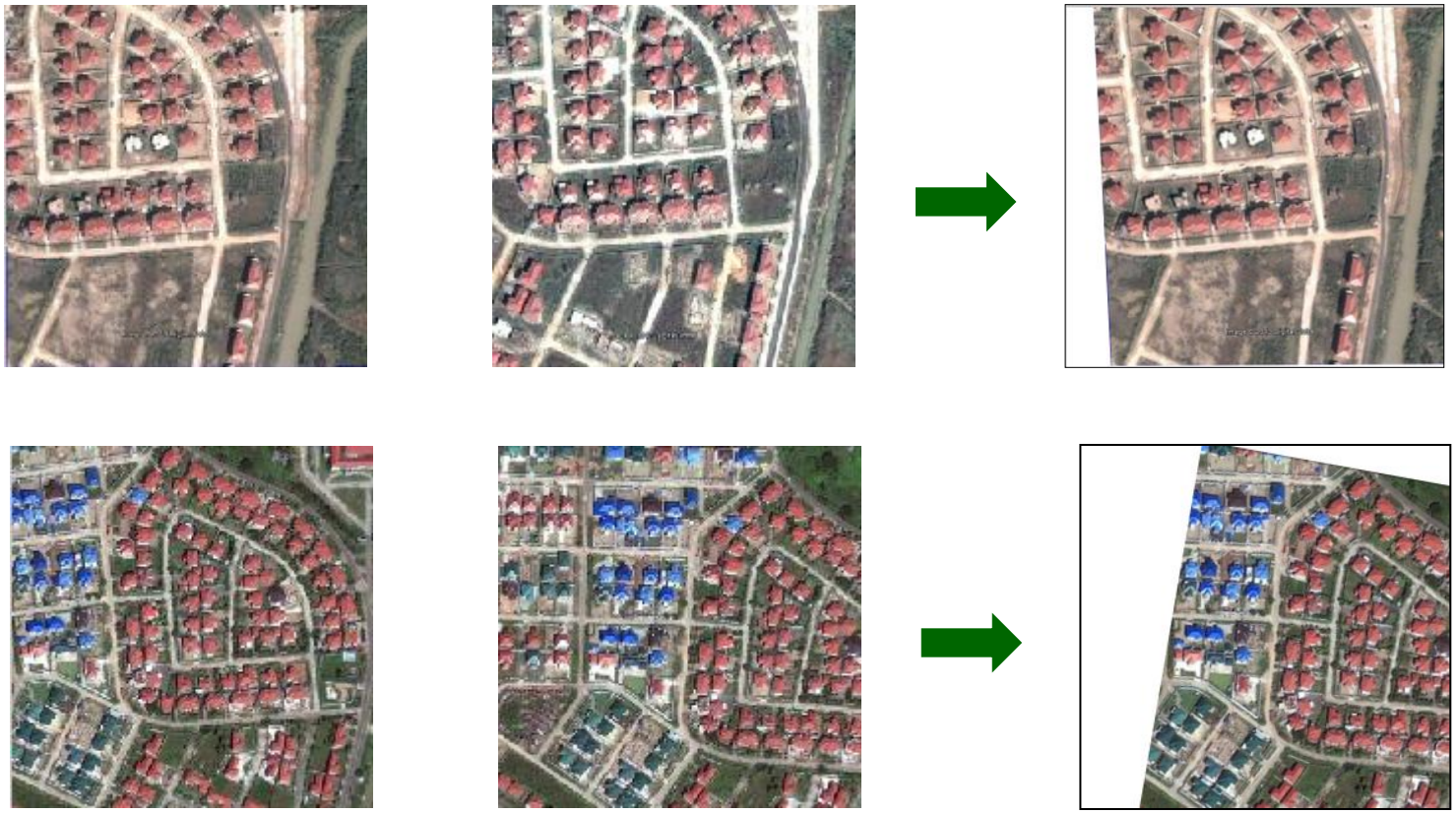
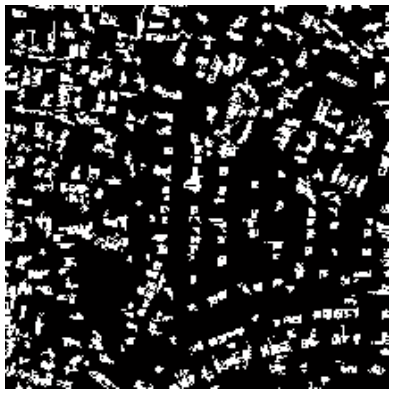


