Analysis and interpretation in the architectonics documents. Past, present and future.

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1. Abstract.

The graphic intention is a peculiarity of the architectural drawing. It is enough to compare the ground plan of an unifamiliar housing insulated of Le Corbusier with another of Mies van der Rohe to realise the diversity of graphic styles, but is important to take conscience of the complexity that carries to interpret the symbols that appear in those documents, because as architects we either realize plans that the instructions are described or measures to be able to execute the work and in other occations representations for his edition aimed to a especialized public.

For this reason, and because not always is arranged the best possible documentation, we consider that the majority of vectorisations they exist in the market don't plenty satisfied our needs as teaching staff of graphic expression and CAD, althoug we can always be using the same systems of projection or codified representations, it is imposed a lot of times to interpret acording the context the different signs and graphic registers used.

We know experimental applications that go beyond, they even arrive to generate a 3D model from a lifted hand draw that represents three orthogonal projections of it, but it isn't less certain that its utility is restricted to fields very specialised and the option that we propose, there is not knowledge at least to us that it exist; commercially speaking.

Our porpose has been to develope a symple metedology of vectorisation but adapted to the special idiosyncrasy of the needs of an architecture student that with frequency for his formation requires to generate with CAD models 2D and 3D of architectural projects from the information contented in magazines, and with them create several formas analysis.

The most important difference in the matter to other systems is the interactivity of the procedure that let personify the exit file, even the wide diversity of graphic registers that it exist in the entrance, being the user only once has to identify and interpret the signs to detect, and then the process is realized automatically to any plant of the building or equivalent projection.

2. Introduction.

Words like digitalize or even more, vectorisation, sound as a miracle to the ears to who has to intervene in a building or built environment and the one that doesn't dispose more than printed or delineated documents demanding him a computerized draw.

For that when someone comments to the interesed that it exist some applications they make it seems to him that is the agile and effective solution to the tedium of what supose to overdraw in the computer.

The final draw is all full of thousands of diminutes stains normally coming from the noise or dirtyness the bottom of the paper or the isolated strokes, the long lines are the addition of several segments sometimes with erratic trajectories, the wideness of the traditional line of lineal draw with hand don't make more than stupefy and don't bring any information about the exact coordinate of a vertex, corner or intersection between walls and that isn't all, the baths, furnitures, links and elements of vegetation and the rotulation join to the group of resultant vectors without any viewpoint.

To sum up is generated one document with thousands of lines, "seemingly" disposed in a similar position to the original ones, but in each line seemed to ignore its relation with the neighbour, inheriting like that the worse part of the conversion process of one image *raster* type to another vectorial.

In front of this desolated panorama, we found important to analyse the state of the investigations and

the specilized works about the issue and concreting in the architectural ambit.

For our surprise, we realised that in this field what it abounds as experimental and theoric prototypes, are analysis and interpretation systems of graphic documents espesialized in some ingeneering areas, one of them is electronics, obviously because traditionally they used graphic registers more codified than the architects (1) (2).

In the dominium of the architectural graphism only four or five articles or reports appeared in magasines or foro no specially architectural in the last five years (3) (4) and the majority concentrate their efforts in the cartography and in applications orientated to the SIG.

The aim of our works, is to incorporate to the postgrade years that we impart in our university, concepts and practics proper otf this informatics dominium, framing inside the most wide set of themes of Treatment and Processing of Architectural images.

Doing it like that, we complete with the Analysis and Interpretation especific of the architectural register, the group of tecnics that are, to our understanding, the second big pillar together with the CAD on the graphic computer it rests.

What we protend is that the students of third cicle, with light knowledge of programation, using rutines Lisp of public dominium, make approximations to the vectorized once analyzed the programs existing in the market, but overcoat for arousing them of what are the possibilities and the limitations of that programs, and then they will apport ideas to adapt and improve them just to fit it to their needs.

The conclusions that we extract will pass to form part of the reports that we refer to the work groups of the Unit of Processing of Images and Artificial Intelligence UPIAI, of the Autonoma University of Barcelona which we colaborate as an advanced user because they use it to improve and unroll new applications.

Nowadays it already exist especialized software (5) that recognized polygons, encounters or lines crossed, and there are also that permit to edit the critic points detected with the corresponding software to the changing direction of the straight lines, or recognize the text, but even like this the resolution of our opinion is poor because for exemple, it doesn’t interpret the coats, although is true that it exist experimental applications that they do, or don’t convert the text in recognized sources for the CAD program, just to make an appointment of some of the limitations that in our opinion they would be easy to surpass.

