

Image Analysis and Object Recognition

Submitted by:

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Answer to the question no.1

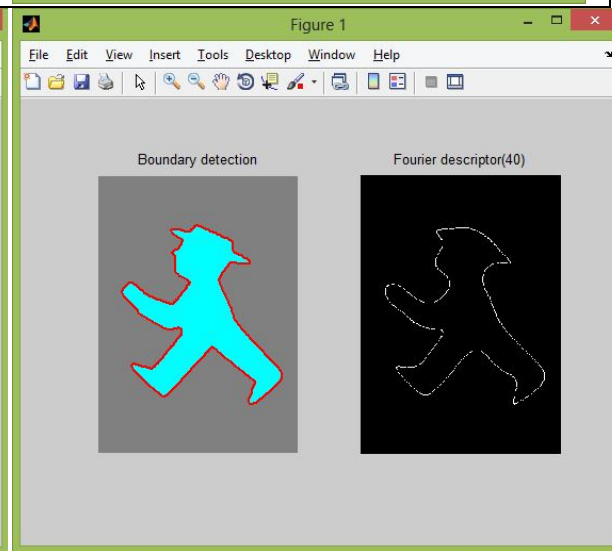
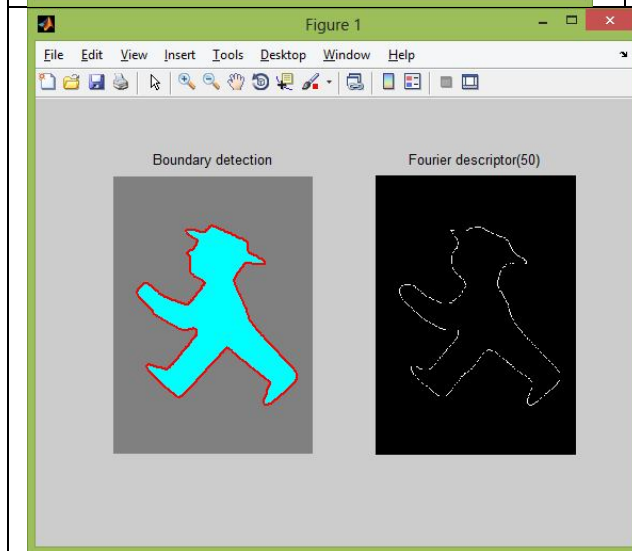
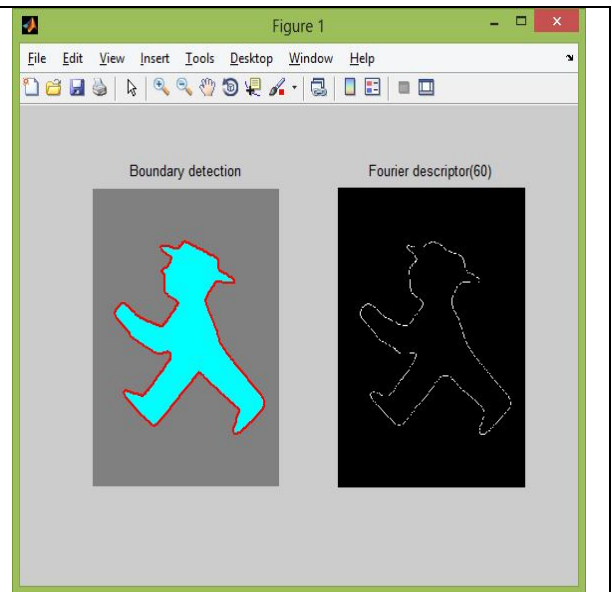
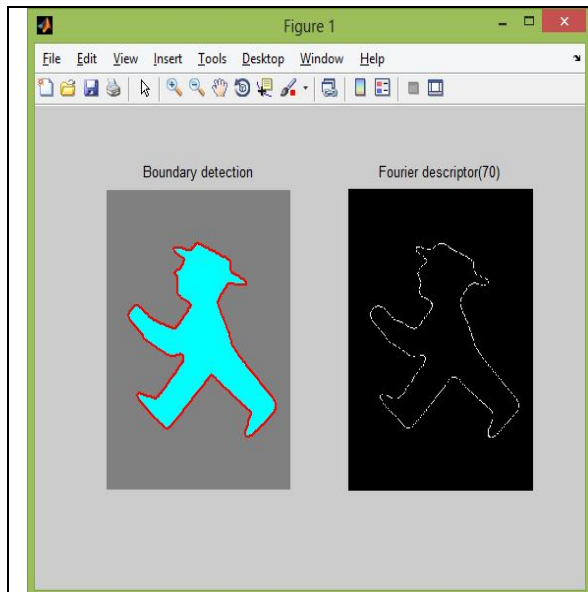
Problem: An Ampelmännchen is the little green figure on pedestrian traffic lights telling you it is safe to cross the road. Use the given picture `ampelmaennchen.png`. How many Fourier coefficients are needed for a minimum representation of the figure's contour? Write a function and prove your results.