Figure: Example of Image Registration from North Dagon Township

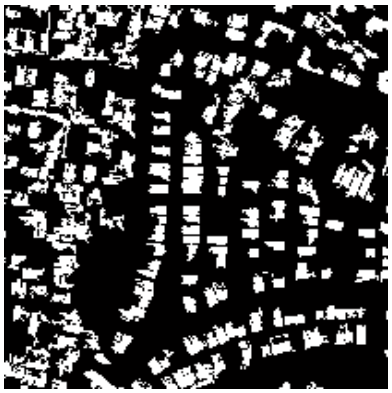
Stage: 2 *(Building Extraction)*

Study area is located in latitude 16°50′ 4.73“ /longitude 96° 7 23.98“ and
latitude 16°49′ 54.73“ /longitude 96°7′ 33.98“

Input Image



SE=3



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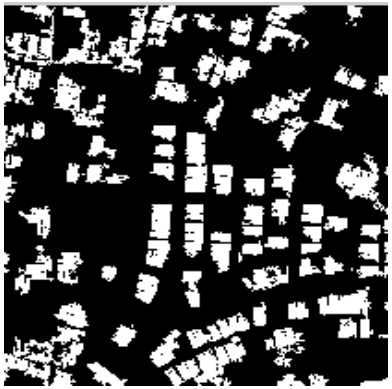

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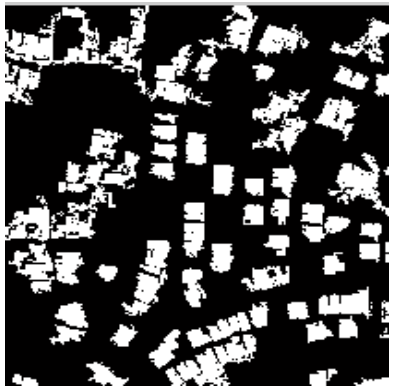