To sum up, we consider that already anyone noticed about the peculiarties habitual architectural work, in the away of our understanding in the UPC and in the professional dispatch consulted.

3. Justification.

In our work we are investigating in the detection and analysis of certain graphic elements characteristic from the architectural graphism, like representations of sanitaries apparatus for several reasons, in first place because its for is more complex than the majority of the symbols that appear in a conventional plan when curves of several types are incorporated and details that sometimes we have to discard according at what scale the computer file is printed.

In second place, we consider that are a clear differential sign of certains spaces and uses, also being

fixed elements that almost always have to be incorporated to the description of the plant. In third place because is one of the elements that with more frequency each architect likes to personalize himself. In the last place because we are able to extract automatically of the original plan makes easier and simplificates a lot the process of traditional vectorisation.

The problem of the automatized detection of this graphic registers still are not satisfactorily solucionated for several reasons like the ones before exposed, and presumably because the context where is inserted admit several interpretations if we speak of architectural drawing (6).

Obviously our strategy is not the most orthodox from the computer point of view, because the several works in the subject are oriented throuhg the tipification of the charctiristics features of the form to analyze and with them to elabotate a program capable to detect them.

But just looking any architecture contemporary magazine to notice the wealth and diversity in the drawing tha an architect can introduce when represents a plant, because is that graphic intention that makes stick out some elements in front a others, one of its principals characteristics, and more if we refer to draws of publication like the ones that we habitually can reach in the especialized editions.

For that we propose that the interpretation makes it the user, he is the one that tells to the computer just for one time what mean for him the most important elements of the plan that has in front, accepting the minimum graphic convections, and the machine has to be the one that completes the job, in a second phase has to be the computer that knowing in advance what the user prefers, it draws again the plan in his way.

In this report we forced this double reading accepting that the original drawing represents a typologic organization expressed with a schematic drawing, and we want to generate draw more descriptive.

We consider that in this way we can tackle satisfactorily the vectorization of the draws of many authors and to generate with them plan with only one style, which is very interesting for us and we think is basic, if for exemple the process is tipified to generate graphic libraries 2D or 3D of the architectural works of themselves and concequently generate database to the disposition of any user.

4. Proposal.

The protocol that we propose to follow is not more than a study of viability that later has to be used to generate an experimental program that several especialized algorithm will be tested in recognition of forms. Each phase has been tested independently and also the automatic execution in the matter concatenate and although for the moment we executated with a rutines LISP elementary, the resoult obtained make us hopeful as in the exemples have demostrated and we consider that in hands of an expert programmer its effectivity can be much better.

For our experiment we used the Vision Lisp(7), software of public dominium especialized in the processing images and in artificial vision as central element of the process. Mixing some of its rutines and tecnics, like the correlation coeficients, the calculation of the gravitation center etc., proceeding to detect in an original image in which a plan of a building is reproduced digitalized with a scanner, the information that intereses' us and appear repeatedly, in a process totally automatized.

The information to extract is verified selectioning a peace of the original image that has to be a smaller new image with a number of rows and column odded and like this be able to obtain as a resoult only one point.

In the first process is obtained when applying the convolution of the resoult mask selectioning a part of the image, from the totallity of the original obtaining another new image where it appears several white points that corresponds with the places where the maximum concidence is detected between both images compering the similarity in a scale of white tones which the highest value is 255, but it can arrive to 220.

To separate those points or littles zones from the rest of the image we proceed to threshold with a determined rank which values are between the before described. In the case that the resoult of the first process is an area and not a point, we apply a second algorithm in which we detect the center of gravitation of the stain previously labeled.

The resoult is a list of points, which coordinates, (x, y) they can be incorpored by a Lisp rutine to a file of format DXF, and in the same time to insert automatically in the CAD program where you invoke, the block, or cell, or the register that interes'us.

The only difficulties are based, in one part the unification of the coordinates systems of both types of files for a defect of the raster, the origin is in the high left corner and in CAD, at least in our environment, they are in the low left corner.

The second difficulty lies in adjusting the capture resolution of the image with the CAD unities, in particularity with the graphic elements scale to incorporate if this ones are obtained from other souces.

When this problems are solved, the option to generate DXF files, it seems very adequate because the standard of interchanging files[8] and there are a lot of applications in CAD that accepts them, but also because its structure is simply and clear and represents the possibility to be edited as ASCII what made our work easier.