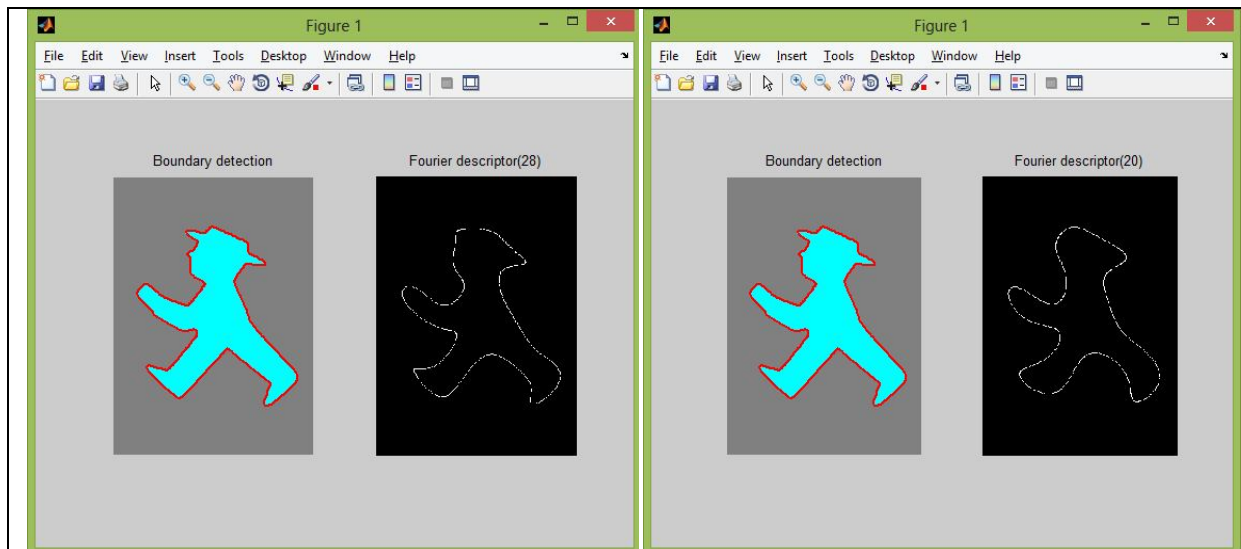
The following steps have been taken to obtain the result:

- Convert image to binary using `im2bw()`.
- Detect boundary of the object using `bwboundaries()`;
- Get the co-ordinates of the boundaries and calculate complex numbers using formula $x + iy$. Hence, transferring from 2D to 1D.
- Use `fft()` function to convert the complex numbers in Fourier descriptors.
- Use `ifft()` for inverse result.
- Create images with different number of descriptors to find the required least number of descriptors.

The following table shows the contour of the target object using different number of Fourier descriptors. We think the best figure of the target object can be created with 70 Fourier Descriptors and the attempt to configure the boundary with less descriptors such as 60 and 50 also produced good result but the nose of the man becomes invisible. However, the image created with 28 Fourier descriptors also shows the contour of the image without front part of the face and the hat. In the next figure the shape of the head has become distorted.

N.B. the functions `ifrdescp()` and `bound2im()` are external resources collected from a text book written by Gonzalez and Woods.