SE=11

Final Extracted Image

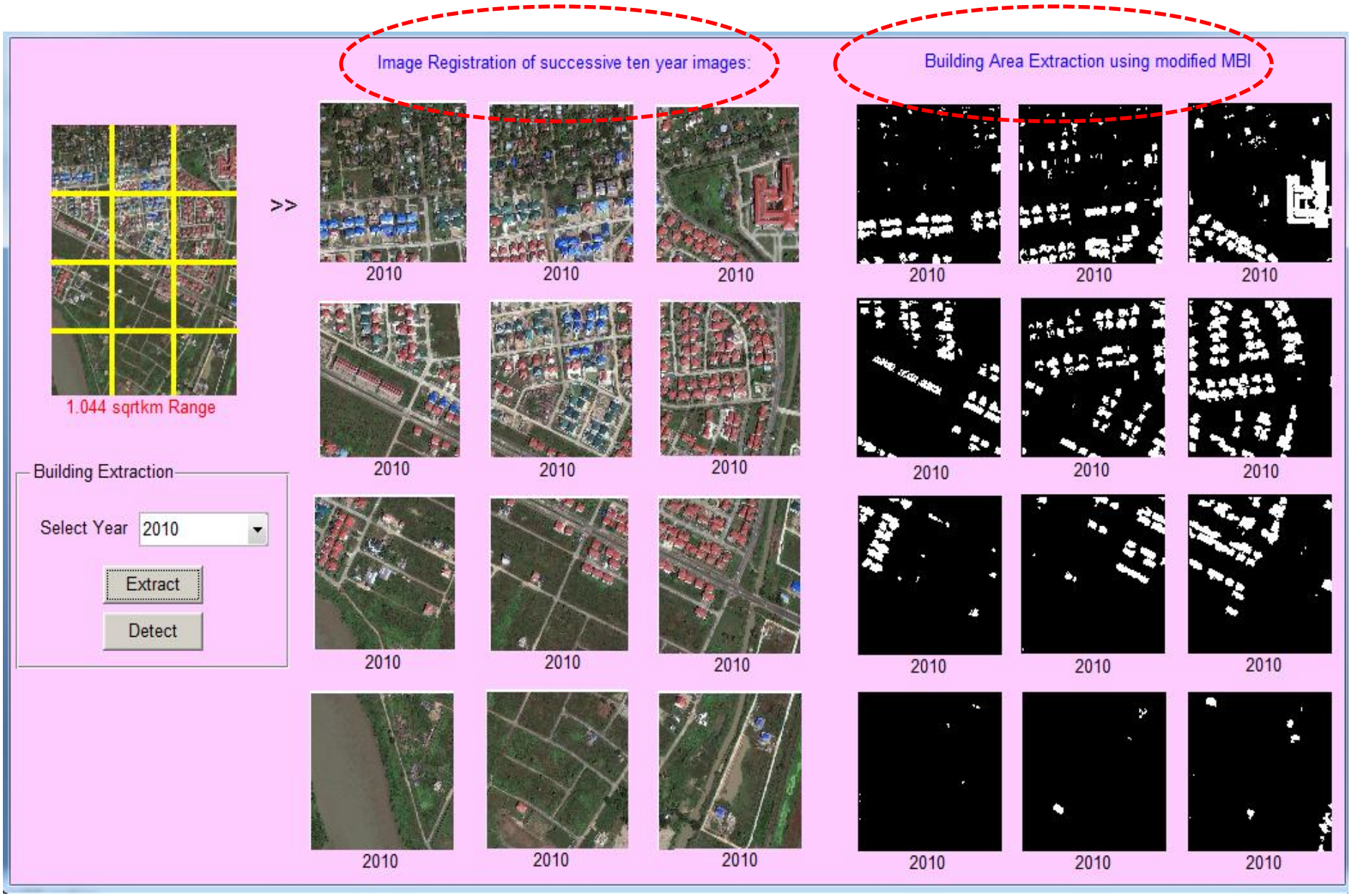
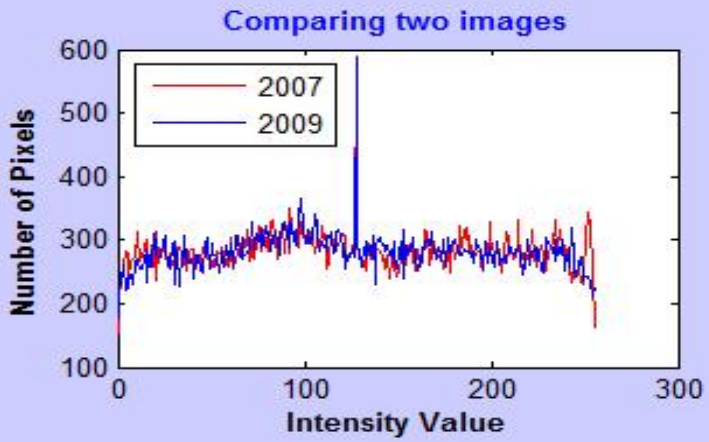


Image Registration of successive ten year images:
Building Area Extraction using modified MBI
1.044 sqrtkm Range
>>
Building Extraction
Select Year
2010
Extract
Detect
2010

Stage: 3 *(Testing for change or unchange)*

Input Area Image



2003 2015

	Year	1	2	3	4	5	6	7	8	9	10	11
1	2003-2004	No	No	Yes	No	Yes	No	No	No	No	Yes	No
2	2004-2005	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No
3	2005-2006	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes
4	2006-2007	Yes	No	No	Yes	No	No	No	Yes	Yes	Yes	No
5	2007-2009	No	Yes	No	Yes	No	No	No	No	Yes	Yes	No
6	2009-2010	No	Yes	Yes	No	No	Yes	No	No	No	Yes	No
7	2010-2013	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
8	2013-2014	No	No	No	No	No	No	Yes	No	Yes	Yes	No
9	2014-2015	No	No	No	No	Yes	No	Yes	No	No	Yes	No