The process can be isolated repeated or concatenatly with other pieces of the original image, as sanitaries, fourniture, doors, windows, paviments, etc., or if you want a new plant of the building, still resting to experiment with meeting walls. The zones where there are diferent wides of line it generates no useful resoults with the present comercial vectorisation and presumably if you mark up conviniently the image to detect, the way that the resolution would be a vertex of it, that would be a great advance.

The resoulting DXF will have a lot of utility so it will incorporate the precise coordenate of a corner of the building, or the meeting point between a thin wall and a frontage values or heights that unfotunely they can't be found with the habitual methods and they finish forcing the redrawing with the CAD program, in the best of the cases to superimpose it in the bottom of the screen where appear the raster image of the plant.

Anyway, if at the end of some of this subprocess you want to appeal again to the conventional vectorisation there is no problem, because the program generates as a secondary resoult a new image from the original where all the zones before detected had been raised.

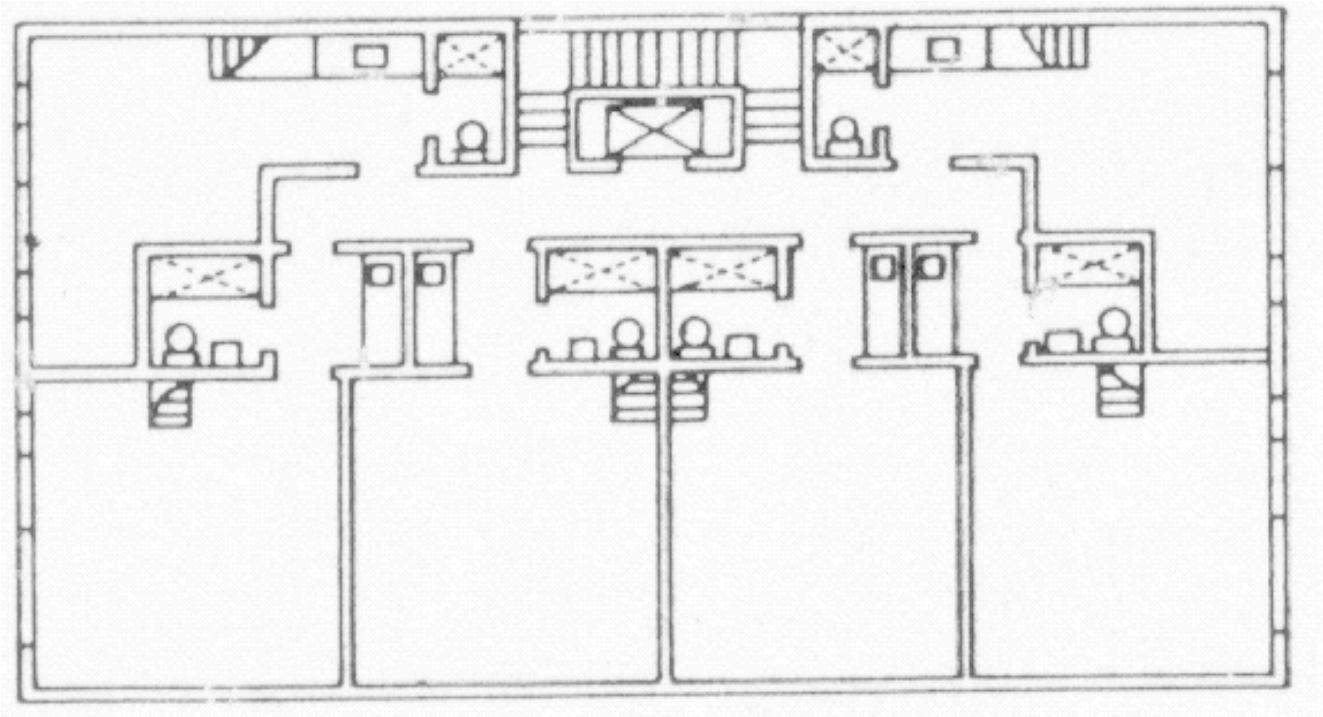
The procedure will be optimize, gived its high cost of computational time, if everytime that a form is detected, the interface would ask if is good or if should pass to the next, but this point with the rest implementation of the application do not worry us, because as we already said, only interes' us for the moment its viability and we think we have demostrated that is feasible.

In the coming future using new algorithms of form detection in C, more powerful, and to be able also to identificate substancial changings of the image, is perfectly workful to implement a demostration

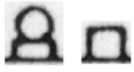
in VisualC++.

