Smart Local Positioning System
(A GPS Counterpart for Indoor Navigation)

Varad Pimpalkhute; Agnel Alappat; Harshal Ambhore; Ambarish Chandurkar
Indian Institute of Information Technology, Nagpur.

Abstract

It is but natural to find difficulty in navigating through a relatively unknown place. This issue arises in the places like Malls, Institution Campuses which are not as large to be navigable by GPS. Negligence of this issue leaves visitors frustrated while searching for destination. We present a compact model of local positioning system, in which the task to identify the input image of the current location and output the most optimum path to the given destination. We first upload image with the help of a local server on a web portal, which we process with the help of complex convolutional neural network. The predicted label is feeded to the Dijkstra's Algorithm, which will thus give the most optimal path from source to destination. We have achieved nearly 90% accuracy on prediction of the input images using MobileNet Architecture along with the traditional 7 layer CNN.

Methods and Tools Used

The CNN model is made using **MobileNet Architecture**. For demo, a classification of 4 labelled classes is performed achieving a validation accuracy of **90%**. The CNN model is saved in a **'.hdf5'** file**.** Next, the server loads the image in the trained CNN model. The label of the test image is predicted using trained model and the output label is fed to Dijkstra's Algorithm. Dijkstra's Algorithm is an algorithm for finding the **shortest paths** between nodes in a graph, which we have used to represent our in campus map, to obtain the most optimal path between source and destination. The optimised path is highlighted and updated on the phone again through the server.

Tools Used : MATLAB, Keras, Tensorflow, OpenCV, Numpy, Pandas, Scipy, Scikit, Matplotlib, Python