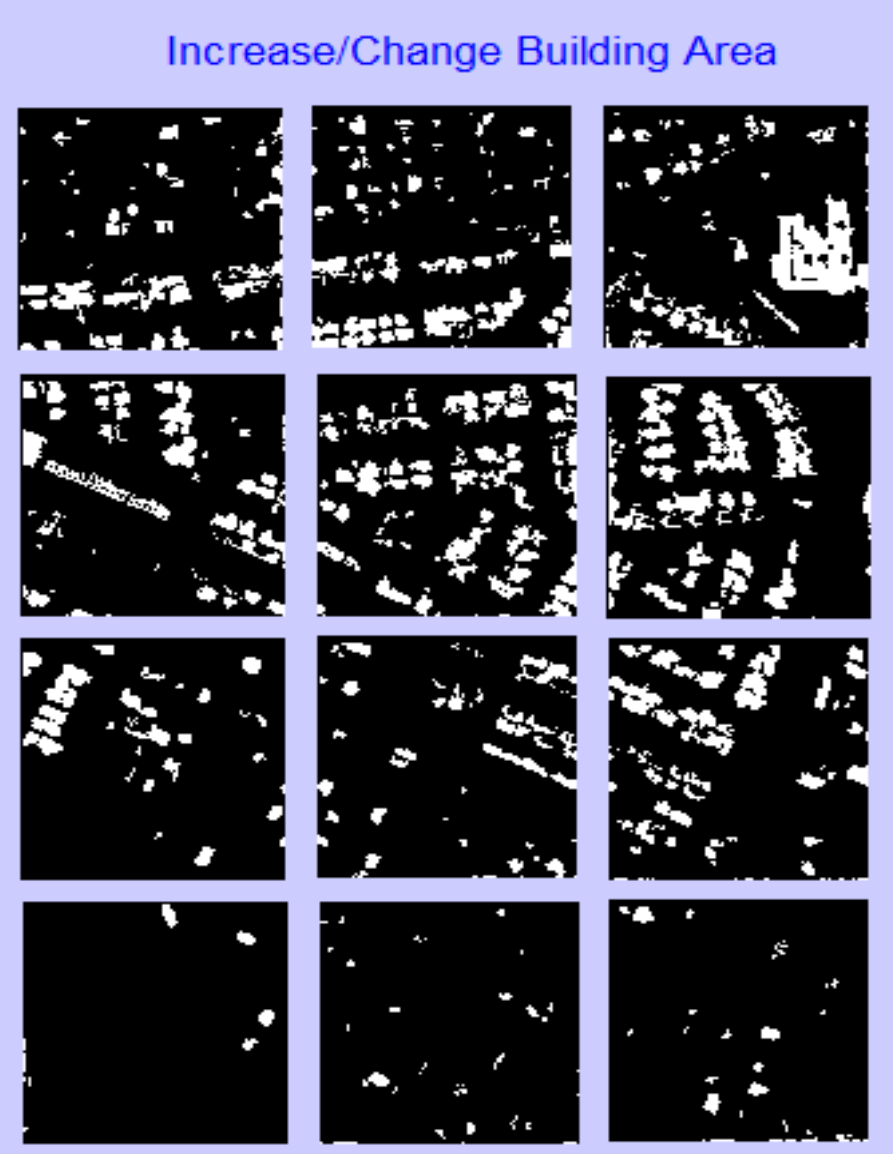
Urban Change

Testing

Change Result

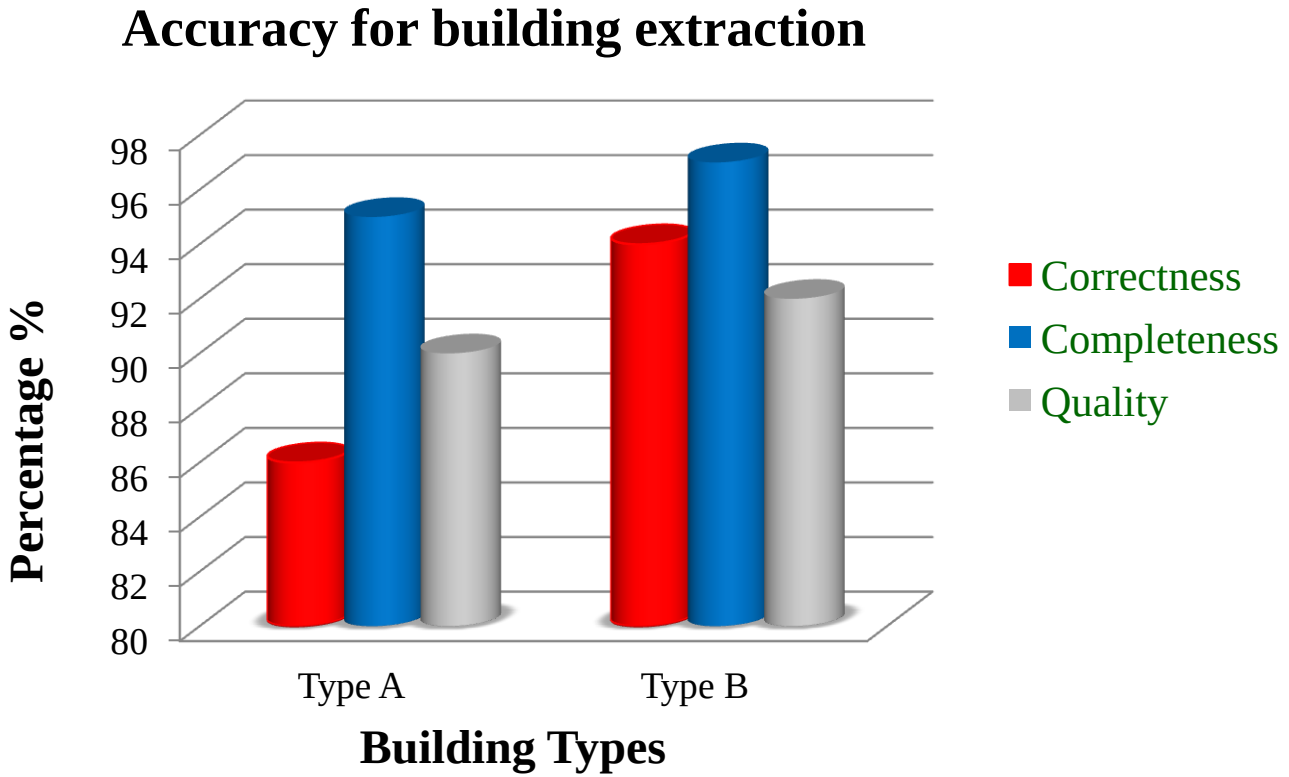
Detect

Stage: 4 *(Change Detection)*



- The total area growth of this region is **18.1937** times increase.
- In which the first five area development is more increase **2.2585** times than the second ones.

- The implementations are conducted on Google Earth satellite image and tested upon 1080 ten seconds (9 townships×12areas×10images) images.



	Correctness	Completeness	Quality
Type A	86.23	95.67	90.76
Type B	94	97.43	92.89

Publications

No.	Publications
[P1]	"**Detection the Changes of Urban Area in Yangon within Ten Years**", 1st International Conference on Energy, Environment and Human Engineering (ICEEHE), December, 2013, Yangon.
[P2]	"**Automatic Building Change Detection and Open Space Area Extraction in Urban Areas**", in Proceedings of the 12th International Conference on Computer Applications (ICCA2014), pp. 291-296,February 2014, Yangon.
[P3]	"**An unsupervised Technique for Building Change Detection in Urban Area**", in Proceedings of International Journal of Computer Application (IJCA), November Edition(106), ISBN: 973-93-80884-12-5, pp. 31-35, November 2014, New York.
[P4]	"**Urban Growth Detection using Morphology of Satellite Image**," in Proceedings of International Conference on Science, Technology, Engineering and Management (ICSTEM,2015), ISBN: 978-93-84209-89-6, pp. 43-47, February 2015, Singapore.

Cont'd

No.	Publications
[P5]	"**Building Area Extraction of Urban region based on GIS**", in Proceedings of the 13th International Conference on Computer Applications (ICCA2015), pp. 329-334, February 2015, Yangon.
[P6]	"**Urban Growth Detection using Morphology of Satellite Image**", in Proceedings of International Journal of Advances in Electronics and Computer Science (IJAECS), Volume-2, Issue-4, ISSN: 2393-2835, April, 2015.
[P7]	"**Urban build-up building change detection using morphology based on GIS**", in Proceedings of the 9th International Conference on Genetic and Evolutionary Computing (ICGEC), Volume- 338, pp. 263-272, August, 2015, Yangon.

Conclusion

- The system can solve necessity of human labor that is required for manual building change detection system.
- To get correct position of building index, combination of geometric coordinate and image registration is essentially needed.
- It is not an easy task to automatically extract buildings from satellite images without any supervised learning but geometric image registration and morphology based method are effective for indication of buildings and will benefits to process large amount of images.
- The system can also eases the government to find how area is free or already built and provides the free space of land to build.
- This system can also calculate damaged areas causing from natural disasters (flood, earthquake and so on).

Thanks for your attention