5. Illustrations.

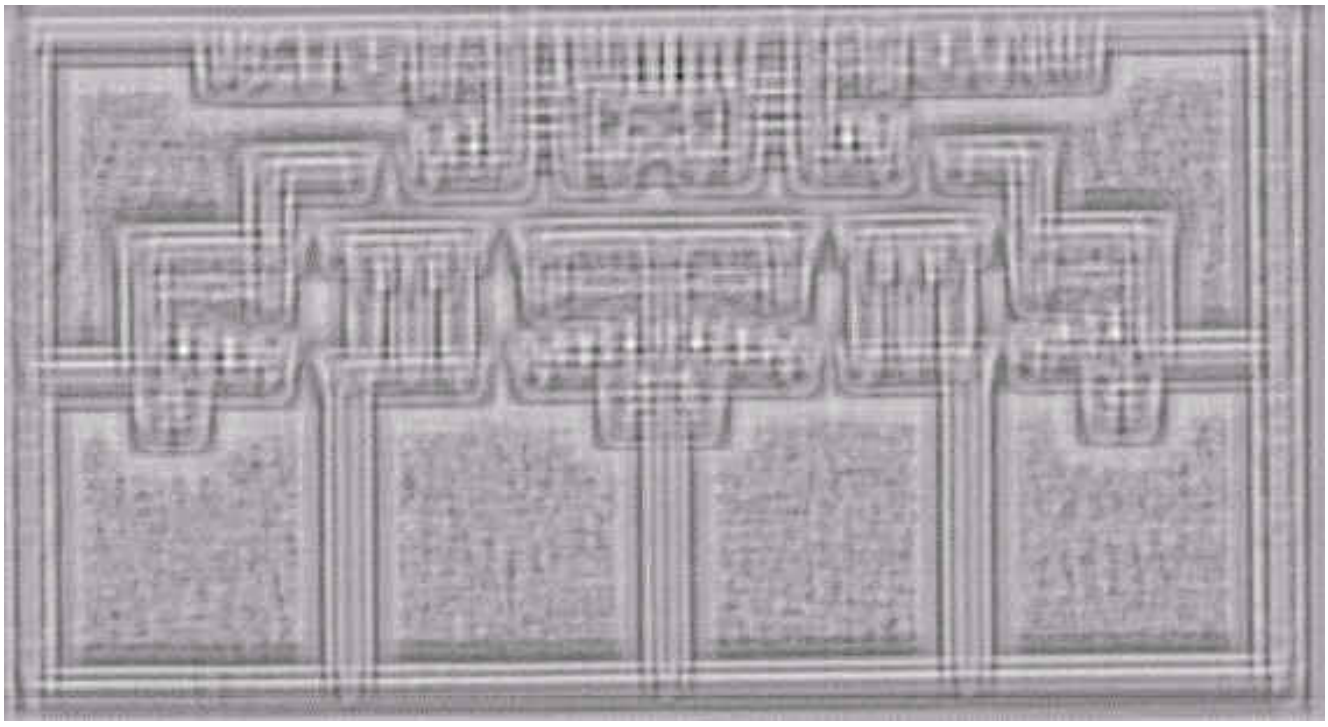
5.1 Original image.