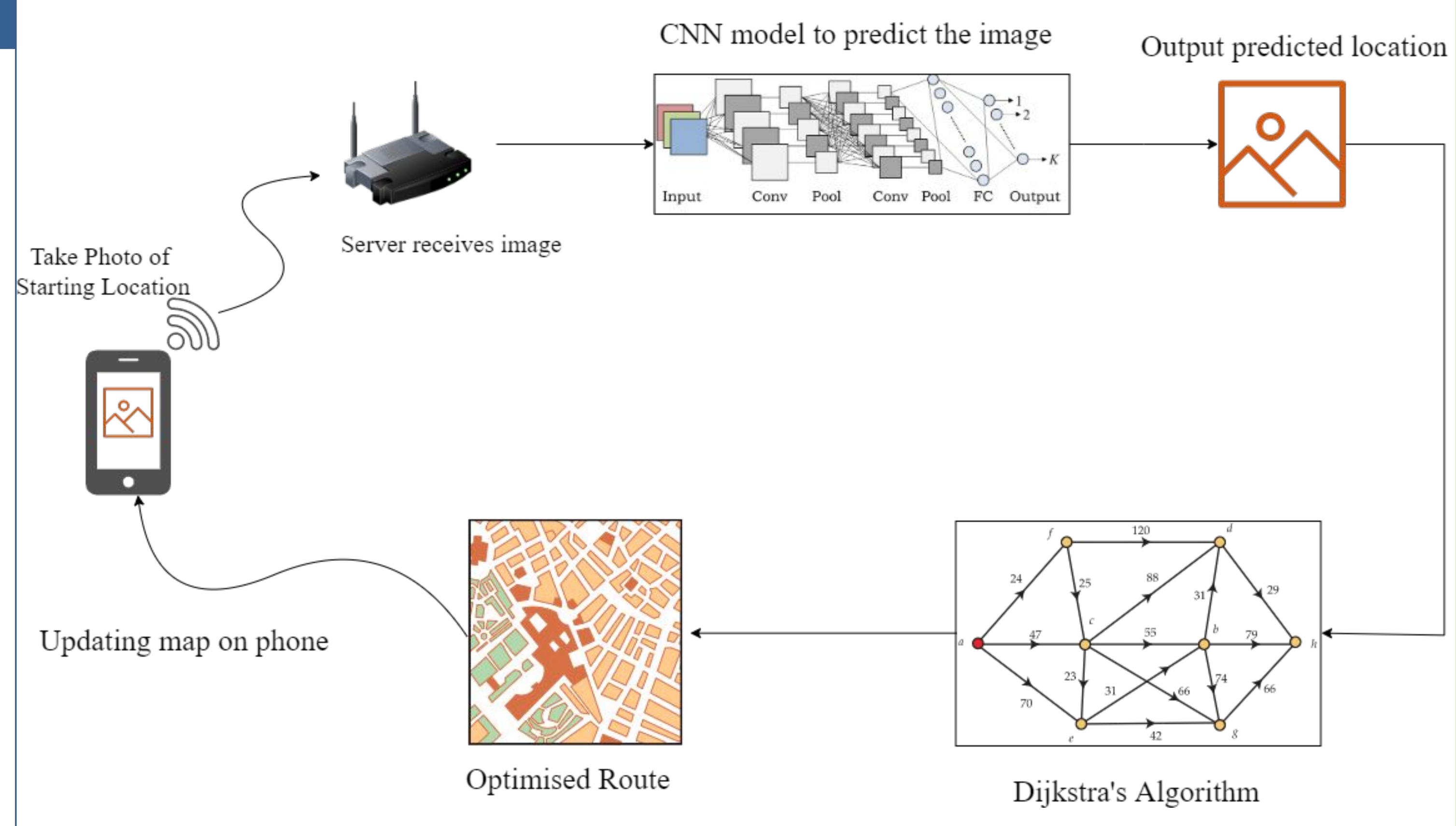

Fig 1. Proposed Methodology.

Introduction

GPS is widely used nowadays for Outdoor Navigational Purposes. By "Outdoor Navigation" we mean, navigating in a geographically large areas like a town, or a locality within a city. We enjoy a hassle-free travel with the aid of GPS in a seemingly unknown place. But it does not always happen that we need aids like GPS in outdoors only. Relatively smaller geographical areas like Shopping Malls, Multiplexes or even tourist marketplace, are also unknown to a first-time visitor. This gives rise to a need for a system for indoor navigation.

We introduce a Modern "Smart" Solution – "Local Positioning System" which is an implementation of local navigational system based on Raspberry Pi hardware backend and using local resources like CCTV Images and Wi-Fi Networks. The main advantage of LPS is its use of the existing infrastructure like WiFi networks present within malls and campuses. Mall Owners may also provide product suggestions based on the shopping list of customer to guide him in shopping in least possible time. Savings in time while shopping leads to Happy Customers. In case of large Institutional Campuses, a local positioning system is a boon for outsiders.

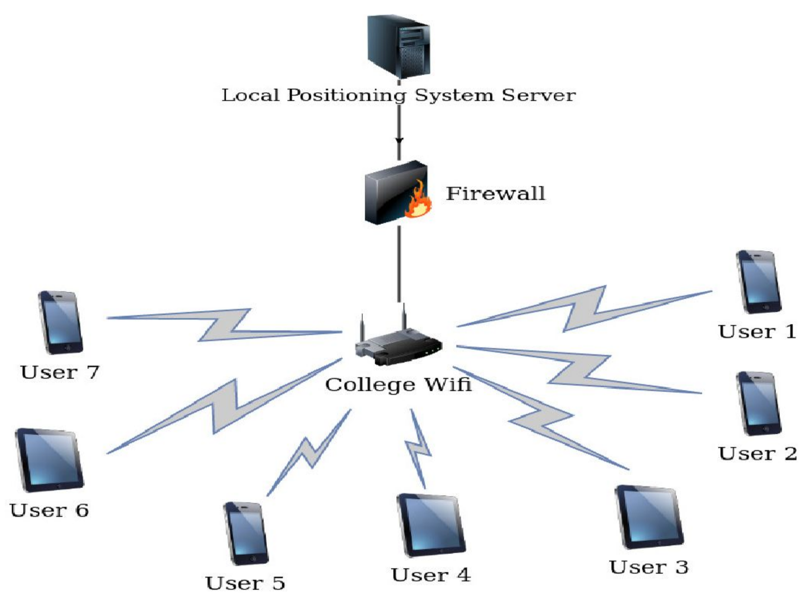

Figure 2. Topology of LPS Network.

Results

LPS will make the customer feel comfortable in large and unknown places. Malls, Tourist places which remain uncaptured by GPS, can now be navigated through our system. The problem of "Visitor Tracking" in garagantum places like Institutional Campuses, Government Offices will be solved.

Ease of interface and lightweight model results in faster accessibility and comfortable use. Importance of CNN for image classification is observed. Further, contribution of the system to Industry 4.0 is realised.