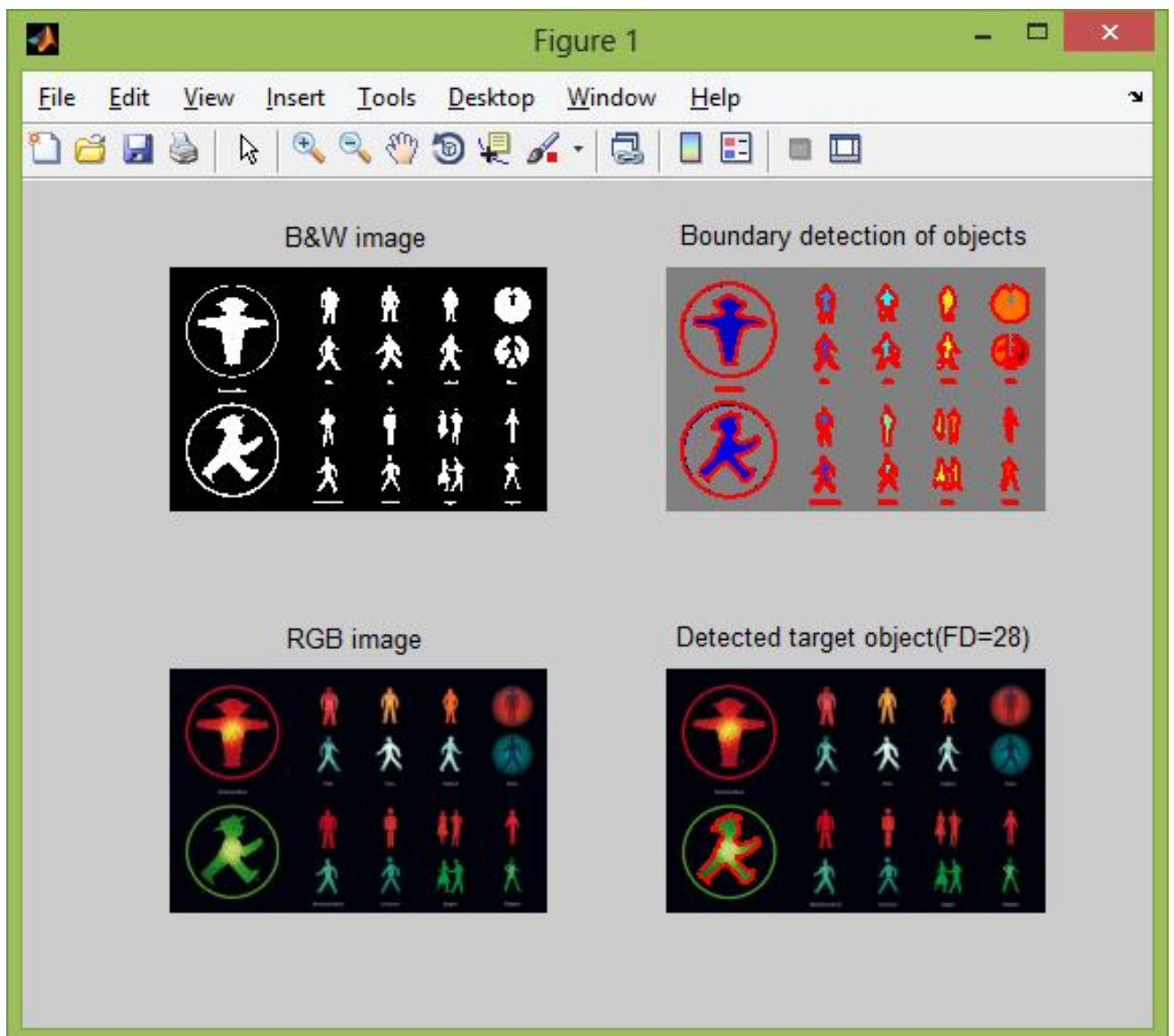
Answer to the question no.2

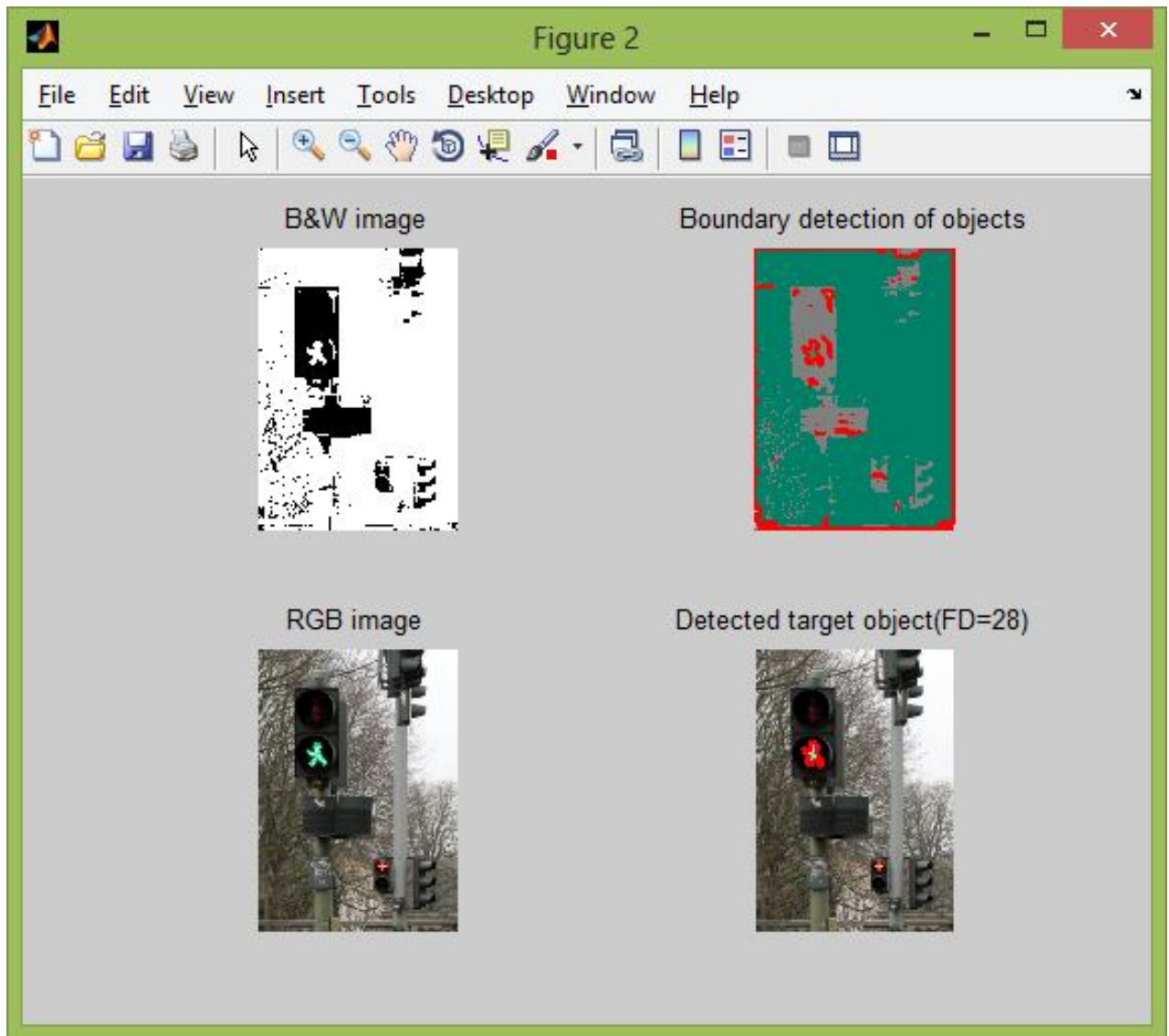
Problem: How could you now find *Ampelmännchen* in other images? On the basis of the previous task, write a function that detects such symbols and test at least two pictures. You can choose your own examples or use the given images *cultural_notes.jpg* and *ampelwelt.jpg*.

The following steps have been taken to obtain the result:

- Convert image to binary using `im2bw()`.
- Detect boundary of the objects using `bwboundaries()`;
- Get the co-ordinates of the boundaries and calculate complex numbers using formula $x + iy$ for each object in the image. Hence, transferring from 2D to 1D.
- Use `fft()` function to convert the complex numbers in Fourier descriptors.
- Take the absolute values of the Fourier descriptors
- Divide the Fourier descriptors by the 2nd Fourier descriptor.
- Remove the first descriptor.
- Compare the Fourier descriptors of the target image and each object in the scene using the formula: $d = \sum_{i=0}^N |F_i - F_j|^2$
- Find the least difference and the associated object in the scene
- Plot the found object, hence the target object.

Our program has detected the target image after comparing up to 28 descriptors with the objects found in the scene.





The following resources have been used to acquire knowledge on this topic:

Object Detection using simple contour based description Santosh Tirunagari / 245577 / santosh.tirunagari@aalto.fi

Fourier Descriptors, computer vision and remote sensing, TU Berlin.

Digital Image Processing , 2nd edition , Gonzalez and Woods.