5.2 Fragment to detect and to substitute.

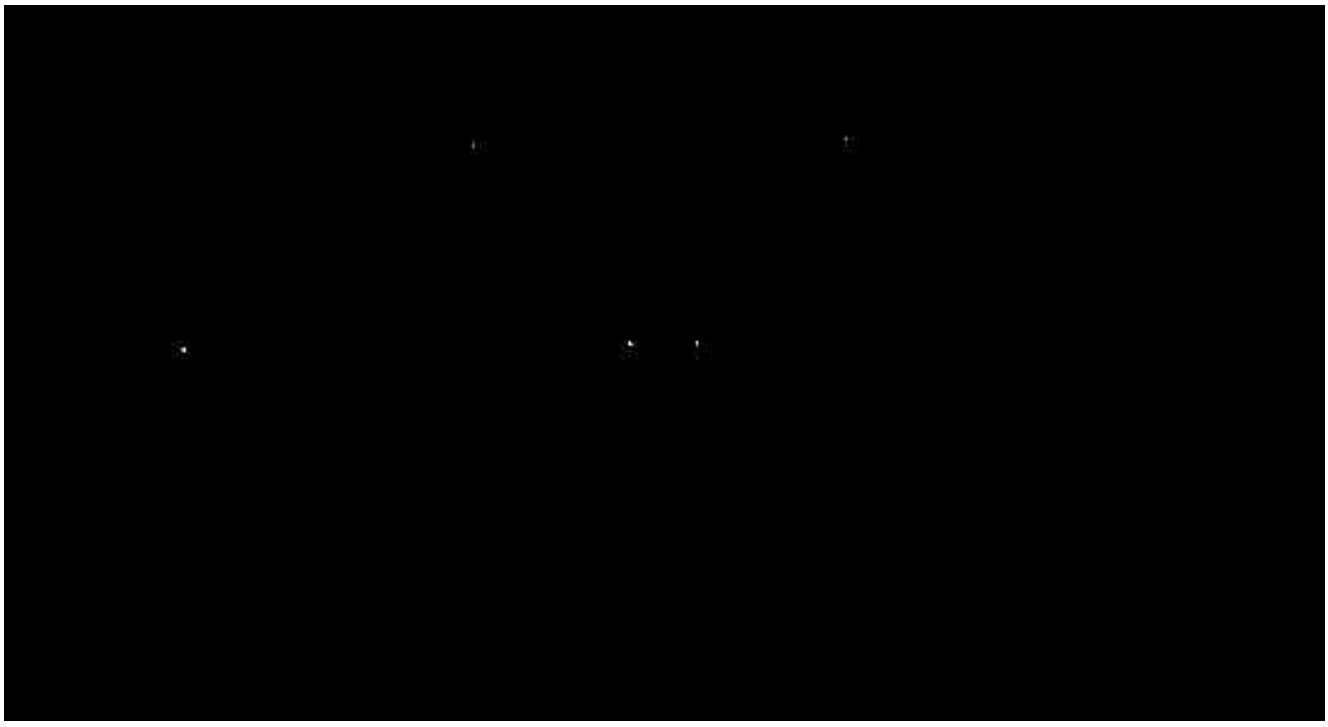


5.3 Resoulting image of the detection process from a given form, in that case an odourless.

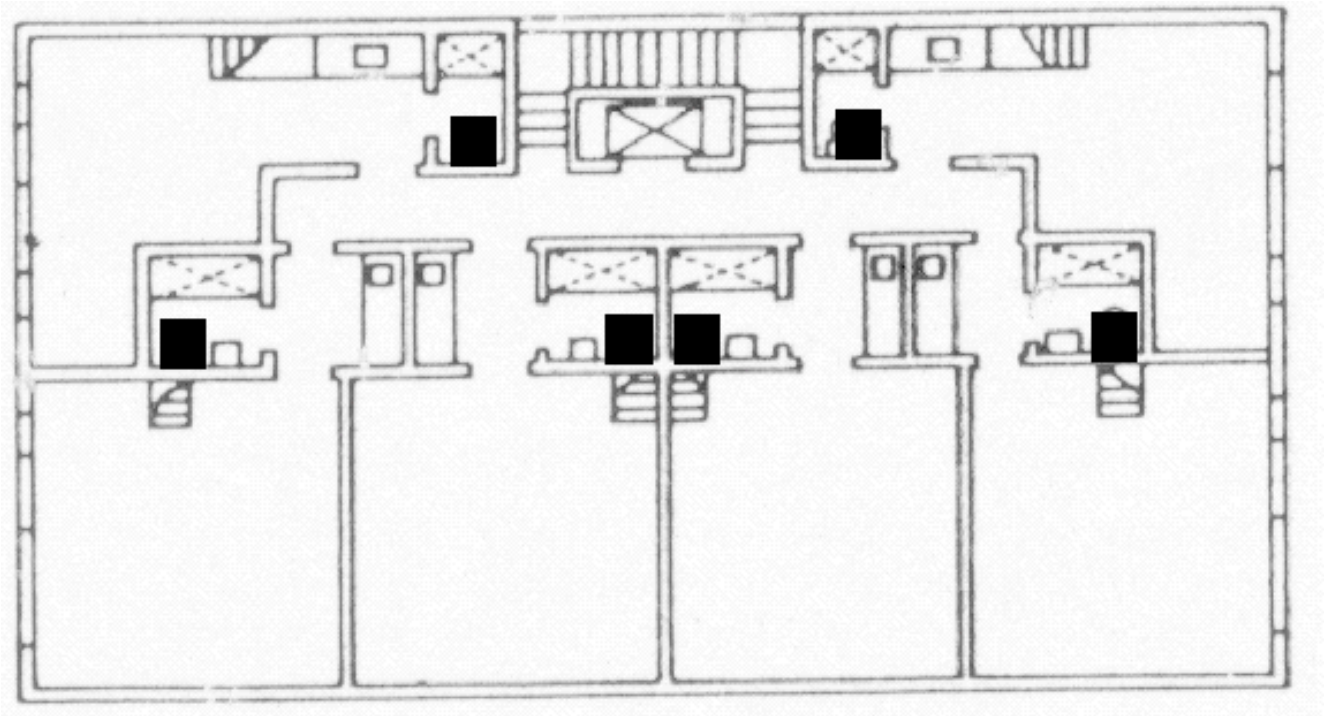


5.4 View 3D of the anterior image where white points are appreciated coming up from the rest and they indicate the places where the form has been detected.