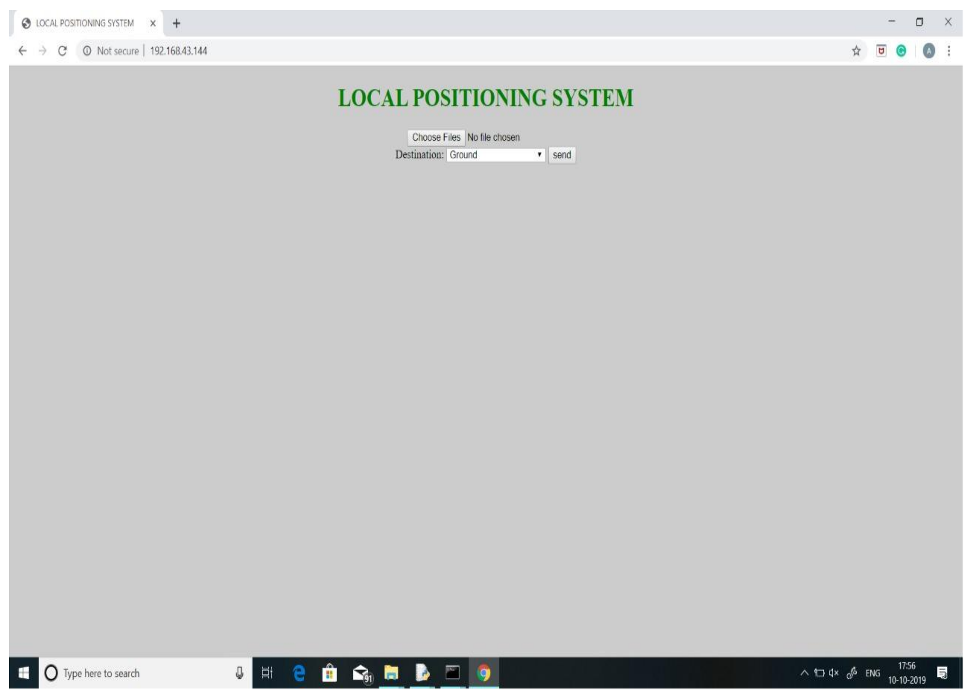

Figure 3. Uploading the image on server.

Figure 4. Predicted Location using CNN.

Discussion & Conclusions

It can be seen that there is a lot of intricacies which have not been covered in our project so far. Though it makes sense for larger computations on a proper CPU, Raspberry Pi can still make up for it easily for a system of this calibre. It will be interesting to observe what happens when the number of locations in the map is increased from 4 to 100 or 1000. That time, Dijkstra's Algorithm will show its real use, as the number of paths to a destination will exponentially increase. This is a proper system which can be implemented in large hospitals, institutes, malls, offices, etc.

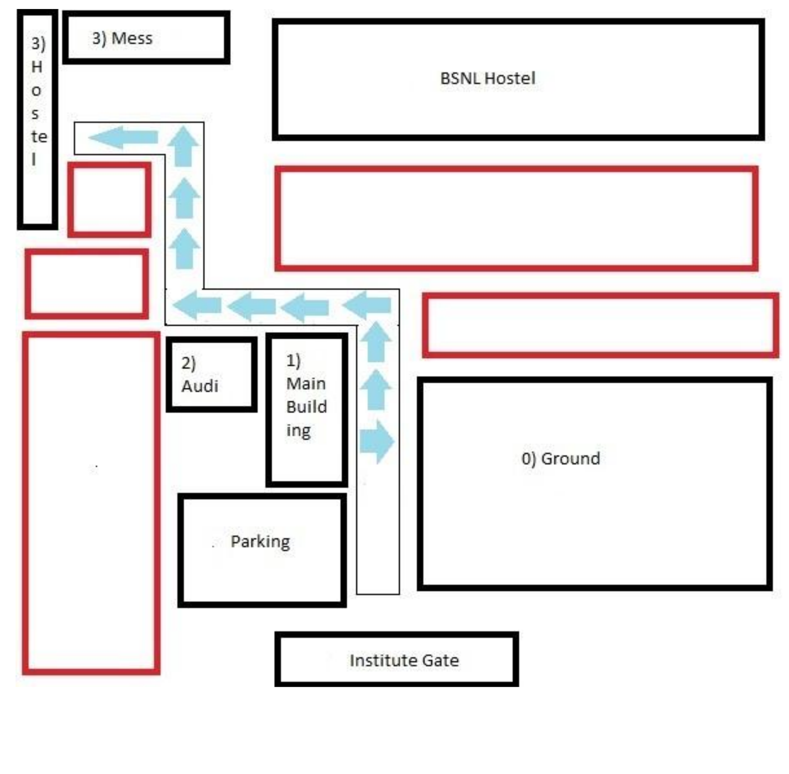

Figure 5. Route highlighted on map.

References

1) Dijkstra, E. W. (1959). A note on two problems in connexion with graphs. *Numerische Mathematik*, *1*(1), 269–271.
2) MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications, Andrew G. Howard and Menglong Zhu and Bo Chen and Dmitry Kalenichenko and Weijun Wang and Tobias Weyand and Marco Andreetto and Hartwig Adam, 2017, 1704.04861, arXiv

Roll no.

Agnel <BT17ECE003>
Harshal <BT17ECE010>
Ambarish <BT17ECE021>
Varad <BT17ECE071>

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Guide

Dr. Tapan Jain
Department of Electronics and Communication Engineering,
IIIT, Nagpur