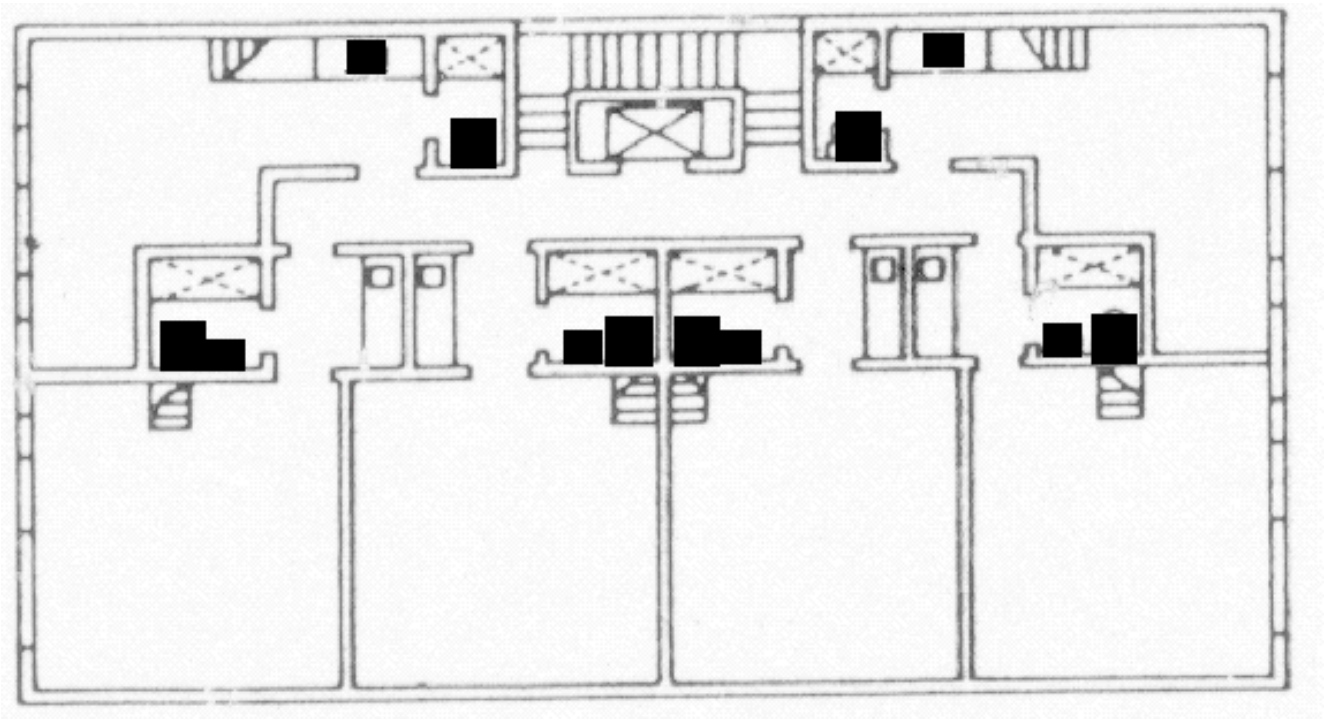
5.5 Extraction of the concreed points imposing an umbral to the original image. to the detection of a new point as the one that should appear to the right of the image that precise to make the umbral rank bigger.



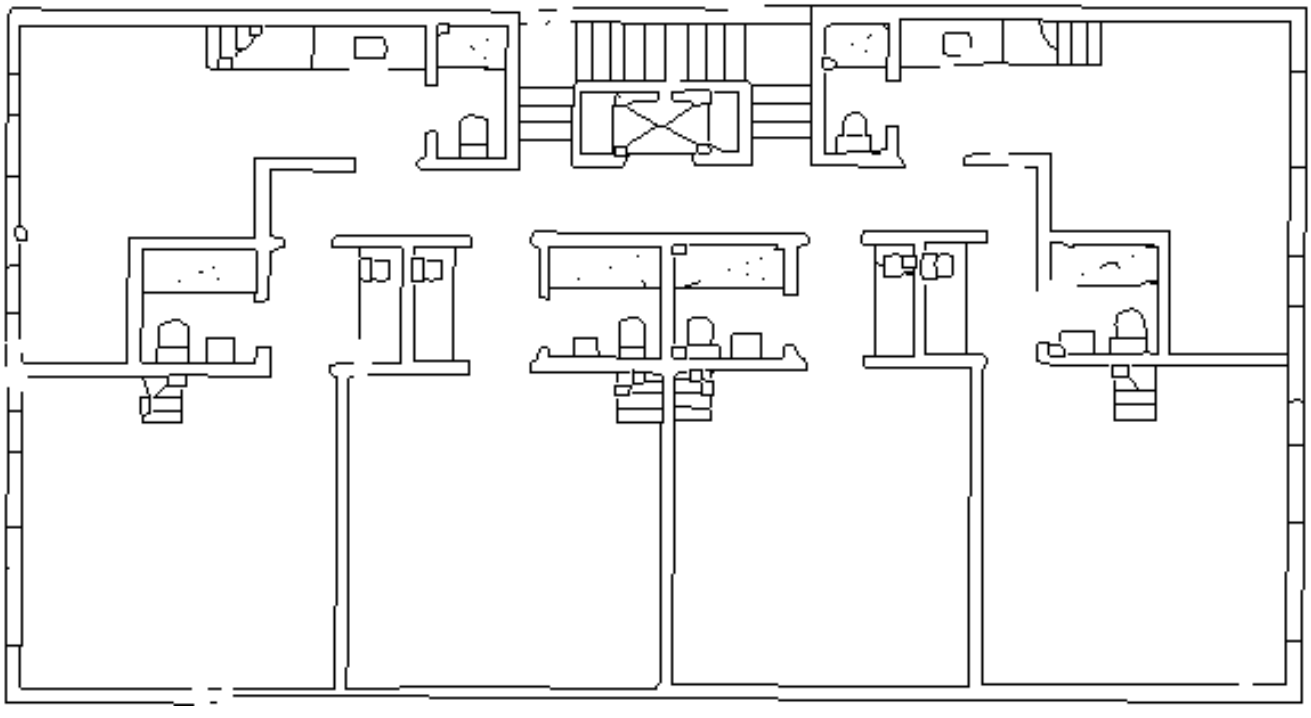
5.6 Resoulting image from the extraction of the first form. The disparities or slippings of the black mask correspond to the initial objects no detected because there were plenty of differences with the searched image, even trying to be representations of the same object. This kind of risk is habitual in the draws hand made.



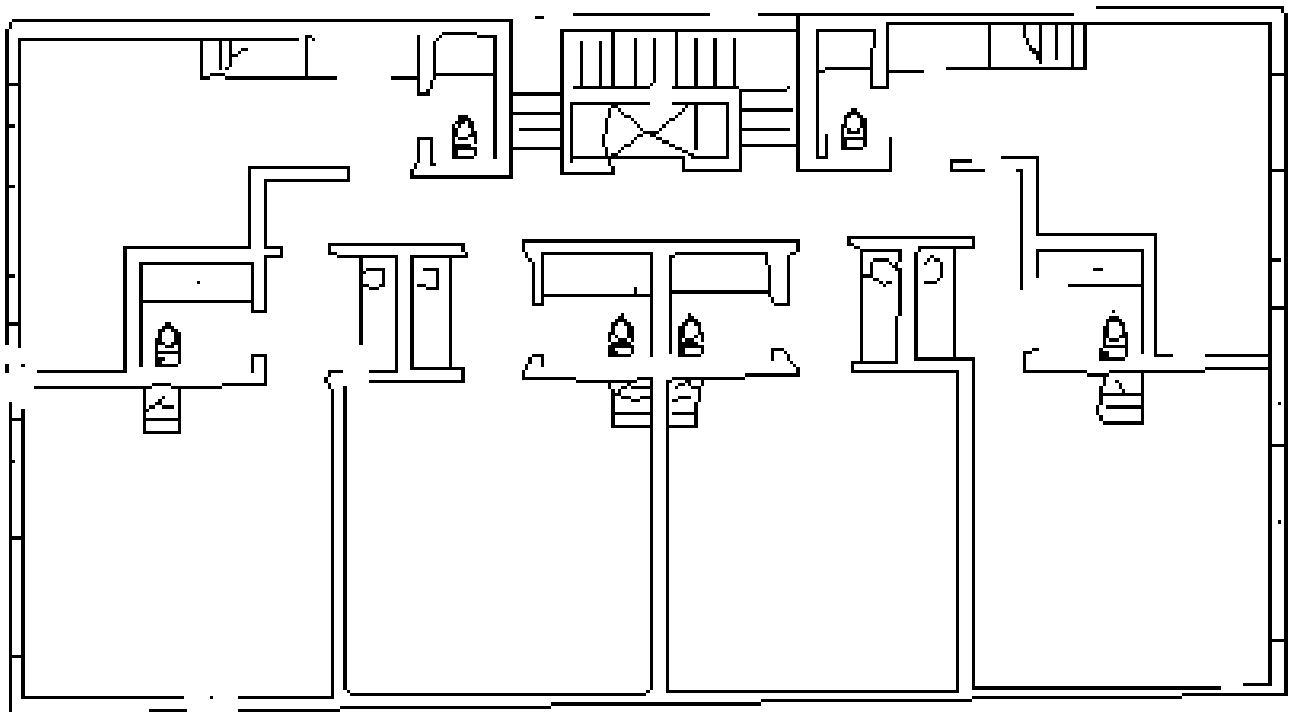
5.7 Resoulting image from the extraction of the second form, a washbasin.



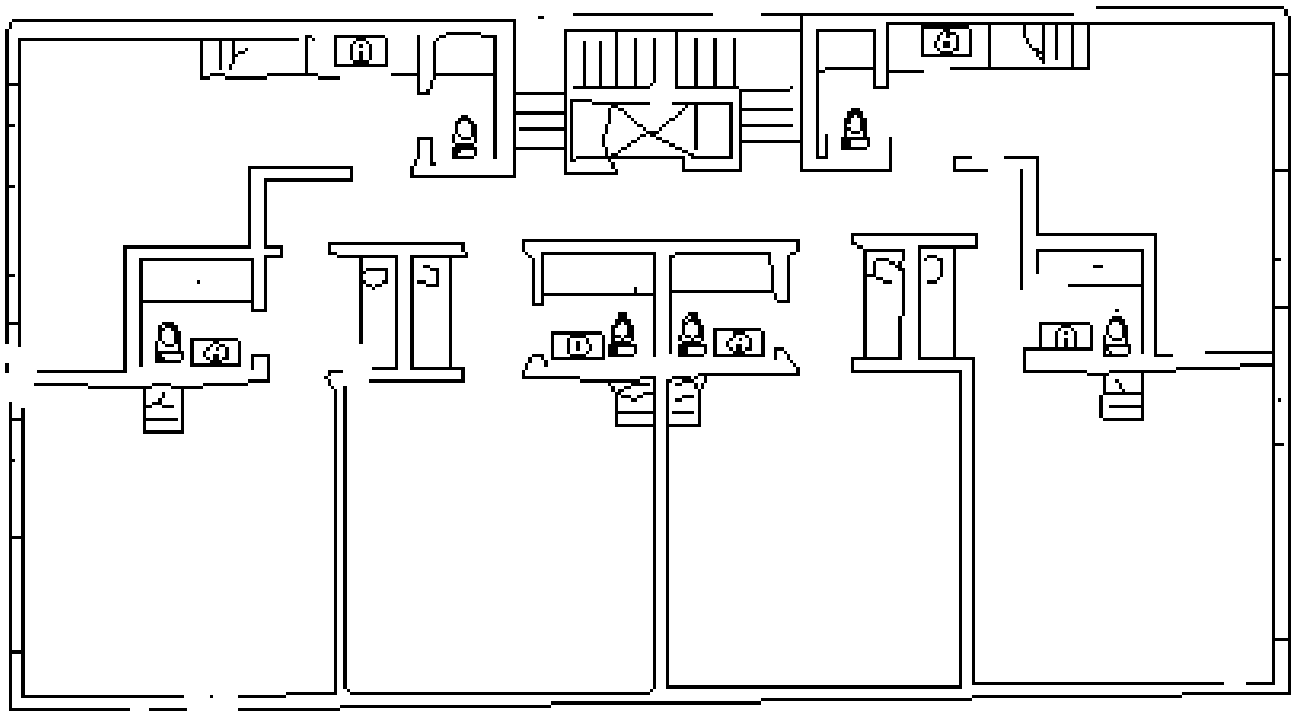
5.8. Draw of the resoult of vectorising the original image with a conventional software.



5.9. Final draw from the first process with the substitution of the original fragment for a register in our way.



5.10. Final draw from the process in the phase where we nowadays found that automatically has substituted the initial forms for the representations that interes' us.



6. References.

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8. Meeran, S. and Pratt, M.J. ‘Automated feature recognition frim 2D drawings’ in *Computer–aided design.* Vol. 25 number 1 jan. 1993.